A DYNAMIC MACROECONOMETRIC INTERINDUSTRY FORECASTING MODEL OF THE BRITISH ECONOMY

by

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CHAPTER I. INTRODUCTION

Economists have been developing empirical models of national economies for over forty years with mixed results. While economic modeling has proven to be a greater challenge than its pioneers perhaps expected, the model development process continues to offer the developer an opportunity to study diverse parts of the economy and to test his grasp not only of the parts but of their interaction within the whole. Just as a model's accurate replication of history may support the modeler's understanding of the economy, an analysis of the weaknesses of a model helps to focus research on those characteristics of the economic process that are less well understood.

This study presents the British Interindustry Model (BRIM), a macro- economic, dynamic, multisectoral forecasting model of the United Kingdom, a type of model I will refer to as a dynamic macroeconometric interindustry (or DMI) model. A DMI model is a hybrid extended Leontief input-output model and econometrically estimated macroeconometric model that combines input-output analysis with extensive use of econometric analysis of disaggregated behavior. In contrast to input-output models that use an aggregate driver, a DMI model predicts intermediate and final demands; gross and net industry and product output; employment; capital formation, consumption and stock; prices; international trade; and technical change, all at a high level of disaggregation; the model then sums the sectoral detail to arrive at the conventional macroeconomic aggregates. This "bottom-up" approach maintains accounting consistency between the aggregates and the sectoral quantities and prices on which they are based, and yields a model with several useful characteristics. First, the model mimics the economy by building up aggregate behavior from detailed industry and consumer activity rather than distributing macroeconomic quantities among industries and commodities. Second, it links changes in a specific industry to changes in related complementary or substituting industries. Finally, it allows for industry- and commodity-specific behavioral equations that reflect characteristics unique to each, including preferences, technology and prices.

Despite its superficial resemblance to a computable general equilibrium (CGE) model, this DMI model does not derive behavioral equations explicitly from neoclassical assumptions of utility- and profit-maximizing behavior. Instead, the model is constructed so as to be compatible with, though not derived from, optimizing behavior, and focuses more directly than do CGE models on the actual dynamic time path of the real economy.

BRIM is composed of three major components. The "real side" derives detailed projections of constant-price output using commodity- and sector-specific econometrically estimated behavioral equations and the Leontief input-output identity. The "price side" estimates detailed components of value added, factor income and commodity prices; and a macroeconomic "accountant" that derives aggregates from the details and distributes income flows through the various sectors of the economy.

BRIM is not the first DMI model of the U.K.; the Cambridge Multisectoral Dynamic Model (CMDM) has a very similar modeling philosophy and structure. Nevertheless BRIM makes several unique contributions to the British modeling endeavor. First, it is a member of the INFORUM family of models and is designed to be linked into INFORUM's international forecasting system.[1] The system provides an environment of international demand and price variables to which the model responds in a dynamic fashion through commodity-specific trade equations.[2] Second, BRIM incorporates functional forms for the consumption and trade equations that were developed by INFORUM and that have not previously been estimated for a model of Britain. These forms offer definite advantages in long-term forecasting.

Third, BRIM represents the first attempt to model constant-price industry output using current-price data from the Annual Census of Manufactures and detailed price data, rather than using the Commodity Flow Accounts (CFA). The CFA, developed by the Department of Trade and Industry, provide quarterly constant-price series for consumption, investment, inventory change, government expenditures, trade and intermediate use for 40 commodities[3], compatible with the National Accounts aggregates and the published Input-Output tables. The alternative approach used in BRIM permits a higher degree of disaggregation (55 sectors) than would use of the CFA, making BRIM the most disaggregated model of the U.K.

Finally, BRIM is the first DMI model of the U.K. to incorporate a commodity-to-commodity input use matrix, albeit one that involves both industry technology and commodity technology assumptions.[4]

For the reader unfamiliar with the British economic developments that are most relevant to the task of model building and forecasting, Chapter II provide a concise review of postwar British economic history. Chapter III reviews, compares and contrasts the existing approaches to large-scale economic modeling, and places BRIM in this broader context. Chapter IV opens with a description of BRIM's general structure and then discusses its components in detail. Finally, Chapter V describes the results of some simulations of BRIM in the broader context of INFORUM's international system. For readers already familiar with the British economy and economic forecast modeling in general, Chapters IV and V can be read independently.

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[1] INFORUM originally stood for Interindustry Forecasting at the University of Maryland but has come to designate a world-wide group of model builders with active centers in the U.S., Germany, France, Italy, Spain, Austria, Poland, Mexico and Korea. INFORUM-type models of Canada and Japan are also in operation.

[2] As yet, there are no international capital flows in the system.

[3] Where Americans generally refer to specific types of goods as "products", the British tend to refer to them as "commodities" (which term tends in the U.S. to be reserved for highly generic, homogeneous products such as wheat or oil). I will consistently use the British term to minimize confusion.

[4] These and other aspects of the data used to develop the model are discussed in detail in the Appendix.

CHAPTER II. RECENT BRITISH ECONOMIC HISTORY

The single outstanding feature of the British economy during the past generation has been its low real rate of growth compared with other industrial economies. For most of the century, British real income per capita has risen only slowly; and while Britain's postwar performance was generally quite good by historical standards — the average Briton was nearly twice as well of in 1970 as in 1950 — Britain's relative living standards have declined sharply as other industrialized economies have outpaced her. In the early 1950's Britain's per capita income was among the highest in Western Europe; it is now among the lowest.

One can attribute this low rate of growth in part — but only in part — to the fact that Britain embarked on its industrial development well before most other countries, so that the gradual deceleration of growth common to all advanced industrial economies has been more pronounced in the U.K. than elsewhere. One can also associate part of the marked slowdown in Britain's GDP growth rate to the distinct decrease in productivity growth that has affected all industrialized economies since the early 1970's, for which economists have as yet little explanation.[5] However, British growth was so low, especially in the 1970's, that other factors must have played a role.

Table II.1: Gross Domestic Product and Productivity Growth: Selected Countries

	Annual Real GDP Growth (%)			Business Sector Productivity (%)		
Country	1951-73	1973-79	1979-88	1960-73	1973-79	1979-88
O.E.C.D.	-	2.7	2.8	-	-	-
U.S.A.	3.7	2.4	2.8	2.2	0.0	0.8
Japan	9.7	3.6	4.0	8.6	3.0	3.2
Germany	6.0	2.3	1.8	4.5	3.1	1.6
France	5.1	2.8	1.9	5.4	3.0	3.2
Italy	5.5	3.7	2.4	6.3	3.0	1.6
U.K.	3.0	1.5	2.2	3.6	1.5	2.4
U.K. non-oil	3.0	1.3	2.0	-	-	-
Total U.K. labor productivity				3.6*	2.2	2.8
U.K. manufacturing labor productivity				3.7*	1.1	4.2

* - 1951-73.
Source: Feinstein and Matthews (1990).

[5] Detailed industry-specific productivity growth estimates in the sources-of-growth framework, such as those found in Jorgenson and Kuroda (1990), find a distinct slowdown in the rate of technical change over the past three decades, but do not explain the reasons for the slowdown. More recent work by Gordon (1992) and others suggests that in the U.S., at least, a substantial portion of the productivity slowdown can be attributed to technological barriers reached in key industries during the late 1960's and early 1970's.

Table II.2: OECD and U.K. Growth Rates; U.K. Industry Shares of GDP

	Annual Real GDP Growth (%)				Industry Shares of GDP (%)		
	Per Capita		Per Worker				
Year	OECD	U.K.	OECD	U.K.	Oil&Gas	Manftg.	Services
1970	2.3	1.9	2.5	2.7	0.1	33.4	55.5
1971	2.5	2.2	3.0	3.7	0.1	31.6	56.6
1972	4.1	2.0	4.2	2.4	0.1	31.8	56.8
1973	4.7	7.4	3.4	5.2	0.1	31.7	57.2
1974	-0.1	-1.0	-0.3	-1.2	0.0	30.5	59.8
1975	-1.1	-0.6	0.4	-0.2	0.0	29.1	59.8
1976	4.0	3.8	3.5	4.7	0.5	28.6	60.0
1977	2.6	1.1	1.8	1.0	1.6	29.5	59.0
1978	3.1	3.6	2.2	3.0	1.9	29.5	58.7
1979	2.3	2.0	1.4	0.6	3.3	28.4	58.9
1980	0.5	-2.2	0.7	-1.8	4.4	26.6	59.8
1981	0.9	-1.3	1.4	2.8	5.5	24.7	61.0
1982	-0.9	1.2	0.2	2.9	5.8	24.5	60.9
1983	2.0	3.4	2.2	4.8	6.2	23.6	60.9
1984	4.0	1.8	3.0	0.1	7.0	23.6	62.1
1985	2.6	3.5	2.1	2.1	6.2	23.9	62.9
1986	2.1	2.6	1.2	2.5	2.8	24.4	65.9
1960-68	3.9	2.4	4.1	2.7			
1968-73	3.6	2.9	3.4	3.0			
1973-79	1.8	1.5	1.5	1.3			
1979-85	1.6	1.3	1.5	1.9			

Sources: Growth rates: OECD Main Economic Indicators; Industry shares: U.K. National Accounts.

The productivity problem. The relative decline is clearly related to relatively low British productivity growth, a phenomenon found across industries and recorded in a number of international productivity comparisons. Table II.1 and the first four columns of Table II.2 on the following page illustrate the productivity shortfall with annual labor productivity growth rates for the U.K. and other OECD countries.

Low British productivity growth has been attributed to, among other things, relatively low levels of capital formation; factors stemming from poor industrial labor relations, such as strikes, work rules, overtime policies, and excess costs incurred by management in dealing with labor relations; low investment in human capital — both labor and management — and in research and development; small relative market, industry, firm and factory sizes; relative capital intensity (or lack thereof); and more general institutional and cultural characteristics.

In recent work by Boskin and Lau (1992) and Kim and Lau (1992) analyzing postwar growth in the Group-of-Five countries (France, West Germany, Japan, the U.K. and the U.S.) and the recently industrialized countries of the Pacific Rim, the U.K. emerges as clearly suffering from impediments to long-run growth that are not found in the other developed countries studied. Boskin and Lau analyzed postwar growth in these countries, using what they refer to as the "meta-production function" approach. This approach is based on the assumptions that 1) the aggregate production possibilities of all five countries can be represented by a single transcendental logarithmic function, and 2) technical progress can be represented as commodity-augmenting, with constant geometric augmentation factors. Several of their findings point to problems unique to the U.K.

1) Over the past thirty years, the capital accumulation rate has been lower in the U.K. than anywhere else, even though investment's share of GDP has actually been slightly higher for the U.K. than for the U.S. This factor alone has given all countries except the U.S. a significant jump over the U.K., from an 8% advantage for Germany to a 50% advantage for Japan, holding all other factors constant.

2) Boskin and Lau found that technical progress is capital-augmenting; that is, technical progress can be represented as an increase in the productive efficiency of the capital stock.[6] This finding implies that capital accumulation and technical change are complementary, and that a country with a low capital/labor ratio, such as Britain, will not benefit from technical change as much as a country with a higher capital/labor ratio, such as Germany.

3) They also found that in addition to augmenting capital, nearly three-quarters of technical progress is embodied in new capital. This implies that lower rates of investment (such as Britain's) imply lower rates of realized technical progress.

4) Finally, they found that the U.K.'s rate of capital augmentation has been lower than that of any country except the United States.

Taken together, these findings imply that average annual rates of realized technical progress have been considerably lower for the U.K. (and the U.S.) than for the other countries studied. Thus while other countries have become increasingly productive over the past forty years relative to the U.S. (which itself has become increasingly productive, albeit at a slower rate), the U.K. has consistently remained about half as productive as the U.S., holding labor force growth and capital accumulation constant. In addition, the U.K.'s relatively low rate of capital accumulation and low level of capital augmentation exacerbate each other. The upshot is that relatively low rates of investment have indeed contributed considerably to Britain's relatively poor performance in the postwar period, but that other influences have conspired to ensure that a unit of investment in the U.K. contributes less to productivity growth than that same unit invested elsewhere.

Ideally, to isolate these influences one would like to study British total factor productivity at a disaggregated industry level, but to date no one has developed the database necessary to do a comprehensive analysis that compares sources-of-growth between a number of countries at a detailed industry level, as Jorgenson and Kuroda (1990) have done for the U.S. and Japan. However, a great deal of work has been done comparing variations in British

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[6] However, as the authors note, the concept of capital-augmenting technical progress does not imply that technological progress improves the quality of capital exclusively. For instance, a rise in computer literacy may be represented as an increase in the quality of computers. Nevertheless the concept does imply that technical progress cannot occur without capital accumulation.

and American manufacturing productivity by industry, and this work has contributed some insights into Britain's problems. In one such recent study, which included a review of the existing literature, Davies and Caves found that nearly every factor examined has had some adverse impact on British productivity.[7] As these authors put it,

> there is no outstanding single variable at which the finger can be pointed: although some are clearly more important than others, the picture to emerge is of a steady accumulation of influences of, in some cases, quite different origins responsible for low British productivity.

Some of these factors seem to affect productivity across all industries. Davies and Caves cite a 1976 study by Pratten[8] that reviewed multinational firms' comparisons of relative performances of their factories in different countries; Pratten guessed that as much as a quarter of Britain's productivity shortfall relative to the U.S. (and as much as half of the shortfall relative to Germany) could be attributed differences in the countries' capital-labor ratios. The authors also cite studies of differences in vocational training (including management training) that suggest that low or inadequate investment in productive skills does indeed affect British firms' ability to adopt and exploit advanced technology.

Caves and Davies extended the study of productivity differences by matching individual British industries with their counterparts in the U.S. for the years 1967-8 and 1977, and using this cross-section data to explain differences in the matched industries' levels and rates of labor productivity growth. Their results indicate that for the industries studied, half of the gap between the best- and worst-performing British industries (relative to their American counterparts) could be explained by low capital intensity, problems associated with large plant size, relative lack of foreign competition, and low levels of research and development.

The authors argue that these findings can be used to explain a significant portion of the overall British productivity gap. They calculate that if each British industry in the study exactly matched its American counterpart in terms of the explanatory variables they used, average British productivity would increase from about 40% of the American average to between 53% and 58% of the total, with relative human capital (as measured by years of formal schooling) and the role of part-time labor being the most important factors. Taking a different approach, they calculate that if each British industry came as close to its American counterpart as seems feasible, given the performance of the best-performing British industries, average British productivity would increase from about 40% of the American average to about 68% of the total. The results of this approach suggest that the constraints to British productivity growth during the period in question included low relative skill levels of the British labor force, low relative levels of physical capital per worker, relative plant size, lack of international competition, low levels of research and development, the high level of union membership, and poor British labor relations.

Still, the Davies and Caves study suggests that although the variables mentioned above

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[7] Davies and Caves (1987), p.92. See also earlier work on the subject in Smith, Hitchens and Davies (1982).

[8] Davies and Caves (1987), p.6.

influence British productivity, other factors that affect the entire economy seem to play an important additional role in constraining productivity. The authors suggest that these factors are rooted in British historical experience and social institutions. They endorse Olson's hypothesis[9] that Britain's long-term stability has served her ill by permitting the gradual proliferation of special-interest groups — unions, cartels, class structures — that effectively block innovations that benefit the economy as a whole but affect their members adversely. It is often the case that a given innovation — new technology that reduces printing costs, for instance — may provide large aggregate benefits to society as a whole but adversely affects a small group — typesetters, in this instance. Although the broader community interest in terms of reduced costs may be very large in the aggregate, the average person receives relatively small gains from lower printing costs and thus has relatively little incentive to mobilize support in favor of the innovation. In contrast, a group of typesetters stand to gain a great deal from blocking the innovation, and thus have a much larger incentive to support a group that furthers their interest in blocking the innovation. Such special interest groups, in effect, provide public goods for their members.

As providers of public goods, however, such groups must persuade potential beneficiaries to contribute resources in proportion to their potential benefits. These beneficiaries, however, have an incentive to let someone else absorb the cost. Thus the formation of special interest groups is often impeded by the free-rider problem, particularly if the benefits they provide are diffuse. They therefore tend to develop only in a stable, accommodating environment, and once in place they tend to conserve their member's special interests at society's expense. As Britain has enjoyed centuries of freedom from revolution, invasion or other social upheavals that could destroy or impede the formation of existing institutions, she has accumulated a plethora of institutions with an interest in delaying or preventing changes that threaten the "quasi-rents" of their members. One might expect, moreover, that these institutions would be all the more fierce in their opposition to change during a period of general relative decline, as Britain has experienced for much of this century.

Correct as this hypothesis may be, Britain's relative decline certainly has been accompanied by significant shifts in the composition of economic output, most notably a fall in manufacturing's share of output and a rise of services'. This sectoral shift is commonly found in industrial economies, and is sharpest in the most advanced countries. It is due mainly to the fact that productivity tends to grow less rapidly in the service sector than in goods-producing sectors, so that as a country's economy becomes increasingly mature, the relative cost of services increases and the cost of manufactured goods falls. Thus, even though manufacturing and services' shares of output remain relatively constant in real terms over time, in terms of current prices manufacturing's share of output falls and services' share rises.[10]

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[9] See Olson (1982).

[10] A corollary to this observation is that when the benchmark prices used to measure real (constant price) economic activity are rebased to later years, the value of manufacturing output in a given year falls - simply because the later constant price tends to be lower. As a result, not only is manufacturing becoming an ever smaller part of the economy, but it is becoming an ever smaller part of our past too!

In Britain, however, manufacturing's decline has been particularly marked, especially since the early 1970's, and has coincided in large part with Britain's emergence as a significant oil and natural gas producer and exporter. The last three columns of Table 2.2 show changes in British sector shares of real gross domestic product, and illustrate the abrupt rise of oil's importance in the British economy.

The rise of oil and the decline in manufacturing may strike the casual observer as not unrelated. Nevertheless it is a difficult matter to distinguish between the effects on British industry of poor productivity growth, the development of oil, other factors affecting the country's trade patterns, and the effects of government economic policy.

The influence of foreign trade. Throughout the postwar era, the British balance of payments has been roughly in balance; so, too have been both the commercial and financial trade accounts. In the early postwar era, Britain's dependence on materials imports and the loss of empire contributed to a massive deterioration of the non-manufacturing portion of the balance of payments, such as primary products, services, and net income from abroad. This deterioration contributed to Britain's subsequent specialization in manufactured exports, and the manufacturing export boom contributed to Britain's relatively high share of manufacturing in total output and employment during the 1950's and 1960's.

Since then, however, net imports of non-manufactured goods (mainly food, fuel and raw materials) have declined from 16% of GDP in 1950 to a small surplus in the late 1980's; while the manufacturing net balance has deteriorated markedly from a surplus of 11% of GDP in 1950 to a deficit. This deterioration has mainly been "a response to autonomous improvements in the sphere of non-manufacturing trade"[11], notably a massive fall in the cost of food and materials imports, increased domestic food and fuel production (in particular, the development of North Sea oil), and the rise of oil exports and oil prices.

The changes in non-manufacturing trade also made British trade more triangular. Imports from primary producers fell, while manufactured exports to them did not; thus Britain runs overall trade surpluses with primary producers. Roughly simultaneously, Britain has become an oil exporter to developed nations. "Thus, if Britain were not to run substantial surpluses on her merchandise trade overall, she had to go into deficit in trade in manufactures with other advanced countries."[12] (As a corollary, the inevitable future decline in oil production will require Britain to reestablish a stronger manufacturing trade balance with other industrialized countries if she is to maintain her capacity to earn foreign exchange to pay for imports.)

Quantitative assessment[13] suggests that these factors, which would have influenced Britain's foreign trade regardless of her industrial performance, account for nearly all of the deterioration of the manufactured trade balance. Industrial decline and stagnation has influenced the trade balance mainly by holding down the demand for non-manufactured

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[11] Much of this discussion of British foreign trade draws on Rowthorn and Wells (1987).

[12] Rowthorn and Wells (1987), p.205.

[13] Ibid.

imports and thus strengthening the non-manufactured trade balance.

The decline in Britain's manufacturing balance of trade clearly contributed to a massive drop in manufacturing employment in the early 1980's. And to the extent that Britain's emergence as an oil and gas exporter was one of the autonomous factors contributing to this decline, there is a direct connection between the development of the oil sector and the decline of British manufacturing industry. Bean[14] estimates that increased oil production and reserves raised the real exchange rate by about 10%, or about half the actual increase; and higher exchange rates clearly affected the demand for British manufacturing exports. Furthermore, the increase in oil prices (as opposed to the increase in the volume of exports) is responsible for a 2% decline in manufacturing output and employment.

Nevertheless, higher exchange rates and oil prices had additional beneficial effects on output and employment that offset (at least in part) the adverse impacts described above. Exchange rate appreciation made it easier to contain pressure for wage increases, so the higher rates had almost no net effect on manufacturing output or exports. Furthermore, the effect of oil prices on employment were partially offset by the oil-induced increase in services employment. Taken together, these estimates imply that oil alone did not cause the collapse of manufacturing industry or the accompanying massive rise in unemployment.

At base, Britain's difficulties seem to stem from a combination of developments, namely the lack of productivity growth coupled with the failure of the manufacturing sector either to maintain cost competitiveness or to provide a strong base for the expansion of demand in other sectors of the economy, especially in the service sector. Despite the very low rates of manufacturing productivity growth registered during the 1960's and 1970's, British workers, a majority of whom are unionized, continued to negotiate relatively large wage increases. Had low productivity growth been accompanied by low relative wage and price growth, the resulting relatively lower growth in prices might have helped sustain higher demand for British products and higher British employment. Conversely, substantial productivity growth would have wiped out virtually as many manufacturing jobs as in fact disappeared[15]; yet the higher sustainable income base resulting from higher productivity growth might have stimulated higher demand for services. Britain's difficulties result from the combined effects of low productivity growth, high wage growth relative to productivity growth, and low rates of job creation outside the manufacturing sector. In addition, both the world recession and the deflationary policies of the Thatcher government played a role, at least in the early 1980's.

Economic policy through the early 1980's. In attempting to guide the economy, successive British governments have been constrained both by the country's poor industrial performance and by her dependence on foreign trade. They have been constrained even further by the economy's chronic price inflation, which seems largely a result of British labor's ability to negotiate relatively large wage increases, even in the face of attempts to enforce incomes policies and, more recently, in spite of high rates of unemployment.

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[14] See Dornbusch and Layard (1987), Chapter 3.

[15] Dornbusch and Layard (1987), p.288.

This combination of constraints — in external trade, productivity growth and the labor market — has impeded attempts to encourage growth through Keynesian demand management policies. Rather than stimulating real output, such policies have tended to result merely in a wage-price spiral, while much of the increase in demand has gone to imports, forming, in effect, a balance of payments constraint to growth. Even the contribution of oil to British exports did little to remove this constraint: by helping strengthen the value of the pound, oil exports raised the price of British manufactures relative to foreign goods. The authors of the Cambridge input-output model of the U.K. recently opined that

> [a]s much as 60% of any increase in domestic demand induced by policy changes is ... spent on imports so that a strategy of increasing employment in the UK on its own is not likely to be sustainable for long without running into a balance of payments crisis.[16]

Until the early 1970's, successive Postwar British governments pursued fairly strong Keynesian demand management policy and paid relatively little attention to monetary policy. The inattention to monetary policy stemmed in part from prevailing economic theory and research that imputed relatively small real effects to monetary policy. In addition, however, the pre-1972 pegged exchange rate system greatly restricted British monetary authorities' ability to control the money supply; instead, supply largely adjusted to demand through the balance of payments mechanism. As long as the United States exercised financial restraint, British monetary policy was in fact less important than fiscal policy.

This combination of policies resulted in relatively high levels of employment, at least until the 1970's. However, Britain gradually came to experience periodic balance of payments problems (in spite of the rough balance throughout the period), relatively high rates of price inflation and, as mentioned, continuing low levels of productivity growth. As these problems became increasingly entrenched and apparent during the 1970's, British economic policy-makers gradually abandoned the concept of demand management, concentrating instead on fiscal and monetary policies intended to control inflation and gradually improve supply-side performance. These efforts enjoyed only partial success.

A casual review of government fiscal policy since 1970 might suggest that British governments have been, if anything, rather profligate. While government's share of total output has been approximately stable (22.3% in 1970, 23.2% in 1986); transfer payments rose from 12.0% to 17.7% during the same period, while debt interest rose from 4.1% to 4.9%. Thus total government spending rose from 38.4% to 46.4% of GDP; and the bulk of the increase was debt-financed transfer payments. In nominal terms, the government has consistently run annual deficits (referred to in polite company as public sector borrowing requirements, or PSBR's) of 4% to 7% of GDP. However, if one adjusts the PSBR for cyclical factors (i.e. what the deficit would have been had the economy been operating at its full "potential") and for real debt service, as done by David Begg[17], one can draw the conclusion that the govern-

[16] Barker and Peterson (1987), p.201.

[17] Dornbush and Layard (1987), p.31. In his discussion, Begg nicely captures some of the difficulties inherent in modeling and measuring macroeconomic policy: "First, no indicator of fiscal policy can be model-free. For example, the consequence of a particular fiscal stimulus

ment ran a real surplus from 1970 to 1972, was in approximate balance from 1973 to 1979, and has run a large surplus since 1979. From this point of view, then, fiscal policy has been fairly restrictive for quite some time.

As with fiscal policy, since the early 1970's British monetary policy has reflected authorities' increasing concern with prices and supply-side issues rather than demand management. From the point of view of the contestants in British policy debates, the past twenty years of monetary policy have been characterized by a movement to a form of monetarism. However, it is important to note that British "monetarism" even now focuses crucially on interest rates in determining money supply, and otherwise gives monetary authorities a role in British fiscal and monetary policy that would be unacceptable to an American monetarist.[18]

Like the American Federal Reserve Bank, the Bank of England carries out British monetary policy; but unlike the Fed, which is largely independent of the Administration, the Bank carries out both monetary policy and management of the British Treasury accounts and is largely circumscribed in its actions by the government. The Chancellor of the Exchequer, appointed by the Prime Minister, is decisive in determining monetary policy. (Furthermore, since British governments are controlled by a Prime Minister who is also a member of Parliament and whose political party dominates Parliament, they are subject to fewer political constraints — short of facing period elections — than are American administrations.)

The Bank controls monetary growth mainly through open market sales and purchases of funds, which are largely Treasury funds. Given their role in managing both monetary policy and government debt, British monetary officials are concerned with the effects of interest rate volatility. (Even the Thatcher government's Medium Term Financial Strategy specified monetary growth and PSBR targets taking into account their likely effect on interest rates.) And because money velocity (by any of the conventional measures) has proved to be rather unstable, interest rates have often been viewed both as instruments for controlling supply and targets to use to measure the real money supply. British monetary authorities also monitor exchange rate movements as indicators of policy effectiveness, because sharp exchange rate adjustments often involve capital flows that reflect market reactions to policy changes.[19]

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will depend critically on the initial level of Keynesian unemployment (if any), the speed with which prices adjust, and the extent of capital market imperfections. Second, no fiscal indicator can be independent of other policies in force. For example, it will depend on the extent of monetary accommodation and on the exchange rate regime. Third ... a complete description of fiscal policy requires a statement of current perceptions about future fiscal variables which, *inter alia*, requires a specification of how information evolves and expectations are formed." However, capturing all of the relevant pieces of the real economy would require a good model of expectations formations and intertemporal decision-making which is beyond our present capacities.

[18] This discussion draws largely on Fisher's chapter in Dornbusch and Layard (1987) and Bootle's chapter in Morris (1985).

[19] This implies that authorities face a trade-off between interest rate and exchange rate fluctuations; so that interest rate stability can be bought only at the price of currency

The shifts in both monetary and fiscal policy over the past two decades were gradual and halting. The Conservative government of Edward Heath (1970-74) inherited a tight fiscal policy from its Labour predecessor and initially faced a growing unemployment problem. Its main response was strong fiscal and monetary stimulus with an attempt at incomes policy to control prices; during the same period, authorities carried out a major reform of the financial regulatory system.

Prior to 1971, interest rates were determined by the effects of debt management (buying and selling Treasury Bills) and the foreign trade balance (capital flows). Monetary authorities concentrated on credit conditions to control the money supply, and during the 1960's this policy amounted to a form of credit control. In 1971, however, the Conservative government introduced the Competition and Credit Control (CCC) proposals, under which financial institutions were significantly deregulated. Under the new system, monetary aggregates were to be controlled through interest rates, which in turn required manipulation of banks' asset ratios. However, authorities misjudged the banks' response to interest rates, and the result of the policy was monetary overexpansion, helping fuel the economic boom (and inflationary burst) of 1972-73 but also resulting in a banking crisis in 1973.

These reforms coincided with the abandonment of fixed exchange rates for the British pound sterling and the move to a floating rate regime; financial markets' adjustments to this change helped make the process of monitoring and guiding developments all the more difficult.

The unfortunate result of these policy initiatives was that the economy was booming and inflation accelerating just as the first oil shock hit; the government's ability to respond was thus limited by the consequences of its previous actions. Deteriorating economic conditions and strikes led to a political crisis and two elections in six months, bringing the Labour Party back to power under Harold Wilson, with a tiny majority in Parliament.

In monetary policy, the new government dealt with the banking crisis by adopting a system (called the "Corset") of controlling the structure of interest rates rather than simply their level, and adopting internal monetary growth targets (primarily £M3) as the method for controlling money growth. To accommodate the oil shock, the government maintained a relatively expansive monetary policy. At the same time, it maintained relatively tight fiscal and incomes policies to discourage a consumption-led boom; it also allowed the exchange rate to depreciate to encourage export-led growth.

Despite these efforts, the oil-shock recession lasted nearly two years. The oil shock accommodation kicked the inflation rate above 20% in 1975; it declined thereafter but remained high throughout the 1970's, fed by rising import prices and wages. Unemployment rose from about 2.5% of the labor force in 1974 to above 5% in 1976, where it remained throughout the 1970's. Speculation on the pound, reflecting concern over policy, resulted in a foreign exchange crisis in 1976, requiring borrowing from the International Monetary Fund.

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movements and vice versa. Since the exchange rate plays such a pervasive role in a trade-dependent economy like Britain — and since capital movements are such a strong signal of market expectations — some observers argue that exchange rate targets are more appropriate than interest rates in controlling British monetary growth.

The remaining Labour years under Prime Minister Callaghan saw continuing stagflation, although the foreign trade picture improved as Britain emerged as an oil exporter. As Begg comments, "the period did not show, as is sometimes asserted, that fiscal policy had ceased to be a powerful weapon; rather, it suggests that considerations of sound finance [reflecting concern over persistent high inflation] and supply-side incentives [reflecting concern over relative economic decline] had emerged as issues whose importance was at least as great."

The Thatcher government came to power in 1979 with a strongly monetarist outlook and a belief that the economy remained close to potential output. Aware of the failures of the Conservative Heath government's policies, the Thatcher government adopted the Medium Term Financial Strategy (MTFS) mentioned above in an effort to reduce inflation. Fiscal and monetary policy were to be coordinated; PSBR was to be determined so as to reduce monetary growth without increasing interest rates excessively. The shift in monetary policy rapidly brought the inflation rate down to about 5% in 1983. However, interest rates rose markedly, and by tying fiscal and monetary policy together, the MTFS precluded the use of a countercyclical fiscal-monetary policy mix, just as the economy was buffeted by a succession of shocks, the principal one being the doubling of oil prices. Although the oil price rise raised government revenues, the rise adversely affected the rest of the economy, as did exchange rate appreciation and accelerating labor costs. British relative unit labor costs in manufacturing rose 25% in 1979-80, as foreign and domestic demand was falling. The real economy went into recession; unemployment rose to 13% and was still climbing in 1986, several years after the economy had recovered from the recession and resumed a slow rate of growth.

Trends in the 1980's. During the extended recovery from the recession over the past decade, several patterns have emerged in the British economy.[20] The recession was by far the worst in the Postwar era, and the recovery, considered from the previous peak year, 1979, has been shallower than any but that of the late 1970's. (In terms of intercyclical averages, in fact, the recovery of the 1980's is the shallowest in the Postwar era.) The average annual rate of GDP growth over the decade was on the order of 2%, considerably higher than that of the 1970's but only about two-thirds the rate of the 1950's and 60's. Moreover, the poor growth performance has been concentrated in manufacturing: while the slowdown of the 1970's affected every sector of the economy except the energy sector (where output grew very rapidly because of the development of North Sea oil), in the 1980's almost every sector of the economy resumed its pre-1973 growth rate almost exactly, except for manufacturing, which barely grew at all, and the Banking and finance industries and the miscellaneous portion of the Other services industry, which both roughly doubled their growth rates.

A similar pattern shows up in the employment statistics. Total British employment was about the same in 1988 as it was at the last cyclical peak in 1979 — about 25 million workers; however, employment in British manufacturing had fallen by nearly two million, made up for by roughly equal increases in employment in the Banking and finance sector and the miscellaneous services in the Other services industry. In terms of hours worked, there were two million fewer full-time employees, nearly a million more part-time employees and over a million more self-employed working people, who tend to work longer hours. As Feinstein and

[20] This discussion of recent developments draws on the excellent summary by Feinstein and Matthews (1990).

Matthews note:

> Since the part-timers, females, and the self-employed all tend to earn less than the average per hour, these changes jointly and severally amounted to a shift towards labour that was cheaper per hour and probably also had a lower efficiency wage.[21]

The employment shifts had a rather counterintuitive effect: despite the enormous increase in unemployment in Britain in the 1980's, the rate of change in total labor input, measured in terms of total hours worked, was about the same as during the 1950's and 1960's. Thus:

> From one point of view, then, British economic performance in the 1980's might be held to have been better than is commonly alleged. The economy proved capable of producing enough work to do for there to be no drastic downward break in the trend of total labour input. This was achieved, however, by means of an increase in the inequality between individuals in the amount of work done: the unemployed were at one extreme and the self-employed at the other.[22]

British labor productivity growth has also improved markedly during the 1980's, though it is still at only about three-quarters of the pre-1973 trend rate. From a comparative international viewpoint British productivity growth, like her real GDP growth, has been well above the O.E.C.D. average during the decade; in fact, taking the post-oil shock 1973-1988 period as a whole, the British growth performance has been well within the O.E.C.D. norm.

Nevertheless the productivity growth improvements have been distributed unevenly through the economy: most sectors have shown reasonably strong growth, while productivity growth in manufacturing — at 4.2% per annum the highest among the O.E.C.D. economies — has been considerably higher than the pre-1973 Postwar average. This has been accompanied by modest changes in labor-management relations and trade union behavior. It is unclear, however, that continued high growth in manufacturing is sustainable: the performance is due in part to the industry shake-out of the early 1980's, during which industry scrapped a great deal of outdated equipment and released a large number of low-skilled workers. Moreover, industry continues to log relatively low investment rates, despite increasing foreign investment in Britain; in consequence, there was very little increase in the gross capital stock of production industries during the 1980's. In addition, only modest steps have been taken to encourage more extensive training of the workforce.

Whatever happens in manufacturing, the services industries, having borne some of the impact of sectoral employment shifts, have had a quite different experience. Although productivity in the miscellaneous services of the Other services sector rose slightly, the huge influx of workers into these low-productivity activities led to an annual **decrease** in average productivity in the Other services sector of -1.7%. Some portion of this decline is due to the growth of part-time employment in these activities, but it is not clear how much. The prospects for productivity growth in this industry are uncertain.

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[21] Matthews and Feinstein (1990), p.82.

[22] Ibid., p.84.

On an even bleaker note, unemployment remained well over two million through the late 1980's — around 7% in 1988 — without significantly affecting industrial wage growth. As Schultze noted in a 1986 study of real wages in Europe,[23] several years after British unemployment had climbed to levels approaching those of the Great Depression:

> The evidence strongly suggests continued severe labor market problems in the United Kingdom. Even at current levels of activity, much less higher ones, there may be some excess wage pressure in the United Kingdom. Earlier wage aspirations have not adjusted downward, and trend productivity growth — while a little higher than earlier — will not support them at even modestly higher levels of activity.

High unemployment seems to have scant effects on British wage aspirations. Layard and Nickell[24] note:

> once we take account of the fact that the long-term unemployed have only a minor impact on wages, we find that, in the long run, the inflation-reducing effects of extra unemployment decline rapidly as unemployment rises. For the same reason, the impact of changes in wage pressure on unemployment increases as the general level of unemployment goes up.

With regard to the causes of continued real wage growth in the face of a large "reserve army of the unemployed", they argue that

> wage pressure has increased partly because of union militancy [70% of British manufacturing workers were union members in 1979; 17% of private service workers], partly because of taxes, and partly because of easier social security. [Regional and skills m]ismatch has contributed little to the increase in unemployment.

Summary. The overall perspective is therefore one of a British economy with

1). a moderate reliance for growth on exploitation of a natural resource base — oil and gas — that will diminish over time;
2). a much diminished but leaner, more productive manufacturing base;
3). an expanded low-skill, low-productivity service sector;
4). a relatively low-skilled but still fairly highly organized workforce that continues to negotiate high levels of wage growth relative to productivity growth;
5). a fairly large surplus of unemployed and underemployed labor; and
6). relatively low investment rates in both human and physical capital that respond poorly to changes in output or financial conditions, and therefore suggest no obvious policy solution to improve them.

These characteristics suggest that a useful model of the British economy should incorporate several features that will be discussed in Section IV.1, covering the rationale and structure of BRIM.

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[23] Schultze (1986), p.100.

[24] Dornbusch and Layard (1987), p.146.

CHAPTER III. REVIEW OF EXISTING MODELS

Section III.1 Types of Macroeconomic Models

Large-scale forecast modeling remains an area of controversy, with several distinct approaches competing in the forecasting, planning and policy analysis markets.[25] These approaches include aggregate macroeconometric models, classical input-output models, input-output models driven by aggregate macro models, computable general equilibrium models, and dynamic macroeconometric interindustry models — the class to which BRIM belongs. A short description and comparison of these types illustrate some of the benefits of the approach taken in developing BRIM.

Aggregate macroeconometric (macro) models. In representing the circular flow of market exchange, macro modelers estimate and link equations that forecast the quarterly national accounts aggregates and related components of economic activity, using lag equations to model slow adjustment processes. For forecasting, the models are solved as a simultaneous system for a given period, given assumptions about the future path of exogenous variables. Most macro models are structural; that is, their equations are linked together in ways that reflect their builders' beliefs about the interactions of components of economic activity. Many macro models now incorporate long-run growth models that simulate aggregate potential output as a function of aggregate inputs of capital, labor, energy and material. This feature gives a model the capability of simulating the effect on long-run growth of policies that stimulate or stifle input supplies.

Structural models are generally Keynesian in the short term, so that fiscal and monetary stimuli have short-term real effects. Many such models, however, are effectively monetarist in the longer term, in that monetary stimulus is ultimately dissipated through a rise in the general price level.[26] Furthermore, in these models fiscal stimulus tends simply to push the economy temporarily above its long-run equilibrium path, to which it eventually returns. The most comprehensive macro models also incorporate submodels of specific sectors of the economy, such as the energy, housing, or manufacturing sectors.

While most macro modelers use a structural approach, a significant minority of economists are highly critical of the large role that human judgement plays in the specification of structure. These modelers have adopted time-series estimation and modeling methods — in particular, vector autoregressive (VAR) techniques — intended to extract maximum information from variance in the data with a minimum of judgement. Despite its users' claim

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[25] In addition, a significant minority in the academic economics community is sharply critical of the entire macroeconomic modeling enterprise: "[L]ittle in the way of scientific knowledge is to be gained from the construction of large-scale models over what can be learned by other means. At present, at least, there are very few spinoffs into academic advance." (Angus Deaton, quoted in Smith (1990), p.302.) However, even the critics generally acknowledge the relevance of large-scale structural modeling to planning and policy analysis.

[26] A trend away from standard Keynesian in favor of monetarist long-term responses could be seen clearly in the major British macro models during the past decade. See Fisher, Turner, Wallis and Whitley (1990).

to greater objectivity, however, time-series analysis still compels the modeler to use a great deal of judgement to identify and select the appropriate variables to include in the model. One observer notes[27] that

> [m]any claim that time-series methods outperform causal methods, mainly because of specification and conditioning errors inherent in the econometric approach. Others claim that this is true only for very short-range forecasts, and that econometric forecasts are superior for longer-range forecasting when one would expect extrapolation methods to fare less well than methods capable of accounting for substantive changes in other variables.

In general, the relative accuracy the two approaches remains a subject of controversy. Several studies in the U.S. have concluded that Bayesian VAR models, in which prior values were imposed on the weights of the lagged independent variables, give better forecasts than macro models.[28] (Note, however, that this BVAR approach clearly involves the imposition of structure on the estimation process with little theoretical economic or econometric justification.) In contrast, studies of U.K. models have yielded mixed results. Wallis et. al. (1987) found a BVAR model to give poorer forecast results than the structural macro models; however, Holden and Broomhead (1990) concluded that the BVAR models they tested did comparatively well. Close examination of their results, however, suggests that the Cambridge CMDM model — the British model closest to BRIM in structure and detail — generally outperforms the BVAR models in forecasting most components of economic activity. No further effort will be made here to review the controversy; but in the author's opinion, structural macro models' usefulness as research tools more than make up for their limitations. The structural approach is the best existing forum for testing empirically the model builder's understanding of aggregate economic activity, and the formal framework of macro modeling is, as one observer has put it, "an irreplaceable adjunct to the processes of policy thought."[29]

Aggregate behavior is relatively stable over the medium term; and adjustments that are particular to specific detailed goods and factor markets generally do not greatly affect the general movements of aggregate volumes and prices. It is this relative stability of the structure of economic activity that makes macro models useful for aggregate forecasting. However, macro models do not generally simulate detailed asset, factor and commodity market activity. More detailed modeling requires data from social accounting matrices (SAM's) or their equivalents; a set of symmetric accounts providing detailed stocks and flows of real and financial assets held by individuals and institutions, intermediate and final commodity and industry output, factor incomes and prices, consistent with aggregate national accounts. It also requires a modeling strategy that can simulate these interactions realistically.

Classical input-output (IO) models. IO models make use of the detailed data found in input-output, final demand and factor distribution tables, typically to develop static multipliers, and do not generally involve econometric estimation of behavioral equations. This form of

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[27] Kennedy (1985), p.207.

[28] Discussed in Holden and Broomhead (1990), p.17.

[29] Higgins, quoted in Smith (1990), p.306.

analysis specifies the magnitude of the first-round effects of an exogenous shock, but ignores both price effects and the timing of adjustments. In dynamic versions, investment is typically related to planned output, an approach that can lead to instability in simulation.

Input-output models driven by macro models (macro IO). As their name suggests, these models are hybrids. Typically, the macro model relies heavily on econometric estimation, and captures many of the dynamic aspects of economic behavior, such as investment, through estimated lag equations. The results are then used as inputs into an input-output table to capture detailed intermediate input, factor and demand flows, using a "row scalar" technique. This type of model, sometimes referred to as a "tailpipe" model, does not guarantee consistency in forecast between the detailed results and the driving aggregates; nor does it typically involve systematic price changes and responses.

Computable General Equilibrium (CGE) models. CGE's descend from extended fixed-price multiplier analyses that made use of social accounting matrices (SAM's) to trace multiplier effects of an exogenous change through production, income-expenditure, capital and financial accounts.[30] CGE models expand on this kind of analysis to include price-responsive behavioral equations for commodity, product and factor demand and supply, embodying preferences and constraints. Building on general equilibrium (GE) theory, the CGE model builder develops a set of behavioral equations that are generally derived from representative agents' utility maximization and cost minimization. Functional forms are typically chosen from a handful of tractable forms to maintain ease of computation; they usually apply only to components of consumption and value added, and often fail to account for rather basic interactions between variables. Often, the required parameter values are set exogenously, drawing on the available empirical literature. Finally, the CGE model builder "calibrates" the behavioral equations to a benchmark SAM so that the model reproduces the SAM as a solution, given the chosen parameters. The solution procedure usually involves a nonlinear search algorithm that solves for a set of equilibrium prices and quantities for all of the specified markets.[31] Furthermore, since the CGE approach explicitly incorporates demand functions derived from the behavior of representative agents, a CGE model can solve for these agents' expectations of the time path of market developments (given the structure specified by the model). CGE models have thus been developed that incorporate dynamic rational expectations, which have not been assimilated into macro models. The result is a model that, given an exogenous shock, produces a price-dependent general equilibrium response that reflects GE theoretical behavioral assumptions. The CGE approach thus provides the user with a powerful comparative statics tool to measure the magnitude of welfare effects of exogenous shocks, and can simulate a model's dynamic equilibrium path, given assumptions about individuals' intertemporal preferences.

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[30] For a comparison of a SAM multiplier analysis by Adelman and Robinson with an DMI analysis using the INFORUM model, see Monaco (1988).

[31] Early CGE's used Scarf's algorithm or various formal Newton methods to solve for equilibrium prices and quantities. More recently, modelers have tended to use Gauss-Seidel iterative methods, which have been found generally to permit substantial savings in computation, especially when used with recursive blocks. For an illuminating comparison of Gauss-Seidel and Newton solution techniques for econometric models of the U.K., see Hallett and Fisher (1990).

Despite their theoretical pedigree, however, CGE models do not provide very plausible forecasting solutions. The GE response is very dependent on the behavioral equation and exogenous parameter specifications, and because the solution typically assumes mobile factors, market clearing and instantaneous adjustment to exogenous changes, the dynamic adjustment path is usually left unspecified, or is specified in a way that does not reflect the rather slow adjustment path that economies tend to follow in response to shocks. Some GE models provide a somewhat more realistic simulation of dynamics by incorporating cost-of-adjustment terms into investment demand functions. This improvement notwithstanding, no GE model has been developed that realistically captures that costs that individuals incur in gathering information about economic developments and adjusting their behavior accordingly. As a result, CGE models tend to show unrealistically rapid adjustments to exogenous shocks. As noted by Whalley, a major proponent of this approach, CGE models

> are not forecasting tools built to give an accurate picture of the future time path of actual economies, but are instead a form of theory with numbers which generates insights rather than precise forecasts.[32]

Three models, however, deserve special mention for partly bridging the gap between CGE and DMI models (discussed below) such as BRIM. One is the detailed DGEM model of the U.S. economy developed by Jorgenson and his many collaborators.[33] The model incorporates a set of rigorously estimated econometric equations into the CGE context. The equations, covering 35 separate industries, provide detailed estimation of demand and supply elasticities and technical change, and allow for a great deal of substitution between intermediate, energy and primary factors in the solution procedure. The authors have also sensibly incorporated intertemporal preferences into the model, so that forward-looking preferences and expectations drive savings and asset accumulation decisions. Furthermore, the model includes a large number of different households with different characteristics, allowing demand to be characterized at a high degree of disaggregation.

However, as with other CGE models, the Jorgenson model assumes perfect factor mobility, ignoring the existence of imperfect adjustment processes, industry-specificity of most capital equipment, and the possibility of long-term factor unemployment. Furthermore, agents' decisions involve full knowledge of the long-term dynamic path of the model, overstating the agents' forward-looking capabilities. On a more technical level, the behavioral equations all use the transcendental logarithmic (translog) functional form, which imposes severe constraints on the interaction between scale (or income) and price effects and tends to be biased toward high factor substitutability, given noisy data. The functional form also forces technical change parameters to go to zero within a few decades. Finally, the many households in the model (termed "dynasties") remain constant over time rather than aging in cohorts. For long-term forecasting in a world with slow adjustment processes and aging populations, these characteristics can become defects.

The second notable model is Goulder's intertemporal model, which incorporates Jorgenson's supply and demand parameters at a somewhat higher level of aggregation, and

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32 Whalley (1986), p.3.

33 See Jorgenson (1984) and Jorgenson and Wilcoxen (1989).

adds several useful features not found in current incarnations of the Jorgenson model. Goulder allows for slow adjustment of capital stocks through increasing investment cost functions, eliminating one of the Jorgenson model's problems. He also includes a detailed representation of both the U.S. tax system and the discovery and depletion of fossil fuel stocks, permitting analysis of the effects of changes in the tax code and world energy prices on agents' behavior. However, the Goulder model has only a single "representative agent", and it still suffers from the other problems that affect the Jorgenson model.

The third notable CGE model is the G-Cubed model being developed by McKibbin and Wilcoxen,[34] which integrates the Jorgenson model with the MSG2 model of McKibbin and Sachs.[35] The G-Cubed model improves on the Jorgenson and Goulder models in several ways. First, it is a six-region, twelve-sector model of the global economy. Second, it incorporates money into the economy by imposing the constraint that money must be used for transactions; and it allows for the integration of markets for real and financial assets within and between regions and sectors. This feature permits the model to simulate the effects on the real economy of changes in monetary policy, unlike most CGE models. Third, it includes intertemporal accounting of stocks and flows of all assets, and imposes intertemporal budget constraints on agents and regions. These features permit the model to account consistently for both current and capital flows between regions. Fourth, it while it solves for rational expectations optimizing behavior, it allows for short-run behavior that is a weighted average of optimizing behavior and *ad hoc* rule-of-thumb and liquidity constrained behavior; furthermore, like the Goulder model, it allows for sector-specific capital stocks and adjustment processes. These last features allow the model to mimic slow adjustment of the real global economy to policy and other shocks.

Despite these virtues, as with the other models, G-Cubed still lacks several important features that would make it more useful as a long-term forecasting or policy analysis tool. Like the Goulder model, it has only a single representative consumer in each region; and unlike the Goulder model it does not include a detailed representation of the tax system or natural resource stocks. Demand and supply side parameters are not specified in the current version of the model in as great detail as in the Jorgenson model. Finally, technical change is represented as purely labor-augmenting, a feature that allows the model to reach a dynamic steady state (and therefore permits a solution), but that runs counter to the available evidence on how technology enters into the economy.[36] These last two features in particular as yet seriously constrain the model's applicability in long-run policy simulation.

Dynamic macroeconometric interindustry (DMI) models. DMI models combine characteristics of the types of models described above, but are unique in their focus on both detailed behavior and realistic dynamic adjustment. Like a macro IO model, a DMI model is a hybrid macro model and extended IO model; and like a CGE model, it is comprised of behavioral equations that forecast detailed industry output, value added, components of demand and prices. However, in contrast to those of a typical CGE, the behavioral equations

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[34] See McKibbin and Wilcoxen (1992) and McKibbin (1992).

[35] See McKibbin and Sachs (1991).

[36] See Boskin and Lau (1992).

of a DMI model are not explicitly derived from optimization behavior; nor does the model assume that general equilibrium obtains in a given period. Rather, the behavioral equations, which apply to industry-level aggregates, are chosen to reflect empirically observed aggregate behavior, which in reality is as often as not disequilibrium adjustment behavior; and they are specified to be consistent with individual optimization, though not derived from it. This emphasis on capturing observed behavior may seem at first glance to ignore economic theory; however, DMI models' superior forecasting characteristics stem precisely from this emphasis on modeling empirically observed behavior in a way that is compatible with optimizing behavior without being explicitly derived from it.

The detailed behavioral equations of a DMI are solved simultaneously according to the Leontief equation, $\boldsymbol{q} = \boldsymbol{Aq} + \boldsymbol{f}$, where $\boldsymbol{q}$ represents the vector of gross industry outputs, $\boldsymbol{f}$ represents the vector of final demands, and $\boldsymbol{A}$ represents the matrix of industry input-output coefficients. The approach also forecasts detailed price changes and price responses through time-series regression forecasts of the components of value added and the Leontief equation's dual, $\boldsymbol{p} = \boldsymbol{pA} + \boldsymbol{v}$, where $\boldsymbol{p}$ represents the vector of industry output prices, $\boldsymbol{v}$ represents the vector of industry value added, and $\boldsymbol{A}$ again represents the matrix of industry input-output coefficients. This approach thus amounts to assuming constant returns and cost-plus pricing. The solution process calculates equilibrium through block recursive linear methods, and — in contrast to macro IO models — ensures accounting consistency between detailed final, intermediate and total demands, and the macroeconomic aggregates, and also between product and input prices and value added. The approach also allows for coefficient change — price-responsive where appropriate — to represent changes in technology.

The DMI approach fails to account for some aspects of economic behavior that theory and intuition suggest might be important. On the consumption side, relatively little work has been done on modeling consumers' intertemporal preferences and relating asset accumulation to these preferences. Interest rates have been incorporated into savings equations in some versions of INFORUM's LIFT model of the U.S., but in general consumption and savings decisions are not explicitly related to intertemporal preferences and expectations. On the production side, neither productivity change nor price changes are explicitly related to the capital formation process that actually embodies a significant portion of technical change; and to an extent, use of Leontief technology imposes low substitutability by assumption. However, the DMI analysis combines input-output accounting, regression analysis, and economic theory to build up a consistent, detailed model that exhibits quantity adjustment in the short run and significant price adjustment only in the longer run, and therefore represents the actual dynamic path of the economy remarkably well. No other detailed models capture the economy's response to exogenous shocks as realistically, allowing for detailed adjustments in both prices and quantities.

Fundamental constraints. The foregoing discussion is intended to place the DMI approach to economic modeling in context, illustrating its strengths and weaknesses. However, a few comments may be in order here regarding constraints basic to the whole forecasting enterprise. Economic forecast modeling, like other forms of large-scale modeling, has proven to be a greater challenge than its pioneers expected in the early postwar era. After nearly half a century of model building, the best we can now reasonably aspire to are models that give us a sense of the general long-run tendencies of the economy and its various sectors; and we must accept that even highly complex models are at best rough, approximate characterizations of the systems whose development we seek to understand. The fundamental constraints involve data limitations, weaknesses in the current economic theory of price adjustment, and limited applicability of mathematical analysis to aggregate social phenomena.

The data limitations involve scale. The macroeconomy involves many actors, each regularly participating in many markets — a much finer scale on several dimensions than we can model or for which we can even collect data. These limitations impose a high level of aggregation in terms of actors, markets and time, with all the index problems inherent in aggregation. In some respects, aggregation is useful in forecasting: it is generally easier to forecast the consumption behavior of a million people that to forecast that of a particular person. Nevertheless, aggregation, combined with the inherent unpredictability of human behavior, imposes inevitable limits to the level of detail we can realistically model.

The weakness in theory is that economists have yet to compile even an adequate taxonomy of price formation and adjustment processes. As its name implies, general equilibrium theory offers a formal model for considering market behavior in balance. It does not address the detailed dynamics of decision making, information processing and negotiation and transactions behavior, and therefore does not adequately account for disequilibrium adjustment processes. As a result, GE theory does not lend itself to an adequate understanding or realistic forecast modeling of the lags ubiquitous in market adjustments.

A more general constraint is that aggregate social behavior does not lend itself to precise mathematical description, unlike physical phenomena. A great deal of judgement is involved in several aspects of model building: choosing plausible and appropriate specifications for behavioral equations with realistic adjustment lags in light of available theory; choosing appropriate estimation procedures, given assumptions about the generation and distribution of errors in the data and the general applicability of probability theory to the data; and choosing appropriate model solution procedures.[37] The fact is that even the most rigorous and comprehensive econometric approaches suggested in the literature — for instance, estimation of the entire set of equations in the model using system nonlinear full-information maximum likelihood methods[38] — raise as many basic issues as they address. It is highly improbable that such a system of equations will be in any sense the "true" system. For one thing, economic systems abound with nonlinearities, most often modeled using linear or log-linear approximations. Besides, the number of parameters to be estimated increases geometrically as the number of separate sectors and/or agents in the model increases, rapidly exceeding the degrees of freedom available given the available data. In practice, the existing modeling approaches are considerably less thorough; but it is not clear that the effort required for such an approach would result in appreciably better forecasting results.

Finally, even very simple nonlinear dynamical systems can be highly unpredictable due to the sensitivity of their dynamic paths to initial conditions.[39] Intuition suggests that some such unpredictability may obtain in complex economic systems, further constraining our

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[37] For a discussion of these problems, see Almon (1989), pp. 53-61.

[38] As suggested by Mansur and Whalley (1984), p.71.

[39] Gleick (1987) provides a good layman's introduction to these issues and a short list of advanced references.

forecasting abilities.

Section III.2 Models of the British Economy

A brief history of British macro modeling. Over the past generation, British model builders have developed macroeconometric, CGE and macro I-O models of the U.K. The first major sustained macroeconomic modeling effort in the U.K. began in 1960 with the advent of Sir Richard Stone's Cambridge Growth Project, although both the London School of Economics and at Oxford University sponsored models in the late 1950's.[40] Still in the process of development today, the CGP model — now the Cambridge Multisectoral Dynamic Model or CMDM — has focused on interindustry analysis from the beginning and developed along lines very similar to BRIM; it is discussed in detail below and throughout this presentation.

Other than these projects, the development of quantitative data-based models of the British economy was largely stalled until the late 1960's by what one observer has called "a rather general scepticism in the economics profession at large in the United Kingdom about the application of mathematical and statistical techniques to economic problems". Based on the implicit assumption — traceable at least in part to Keynes — that random events dominate aggregate economic activity to the point of precluding structural modeling of aggregate economic activity, this general skepticism resulted in a general dearth of funding for models. As a consequence, until the mid-1970's the relatively few model-building projects in the U.K. — the CGP, the London Business School, the University of Southampton, and the National Institute of Social and Economic Research — were bankrolled mainly by the quasi-public Social Science Research Council, now the Economic and Social Research Council or ESRC.

These early models were all more or less explicitly Keynesian, linking consumption to income within the framework of the National Accounts and focusing almost exclusively on real flows, largely ignoring detailed accounting or projection of monetary and financial developments and their real effects. The models reflected the British economics profession's general Keynesian conviction that money and monetary variables have relatively little effect either on real output or on price behavior, a conviction that emphasized the importance (and usefulness) of fiscal policy in managing macroeconomic growth and downplayed the significance of monetary policy. This attitude had several historical roots independent of Keynesian theory. British economists found relatively little correlation between financial variables and real developments in the Depression and early postwar periods, and their findings suggested little real effects of monetary policy. Furthermore, the pre-1972 pegged exchange rate system greatly restricted British monetary authorities' ability to control the money supply; in effect, supply largely adjusted to demand through the balance of payments mechanism. As long as the United States exercised financial restraint, British monetary policy was in fact less important than fiscal policy.

In 1970, Her Majesty's Treasury began to formalize the government's official economic assumptions and forecasting procedures using a model based on the Keynesian LBS model. Over the next few years, however, a number of economists became concerned with Treasury's inattention to the impact of the shift to a floating exchange rate regime, which could allow both fiscal and monetary policy to affect the real economy through their effect on

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[40] A concise history of macroeconomic model-building in the United Kingdom is presented by Ball and Holly in Bodkin, Klein and Marwah (1991), from which this short review is drawn.

exchange rates and hence on international financial and trade flows. This "international monetarist" paradigm shift, led by the Cambridge Economic Policy Group, strongly influenced both official policy and other British modelers, and by the early 1980's a number of private forecasting groups had developed similar models.

Since then, other developments in the economy — the policy changes of the Conservative government, the adoption of the Medium-Term Financial Policy, the development of North Sea oil and the related appreciation of sterling, and the great rise in unemployment after 1980 — have all greatly complicated the process of modeling and placed enormous challenges on macro model builders. These changes have forced model builders to pay a great deal more attention to financial markets, the exchange market and supply-side factors (particularly the labor market) than they previously had.

Meanwhile, New Classical theorists and sophisticated econometricians within the economics profession challenged the intellectual foundations of macro modeling. Partly in response to this criticism, the ESRC's funding priorities shifted away from the Cambridge efforts to such approaches as vector autoregression, CGE and econometric testing. In the area of CGE modeling, Piggot and Whalley (1982) pioneered the development of applied GE tax models in the mid-1970's with a 33-sector, 100-consumer group model that incorporated all major British taxes and subsidies and allowed for comparative static effects of changes in the tax system. The model was used evaluate the detailed welfare and distributional effects of the existing tax system, in particular the effects of housing subsidies and the recently introduced value added tax system.

Comparison of models by the ESRC. In 1983, the ESRC's Macroeconomic Modelling Bureau began to methodically review and compare results of the best-known U.K. macro models, hoping to achieve a better general understanding of their properties.[41] The Bureau began with the five ESRC-financed models; the London Business School, National Institute for Economic and Social Research, the Cambridge Growth Project, the Liverpool University and City University Business School models (discussed at length below). In addition, it included in its assessments the independently-financed models at Her Majesty's Treasury and the Bank of England. Since then, the Bureau has dropped support of the CGP and CUBS models, but has included the Oxford Economic Forecasting model in its testing.

The Bureau now has a number of annual sets of forecasts which it can systematically compare, and whose forecast errors it can decompose into model errors and incorrect assumptions about exogenous variables. The Bureau's model evaluations have provide consistent disinterested comparisons between the macro models, and most of what is known about the comparative properties of the models is due to the Bureau's efforts. Furthermore, the evaluations have aided modelers in addressing deficiencies in the models. Nevertheless, the results are disappointing. Analyses of historical simulations and ex ante and ex post forecasts suggest that, although the models tend to outperform simple time-series and VAR forecasts, and some even outperform Bayesian VAR forecasts, they suffer severe problems as descriptions of economic activity. Even excluding forecasts of the exchange rate, which has proven particularly difficult to model realistically, forecasts of critical variables outperformed a

[41] See the reviews edited by Wallis (1984, 1985, 1986, 1987).

random walk only half the time over the period 1978-85.[42]

The major macro models. The following descriptions of the major models draws on several discussions presented over the years by the Macroeconomic Modelling Bureau. The existing major British macro models are nearly all quarterly, although the CMDM, the only input-output model, is annual. The models differ considerably in incorporating differing conceptual models of economic activity and in emphasizing the relative importance of the interrelations between components of real activity, prices, monetary policy, and interest and exchange rates. Most of the models incorporate fairly extensive treatment of financial and asset markets and some incorporate a rational expectations paradigm. Even so, nearly all of them still can be fairly called Keynesian macroeconomic models, at least in their short run properties. As such, they take variations in aggregate demand and especially consumption as the main determinants of general economic fluctuations and derive changes in output and employment from them; and monetary and fiscal stimuli lead to increased demand and output in the short run. As mentioned in the previous section, however, most of the models' supply sides have been extended to account for the importance of inflationary pressures in choking off expansionary demand and monetary policies; and so the models tend to be monetarist in the longer run.

The models include various influences on consumption other than income and prices, such as wealth (particularly housing assets), inflation rates, interest rates, or liquidity. The models generally distinguish several categories of investment, which are determined by some combination of changes in output or expected output, changes in the capital stock, input costs, profit levels, and/or interest rates. Inventories depend on demand, interest rates, prices, and/or expected output. Exports are generally determined by some exogenous measure of world demand; imports are a function of domestic demand and relative import prices. Government demand is usually exogenous.

Given final demand, employment is determined by the level of output (or expected output) and factor costs, including wages. Wages can depend on a bewildering variety of influences, including output, prices, taxes, target real wage, and/or the level of unemployment. A crucial variable that drastically affects the overall properties of a particular model is the extent to and rapidity with which changes in unemployment affect wages; this effect is often a major source of nonlinearities in the models. Prices are generally determined by some measure of costs, mainly wage costs, although some models allow for influences from capacity utilization and/or import prices. Profits are determined from prices and costs. Given employment, profits and prices, income can be calculated, and the systems are normally solved recursively until the level of income used to predict final demand equals that resulting from the production needed to fill that demand.

The macro models all treat international trade and finance fairly extensively, incorporating forecasts of exchange rates and relative import prices. Several of them include sub-models of North Sea oil production, recognizing both its importance to and independence from the rest of the economy and its independent influence on the balance of trade and payments.

[42] Smith (1990), p.305.

The models differ considerably in their simulation of monetary flows and effects. This is understandable in light of the complexity of money's influence on the real economy; one should properly take into account interest rate and exchange rate effects on prices and aggregate demand, as well as expectations effects on wages, prices and interest rates. Furthermore, the effects on interest and exchange rates tend to be more rapid than those on demand and wages, so monetary policy affects real interest rates and, most importantly, exchange rates. No model captures all of these effects, and a given model's response to monetary policy depends on which channels it incorporates. All of the models, however, include a very rapid response of wages to changes in consumer prices, a characteristic of the British economy that more than a decade of high unemployment has not altered. Furthermore, some of them incorporate an exchange rate mechanism to account for most of the transmission of monetary growth to prices: monetary stimulus results in an expectations-driven fall in the exchange rate, raising import prices, consumer prices, and hence wages and domestic prices.

In recent years, the major British modelers have focused their attention on more rigorous specification of supply side constraints and technological developments in the British economy. Until recently, the models did not contain a specification of British industry adequate to simulate the strength of supply responses to wage restraints, tariff protection and other policies aimed at improving British economic performance. The models still have relatively poor measures of capacity utilization and poorly specified interaction of key variables (such as prices) to changes in capacity utilization, and they differ markedly in these specifications.

Comparison of the models shows that they differ most markedly in their approach to the interactions between wages, prices and the exchange rate.[43] Differences between these core interactions account for much of their distinctive long-run properties, as discussed below. The other crucial difference revealed by detailed comparison is the relative importance attached by different modeling groups to economic theory and empirical evidence. This shows up most clearly in two issues. One is the degree of homogeneity imposed in the wage, price and exchange rate equations (and the lag structure by which homogeneity obtains); the other is in the specification of responses to changes in tax rates, again especially in the wage equations. Here the tax coefficients "tend to be poorly determined in empirical estimation, partly because the aggregate tax variables do not adequately reflect changes in the particular taxes which influence decisions at the micro level",[44] and because the choice between imposing a theoretical prior or relying on the (poor) statistical evidence strongly affects forecasting results.

The London Business School model. The LBS model is an aggregate quarterly model of about 100 equations. The LBS model has a very extensive real sector as described above; in addition, it contains an extensive financial sector in which market-clearing prices are determined for money, government bonds and equities in a rational expectations framework. The LBS used to be referred to as an "international monetarist" model because of its extensive treatment of asset markets in an international context. Money's main influence was on the exchange rate, and the presence of expectations in the exchange rate equations caused overshooting in the spirit of Dornbusch. This, paradoxically, made the quantity adjustment

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[43] Fisher et.al. (1990).

[44] Fisher et. al. (1990), p.100.

mechanism even more sluggish. However, foreign exchange markets are now modeled separately based on uncovered interest parity conditions, and respond only partially to expectations.

The real side remains neo-Keynesian in that quantities adjust more rapidly than prices. For many years, the LBS price mechanism was specified in such a way that prices responded quite slowly to changes in costs, so that the model had a markedly sluggish inflation response and moved only slowly to equilibrium. Paradoxically, the model's wage equation included a large response of real wages to changes in employment, so that expansionary demand policies led to higher real wages, which only gradually fed through to higher prices. In the present version, however, wages respond to changes in productivity, and prices respond more rapidly both to wage increases and to capacity utilization. Taken together, this set of changes reduces the influence of the exchange rate in transmitting inflation, and increases that of domestic supply factors.

The National Institute of Economic and Social Research model. The NIESR model contains some 90 equations and was originally a neo-Keynesian "quantity adjustment" model, being relatively insensitive to money and prices. In recent years the NIESR model has been revised to incorporate extensive treatment of the supply side. One manifestation is that wages are influenced not by the unemployment rate but by the proportion of the adult population not working, whether in the labor force or not. (I believe this is due to its builders' dissatisfaction with the available measures of the British workforce.) Another related change is that productivity growth is included directly in wage equations, as with the LBS; this leads to sharp increases in real wages when output rises. At present, the model includes forward expectations in equations for many key variables, including the exchange rate, which is determined by its expected value, real interest rate differentials, relative prices, and the change in the trade balance.

Her Majesty's Treasury model. HMT maintains a large 700 equation model which concentrates on the behavior of the public sector. As with the LBS model, the real side of the model is conventional, and the financial sector is extensively modelled. From the description available, the model does not seem to integrate asset markets as well as the LBS model; however, it resembles older versions of the LBS model in being on the borderline between a sluggish price adjustment model and a quantity adjustment model. Money supply responds to demand, which itself is dependent on gross wealth, final demand and interest rates. Again like older versions of the LBS model, money's main influence is on the exchange rate, which is homogeneous in domestic prices by imposition, but adjusts to changes in the current account balance. In recent years, the supply side has been greatly expended; the model now incorporates detailed treatment of the relation between imports and domestic output, reflecting the British government's increasing appreciation of the importance of relative supply conditions on British domestic activity.

The Bank of England model. The BE was originally based on the LBS model and is generally similar in structure. Because the reciprocal of the unemployment rate enters into the wage equation, the unemployment response is highly nonlinear: while wage growth barely responds to unemployment at high levels of unemployment, it responds very strongly as demand approaches capacity constraints. Prices respond rapidly to cost increases. Homogeneity is imposed on the exchange rate, which also responds to changes in the current balance.

The Oxford Economic Forecasting model. The OEF model, run by a private forecasting organization, is an offshoot of the HMT model, though it has been considerably revised and extended in recent years. It, too, contains fairly detailed modeling of the price side, though it does not incorporate as detailed modeling of the relations between imports and domestic output. Wages are barely affected by changes in unemployment, but respond rapidly to prices and fairly rapidly to productivity growth. Prices increase fairly rapidly in response to cost increases. Exchange rates and interest rates are estimated jointly, though not in a rational expectations framework; and the exchange rate equation has the peculiar property of including the dollar value of British labor costs, so that increases in labor costs do not lead to exchange rate depreciation compatible with long-run homogeneity.

The City University Business School model. The CUBS model is a small annual model of only 10 behavioral equations. This model does not use the National Accounts framework, and instead emphasizes supply-side factors. The aggregate demand for capital, labor, energy and raw materials are determined by a model that assumes perfectly competitive profit maximization. Labor supply depends on population and the wage; there is a natural rate of unemployment determined by the level of unemployment benefits. In the long run, total output depends upon labor supply, energy demand, real material prices, the capital stock, and real money supply. There is no financial sector, nor are expectations modeled. Money's main role is in determining the inflation rate and thus the price level and wage rate, which all respond rapidly to monetary stimulus. In sum, although the model is based on the concept of competitive profit maximization it can be thought of as a Keynesian sluggish price adjustment model. The CUBS model is no longer funded by the ESRC.

The Liverpool model. The model of the Liverpool University Research Group in Macroeconomics (LPL) is a small "new classical" model of about 20 equations that is unique in imposing model-consistent rational expectations in its solution. It has remained almost unchanged since its inception in 1980, although it is now quarterly rather than annual. In this model, such variables as expected future exchange rates or interest rates coincide with the model's forecasts, forcing the model to meet a theoretical ideal. Demand is related to wealth rather than income; monetary growth directly increases inflation, which in turn alters prices, wages, interest rates and real wealth. Labor supply is determined in the model and the labor market clears by construction. Government spending is determined endogenously, given a target deficit and tax rates. The real exchange rate responds immediately to relative price changes and real wages.

The Cambridge Multisectoral Dynamic model of the British Economy. The CMDM, formerly referred to as the CGP, was initiated by Richard Stone's Cambridge Growth Project and has been overseen by Terry Barker of the Department of Applied Economics at Cambridge. It is not the only input-output model of Britain; another is being built by officials who provide the Commodity Flow Accounts at the Department of Trade and Industry. However, it is the most complete and comprehensive existing model of the British economy at present, with nearly 5200 endogenous variables and 500 exogenous ones, 700 stochastic equations and 4500 identities. It is therefore doubly unfortunate that the model is no longer funded or tested by the ESRC.

The CMDM model is conceptually similar to Inforum's LIFT model of the American economy and thus is similar to BRIM. It has been a very helpful resource in building a model of the U.K. and throughout this presentation, I will make reference to its equations, both to critique them and to draw attention to their strengths.

The CMDM's accounting framework is that of the British National Accounts and input-output tables, augmented by data that provides a detailed set of production, income-outlay, accumulation and financial accounts in accordance with the UN System of National Accounts (SNA). The description that follows is of the MDM6 version of the model described in Barker and Peterson (1987).

At the model's core is a structural Leontief input-output model disaggregated to 39 industries and commodities. The primary data source for these industries is the Commodity Flow Accounts produced by the Department of Trade and Industry, which are based on the National Accounts and input-output data. (North Sea oil is modelled as one of these industries.) As with BRIM, the CMDM model mimics the economy in building from detailed industry activity to the macroeconomic aggregates, rather than estimating aggregates and then distributing the results to industries. Industries are, as Barker puts it, "behavioural and technical agents" in the model. For each industry, total final and intermediate demand equals total supply in a given year; investment and employment are determined by developments within the industry, and they in turn affect its capital stock, productivity, costs and prices.

The model is dynamic, involving difference equations in which developments have lagged effects over several years, so that annual flows (such as investment) affect stocks (such as the capital stock) which themselves influence future flows. It offers projections over a ten- to fifteen-year period. It is also distinguished by a very detailed treatment of the British tax and public expenditure system, with some 400 of its 500 exogenous variables being government policy instruments. It is therefore ideal for examining the effects of policy changes.

The model is essentially Keynesian; it is driven primarily by quantity factors, rather than relative prices, with monetary factors having a relatively minor influence. Like BRIM, it is not a general equilibrium model in which equilibrium solutions are derived based on the assumption of utility and profit maximization by representative agents and firms. Rather, as its builders state:

> Inherent in our approach is a theory of the complete model as a system which presupposes poor information flows, few futures markets, general oligopolistic or monopolistic behavior in markets for goods and services, and dominance of trade unions in the wage-bargaining procedure. Maximizing behaviour is assumed for agents such as 'industries' operating in particular markets in deriving specifications of factor-demand functions, or for consumers allocating their spending across categories, in deriving the expenditure system we use. However there is no assumption that the agents interact so as to move to an equilibrium determined by a hypothetical social-welfare function or according to any other general equilibrium rule. . . . This treatment means that there is no automatic mechanism to prevent crises occurring. . . . There is no automatic clearing of markets except in the goods and services market where the stock-adjustment model prevents stockbuilding from veering out of control.[45]

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[45] Barker (1987), p.14.

As with the aggregate models described above, the CMDM is driven primarily by final demand, which is modeled by detailed commodity demand functions for consumption demand, government final consumption, public and private investment inventory change, and exports. Of these, all but government demand are endogenously determined. I will describe these equations in greater detail as I compare them to my own in the following chapters. Intermediate demand is embodied in the input-output matrix, whose coefficients are projected mainly through time trends. However, there is a submodel of energy demand that influences the coefficients for energy inputs. Intermediate demand, imports and domestic output are determined interdependently, as total domestic demand is divided between imports and domestic output and then run through the input-output matrix.

Domestic prices are determined endogenously in the model, which distinguishes between prices of domestic sales, exports and imports. Prices in most industries are explained by production costs (mainly labor costs). The wage equations, in turn, are based on a "real wage resistance" hypothesis which assumes that workers and unions bargain and generally win target real wage increases. Therefore increases in consumer prices ultimately end up increasing wage rates, which themselves are the largest component of costs and prices. This wage-price relation seems to be the process by which the model simulates Britain's persistently high inflation is spite of high unemployment levels.

The CMDM labor equations explain employment essentially through output levels, so that the labor and goods markets interact through quantities in that higher employment yields an increase in aggregate disposable income and spending, and hence raises employment. In keeping with its Keynesian pedigree, the model incorporates market-clearing forces that are rather weak and indirect. However, to the extent that market-clearing forces operate they are essentially classical: rising unemployment puts some pressure on wages and prices, but this does not lead directly to increased employment; rather the reduced inflation rate may lead to an increase in the quantity of output demanded, and only thus affect employment.

The CMDM also incorporates a highly developed model of the financial sector with full current and capital accounts for seven domestic institutions; these accounts are expanded to full financial capital accounts for eleven institutions, all integrated with commodity and industry flows. The financial model is not as detailed as that of the LBS in that it does not involve a rational expectations framework or develop market-clearing prices for different assets. Instead, assets and liabilities are allocated by fixed shares. It is relatively independent of the rest of the model; financial variables affect goods markets only through exchange rate effects, interest rate effects on housing demand and profits, and wealth effects on consumer spending. Interest rates are determined by the banks' base rate, which is exogenous. Long-run exchange rates are driven toward purchasing-power parity, but the main influence in the equation is the difference between British and American interest rates, which drive short-term international capital movements.

General conclusions. Taking together all of the models discussed above, one can make several important points. First, they represent an impressive demonstration of the strength of the basic Keynesian paradigm in explaining short-term aggregate economic developments, once adequate allowance is made for the importance of real and financial stock adjustments. At the same time, they also reflect increasing consensus among macro modelers that fiscal and monetary stimuli have only relatively short-term effects, and tend to be neutral or even counterproductive in the long run, except during periods of serious recession. There is significant and increasing — though by no means complete —agreement on a wide range of issues, including the appropriate methods of modeling wage, price, exchange rate and expectations behavior. The ESRC Macroeconomic Modelling Bureau has played a useful role in comparing models and pointing up both their strengths and shortcomings.

Second, the models do not vary greatly in short-term forecast performance, and furthermore many observers believe that this performance is about as good as can be expected. As noted by Ball and Holly[46]:

> The observed absolute errors ... are easily within the average range of adjustments in the data themselves five years after the date of initial publication. . . . it is hardly likely that we shall see much, if any, improvement in the recorded forecast errors, so that the worth of such models and forecasting exercises must probably be judged on the basis of what we can now do.

Third, for purposes of policy evaluation the models turn out to have similar strengths and shortcomings. All of the models suggest that any major monetary or fiscal stimulus aimed at increasing real output and employment will result either in unacceptable levels of inflation or in severe deterioration in the balance of payments, or both. The leading participants in British policy debates have recognized this basic constraint, and three diverging views have developed about the appropriate direction for British macroeconomic policy. One group argues that the balance of payments is the major constraint to fiscal expansion, and that it can best be dealt with through an policy designed to encourage trade through exchange rate devaluation while using incomes policies to prevent a rapid price response to the devaluation. A second group calls for protectionism rather than devaluation; while a third group argues that the underlying constraints are on the supply side and that, consequently, devaluation and protectionism are inappropriate solutions. However — and this is the most important general observation — the models are still not adequately specified to be able to test these arguments and thus contribute to the policy debate. The main problem is that no model embodies as yet an adequate specification of British supply side characteristics to simulate in detail the strength of supply responses to wage restraints, tariff protection or other alternative policies aimed at improving British economic performance.

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[46] Ball and Holly in Bodkin, Klein and Marwah (1991), p.224.

CHAPTER IV. BRIM: THE BRITISH INTERINDUSTRY MODEL

Section IV.1 Rationale and Structure of the Model

The discussion of recent British economic trends in Chapter II and the review of existing models of Britain in section III.2 suggest that a useful model of Britain should take into account several features:

1). Potential output may be best modeled as the result of essentially exogenous productivity trends. Were sufficient data available, it would be useful to relate these trends to the growth and age distribution of the stock of productive capital.

2). The accelerator parameters in the investment functions should probably be small: an increase in output should lead to only modest increases in investment.

3). Inflation should be generated through monetary policy that accommodates wage increases; and wage growth should be partially exogenous (or at least only tenuously related to productivity growth) but also should respond to recent inflation levels. Furthermore, wage growth should be relatively impervious to changes in unemployment levels. This mechanism implies that wage-price inflation spirals can be started relatively easily and dampened only with difficulty.

4). The savings equation should smooth the effect of income growth on consumption and should play a crucial role in dampening consumer spending during periods of high inflation or high unemployment.

5). Since profits fluctuate procyclically, the equations for profit income should have this component of value added capture a significant portion of rising income during booms, dampening the boom and stabilizing the economy (and the model).

6). Interest rates are British monetary authorities' main policy instrument and have been controlled during much of the period over which the equations are estimated. Although the authorities really control only the monetary aggregates, their focus on interest rates leads me to believe that interest rates may best be considered exogenous, at least during the model's initial stages of development.

7). However, exchange rates should depend on relative real interest rates and changes in the trade balance; rapid monetary growth should lead to a capital outflow, a declining exchange rate, and import price inflation.

BRIM tries to incorporate all of these characteristics.

As with Inforum's LIFT model of the United States (on which it is closely based) and the Cambridge CMDM, BRIM is a hybrid extended Leontief input-output model and econometrically estimated macroeconomic model. Like other macroeconomic models, it is intended to estimate and simulate the relationships between output and income flows. In doing so, it captures many of the dynamic aspects of economic behavior through estimated lag equations. (In consequence, the model portrays economic behavior in a framework of adaptive rather than rational expectations.) However, BRIM differs from most macroeconomic models in that most of its behavioral equations are estimated at a detailed industry or commodity level, and in the process of determining an aggregate equilibrium it captures intermediate flows of inputs like a traditional input-output model. Thus BRIM combines input-output accounting with macroeconomics to build up a consistent and dynamic picture of the economy.

This approach has several virtues. First, the model mimics the economy in that the macroeconomic aggregates are built up from detailed projections of industry activity, rather than being estimated on aggregates and then distributed among industries. Second, the model can be used to trace in detail the effects of changes in one industry on other, related sectors. Third, parameters in the behavioral equations may differ among industries, reflecting differences in supply conditions, industrial structure, tax incentives, or the lag structures of responses to economic developments. Fourth, the detailed level of disaggregation permits the modeling of price changes by industry, allowing one to explore some of the causes of relative price changes and their effects on industry output, structure, and employment. This last point is particularly important: because the economy is disaggregated into industries that, in effect, behave independently of each other, one can simultaneously model the effect of changes in output on relative prices, and changes in prices on demand and output.

It is important to note, however, that the price modeling is not based on maximization of various agents' objective functions: the consumption, labor supply and savings functions are not based on explicit utility maximization by representative agents; nor are industry production functions derived from profit maximization. The model-building process is informed with a moderate distrust of the applicability of neoclassical theory at the industry aggregate level, especially for Britain. For aggregate modeling, the important thing is not that equations be derived from models that assume optimizing behavior, but that the equations be consistent with such behavior. On the demand side, consumers' income and price responses are modeled at the aggregate level, and therefore individual demand theory has only limited application. For example, while Slutsky symmetry may apply to individual demand functions, it need not — in fact, almost certainly does not — apply to aggregate demand. Imposing symmetry on aggregate equations is therefore likely to make a model less realistic rather than more so. On the supply side, the modeling approach assumes, as do the builders of the CMDM model, very inflexible labor markets, and relatively rigid commodity markets that involve cost-plus commodity pricing and quantity adjustment in the short run and significant price adjustment only in the longer run. For the British economy, this approach does not seem inappropriate. It is very clear that British labor markets do not clear, even in the medium- to long-run; and even quite sophisticated studies fail to turn up much price responsiveness in British investment behavior. Thus for the major components of British value added, I think it is safe to assume that relatively little is lost by neglecting to specify neoclassical production functions at the industry level.

To some extent, however, the modeling of price behavior is limited by the available data, from which it is difficult to estimate equations that reflect the types of optimizing behavior that theory suggests we should see. This is particularly true of commodity prices and the non-wage components of value added, which are crucial to modeling producers' price responses to changes in demand patterns. Data restrictions severely limit our ability to specify such price responses in a way that is either realistic or compatible with theory.

BRIM can be decomposed into three major components: a "real side" which models constant-price economic activity; a "price side" involving changes in relative prices, income and the price level; and an accounting process that calculates the aggregates as presented in the National Accounts, completes interinstitutional transactions that have not been calculated elsewhere in the model, and ensures consistency between the forecast commodity and industry detail and the derived aggregates. In the solution procedure for any particular year, the model receives data exogenous for the current forecasting period and iterates through the equations in these three components until the model converges. There are convergence criteria in each process. The real side generates final commodity demands and outputs interactively, continuing through a cycle of calculations known as the Seidel loop until output by commodity equals demand by commodity at specified relative domestic and import prices. These commodity outputs are translated through the "make" matrix into industry outputs, which form the input into the price side of the model. The price side generates a vector of current-price value added by industry, which is converted through a value-added matrix to a value added vector by commodity; then, a second Seidel loop generates a vector of prices consistent with the vector of value added and the input-output matrix. Convergence requires consistency in the vector of domestic commodity prices at specified levels of primary and intermediate inputs, real outputs, and import prices. Next, the resulting income and price forecasts are aggregated to produce sums corresponding to the National Accounts data. Then the income and price solutions are sent back into the real side, which must be solved again at the predicted levels of income and prices. The iteration procedure continues until the price and output changes from one iteration to the next are negligible. It thus achieves a simultaneous and interdependent solution of outputs and prices.

The real side of the model consists mainly of behavioral equations used to forecast a vector of constant-price final demand by commodity. Most of the final demand vectors are forecast using regression equations estimated on disaggregated data, although some final demands, such as government expenditures, are provided exogenously. For the most part, components of final demand are calculated using income, prices and outputs as determining variables. For the British model, the components of final demand are:

Personal consumption expenditures (39 functional categories)
Gross fixed capital formation (3 assets, 55 industries)
Inventory investment (55 industries)
Exports (55 commodities)
Imports (55 commodities)
Government expenditures (4 categories)

Where the level of aggregation of a component of final demand differs from the 55-commodity breakdown of the input-output portion of the model, demand is translated into a final demand vector of 55 commodities by means of a "bridge" matrix which translates one ordering into the other. Thus the 39 functional demands for personal consumption expenditures (PCE) are translated into demands for the 55 commodities by means of a 55 by 39 PCE bridge matrix; a "B" matrix translates investment demand by 55 investing industries into demand for 55 commodities; and a "G" matrix bridges 4 categories of government spending into demand for 55 commodities. Taking these bridges into account, the final demand vector is

$$\boldsymbol{f} = \boldsymbol{PCE}\,\boldsymbol{c} + \boldsymbol{B}\,(\boldsymbol{v}_v + \boldsymbol{v}_p + \boldsymbol{v}_s) + \boldsymbol{n} + \boldsymbol{G}\,\boldsymbol{g} + \boldsymbol{x} - \boldsymbol{m}$$

where

f is a 55-element column vector of final demand by commodity;
PCE is a 55 by 39 PCE bridge matrix;
c is a 39-element consumption vector;
B is a 55 commodity by 55 industry investment bridge matrix;
v_v, v_p, and v_s are 55-element industry investment vectors for vehicles, equipment and structures, respectively;
n is a 55-element commodity inventory change vector;

G is a 55 by 4 government consumption bridge matrix;
g is a 4-element government consumption vector;
m is a 55-element commodity import vector; and
x is a 55-element commodity export vector.

The distinction between commodities and industries is vital because most of the detailed final demand and price data in the model is commodity-specific, while nearly all output data is industry-specific. (An industry is typically defined as composed of productive establishments that all produce the same specific commodity as their principal product; usually the bulk of the commodity is produced by establishments within that industry.) Most input-output models tend to gloss over the distinction because of the tendency for firms' output mix to vary over time and the difficulties inherent in trying to measure or predict this variation. Despite these difficulties, it is vital to distinguish between industry and commodity measures of output and value added, for prices must be determined on a commodity basis even though value added can be forecast realistically only on an industry basis. To accomplish this, BRIM distinguishes between industry and commodity measures of output and value added, and translates between them by means of a static "make" matrix (for output), and a commodity-to-industry value-added matrix derived from the make matrix (for value added). Although problems may arise from using a static make matrix, they are trivial in comparison to the distortions introduced by ignoring the distinction between industries and commodities altogether.

Given a forecast vector of final commodity demands, the model uses a 55 by 55 commodity-commodity total requirements or "use" matrix (the A matrix) to determine gross commodity outputs. The A matrix used in BRIM is derived from a commodity-industry matrix using both industry technology and commodity technology assumptions.[47]

Gross outputs (q) are calculated according to the basic Leontief input-output equation

$$q = Aq + f$$

or alternatively

$$q - Aq = f$$

where

q is a 55-element vector of constant price commodity outputs; and
A is the 55 by 55 commodity-commodity use matrix, where each coefficient a_{ij} of the use matrix gives the total constant-price amount of good *i* needed to produce a unit of good *j*.

This right-hand side of this last equation is the expenditure measure of gross domestic product, while the left-hand side is the value-added or income measure. This approach to calculating

[47] The distinction between technology assumptions is discussed further in the Appendix. For a more detailed discussion of the techniques used to derive the tables, see the introductions to the published tables.

total output ensures that the income-expenditure identity obtains in the model. Moreover, the technical coefficients of the A matrix, while exogenous to the model, are allowed to vary over time.

In the solution process, domestic commodity output, imports and inventory change are mutually dependent; and imports are allocated between final and domestic use according to an imports use matrix derived from the official tables. These three sets of equations are therefore solved together in the iterative Seidel loop mentioned above. However, investment demand depends on current output, so that a second iterative loop must be used to recalculate investment demand, taking into account the iterative solution for gross outputs. Outputs are then recalculated, and the cycle continues until the model achieves consistency between output and demand.

Given a consistent commodity output vector, the model uses the make matrix to allocate output between industries. The model then calculates industry-specific labor productivity trends and uses them to determine the quantities of labor required to produce the specified output, thus arriving at total employment. Unemployment is calculated as the difference between employment and an exogenously specified labor force. This completes the real side of the model, with all components of economic activity specified in constant prices.

The price side builds on the results of the real side by determining current price values for elements of economic activity, relative prices, and the general price level. Unit commodity prices are determined through the dual Leontief equation

$$p = pA + v$$

which says that any commodity i's unit price p_i is equal to the sum of unit intermediate input costs

$$\sum_{j=1}^{55} a_{ji}\, p_j$$

plus unit value-added costs v_i. Under this approach, the intermediate input mix is price-independent. This can be a significant drawback in modelling, say, substitution between alternative forms of energy, but can be remedied either by making individual coefficients price dependent (complicating the solution process) or by removing a set of commodities (e.g. energy) from the intermediate matrix and treating them as components of value added.[48] For BRIM, however, such work requires further effort.

To calculate prices, the model must calculate values for the three components available for Britain of value added by industry: compensation of employees, other income and indirect business taxes. Labor compensation, accounting for nearly two-thirds of total value added, is a function of the level of employment and the growth of two aggregate wages, one for manufacturing industries and one for other industries. Both aggregate wage equations depend on inflation rates; in the manufacturing wage equation, real wages grow at an exogenous rate, while real wage growth is tied to productivity growth in the service industries.

[48] See, for instance, Treyz (1990) or Jorgenson and Wilcoxen (1990).

The other income component is composed of income from self-employment, gross profits of companies, rents (including imputed rents from ownership of dwellings), trading income from public enterprises, other income, and adjustments for stock appreciation. These components are not given separately for any detailed breakdown by industry; the other income component is therefore calculated by industry and only capital consumption is developed separately at the disaggregated level.

Indirect business taxes by industry are determined using exogenously set rates derived from the 1984 input-output tables.

Once the components of value added are determined for each industry, they are summed to determine total value added by industry. An adjustment is made to these value-added components to account for financial services provided by the Banking and finance industry. Finally, the industry value-added totals are translated to commodity value-added totals through a value-added matrix that was derived from the make matrix using a RAS technique. These commodity value-added totals are used to determine commodity prices as described above.

The current-price components of economic activity are then aggregated and allocated to the personal, corporate and state sectors according to estimated equations; and these sector incomes feed back to demand, along with the commodity prices determined on the price side of the model, until an iterative solution is reached.

Equation Specification Criteria. In a forecasting model of the size and complexity of BRIM, a given behavioral equation is specified to relate the dependent variable to a number of other model variables, some of which are exogenous but many of which are endogenously determined in a manner similar to that of the dependent variable. The fact that the equation must give reasonable solutions in the context of a set of simultaneous equations gives rise to a set of considerations that guide the specification and evaluation of functional forms in the behavioral equations.[49] First, the equations should include variables for which data is available. Second, the equations should be relatively easy to estimate given the available computing resources.

Third, the equations should be consistent with actual observed economic behavior (though, as mentioned before, this does not require that the equations be derived from neoclassical optimization theory.) Fourth, since the model is a long-run model, the equations should yield reasonable long-term predictions that capture fundamental structural relations between the dependent and explanatory variables and are consistent with the general framework of the model. This requirement has three related implications. It suggests that we be as spare as possible in our specifications, since every explanatory variable must either be calculated within the model or specified exogenously. Furthermore, it implies that we may at times need to include variables whose coefficients are statistically insignificant but whose presence provides interactions that are important for the stability of the model. Finally, it generally precludes the use of lagged dependent variables as explanators. Although lagged dependent variables often provide very good fits for variables with significant trends, they do little to capture structural relations between the variable and related economic phenomena, and

[49] I draw here on the discussion by Werling (1992).

generally provide quite poor long-run predictions.

Rho adjustments. An additional feature of the model specification that should be noted is its treatment of autocorrelation in the errors of the regressions. One result of excluding lagged dependent variables is that there is often a high degree of autocorrelation in the residuals, generally due to the omission of explanatory variables that are impractical or impossible to include. The equations are not corrected for autocorrelation using a Cochrane-Orcutt or Hildreth-Lu adjustment, but instead use a "rho adjustment" technique, in which, as Werling (1992) explains,

> the predictions in the forecast period provided by an equation are adjusted by the error in the last year of the estimation period multiplied by the autocorrelation coefficient raised to the power of the forecast period, i.e.
>
> $$y_1' = y_1 + (r_0 \times \rho)$$
> $$y_2' = y_2 + (r_0 \times \rho^2)$$
> $$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$
> $$y_n' = y_n + (r_0 \times \rho^n)$$

This rho-adjustment technique says, in effect, that for unspecified reasons the model's equations are likely to err in future forecasts in much the same way as they have in the past, and that successive errors are likely to be correlated to each other in the same way that they were during the period of estimation. In the experience of the INFORUM group, this type of adjustment for autocorrelation produces better forecasting results than correction of the equations through standard autocorrelation correction techniques.

Equation Evaluation Criteria. For the purposes of model building, I have relied almost entirely on ordinary least squares and simple non-linear estimation techniques. Neither the theory nor the data available for large-scale model construction is sufficient to warrant the application of sophisticated econometrics. As Werling (1992) notes,

> we regard econometric techniques as simple tools used to construct crude approximations of complicated processes, rather than complex statistical processes used to prove or disprove simple hypotheses. The functional specifications are not regarded as "true" equations, and there is no attempt to acquire "efficient" estimates of parameters. The objective is to obtain parameters which depict plausible economic behavior, fit the historical data reasonably well, and produce equation properties which work together to yield a useful forecasting or policy analysis tool.

Although the significance of a given independent variable in a given equation can be judged by examining the conventional t-statistic, I have usually followed Almon's example and used mexvals to evaluate the importance of a given variable. A variable's mexval is defined as the percentage increase in the equation's standard error of the equation that would result from omitting the variable; put more simply, it is the variable's marginal contribution to the fit. The mexval conveys essentially the same information as the t-statistic except that its calculation does not involve the number of degrees of freedom in the estimation. The mexval therefore does not embody any assumptions about the validity of the equation's form, the non-stochastic nature of the X-matrix, or the distribution of errors in the equation; nor is the mexval sensitive to the number of observations in the sample. Furthermore, the interpretation of t-statistics becomes increasingly problematic when constraints are placed on the parameter estimations, as they are in these equations; although the same is true for the mexval it is usually easier to recognize and discount the effect of constraints on the mexval. In addition to the mexval, the elasticity of the dependent variable with respect to the explanatory variable (evaluated at the mean) can help one judge whether the magnitude of an estimated parameter is reasonable.

Since the purpose of estimation is to develop parameters for long-run estimation, it is very useful, if possible, to gauge both the stability of the parameters when they are estimated over different periods, and to examine the accuracy of out-of-sample predictions using the parameters. Either significant changes in parameter estimates in different periods or poor out-of-sample performance can indicate the presence of major structural or behavioral changes over time, and either suggest that the estimated parameters may not be very useful in long-term forecasting.

Unfortunately, one's ability to conduct such tests is often circumscribed by data limitations, and we may have no alternative to the estimated parameters other than our *a priori* sense that they are unsatisfactory for use in the model. In these circumstances I employ "soft constraints" in the estimation, either by minimizing a linear combination of the sum of squared errors and deviations from the constraints, or by adding to the data a number of observations that impose the constraint within the least squares process. These constraints are used to force parameters to take *a priori* values or to smooth distributed lags on the independent variables.

Section IV.2 Final Demand: Consumption

Personal consumption expenditures are the backbone of economic activity — PCE accounted for 61.2% of gross domestic product measured at market prices in 1984. Accurate modeling of consumption is therefore crucial to any exercise in macroeconomic forecasting; furthermore, in contrast to quarterly aggregate models, disaggregated long-term forecasting requires realistic modeling of consumers' responses to proportionately large changes in income and relative prices. In contrast to the objective of much of the econometric work that has been done on consumption functions, however, long-term forecasting does not demand that we develop "true" structural equations for aggregate consumption expenditures — an impossible goal at any rate. Rather, the aim is, as Almon has put it, to "find values for ... parameters which both imply plausible reactions to changes in prices and incomes and give a tolerably good fit to historical data." There is therefore no need for "elaborate attempts to obtain 'efficient' estimates of the parameters of the approximations ... Likewise, use of Bayesian-like a priori information is entirely justified if it can improve plausibility yet preserve a good fit."[50]

Unfortunately, even the most sophisticated utility functions in the literature generally impose overly restrictive and unrealistic conditions on parameters that one would like either to uncover from the data or at least to have take on values that do not conflict with common sense. In part, the limitations of many of these functions are purely formal.[51] However, several limitations are imposed by the inappropriate application of microeconomic theory to aggregate phenomena. Many functional forms are derived from utility maximization by a representative consumer, a derivation that is neither necessary nor sufficient for the econometric estimation of market demand. Aggregate demand functions need not satisfy Slutsky symmetry (equivalence of compensated cross-price elasticities) because Slutsky income effects generally do not aggregate over individuals with different incomes and (likely) different utility functions. Such functions also impose the assumption that individuals' utility functions are stable over the period of time covered by market demand studies. Furthermore, the functions impose the assumption that consumers are optimizing only over the set of commodities for which the researcher has data. In reality, people optimize over a range of commodities that includes the services of durable goods, non-market activities not covered by the available data, are fundamental constraints such as time and information. Since we do not have data for most of these variables, it is not realistic to impose a system of demand functions derived axiomatically from demand theory on the empirical regularities to be uncovered by econometric estimation using the kind of aggregate data we have available.

Requirements for the form. While axiomatic derivation and elaborate estimation techniques may be superfluous in this exercise, the estimated equation system must achieve a degree of realism and plausibility at reasonable cost; and to do this it must satisfy a number of requirements:[52]

— It should be relatively easy to economize on the parameters of the system and

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[50] See Almon (1979), p.99.

[51] The translog function, for instance, forces price elasticities to -1.0 asymptotically as income increases, despite its great flexibility in other respects.

[52] This discussion draws on Almon (1979).

relatively easy to estimate them.

— The system should satisfy the adding up requirement — expenditures plus saving should sum to disposable income — and should be homogeneous of degree zero in income and prices.

— It should allow for both substitution or complementarity between goods; furthermore, it should allow both for goods with close substitutes and high own- and cross-price elasticities, and for goods with no substitutes and low elasticities. Further, although aggregate market demand need not satisfy Slutsky symmetry, one may require the functional form to approximate symmetry to reduce the number of parameters to be estimated.

— Marginal propensities to consume out of income should be allowed to vary between goods and to interact with prices. Furthermore, as income increases, asymptotic proportions of amounts consumed should depend on prices.

— Variables other than income and prices should be easily included, and the effects of these variables on consumption also should interact with price effects. Furthermore, price changes should alter the effects of income and non-income determinants of demand in roughly equal proportions.

Alternative forms: the Rotterdam system. No system currently employed in any other British model meets all of these rather simple, common-sense requirements. The Cambridge CMDM model, for instance, employs the Rotterdam system, which relates the change in the constant-price (or real) budget share of each commodity to the change in real total expenditures and relative commodity prices. The system is derived from a demand function that features a multiplicative relation between prices and income:

$$x_i = e^{a_i} y^{e_i} \prod_{j=1}^{n} p_j^{e_{ij}}$$

where

x_i is the quantity bought of the i^{th} commodity;
e_i is the income or expenditure elasticity of good i;
e_{ii} is the own-price elasticity of good i,
e_{ij} is the cross-price elasticity of goods i and j.

The estimated equation is

$$w_i \, dlog \, x_i = b_i \sum_{j=1}^{n} w_j \, dlog \, x_j + \sum_{j=1}^{n} c_{ij} \, dlog \, p_j$$

where

$w_i = p_i \, q_i / y$ is the budget share of the i^{th} commodity;
$b_i = p_i \, (\delta x_i / \delta p_i) = w_i \, e_i$ is the budget share of the i^{th} commodity times its income elasticity; and
$c_{ij} = w_i \, e_{ij}$ is the cross-price elasticity between i and j times i's budget share.

Since $dw_i = d(p_i x_i / y) = w_i \, dlog \, p_i + w_i \, dlog \, x_i - w_i \, dlog \, y$, the dependent variable $w_i \, dlog \, x_i$ is the change in the budget share of the i^{th} commodity caused by a change in the quantity bought of the i^{th} commodity, or the "real" change in the budget share. Likewise, since

$$dlog\ y = \sum_{j=1}^{n} w_j\ dlog\ p_j + \sum_{j=1}^{n} w_j\ dlog\ x_j$$

the first explanatory variable is the proportionate change in total real expenditures (that is, with prices unchanged). The other explanatory variables are proportionate price changes. Thus the estimated equation relates the change in real budget share to proportionate changes in real expenditures and relative prices, yielding in the process income elasticities (b_i / w_i) and compensated price elasticities ($e^*_{ij} = c_{ij} / w_i$).

While this form meets most of the requirements discussed above, it has two obvious flaws in application to aggregate consumption modeling. First — and fatally for long-term modelling, where income may increase significantly — the income elasticity of demand for any particular good is constant for all levels of income. This implies that any good which has an income elasticity exceeding unity will, as income increases in the absence of price changes, account for an increasingly large portion of consumption, ultimately absorbing all income. This is a clearly unrealistic and unacceptable result. Second, the price elasticity of the marginal propensity to consume out of nominal income is constant and equal to the own-price elasticity for each commodity. This implies that (assuming my demand for beer is unit elastic) if a \$1,000 raise induces me to buy an additional six-pack of beer, then should the price of beer double, the same \$1,000 raise will induce me to buy only three cans of beer. If my demand for beer were inelastic — say an -0.5 elasticity — then after the price hike the raise would increase my beer demand by only 4.5 cans; conversely, if my demand were very elastic — an elasticity of -2.0, perhaps — if would increase my beer demand by scant can and a half. There is no obvious reason why such a relation should obtain, and the form thus solves by assumption an important relation that, with a more flexible form, might be derived from the data. On the whole, however, the Cambridge consumption estimations provide values of other parameters with which to compare our own results.

The AIDS system. The "almost ideal demand system" of demand equations proposed by Deaton and Muellbauer has similar flaws. The AIDS form is

$$w_i = a_i + \sum_{j=1}^{n} \gamma_{ij} \log p_j + b_i \log \left(\frac{y}{P}\right)$$

where

w_i is the budget share for commodity i, and
P is a price index defined by

$$\log P = a_0 + \sum_{k=1}^{n} a_k \log p_k + ½ \sum_{k=1}^{n} \sum_{l=1}^{n} \gamma_{kl} \log p_k \log p_l$$

which is homogeneous of degree one in prices and is generally approximately proportional to any appropriately defined price index. In this form, then, the term *(y/P)* represents real income and b_i is the marginal propensity to increase commodity i's budget share out of real income. This gives rise to the same kind of problem as the Rotterdam model does: with constant prices, as income rises, a good which has a positive marginal propensity to consume from income will ultimately absorb all increases in income. In addition, this marginal propensity is unaffected by prices; this is equivalent to assuming a unitary price elasticity of the marginal propensity to consume out of real income, and again amounts to solving by assumption an important aspect of consumer behavior.

The Almon form. To avoid these pitfalls and meet the requirements described above, I have used an interdependent system of demand equations developed by Almon (1979). The system has been used with good results in several other models, and Gauyacq (1985), in an exhaustive review of aggregate consumption models and their application to French economic data, has concluded that the Almon model was the only one of real practical use in simulating and forecasting French consumption over the period 1959 to 1979.

These equations incorporate a multiplicative relation between aggregate disposable income and relative prices:

$$x_i = \left(a_i(t) + b_i\left(\frac{y}{\bar{p}}\right)\right)\prod_{k=1}^{n} p_k^{c_{ik}}$$

where

x_i is estimated per capita demand for the i^{th} commodity;
$a_i(t)$ represents a constant term and non-income, non-price variables;
y is per capita nominal personal disposable income;
p_k is the nominal price index for the k^{th} commodity;

$\sum_{k=1}^{n} b_k = 1$ to give constant-price adding-up;

$\sum_{k=1}^{n} c_{ik} = 0$ to give homogeneity of degree zero in income and prices;

and

$\bar{p} = \prod_{k=1}^{n} p_k^{s_k^0}$ where

$s_k^0 = \dfrac{p_k^0 q_k^0}{y^0}$ are the budget shares in the base year.

The adding up requirement is automatically met only in the constant prices of the base year. For other years with different prices, total expenditure will not necessarily add up to disposable income minus savings. A "spreader" term, x_i^*, is appended to allocate the difference across goods:

$$x_i^* = x_i + \frac{p_i\, x_i}{\sum_j p_j\, x_j} \left(y - \sum_j p_j\, x_j \right)$$

The system can become unwieldy without restrictions on the number of parameters (the number of own- and cross-price terms to be estimated increases as the square of the number of commodities). The easiest restriction to impose is Slutsky symmetry in a specific year; this reduces the parameters by nearly half. (For other years, the symmetric cross-price parameters that obtain will only approximate the compensated cross-price term.) The function's compensated cross-price derivative for a specific year is

$$\left(\frac{\partial x_i}{\partial p_j}\right)^* = c_{ij} \frac{x_i^0}{p_j^0}$$

so Slutsky symmetry implies that

$$\lambda_{ij} = c_{ij} \frac{x_i^0}{p_j^0} = c_{ji} \frac{x_j^0}{p_i^0} = \lambda_{ji}$$

Thus symmetry can be imposed by rewriting the equations in these terms and imposing the equality across equations.

One can further cut the number of cross-price terms to a manageable number by employing the concept of groups and subgroups of related commodities, and imposing the restriction that the λ between any two goods in the same group or subgroup be the same. (Obviously, one's classification of commodities will be based on prior common-sense knowledge of their uses rather than any formal procedure.) Thus, for example, automobile maintenance services, which might be considered part of an "automotive transportation" subgroup, would be required to be equally complementary with all other commodities in the subgroup (e.g. gasoline). In addition, they would also be required to be equally substitutable for public transportation services, which are in the larger transportation group. Finally, they would be only weakly substitutable with other, unrelated goods, and they would share that level of weak elasticity with all other pairs of commodities not in the same group. Thus the same cross-price elasticity would apply between cars and food as between housing and education. Mathematically, then, for a commodity i in a group G (composed of subgroups A and B) and subgroup A, the estimated equation takes the form

$$x_i = \left(a_i\,(t) + b_i \left(\frac{y}{\bar{p}}\right)\right) \left(\frac{p_i}{p_A}\right)^{-\lambda_A'} \left(\frac{p_i}{p_G}\right)^{-\lambda_G'} \left(\frac{p_i}{\bar{p}}\right)^{-\lambda_0}$$

where

$$\lambda'_A = \left(\sum_{j \in A} \frac{p_j q_j}{y} \right) (\lambda_A - \lambda_G)$$

$$\lambda'_G = \left(\sum_{j \in G} \frac{p_j q_j}{y} \right) (\lambda_G - \lambda_0)$$

$$p_A = \left(\prod_{j \in A} p_j^{s_j^0} \right)^{\left(\frac{1}{s_A^0}\right)}$$

$$p_G = \left(\prod_{j \in G} p_j^{s_j^0} \right)^{\left(\frac{1}{s_A^0 + s_B^0}\right)}$$

The λ's, a_i's and b_i's are estimated by non-linear regression, and the elasticities are calculated from them.

For a commodity i in a group C, not in group G, and containing no subgroups, the estimated equation takes the form

$$x_i = \left(a_i\,(t) + b_i \left(\frac{y}{\bar{P}} \right) \right) \left(\frac{p_i}{p_C} \right)^{-\lambda_C'} \left(\frac{p_i}{\bar{P}} \right)^{-\lambda_0}$$

where

$$\lambda'_C = \left(\sum_{j \in C} \frac{p_j q_j}{y} \right) (\lambda_C - \lambda_0)$$

$$p_C = \left(\prod_{j \in C} p_j^{s_j^0} \right)^{\left(\frac{1}{s_C^0}\right)}$$

For commodities that are not considered to have a strong relation to any others, the estimated equation takes a simpler form; under this form, all such goods are constrained to have the same own-price elasticity by this estimating procedure:

$$x_i = \left(a_i\,(t) + b_i \left(\frac{y}{\bar{P}} \right) \right) \left(\frac{p_i}{\bar{P}} \right)^{-\lambda_0}$$

The income-compensated elasticities (not Hicksian elasticities, since the form is not derived from optimization) are as follows.

For $i \in A$,

$$\eta_{ii} = -\lambda_A' \left(1 - \frac{s_i}{s_A} \right) - \lambda_G' \left(1 - \frac{s_i}{s_G} \right) - \lambda_0 \,(1 - s_i)$$

$$\eta_{ij} = \lambda_A' \frac{s_j}{s_A} + \lambda_G' \frac{s_j}{s_G} + \lambda_0 s_j \qquad \text{for } j \in A,\ j \neq i$$

$$\eta_{ij} = \lambda_G' \frac{s_j}{s_G} + \lambda_0 s_j \qquad \text{for } j \in G,\ j \notin A$$

$$\eta_{ij} = \lambda_0 s_j \qquad \text{for } j \notin G$$

For $i \in B$, B replaces A in the equations above.

For $i \in C$,

$$\eta_{ii} = \lambda_C' \left(1 - \frac{s_i}{s_C}\right) - \lambda_0 (1 - s_i)$$

$$\eta_{ij} = \lambda_C' \frac{s_j}{s_C} + \lambda_0 s_j \qquad \text{for } j \in C,\ j \neq i$$

$$\eta_{ij} = \lambda_0 s_j \qquad \text{for } j \notin C$$

For $i \in D$,

$$\eta_{ii} = - \lambda_0 (1 - s_i)$$

$$\eta_{ij} = \lambda_0 s_j \qquad \text{for } i \neq j$$

Note that the Almon approach to estimating consumption parameters imposes a number of a priori expectations: rather than simply estimating hundreds of parameters within a particular, theoretically appealing form and letting the data tell us what it will, we are greatly reducing the number of parameters — in this case, by an order of magnitude — to increase the ease of estimation while requiring the results to meet our priors. Within the confines of our imposed expectations, however, there is a great deal of room for the parameters to inform us about the nature and magnitude of consumer responses to income and price changes; more so, in fact, than in any existing estimations using more sophisticated estimation techniques. To the sophisticated econometrician, the system might be more appropriately solved by a full information maximum likelihood simultaneous equation estimator for this functional form. Nevertheless, such an exercise would involve much greater computational cost with,

TABLE IV.2.1: GROUP CLASSIFICATION OF COMMODITIES WITH SHARES OF PERSONAL CONSUMPTION EXPENDITURES

Group	Subgroup	Commodity
Food, Alcohol, Tobacco (25.4%)	—	Food (14.6%)
		Alcohol (7.4%)
		Tobacco (3.4%)
Clothing and Footwear (6.8%)	—	Clothing (5.5%)
		Footwear (1.3%)
Household Activities (28.6%)	Housing (17.1)	Owner-Occupied Dwellings (6.0%)
		Other Housing (11.1%)
	Energy (4.9%)	Electricity (2.3%)
		Natural Gas (1.9%)
		Coal and Coke (0.4%)
		Other Energy (0.3%)
	Household Durables (5.0%)	Furniture (1.4%)
		Floor Coverings (0.7%)
		Household Appliances (1.5%)
		Other Textiles (0.6%)
		Hardware (0.8%)
	Other Household (1.6%)	Cleaning Materials (0.6%)
		Hsehold. & Dom. Services (1.0%)
Transport & Communication (16.6%)	Motor Vehicles (11.5%)	Motor Vehicles (4.5%)
		Excise Tax on M. Veh. (0.7%)
		Gasoline (3.8%)
		Other M.V. Running Costs (2.5%)
	Other Transp. and Comm. (5.1%)	Other Travel (3.3%)
		Postal & Telecommun. (1.8%)
Health Care (2.3%)	—	Medical Goods & Services (1.2%)
		Toiletries and Perfumery (1.1%)
Information & Education (2.2%)	—	Books, Mag.'s, Newspr.'s (1.4%)
		Education (0.8%)
Entertainment (13.1%)	—	Sporting Goods & Toys (0.9%)
		Other Recreat. Goods (1.6%)
		Other Recreat. Services (2.1%)
		Hairdressing and Beauty (0.6%)
		Catering (5.7%)
		U.K. Tourists Abroad (2.2%)

(Continued)

TABLE IV.2.1: GROUP CLASSIFICATION OF COMMODITIES (Continued) WITH SHARES OF PERSONAL CONSUMPTION EXPENDITURES

Group	Subgroup	Commodity
Other Goods and Services (7.4%)	—	Other Durables (2.5%)
		Other Goods (1.6%)
		Other Services (3.6%)
		Tourist Spending in U.K (-2.7%)
		Non-Profit Making Bodies (2.4%)

most likely, relatively little improvement in the reliability and realism of the parameters. Furthermore, this approach would still require us to impose a number of assumptions about the data, the distribution of errors, and the nature of the functional form. By comparison, the *a priori* information imposed here is clear and based on common-sense experience. We are under no delusion that our resulting estimates are anything other than useful approximations to a far more complex reality.

Classifications and data. The equations cover 38 separate commodities as defined in the National Accounts, with the results converted to the 55-sector input-output classification through a fixed PCE bridge matrix. The commodities were arranged into groups and subgroups as shown in Table IV.2.1. The grouping draws mainly on the official classification scheme and appears quite reasonable: we eat (and drink and smoke), clothe and house ourselves; these accomplished, we get around and talk, groom ourselves, learn and amuse ourselves. Only two peculiaritiesof the classification merit mention. First, the commodity "Owner-occupied Dwellings" is an artifact of the developers of the National Accounts that measures the implicit rental return to homeowners. There is no compelling reason to assume that this series is particularly price-sensitive, and indeed, it seems to have an elasticity of nearly zero. (Additionally, all other housing expenditures, including rent and maintenance, are included in the Other Housing category.) Second, there is no pressing reason for postal services and telecommunications to be included with transport, except that I did not want communication services to stand alone and travel is the closest substitute except, perhaps, reading matter; and I wanted other travel to have a subgroup separate from motor vehicles.

Income Elasticities. The equations were estimated using time-series data from the National Accounts and cross-section data from the 1986 Family Expenditure Survey (FES). The FES gives average weekly consumption of nearly one hundred commodities by ten income classes. This cross-section data was used to derive income elasticities through a variety of methods. The income elasticities were then imposed in the time-series estimations, using the form described above. Use of cross-section elasticities in time-series estimations of per capita consumption may not seem entirely plausible, with good reason. However, it is generally the case that income coefficients estimated directly from aggregate time-series data are simply unreliable because of the strong time trends in both income and consumption series. In contrast, elasticities derived from cross-section data have been shown to give reasonably good results in time-series analysis in empirical work on other models of this form. Moreover, the results are only marginally improved upon by introducing greater demographic and

TABLE IV.2.2: CROSS-SECTION INCOME ELASTICITIES FOR BRITISH CONSUMPTION, 1984

	Consumption Category	OLS Elasticity	OLS (logs) Coefficient	Pop.-Weighted Elasticity	Used in Estimation
1.	Food	0.47	0.52	0.46	0.46
2.	Alcohol	1.02	1.09	1.03	1.03
3.	Tobacco	0.22	0.35	0.22	0.22
4.	Clothing	1.09	1.07	1.35	1.35
5.	Footwear	0.87	0.90	0.83	0.83
6-7.	Housing	1.05	1.16	0.91	1.10, 0.50
8.	Energy: Electricity	0.21	0.21	0.15	0.50
9.	Energy: Natural Gas	0.51	0.48	0.41	0.50
10.	Energy: Coal	-0.33	-0.39	-0.31	-0.31
11.	Energy: Other	0.39	0.20	0.46	0.46
12.	Furniture	1.26	1.44	1.17	1.17
13.	Floor Coverings	2.05	1.42	0.58	0.58
14.	Domestic Appliances	1.06	1.21	1.04	1.04
15.	Textiles and Soft Furnishings	1.01	0.95	1.24	1.24
16.	Hardware	1.10	1.15	1.33	0.80
17.	Cleaning Materials	0.34	0.38	0.23	0.23
18.	Household and Domestic Services	1.36	1.00	0.72	0.72
19.	Motor Vehicles	1.43	1.89	1.50	1.50
20-22	Other M.V. Running Costs	1.05	1.35	1.09	1.09
23.	Other Transportation	1.21	1.00	1.01	1.01
24.	Postal and Telecommunications	0.51	0.50	0.47	0.47
25.	Other Durables	0.28	0.30	0.34	0.34
26-27	Recreational Goods	1.17	1.19	1.10	1.10
28.	Recreational Services	1.36	1.52	1.61	1.61
29.	Books, Newspapers & Magazines	0.69	0.65	0.62	0.62
30.	Education	2.18	2.07	2.44	2.44
31.	Medical Goods and Services	0.70	0.83	0.95	0.95
32.	Toilet Articles and Perfumery	0.81	0.80	0.68	0.68
33.	Hairdressing and Beauty Care	0.83	0.70	0.75	0.75
34.	Other Goods	0.97	1.04	0.81	0.81
35.	Catering	1.37	1.36	1.24	1.24
36.	Other Services	0.92	0.89	0.94	0.94
38.	U.K. Tourists	1.61	1.90	1.21	1.21
39.	Non-Profit Making Bodies	1.21	1.26	1.70	1.70

distributional detail into the estimation.[53]

The cross-section data was used to derive income elasticities in three different ways. The first was a set of ordinary least squares regressions with commodity consumption by income class regressed against average disposable income minus savings by income class; for these regressions, income elasticities were derived at the means. The second approach was a set of OLS regressions on the logs of the variables described above, yielding coefficients that can be interpreted as elasticities. The results, found in Table IV.2.2, are reasonably plausible and strongly significant.

Evaluating elasticities at the means fails to take into account the likelihood that income elasticities vary with income; and their use in the time series estimation amounts either to imposing the assumption that all households have approximately similar income elasticities (and that as average income increases, households all adjust their spending patterns in approximately the same way); or at least to assuming that patterns of income distribution and expenditure adjustment do not vary radically from such an assumption. The estimation could thus be improved by accounting for variations in income elasticities across income classes. One approach to accounting for this variation is to measure income elasticities for each income class and to derive a weighted aggregate elasticity, using population shares of the income groups as weights. Results using this approach are shown in the third column of Table IV.2.2.

The last column of Table IV.2.2 shows the income elasticities used for the time series estimation in BRIM. In nearly all cases, the elasticities are the same as those in the third column, derived using the last approach described above. Four elasticities have been modified on the basis of other information. The elasticities for owner-occupied housing and other housing (categories 6 and 7) were modified to take into account the low elasticity for other housing expenditures derived from time-series data, because it better fits my prior assumption that rental housing demand is, in general, relatively income-inelastic. In addition, I find the cross-section income elasticities for electricity and natural gas to be implausibly low for use in time series analysis. On the basis of my experience in modeling energy demand, I believe that electricity demand has a higher elasticity than 0.15, and have imposed a value of 0.5. Likewise, I have raised the elasticity for natural gas from 0.41 to 0.5.

Time series estimation and results. The estimation procedure involves picking a single general λ_0 and estimating each group of equations separately through an iterative process of joint OLS estimation of the linear terms of their Taylor series. The procedure also allows for constraints on group and subgroup elasticities if one chooses to force them to approximate *a priori* values.

The equations were estimated initially over the period 1963-86 and later over the period 1963-90 as more data became available. The functions were estimated using λ_0's ranging from 0.1 to 0.9; individual equations reached minimum sum of squared errors (SSE) throughout this range, with more than half of the equations reaching their minima at one or the other of the extremes. A value of 0.5 minimizes the total SSE for all equations for unconstrained estimations over both estimation periods.

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[53] See Reimbold's chapter in Almon (1974).

For the 1963-86 period, I had to apply a constraint in the Health care sector to ensure negative own-price elasticities. For the 1963-90 period, I applied constraints to three sectors. For the Education group, I constrained the group elasticities to be negative (λ_G = 0.3), as they were in 1963-86. For the Entertainment group I constrained the group elasticities to be positive (λ_G = -0.2). I don't believe that these commodities all suddenly became complementary, and furthermore the constraint greatly reduces the mean errors of all commodity equations in the group except the equation for Catering, whose mean error increases only slightly. Finally, for the Other goods and services group, I constrained the group elasticities to be positive to force the own-elasticities to be negative (λ_G = -0.1). As with the Entertainment group, the problem seems to lie with a single commodity, in this case Other services. For all three groups, the particular group elasticities were chosen because they brought the estimation results closely in line with the results from estimations over the 1963-86 period.

As with the unconstrained equations, a value of 0.5 for λ_0 minimizes the total SSE for all equations for the constrained estimations over the 1963-86 period. However, for the 1963-90 period, the total SSE for the constrained set of equations is minimized at a value for λ_0 of 0.2. Nevertheless, the total SSE rises by only 1,600 (about 3.5%) between λ_0 values of 0.2 and 0.5, while the SSE's for the two problem commodities, Catering and Other services, rise by over 3,900. Choosing a λ_0 value of 0.5 rather than 0.2 leads to a very minor increase in total SSE, a noticeable decrease in SSE for nearly all commodities in nearly all groups, and only a minor increase in mean error (AAPE) for the two problem commodities. I therefore chose a value of 0.5 for the constrained equations estimated over the period 1963-90, which are actually used in the model. The following Tables IV.2.3 and IV.2.4 show the results.

Examination of Table IV.2.4, which presents the parameters actually incorporated into BRIM, suggest that the detailed estimation results are quite reasonable. (Graphs of the results are shown at the end of this chapter.) The first column of numbers shows the effect of the time parameter measured as its contribution to the value of the dependent variable in the last year of the estimation. The column shows that in nearly every equation, the time trend plays a very minor role in explaining consumption. The trends' negligible role reinforces our sense that the income elasticities are generally reliable, the only exception being Coal and coke. In the second column of numbers, all of the income-compensated own-price elasticities are negative. They range in value from -0.1 to -0.9 and nearly all take reasonable values, with the possible exception of rather high values for Other Transportation and Communication. In the third and fourth columns, the cross-price effects within groups and subgroups are generally sensible. It is true that the equations for the last three groups required constraints to yield sensible cross-price parameters; however, the constraints had only very minor effects on the fits of the equations. In the first group, the positive numbers in the fourth column imply that substitution obtains between Food and the vices. Substitution also turns up between Clothing and Footwear; between competing forms of household energy use in the Energy subgroup; between the various Household Durables; between Cleaning Materials and Household and Domestic Services; between driving (Motor Vehicles) and other forms of travel in the Transport and Communication group; between various forms of Entertainment; and between the commodities that make up the Other Goods and Services group. Meanwhile, for Household Activities taken together as a group, the (very small) negative numbers in the fourth column indicate that some complementarity obtains between them. Complementarity is also implied by the negative numbers in the fifth column for Owner-Occupied Dwellings and Other Housing

TABLE IV.2.3: TIME-SERIES CONSUMPTION EQUATION RESULTS, 1963-86
λ_0 = 0.5, Health Care Own-Elasticities Constrained to be Positive

SECTOR	(SUBGROUP)	COMMODITY	TIME IN % OF LAST YR.	PRICE ELASTICITIES OWN	GROUP	SUB.	GENERAL	AAPE	RHO
		1. Food, Alcohol and Tobacco							
1		Food	-0.9	-0.468	0.125	-	0.071	1.0	0.48
2		Alcohol	0.3	-0.530	0.063	-	0.036	3.6	0.84
3		Tobacco	-2.1	-0.564	0.029	-	0.016	1.3	0.41
		2. Clothing and Footwear							
4		Clothing	-0.8	-0.512	0.189	-	0.027	3.1	0.70
5		Footwear	-0.1	-0.656	0.045	-	0.006	4.2	0.84
		3. Household Activities							
		(4. Housing)							
6	(4)	Owner-Occupied Dwellings	0.9	-0.024	-0.023	-0.202	0.029	2.3	0.65
7	(4)	Other Housing	0.4	-0.124	-0.035	-0.302	0.044	1.6	0.84
		(5. Energy)							
8	(5)	Electricity	0.8	-0.382	-0.009	0.087	0.011	3.9	0.89
9	(5)	Natural Gas	2.4	-0.399	-0.007	0.070	0.009	4.2	0.70
10	(5)	Coal and Coke	-11.9	-0.454	-0.002	0.015	0.002	14.2	0.87
11	(5)	Other Energy	-0.1	-0.458	-0.001	0.011	0.001	10.4	0.81
		(7. Household Durables)							
12	(7)	Furniture	-0.2	-0.426	-0.006	0.054	0.007	3.8	0.66
13	(7)	Floor Coverings	-0.6	-0.454	-0.003	0.026	0.003	4.0	0.69
14	(7)	Household Appliances	0.8	-0.423	-0.006	0.057	0.007	7.4	0.81
15	(7)	Other Textiles	-0.8	-0.457	-0.002	0.023	0.003	5.6	0.85
16	(7)	Hardware	-0.8	-0.448	-0.003	0.032	0.004	5.3	0.63
		(6. Other Household)							
17	(6)	Cleaning Materials	-1.2	-0.865	-0.002	0.343	0.003	4.5	0.93
18	(6)	Household & Dom. Serv.	-2.7	-0.617	-0.004	0.591	0.005	5.9	0.90
		8. Transport & Communication							
		(9. Motor Vehicles)							
19	(9)	Motor Vehicles	-0.4	-0.426	0.169	-0.118	0.022	6.5	0.36
20	(9)	Excise Tax on M.V.'s	-0.6	-0.325	0.025	-0.017	0.003	7.7	0.79
21	(9)	Gasoline	0.6	-0.407	0.142	-0.099	0.019	5.0	0.79
22	(9)	Other M.V. Running Costs	0.4	-0.374	0.093	-0.066	0.012	4.8	0.71
		(10. Other Transportation & Communication)							
23	(10)	Other Travel	-0.6	-0.793	0.122	-0.100	0.016	2.0	0.53
24	(10)	Post & Telecomm.	2.2	-0.748	0.067	-0.055	0.009	5.2	0.57
		11. Health Care							
31		Medical Goods & Services	0.2	-0.500	0.010	-	0.006	8.9	0.88
32		Toiletries & Perfumery	0.3	-0.501	0.009	-	0.005	5.0	0.79
33		Hairdressing & Beauty	-1.4	-0.505	0.005	-	0.003	4.0	0.86

(Continued)

TABLE IV.2.3: TIME-SERIES CONSUMPTION EQUATION RESULTS (continued)
λ_0 = 0.5, Health Care Own-Elasticities Constrained to be Positive

SECTOR (SUBGROUP)	COMMODITY	TIME IN % OF LAST YR.	PRICE ELASTICITIES OWN	GROUP	SUB.	GENERAL	AAPE	RHO
		12. Education						
29	Books, Mag.s & Papers	-1.0	-0.413	-0.140	-	0.007	1.9	0.57
30	Education	-1.7	-0.349	-0.076	-	0.004	7.9	0.71
		13. Entertainment						
25	Other Durables	1.1	-0.662	0.047	-	0.012	5.3	0.75
26	Sporting Goods, Toys etc.	0.7	-0.693	0.016	-	0.004	4.0	0.72
27	Other Recreat. Goods	0.2	-0.679	0.030	-	0.008	2.3	0.18
28	Other Recreat. Services	-1.2	-0.670	0.039	-	0.010	5.1	0.72
35	Catering	-1.0	-0.602	0.107	-	0.028	2.8	0.73
37	U.K. Tourists Exp. Abroad	0.0	-0.668	0.041	-	0.011	15.1	0.88
		14. Other Goods and Services						
34	Other Goods	0.9	-0.574	0.031	-	0.008	5.4	0.77
36	Other Services	0.9	-0.538	0.067	-	0.017	8.7	0.85
38	Non-Profit Making Bodies	0.0	-0.560	0.045	-	0.012	0.0	0.80

TABLE IV.2.4: TIME-SERIES CONSUMPTION EQUATION RESULTS, 1963-90
λ_0 = 0.5, Constrained Group Elasticities for Education, Entertainment and Other Goods and Services

SECTOR	(SUBGROUP)	COMMODITY	TIME IN % OF LAST YR.	PRICE ELASTICITIES OWN	GROUP	SUB.	GENERAL	AAPE	RHO
		1. Food, Alcohol and Tobacco							
1		Food	-0.7	-0.512	0.189	-	0.071	0.9	0.55
2		Alcohol	0.3	-0.609	0.092	-	0.035	5.0	0.89
3		Tobacco	-2.0	-0.658	0.043	-	0.016	1.6	0.59
		2. Clothing and Footwear							
4		Clothing	-0.6	-0.497	0.121	-	0.026	3.1	0.62
5		Footwear	-0.1	-0.589	0.029	-	0.006	3.3	0.76
		3. Household Activities							
		(4. Housing)							
6	(4)	Owner-Occupied Dwellings	0.7	-0.014	-0.080	-0.140	0.029	3.0	0.68
7	(4)	Other Housing	0.4	-0.082	-0.120	-0.208	0.043	2.1	0.79
		(5. Energy)							
8	(5)	Electricity	0.8	-0.263	-0.031	0.163	0.011	5.7	0.88
9	(5)	Natural Gas	2.4	-0.294	-0.025	0.132	0.009	4.4	0.70
10	(5)	Coal and Coke	-16.5	-0.399	-0.005	0.027	0.002	16.8	0.85
11	(5)	Other Energy	-1.6	-0.408	-0.003	0.018	0.001	16.9	0.90
		(7. Household Durables)							
12	(7)	Furniture	0.0	-0.370	-0.018	0.107	0.007	4.5	0.46
13	(7)	Floor Coverings	-0.1	-0.426	-0.009	0.051	0.003	5.1	0.56
14	(7)	Household Appliances	0.9	-0.360	-0.020	0.117	0.007	8.1	0.69
15	(7)	Other Textiles	-0.3	-0.428	-0.008	0.049	0.003	4.6	0.64
16	(7)	Hardware	0.0	-0.412	-0.011	0.065	0.004	7.0	0.67
		(6. Other Household)							
17	(6)	Cleaning Materials	0.0	-0.383	-0.008	0.199	0.003	5.6	0.90
18	(6)	Household & Dom. Serv.	-1.9	-0.242	-0.013	0.340	0.005	10.0	0.88
		8. Transport & Communication							
		(9. Motor Vehicles)							
19	(9)	Motor Vehicles	-0.3	-0.262	0.218	-0.256	0.022	6.5	0.36
20	(9)	Excise Tax on M.V.'s	-0.3	-0.042	0.031	-0.037	0.003	7.7	0.79
21	(9)	Gasoline	0.4	-0.219	0.182	-0.213	0.018	5.0	0.79
22	(9)	Other M.V. Running Costs	0.5	-0.165	0.136	-0.159	0.014	4.8	0.71
		(10. Other Transportation & Communication)							
23	(10)	Other Travel	-0.2	-0.893	0.168	-0.173	0.017	2.0	0.53
24	(10)	Post & Telecomm.	1.8	-0.809	0.087	-0.089	0.009	5.2	0.57
		11. Health Care							
31		Medical Goods & Services	0.5	-0.148	-0.233	-	0.006	9.1	0.83
32		Toiletries & Perfumery	0.9	-0.140	-0.225	-	0.005	6.7	0.75
33		Hairdressing & Beauty	-1.8	-0.028	-0.113	-	0.003	5.2	0.79

(Continued)

TABLE IV.2.4: TIME-SERIES CONSUMPTION EQUATION RESULTS (continued)
λ_0 = 0.5, Constrained Group Elasticities for Education, Entertainment and Other Goods and Services

SECTOR (SUBGROUP)	COMMODITY	TIME IN % OF LAST YR.	PRICE ELASTICITIES OWN	GROUP	SUB.	GENERAL	AAPE	RHO
			12. Education					
29	Books, Mag.s & Papers	-0.7	-0.390	-0.181	-	0.007	2.1	0.65
30	Education	-1.7	-0.309	-0.100	-	0.004	8.5	0.74
			13. Entertainment					
25	Other Durables	0.9	-0.644	0.043	-	0.012	4.6	0.58
26	Sporting Goods, Toys etc.	0.6	-0.672	0.015	-	0.004	3.0	0.63
27	Other Recreat. Goods	0.0	-0.661	0.026	-	0.008	3.0	0.39
28	Other Recreat. Services	-1.0	-0.653	0.034	-	0.010	4.7	0.78
35	Catering	-0.4	-0.580	0.107	-	0.031	7.7	0.83
37	U.K. Tourists Exp. Abroad	0.2	-0.651	0.036	-	0.010	15.5	0.85
			14. Other Goods and Services					
34	Other Goods	0.6	-0.570	0.029	-	0.008	5.2	0.76
36	Other Services	0.9	-0.535	0.064	-	0.017	16.1	0.81
38	Non-Profit Making Bodies	0.0	-0.556	0.043	-	0.011	0.0	0.79

(which includes repairs and maintenance), and between the activities associated with Motor Vehicles. Complementarity is also found between Other Travel and Postal and Telecommunications, between the various components of Health Care; and between Education and Books, Magazines and Newspapers.

Finally, another aspect of the results reveals a weakness of the analysis; the high rho in nearly every equation (ranging generally from 0.70 to 0.90) reveals a high degree of serial correlation of the errors. I take this either to suggest a missing variable, quite possibly lagged price effects that are not included in this specification, or perhaps a business cycle effect not captured by the income effect; or perhaps serial correlation arises from using income elasticities derived from a particular year's cross-section data to account for income effects over two decades.

Table IV.2.5 shows values of the SSR's for the equations using values of λ_0 ranging from 0.1 to 0.9, illustrating the range of λ_0's over which individual equations are optimized. Table IV.2.6 shows the own-elasticities for the same set of estimations, illustrating the effect on these elasticities of varying the λ_0. In each Table, the middle column shows the values for the equations actually used in the model. The results underscore two important observations mentioned before. First, this estimation procedure is aimed only at deriving a reasonable approximation to a highly complex reality; second, these estimations are by no means "true" equations. These observations are underscored by the fact that most individual equations' errors are minimized at values of λ_0 other than the particular value chosen.

Comparison with Almon's results for Belgium. Reassuringly, the results using current prices are broadly similar to those obtained for Belgium by Almon (1979). Income, own-price and cross-price elasticities are generally of the same magnitude in both countries, with some important exceptions. Housing own-price elasticities are much lower in the U.K.; household activities' price elasticities in general are noticeably lower; and Health care price elasticities are much lower. Other transportation and communication price elasticities are higher. Health care cross-price elasticities are negative rather than positive, indicating complementarity between the commodities in this group rather than substitutability. Finally, the income elasticity of education is much higher.

Comparison with the Cambridge results. The results differ rather strongly from those of the Cambridge estimations, as shown in Table IV.2.7. Both income and own-price elasticities are generally similar for many commodities, but there are a number of important exceptions. Most of BRIM's price elasticities for commodities that might be considered necessities — food, clothing, energy and transportation — are considerably higher than their CMDM counterparts, while those for housing and household durables are considerably lower. BRIM's and CMDM's estimates of income elasticities are broadly similar, though where they differ I am more inclined to accept those of BRIM. The use of income elasticities from cross-section data seems to provide, on the whole, somewhat better estimates.

Suggestions for further work. Ideally, one should adjust for the fact that the National Accounts effectively measure durables consumption as occurring entirely in the period of purchase. Durables consumption is more appropriately thought of as consumption of a flow of services from durable goods bought in previous periods rather than as the durables bought in the current period. It would be advisable to incorporate measures of the stock of various consumer durables into the equations, to account for stock replacement demand, but that is an exercise to be left for another time.

TABLE IV.2.5: TIME-SERIES CONSUMPTION EQUATION RESIDUALS

λ =	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Food	1704.0	1569.0	1452.0	1353.4	1273.4	1212.3	1169.4	1151.5	1144.7
Alcohol	4743.3	4631.3	4521.6	4414.1	4309.0	4206.3	4107.3	4003.0	3913.4
Tobacco	154.1	165.8	182.0	202.9	228.5	259.0	294.1	336.4	380.4
Food, Alcohol & Tobacco	**6601.4**	**6366.1**	**6155.6**	**5970.4**	**5810.9**	**5677.6**	**5570.8**	**5490.9**	**5438.5**
Clothing	1851.6	1690.9	1573.9	1491.2	1443.1	1417.4	1411.7	1420.3	1441.9
Footwear	246.2	184.9	138.5	108.3	85.7	76.6	77.0	86.6	102.5
Clothing & Footwear	**2097.8**	**1875.8**	**1712.4**	**1599.5**	**1528.8**	**1494.0**	**1488.7**	**1506.9**	**1544.4**
Owner-Occupied Dwellings	1268.7	1305.5	1345.9	1389.8	1437.5	1489.0	1549.3	1610.5	1675.7
Other Housing	1774.9	1766.3	1765.5	1772.4	1786.9	1808.8	1831.9	1865.7	1907.5
Electricity	720.0	720.7	721.6	722.7	724.1	725.8	729.9	733.4	737.0
Natural Gas	271.7	270.5	269.7	269.3	269.3	269.7	270.1	271.1	272.7
Coal and Coke	637.7	616.0	594.9	574.3	554.2	534.6	513.9	494.7	476.1
Other Energy	198.2	199.5	200.8	202.1	203.3	204.6	206.3	207.7	209.1
Furniture	182.6	181.7	181.1	180.8	180.8	181.1	176.6	176.1	175.9
Floor Coverings	52.4	53.0	53.6	54.4	55.2	56.2	55.8	56.6	57.4
Household Appliances	282.1	295.3	308.6	322.2	336.0	350.4	382.6	404.1	426.3
Other Textiles	34.5	34.4	34.5	34.7	35.0	35.5	34.1	34.2	34.4
Hardware	154.6	157.8	161.7	166.6	172.5	179.7	178.0	183.6	189.9
Cleaning Materials	79.9	71.0	63.4	57.0	52.2	48.8	87.3	75.2	65.3
Household & Dom. Services	777.3	755.0	735.8	719.3	705.4	693.7	652.7	651.9	653.3
Household Activities	**6434.6**	**6426.7**	**6437.1**	**6465.6**	**6512.4**	**6577.9**	**6668.5**	**6764.8**	**6880.6**
Motor Vehicles	3858.9	3782.5	3715.0	3656.5	3606.8	3565.9	3533.9	3510.6	3496.1
Excise Tax on M.V.'s	22.7	22.1	21.6	21.4	21.3	21.5	21.8	22.3	23.0
Gasoline	702.4	678.5	660.2	647.4	640.2	638.5	642.2	651.5	666.1
Other M.V. Running Costs	639.5	623.4	610.9	602.0	596.7	595.1	596.9	602.4	611.4
Other Travel	897.3	840.3	789.0	743.3	703.4	669.0	640.3	617.2	599.7
Postal & Telecommunic.	226.8	214.3	203.8	195.3	188.9	184.4	181.9	181.4	182.8
Transport & Communic.	**6347.6**	**6161.1**	**6000.5**	**5865.9**	**5757.3**	**5674.4**	**5617.0**	**5585.4**	**5579.1**
Medical Goods & Services	254.9	273.7	293.4	313.8	335.0	357.0	379.8	403.2	427.4
Toiletries & Perfumery	200.8	210.5	221.6	234.0	247.9	263.5	280.8	300.0	321.3
Hairdressing & Beauty	28.5	31.4	34.9	39.0	43.6	49.0	55.3	62.5	70.9
Health Care	**484.2**	**515.6**	**549.9**	**586.8**	**626.5**	**669.5**	**715.9**	**765.7**	**819.6**
Books, Mag.'s, Papers	65.6	60.7	59.4	61.2	65.8	72.9	82.4	94.4	108.8
Education	255.7	242.6	230.1	218.4	207.5	197.6	188.9	181.5	175.6
Education	**321.3**	**303.3**	**289.5**	**279.6**	**273.3**	**270.5**	**271.3**	**275.9**	**284.4**
Other Durables	870.9	628.2	470.5	380.3	341.7	340.5	364.2	402.5	446.5
Sporting Goods & Toys	36.0	31.1	27.8	26.0	25.5	26.3	28.1	30.8	34.3
Other Recreat. Goods	176.8	151.6	132.0	117.9	108.9	104.8	105.4	110.5	119.7
Other Recreat. Services	709.0	638.2	574.2	517.4	468.2	427.0	394.2	370.3	355.5
Catering	9622.3	10199.9	10840.3	11547.6	12325.8	13178.8	14110.3	15124.1	16223.7
U.K. Tourists Abroad	3101.8	2924.1	2758.1	2603.5	2460.5	2328.8	2208.6	2099.5	2001.7
Entertainment	**14516.8**	**14573.1**	**14802.9**	**15192.7**	**15730.6**	**16406.2**	**17210.8**	**18137.7**	**19181.4**
Other Goods	577.8	503.2	435.9	376.0	323.7	279.1	242.4	213.7	193.1
Other Services	5614.0	6158.2	6731.3	7333.1	7963.7	8622.9	9310.8	10027.0	10771.7
Non-Profit Making Bodies	1115.7	1110.5	1106.1	1102.6	1100.0	1098.2	1097.4	1097.4	1098.3
Other Goods & Services	**7307.5**	**7771.9**	**8273.3**	**8811.7**	**9387.4**	**10000.2**	**10650.6**	**11338.1**	**12063.1**
Total	**44111.2**	**43993.6**	**44402.2**	**44772.2**	**45627.2**	**46770.3**	**48193.6**	**49865.4**	**51791.1**

TABLE IV.2.6: TIME-SERIES CONSUMPTION EQUATION OWN-PRICE ELASTICITIES

λ =	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Food	-0.324	-0.371	-0.418	-0.465	-0.512	-0.559	-0.607	-0.654	-0.701
Alcohol	-0.501	-0.528	-0.555	-0.581	-0.609	-0.635	-0.662	-0.690	-0.717
Tobacco	-0.592	-0.608	-0.625	-0.641	-0.658	-0.674	-0.691	-0.709	-0.725
Clothing	-0.307	-0.357	-0.405	-0.457	-0.497	-0.538	-0.581	-0.614	-0.649
Footwear	-0.997	-0.907	-0.809	-0.725	-0.589	-0.462	-0.342	-0.177	-0.022
Owner-Occupied Dwellings	0.040	0.026	0.012	-0.001	-0.014	-0.028	-0.040	-0.052	-0.065
Other Housing	0.002	-0.020	-0.041	-0.062	-0.082	-0.104	-0.123	-0.143	-0.164
Electricity	-0.273	-0.270	-0.278	-0.266	-0.263	-0.261	-0.258	-0.255	-0.252
Natural Gas	-0.307	-0.304	-0.301	-0.298	-0.294	-0.292	-0.288	-0.285	-0.281
Coal and Coke	-0.422	-0.417	-0.411	-0.405	-0.399	-0.394	-0.389	-0.384	-0.378
Other Energy	-0.432	-0.427	-0.420	-0.414	-0.408	-0.402	-0.398	-0.392	-0.386
Furniture	-0.271	-0.292	-0.315	-0.342	-0.370	-0.403	-0.354	-0.366	-0.379
Floor Coverings	-0.310	-0.334	-0.361	-0.393	-0.426	-0.466	-0.407	-0.421	-0.436
Household Appliances	-0.265	-0.284	-0.307	-0.333	-0.360	-0.392	-0.345	-0.356	-0.369
Other Textiles	-0.312	-0.335	-0.363	-0.395	-0.428	-0.468	-0.408	-0.423	-0.438
Hardware	-0.300	-0.323	-0.350	-0.380	-0.412	-0.450	-0.393	-0.407	-0.422
Cleaning Materials	-0.125	-0.187	-0.251	-0.317	-0.383	-0.453	-1.486	-1.340	-1.189
Household & Dom. Services	-0.106	-0.139	-0.172	-0.207	-0.242	-0.279	-0.879	-0.789	-0.696
Motor Vehicles	-0.183	-0.203	-0.223	-0.243	-0.262	-0.282	-0.302	-0.321	-0.341
Excise Tax on M.V.'s	-0.043	-0.043	-0.043	-0.043	-0.042	-0.042	-0.042	-0.042	-0.042
Gasoline	-0.156	-0.172	-0.188	-0.204	-0.219	-0.235	-0.251	-0.266	-0.282
Other M.V. Running Costs	-0.121	-0.133	-0.144	-0.155	-0.165	-0.176	-0.187	-0.198	-0.209
Other Travel	-0.865	-0.872	-0.879	-0.887	-0.893	-0.900	-0.907	-0.914	-0.921
Postal & Telecommunic.	-0.844	-0.836	-0.827	-0.819	-0.809	-0.801	-0.792	-0.784	-0.776
Medical Goods & Services	0.009	-0.035	-0.076	-0.114	-0.148	-0.180	-0.208	-0.234	-0.258
Toiletries & Perfumery	0.012	-0.031	-0.070	-0.107	-0.140	-0.169	-0.196	-0.221	-0.242
Hairdressing & Beauty	0.047	0.022	0.001	-0.016	-0.028	-0.036	-0.040	-0.041	-0.038
Books, Mag.'s, Papers	0.003	-0.095	-0.193	-0.292	-0.390	-0.488	-0.586	-0.684	-0.782
Education	0.085	-0.014	-0.112	-0.211	-0.309	-0.407	-0.505	-0.603	-0.702
Other Durables	-0.260	-0.356	-0.452	-0.548	-0.644	-0.740	-0.837	-0.934	-1.031
Sporting Goods & Toys	-0.283	-0.380	-0.477	-0.575	-0.672	-0.770	-0.868	-0.966	-1.065
Other Recreat. Goods	-0.274	-0.371	-0.467	-0.564	-0.661	-0.758	-0.856	-0.954	-1.052
Other Recreat. Services	-0.267	-0.364	-0.460	-0.556	-0.653	-0.750	-0.847	-0.944	-1.042
Catering	-0.210	-0.302	-0.395	-0.488	-0.580	-0.674	-0.767	-0.860	-0.954
U.K. Tourists Abroad	-0.266	-0.362	-0.458	-0.554	-0.651	-0.748	-0.845	-0.942	-1.040
Other Goods	-0.176	-0.275	-0.373	-0.472	-0.570	-0.669	-0.767	-0.865	-0.964
Other Services	-0.149	-0.245	-0.342	-0.438	-0.535	-0.632	-0.728	-0.825	-0.921
Non-Profit Making Bodies	-0.166	-0.263	-0.361	-0.459	-0.556	-0.654	-0.752	-0.850	-0.947

TABLE IV.2.7: COMPARISON OF RESULTS WITH CAMBRIDGE MODEL

Sector	(Subgroup)	Commodity	Price Elasticities Inforum	Price Elasticities CMDM	Income Elasticities Inforum	Income Elasticities CMDM
		1. Food, Alcohol and Tobacco				
1		Food	-0.512	-0.089	0.524	0.616
2		Alcohol	-0.609	-0.116 (Beer)	1.026	0.540 (Beer)
				-0.313 (Wine)		1.370 (Wine)
3		Tobacco	-0.658	-0.112	0.251	1.192
		2. Clothing and Footwear				
4		Clothing	-0.497	-0.106	1.253	1.016
5		Footwear	-0.589	-0.500	0.946	0.923
		3. Household Activities				
		(4. Housing)				
6	(4)	Owner-Occ. Dwell.	-0.014	-0.133 (Rent & Rates)	1.140	0.927 (Rent & Rates)
7	(4)	Other Housing	-0.082	-0.574 (Maintenance)	0.570	1.322 (Maintenance)
		(5. Energy)				
8	(5)	Electricity	-0.263	-0.200	0.570	0.738
9	(5)	Natural Gas	-0.294	-0.302	0.570	0.565
10	(5)	Coal and Coke	-0.399	-1.449	-0.456	3.613
11	(5)	Other Energy	-0.408	-0.646	0.524	0.950
		(7. Household Durables)				
12	(7)	Furniture	-0.370	-0.469	1.333	0.620
13	(7)	Floor Coverings	-0.426	-0.597 (Textiles)	0.661	0.934 (Textiles)
14	(7)	Hsehld. Appliances	-0.360	-0.668 (Oth. Durables)	1.060	0.922 (Oth. Durables)
15	(7)	Other Textiles	-0.428	-0.597 (Textiles)	1.413	0.934 (Textiles)
16	(7)	Hardware	-0.412	-0.460	0.912	1.423
		(6. Other Household)				
17	(6)	Cleaning Materials	-0.383	-0.478	0.262	0.441
18	(6)	Hsehld. & Dom. Serv.	-0.242	N.A.	0.820	-0.242
		8. Transport & Communication				
		(9. Motor Vehicles)				
19	(9)	Motor Vehicles	-0.262	-0.077	1.709	1.269
20	(9)	Excise Tax on M.V.'s	-0.042	N.A.	1.709	N.A.
21	(9)	Gasoline	-0.219	N.A.	1.242	N.A.
22	(9)	Other M.V. Run. Costs	-0.165	-0.350	1.242	0.716
		(10. Other Transport & Communication)				
23	(10)	Other Travel	-0.893	-0.784 (Rail)	1.151	0.590 (Rail)
				-0.967 (Bus)		1.154 (Bus)
				-0.647 (Other)		1.140 (Other)
24	(10)	Post & Telecomm.	-0.809	-0.594 (Post)	0.536	2.268 (Post)
				-0.119 (Telecomm.)		0.746 (Telecomm.)
		11. Health Care				
31		Medical Goods & Serv.	-0.148	N.A.	1.083	1.377 (Chemists')
32		Toiletries & Perfume.	-0.140	N.A.	0.775	1.377 (Chemists')
33		Hairdress. & Beauty	-0.028	N.A.	0.855	N.A.

(continued)

TABLE IV.2.7: COMPARISON OF RESULTS WITH CAMBRIDGE MODEL (continued)

Sector (Subgroup)	Commodity	Price Elasticities Inforum	Price Elasticities CMDM	Income Elasticities Inforum	Income Elasticities CMDM
			12. Education		
29	Books, Mag.s, Papers	-0.390	-0.434 (Books) -0.210 (Papers) -0.105 (Magazines)	0.707	1.083 (Books) 0.843 (Papers) 1.412 (Magazines)
30	Education	-0.309	N.A.	2.780	N.A.
			13. Entertainment		
25	Other Durables	-0.644	-0.668	0.912	0.922
26	Sport Goods, Toys etc.	-0.672	N.A.	1.253	N.A.
27	Other Recreat. Goods	-0.661	N.A.	1.253	1.009
28	Other Recreat. Serv.	-0.653	N.A.	1.835	0.983 (Entertainment)
35	Catering	-0.580	N.A.	1.413	0.685
37	Tourist. Exp. Abroad	-0.651	-0.891	1.379	1.911
			14. Other Goods and Services		
34	Other Goods	-0.570	N.A.	0.923	0.978
36	Other Services	-0.535	N.A.	1.071	1.437
39	Non-Profit Bodies	-0.556	N.A.	1.947	0.949

Another useful addition would be to incorporate data on British income distribution by occupation sector and income class, so as to model the consumption effects of industrial, distributional and tax changes.[54] However, this extension of the model requires more resources than are currently available.

A final useful addition to the analysis would be to estimate the consumption effects of lagged prices, rather than imposing the assumption that consumers fully adjust to price changes in the year that they occur. For some commodities, both my *a priori* expectations and a considerable body of research suggest that consumers do take time — in the case of energy, several years — to adjust to changes in relative prices.

I made two attempts to estimate consumption equations with lagged price terms. In the first attempt, I imposed price terms of the form

$$c_1 \frac{p_{it}}{\bar{p}_t} + c_2 \frac{p_{it-1}}{\bar{p}_{t-1}} + c_3 \frac{p_{it-2}}{\bar{p}_{t-2}}$$

into the estimation procedure described above. I performed a number of estimations while imposing various values for the parameters c_1, c_2 and c_3. This approach, however, has the formal weakness that it introduces both current and lagged prices into the budget constraint, where only current prices are actually appropriate. I therefore made a second attempt to

[54] An interesting example of this is found in Rose et al. (1988).

introduce lagged prices by estimating equations with additional linear lagged price terms, of the form

$$x_i = \left(a_i(t) + \sum_{j=1}^{m} d_{ij}\, p_{i(t-j)} + b_i \left(\frac{y}{P}\right)\right) \prod_{k=1}^{n} p_k^{c_{ik}}$$

where m was an arbitrarily chosen lag length. This form appears to stretch the limit of information that can be reliably extracted from the data, and yields nonsensical, implausibly large values for the d's. The form also fails to capture lagged cross-price interactions. It may be possible to constrain the parameters to yield sensible results, and to include lagged cross-price terms, but I am leaving this work to the future.

Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990
Crosses - Historical; Squares - Predicted

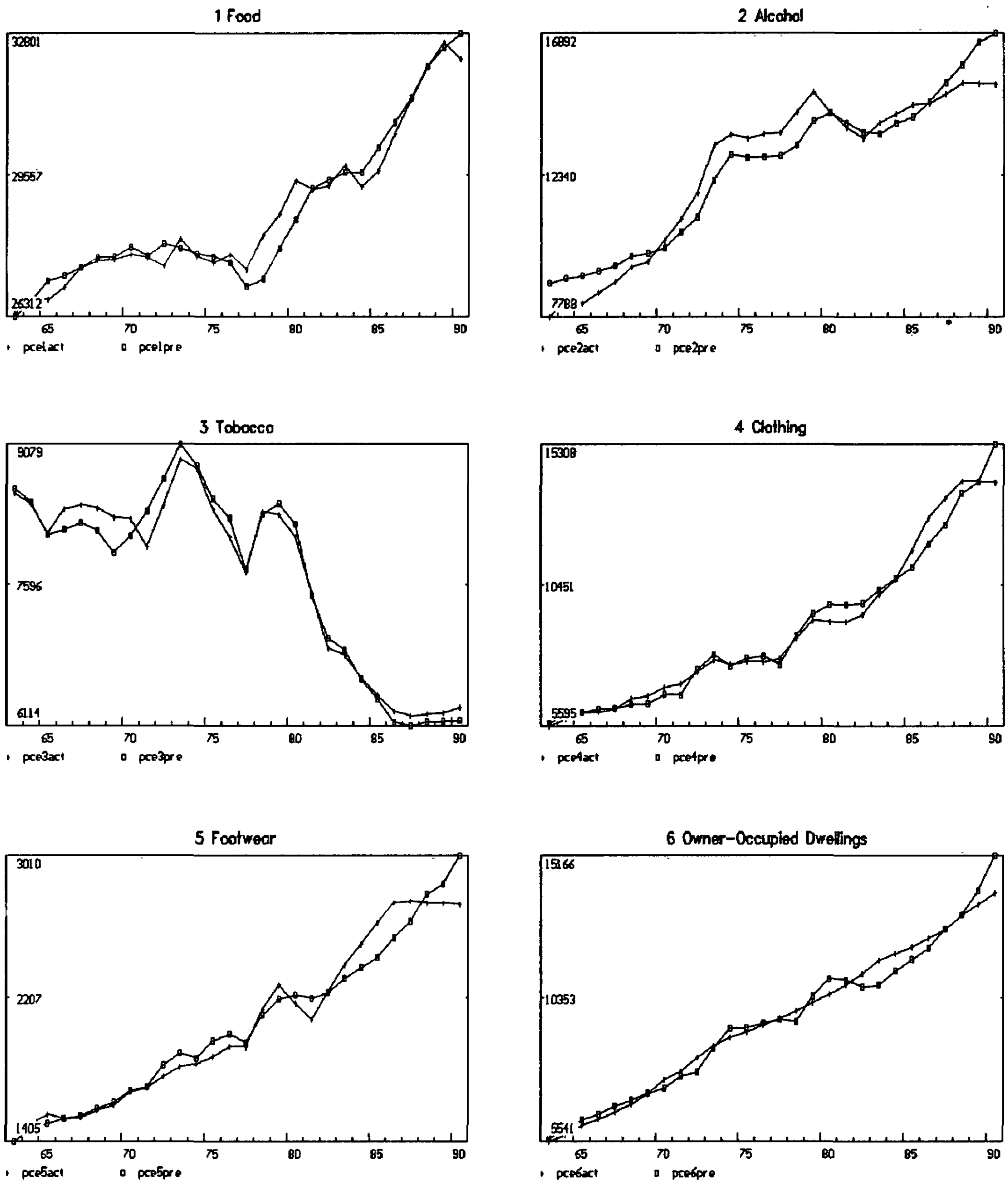
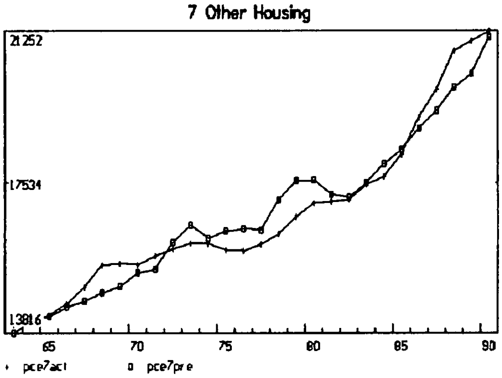
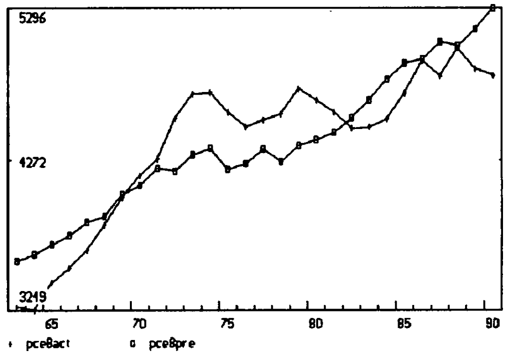


Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted

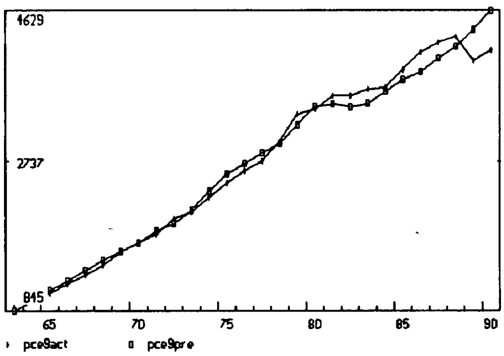
7 Other Housing



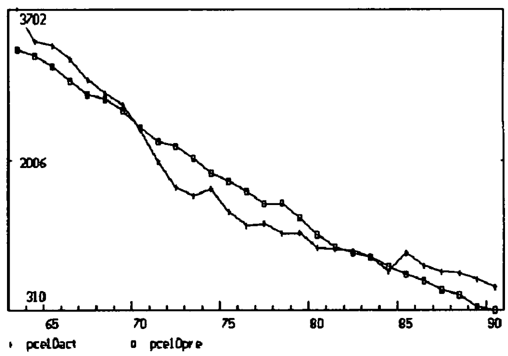
8 Electricity



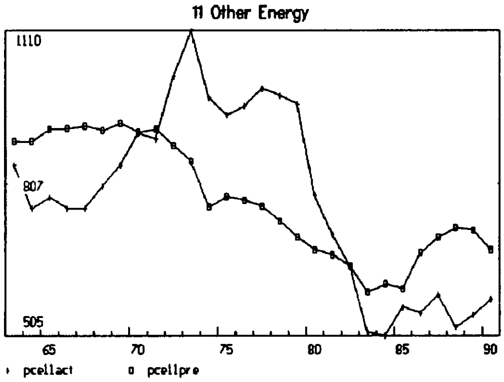
9 Natural Gas



10 Coal and Coke



11 Other Energy



12 Furniture

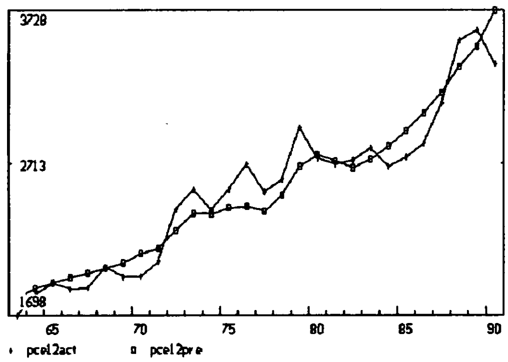
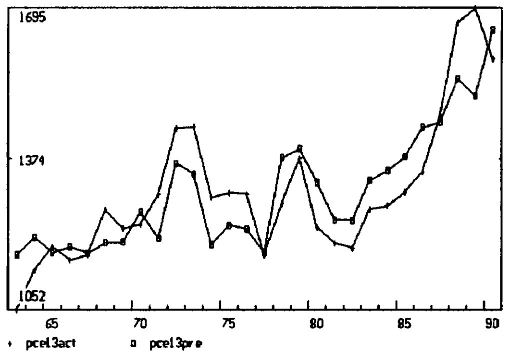
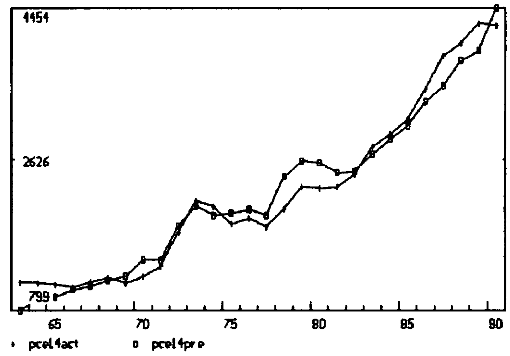


Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted

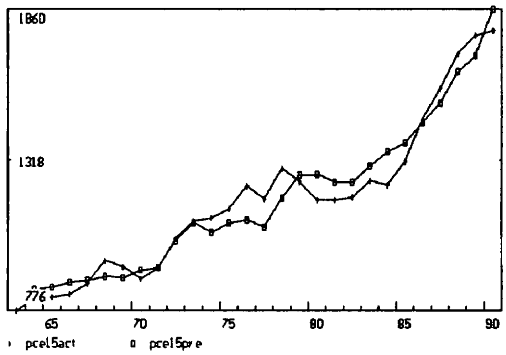
13 Floor Coverings



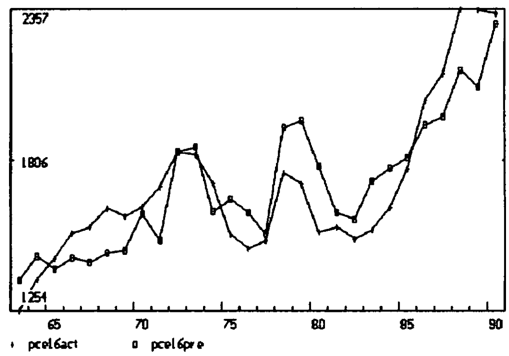
14 Household Appliances



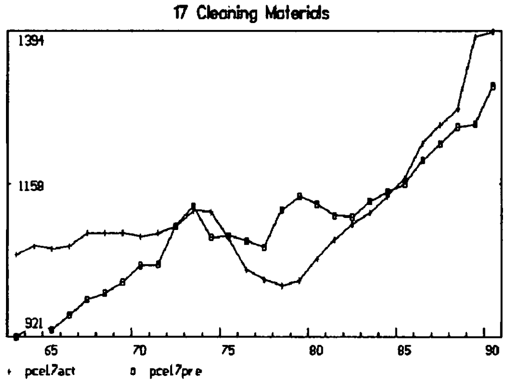
15 Other Textiles



16 Hardware



17 Cleaning Materials



18 Household and Domestic Serv.

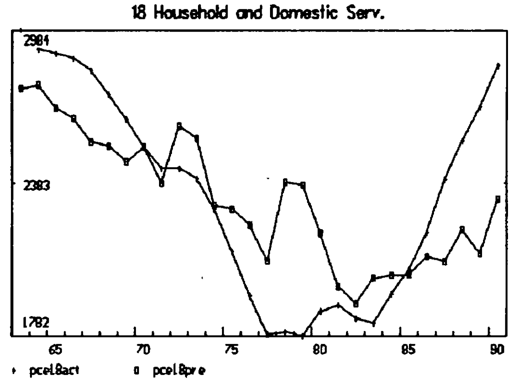
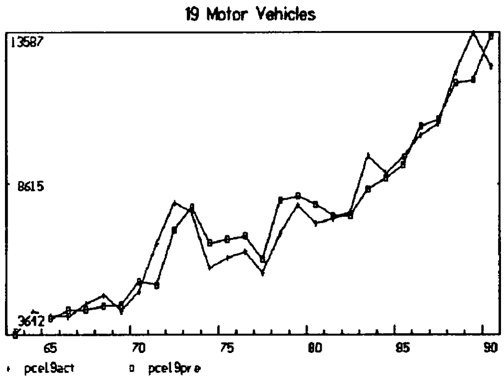
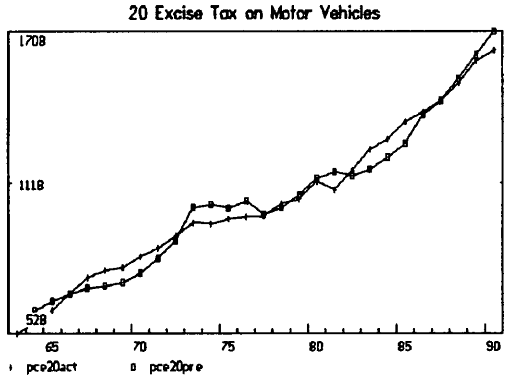
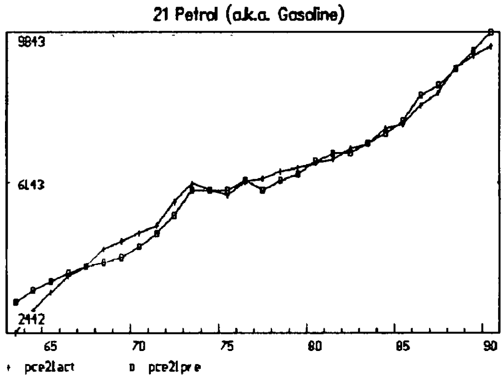
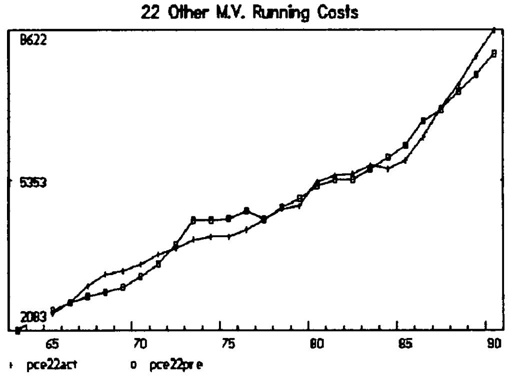


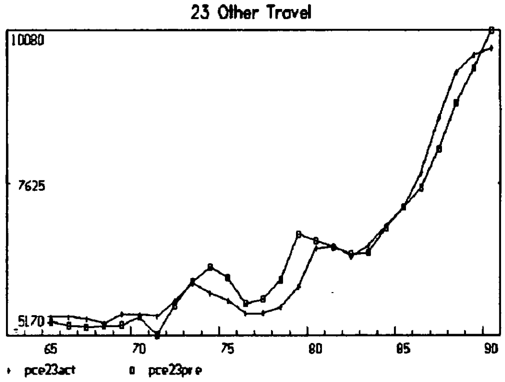
Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted











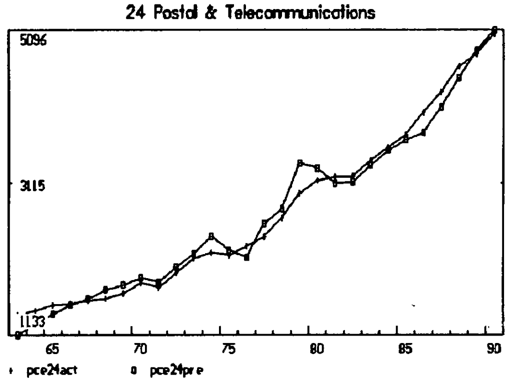


Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted

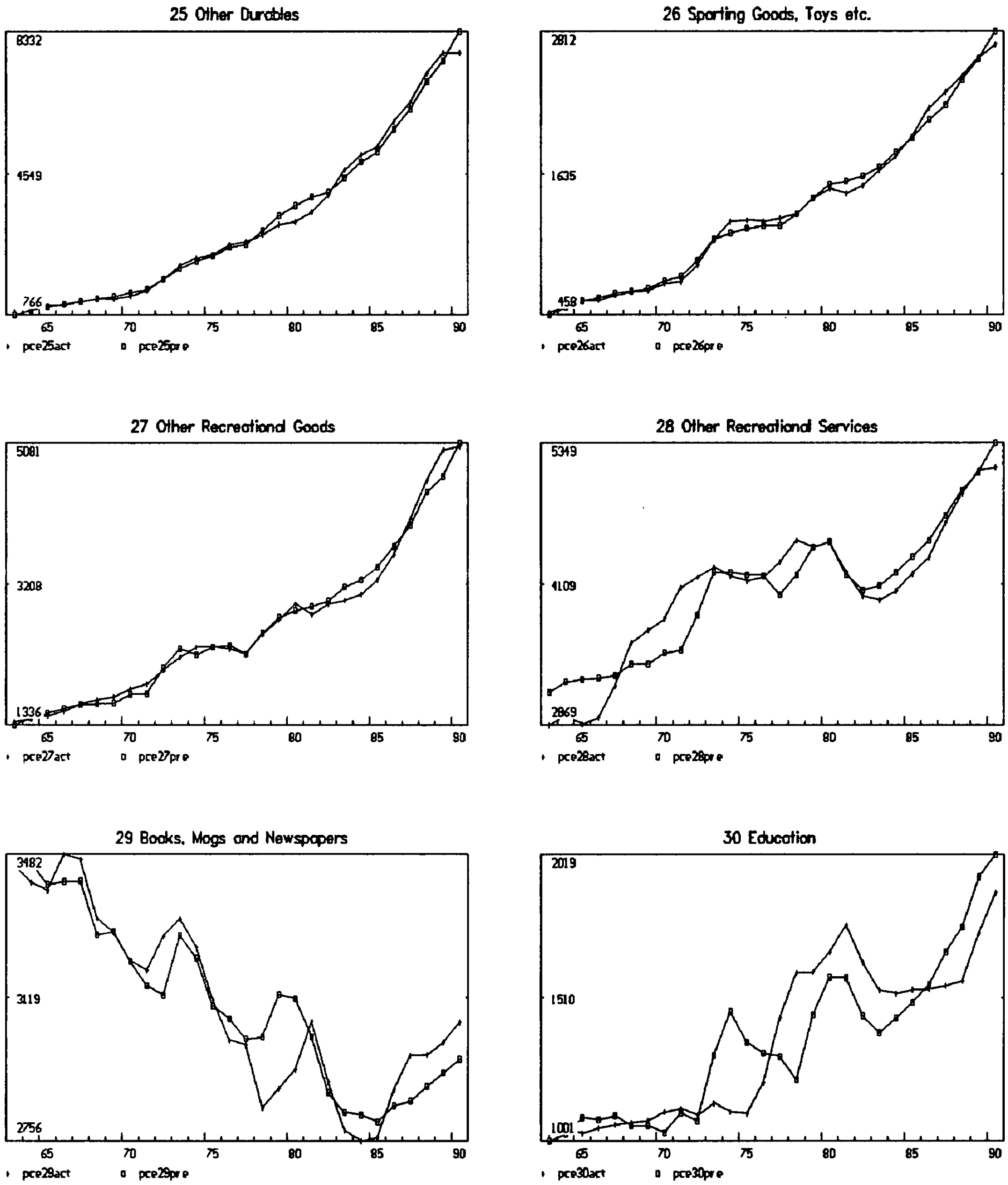
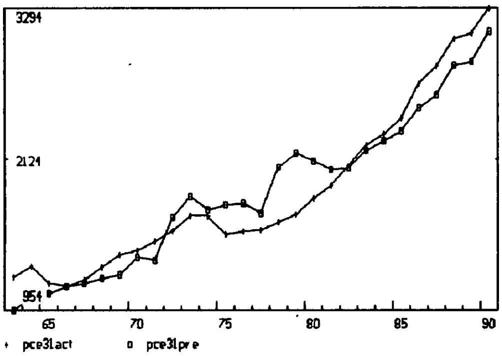
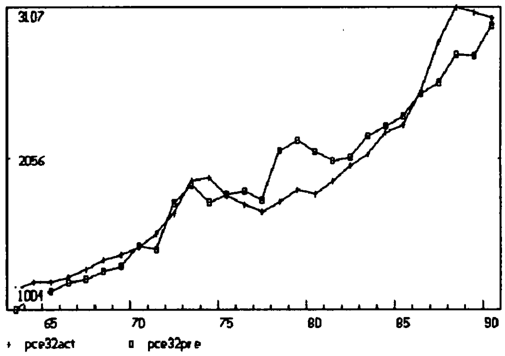


Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted

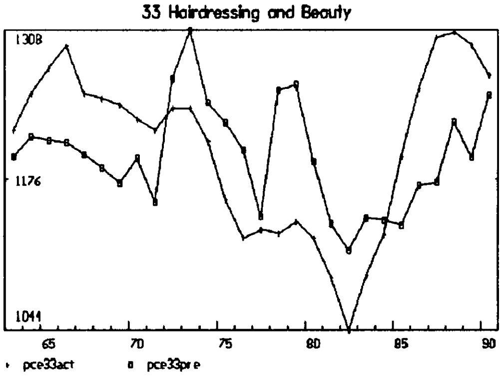
31 Medical Goods and Services



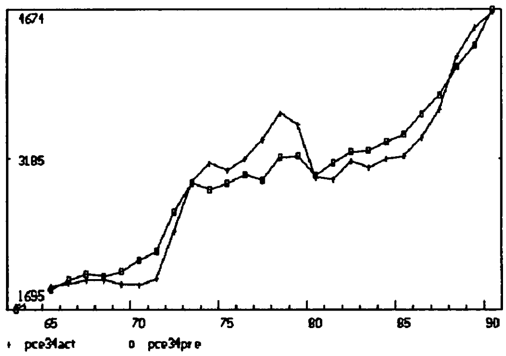
32 Toiletries and Perfumery



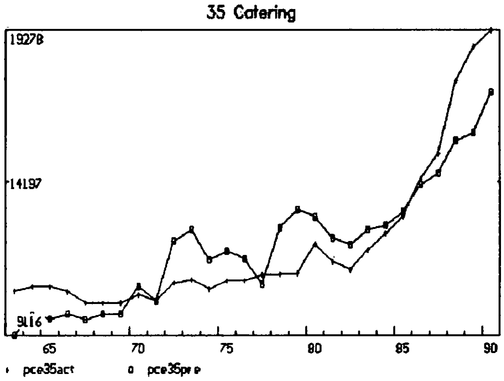
33 Hairdressing and Beauty



34 Other Goods



35 Catering



36 Other Services

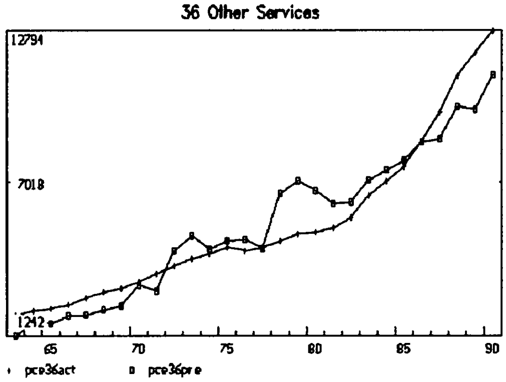
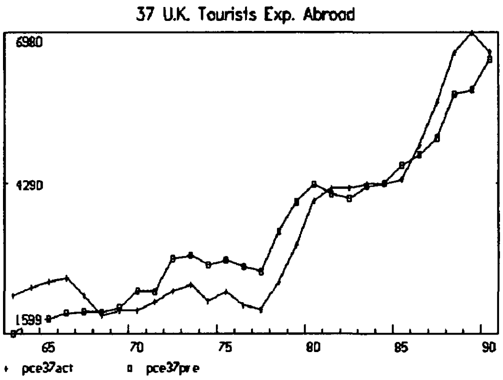
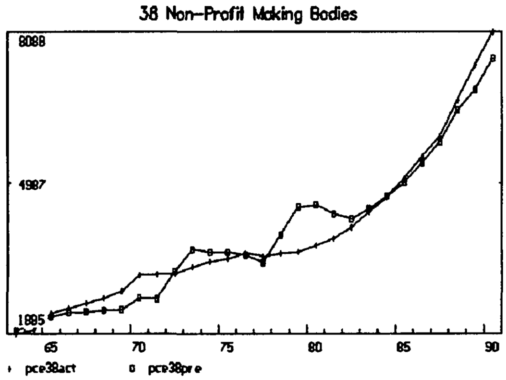


Chart IV.2.1: BRIM Personal Consumption Expenditure Regression Results, 1963-1990 (Continued)
Crosses - Historical; Squares - Predicted





Section IV.3 Final Demand: Investment

Gross domestic fixed capital formation — which includes government fixed investment in the British National Accounts, unlike their American counterparts — accounted for over 20% of British gross domestic product in 1984. Investment renews and expands current and future productive capacity, and is the vehicle through which technical progress enters into the existing capital stock. Investment behavior thus plays a crucial role in determining the long-term pattern of future output and prices, in both the real economy and in a dynamic forecasting model. Furthermore, investment is one of the most volatile components of economic activity, and variations in investment spending greatly affect aggregate levels of output and employment. Unfortunately, it is also one of the most difficult components of economic activity to forecast, especially if one attempts to forecast detailed industry-specific investment in specific assets, as has been attempted in BRIM.

Economists have devoted a great deal of intellectual energy to developing appropriate measures of investment, accumulated capital stock, depreciation of the stock, and the variables that influence them: output, prices, expectations, adjustment costs, market structure and technological change, among others. The voluminous economic literature on investment includes studies based on a variety of theoretical approaches, many of them complementary, focusing on differing combinations of the influences mentioned above. These approaches include the simple accelerator model, liquidity theory, neoclassical theory, Tobin's *q* theory, duality theory, the theory of adjustment costs, and the theory of interrelated factor demands.[55] Additionally, studies have employed a plethora of increasingly powerful and sophisticated econometric techniques to analyze aggregate and detailed investment behavior.

A dynamic forecasting model such as BRIM requires a set of equations that are consistent with economic theory and that yield accurate and reasonable forecasts in the context of a complete interindustry model, given the relative paucity of the readily available data. Some of the approaches mentioned above — the *q* model, the liquidity model, and other profits models related to the *q* model — are attractive from the standpoint of theory, but are not very applicable to large-scale modeling because they involve variables that are even more difficult to forecast than investment. A further consideration is the degree to which a particular functional form imposes subtle biases on estimated parameters when the data used for the estimation are relatively poor. This is an important consideration in the case of the translog cost function, which can be thought of as a second-order Taylor's series approximation in logarithms to an arbitrary nonhomothetic cost function.[56] The translog has received a great deal of attention because of its generality; however, it can be biased towards unitary elasticity of substitution in the presence of measurement error, effectively allowing for a greater amount of price responsiveness in input demand than is actually the case. Other forms, such as the fixed-coefficient or the generalized Leontief (GL) models, may produce considerably lower estimates of price responsiveness given the same set of noisy data (i.e. the GL form is biased

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[55] For a selective review of recent theoretical and empirical work on models of investment behavior, see Meade (1990), Chapter II. The following discussion draws at length from Meade's work, which is the most extensive recent study of investment in the context of a dynamic macroeconometric interindustry model.

[56] See Berndt (1991).

toward zero elasticity of substitution). In this case, the choice between equation forms necessarily depends in part on the modeler's judgement of the flexibility of technologies and the price responsiveness of firms' production choices, independent of the data. Similarly, economists agree that technical change occurs mainly as capital formation brings more advanced technologies into the production process. However, in some instances technological change is clearly "embodied" in specific pieces of investment equipment that displace or substitute for older equipment, such as electric power generation facilities; while in other instances the new equipment increases the productivity of older vintages of equipment, as when a new generation of microprocessors can be used to upgrade numerically-controlled machine tools. The former process can expressed in a "putty-clay" model that assumes that the existing capital stock cannot be made more productive, and that adjustments can come about only by replacing old capital goods with new ones. The latter process can be expressed in a "putty-putty" model that assumes that the productivity of all existing vintages of capital goods can be increased by an investment response to a change in prices. Both models clearly have an element of truth to them. Nevertheless, a modeler must choose between them, and the choice between them produces different results in investment equations, given the same data.

For forecast modeling purposes, a variation of the basic neoclassical investment model involving output, relative prices and depreciation is likely to be most suitable. Even in this restricted arena, however, there is a wide variety of functional forms to choose from, and while more complex forms may be more attractive from a theoretic viewpoint, one may want to choose a form that is fairly convenient to estimate.

It is important to keep in mind, however, that investment behavior remains very difficult to model and forecast. As Berndt notes,[57] no proposed investment model consistently outperforms all the others, and

> [w]hile theoretical and computational developments ... have provided us with necessary tools, successful measurement and forecasting still elude us ... we are still not able to predict investment to a reasonably precise level, nor can we conclude on the basis of empirical performance what form of the investment equation is preferable and stable ... It is difficult to reduce with success the very complex investment process to a limited number of variables and parameters.

Comparison of different model types. Berndt's observations are supported by Meade's (1990) detailed study of models of investment in the context of a dynamic macroeconometric interindustry model. Meade examined eight alternative investment models and their applicability to investment behavior over the period 1953-85 in the INFORUM's LIFT model of the U.S economy. The first is a simple **autoregressive model** in which current investment is related to its own lagged values:

$$(1)\ I_t = a_0 + \sum_{i=1}^{4} a_i I_{t-i}$$

The autoregressive model has no economic rationale; it is not a structural model (that is, it fails to link investment behavior to other components of economic activity), and furthermore

[57] Berndt (1991), p.276-7.

generally fails to capture turning points in investment series. However, the model generally yields the best fits to the data, and was used as a benchmark to which to compare the others. The other seven models, chosen for their appropriateness to modeling investment in a general equilibrium framework, are described below.

Accelerator models, first developed by J. M. Clark seventy-five years ago, relate firms' desired capital stock directly to output levels, the most important determinant of investment demand, with no influence from any of the theoretically relevant price variables. The equation is derived from the basic identity

$$I_t \equiv (K_t - K_{t-1}) + \delta K_t$$

which states that current investment is simply this period's gross change in the capital stock plus the depreciated portion of the stock. Making the simplifying assumption that firms wish to maintain an approximately constant capital stock ratio,[58] so that desired stock is simply a proportion of output, the above identity yields a simple investment equation:

$$I_t = \hat{k}_t (Q_t - Q_{t-1}) + \delta K_t$$

where the parameter on the change in output term is simply the desired capital output ratio. The only addition needed for estimation is to recognize the existence of lags, due either to the time needed for firms to recognize changes in output as fairly permanent and to adjust their expectations, or to the time necessary for any large investment undertaking, or both. The resulting equation consists of terms representing a distributed lag of values of changes in output (requiring new capacity) and a term representing depreciation of the existing capital stock (requiring replacement investment). The general form is

$$(2)\ I_t = a + \sum_{i=0}^{3} b_i \Delta Q_{t-i} + cW$$

where ΔQ is the change in industry output and W is a measure of depreciation of the capital stock. As with all of the forms described below, the distributed lag can be interpreted as the result of slow adjustments in either expectations or concrete responses, or in both. Meade found that the accelerator form yielded fairly good fits, though not as good as the autoregressive model, and was better than that the autoregressive model at predicting major turning points. However, the equations had worse fits over the extended period 1953-85 than the shorter period 1953-77. Furthermore, the estimated parameters were quite sensitive to the period of estimation, suggesting that this model is not picking up the underlying structural relationship between investment and output, or that the relationship has changed between the

[58] This is a debatable assumption, given the available data of the U.K.: both the net stock/output and gross stock/output ratios were quite constant before 1970; the former's standard deviation has been about 10% of its mean during the past two decades, while the latter's has been about 5%. Given the fairly violent cyclical behavior of the British economy during a large part of the period, one might not be too far off in arguing that British industry tried to maintain a fairly constant capital output ratio. This argument, however, applies only to the aggregate data.

two periods. This tends to throw doubt on the forecasting ability of the model.[59] Furthermore, many coefficients took nonsense values, even when an Almon lag was imposed, and the replacement investment term took values considerably lower than 1.0, the expected value, suggesting that either there is high multicollinearity between changes in output and the replacement variable, or that changes in current output actually stimulate replacement investment, so that the output terms are capturing part of the replacement investment in the equation.[60] However, for total equipment investment in the economy as a whole, the accelerator model does extremely well.

The **Joregenson Cobb-Douglas model** extends the accelerator model by including with the output term a measure of the user cost of capital relative to the price of the firms' output. The form imposes the same distributed lag on both the output and price effects, which can render the estimated price response ambiguous: if output changes have a strong effect on investment, so that the parameters on the combined price/output term are large, then changes in the cost of capital will also have a strong effect. Like the accelerator model, the form also includes a measure of replacement investment: in this case the depreciation rate is estimated as a parameter on a capital stock variable. The general form is

$$(3)\ I_t = a_0 + \sum_{i=0}^{3} b_i \left[\Delta \frac{pQ}{c}\right]_{t-i} + \delta K_{t-1}$$

where p is the price of the firms' output, c is the user cost of capital, and δ is an estimated depreciation rate. Meade found that estimations of this equation produced fits that were only slightly worse than those of the accelerator equations, and showed the same sensitivity to the period of estimation.

Meade examined two **CES models** based on the constant elasticity of supply production function, which augment the previous models by taking into account the elasticity of substitution between capital and labor, σ. The first of these equations takes the form

$$(4)\ I_t = a_0 + \sum_{i=0}^{3} w_i \left[\%\Delta Q_{t-i} - \sigma\%\Delta c_{t-i}\right] K_{t-i-1} + \delta K_{t-1}$$

where the first term within the brackets represents the output effect on the demand for capacity and the second term represents the effects of changes in the user cost of capital, weighted by the elasticity of substitution. Like the Jorgenson Cobb-Douglas model, this formulation imposes the same distributed lag structure on both output and price effects. Meade found the form to give worse estimates than either the simple accelerator or Cobb-Douglas models.

The second CES model allows for separate lag structures for output and price effects:

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[59] Meade (1190), p.IV-7.

[60] Ibid., p.IV-8.

$$(5)\ I_t = (a + \delta)K_{t-1} + K_{t-1} \sum_{i=0}^{3} w_i\ \%\Delta Q_{t-i} - K_{t-1} \sum_{i=0}^{3} \sigma_i \%\Delta c_{t-i}$$

Estimates using this form proved better than those of the simpler CES model but worse than the other models described above.

The next two equations tested by Meade are based on the **Generalized Leontief Cost function**, which is intended to allow not only for output, stock and capital cost effects but also for relative price effects between several factors (in the versions tested, between capital, labor and energy). In this formulation, the long-run capital-output ratio, and therefore the desired capital stock, is a function of the relative prices of all inputs. The first is a **putty-putty** model, which applies to the case in which all vintages of capital may be augmented by investment expenditure in response to price changes:

$$(6)\ I_t = e^{-a_K t} \left[\begin{array}{c} \left\{ \sum_m b_{Km} \left(P_m / P_K\right)^{1/2} \sum_{i=0}^{3} w_i^K\ \Delta Q_{t-i} \right\} \\ + Q_t \sum_{i=0}^{3} v_i^K \left\{ b_{KL}\ \Delta\left(P_L / P_K\right)_{t-i}^{1/2} + b_{KE}\ \Delta\left(P_E / P_K\right)_{t-i}^{1/2} \right\} \end{array} \right] + \delta K_{t-1}$$

where $m = E, L, K; \quad \sum_{i=0}^{3} w_i^K = 1; \quad \sum_{i=0}^{3} v_i^K = 1$

Several restrictions must be placed on the b's to yield estimates of the price elasticities that are consistent with economic theory and yield reasonable forecasting properties. The exponential term at the beginning of the equations contains a time trend, t, and the coefficient a_t provides an estimate of the rate of technological change. (More than one trend can be included if considered appropriate.) The top term in the large square brackets represents the effect on the desired capital stock resulting from changes in output; while the bottom term represents the change in desired stock — applying to all vintages of capital — resulting from relative price changes.

The **putty-clay** version of the Generalized Leontief model differs from the putty-putty version in that the bottom term is left out of the equation, since older vintages of capital cannot be augmented. Furthermore, in this model the productive capacity of the existing capital stock — and therefore the amount of economic depreciation — is a function of the optimal capital-output ratio, which itself is a function of relative prices. As a result, in the putty-clay model replacement investment and new investment must be estimated jointly, with replacement investment determined as a function of the b's and netted out of gross investment to yield the net.

Meade estimated the putty-putty and putty-clay models using a two-stage procedure in which the trend and price elasticities were determined in the first stage and the distributed lag parameters were estimated in the second stage. He found that the two models produced very similar results in terms of fit, with the putty-clay model yielding slightly better fits in general. Although most of the parameters were economically sensible (as one would expect, since they were so constrained), the fits were generally worse than those of the accelerator model and the second CES model.

The last approach examined, the **dynamic factor demand** model, distinguishes variable factors such as labor and quasi-fixed factors such as capital and allows for adjustment costs in changing the stock of the fixed factors. In the case of one fixed factor, assuming a tractable quadratic restricted cost function in which the prices of labor and capital are normalized by the price of energy, the approach yields a flexible accelerator model with an adjustment coefficient that is a function of the real interest rate and parameters of the cost function:

$$(8)\ I_t = -\frac{1}{2}\left[r - \left(r^2 + \frac{4\gamma_{KK}}{\gamma_{\dot{K}\dot{K}}} \right)^{1/2} \right]$$
$$\cdot \left[-\frac{1}{\gamma_{KK}} \left(\alpha_K + \gamma_{LK}\hat{P}_L + \gamma_{QK} Q + \alpha_{K\,t} + \hat{P}_K \right) - K_{t-1} \right] + \delta K_{t-1}$$

The equation is estimated simultaneously with related equations for the demand for labor and energy. As with the previous models, restrictions must be imposed on the parameters to render the parameters consistent with economic theory. Meade found that further restrictions were required to force the optimal capital stock to be sensibly close to the actual stock. The resulting estimations, however, generally yielded very poor fits and many nonsensical elasticity values; and Meade judged this model to be a complete failure.

Taking the estimated equations based on the different models as a whole, Meade compared their simulation performances both singly and in the context of the entire real side of the LIFT model, according to a variety of measures of mean error. Perhaps the two most informative measures are the **root-mean-square simulation error (or RMSE)** and the **mean simulation error** (MSE). The RMSE is analogous to a standard error, and is defined as

$$RMSE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(Y_t^s - Y_t^a \right)^2}$$

where

Y_t^s is the forecast value of Y_t;
Y_t^a is the actual value of Y_t; and
T is the number of periods in the simulation.

The MSE is defined as

$$MSE = \frac{1}{T}\sum_{t=1}^{T}\left(Y_t^s - Y_t^a \right)$$

where

Y_t^s is the forecast value of Y_t;
Y_t^a is the actual value of Y_t; and
T is the number of periods in the simulation.

In **within-sample simulations of single equations**, Meade found that in general no structural model was clearly superior across all industries by any measure; but that, of the structural models, the accelerator model performed better in most industries by most measures. In terms of total root mean square error (RMSE) across all industries, the accelerator model provided a better overall forecast, followed by the second CES model; while in terms of total mean simulation error (MSE), the Cobb-Douglas model was best, also followed by the second CES model. In within-sample simulations **of the entire model**, however, none of the structural equations did well compared to the autoregressive model by almost any measure, although the Cobb-Douglas model was fairly close in terms of total RMSE and MSE.

In **out-of-sample simulations with single equations** over the period 1977-85, Meade found that the autoregressive model performed better in more industries — by all measures — than the structural models, but that the generalized Leontief models did nearly as well by some measures. In terms of total RMSE and MSE for all equations — which were roughly double those of the within-sample simulations — the Cobb-Douglas model outperformed even the autoregressive model, and the accelerator model did nearly as well. In simulations of **the entire model**, the autoregressive model still performed best in more industries by most measures, although the generalized Leontief model did better by some measures. In terms of *total* RMSE and MSE, however, the Cobb-Douglas equations again distinctly outperformed the autoregressive model, as did the Generalized Leontief putty-clay model; and in terms of total MSE the accelerator and the first CES models did nearly as well as the autoregressive model.

In sum, Meade concluded that for medium- to long-term forecasting purposes, the Cobb-Douglas model is likely to give superior forecasts, but he found the generalized Leontief models preferable because they are nearly as good and, moreover, are richer in terms of the influences they incorporate and the variety of policy issues they can be used to examine. He notes that

> [a] possible drawback of the GL models is that the many influences they incorporate ... can cause the forecasts to go astray. If energy prices, wages or capital cots are forecasted inaccurately, then the investment forecast will be adversely affected. A simpler model like the Autoregressive or the Accelerator model does not share this problem. However, the latter models severely limit the types of questions that can be asked with the model.[61]

He also notes that in comparison to many of the other available functional forms (other than those he actually estimated), the GL form is fairly convenient to estimate; and that it yields relatively conservative estimates of substitutability in existing production technology in the presence of measurement error in the data.

The Cambridge CMDM model incorporates estimates of gross fixed capital formation for three assets — vehicles, plant and machinery, and structures — for each of 40 industries, all estimated simultaneously. From their discussion of their work[62] it is clear that the CMDM's builders, like myself, have had a very difficult time developing detailed sectoral investment

[61] Meade (1990), p.V-19.

[62] Peterson in Barker and Peterson (1987), pp.151-83.

equations that are either theoretically satisfying or empirically useful. To model capital expenditures, they have derived equations from the standard Jorgenson neoclassical model of investment behavior, in which firms maximize the net present value of an expected stream of profits subject to production and capital accumulation constraints. From this model they derive an equation of investment as a function of the firm's optimal level of output (which is itself a function of the firm's profitability), adjustment costs, depreciation rates, and the user cost of capital, under the assumption of constant returns. However, the Cambridge group has found — as have others — little support for the applicability of the neoclassical model to British investment behavior. Even attempts to include current and lagged industry profitability levels as explanatory variables have produced practically no improvement over a simple accelerator model. A large part of the problem likely stems from the difficulties involved in constructing appropriate data series for the user cost of capital. Peterson states[63]:

> During the estimation period, ... the UK government operated a bewildering assortment of corporate-tax regimes and investment incentives .... However the most acute problems in measuring the user cost of capital arise because of the interactions between an imperfect capital market, a distortionary corporate-tax system and a volatile inflation rate.

I am inclined to view this as evidence of rigidity in British industry.

Failing to find empirically substantiated neoclassical investment equations, the Cambridge group has developed a set of hybrid autoregressive/log-linear accelerator equations relating the logs of industry-specific investment in several assets mainly to current and lagged values of industry output. In these equations, the "accelerator" variables are logs of output levels rather than of changes in output. Furthermore, the functions incorporate serial correlation corrections, time trends and several lagged values of the dependent variable, the latter carrying much of the weight of the estimation with little theoretical justification.

$$\ln v_t^{ij} = a + b_1\, time + b_2 \ln q_t^{j} + b_3 \ln q_{t-1}^{j} + b_4 \ln q_{t-2}^{j} + b_5 \ln q_{t-3}^{j} + b_6 \ln v_{t-1}^{ij} + b_7 \ln v_{t-2}^{ij} + b_8 \ln v_{t-3}^{ij}$$

In some cases, this leads to equations that provide good fits in terms of R-squares but are essentially useless in explaining investment in terms of any other economic activity, such as output. Good examples are the equations for investment in plant and machinery in the Electricity and Miscellaneous services industries, which together account for almost 13% of investment in these assets. The Electricity equation's coefficients on current and lagged output are 1.1995 and -1.1911, respectively; the corresponding coefficients for Miscellaneous services, 1.0929 and -1.0941; in both equations the coefficient on the lagged value of the dependent variable is almost exactly 1. On their face, the output coefficients say that investment in these industries is positively correlated with this year's output and negatively correlated with last year's, in almost exactly equal proportions. These equations can be interpreted in terms of first differences; they then suggest that an increase in electricity output of one million pounds sterling *ceteris paribus* induces less than ten thousand pound's worth of investment in plant and machinery; in Miscellaneous services, the response is about a thousand

[63] Ibid. p.164.

pounds. Combined with the positive parameters values of slightly less than 1.0 on the lagged values of the dependent variables, these equations amount to a very long exponential accelerator model, in which changes in output have a very gradual impact on investment. For other industries, interpretation of the coefficients in terms of first differences yields negative investment responses to output, as in the Agriculture and Coal mining industries. The authors recognize these difficulties, noting that the Coal mining and the government-dominated Miscellaneous services industries are primarily state-run (as is the Electricity industry) and are therefore notoriously difficult to forecast. In these industries "investment appears to be a random walk which is unrelated to output". For agriculture, the results "may reflect the inclusion in investment of changes in the stock of breeding animals, so that sales of livestock lead to a fall in investment but a corresponding increase in output." In these cases, the Cambridge group overrides the equations in forecasting. In sum, the Cambridge functional form is questionable, especially given the heavy reliance on lagged values of the dependent variable; however, the poor results are not entirely the result of the choice of form, but stem from very basic problems in forecasting British industry-specific investment.

Investment in BRIM. Given the Cambridge group's poor results from experimentation with relatively complex investment functions, I chose a simple accelerator function for a first cut, despite its limitations. I estimated investment demand or gross domestic fixed capital formation (GDFCF) for 52 industries and three assets: vehicles, plant and equipment, and other buildings. The main variables are the industry's estimated capital consumption and current and lagged changes in the industry's gross output. Investment in dwellings is forecast separately as a separate industry. The lag structure varies between assets; I allowed vehicles a two-year lag, plant and machinery three and buildings four. I imposed (1) a constraint to force the coefficient on depreciation to take a value close to 1, and (2) an Almon lag constraint to force the coefficients on lagged output changes to follow a quadratic or cubic polynomial. For investment in vehicles and buildings, I included a variable measuring the return on short-term Treasury bills minus the annual rate of change in the GDP deflator (rtb$). The variable is a convenient proxy for general short-term interest rates.

Aggregate equations. Although they are not incorporated into BRIM, aggregate accelerator investment equations illustrate the applicability of the basic accelerator paradigm in modelling British capital formation. The aggregate equations below and on the following page — for total investment, vehicles, plant and machinery, and non-residential buildings — work fairly well despite the small number of observations. In these equations, the parameters on capital consumption (the second parameter) are constrained to take values close to 1.0, and in both the total investment and non-residential buildings equations the change in output parameters are constrained to lie along a straight line. In the unconstrained equations, the capital consumption parameters take values of 0.62, -0.48, 0.78, and 1.25, respectively; but the constraints produce the results shown below with only modest sacrifices of fits. Note that the aggregate change in output variables are for change in gross output, including intermediate output, as with the industry-specific equations.

The results below (and most of the other regression results throughout the text) are presented in a format designed by Clopper Almon. The first three lines present summary statistics as follows.

SEE — the standard error of the estimate, or the square root of the average of the squares of the residuals, not adjusted for degrees of freedom;

RSQ	the coefficient of multiple determination, or the share of the total variance "explained" by variation in the independent variables;
RHO	the autocorrelation coefficient of the residuals;
Obser	the number of observations;
SEE+1	the SEE for forecasts one period ahead using a rho adjustment; that is, adjusting for the degree of autocorrelation between the residuals;
RBSQ	the coefficient of multiple determination, adjusted for the degrees of freedom;
DW	the Durbon-Watson statistic, which contains the same information as RHO; a DW statistic near 2.0 indicates little autocorrelation, while values nearer to 0.0 or 4.0 indicate a high degree of autocorrelation;
DoFree	the number of degrees of freedom, or the number of observations minus the number of independent variables;
from	the first period of data;
to	the last period of data; and
MAPE	the mean absolute percentage error.

If the regression includes the lagged dependent variable as a regressor, the results show the Durbin-H statistic (DH) rather than the Durbin-Watson. The Durbon-H statistic is the appropriate test in the presence of autoregression, and can be considered as normally distributed with unit variance for the purposes of testing for autocorrelation.

For each independent variable, the table presents the following data in columns.

Reg-Coef	the regression coeeficient for the varaible;
Mexval	the marginal explantory value, or the percentage increase in the SEE if the variable is left out fo the regression;
t-value	the Student-t statistic, the ratio of the regression coefficient to an estimate of its standard deviation based on the variance of the residuals and the number of degrees of freedom;
Elas	the elasticity of the dependent variable with respect to the independent variable, measured at their means;
Beta	the regression coefficient with the variables normalized to have unit variances; this statistic can be interpreted as the number of standard error changes in the dependent variable resulting from a standard error change in the independent variable, and is used as a measure of the relative strength of the independent variable in affecting the dependent variable; and
Mean	the mean of the variable.

In some of the results that were produced during the latter part of this thesis research, the presentation is altered by the replacement of the beta coefficient with a statistic called the NorRes or normalized residual. For each variable, this statistic measures the ratio of the final sum of squared residuals in the whole regression to the sum of squared residuals given only the independent variables up to and including the given variable; for the intercept it is ratio of the final sum of squared residuals to the total sum of squares — or the inverse of the RSQ — and for the last variable it is always 1.0. This statistic is often more useful than the beta coeeficient for gauging the relative strength of the independent variable in affecting the dependent variable, since it does not depend on any estimate of the distribution of the errors.

Aggregate total investment accelerator equation, 1975-87

SEE = 613.83 RSQ = 0.9717 RHO = 0.29 Obser = 13 from 1975.000
SEE+1 = 596.38 RBSQ = 0.9322 DW = 1.42 DoFree = 5 to 1987.000
MAPE = 1.26

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 v$	- -					38902.29
1 intercept	11163.18321	144.7	5.132	0.29	0.000	1.00
2 d$	0.97060	416.0	11.629	0.65	0.753	26025.05
3 dgout$	0.15725	245.5	7.598	0.03	0.729	7659.35
4 dgout$[1]	0.06264	56.1	2.752	0.01	0.246	5229.02
5 dgout$[2]	0.07324	80.7	3.457	0.01	0.303	6264.96
6 dgout$[3]	0.05027	46.3	2.455	0.01	0.205	5923.21
7 dgout$[4]	0.02114	7.8	0.924	0.00	0.082	4523.01
8 rtb$	-320.37855	136.2	-4.916	0.00	-0.561	-0.30

Aggregate vehicles investment accelerator equation, 1974-87

SEE = 491.08 RSQ = 0.5970 RHO = 0.15 Obser = 14 from 1974.000
SEE+1 = 497.52 RBSQ = 0.3451 DW = 1.71 DoFree = 8 to 1987.000
MAPE = 6.61

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv$	- -					5690.37
1 intercept	886.92516	7.0	1.085	0.16	0.000	1.00
2 dv$	0.93399	117.2	5.503	0.75	0.497	4567.36
3 dgout$	0.03589	36.1	2.635	0.05	0.757	7634.78
4 dgout$[1]	0.02350	18.7	1.825	0.03	0.443	6523.66
5 dgout$[2]	0.00531	1.1	0.424	0.01	0.101	6806.51
6 rtb$	-135.75682	65.6	-3.766	0.01	-1.093	-0.55

Aggregate plant and machinery investment accelerator equation, 1975-87

SEE = 198.29 RSQ = 0.9938 RHO = -0.31 Obser = 13 from 1975.000
SEE+1 = 181.88 RBSQ = 0.9852 DW = 2.63 DoFree = 5 to 1987.000
MAPE = 0.85

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp$	- -					19033.78
1 intercept	3604.20678	303.4	8.798	0.19	0.000	1.00
2 dp$	0.99268	1502.3	36.002	0.75	0.693	14392.94
3 dgout$	0.04624	220.5	6.855	0.02	0.310	7659.35
4 dgout$[1]	0.05188	224.0	6.938	0.01	0.295	5229.02
5 dgout$[2]	0.04388	191.0	6.153	0.01	0.262	6264.96
6 dgout$[3]	0.03174	128.5	4.624	0.01	0.187	5923.21
7 dgout$[4]	0.01096	18.8	1.445	0.00	0.062	4523.01
8 rtb$	-13.50337	4.9	-0.715	0.00	-0.034	-0.30

Aggregate new building investment accelerator equation, 1975-87

SEE = 824.75 RSQ = 0.6361 RHO = 0.60 Obser = 13 from 1975.000
SEE+1 = 687.68 RBSQ = 0.1266 DW = 0.81 DoFree = 5 to 1987.000
MAPE = 4.60

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb$	- -					14256.96
1 intercept	6703.23869	49.1	2.651	0.47	0.000	1.00
2 db$	0.94701	48.9	2.646	0.47	0.498	7007.44
3 dgout$	0.05472	40.9	2.379	0.03	0.678	7659.35
4 dgout$[1]	0.02362	14.5	1.337	0.01	0.248	5229.02
5 dgout$[2]	0.01894	9.6	1.073	0.01	0.209	6264.96
6 dgout$[3]	0.02287	13.2	1.271	0.01	0.249	5923.21
7 dgout$[4]	0.01709	8.0	0.981	0.01	0.178	4523.01
8 rtb$	-146.87713	27.1	-1.881	0.00	-0.687	-0.30

The regressions shown above give quite reasonable parameters; and both the output and interest rate parameters of the three asset equations sum very closely to those of the aggregate equation, as shown in Table IV.3.1. These results reinforce the impression that the specification is capturing essential structural relations.

Table IV.3.1: Output and Interest Rate Parameters in Aggregate Equations

Year	Vehicles	P. & E.	Buildings	Summed	Aggregate
Current year	0.03589	0.04624	0.05472	0.13685	0.15725
One lag	0.02350	0.05188	0.02362	0.09900	0.06264
Two lags	0.00531	0.04388	0.01894	0.06813	0.07324
Three lags		0.03174	0.02287	0.05461	0.05027
Four lags		0.01096	0.01709	0.02805	0.02114
Total response	0.06470	0.18470	0.13724	0.38664	0.36454
Interest rate	-135.8	-13.5	-146.9	-296.2	-320.4

The regressions imply that a rise in aggregate gross output of one million pounds induces an increase in investment of about £390,000. Since annual investment in these categories averaged about £40 billion over the period in question, while both gross output and the capital stock averaged about £500 billion, the regressions suggest an aggregate output elasticity of investment of about 5.0 and an aggregate output elasticity of the capital stock — and a marginal capital-output ratio — of about 0.39. The implied distribution of investment among assets — 17% to vehicles, 48% to plant and machinery, and 35% to buildings — is almost exactly the same as the actual historical distribution. Perhaps because the equations are specified using annual data, aggregate investment does not display the characteristic "humped" lagged response pattern except for plant and machinery. Instead, over 40% of the response occurs within the first year, 18-19% occurs in each of the next two years, 15% in the fourth year and about 7% in the fifth.

The interest rate parameters imply a very modest investment response to changes in real interest rates, once the effect of changes in output are accounted for: a percentage point decrease in real interest rates stimulates about £300 million in investment, half of it in buildings and nearly all of the rest in vehicles. The implied aggregate interest elasticity of investment is less than 0.01.

Interestingly, the output and interest rate parameters for all four asset regressions still sum to those of the aggregate regression if a similar equation is included for investment in dwellings and imputed rent is included in output. However, the regression for investment in dwellings yields a rather poor fit once its capital consumption parameter is constrained close to 1.0, and the asset shares of investment implied by the resulting output parameters does not correspond to the actual historical shares (residential investment takes an inordinately large share). These latter results suggest either that the accelerator form is inappropriate for residential investment, or that the depreciation variable for the residential stock is poorly measured, or perhaps both.

Table IV.3.2: Output and Interest Rate Parameters in Aggregate Equations

Year	Vehicles	P. & E.	Building	Residences	Summed	Aggregate
Current year	0.03996	0.04981	0.05679	0.12117	0.26773	0.29514
One lag	0.02241	0.05256	0.02519	0.02373	0.12389	0.08818
Two lags	0.00723	0.04651	0.02068	0.05603	0.13045	0.13958
Three lags		0.03309	0.02482	0.03112	0.08903	0.08726
Four lags		0.01394	0.01870	0.07021	0.10285	0.10403
Total response	0.06960	0.19591	0.14618	0.30226	0.71395	0.65380
Interest rate	-138.6	-12.2	-144.5	-184.2	-479.5	-514.4

The interest rate parameters for vehicles, equipment and non-residential buildings are almost exactly the same as in the previous case, while the parameter for residential construction implies a similarly modest response to changes in interest rates.

One problem with these equations is that they imply investment responses to changes in output that are low relative to historical capital-output ratios. During the period of estimation, the capital-output ratio (measured as real net capital stock to real gross output) grew from about 0.89 in 1970 to 1.10 in 1981 as the net stock grew slightly more quickly than gross output. In the 1980's, the ratio declined but remained above 1.0. If producers attempt to maintain a relatively constant capital-output ratio, then, one would expect an aggregate output elasticity of investment of close to 1.0, instead of something like 0.39 (or, if one includes dwellings, 0.65 to 0.70). The explanation for the discrepancy is found, I think, in the enormous change in the composition of British output during the period. While capital-intensive manufacturing output declined markedly during the period — and manufacturing industries almost certainly scrapped more equipment than the capital consumption data suggests — output increased in labor-intensive service industries, and the oil sector boomed. Taken together, these trends imply that investment would have been relatively low in the sectors with traditionally high capital-output ratios and high in the sectors with low capital-output ratios; and that therefore the marginal capital-output ratio for the economy as a whole (presumably what is being estimated by the regression parameters) is probably lower than suggested by the average ratio measuring the existing stock. These factors probably account for the observation of marginal aggregate investment responses to changes in aggregate output that were lower than the average capital-output ratio would suggest. These factors, however, also imply that the equations are very sensitive to the period of estimation, and this sensitivity places some doubt whether parameters estimated over the period are very applicable in a forecasting context.

Industry equations. The detailed industry equations do not produce as appealing results as the aggregate equations, but given the short period of estimation and the problems that the British economy faced during the period, the results are surprisingly good. Tables IV.3.3 through IV.3.5 on the following pages present the results of simple accelerator regressions with constrained replacement investment terms for 52 industries and 3 assets. (These equations are shown only to illustrate the results of using the simplest forms. The equations used in the model are shown and discussed in detail on the pages following the Tables.) Three output terms — one current and two lagged — are specified for vehicles; four for plant and machinery; and five for buildings. Surprisingly, although the interest rate variable was valuable in the aggregate equations, it proved essentially useless in all but a handful of the non-residential building regressions. The variable is not included in the regressions shown in the Tables. As with the aggregate equations, the parameters on capital consumption (the second parameter) are constrained to take values close to 1.0, and the change in output parameters are constrained to lie along a cubic polynomial.

The tables show the values of all the parameters, the adjusted R-squares, the rho's and the mean absolute percentage errors (MAPE's). The table also gives the parameters' mexvals, or marginal explanatory values, instead of the usual t-statistics. As explained previously, a variable's mexval is defined as the percentage increase in the equation's standard error that would result from omitting the variable; put more simply, it is the variable's marginal contribution to the fit. The mexval conveys essentially the same information as the t-statistic except that its calculation does not involve the number of degrees of freedom in the estimation. The mexval therefore does not incorporate any assumptions about the validity of the equation's form, the non-stochastic nature of the X-matrix, or the distribution of errors in the equation. Furthermore, the interpretation of t-statistics becomes increasingly problematic when constraints are placed on the parameter estimations, as they are in these equations. Readers unfamiliar with mexvals may consult Almon (1989) for further details.

At first glance, the results are discouraging. Most of the equations have very poor fits; only five vehicles equations, eleven plant and machinery equations and eight buildings equations have adjusted R-squares of over 0.5, and some equations have negative R-squares because of the imposition of constraints on the estimation. Many equations also have high mean average percent errors (only nineteen out of 156 equations have mean errors of under 10%), and the imposition of constraints on the depreciation variable raises the standard error of the estimate by fairly large proportions in about one-third of the equations. For each asset, one-third to one-half of the equations contain negative output parameters that would yield perverse results in a forecasting context. Finally, although shortness of the time series makes it difficult to test the equations out of sample, it is apparent that the results are quite dependent on the period of estimation.

Despite the poor general first impression of the results, they turn out to be quite consistent with the aggregate equations described above. As one would expect, the mean change in output and depreciation variables in the sectoral regressions sum very closely to the mean values of the aggregate change in output and depreciation variables in the aggregate equations. Reassuringly, however, the sectoral investment levels predicted using the mean values for the sectoral independent variables sum very closely to the aggregate investment levels predicted using the mean values for the aggregate independent variables. Moreover, the sectoral investment levels predicted over more of the estimation period sum rather closely to the predicted aggregate levels. Thus the predicted sectoral and aggregate accelerator effects seem to be in agreement for each class of investment good.

For certain sets of equations, moreover, the odd results can be easily explained. For industries that are largely state-run or heavily influenced by government policy, investment appears to be nearly a random walk with respect to output; in some such cases investment is actually negatively correlated with output, suggesting that state-run firms respond to decreasing demand by investing heavily to upgrade productive capacity. These government-influenced industries certainly include all the public utilities (Electricity, Gas, and Water), Agriculture, Coal Mining, Iron and steel, Ordnance, Motor Vehicles, Shipbuilding, Transportation and perhaps Other Services.

Even in the private sector, however, perverse results appear in manufacturing industries that suffered severe declines in demand during the period of estimation. I believe that the poor results are due in part to use of an accelerator model in a context of de-industrialization. The accelerator model makes fairly good sense when an industry is growing in a growing economy subject to business cycles. It may not be as applicable to industries in a period of chronic stagflation followed by a period of precipitous decline in an economy undergoing rapid structural shifts, and even where the parameters take the expected signs, I suspect that their estimated values are in large part a consequence of the unusual circumstances of the period of estimation, and may not be robust enough to apply in a forecasting context. I believe that this problem led the CMDM modelers to employ their "accelerator" form essentially relying only on output levels to explain investment, but I don't see their approach as an improvement. However, I do not have a better alternative to present at present.

The poor results also may be partly caused by the assumption of straight-line depreciation used in constructing the net stock data. During the late 1970's and early 1980's British manufacturing firms sloughed off a third of their workforce and almost certainly scrapped more capital assets than measured by perpetual inventory methods using straight-line depreciation. Given depreciation rates that may have been considerably higher than the official data suggests, and given the decline in demand for many types of British manufactured goods, it is not at all clear that the parameter on depreciation should take a value of unity. Neither is it clear what value the parameter should take under the circumstances, and in unconstrained equations the parameters take values from -14.75 to 25.93. Correction of these weaknesses in the data and specification awaits further work.

To develop detailed equations with appropriate signs for inclusion in the model, I used varying specifications of the number of lagged output variables. One such variation has a plausible justification: investment in buildings may reasonably respond to changes in output only with a lag of a year or more, so that exclusion of the current change in output variable is not unsound. The other variations, however, have no theoretical or common-sense justification, but were necessary to develop equations that would not yield perverse results in the context of a dynamic model. The equations are shown and discussed on the pages following Table IV.3.5.

Several general observations are in order here. Many of the equations yield very poor fits and clearly fail to capture much of the historical variation in investment. However, they do reflect the general levels and trends of investment in each industry, and generally yield reasonable parameters and plausible investment behavior in the context of the model. The equations succeed in this respect despite the fact that they are estimated on a very short time period (12-14 years) during which many of the industries underwent major structural change, and despite the fact that in many cases the positive change in output parameters reflect a correlation between chronically declining output and investment. Given these major problems, the results are much better than I expected. However, for industries in which output was more or less stagnant and/or investment was heavily influenced by political considerations during the period of estimation, the equations imply very little investment responsiveness to changes in output. This is not a problem in the model so long as demand and output remain roughly near current levels; but in long-term forecasting scenarios involving major changes in output, the equations will yield perverse results. This is a problem that calls for further work.

Table IV.3.3: Industry Accelerator Investment Equations: Vehicles
(Mexvals below parameters)

Industry	Intercept	Replacement	Change in Output (lags) 0	1	2	Adj.R^2	Rho	MAPE
1 Agriculture	1.44719	0.99827	0.01175	0.01847	0.00841	-0.1078	0.77	19.68
	0.0	409.0	0.6	1.6	0.3			
2 Coal	-0.02252	0.99919	0.00029	-0.00013	-0.00005	-0.0723	0.53	38.19
	0.0	632.9	3.1	0.5	0.1			
3 Oil	7.06821	0.62587	-0.00743	0.01969	-0.00780	0.0160	-0.04	105.87
	0.5	1.9	4.6	24.5	4.8			
4 OilProcessing	0.35882	0.99989	-0.00005	-0.00017	-0.00018	-0.1921	0.40	23.91
	2.9	2079.1	0.7	8.0	8.9			
5 Electricity	2.25619	0.99044	0.01278	0.00164	0.00568	-0.1519	0.63	54.81
	1.3	218.8	10.0	0.3	3.2			
6 Gas	4.12306	1.02176	-0.02131	0.00348	0.01066	0.2181	0.33	29.25
	4.5	115.0	27.1	2.1	16.3			
7 Water	5.99822	1.00638	-0.00803	0.00700	0.00788	0.6457	0.27	18.98
	125.3	105.6	3.5	3.0	4.4			
8 MetalOres	1.52435	0.78653	0.00490	-0.00989	-0.01156	-0.5253	0.34	37.08
	15.4	25.0	1.0	6.6	9.8			
9 NonMetalOres	1.77802	1.01389	0.02761	0.03502	0.01149	0.1853	0.33	59.33
	0.4	11.5	9.1	16.7	1.9			
10 IronSteel	-1.77224	1.02649	0.00075	0.00087	-0.00005	0.3484	0.58	24.56
	6.6	270.3	1.6	2.2	0.0			
11 OtherMetals	-1.35818	1.05702	0.00348	0.00158	0.00163	0.7182	-0.08	16.61
	14.0	200.5	47.2	10.8	11.9			
12 MineralProducts	-5.34145	1.20511	0.01044	0.02302	0.00336	0.2879	0.53	16.24
	0.4	49.3	3.9	17.4	0.6			
13 BasicChemicals	3.72324	1.02434	0.00178	0.00256	0.00098	-0.1549	0.58	14.18
	0.7	62.9	3.4	6.9	1.1			
14 Pharmaceuticals	5.40237	0.94946	0.01671	-0.00147	-0.00376	-0.0892	0.72	21.45
	10.8	31.0	16.8	0.2	1.0			
15 SoapToiletries	-0.80208	0.98585	0.00639	0.00227	0.00348	0.1571	0.01	15.30
	3.8	129.2	23.5	4.3	10.0			
16 ManMadeFibers	0.27302	1.00737	-0.00081	0.00245	0.00070	0.3801	0.45	25.95
	8.5	166.4	2.0	29.0	3.1			
17 MetalGoodsNES	-3.05557	1.28398	0.00836	0.00515	0.00343	0.2150	0.60	14.43
	0.2	47.2	18.2	7.6	3.5			
18 IndustrialPlant	2.99097	1.00033	0.01430	0.00762	0.01095	0.5884	0.35	12.12
	34.8	388.3	50.9	23.0	34.3			
19 AgriculturalMachinery	-0.43857	1.06826	-0.00178	0.00186	0.00327	0.1537	0.06	24.98
	0.9	56.0	3.7	6.1	17.9			
20 MachineTools	-0.23710	1.23014	0.00792	0.00555	-0.00014	0.1931	0.56	20.36
	0.0	46.0	9.1	8.0	0.0			
21 TextileEtc.Machinery	-7.05113	1.53671	0.00448	0.00231	0.00109	0.0231	0.52	20.76
	1.6	25.9	3.7	1.3	0.3			
22 OtherMachinery	-23.24136	1.70091	0.01329	0.00032	0.00303	0.2920	0.40	11.63
	4.4	34.7	19.5	0.0	3.2			
23 Ordnance	0.53934	1.00065	0.00050	-0.00000	0.00003	-0.2128	0.49	34.41
	53.6	645.7	3.8	0.0	0.0			
24 OfficeMachComputers	1.11303	0.99169	0.00081	0.00264	0.00114	-0.3125	0.54	40.71
	10.9	453.3	1.3	10.5	1.8			
25 BasicElectricalEquip	0.55121	1.05945	-0.00010	0.00172	0.00085	-0.2920	0.42	26.52
	0.1	39.4	0.0	0.8	0.3			
26 ElectronicEquipment	2.12596	1.00207	0.00014	0.00371	-0.00214	0.0763	0.26	11.93
	1.7	54.8	0.0	15.6	5.1			
27 DomesticElectricalApp	1.01760	0.98036	0.00395	0.00541	0.00519	-0.2468	0.16	23.13
	4.4	65.1	2.1	6.0	5.2			
28 ElectricLighting	0.91358	1.00019	0.00641	-0.00069	-0.00233	0.1560	-0.36	15.16
	104.8	22.4	25.5	1.5	23.3			

(continued)

Table IV.3.3: Industry Accelerator Investment Equations: Vehicles (continued)
(Mexvals below parameters)

Industry	Intercept	Replace-ment	Change in Output (lags) 0	1	2	Adj.R^2	Rho	MAPE
29 MotorVehicles	8.35830	0.99453	0.00755	0.00511	-0.00527	0.4409	-0.32	25.19
	7.9	46.3	36.9	16.2	17.0			
30 Shipbuilding	0.34534	0.94561	-0.00215	0.00174	-0.00077	-0.4870	0.31	25.98
	0.5	52.9	3.1	2.0	0.4			
31 Aerospace	1.94414	1.10975	0.00374	0.00133	-0.00122	0.2673	-0.14	16.55
	1.0	13.6	19.7	3.0	2.1			
32 OtherVehicles	0.46186	0.99641	-0.00082	0.00109	0.00609	-0.2208	0.18	55.29
	2.9	140.8	0.1	0.3	8.2			
33 InstrumentEngineering	1.19426	1.00266	0.00662	0.00432	0.00415	0.1558	0.44	18.66
	13.8	352.0	12.4	5.8	5.5			
34 Food	31.81833	1.00342	0.00246	0.00401	0.00282	0.2391	0.33	9.64
	113.8	717.3	1.4	4.3	2.1			
35 Drink	-1.14093	1.05211	0.00606	0.00638	0.00562	0.5297	0.44	10.12
	0.1	68.6	11.9	19.1	14.3			
36 Tobacco	1.06761	1.02733	-0.00436	0.00099	-0.00462	-0.0559	0.21	45.82
	2.5	26.5	2.4	0.3	5.4			
37 Yarn	-0.05918	1.05904	0.00333	0.00092	0.00113	0.2036	0.34	23.67
	0.0	136.8	6.4	0.5	1.1			
38 Textiles	0.14900	1.06936	0.00503	0.00571	0.00666	0.4076	0.13	13.70
	0.0	100.1	8.0	9.2	13.1			
39 Apparel	1.64551	1.04820	0.01357	0.00283	-0.00279	0.3588	0.02	11.95
	1.1	107.1	29.8	2.0	1.8			
40 LeatherFootwear	0.71842	1.02602	-0.00028	0.00702	0.00068	0.2321	0.05	11.66
	2.8	181.3	0.0	12.3	0.2			
41 TimberWood	4.42809	1.01951	0.00797	0.01010	0.00934	-0.0800	0.59	18.22
	1.8	148.1	3.0	4.4	3.8			
42 PulpPaper	5.95430	0.97654	0.00325	0.00464	0.00254	0.1371	-0.30	10.97
	6.5	56.4	10.0	21.6	6.7			
43 PrintingPublishing	8.18502	1.07974	0.01605	0.00185	0.00662	0.3874	0.57	13.07
	4.6	90.1	32.2	0.5	6.1			
44 Rubber	0.42357	1.00593	-0.00428	0.00424	0.00651	0.1209	0.30	13.85
	1.3	247.2	5.9	7.1	17.8			
45 Plastics	2.84073	1.01358	0.00811	0.00383	0.00159	0.2066	0.45	13.40
	5.4	136.3	34.5	7.2	1.3			
46 OtherManufacturing	0.49752	1.04389	0.00406	0.00368	0.00391	0.1293	0.49	26.80
	0.1	74.0	7.6	6.2	7.2			
47 Construction	3.58914	0.99997	-0.00570	0.00581	-0.00133	-0.0550	0.31	16.12
	0.1	482.0	3.3	3.0	0.2			
48 Distribution	181.14189	0.99385	-0.00811	0.03409	-0.01539	-0.2005	0.54	10.55
	28.9	576.4	0.7	9.0	2.2			
49 Transportation	-155.86225	1.01475	0.12002	0.14083	-0.10752	-0.0929	0.54	18.55
	1.8	136.9	3.2	3.0	1.8			
50 Communications	-31.80451	0.99904	0.05157	0.01162	0.04717	0.3279	0.63	43.06
	28.9	348.1	15.0	0.6	12.4			
51 Banking	182.04327	0.55863	0.03938	0.00551	-0.00703	0.7910	0.33	15.30
	14.3	31.0	2.0	0.1	0.1			
53 OtherServices	31.13517	1.00002	0.02314	-0.00044	-0.00990	0.4843	-0.03	7.32
	9.9	11390.0	27.1	0.0	8.4			

Table IV.3.4: Industry Accelerator Investment Equations: Plant and Machinery
(Mexvals below parameters)

Industry	Intercept	Replace-ment	Change in Output (lags) 0	1	2	3	Adj.R^2	Rho	MAPE
1 Agriculture	91.89248	1.00449	-0.03324	-0.02620	-0.05929	-0.07052	0.1062	0.47	8.79
	6.7	257.1	1.0	0.8	5.7	4.5			
2 Coal	138.58394	0.99562	0.06662	0.06249	0.09235	0.11227	0.1382	0.24	16.47
	35.3	262.1	31.1	22.4	38.8	48.2			
3 Oil	383.03842	0.69066	0.17340	0.02458	-0.01928	0.00726	0.4239	0.27	27.63
	23.7	48.3	30.9	0.7	0.5	0.1			
4 OilProcessing	-11.63702	0.99179	-0.00418	-0.00414	-0.00508	-0.01296	-0.4170	0.62	26.39
	0.3	151.8	0.6	0.9	1.7	11.0			
5 Electricity	-197.34218	1.00751	0.10537	-0.20679	-0.12207	-0.05000	0.0379	0.73	6.73
	4.9	194.8	3.6	20.4	9.1	1.1			
6 Gas	96.64664	0.99859	-0.10257	-0.05125	-0.04877	-0.12280	-0.2985	-0.05	20.68
	41.7	602.4	8.4	2.6	2.6	19.7			
7 Water	-8.32350	1.00095	0.00576	0.00423	0.00435	-0.00321	-0.5127	0.42	13.19
	43.3	530.5	0.3	0.3	0.3	0.2			
8 MetalOres	1.24502	0.97681	0.10756	0.14079	0.14821	0.11689	0.3943	0.11	26.95
	0.2	42.3	9.5	37.5	55.4	29.9			
9 NonMetalOres	10.66254	0.97894	0.07559	0.08525	0.09949	0.08381	0.4527	0.28	24.47
	3.9	39.8	27.2	45.7	77.4	46.9			
10 IronSteel	-263.60205	0.93329	-0.26611	-0.30009	-0.05944	0.12248	0.2216	0.63	54.82
	7.1	36.9	30.3	30.6	1.9	8.8			
11 OtherMetals	-23.38356	1.03166	0.00116	0.02349	0.03551	0.04291	-0.2030	0.16	21.36
	2.1	45.1	0.0	4.1	9.6	15.0			
12 MineralProducts	112.22260	0.97281	-0.00859	0.07312	0.06885	0.00901	0.4516	-0.26	7.03
	7.0	46.9	0.4	29.2	30.0	0.6			
13 BasicChemicals	153.74088	0.88430	0.01549	0.05045	0.09076	0.06488	-0.6809	0.67	19.32
	2.4	44.0	0.3	3.1	14.4	8.5			
14 Pharmaceuticals	49.37266	1.05822	0.04910	0.10843	0.09803	0.05113	-0.0859	0.73	24.40
	10.6	91.4	0.9	7.0	8.7	1.4			
15 SoapToiletries	18.21549	1.05632	0.03889	0.02330	0.01132	0.00348	-0.1272	0.78	28.25
	24.9	100.1	4.7	2.7	1.0	0.1			
16 ManMadeFibers	-23.24153	0.92113	-0.04273	0.05059	0.08290	0.09158	0.0719	0.33	27.99
	12.4	98.3	5.9	7.6	34.1	41.2			
17 MetalGoodsNES	48.65330	0.96380	0.00367	0.04027	0.04868	0.03440	-0.3688	0.80	15.20
	3.2	98.7	0.1	10.3	16.6	9.1			
18 IndustrialPlant	31.82702	1.01854	0.03237	0.02799	0.02764	0.03858	-0.0691	0.48	13.62
	72.3	166.3	7.0	5.8	6.0	13.6			
19 AgriculturalMachinery	10.44550	0.81198	-0.03660	0.01606	0.05239	0.04826	0.4370	0.31	22.37
	3.1	28.8	7.7	2.2	51.0	21.9			
20 MachineTools	13.84231	0.96730	0.02218	0.05911	0.03330	0.00712	-0.3457	0.85	23.13
	7.3	111.7	1.6	16.9	8.7	0.4			
21 TextileEtc.Machinery	32.43467	0.91438	0.01289	0.00366	0.01100	0.03027	-0.7568	0.73	13.75
	12.2	75.8	2.4	0.2	2.7	16.2			
22 OtherMachinery	98.62003	0.89496	0.05607	0.06342	0.01297	0.02875	0.5014	0.42	5.40
	14.0	63.4	34.9	52.4	3.8	28.5			
23 Ordnance	18.59676	1.00885	0.00208	-0.00477	-0.01487	-0.00774	-0.1839	0.63	29.54
	78.8	230.8	0.1	0.6	5.0	1.4			
24 OfficeMachineryComputers	17.29370	1.05887	0.04889	0.05832	0.03384	0.01352	0.9292	0.48	13.70
	50.4	194.6	128.7	162.3	70.2	8.0			
25 BasicElectricalEquip	42.16981	1.03209	-0.01747	0.00230	0.01525	0.00479	0.5151	0.25	6.30
	51.6	232.5	5.3	0.1	8.7	1.1			
26 ElectronicEquipment	53.16982	1.05001	0.09919	0.07255	0.08215	0.05329	0.8915	0.41	8.01
	11.9	68.9	76.4	61.3	73.5	34.0			
27 DomesticElectricalApp	9.16572	0.97510	0.00575	0.01133	0.01026	0.00374	0.0810	0.21	10.43
	40.8	179.6	0.5	3.2	4.9	0.4			
28 ElectricLighting	5.08144	1.01042	0.02066	0.02315	0.01023	-0.00246	0.1723	0.34	12.47
	63.1	291.8	3.5	6.1	4.1	0.3			

(Continued)

Table IV.3.4: Industry Accelerator Investment Equations: Plant and Machinery (continued)
(Mexvals below parameters)

Industry	Intercept	Replace-ment	Change in Output (lags) 0	1	2	3	Adj.R^2	Rho	MAPE
29 MotorVehicles	167.55612	1.01598	-0.02648	0.04657	0.02033	-0.02280	-0.3848	0.43	15.39
	4.8	30.1	1.4	5.0	1.7	1.1			
30 Shipbuilding	-6.46387	0.99926	-0.04074	-0.00117	-0.00935	-0.02427	-0.5304	0.59	20.85
	0.8	76.3	5.7	0.0	0.6	2.7			
31 Aerospace	33.20534	0.96701	0.04983	0.03252	0.02932	-0.00247	0.4559	0.35	14.53
	1.3	9.9	30.5	18.0	15.0	0.1			
32 OtherVehicles	0.15650	0.99369	0.02520	0.02599	0.01331	0.00027	0.1990	0.08	17.86
	0.0	181.2	18.4	23.4	13.2	0.0			
33 InstrumentEngineering	11.76932	1.03311	0.03356	0.02618	0.00863	-0.00491	0.6044	0.33	8.11
	13.1	131.7	21.4	17.8	3.3	0.6			
34 Food	159.01325	1.07115	0.00644	0.02158	0.00873	-0.00814	0.4180	0.73	10.59
	32.5	230.1	0.3	4.1	0.9	0.6			
35 Drink	84.05802	0.81969	0.01575	0.05222	0.04991	0.01193	-0.2039	0.26	9.05
	13.1	43.9	2.4	26.3	33.4	2.1			
36 Tobacco	46.90465	0.19139	-0.02011	0.02644	0.01408	-0.00493	-0.6015	0.60	22.70
	10.4	0.3	1.8	3.1	1.9	0.2			
37 Yarn	-44.48348	0.98902	-0.02131	0.06807	0.03565	-0.02022	-0.3413	0.68	23.94
	13.2	96.3	1.2	17.2	9.7	1.9			
38 Textiles	-41.53734	0.99308	0.03472	0.04410	0.05235	0.04317	0.8609	-0.03	4.59
	41.4	350.1	63.1	102.9	206.1	106.4			
39 Apparel	8.05262	1.24238	0.04951	0.03462	0.02099	0.00925	0.3831	0.58	14.79
	0.9	47.4	28.0	26.5	13.6	1.7			
40 LeatherFootwear	-5.36094	1.29770	0.01291	0.01887	0.01694	0.00977	0.5243	0.26	13.15
	1.4	48.4	6.4	19.9	42.6	5.5			
41 TimberWood	55.87074	0.91643	0.01643	0.05166	0.04496	0.02122	0.0290	0.29	13.96
	37.6	80.3	3.2	19.4	17.8	4.7			
42 PulpPaper	104.88656	0.93207	0.02610	0.05593	0.03999	0.02580	0.4777	0.38	7.19
	37.0	96.9	10.6	42.7	26.9	12.7			
43 PrintingPublishing	90.19016	1.15445	0.08223	0.07423	0.05234	0.02461	0.2297	0.90	22.76
	14.3	77.5	10.5	13.5	8.9	1.3			
44 Rubber	-16.64334	0.99717	-0.01579	0.04585	0.05248	0.02897	0.0147	-0.08	10.14
	7.9	159.6	1.8	19.2	44.7	8.8			
45 Plastics	-17.01583	1.08763	0.08418	0.12568	0.09073	0.03155	0.8471	0.46	7.48
	1.3	122.6	106.1	163.4	124.6	19.5			
46 OtherManufacturing	19.04813	0.75190	-0.00243	0.00463	0.00365	0.00829	-0.9905	0.68	18.14
	3.5	17.8	0.2	0.9	0.7	2.9			
47 Construction	28.39912	0.98264	-0.01816	0.00226	-0.00431	-0.00393	-1.1782	0.53	21.13
	2.7	285.1	13.4	0.2	0.7	0.6			
48 Distribution	773.91880	1.03213	0.08410	0.06587	0.05349	0.03400	0.8139	0.72	10.82
	169.3	400.4	39.6	33.9	35.6	8.9			
49 Transportation	117.08044	1.01753	0.02856	0.03487	-0.01048	-0.04430	0.4396	0.75	21.02
	57.2	376.6	4.2	6.0	1.2	9.4			
50 Communications	93.74056	0.96681	0.10545	0.44603	0.39598	0.21239	-0.0687	0.78	10.47
	0.6	257.6	0.3	6.6	12.7	1.3			
51 Banking	-78.49896	0.97971	0.10342	0.02699	0.03530	0.10796	0.9284	0.61	14.26
	1.1	363.1	6.2	0.3	0.9	5.6			
53 OtherServices	238.47360	1.01030	0.12262	0.05020	-0.00548	-0.03299	0.5395	0.72	9.99
	8.7	653.4	15.8	3.7	0.1	1.7			

Table IV.3.5: Industry Accelerator Investment Equations: Buildings
(Mexvals below parameters)

Industry	Intercept	Replace-ment	Change in Output (lags) 0	1	2	3	4	Adj.R²	Rho	MAPE
1 Agriculture	161.56073	0.76848	0.09021	0.10021	0.09417	0.07913	0.06975	-0.6502	0.64	12.05
	6.5	38.1	6.7	8.3	10.4	5.7	3.5			
2 Coal	9.40637	1.65852	0.03736	0.04896	0.04598	0.05186	0.04841	0.1413	0.63	27.88
	0.1	32.8	20.2	24.9	19.1	18.8	17.5			
3 Oil	1197.82426	0.74424	0.19528	-0.03211	-0.08841	-0.08696	-0.07953	-0.1212	0.35	24.72
	63.8	22.9	16.0	0.4	2.8	2.5	2.4			
4 OilProcessing	-4.18004	0.98207	0.00189	0.00377	0.00193	0.00098	0.00046	0.5738	0.18	38.43
	2.7	82.6	23.5	109.7	45.2	13.8	2.9			
5 Electricity	-36.13941	1.20507	-0.04251	-0.06472	-0.08287	-0.06905	-0.02558	0.5568	0.40	5.90
	0.6	82.0	8.3	24.8	60.0	32.8	4.0			
6 Gas	54.77941	0.99579	-0.05860	0.17993	0.11304	0.03991	0.03022	0.5054	-0.15	7.59
	1.7	41.3	5.7	50.6	22.8	4.3	2.7			
7 Water	71.64330	1.13279	-0.04610	-0.10440	-0.00282	-0.06639	0.15197	-0.1335	0.34	6.33
	3.8	49.0	0.4	4.2	0.0	1.6	8.5			
8 MetalOres	-1.09740	0.98983	0.05000	0.03180	0.03137	0.03184	0.02702	0.1941	-0.35	86.03
	1.9	39.5	17.9	19.9	25.7	26.7	17.0			
9 NonMetalOres	-0.42738	0.99929	0.00984	0.00798	0.00630	0.00456	0.00253	-0.4625	0.34	66.78
	1.5	573.2	12.8	13.8	11.0	6.0	1.8			
10 IronSteel	-67.07939	0.99850	-0.05488	-0.04434	-0.00015	0.02293	0.01109	0.2035	0.53	173.81
	12.7	31.1	37.9	23.7	0.0	9.7	2.6			
11 OtherMetals	-6.00194	1.00903	-0.01051	0.00353	0.00291	0.00405	0.00266	-0.0869	0.25	45.85
	23.2	162.8	11.2	2.8	2.3	4.6	2.0			
12 MineralProducts	-4.87973	0.98157	-0.01528	0.02111	0.00543	-0.00299	0.01099	-0.4584	0.70	19.37
	1.1	126.5	9.8	15.3	2.1	0.7	6.4			
13 BasicChemicals	-3.56083	0.95303	0.00244	0.00814	0.01166	0.00807	0.00807	-0.4325	0.68	18.22
	0.2	82.7	0.7	7.4	21.0	11.2	11.7			
14 Pharmaceuticals	14.40976	1.00042	0.04063	-0.00534	0.04347	0.04072	0.01464	-0.2802	0.65	22.00
	10.1	1418.7	5.1	0.1	8.4	7.9	0.7			
15 SoapToiletries	0.37743	0.97871	-0.01321	0.01550	0.01517	0.01454	0.00096	0.1075	0.07	20.49
	0.1	39.2	6.4	14.2	17.0	14.3	0.0			
16 ManMadeFibers	-4.47772	0.96957	-0.00657	0.00312	0.00951	0.01048	0.00208	-0.0031	0.38	175.10
	41.8	113.2	7.0	1.8	28.3	37.1	1.4			
17 MetalGoodsNES	-20.16405	1.00411	0.00245	0.01324	0.01413	0.01001	0.00615	-0.0896	0.62	31.24
	2.5	27.6	0.6	19.3	23.6	13.7	5.0			
18 IndustrialPlant	5.40578	1.00691	0.00552	0.03376	0.04155	0.04337	0.03164	0.4065	-0.33	30.83
	12.3	95.4	1.8	52.8	53.5	79.4	45.8			
19 Agricult.Machinery	1.78595	0.94680	-0.01992	0.01274	0.00910	0.00255	0.01142	0.4631	0.50	60.63
	2.0	48.0	26.2	11.8	8.4	0.8	10.6			
20 MachineTools	-1.27535	0.93332	0.00013	0.01175	0.00809	0.00099	0.00299	-0.7859	0.54	122.77
	0.3	14.7	0.0	4.6	3.3	0.1	0.7			
21 TextileEtc.Mach.	5.14104	0.80165	-0.00718	0.00537	0.01293	0.01558	0.01142	0.1705	0.56	41.57
	0.4	8.3	3.8	2.4	20.1	27.0	12.4			
22 OtherMachinery	5.54630	0.86777	0.01606	0.02299	0.01558	0.01341	0.02053	0.5221	0.64	21.13
	0.4	30.1	16.4	40.6	28.1	34.7	65.7			
23 Ordnance	5.62712	1.03926	-0.00313	-0.00512	-0.00627	0.00289	0.01414	0.0051	0.16	87.85
	20.3	19.1	1.3	4.1	7.2	1.6	24.7			
24 Off.Mach.Cmputers	5.57722	0.99251	0.00777	0.00679	0.00968	0.00293	-0.01831	0.2804	-0.24	32.66
	10.8	22.7	9.2	7.3	14.4	1.1	15.9			
25 BasicElect.Equip	-2.26173	0.95893	0.00362	0.00497	0.01042	0.00983	0.00882	-0.0386	0.59	28.29
	1.5	115.4	1.1	2.8	25.0	23.4	19.9			
26 ElectronicEquip	2.20490	0.99965	-0.00385	0.01503	0.02358	0.00883	0.00168	0.8217	-0.45	10.82
	0.2	33.1	3.2	50.9	100.2	22.3	0.5			
27 DomesticElectrApp	2.43903	0.97599	-0.01519	0.00164	0.00408	0.00178	0.00082	-0.5350	0.06	59.87
	21.2	110.8	20.6	0.5	4.2	0.9	0.1			
28 ElectricLighting	-0.39589	0.99469	0.00280	-0.00325	-0.00205	0.00188	0.00353	-0.6709	-0.08	70.19
	5.4	190.6	0.9	3.7	2.9	6.5	13.3			

(Continued)

Table IV.3.5: Industry Accelerator Investment Equations: Buildings (continued)
(Mexvals below parameters)

Industry	Intercept	Replacement	Change in Output (lags) 0	1	2	3	4	Adj.R²	Rho	MAPE
29 MotorVehicles	-20.06355	0.95659	-0.01442	-0.00325	0.00210	-0.00585	-0.00132	-0.8966	0.61	40.45
	2.1	37.9	6.5	0.3	0.1	0.8	0.0			
30 Shipbuilding	-15.73615	0.99909	-0.02381	-0.00275	0.03326	0.01488	0.02443	-0.3757	0.55	34.14
	2.7	29.6	2.2	0.0	6.5	1.4	2.5			
31 Aerospace	-2.48624	1.01717	0.01771	0.00756	0.00402	0.00490	0.00607	-0.1177	0.41	34.05
	0.7	49.1	16.1	11.4	3.4	2.8	2.9			
32 OtherVehicles	-2.47317	1.01165	0.00929	0.00335	-0.00109	-0.00684	-0.00859	-0.3814	0.24	32.84
	6.8	66.4	6.8	1.3	0.2	7.1	9.2			
33 Instr.Engineering	0.52017	1.02183	0.00315	0.00801	0.00433	-0.00412	-0.00689	-0.3665	0.50	29.40
	0.4	84.4	0.7	7.3	2.7	1.9	3.7			
34 Food	-48.86228	1.21414	0.01189	0.01712	0.01542	0.00659	-0.00438	0.3376	-0.18	11.81
	1.8	21.0	14.6	39.0	39.4	8.0	2.9			
35 Drink	4.57359	0.92869	0.01214	0.02574	0.02116	0.01388	0.01171	0.3636	-0.23	13.18
	0.2	34.9	10.0	44.2	47.2	21.9	14.3			
36 Tobacco	-1.84061	0.98512	0.00058	-0.00458	0.00037	0.00363	0.00418	-0.7484	0.29	37.99
	7.2	88.8	0.1	4.4	0.1	6.2	5.4			
37 Yarn	-15.91509	1.00885	-0.00791	0.00653	0.00409	-0.00472	-0.00947	-0.1796	0.53	52.76
	75.2	318.3	2.9	6.1	2.8	4.2	9.1			
38 Textiles	-19.52186	0.99012	-0.00030	0.00403	0.00771	0.00791	0.00144	0.5026	0.08	16.69
	131.8	306.5	0.0	7.9	36.6	40.3	1.1			
39 Apparel	-7.90573	0.84137	0.01438	0.00956	0.00696	0.00529	0.00334	-0.3168	0.75	28.55
	4.5	26.5	21.3	24.3	14.3	6.3	2.4			
40 LeatherFootwear	-2.37447	0.90346	0.01077	0.00001	0.00190	0.00689	0.00736	-0.5904	0.74	40.75
	3.6	46.8	10.7	0.0	1.0	11.9	7.2			
41 TimberWood	5.43545	0.96932	0.00052	0.00984	0.01531	0.01228	0.00585	-0.7311	0.56	23.64
	1.7	48.0	0.0	3.9	9.7	7.4	2.1			
42 PulpPaper	-4.40354	0.98805	0.00551	0.01717	0.01279	0.00889	-0.00303	0.3735	0.20	18.84
	0.6	38.2	6.0	44.4	27.7	17.0	2.0			
43 PrintingPublishing	-9.01204	1.06220	0.01414	0.00749	0.01383	0.01168	-0.01848	0.0217	0.58	37.42
	0.4	10.1	5.8	1.9	7.5	5.5	7.0			
44 Rubber	-2.38505	0.97443	-0.00598	-0.00028	0.00672	0.01260	0.01548	0.0021	0.22	44.83
	3.8	82.8	2.1	0.0	6.5	25.4	22.0			
45 Plastics	8.52571	0.96061	0.00582	0.01495	0.00967	0.00212	-0.00451	-0.3454	0.33	27.97
	11.2	51.5	3.4	17.6	9.0	0.5	1.8			
46 OthManufacturing	-8.99118	1.02911	0.00735	0.00177	0.00048	0.00365	0.00656	-0.2084	0.67	59.84
	31.4	122.9	8.0	1.1	0.1	5.8	8.4			
47 Construction	24.33217	0.99493	-0.00282	-0.00264	-0.00118	-0.00014	0.00016	-0.6272	0.50	31.04
	28.5	305.4	3.5	2.5	0.5	0.0	0.0			
48 Distribution	635.92969	1.03769	0.09660	0.04865	0.09075	0.02532	0.06527	0.8136	0.24	9.42
	158.4	148.5	70.2	16.0	43.5	4.8	28.8			
49 Transportation	92.15773	0.99951	0.01940	0.03281	0.01283	-0.01158	0.06351	-0.4106	0.58	11.13
	17.5	435.7	1.3	2.3	0.4	0.3	8.7			
50 Communications	148.72789	0.99730	-0.02560	-0.01033	-0.01163	-0.01711	-0.01639	-0.9748	0.59	19.67
	50.2	446.2	1.1	0.5	0.6	1.0	0.6			
51 Banking	847.74449	0.99194	0.08074	-0.04505	0.00831	0.11961	0.16114	0.5492	0.41	9.28
	55.4	302.0	3.4	1.8	0.1	10.9	14.4			
53 OtherServices	1360.45990	0.95659	0.83174	0.75782	0.36176	-0.09738	-0.32791	0.0981	0.47	12.32
	9.1	73.2	28.9	36.5	10.6	0.9	9.9			

1. Agriculture, Forestry and Fishing

```
                                   Vehicles
SEE    =        44.87 RSQ   = 0.1876 RHO =    0.77 Obser  =    16 from 1972.000
SEE+1  =        32.83 RBSQ  = -0.1078 DW  =    0.46 DoFree =    11 to    1987.000
MAPE   =        19.68
  Variable name                Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vv1$                       - - - - - - - - - - - - - - - - - - - - - -   198.66
1 intercept                    1.44719     0.0   0.069   0.01    0.000       1.00
2 dv1$                         0.99827   409.0  16.555   0.96    0.405     190.07
3 dgout1$                      0.01175     0.6   0.364   0.01    0.102     160.51
4 dgout1$[1]                   0.01847     1.6   0.599   0.02    0.168     199.78
5 dgout1$[2]                   0.00841     0.3   0.273   0.01    0.076     225.34

                             Plant and Machinery
SEE    =       100.69 RSQ   = 0.3490 RHO =    0.54 Obser  =    15 from 1973.000
SEE+1  =        94.89 RBSQ  = 0.2989 DW  =    0.92 DoFree =    13 to   1987.000
MAPE   =        10.34
  Variable name                Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vp1$                       - - - - - - - - - - - - - - - - - - - - - -   749.47
1 intercept                   53.96730     2.5   0.818   0.07    0.000       1.00
2 dp1$                         0.99981   237.6  11.628   0.93    0.593     695.64

                                New Buildings
SEE    =        76.69 RSQ   = 0.0856 RHO =    0.53 Obser  =    14 from 1974.000
SEE+1  =        70.34 RBSQ  = -0.6982 DW  =    0.94 DoFree =     7 to    1987.000
MAPE   =        10.55
  Variable name                Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vb1$                       - - - - - - - - - - - - - - - - - - - - - -   599.32
1 intercept                  132.27278     6.1   0.952   0.22    0.000       1.00
2 db1$                         0.85238    58.0   3.297   0.68    0.556     478.25
3 dgout1$                      0.07211     6.2   0.965   0.02    0.414     147.88
4 dgout1$[1]                   0.07732     7.1   1.035   0.02    0.444     157.74
5 dgout1$[2]                   0.05573     4.9   0.858   0.02    0.317     180.77
6 dgout1$[3]                   0.05293     3.6   0.733   0.02    0.295     262.03
7 dgout1$[4]                   0.05499     3.2   0.682   0.02    0.290     229.05
```

The agriculture equations for vehicles and buildings yielded sensible results and relatively low percentage errors, even though they have very poor fits. For plant and machinery, however, the change in output parameters took negative values under every specification attempted. Several considerations led me to choose the simple equation based solely on depreciation. First, agriculture is subject to swings in output that are quite independent of changes in demand. Second, changes in the stock of breeding animals are included in investment, so that livestock sales increase output but depress investment. Third, the industry is heavily subsidized, so that there is no reason to expect investment to be related to output. Finally, there is little reason to believe that British agricultural output will expand substantially over time, so that replacement investment is likely to suffice over the middling future.

2. Coal and Coke

```
                                   Vehicles
SEE    =         1.39 RSQ   = 0.2498 RHO =    0.53 Obser  =    14 from 1974.000
SEE+1  =         1.25 RBSQ  = 0.1134 DW  =    0.94 DoFree =    11 to   1987.000
MAPE   =        40.48
  Variable name                Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vv2$                       - - - - - - - - - - - - - - - - - - - - - -     1.72
1 intercept                    0.01354     0.0   0.032   0.01    0.000       1.00
2 dv2$                         0.99900   629.0  23.951   1.01    0.474       1.74
3 dgout2$                      0.00035     6.0   1.161  -0.02    0.303     -95.22
```

Plant and Machinery

SEE = 91.22	RSQ = 0.4973	RHO = 0.24	Obser = 13 from 1975.000			
SEE+1 = 91.94	RBSQ = 0.1382	DW = 1.51	DoFree = 7 to 1987.000			
MAPE = 16.47						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp2$						460.11
1 intercept	138.58394	35.3	2.413	0.30	0.000	1.00
2 dp2$	0.99562	262.1	9.209	0.86	0.424	396.35
3 dgout2$	0.06662	31.1	2.242	-0.03	0.700	-213.36
4 dgout2$[1]	0.06249	22.4	1.867	-0.01	0.691	-92.35
5 dgout2$[2]	0.09235	38.8	2.548	-0.03	1.051	-165.48
6 dgout2$[3]	0.11227	48.2	2.895	-0.08	1.021	-336.87

Buildings

SEE = 60.40	RSQ = 0.5707	RHO = 0.63	Obser = 13 from 1975.000			
SEE+1 = 49.18	RBSQ = 0.1413	DW = 0.73	DoFree = 6 to 1987.000			
MAPE = 27.88						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb2$						226.82
1 intercept	9.40637	0.1	0.082	0.04	0.000	1.00
2 db2$	1.65852	32.8	2.263	1.17	0.327	160.04
3 dgout2$	0.03736	20.2	1.729	-0.04	0.548	-213.36
4 dgout2$[1]	0.04896	24.9	1.938	-0.02	0.756	-92.35
5 dgout2$[2]	0.04598	19.1	1.678	-0.03	0.730	-165.48
6 dgout2$[3]	0.05186	18.8	1.660	-0.08	0.658	-336.87
7 dgout2$[4]	0.04841	17.5	1.597	-0.05	0.461	-215.72

Despite their poor fits and relatively high errors, all of the coal industry investment equations produced reasonable parameters. However, I have concerns about using accelerator equations for this and the other extractive industries, because as a rule, the causal relation between output and investment is reversed: for these industries, one would expect that increased investment yields higher (or at least stable) output, not vice versa. It would be preferable to use investment equations that respond to changes in output prices, but the available data will not yet support their development.

3. Oil and Natural Gas Extraction

Vehicles

SEE = 37.25	RSQ = 0.2094	RHO = -0.04	Obser = 13 from 1975.000			
SEE+1 = 37.13	RBSQ = 0.0513	DW = 2.08	DoFree = 10 to 1987.000			
MAPE = 107.57						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv3$						20.50
1 intercept	-8.72920	0.9	-0.427	-0.43	-0.000	1.00
2 dv3$	0.68485	2.0	0.637	0.28	0.074	8.53
3 dgout3$[1]	0.01341	13.9	1.728	1.14	0.487	1744.21

Plant and Machinery

SEE = 228.52	RSQ = 0.1999	RHO = 0.25	Obser = 13 from 1975.000			
SEE+1 = 226.97	RBSQ = -0.3716	DW = 1.50	DoFree = 7 to 1987.000			
MAPE = 16.51						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp3$						1237.50
1 intercept	555.13713	28.3	2.460	0.45	0.000	1.00
2 dp3$	0.58034	33.3	2.696	0.35	0.714	747.08
3 dgout3$	0.14965	24.3	2.259	0.20	0.930	1692.31
4 dgout3$[1]	0.02063	0.6	0.322	0.03	0.123	1744.21
5 dgout3$[2]	-0.02090	0.7	-0.357	-0.03	-0.123	1753.07
6 dgout3$[3]	-0.00220	0.0	-0.034	-0.00	-0.013	1731.62

Buildings

SEE =	364.06	RSQ = 0.2473	RHO = 0.27	Obser =	13 from 1975.000		
SEE+1 =	351.62	RBSQ = -0.0036	DW = 1.45	DoFree =	9 to 1987.000		
MAPE =	13.82						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb3$	- - - - -	- - - -	- - - -	- - -	- - -	1852.23
1 intercept	979.43766	24.0	2.306	0.53	0.000	1.00
2 db3$	0.63698	14.7	1.769	0.34	0.496	998.47
3 dgout3$	0.12899	12.9	1.650	0.12	0.488	1692.31
4 rtb$	-62.45417	27.2	-2.472	0.01	-0.952	-0.30

The same argument applies to the oil extraction industry as to coal above. The fact that lagged output variables have little significance probably reflects the fact that output results from increased investment rather than vice versa. Since oil production is set exogenously in BRIM for the time being, it may be appropriate to have a single current change in output variable, so that, although the causal relation is reversed, changes in investment are associated with changes in output. While this was one of the few sectors in which real industries in which a strong real interest rate effect appeared, the effect may be spurious.

4. Mineral Oil Processing

Vehicles

SEE =	1.46	RSQ = 0.1624	RHO = 0.45	Obser =	14 from 1974.000		
SEE+1 =	1.34	RBSQ = -0.0889	DW = 1.09	DoFree =	10 to 1987.000		
MAPE =	24.70						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv4$	- - - - -	- - - -	- - - -	- - -	- - -	5.69
1 intercept	0.34957	2.7	0.744	0.06	0.000	1.00
2 dv4$	0.99989	2063.1	68.330	0.94	0.084	5.34
3 dgout4$[1]	-0.00016	7.4	-1.240	0.00	-0.359	-77.21
4 dgout4$[2]	-0.00017	8.2	-1.304	-0.00	-0.378	108.17

Plant and Machinery

SEE =	107.75	RSQ = -0.0394	RHO = 0.70	Obser =	13 from 1975.000		
SEE+1 =	80.19	RBSQ = -0.1339	DW = 0.59	DoFree =	11 to 1987.000		
MAPE =	33.12						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp4$	- - - - -	- - - -	- - - -	- - -	- - -	281.19
1 intercept	-13.53623	0.3	-0.251	-0.05	-0.000	1.00
2 dp4$	0.99407	129.5	6.852	1.05	0.115	296.48

Buildings

SEE =	6.43	RSQ = 0.7869	RHO = 0.18	Obser =	13 from 1975.000		
SEE+1 =	6.35	RBSQ = 0.5738	DW = 1.65	DoFree =	6 to 1987.000		
MAPE =	38.43						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb4$	- - - - -	- - - -	- - - -	- - -	- - -	19.69
1 intercept	-4.18004	2.7	-0.568	-0.21	-0.000	1.00
2 db4$	0.98207	82.6	3.745	1.30	0.064	26.03
3 dgout4$	0.00189	23.5	1.777	-0.05	0.410	-571.01
4 dgout4$[1]	0.00377	109.7	4.518	-0.07	0.985	-343.32
5 dgout4$[2]	0.00193	45.2	2.579	0.01	0.513	115.48
6 dgout4$[3]	0.00098	13.8	1.333	0.02	0.254	343.10
7 dgout4$[4]	0.00046	2.9	0.599	0.01	0.118	258.78

Except for buildings, the Oil processing industry equations were a failure. The industry suffered a continuous decline in output during the period of estimation, even though British oil production boomed. Since investment in vehicles, plant and machinery continued apace, they were negatively correlated with output. However, since output remains relatively low, replacement investment may prove adequate over the next decade.

5. Electricity

Vehicles

SEE = 10.06	RSQ = 0.2025	RHO = 0.63	Obser = 14 from 1974.000
SEE+1 = 8.02	RBSQ = -0.1519	DW = 0.75	DoFree = 9 to 1987.000
MAPE = 54.81			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv5$	- -					27.40
1 intercept	2.25619	1.3	0.501	0.08	0.000	1.00
2 dv5$	0.99044	218.8	9.358	0.84	0.166	23.31
3 dgout5$	0.01278	10.0	1.418	0.04	0.416	85.82
4 dgout5$[1]	0.00164	0.3	0.224	0.01	0.058	119.84
5 dgout5$[2]	0.00568	3.2	0.788	0.03	0.201	134.46

Plant and Machinery

SEE = 147.04	RSQ = 0.0819	RHO = 0.74	Obser = 13 from 1975.000
SEE+1 = 103.42	RBSQ = -0.1017	DW = 0.53	DoFree = 10 to 1987.000
MAPE = 8.99			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp5$	- -					1467.12
1 intercept	-222.11511	3.9	-0.887	-0.15	-0.000	1.00
2 dp5$	1.00212	137.8	6.824	1.14	0.107	1673.32
3 dgout5$	0.09313	2.3	0.675	0.01	0.205	132.79

Buildings

SEE = 53.87	RSQ = 0.2380	RHO = 0.62	Obser = 13 from 1975.000
SEE+1 = 43.39	RBSQ = 0.1688	DW = 0.76	DoFree = 11 to 1987.000
MAPE = 10.27			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb5$	- -					412.04
1 intercept	-31.39534	0.2	-0.189	-0.08	-0.000	1.00
2 db5$	1.11855	28.4	2.678	1.08	0.410	396.44

Investment in the Electricity seems to follow a random walk with respect to output, and approximated replacement investment over the period of estimation. The same seems to hold in the Gas industry, except for buildings.

6. Public Gas Supply

Vehicles

SEE = 6.85	RSQ = 0.1268	RHO = 0.51	Obser = 14 from 1974.000
SEE+1 = 5.96	RBSQ = -0.1351	DW = 0.99	DoFree = 10 to 1987.000
MAPE = 34.98			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv6$	- -					19.55
1 intercept	1.15628	0.2	0.220	0.06	0.000	1.00
2 dv6$	1.02689	80.8	4.767	0.85	0.189	16.12
3 dgout6$[1]	0.00433	1.0	0.444	0.05	0.132	233.44
4 dgout6$[2]	0.00279	0.7	0.366	0.04	0.109	296.37

Plant and Machinery

SEE = 65.14	RSQ = -0.5482	RHO = 0.51	Obser = 13 from 1975.000
SEE+1 = 58.27	RBSQ = -0.6890	DW = 0.99	DoFree = 11 to 1987.000
MAPE = 27.39			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp6$	- -					206.51
1 intercept	20.25280	3.5	0.887	0.10	0.000	1.00
2 dp6$	0.98516	390.8	15.978	0.90	0.720	189.06

Buildings

SEE = 33.64	RSQ = 0.7241	RHO = 0.06	Obser = 13	from 1975.000
SEE+1 = 33.70	RBSQ = 0.5270	DW = 1.88	DoFree = 7	to 1987.000
MAPE = 7.87				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb6$	- -					409.94
1 intercept	37.64438	0.7	0.321	0.09	0.000	1.00
2 db6$	1.01324	39.1	2.557	0.69	0.160	279.48
3 dgout6$[1]	0.17952	45.7	2.803	0.10	0.644	224.41
4 dgout6$[2]	0.09353	14.7	1.489	0.06	0.334	244.93
5 dgout6$[3]	0.05170	6.8	0.995	0.04	0.237	281.38
6 dgout6$[4]	0.03611	3.5	0.710	0.03	0.175	315.15

7. Water Supply

Vehicles

SEE = 3.00	RSQ = 0.7373	RHO = 0.26	Obser = 14	from 1974.000
SEE+1 = 3.09	RBSQ = 0.6585	DW = 1.48	DoFree = 10	to 1987.000
MAPE = 17.09				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv7$	- -					11.51
1 intercept	6.04938	121.1	6.251	0.53	0.000	1.00
2 dv7$	1.00628	969.0	33.729	0.46	0.636	5.31
3 dgout7$[1]	0.00413	0.9	0.431	0.00	0.078	5.00
4 dgout7$[2]	0.00797	3.6	0.858	0.01	0.156	11.62

Plant and Machinery

SEE = 5.09	RSQ = 0.1145	RHO = 0.40	Obser = 13	from 1975.000
SEE+1 = 4.92	RBSQ = -0.3283	DW = 1.21	DoFree = 8	to 1987.000
MAPE = 13.18				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp7$	- -					29.44
1 intercept	-8.31959	43.1	-2.896	-0.28	-0.000	1.00
2 dp7$	1.00099	529.5	17.578	1.29	0.138	37.92
3 dgout7$	0.00779	0.7	0.324	-0.01	0.111	-24.37
4 dgout7$[1]	0.00396	0.3	0.209	-0.00	0.078	-6.36
5 dgout7$[2]	0.00301	0.2	0.174	0.00	0.064	3.46

Buildings

SEE = 33.91	RSQ = 0.4029	RHO = 0.38	Obser = 13	from 1975.000
SEE+1 = 34.19	RBSQ = 0.1044	DW = 1.24	DoFree = 8	to 1987.000
MAPE = 6.81				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb7$	- -					358.26
1 intercept	73.40831	3.6	0.776	0.20	0.000	1.00
2 db7$	1.13633	46.6	3.056	0.79	0.225	248.88
3 dgout7$[4]	0.16610	12.4	1.466	0.01	0.455	25.58
4 dgout7$[5]	-0.02060	1.4	-0.478	-0.01	-0.176	134.81
5 dgout7$[6]	0.01446	1.3	0.468	0.00	0.162	39.59

Both mineral extraction industries yielded investment equations that had very poor fits, because investment levels were both very low and very volatile; and the argument applied to the coal industry above applies to these industries also. However, for all the equations the parameters imply reasonable investment behavior

8. Metal Ores and Minerals N.E.S.

Vehicles

SEE = 1.19	RSQ = -0.2290	RHO = 0.40	Obser = 14	from 1974.000
SEE+1 = 1.12	RBSQ = -0.4524	DW = 1.20	DoFree = 11	to 1987.000
MAPE = 40.03				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv8$	- -					3.29
1 intercept	1.72228	16.9	2.070	0.52	0.000	1.00
2 dv8$	0.70214	18.0	2.140	0.48	0.298	2.27
3 dgout8$	0.00558	0.9	0.449	-0.01	0.151	-3.73

Plant and Machinery

SEE = 5.33	RSQ = 0.6467	RHO = 0.11	Obser = 13 from 1975.000				
SEE+1 = 5.31	RBSQ = 0.3943	DW = 1.79	DoFree = 7 to 1987.000				
MAPE = 26.95							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp8$	- - -	- - -	- - -	- - -	- - -	20.01
1 intercept	1.24502	0.2	0.161	0.06	0.000	1.00
2 dp8$	0.97681	42.3	2.687	1.00	0.101	20.38
3 dgout8$	0.10756	9.5	1.183	-0.05	0.264	-9.22
4 dgout8$[1]	0.14079	37.5	2.504	-0.02	0.471	-3.04
5 dgout8$[2]	0.14821	55.4	3.153	0.02	0.520	2.08
6 dgout8$[3]	0.11689	29.9	2.199	-0.00	0.428	-0.34

Buildings

SEE = 1.76	RSQ = 0.5970	RHO = -0.35	Obser = 13 from 1975.000
SEE+1 = 1.56	RBSQ = 0.1941	DW = 2.70	DoFree = 6 to 1987.000
MAPE = 86.03			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb8$	- - -	- - -	- - -	- - -	- - -	3.50
1 intercept	-1.09740	1.9	-0.477	-0.31	-0.000	1.00
2 db8$	0.98983	39.5	2.390	1.47	0.039	5.20
3 dgout8$	0.05000	17.9	1.537	-0.13	0.397	-9.22
4 dgout8$[1]	0.03180	19.9	1.626	-0.03	0.344	-3.04
5 dgout8$[2]	0.03137	25.7	1.873	0.02	0.356	2.08
6 dgout8$[3]	0.03184	26.7	1.912	-0.00	0.377	-0.34
7 dgout8$[4]	0.02702	17.0	1.492	-0.02	0.321	-1.97

9. Non-Metallic Minerals

Vehicles

SEE = 4.95	RSQ = 0.4360	RHO = 0.33	Obser = 14 from 1974.000
SEE+1 = 4.67	RBSQ = 0.1853	DW = 1.34	DoFree = 9 to 1987.000
MAPE = 59.33			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv9$	- - -	- - -	- - -	- - -	- - -	8.17
1 intercept	1.77802	0.4	0.262	0.22	0.000	1.00
2 dv9$	1.01389	11.5	1.488	1.11	0.178	8.91
3 dgout9$	0.02761	9.1	1.314	-0.13	0.330	-38.50
4 dgout9$[1]	0.03502	16.7	1.810	-0.14	0.445	-33.01
5 dgout9$[2]	0.01149	1.9	0.595	-0.05	0.147	-36.88

Plant and Machinery

SEE = 7.29	RSQ = 0.6807	RHO = 0.28	Obser = 13 from 1975.000
SEE+1 = 7.24	RBSQ = 0.4527	DW = 1.44	DoFree = 7 to 1987.000
MAPE = 24.47			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp9$	- - -	- - -	- - -	- - -	- - -	33.89
1 intercept	10.66254	3.9	0.751	0.31	0.000	1.00
2 dp9$	0.97894	39.8	2.585	1.08	0.177	37.49
3 dgout9$	0.07559	27.2	2.081	-0.10	0.461	-44.38
4 dgout9$[1]	0.08525	45.7	2.805	-0.10	0.535	-41.40
5 dgout9$[2]	0.09949	77.4	3.878	-0.10	0.669	-34.28
6 dgout9$[3]	0.08381	46.9	2.849	-0.09	0.566	-37.87

Buildings

SEE = 1.50	RSQ = 0.2688	RHO = 0.34	Obser = 13 from 1975.000
SEE+1 = 1.43	RBSQ = -0.4625	DW = 1.32	DoFree = 6 to 1987.000
MAPE = 66.78			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb9$	- - -	- - -	- - -	- - -	- - -	3.33
1 intercept	-0.42738	1.5	-0.424	-0.13	-0.000	1.00
2 db9$	0.99929	573.2	16.307	1.50	0.066	5.00
3 dgout9$	0.00984	12.8	1.280	-0.13	0.441	-44.38
4 dgout9$[1]	0.00798	13.8	1.333	-0.10	0.368	-41.40
5 dgout9$[2]	0.00630	11.0	1.180	-0.06	0.311	-34.28
6 dgout9$[3]	0.00456	6.0	0.861	-0.05	0.227	-37.87
7 dgout9$[4]	0.00253	1.8	0.471	-0.02	0.122	-31.48

10. Iron and Steel and Steel Products

Vehicles

SEE = 2.92	RSQ = 0.5489	RHO = 0.58	Obser = 14 from 1974.000			
SEE+1 = 2.43	RBSQ = 0.3484	DW = 0.84	DoFree = 9 to 1987.000			
MAPE = 24.56						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv10$						10.32
1 intercept	-1.77224	6.6	-1.109	-0.17	-0.000	1.00
2 dv10$	1.02649	270.3	10.741	1.21	0.580	12.21
3 dgout10$	0.00075	1.6	0.536	-0.02	0.127	-285.61
4 dgout10$[1]	0.00087	2.2	0.634	-0.02	0.150	-272.87
5 dgout10$[2]	-0.00005	0.0	-0.039	0.00	-0.009	-194.57

Plant and Machinery

SEE = 343.47	RSQ = -0.0751	RHO = 0.91	Obser = 13 from 1975.000			
SEE+1 = 212.96	RBSQ = -0.1728	DW = 0.18	DoFree = 11 to 1987.000			
MAPE = 74.12						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp10$						489.61
1 intercept	-68.46770	0.2	-0.226	-0.14	-0.000	1.00
2 dp10$	0.90144	16.1	1.962	1.14	0.077	619.09

Buildings

SEE = 32.33	RSQ = 0.7002	RHO = 0.38	Obser = 13 from 1975.000			
SEE+1 = 29.86	RBSQ = 0.6402	DW = 1.23	DoFree = 10 to 1987.000			
MAPE = 90.04						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb10$						53.69
1 intercept	-45.40813	8.8	-1.359	-0.85	-0.000	1.00
2 db10$	0.98179	38.8	3.043	1.80	0.034	98.63
3 rtb$	-7.64937	81.3	-4.784	0.04	-0.829	-0.30

In the Iron and steel industry, long an object of both foreign competition and public intervention, investment is unrelated to output, and net investment has been negative for some time as the industry continues to downsize.

11. Other Metals

Vehicles

SEE = 0.94	RSQ = 0.8049	RHO = -0.08	Obser = 14 from 1974.000			
SEE+1 = 0.93	RBSQ = 0.7182	DW = 2.16	DoFree = 9 to 1987.000			
MAPE = 16.61						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv11$						5.26
1 intercept	-1.35818	14.0	-1.660	-0.26	-0.000	1.00
2 dv11$	1.05702	200.5	8.585	1.24	0.614	6.15
3 dgout11$	0.00348	47.2	3.271	0.01	0.493	19.56
4 dgout11$[1]	0.00158	10.8	1.443	0.00	0.221	9.22
5 dgout11$[2]	0.00163	11.9	1.523	0.01	0.229	21.59

Plant and Machinery

SEE = 22.11	RSQ = 0.2983	RHO = 0.16	Obser = 13 from 1975.000			
SEE+1 = 22.09	RBSQ = -0.2030	DW = 1.69	DoFree = 7 to 1987.000			
MAPE = 21.36						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp11$						96.40
1 intercept	-23.38356	2.1	-0.540	-0.24	-0.000	1.00
2 dp11$	1.03166	45.1	2.784	1.23	0.205	114.76
3 dgout11$	0.00116	0.0	0.026	-0.00	0.010	-40.78
4 dgout11$[1]	0.02349	4.1	0.769	0.00	0.274	6.04
5 dgout11$[2]	0.03551	9.6	1.186	0.00	0.415	11.95
6 dgout11$[3]	0.04291	15.0	1.506	0.01	0.504	20.26

```
                              Buildings
SEE    =        4.56 RSQ    = 0.3283 RHO =    0.47 Obser   =    13 from 1975.000
SEE+1  =        4.25 RBSQ   = -0.1515 DW  =    1.06 DoFree =     7 to   1987.000
MAPE   =       53.78
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 vb11$                   - - - - - - - - - - - - - - - - - - - - -    12.09
1 intercept                -5.71312    17.8  -1.657  -0.47  -0.000      1.00
2 db11$                     1.01207   142.7   5.881   1.45   0.066     17.31
3 dgout11$[1]               0.00707    10.2   1.233   0.00   0.392      6.04
4 dgout11$[2]               0.00436     4.1   0.771   0.00   0.242     11.95
5 dgout11$[3]               0.00602     8.6   1.125   0.01   0.336     20.26
6 dgout11$[4]               0.00300     2.1   0.548   0.01   0.168     24.79
```

As with the Iron and steel industry, the Other metals industry has had negative net investment for some time, as reflected in the negative intercepts in these equations. Despite their poor fits, however, the equations have reasonable parameters.

12. Non-Metallic Mineral Products

```
                              Vehicles
SEE    =       12.23 RSQ    = 0.5070 RHO =    0.53 Obser   =    14 from 1974.000
SEE+1  =       10.40 RBSQ   = 0.2879 DW  =    0.95 DoFree =     9 to   1987.000
MAPE   =       16.24
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 vv12$                   - - - - - - - - - - - - - - - - - - - - -    59.37
1 intercept                -5.34145     0.4  -0.261  -0.09  -0.000      1.00
2 dv12$                     1.20511    49.3   3.398   1.18   0.522     58.08
3 dgout12$                  0.01044     3.9   0.869  -0.02   0.235   -125.82
4 dgout12$[1]               0.02302    17.4   1.884  -0.06   0.471   -155.96
5 dgout12$[2]               0.00336     0.6   0.334  -0.01   0.082   -112.36

                         Plant and Machinery
SEE    =       32.49 RSQ    = 0.6811 RHO =   -0.25 Obser   =    13 from 1975.000
SEE+1  =       30.32 RBSQ   = 0.5216 DW  =    2.51 DoFree =     8 to   1987.000
MAPE   =        6.84
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 vp12$                   - - - - - - - - - - - - - - - - - - - - -   398.00
1 intercept              119.08598     8.3   1.174   0.30   0.000      1.00
2 dp12$                     0.95459    46.9   3.045   0.77   0.330    319.54
3 dgout12$[1]               0.06492    19.5   1.854  -0.03   0.411   -173.85
4 dgout12$[2]               0.07792    25.6   2.154  -0.04   0.486   -180.05
5 dgout12$[3]               0.00682     0.3   0.229  -0.00   0.052   -116.96

                              Buildings
SEE    =        7.61 RSQ    = 0.6195 RHO =    0.51 Obser   =    13 from 1975.000
SEE+1  =        6.86 RBSQ   = 0.2391 DW  =    0.98 DoFree =     6 to   1987.000
MAPE   =       13.16
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 vb12$                   - - - - - - - - - - - - - - - - - - - - -    49.49
1 intercept                -6.49647     3.9  -0.703  -0.13  -0.000      1.00
2 db12$                     0.99563   204.3   7.171   1.19   0.111     59.06
3 dgout12$[1]               0.01346    12.7   1.297  -0.05   0.397   -173.85
4 dgout12$[2]               0.00716     5.5   0.842  -0.03   0.208   -180.05
5 dgout12$[3]              -0.00434     2.9  -0.603   0.01  -0.155   -116.96
6 dgout12$[4]               0.00136     0.2   0.165  -0.00   0.049   -113.19
7 rtb$                     -1.55001    53.1  -2.891   0.01  -0.804     -0.30
```

The Non-metallic mineral products industry equations produced good results, considering the poor state of the industry during the period of estimation. The same holds for the Basic chemicals, Pharmaceuticals and Soap and toiletries industry equations, shown below, are similar. Despite their very poor fits, they yield fairly small errors and sensible parameters.

13. Basic Chemicals

Vehicles

SEE = 8.00 RSQ = 0.2004 RHO = 0.58 Obser = 14 from 1974.000
SEE+1 = 6.82 RBSQ = -0.1549 DW = 0.84 DoFree = 9 to 1987.000
MAPE = 14.18

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv13$						43.85
1 intercept	3.72324	0.7	0.351	0.08	0.000	1.00
2 dv13$	1.02434	62.9	3.859	0.90	0.122	38.53
3 dgout13$	0.00178	3.4	0.787	0.00	0.252	68.66
4 dgout13$[1]	0.00256	6.9	1.132	0.01	0.376	115.91
5 dgout13$[2]	0.00098	1.1	0.445	0.01	0.138	241.39

Plant and Machinery

SEE = 193.45 RSQ = 0.0195 RHO = 0.67 Obser = 13 from 1975.000
SEE+1 = 144.27 RBSQ = -0.6809 DW = 0.65 DoFree = 7 to 1987.000
MAPE = 19.32

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp13$						871.32
1 intercept	153.74088	2.4	0.589	0.18	0.000	1.00
2 dp13$	0.88430	44.0	2.771	0.79	0.266	773.61
3 dgout13$	0.01549	0.3	0.203	-0.00	0.095	-71.63
4 dgout13$[1]	0.05045	3.1	0.673	-0.00	0.330	-11.54
5 dgout13$[2]	0.09076	14.4	1.486	0.02	0.605	223.12
6 dgout13$[3]	0.06488	8.5	1.122	0.02	0.433	230.05

Buildings

SEE = 19.76 RSQ = 0.2837 RHO = 0.68 Obser = 13 from 1975.000
SEE+1 = 14.98 RBSQ = -0.4325 DW = 0.64 DoFree = 6 to 1987.000
MAPE = 18.22

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb13$						82.19
1 intercept	-3.56083	0.2	-0.154	-0.04	-0.000	1.00
2 db13$	0.95303	82.7	3.755	0.98	0.157	84.13
3 dgout13$	0.00244	0.7	0.284	-0.00	0.126	-71.63
4 dgout13$[1]	0.00814	7.4	0.965	-0.00	0.445	-11.54
5 dgout13$[2]	0.01166	21.0	1.672	0.03	0.650	223.12
6 dgout13$[3]	0.00807	11.2	1.196	0.02	0.450	230.05
7 dgout13$[4]	0.00807	11.7	1.221	0.02	0.449	171.32

14. Pharmaceuticals

Vehicles

SEE = 3.59 RSQ = 0.2285 RHO = 0.71 Obser = 14 from 1974.000
SEE+1 = 2.64 RBSQ = 0.0883 DW = 0.58 DoFree = 11 to 1987.000
MAPE = 22.17

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv14$						14.80
1 intercept	4.87765	9.5	1.481	0.33	0.000	1.00
2 dv14$	0.94984	30.5	2.781	0.56	0.056	8.73
3 dgout14$	0.01734	18.8	2.129	0.11	0.564	93.89

Plant and Machinery

SEE = 45.92 RSQ = 0.3666 RHO = 0.73 Obser = 13 from 1975.000
SEE+1 = 33.26 RBSQ = -0.0859 DW = 0.54 DoFree = 7 to 1987.000
MAPE = 24.40

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp14$						184.55
1 intercept	49.37266	10.6	1.253	0.27	0.000	1.00
2 dp14$	1.05822	91.4	4.336	0.59	0.142	102.36
3 dgout14$	0.04910	0.9	0.359	0.03	0.112	104.69
4 dgout14$[1]	0.10843	7.0	1.013	0.05	0.233	77.57
5 dgout14$[2]	0.09803	8.7	1.132	0.05	0.232	92.54
6 dgout14$[3]	0.05113	1.4	0.450	0.02	0.122	82.93

Buildings

SEE = 14.66 RSQ = 0.3599 RHO = 0.65 Obser = 13 from 1975.000
SEE+1 = 11.54 RBSQ = -0.2802 DW = 0.69 DoFree = 6 to 1987.000
MAPE = 22.00

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb14$						64.91
1 intercept	14.40976	10.1	1.138	0.22	0.000	1.00
2 db14$	1.00042	1418.7	37.382	0.59	0.096	38.34
3 dgout14$	0.04063	5.1	0.796	0.07	0.293	104.69
4 dgout14$[1]	-0.00534	0.1	-0.103	-0.01	-0.036	77.57
5 dgout14$[2]	0.04347	8.4	1.032	0.06	0.325	92.54
6 dgout14$[3]	0.04072	7.9	1.002	0.05	0.307	82.93
7 dgout14$[4]	0.01464	0.7	0.298	0.01	0.105	61.78

15. Soap and Toilet Preparations

Vehicles

SEE = 0.93 RSQ = 0.4164 RHO = 0.01 Obser = 14 from 1974.000
SEE+1 = 0.93 RBSQ = 0.1571 DW = 1.98 DoFree = 9 to 1987.000
MAPE = 15.30

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv15$						5.11
1 intercept	-0.80208	3.8	-0.864	-0.16	-0.000	1.00
2 dv15$	0.98585	129.2	6.366	1.06	0.123	5.50
3 dgout15$	0.00639	23.5	2.238	0.05	0.560	41.52
4 dgout15$[1]	0.00227	4.3	0.912	0.02	0.199	42.55
5 dgout15$[2]	0.00348	10.0	1.413	0.03	0.309	37.67

Plant and Machinery

SEE = 13.64 RSQ = 0.3425 RHO = 0.78 Obser = 13 from 1975.000
SEE+1 = 9.86 RBSQ = -0.1272 DW = 0.43 DoFree = 7 to 1987.000
MAPE = 28.25

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp15$						52.46
1 intercept	18.21549	24.9	1.986	0.35	0.000	1.00
2 dp15$	1.05632	100.1	4.604	0.59	0.141	29.53
3 dgout15$	0.03889	4.7	0.828	0.03	0.256	40.15
4 dgout15$[1]	0.02330	2.7	0.623	0.02	0.153	39.51
5 dgout15$[2]	0.01132	1.0	0.384	0.01	0.075	41.97
6 dgout15$[3]	0.00348	0.1	0.087	0.00	0.022	28.68

Buildings

SEE = 3.42 RSQ = 0.4847 RHO = 0.23 Obser = 13 from 1975.000
SEE+1 = 3.49 RBSQ = 0.1166 DW = 1.55 DoFree = 7 to 1987.000
MAPE = 22.23

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb15$						11.70
1 intercept	-0.36773	0.0	-0.082	-0.03	-0.000	1.00
2 db15$	0.97432	35.1	2.412	0.87	0.097	10.39
3 dgout15$[1]	0.01584	11.4	1.303	0.05	0.368	39.51
4 dgout15$[2]	0.01563	13.2	1.407	0.06	0.365	41.97
5 dgout15$[3]	0.01767	17.9	1.659	0.04	0.398	28.68
6 dgout15$[4]	0.00842	3.4	0.699	0.01	0.181	18.51

Investment in both vehicles and plant and machinery in the Man-made fibers industry was negatively correlated with current output, so the variable was excluded from the equations. Note that output was declining through much of the period, so that the positive output parameters are reflecting declines in both investment and output; note also that capital consumption of both plant and machinery and buildings greatly exceeded net investment, and that the difference is accommodated by fairly large negative intercepts.

16. Man-Made Fibers

Vehicles

SEE =	0.39	RSQ = 0.5650	RHO = 0.56	Obser = 14 from 1974.000				
SEE+1 =	0.33	RBSQ = 0.4345	DW = 0.88	DoFree = 10 to 1987.000				
MAPE =	25.79							
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 vv16$							1.38	
1 intercept		0.31336	13.2	1.678	0.23	0.000	1.00	
2 dv16$		1.00893	179.1	8.241	0.83	0.054	1.13	
3 dgout16$[1]		0.00307	47.9	3.449	-0.05	0.728	-22.61	
4 dgout16$[2]		0.00039	0.9	0.435	-0.00	0.092	-16.01	

Plant and machinery

SEE =	12.88	RSQ = 0.3964	RHO = 0.52	Obser = 13 from 1975.000			
SEE+1 =	11.16	RBSQ = 0.0945	DW = 0.95	DoFree = 8 to 1987.000			
MAPE =	27.68						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp16$							44.73
1 intercept		-19.95356	8.7	-1.218	-0.45	-0.000	1.00
2 dp16$		0.90627	88.4	4.575	1.60	0.327	78.74
3 dgout16$[1]		0.06378	11.6	1.420	-0.07	0.418	-48.02
4 dgout16$[2]		0.08733	34.3	2.570	-0.04	0.759	-20.56
5 dgout16$[3]		0.08348	33.7	2.542	-0.04	0.723	-21.75

Buildings

SEE =	0.90	RSQ = 0.8440	RHO = 0.10	Obser = 13 from 1975.000			
SEE+1 =	0.90	RBSQ = 0.6256	DW = 1.80	DoFree = 5 to 1987.000			
MAPE =	72.35						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb16$							2.50
1 intercept		-4.72937	107.4	-4.284	-1.89	-0.000	1.00
2 db16$		1.00321	247.9	7.856	3.05	0.152	7.58
3 dgout16$		0.00259	2.3	0.510	-0.04	0.126	-36.73
4 dgout16$[1]		0.00559	15.1	1.344	-0.11	0.266	-48.02
5 dgout16$[2]		0.00366	9.8	1.069	-0.03	0.231	-20.56
6 dgout16$[3]		0.00419	13.2	1.249	-0.04	0.263	-21.75
7 dgout16$[4]		-0.00225	4.0	-0.673	0.02	-0.141	-22.23
8 rtb$		-0.33225	71.6	-3.288	0.04	-0.929	-0.30

17. Other Metal Products, N.E.S.

Vehicles

SEE =	8.62	RSQ = 0.4565	RHO = 0.60	Obser = 14 from 1974.000			
SEE+1 =	7.14	RBSQ = 0.2150	DW = 0.80	DoFree = 9 to 1987.000			
MAPE =	14.43						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv17$							52.24
1 intercept		-3.05557	0.2	-0.174	-0.06	-0.000	1.00
2 dv17$		1.28398	47.2	3.327	1.13	0.321	45.82
3 dgout17$		0.00836	18.2	1.940	-0.03	0.498	-215.91
4 dgout17$[1]		0.00515	7.6	1.226	-0.02	0.313	-198.88
5 dgout17$[2]		0.00343	3.5	0.818	-0.01	0.207	-207.17

Plant and Machinery

SEE =	56.39	RSQ = 0.2015	RHO = 0.80	Obser = 13 from 1975.000			
SEE+1 =	34.23	RBSQ = -0.3688	DW = 0.40	DoFree = 7 to 1987.000			
MAPE =	15.20						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp17$							319.50
1 intercept		48.65330	3.2	0.677	0.15	0.000	1.00
2 dp17$		0.96380	98.7	4.553	0.94	0.203	311.23
3 dgout17$		0.00367	0.1	0.105	-0.00	0.038	-294.74
4 dgout17$[1]		0.04027	10.3	1.231	-0.03	0.453	-250.98
5 dgout17$[2]		0.04868	16.6	1.592	-0.03	0.565	-219.30
6 dgout17$[3]		0.03440	9.1	1.154	-0.02	0.400	-210.86

Buildings

SEE =	7.20	RSQ = 0.8239	RHO = 0.44	Obser =	13 from 1975.000		
SEE+1 =	6.73	RBSQ = 0.5774	DW = 1.11	DoFree =	5 to 1987.000		
MAPE =	19.76						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb17$	- -					38.57
1 intercept	-22.28480	9.1	-0.978	-0.58	-0.000	1.00
2 db17$	1.01861	73.1	3.164	1.83	0.033	69.34
3 dgout17$	0.01437	39.0	2.162	-0.11	0.552	-294.74
4 dgout17$[1]	0.00920	26.3	1.727	-0.06	0.381	-250.98
5 dgout17$[2]	0.01065	37.2	2.102	-0.06	0.454	-219.30
6 dgout17$[3]	0.00462	8.2	0.925	-0.03	0.197	-210.86
7 dgout17$[4]	0.00228	2.0	0.454	-0.02	0.096	-265.55
8 rtb$	-2.32157	75.7	-3.234	0.02	-0.865	-0.30

As with the previous equations, output in the Other metal products industry was declining through much of the period, so that the positive output parameters are reflecting declines in both investment and output; and capital consumption of buildings greatly exceeded net investment, and that the difference is accomodated by a large negative intercept. However, the mean errors are fairly low and the parameters reasonable.

The following set of industries, Industrial plant and steelwork (18), Agricultural machinery (19), Machine tools and engineers' tools (20), Textile, etc. machinery (21), and Other machinery (21), are the core mechanical engineering industries that bore the brunt of the pound's appreciation and the resulting loss of British relative price competitiveness. In each of these industries, output in the late 1980's was still considerably lower than it was before the first oil crisis. The surviving firms in these industries shed a great deal of capital and labor, invested heavily in the 1980's and emerged from the period in far better shape than they were in 1979. Capital consumption exceeded gross investment for several of the industries. From a forecasters' perspective, the surprising thing is that most of the equations yield reasonable parameters, even though the fits are quite poor and errors high.

18. Industrial Plant and Steelwork

Vehicles

SEE =	1.95	RSQ = 0.7151	RHO = 0.35	Obser =	14 from 1974.000		
SEE+1 =	1.85	RBSQ = 0.5884	DW = 1.30	DoFree =	9 to 1987.000		
MAPE =	12.12						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv18$	- -					13.90
1 intercept	2.99097	34.8	2.915	0.22	0.000	1.00
2 dv18$	1.00033	388.3	15.405	0.84	0.230	11.69
3 dgout18$	0.01430	50.9	3.641	-0.04	0.795	-39.26
4 dgout18$[1]	0.00762	23.0	2.310	-0.01	0.417	-9.77
5 dgout18$[2]	0.01095	34.3	2.892	-0.01	0.612	-13.66

Plant and machinery

SEE =	12.91	RSQ = 0.3763	RHO = 0.48	Obser =	13 from 1975.000		
SEE+1 =	11.34	RBSQ = -0.0691	DW = 1.03	DoFree =	7 to 1987.000		
MAPE =	13.62						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp18$	- -					71.06
1 intercept	31.82702	72.3	3.766	0.45	0.000	1.00
2 dp18$	1.01854	166.3	6.626	0.60	0.196	41.92
3 dgout18$	0.03237	7.0	1.023	-0.03	0.366	-66.45
4 dgout18$[1]	0.02799	5.8	0.926	-0.01	0.346	-22.87
5 dgout18$[2]	0.02764	6.0	0.945	0.00	0.339	4.82
6 dgout18$[3]	0.03858	13.6	1.445	-0.01	0.497	-20.89

Buildings

SEE =	4.25	RSQ	= 0.7032	RHO =	-0.33	Obser =	13 from	1975.000
SEE+1 =	3.93	RBSQ	= 0.4065	DW =	2.66	DoFree =	6 to	1987.000
MAPE =	30.83							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb18$						19.19
1 intercept	5.40578	12.3	1.254	0.28	0.000	1.00
2 db18$	1.00691	95.4	4.118	0.83	0.070	15.75
3 dgout18$	0.00552	1.8	0.463	-0.02	0.131	-66.45
4 dgout18$[1]	0.03376	52.8	2.833	-0.04	0.876	-22.87
5 dgout18$[2]	0.04155	53.5	2.856	0.01	1.070	4.82
6 dgout18$[3]	0.04337	79.4	3.653	-0.05	1.171	-20.89
7 dgout18$[4]	0.03164	45.8	2.603	-0.01	0.835	-7.25

19. Agricultural Machinery

Vehicles

SEE =	0.91	RSQ	= 0.4028	RHO =	0.17	Obser =	14 from	1974.000
SEE+1 =	0.90	RBSQ	= 0.2236	DW =	1.65	DoFree =	10 to	1987.000
MAPE =	24.38							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv19$						3.32
1 intercept	-0.49159	1.1	-0.463	-0.15	-0.000	1.00
2 dv19$	1.09353	58.0	3.888	1.21	0.245	3.67
3 dgout19$[1]	0.00011	0.0	0.046	-0.00	0.014	-63.19
4 dgout19$[2]	0.00404	14.6	1.782	-0.06	0.563	-46.99

Plant and machinery

SEE =	10.66	RSQ	= 0.6339	RHO =	0.49	Obser =	13 from	1975.000
SEE+1 =	10.36	RBSQ	= 0.4508	DW =	1.03	DoFree =	8 to	1987.000
MAPE =	26.56							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp19$						39.90
1 intercept	13.17973	4.5	0.873	0.33	0.000	1.00
2 dp19$	0.78965	24.9	2.157	0.80	0.136	40.39
3 dgout19$[1]	-0.01176	1.0	-0.401	0.02	-0.109	-73.67
4 dgout19$[2]	0.06245	17.7	1.788	-0.09	0.589	-57.40
5 dgout19$[3]	0.05095	17.2	1.760	-0.06	0.493	-48.10

Buildings

SEE =	3.44	RSQ	= 0.5612	RHO =	0.53	Obser =	13 from	1975.000
SEE+1 =	3.18	RBSQ	= 0.2478	DW =	0.95	DoFree =	7 to	1987.000
MAPE =	74.56							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb19$						6.40
1 intercept	-0.06837	0.0	-0.017	-0.01	-0.000	1.00
2 db19$	0.94416	32.1	2.303	1.38	0.059	9.35
3 dgout19$[1]	0.00878	3.1	0.668	-0.10	0.275	-73.67
4 dgout19$[2]	0.00206	0.2	0.171	-0.02	0.066	-57.40
5 dgout19$[3]	0.00549	2.3	0.581	-0.04	0.180	-48.10
6 dgout19$[4]	0.01878	18.8	1.711	-0.21	0.627	-70.42

20. Machine Tools and Engineers' Tools

Vehicles

SEE =	2.34	RSQ	= 0.4414	RHO =	0.56	Obser =	14 from	1974.000
SEE+1 =	1.96	RBSQ	= 0.1931	DW =	0.87	DoFree =	9 to	1987.000
MAPE =	20.36							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv20$						9.05
1 intercept	-0.23710	0.0	-0.075	-0.03	-0.000	1.00
2 dv20$	1.23014	46.0	3.257	1.10	0.229	8.10
3 dgout20$	0.00792	9.1	1.334	-0.06	0.335	-64.96
4 dgout20$[1]	0.00555	8.0	1.248	-0.02	0.325	-31.86
5 dgout20$[2]	-0.00014	0.0	-0.037	0.00	-0.010	-59.58

Plant and machinery

SEE = 16.44 RSQ = 0.2150 RHO = 0.85 Obser = 13 from 1975.000
SEE+1 = 8.99 RBSQ = -0.3457 DW = 0.29 DoFree = 7 to 1987.000
MAPE = 23.13

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp20$						59.40
1 intercept	13.84231	7.3	1.035	0.23	0.000	1.00
2 dp20$	0.96730	111.7	4.962	0.88	0.213	54.19
3 dgout20$	0.02218	1.6	0.476	-0.02	0.164	-63.87
4 dgout20$[1]	0.05911	16.9	1.611	-0.07	0.437	-67.19
5 dgout20$[2]	0.03330	8.7	1.133	-0.02	0.341	-28.02
6 dgout20$[3]	0.00712	0.4	0.230	-0.01	0.083	-75.00

Buildings

SEE = 5.27 RSQ = 0.1071 RHO = 0.54 Obser = 13 from 1975.000
SEE+1 = 4.51 RBSQ = -0.7859 DW = 0.92 DoFree = 6 to 1987.000
MAPE = 122.77

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb20$						5.75
1 intercept	-1.27535	0.3	-0.180	-0.22	-0.000	1.00
2 db20$	0.93332	14.7	1.379	1.48	0.052	9.09
3 dgout20$	0.00013	0.0	0.008	-0.00	0.003	-63.87
4 dgout20$[1]	0.01175	4.6	0.750	-0.14	0.290	-67.19
5 dgout20$[2]	0.00809	3.3	0.635	-0.04	0.276	-28.02
6 dgout20$[3]	0.00099	0.1	0.089	-0.01	0.038	-75.00
7 dgout20$[4]	0.00299	0.7	0.285	-0.06	0.123	-121.28

21. Textile, etc. Machinery

Vehicles

SEE = 5.21 RSQ = 0.3237 RHO = 0.52 Obser = 14 from 1974.000
SEE+1 = 4.48 RBSQ = 0.0231 DW = 0.96 DoFree = 9 to 1987.000
MAPE = 20.76

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv21$						22.80
1 intercept	-7.05113	1.6	-0.550	-0.31	-0.000	1.00
2 dv21$	1.53671	25.9	2.367	1.34	0.348	19.88
3 dgout21$	0.00448	3.7	0.854	-0.02	0.246	-103.84
4 dgout21$[1]	0.00231	1.3	0.500	-0.01	0.143	-72.48
5 dgout21$[2]	0.00109	0.3	0.243	-0.00	0.069	-55.70

Plant and machinery

SEE = 20.05 RSQ = -0.0248 RHO = 0.73 Obser = 13 from 1975.000
SEE+1 = 14.39 RBSQ = -0.7568 DW = 0.53 DoFree = 7 to 1987.000
MAPE = 13.75

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp21$						114.45
1 intercept	32.43467	12.2	1.361	0.28	0.000	1.00
2 dp21$	0.91438	75.8	3.875	0.76	0.332	95.60
3 dgout21$	0.01289	2.4	0.591	-0.01	0.235	-108.77
4 dgout21$[1]	0.00366	0.2	0.174	-0.00	0.065	-127.03
5 dgout21$[2]	0.01100	2.7	0.631	-0.01	0.225	-80.18
6 dgout21$[3]	0.03027	16.2	1.588	-0.02	0.608	-87.32

Buildings

SEE = 6.89 RSQ = 0.7378 RHO = 0.31 Obser = 13 from 1975.000
SEE+1 = 6.73 RBSQ = 0.4757 DW = 1.38 DoFree = 6 to 1987.000
MAPE = 35.73

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb21$						25.83
1 intercept	-1.75171	0.1	-0.091	-0.07	-0.000	1.00
2 db21$	0.99255	19.0	1.581	1.17	0.077	30.34
3 dgout21$[1]	0.00665	5.2	0.799	-0.03	0.173	-127.03
4 dgout21$[2]	0.00200	0.5	0.244	-0.01	0.060	-80.18
5 dgout21$[3]	0.00847	10.0	1.121	-0.03	0.250	-87.32
6 dgout21$[4]	0.01005	15.5	1.416	-0.05	0.297	-117.34
7 rtb$	-1.30107	31.1	-2.080	0.01	-0.618	-0.30

22. Other Machinery N.E.S.

Vehicles

SEE =	7.46	RSQ	= 0.5098	RHO =	0.40	Obser =	14 from 1974.000
SEE+1 =	6.83	RBSQ	= 0.2920	DW =	1.20	DoFree =	9 to 1987.000
MAPE =	11.63						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv22$						45.32
1 intercept	-23.24136	4.4	-0.937	-0.51	-0.000	1.00
2 dv22$	1.70091	34.7	2.824	1.55	0.475	41.29
3 dgout22$	0.01329	19.5	2.051	-0.03	0.588	-92.35
4 dgout22$[1]	0.00032	0.0	0.062	-0.00	0.016	-36.41
5 dgout22$[2]	0.00303	3.2	0.795	-0.01	0.201	-140.04

Plant and machinery

SEE =	22.91	RSQ	= 0.7092	RHO =	0.42	Obser =	13 from 1975.000
SEE+1 =	21.26	RBSQ	= 0.5014	DW =	1.17	DoFree =	7 to 1987.000
MAPE =	5.40						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp22$						309.91
1 intercept	98.62003	14.0	1.538	0.32	0.000	1.00
2 dp22$	0.89496	63.4	3.628	0.75	0.411	259.70
3 dgout22$	0.05607	34.9	2.543	-0.03	0.531	-166.81
4 dgout22$[1]	0.06342	52.4	3.230	-0.02	0.728	-102.52
5 dgout22$[2]	0.01297	3.8	0.784	-0.00	0.163	-5.88
6 dgout22$[3]	0.02875	28.5	2.264	-0.02	0.486	-181.00

Buildings

SEE =	7.54	RSQ	= 0.8733	RHO =	-0.08	Obser =	13 from 1975.000
SEE+1 =	7.42	RBSQ	= 0.6960	DW =	2.16	DoFree =	5 to 1987.000
MAPE =	15.40						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb22$						45.10
1 intercept	-2.50042	0.1	-0.122	-0.06	-0.000	1.00
2 db22$	0.95675	60.6	2.845	1.27	0.093	59.66
3 dgout22$	0.01492	25.7	1.726	-0.06	0.283	-166.81
4 dgout22$[1]	0.01458	25.9	1.733	-0.03	0.336	-102.52
5 dgout22$[2]	0.00745	9.7	1.023	-0.00	0.188	-5.88
6 dgout22$[3]	0.01319	58.0	2.771	-0.05	0.447	-181.00
7 dgout22$[4]	0.01560	60.7	2.848	-0.08	0.516	-227.18
8 rtb$	-1.61756	37.9	-2.150	0.01	-0.488	-0.30

The Ordnance industry equations must be judged a failure. Output essentially followed a random walk during the period, and investment apparently was unrelated to output. Since output has no obvious trend, I believe that equations with capital consumption and an intercept are the best that can be done for the time being.

23. Ordnance

Vehicles

SEE =	0.43	RSQ	= 0.1604	RHO =	0.49	Obser =	14 from 1974.000
SEE+1 =	0.38	RBSQ	= -0.2128	DW =	1.02	DoFree =	9 to 1987.000
MAPE =	34.41						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv23$						1.24
1 intercept	0.53934	53.6	3.496	0.43	0.000	1.00
2 dv23$	1.00065	645.7	22.171	0.55	0.105	0.68
3 dgout23$	0.00050	3.8	0.835	0.02	0.279	42.85
4 dgout23$[1]	-0.00000	0.0	-0.004	-0.00	-0.001	58.61
5 dgout23$[2]	0.00003	0.0	0.047	0.00	0.016	46.89

```
                               Plant and Machinery
SEE    =        11.26 RSQ    = 0.1458 RHO =    0.57 Obser  =    13 from 1975.000
SEE+1  =         9.99 RBSQ   = 0.0681 DW  =    0.86 DoFree =    11 to   1987.000
MAPE   =        31.78
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp23$                    - - - - - - - - - - - - - - - - - - - - -    36.95
1 intercept                 17.33527    65.0   4.353  0.47   0.000       1.00
2 dp23$                      1.00964   200.9   9.416  0.53   0.121      19.43

                                  Buildings
SEE    =         7.05 RSQ    = 0.0199 RHO =    0.41 Obser  =    13 from 1975.000
SEE+1  =         6.48 RBSQ   = -0.0692 DW  =    1.18 DoFree =    11 to   1987.000
MAPE   =        88.21
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vb23$                    - - - - - - - - - - - - - - - - - - - - -     9.97
1 intercept                  5.95254    13.5   1.782  0.60   0.000       1.00
2 db23$                      1.04710    10.5   1.560  0.40   0.019       3.84
```

The Office machinery and computers industry yields good results.

24. Office Machinery and Computers

```
                                  Vehicles
SEE    =         1.82 RSQ    = 0.0914 RHO =    0.54 Obser  =    14 from 1974.000
SEE+1  =         1.83 RBSQ   = -0.3125 DW  =    0.91 DoFree =     9 to   1987.000
MAPE   =        40.71
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vv24$                    - - - - - - - - - - - - - - - - - - - - -     4.34
1 intercept                  1.11303    10.9   1.443  0.26   0.000       1.00
2 dv24$                      0.99169   453.3  16.344  0.58   0.332       2.54
3 dgout24$                   0.00081     1.3   0.478  0.03   0.155     181.06
4 dgout24$[1]                0.00264    10.5   1.413  0.09   0.457     141.37
5 dgout24$[2]                0.00114     1.8   0.567  0.04   0.187     164.94

                               Plant and machinery
SEE    =         8.54 RSQ    = 0.9587 RHO =    0.48 Obser  =    13 from 1975.000
SEE+1  =         7.90 RBSQ   = 0.9292 DW  =    1.04 DoFree =     7 to   1987.000
MAPE   =        13.70
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp24$                    - - - - - - - - - - - - - - - - - - - - -    77.57
1 intercept                 17.29370    50.4   3.033  0.22   0.000       1.00
2 dp24$                      1.05887   194.6   7.481  0.46   0.212      33.49
3 dgout24$                   0.04889   128.7   5.552  0.12   0.439     195.30
4 dgout24$[1]                0.05832   162.3   6.546  0.10   0.476     136.99
5 dgout24$[2]                0.03384    70.2   3.719  0.08   0.260     172.38
6 dgout24$[3]                0.01352     8.0   1.103  0.02   0.078     106.79

                                  Buildings
SEE    =         7.23 RSQ    = 0.4752 RHO =   -0.11 Obser  =    13 from 1975.000
SEE+1  =         7.15 RBSQ   = 0.1004 DW  =    2.23 DoFree =     7 to   1987.000
MAPE   =        41.88
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vb24$                    - - - - - - - - - - - - - - - - - - - - -    15.64
1 intercept                  4.50270     5.5   0.894  0.29   0.000       1.00
2 db24$                      0.95066    16.1   1.566  0.40   0.085       6.58
3 dgout24$                   0.01073    13.9   1.447  0.13   0.405     195.30
4 dgout24$[1]                0.00859     8.9   1.145  0.08   0.295     136.99
5 dgout24$[2]                0.00541     3.5   0.710  0.06   0.175     172.38
6 dgout24$[3]                0.00634     2.6   0.613  0.04   0.153     106.79
```

The Basic electrical equipment industry was as greatly affected by the events of the 1970's as the mechanical engineering industries, and shows relatively poor equations that imply little responsiveness of investment to output. In contrast, the Electronics industry was relatively undisturbed, and the equations yield much better fits and results.

25. Basic Electrical Equipment

Vehicles

SEE =	4.24	RSQ	= 0.1055	RHO =	0.42	Obser =	14 from 1974.000
SEE+1 =	3.88	RBSQ	= -0.2920	DW =	1.17	DoFree =	9 to 1987.000
MAPE =	26.52						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv25$						13.98
1 intercept	0.55121	0.1	0.114	0.04	0.000	1.00
2 dv25$	1.05945	39.4	2.919	0.97	0.154	12.74
3 dgout25$	-0.00010	0.0	-0.016	0.00	-0.005	-90.19
4 dgout25$[1]	0.00172	0.8	0.381	-0.00	0.129	-17.65
5 dgout25$[2]	0.00085	0.3	0.214	-0.00	0.073	-62.99

Plant and machinery

SEE =	11.95	RSQ	= 0.6863	RHO =	0.41	Obser =	13 from 1975.000
SEE+1 =	10.99	RBSQ	= 0.5294	DW =	1.18	DoFree =	8 to 1987.000
MAPE =	6.62						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp25$						153.57
1 intercept	43.29946	49.8	3.167	0.28	0.000	1.00
2 dp25$	1.03323	217.7	8.561	0.72	0.785	107.13
3 dgout25$[1]	-0.00273	0.1	-0.142	0.00	-0.030	-86.92
4 dgout25$[2]	0.01354	6.4	1.030	-0.00	0.220	-12.05
5 dgout25$[3]	0.00674	2.1	0.583	-0.00	0.125	-72.37

Buildings

SEE =	4.99	RSQ	= 0.4807	RHO =	0.59	Obser =	13 from 1975.000
SEE+1 =	4.48	RBSQ	= -0.0386	DW =	0.82	DoFree =	6 to 1987.000
MAPE =	28.29						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb25$						16.63
1 intercept	-2.26173	1.5	-0.437	-0.14	-0.000	1.00
2 db25$	0.95893	115.4	4.727	1.29	0.146	22.42
3 dgout25$	0.00362	1.1	0.363	-0.02	0.122	-89.82
4 dgout25$[1]	0.00497	2.8	0.588	-0.03	0.167	-86.92
5 dgout25$[2]	0.01042	25.0	1.858	-0.01	0.522	-12.05
6 dgout25$[3]	0.00983	23.4	1.792	-0.04	0.560	-72.37
7 dgout25$[4]	0.00882	19.9	1.641	-0.06	0.510	-115.29

26. Electronic Equipment

Vehicles

SEE =	2.72	RSQ	= 0.3605	RHO =	0.26	Obser =	14 from 1974.000
SEE+1 =	2.63	RBSQ	= 0.0763	DW =	1.48	DoFree =	9 to 1987.000
MAPE =	11.93						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv26$						15.70
1 intercept	2.12596	1.7	0.553	0.14	0.000	1.00
2 dv26$	1.00207	54.8	3.553	0.84	0.198	13.15
3 dgout26$	0.00014	0.0	0.065	0.00	0.018	256.21
4 dgout26$[1]	0.00371	15.6	1.741	0.06	0.491	253.61
5 dgout26$[2]	-0.00214	5.1	-0.974	-0.04	-0.272	273.83

Plant and machinery

SEE =	24.97	RSQ	= 0.9367	RHO =	0.41	Obser =	13 from 1975.000
SEE+1 =	23.84	RBSQ	= 0.8915	DW =	1.17	DoFree =	7 to 1987.000
MAPE =	8.01						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp26$						299.36
1 intercept	53.16982	11.9	1.342	0.18	0.000	1.00
2 dp26$	1.05001	68.9	3.632	0.53	0.241	150.85
3 dgout26$	0.09919	76.4	3.878	0.11	0.407	318.54
4 dgout26$[1]	0.07255	61.3	3.378	0.06	0.338	233.98
5 dgout26$[2]	0.08215	73.5	3.781	0.08	0.367	293.75
6 dgout26$[3]	0.05329	34.0	2.381	0.05	0.240	283.44

Buildings

```
SEE    =        5.23 RSQ   = 0.9060 RHO =  -0.26 Obser  =   13 from 1975.000
SEE+1  =        4.90 RBSQ  = 0.8388 DW  =   2.52 DoFree =    7 to   1987.000
MAPE   =       11.59
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb26$	- -					45.19
1 intercept	1.68371	0.1	0.127	0.04	0.000	1.00
2 db26$	0.98416	30.9	2.243	0.67	0.084	30.94
3 dgout26$[1]	0.01324	47.5	2.876	0.07	0.359	233.98
4 dgout26$[2]	0.02539	123.0	5.289	0.17	0.660	293.75
5 dgout26$[3]	0.00836	19.0	1.712	0.05	0.220	283.44
6 dgout26$[4]	0.00064	0.1	0.101	0.00	0.013	202.52

Both output and investment in the Domestic electrical appliances industry were subject to quite wide swings during the period of estimation, but investment apparently did not move in response to the changes in output. These equations therefore yield poor fits and small output parameters. The Electrical lighting industry equations, shown on the next page, are even worse.

27. Domestic Electrical Appliances

Vehicles

```
SEE    =        1.30 RSQ   = 0.1369 RHO =   0.16 Obser  =   14 from 1974.000
SEE+1  =        1.29 RBSQ  = -0.2468 DW  =   1.68 DoFree =    9 to   1987.000
MAPE   =       23.13
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv27$	- -					5.25
1 intercept	1.01760	4.4	0.903	0.19	0.000	1.00
2 dv27$	0.98036	65.1	3.942	0.77	0.148	4.12
3 dgout27$	0.00395	2.1	0.612	0.01	0.194	8.40
4 dgout27$[1]	0.00541	6.0	1.054	0.02	0.316	18.27
5 dgout27$[2]	0.00519	5.2	0.979	0.01	0.286	10.97

Plant and machinery

```
SEE    =        3.86 RSQ   = 0.4639 RHO =   0.21 Obser  =   13 from 1975.000
SEE+1  =        3.79 RBSQ  = 0.0810 DW  =   1.58 DoFree =    7 to   1987.000
MAPE   =       10.43
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp27$	- -					31.57
1 intercept	9.16572	40.8	2.633	0.29	0.000	1.00
2 dp27$	0.97510	179.6	6.935	0.70	0.635	22.69
3 dgout27$	0.00575	0.5	0.273	0.00	0.077	10.69
4 dgout27$[1]	0.01133	3.2	0.679	0.00	0.151	5.67
5 dgout27$[2]	0.01026	4.9	0.838	0.00	0.155	10.69
6 dgout27$[3]	0.00374	0.4	0.238	0.00	0.057	10.92

Buildings

```
SEE    =        1.23 RSQ   = 0.5727 RHO =   0.14 Obser  =   13 from 1975.000
SEE+1  =        1.23 RBSQ  = 0.1454 DW  =   1.72 DoFree =    6 to   1987.000
MAPE   =       44.92
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb27$	- -					3.29
1 intercept	-2.73557	44.3	-2.549	-0.83	-0.000	1.00
2 db27$	0.99858	176.0	6.302	1.81	0.149	5.95
3 dgout27$[1]	0.00423	2.6	0.566	0.01	0.158	5.67
4 dgout27$[2]	0.00088	0.2	0.163	0.00	0.037	10.69
5 dgout27$[3]	-0.00108	0.5	-0.257	-0.00	-0.046	10.92
6 dgout27$[4]	-0.00170	0.8	-0.314	-0.01	-0.072	11.49
7 rtb$	-0.26849	61.2	-3.099	0.02	-0.914	-0.30

28. Electrical Lighting Equipment

Vehicles

SEE = 0.40	RSQ = 0.1157	RHO = 0.14	Obser = 14 from 1974.000
SEE+1 = 0.40	RBSQ = -0.0451	DW = 1.71	DoFree = 11 to 1987.000
MAPE = 19.82			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv28$	- - -	- - -	- - -	- - -	- - -	1.99
1 intercept	0.84467	70.4	4.578	0.42	0.000	1.00
2 dv28$	1.00438	170.7	8.343	0.55	0.131	1.09
3 dgout28$	0.00291	5.9	1.155	0.03	0.328	17.64

Plant and machinery

SEE = 2.68	RSQ = 0.5158	RHO = 0.38	Obser = 13 from 1975.000
SEE+1 = 2.71	RBSQ = 0.2736	DW = 1.25	DoFree = 8 to 1987.000
MAPE = 12.11			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp28$	- - -	- - -	- - -	- - -	- - -	15.12
1 intercept	5.02513	64.6	3.701	0.33	0.000	1.00
2 dp28$	1.01145	292.2	10.737	0.63	0.371	9.34
3 dgout28$	0.02224	4.6	0.873	0.01	0.222	9.24
4 dgout28$[1]	0.02164	6.1	1.002	0.02	0.273	14.99
5 dgout28$[2]	0.00623	0.6	0.311	0.01	0.082	17.54

Buildings

SEE = 0.84	RSQ = 0.1116	RHO = 0.06	Obser = 13 from 1975.000
SEE+1 = 0.84	RBSQ = -0.0660	DW = 1.88	DoFree = 10 to 1987.000
MAPE = 68.31			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb28$	- - -	- - -	- - -	- - -	- - -	1.72
1 intercept	-0.22735	2.1	-0.648	-0.13	-0.000	1.00
2 db28$	0.99638	184.1	8.411	1.12	0.102	1.94
3 rtb$	-0.06681	12.2	-1.612	0.01	-0.481	-0.30

The Motor vehicles industry was seriously hurt in the late 1970's and has never fully recovered. Part of the industry has been government-run for some time, and so investment has responded more to political considerations than changes in demand and output. The equations reflect this fact: the change in output parameters were mostly negative, and on average, gross investment is simply replacement investment plus a constant captured by the intercept. As mentioned in the general remarks, in long-term forecasting scenarios involving large increases in output and demand, these equations may yield perverse results.

29. Motor Vehicles and Parts

Vehicles

SEE = 7.79	RSQ = 0.4645	RHO = 0.06	Obser = 14 from 1974.000
SEE+1 = 7.85	RBSQ = 0.3039	DW = 1.88	DoFree = 10 to 1987.000
MAPE = 28.47			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv29$	- - -	- - -	- - -	- - -	- - -	27.64
1 intercept	9.46758	7.5	1.246	0.34	0.000	1.00
2 dv29$	0.96743	33.8	2.814	0.72	0.122	20.61
3 dgout29$	0.00653	22.4	2.233	-0.03	0.518	-125.31
4 dgout29$[1]	0.00470	10.2	1.467	-0.03	0.341	-200.24

Plant and machinery

SEE = 132.90	RSQ = 0.1637	RHO = 0.56	Obser = 13 from 1975.000
SEE+1 = 113.61	RBSQ = -0.1151	DW = 0.87	DoFree = 9 to 1987.000
MAPE = 16.10			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp29$	- - -	- - -	- - -	- - -	- - -	588.19
1 intercept	179.06385	5.4	0.998	0.30	0.000	1.00
2 dp29$	1.00638	29.0	2.443	0.72	0.276	418.87
3 dgout29$[1]	0.04319	3.3	0.772	-0.02	0.237	-223.95
4 dgout29$[2]	0.01487	0.4	0.267	-0.00	0.082	-184.62

Buildings

SEE =	31.81	RSQ = 0.0625	RHO =	0.70	Obser =	13	from	1975.000
SEE+1 =	25.25	RBSQ = -0.1249	DW =	0.61	DoFree =	10	to	1987.000
MAPE =	39.16							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb29$	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	67.02
1 intercept	-19.15967	2.1	-0.652	-0.29	-0.000	1.00
2 db29$	0.98639	40.2	3.106	1.28	0.119	86.75
3 rtb$	-2.03309	7.9	-1.285	0.01	-0.396	-0.30

The British Shipbuilding industry has been in chronic decline for a generation and has been the recipient of much government aid. Replacement investment has more than sufficed to meet capital requirements, and will probably continue to do so for the foreseeable future.

30. Shipbuilding and Repairing

Vehicles

SEE =	1.20	RSQ = -0.1019	RHO =	0.39	Obser =	14	from	1974.000
SEE+1 =	1.14	RBSQ = -0.3023	DW =	1.23	DoFree =	11	to	1987.000
MAPE =	27.19							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv30$	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	4.01
1 intercept	0.49527	1.0	0.478	0.12	0.000	1.00
2 dv30$	0.95305	51.1	3.762	0.90	0.172	3.80
3 dgout30$[1]	0.00149	1.4	0.550	-0.03	0.174	-73.44

Plant and machinery

SEE =	16.36	RSQ = -0.0065	RHO =	0.53	Obser =	13	from	1975.000
SEE+1 =	14.52	RBSQ = -0.0980	DW =	0.94	DoFree =	11	to	1987.000
MAPE =	22.96							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp30$	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	62.00
1 intercept	-0.76539	0.0	-0.052	-0.01	-0.000	1.00
2 dp30$	0.99737	69.2	4.526	1.01	0.058	62.93

Buildings

SEE =	12.02	RSQ = 0.3106	RHO =	0.52	Obser =	13	from	1975.000
SEE+1 =	11.10	RBSQ = -0.1818	DW =	0.96	DoFree =	7	to	1987.000
MAPE =	35.11							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb30$	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	34.34
1 intercept	-12.57437	1.8	-0.516	-0.37	-0.000	1.00
2 db30$	1.00800	29.8	2.231	1.55	0.102	52.69
3 dgout30$[1]	-0.00622	0.2	-0.168	0.01	-0.058	-81.27
4 dgout30$[2]	0.04841	12.0	1.358	-0.09	0.437	-61.20
5 dgout30$[3]	0.01883	2.6	0.614	-0.04	0.185	-72.32
6 dgout30$[4]	0.03821	8.5	1.134	-0.07	0.366	-62.05

The Aerospace industry, in contrast, has done fairly well, and the regressions yield fairly good results.

31. Aerospace Engineering

Vehicles

SEE =	2.20	RSQ = 0.4698	RHO =	-0.18	Obser =	14	from	1974.000
SEE+1 =	2.15	RBSQ = 0.3108	DW =	2.35	DoFree =	10	to	1987.000
MAPE =	17.56							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv31$	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	9.76
1 intercept	1.86955	0.9	0.416	0.19	0.000	1.00
2 dv31$	1.11123	13.2	1.677	0.77	0.134	6.72
3 dgout31$	0.00401	22.4	2.233	0.03	0.539	78.85
4 dgout31$[1]	0.00101	1.7	0.588	0.01	0.140	99.68

```
                         Plant and machinery
SEE    =       21.13 RSQ   = 0.6848 RHO =   0.34 Obser  =   13 from 1975.000
SEE+1  =       20.37 RBSQ  = 0.5272 DW  =   1.31 DoFree =    8 to   1987.000
MAPE   =       14.15
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp31$                    - - - - - - - - - - - - - - - - - - - - -   135.22
1 intercept                 32.19998     1.2   0.447  0.24   0.000       1.00
2 dp31$                      0.97317    10.3   1.316  0.70   0.038      96.83
3 dgout31$                   0.05378    38.0   2.689  0.04   0.590     101.35
4 dgout31$[1]                0.02795    11.4   1.392  0.01   0.311      67.41
5 dgout31$[2]                0.03538    16.0   1.663  0.01   0.354      40.87

                              Buildings
SEE    =        9.12 RSQ   = 0.4412 RHO =   0.41 Obser  =   13 from 1975.000
SEE+1  =        8.93 RBSQ  = -0.1177 DW  =   1.17 DoFree =    6 to   1987.000
MAPE   =       34.05
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vb31$                    - - - - - - - - - - - - - - - - - - - - -    21.39
1 intercept                 -2.48624     0.7  -0.286 -0.12  -0.000       1.00
2 db31$                      1.01717    49.1   2.733  0.98   0.048      20.68
3 dgout31$                   0.01771    16.1   1.459  0.08   0.599     101.35
4 dgout31$[1]                0.00756    11.4   1.212  0.02   0.260      67.41
5 dgout31$[2]                0.00402     3.4   0.647  0.01   0.124      40.87
6 dgout31$[3]                0.00490     2.8   0.585  0.01   0.146      28.15
7 dgout31$[4]                0.00607     2.9   0.602  0.01   0.178      38.33
```

The Other vehicles industry has been in serious trouble, and the equations yield poor results.

32. Other Vehicles

```
                              Vehicles
SEE    =        1.43 RSQ   = 0.1548 RHO =   0.16 Obser  =   14 from 1974.000
SEE+1  =        1.43 RBSQ  = -0.0988 DW  =   1.69 DoFree =   10 to   1987.000
MAPE   =       54.84
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vv32$                    - - - - - - - - - - - - - - - - - - - - -     2.83
1 intercept                  0.47214     3.0   0.787  0.17   0.000       1.00
2 dv32$                      0.99653   141.8   6.963  0.89   0.088       2.53
3 dgout32$[1]                0.00054     0.1   0.111 -0.00   0.033     -23.32
4 dgout32$[2]                0.00646     8.7   1.351 -0.06   0.395     -24.16

                         Plant and machinery
SEE    =        3.78 RSQ   = 0.5328 RHO =   0.08 Obser  =   13 from 1975.000
SEE+1  =        3.78 RBSQ  = 0.1990 DW  =   1.84 DoFree =    7 to   1987.000
MAPE   =       17.86
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp32$                    - - - - - - - - - - - - - - - - - - - - -    19.51
1 intercept                  0.15650     0.0   0.047  0.01   0.000       1.00
2 dp32$                      0.99369   181.2   6.955  1.06   0.056      20.74
3 dgout32$                   0.02520    18.4   1.677 -0.02   0.447     -19.28
4 dgout32$[1]                0.02599    23.4   1.914 -0.03   0.459     -21.15
5 dgout32$[2]                0.01331    13.2   1.406 -0.01   0.226     -15.82
6 dgout32$[3]                0.00027     0.0   0.020 -0.00   0.005     -24.20

                              Buildings
SEE    =        2.65 RSQ   = 0.1514 RHO =   0.41 Obser  =   13 from 1975.000
SEE+1  =        2.64 RBSQ  = -0.1315 DW  =   1.18 DoFree =    9 to   1987.000
MAPE   =       38.73
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vb32$                    - - - - - - - - - - - - - - - - - - - - -     5.62
1 intercept                 -2.41385     5.4  -0.996 -0.43  -0.000       1.00
2 db32$                      1.01834    57.4   3.647  1.46   0.079       8.06
3 dgout32$                   0.01002     6.6   1.110 -0.03   0.341     -19.28
4 dgout32$[1]               -0.00103     0.1  -0.113  0.00  -0.035     -21.15
```

For Instrument engineering, the vehicles and plant and machinery equations are fairly good, but the buildings equation is not. The Food and Drink industries equations, also shown below, are quite good, as one might expect for a competitive industry with numerous firms. In contrast, the Tobacco industry equations are poor, though perhaps not so bad for a small, concentrated industry.

33. Instrument Engineering

Vehicles

SEE = 1.61 RSQ = 0.4156 RHO = 0.44 Obser = 14 from 1974.000
SEE+1 = 1.48 RBSQ = 0.1558 DW = 1.12 DoFree = 9 to 1987.000
MAPE = 18.66

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv33$						7.81
1 intercept	1.19426	13.8	1.631	0.15	0.000	1.00
2 dv33$	1.00266	352.0	13.233	0.82	0.155	6.37
3 dgout33$	0.00662	12.4	1.540	0.02	0.411	21.47
4 dgout33$[1]	0.00432	5.8	1.040	0.01	0.266	18.22
5 dgout33$[2]	0.00415	5.5	1.012	0.00	0.267	2.77

Plant and machinery

SEE = 5.65 RSQ = 0.7744 RHO = 0.35 Obser = 13 from 1975.000
SEE+1 = 5.74 RBSQ = 0.6616 DW = 1.30 DoFree = 8 to 1987.000
MAPE = 8.01

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp33$						59.11
1 intercept	12.14494	14.5	1.577	0.21	0.000	1.00
2 dp33$	1.02428	133.7	5.980	0.76	0.574	44.05
3 dgout33$	0.03434	23.8	2.067	0.02	0.356	36.53
4 dgout33$[1]	0.02103	10.9	1.358	0.01	0.237	16.15
5 dgout33$[2]	0.01740	7.6	1.124	0.00	0.196	14.44

Buildings

SEE = 3.03 RSQ = 0.2732 RHO = 0.57 Obser = 13 from 1975.000
SEE+1 = 2.66 RBSQ = -0.0902 DW = 0.85 DoFree = 8 to 1987.000
MAPE = 32.02

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb33$						9.24
1 intercept	0.64076	0.5	0.288	0.07	0.000	1.00
2 db33$	1.01607	80.4	4.249	0.88	0.108	8.03
3 dgout33$	0.00584	2.7	0.658	0.02	0.202	36.53
4 dgout33$[1]	0.00794	7.0	1.079	0.01	0.299	16.15
5 dgout33$[2]	0.00672	5.0	0.903	0.01	0.252	14.44

34. Food

Vehicles

SEE = 12.39 RSQ = 0.4732 RHO = 0.33 Obser = 14 from 1974.000
SEE+1 = 11.91 RBSQ = 0.2391 DW = 1.35 DoFree = 9 to 1987.000
MAPE = 9.64

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv34$						114.29
1 intercept	31.81833	113.8	5.671	0.28	0.000	1.00
2 dv34$	1.00342	717.3	24.345	0.70	0.408	80.19
3 dgout34$	0.00246	1.4	0.510	0.00	0.124	207.65
4 dgout34$[1]	0.00401	4.3	0.885	0.01	0.203	208.06
5 dgout34$[2]	0.00282	2.1	0.623	0.01	0.145	231.94

Plant and machinery

SEE = 76.78 RSQ = 0.6569 RHO = 0.78 Obser = 13 from 1975.000
SEE+1 = 52.75 RBSQ = 0.4854 DW = 0.43 DoFree = 8 to 1987.000
MAPE = 10.44

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp34$	- -					664.34
1 intercept	155.46971	31.6	2.473	0.23	0.000	1.00
2 dp34$	1.07338	229.3	9.075	0.75	0.429	466.88
3 dgout34$	0.00716	0.3	0.228	0.00	0.048	238.65
4 dgout34$[1]	0.02075	2.7	0.679	0.01	0.141	186.66
5 dgout34$[2]	0.01231	0.9	0.393	0.00	0.083	173.70

Buildings

SEE = 19.05 RSQ = 0.6519 RHO = -0.16 Obser = 13 from 1975.000
SEE+1 = 18.28 RBSQ = 0.4032 DW = 2.33 DoFree = 7 to 1987.000
MAPE = 11.91

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb34$	- -					135.07
1 intercept	-63.09500	3.0	-0.661	-0.47	-0.000	1.00
2 db34$	1.29982	24.0	1.965	1.38	0.176	143.60
3 dgout34$	0.01317	17.7	1.661	0.02	0.362	238.65
4 dgout34$[1]	0.01585	31.5	2.290	0.02	0.437	186.66
5 dgout34$[2]	0.01581	40.8	2.657	0.02	0.433	173.70
6 dgout34$[3]	0.01165	18.9	1.723	0.02	0.329	228.54

35. Drink

Vehicles

SEE = 4.68 RSQ = 0.6744 RHO = 0.44 Obser = 14 from 1974.000
SEE+1 = 4.26 RBSQ = 0.5297 DW = 1.11 DoFree = 9 to 1987.000
MAPE = 10.12

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv35$	- -					38.67
1 intercept	-1.14093	0.1	-0.120	-0.03	-0.000	1.00
2 dv35$	1.05211	68.6	4.079	1.00	0.373	36.73
3 dgout35$	0.00606	11.9	1.513	0.00	0.292	9.81
4 dgout35$[1]	0.00638	19.1	1.943	0.02	0.371	107.11
5 dgout35$[2]	0.00562	14.3	1.665	0.01	0.326	75.66

Plant and machinery

SEE = 26.90 RSQ = 0.2977 RHO = 0.26 Obser = 13 from 1975.000
SEE+1 = 26.70 RBSQ = -0.2039 DW = 1.48 DoFree = 7 to 1987.000
MAPE = 9.05

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp35$	- -					249.14
1 intercept	84.05802	13.1	1.434	0.34	0.000	1.00
2 dp35$	0.81969	43.9	2.806	0.63	0.600	192.73
3 dgout35$	0.01575	2.4	0.599	-0.00	0.195	-17.06
4 dgout35$[1]	0.05222	26.3	2.090	0.01	0.656	30.61
5 dgout35$[2]	0.04991	33.4	2.394	0.02	0.763	90.80
6 dgout35$[3]	0.01193	2.1	0.558	0.00	0.179	103.82

Buildings

SEE = 10.29 RSQ = 0.6818 RHO = -0.23 Obser = 13 from 1975.000
SEE+1 = 9.80 RBSQ = 0.3636 DW = 2.46 DoFree = 6 to 1987.000
MAPE = 13.18

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb35$	- -					70.22
1 intercept	4.57359	0.2	0.165	0.07	0.000	1.00
2 db35$	0.92869	34.9	2.230	0.86	0.134	64.78
3 dgout35$	0.01214	10.0	1.127	-0.00	0.265	-17.06
4 dgout35$[1]	0.02574	44.2	2.557	0.01	0.569	30.61
5 dgout35$[2]	0.02116	47.2	2.659	0.03	0.570	90.80
6 dgout35$[3]	0.01388	21.9	1.718	0.02	0.367	103.82
7 dgout35$[4]	0.01171	14.3	1.363	0.02	0.310	131.75

36. Tobacco

Vehicles

SEE = 2.57 RSQ = 0.0137 RHO = 0.23 Obser = 14 from 1974.000
SEE+1 = 2.53 RBSQ = -0.1656 DW = 1.55 DoFree = 11 to 1987.000
MAPE = 64.26

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv36$	- -					4.45
1 intercept	1.47964	4.0	0.943	0.33	0.000	1.00
2 dv36$	0.99526	20.7	2.242	0.68	0.092	3.02
3 dgout36$[1]	0.00111	0.2	0.218	-0.01	0.066	-34.97

Plant and machinery

SEE = 12.23 RSQ = 0.0162 RHO = 0.66 Obser = 13 from 1975.000
SEE+1 = 9.87 RBSQ = -0.3117 DW = 0.69 DoFree = 9 to 1987.000
MAPE = 22.22

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp36$	- -					53.75
1 intercept	44.01891	10.4	1.447	0.82	0.000	1.00
2 dp36$	0.29670	0.8	0.382	0.22	0.118	40.32
3 dgout36$[1]	0.03368	3.5	0.832	-0.04	0.316	-63.65
4 dgout36$[2]	0.00353	0.1	0.111	-0.00	0.044	-25.59

Buildings

SEE = 1.91 RSQ = 0.1258 RHO = 0.29 Obser = 13 from 1975.000
SEE+1 = 1.92 RBSQ = -0.7484 DW = 1.41 DoFree = 6 to 1987.000
MAPE = 37.99

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb36$	- -					5.07
1 intercept	-1.84061	7.2	-0.964	-0.36	-0.000	1.00
2 db36$	0.98512	88.8	3.987	1.32	0.132	6.80
3 dgout36$	0.00058	0.1	0.089	-0.01	0.035	-55.58
4 dgout36$[1]	-0.00458	4.4	-0.749	0.06	-0.259	-63.65
5 dgout36$[2]	0.00037	0.1	0.090	-0.00	0.028	-25.59
6 dgout36$[3]	0.00363	6.2	0.889	-0.01	0.271	-10.40
7 dgout36$[4]	0.00418	5.4	0.832	0.00	0.304	0.82

The Yarn and Textiles industries declined in the late 1970's, and the poor equations reflect it. Replacement investment has exceeded gross investment in both industries. The Apparel and Leather and footwear industries have fared somewhat better, and their equations are correspondingly better.

37. Yarn

Vehicles

SEE = 1.60 RSQ = 0.4486 RHO = 0.34 Obser = 14 from 1974.000
SEE+1 = 1.57 RBSQ = 0.2036 DW = 1.32 DoFree = 9 to 1987.000
MAPE = 23.67

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv37$	- -					6.70
1 intercept	-0.05918	0.0	-0.047	-0.01	-0.000	1.00
2 dv37$	1.05904	136.8	6.486	1.09	0.500	6.88
3 dgout37$	0.00333	6.4	1.096	-0.04	0.294	-87.24
4 dgout37$[1]	0.00092	0.5	0.288	-0.01	0.079	-99.44
5 dgout37$[2]	0.00113	1.1	0.441	-0.02	0.115	-131.02

Plant and machinery

SEE = 26.59 RSQ = 0.1935 RHO = 0.75 Obser = 13 from 1975.000
SEE+1 = 25.90 RBSQ = -0.0753 DW = 0.49 DoFree = 9 to 1987.000
MAPE = 21.27

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp37$	- -					80.12
1 intercept	-40.42483	11.1	-1.452	-0.50	-0.000	1.00
2 dp37$	0.99104	94.5	5.006	1.62	0.088	131.33
3 dgout37$[1]	0.04113	3.8	0.830	-0.05	0.268	-98.24
4 dgout37$[2]	0.05599	6.9	1.130	-0.07	0.365	-99.45

Buildings

SEE =	3.72	RSQ = 0.7359	RHO = 0.57	Obser = 13	from 1975.000		
SEE+1 =	3.42	RBSQ = 0.6830	DW = 0.87	DoFree = 10	to 1987.000		
MAPE =	40.72						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb37$						10.09
1 intercept	-13.76619	173.1	-8.038	-1.36	-0.000	1.00
2 db37$	0.99664	507.5	18.952	2.34	0.238	23.71
3 rtb$	-0.76886	65.4	-4.169	0.02	-0.679	-0.30

38. Textiles

Vehicles

SEE =	3.02	RSQ = 0.5899	RHO = 0.13	Obser = 14	from 1974.000		
SEE+1 =	2.99	RBSQ = 0.4076	DW = 1.73	DoFree = 9	to 1987.000		
MAPE =	13.70						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv38$						16.85
1 intercept	0.14900	0.0	0.043	0.01	0.000	1.00
2 dv38$	1.06936	100.1	5.230	1.04	0.553	16.44
3 dgout38$	0.00503	8.0	1.233	-0.01	0.280	-42.06
4 dgout38$[1]	0.00571	9.2	1.325	-0.02	0.299	-53.36
5 dgout38$[2]	0.00666	13.1	1.595	-0.02	0.348	-55.26

Plant and machinery

SEE =	7.17	RSQ = 0.9188	RHO = -0.03	Obser = 13	from 1975.000		
SEE+1 =	7.12	RBSQ = 0.8609	DW = 2.07	DoFree = 7	to 1987.000		
MAPE =	4.59						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp38$						127.93
1 intercept	-41.53734	41.4	-2.645	-0.32	-0.000	1.00
2 dp38$	0.99308	350.1	11.618	1.41	0.143	181.37
3 dgout38$	0.03472	63.1	3.412	-0.01	0.375	-36.43
4 dgout38$[1]	0.04410	102.9	4.673	-0.03	0.426	-74.72
5 dgout38$[2]	0.05235	206.1	7.659	-0.03	0.526	-64.49
6 dgout38$[3]	0.04317	106.4	4.780	-0.02	0.435	-62.77

Buildings

SEE =	2.53	RSQ = 0.7513	RHO = 0.08	Obser = 13	from 1975.000		
SEE+1 =	2.53	RBSQ = 0.5026	DW = 1.84	DoFree = 6	to 1987.000		
MAPE =	16.69						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb38$						14.03
1 intercept	-19.52186	131.8	-5.214	-1.39	-0.000	1.00
2 db38$	0.99012	306.5	9.825	2.49	0.502	35.27
3 dgout38$	-0.00030	0.0	-0.073	0.00	-0.016	-36.43
4 dgout38$[1]	0.00403	7.9	1.011	-0.02	0.193	-74.72
5 dgout38$[2]	0.00771	36.6	2.319	-0.04	0.384	-64.49
6 dgout38$[3]	0.00791	40.3	2.453	-0.04	0.396	-62.77
7 dgout38$[4]	0.00144	1.1	0.364	-0.01	0.073	-58.62

39. Apparel

Vehicles

SEE =	3.27	RSQ = 0.5421	RHO = 0.07	Obser = 14	from 1974.000		
SEE+1 =	3.26	RBSQ = 0.4048	DW = 1.85	DoFree = 10	to 1987.000		
MAPE =	12.22						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv39$						20.95
1 intercept	1.45904	0.8	0.410	0.07	0.000	1.00
2 dv39$	1.05563	106.1	5.724	0.93	0.279	18.47
3 dgout39$	0.01463	34.3	2.849	-0.00	0.616	-3.09
4 dgout39$[1]	0.00256	1.3	0.520	0.00	0.112	12.99

Plant and machinery

SEE = 11.59	RSQ = 0.6402	RHO = 0.58	Obser = 13	from 1975.000	
SEE+1 = 10.04	RBSQ = 0.3831	DW = 0.84	DoFree = 7	to 1987.000	
MAPE = 14.79					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp39$						70.66
1 intercept	8.05262	0.9	0.367	0.11	0.000	1.00
2 dp39$	1.24238	47.4	2.928	0.89	0.169	50.63
3 dgout39$	0.04951	28.0	2.161	-0.01	0.531	-14.00
4 dgout39$[1]	0.03462	26.5	2.093	-0.00	0.379	-3.35
5 dgout39$[2]	0.02099	13.6	1.456	0.01	0.237	21.28
6 dgout39$[3]	0.00925	1.7	0.505	0.00	0.102	7.47

Buildings

SEE = 3.57	RSQ = 0.3416	RHO = 0.75	Obser = 13	from 1975.000	
SEE+1 = 2.90	RBSQ = -0.3168	DW = 0.50	DoFree = 6	to 1987.000	
MAPE = 28.55					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb39$						12.11
1 intercept	-7.90573	4.5	-0.748	-0.65	-0.000	1.00
2 db39$	0.84137	26.5	1.916	1.66	0.204	23.86
3 dgout39$	0.01438	21.3	1.698	-0.02	0.677	-14.00
4 dgout39$[1]	0.00956	24.3	1.827	-0.00	0.459	-3.35
5 dgout39$[2]	0.00696	14.3	1.369	0.01	0.344	21.28
6 dgout39$[3]	0.00529	6.3	0.892	0.00	0.255	7.47
7 dgout39$[4]	0.00334	2.4	0.541	-0.00	0.154	-2.96

40. Leather and Footwear

Vehicles

SEE = 1.22	RSQ = 0.4700	RHO = 0.10	Obser = 14	from 1974.000	
SEE+1 = 1.22	RBSQ = 0.3110	DW = 1.81	DoFree = 10	to 1987.000	
MAPE = 11.50					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv40$						7.84
1 intercept	0.70409	2.8	0.751	0.09	0.000	1.00
2 dv40$	1.02800	186.1	8.500	0.93	0.301	7.08
3 dgout40$[1]	0.00764	18.8	2.031	-0.02	0.581	-18.69
4 dgout40$[2]	-0.00004	0.0	-0.012	0.00	-0.003	-20.77

Plant and machinery

SEE = 3.98	RSQ = 0.7225	RHO = 0.26	Obser = 13	from 1975.000	
SEE+1 = 3.96	RBSQ = 0.5243	DW = 1.47	DoFree = 7	to 1987.000	
MAPE = 13.15					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp40$						28.66
1 intercept	-5.36094	1.4	-0.449	-0.19	-0.000	1.00
2 dp40$	1.29770	48.4	2.980	1.23	0.243	27.14
3 dgout40$	0.01291	6.4	0.988	-0.01	0.237	-14.88
4 dgout40$[1]	0.01887	19.9	1.800	-0.02	0.328	-23.51
5 dgout40$[2]	0.01694	42.6	2.764	-0.01	0.297	-17.95
6 dgout40$[3]	0.00977	5.5	0.915	-0.01	0.169	-27.26

Buildings

SEE = 2.66	RSQ = 0.2048	RHO = 0.74	Obser = 13	from 1975.000	
SEE+1 = 2.10	RBSQ = -0.5904	DW = 0.52	DoFree = 6	to 1987.000	
MAPE = 40.75					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb40$						5.88
1 intercept	-2.37447	3.6	-0.668	-0.40	-0.000	1.00
2 db40$	0.90346	46.8	2.654	1.51	0.133	9.84
3 dgout40$	0.01077	10.7	1.171	-0.03	0.501	-14.88
4 dgout40$[1]	0.00001	0.0	0.002	-0.00	0.001	-23.51
5 dgout40$[2]	0.00190	1.0	0.358	-0.01	0.085	-17.95
6 dgout40$[3]	0.00689	11.9	1.241	-0.03	0.302	-27.26
7 dgout40$[4]	0.00736	7.2	0.952	-0.04	0.307	-33.81

The Timber and wood products industry has fared rather badly. The equations are poor in terms of fit, but yield fairly sensible parameters and have relatively low mean errors. The same observations hold for the Pulp and Paper industry, while the Printing and publishing industry equations are fairly good.

41. Timber and Wood Products

Vehicles

SEE = 10.16 RSQ = 0.2523 RHO = 0.59 Obser = 14 from 1974.000
SEE+1 = 8.36 RBSQ = -0.0800 DW = 0.82 DoFree = 9 to 1987.000
MAPE = 18.22

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv41$	- -					49.96
1 intercept	4.42809	1.8	0.578	0.09	0.000	1.00
2 dv41$	1.01951	148.1	6.819	0.94	0.417	46.24
3 dgout41$	0.00797	3.0	0.737	-0.01	0.239	-52.76
4 dgout41$[1]	0.01010	4.4	0.903	-0.01	0.283	-68.31
5 dgout41$[2]	0.00934	3.8	0.841	-0.01	0.269	-53.76

Plant and machinery

SEE = 19.91 RSQ = 0.4336 RHO = 0.29 Obser = 13 from 1975.000
SEE+1 = 19.17 RBSQ = 0.0290 DW = 1.41 DoFree = 7 to 1987.000
MAPE = 13.96

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp41$	- -					122.68
1 intercept	55.87074	37.6	2.522	0.46	0.000	1.00
2 dp41$	0.91643	80.3	4.005	0.63	0.377	84.08
3 dgout41$	0.01643	3.2	0.678	-0.00	0.201	-7.88
4 dgout41$[1]	0.05166	19.4	1.740	-0.04	0.626	-99.47
5 dgout41$[2]	0.04496	17.8	1.660	-0.03	0.576	-78.04
6 dgout41$[3]	0.02122	4.7	0.825	-0.01	0.278	-69.48

Buildings

SEE = 6.75 RSQ = 0.5016 RHO = 0.49 Obser = 13 from 1975.000
SEE+1 = 6.15 RBSQ = -0.1961 DW = 1.03 DoFree = 5 to 1987.000
MAPE = 15.05

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb41$	- -					31.97
1 intercept	4.30256	1.8	0.426	0.13	0.000	1.00
2 db41$	1.00530	78.5	3.332	0.97	0.079	30.73
3 dgout41$	0.01270	11.1	1.093	-0.00	0.431	-7.88
4 dgout41$[1]	0.01809	18.7	1.443	-0.06	0.606	-99.47
5 dgout41$[2]	0.01454	14.7	1.264	-0.04	0.516	-78.04
6 dgout41$[3]	0.00913	6.9	0.852	-0.02	0.331	-69.48
7 dgout41$[4]	-0.00229	0.5	-0.218	0.00	-0.081	-38.48
8 rtb$	-1.18811	30.9	-1.905	0.01	-0.795	-0.30

42. Pulp and Paper

Vehicles

SEE = 3.79 RSQ = 0.4026 RHO = -0.30 Obser = 14 from 1974.000
SEE+1 = 3.54 RBSQ = 0.1371 DW = 2.59 DoFree = 9 to 1987.000
MAPE = 10.97

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv42$	- -					24.59
1 intercept	5.95430	6.5	1.096	0.24	0.000	1.00
2 dv42$	0.97654	56.4	3.608	0.77	0.268	19.51 3
dgout42$	0.00325	10.0	1.375	-0.01	0.374	-52.56
4 dgout42$[1]	0.00464	21.6	2.076	-0.01	0.551	-34.21
5 dgout42$[2]	0.00254	6.7	1.114	-0.00	0.302	-32.02

Plant and machinery

SEE = 27.39 RSQ = 0.6953 RHO = 0.38 Obser = 13 from 1975.000
SEE+1 = 25.77 RBSQ = 0.4777 DW = 1.23 DoFree = 7 to 1987.000
MAPE = 7.19

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp42$						275.36
1 intercept	104.88656	37.0	2.499	0.38	0.000	1.00
2 dp42$	0.93207	96.9	4.526	0.65	0.486	193.22
3 dgout42$	0.02610	10.6	1.259	-0.01	0.305	-73.75
4 dgout42$[1]	0.05593	42.7	2.715	-0.02	0.646	-85.25
5 dgout42$[2]	0.03999	26.9	2.087	-0.01	0.483	-54.61
6 dgout42$[3]	0.02580	12.7	1.389	-0.00	0.315	-28.93

Buildings

SEE = 7.32 RSQ = 0.6868 RHO = 0.20 Obser = 13 from 1975.000
SEE+1 = 7.24 RBSQ = 0.3735 DW = 1.59 DoFree = 6 to 1987.000
MAPE = 18.84

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb42$						31.08
1 intercept	-4.40354	0.6	-0.264	-0.14	-0.000	1.00
2 db42$	0.98805	38.2	2.340	1.23	0.031	38.56
3 dgout42$	0.00551	6.0	0.866	-0.01	0.244	-73.75
4 dgout42$[1]	0.01717	44.4	2.556	-0.05	0.752	-85.25
5 dgout42$[2]	0.01279	27.7	1.950	-0.02	0.586	-54.61
6 dgout42$[3]	0.00889	17.0	1.491	-0.01	0.411	-28.93
7 dgout42$[4]	-0.00303	2.0	-0.495	0.01	-0.139	-69.38

43. Printing and Publishing

Vehicles

SEE = 8.29 RSQ = 0.5759 RHO = 0.57 Obser = 14 from 1974.000
SEE+1 = 7.47 RBSQ = 0.3874 DW = 0.85 DoFree = 9 to 1987.000
MAPE = 13.07

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv43$						52.63
1 intercept	8.18502	4.6	0.927	0.16	0.000	1.00
2 dv43$	1.07974	90.1	4.885	0.76	0.218	37.20
3 dgout43$	0.01605	32.2	2.615	0.05	0.595	175.69
4 dgout43$[1]	0.00185	0.5	0.312	0.01	0.068	169.31
5 dgout43$[2]	0.00662	6.1	1.073	0.02	0.244	173.37

Plant and machinery

SEE = 78.97 RSQ = 0.5507 RHO = 0.90 Obser = 13 from 1975.000
SEE+1 = 37.02 RBSQ = 0.2297 DW = 0.19 DoFree = 7 to 1987.000
MAPE = 22.76

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp43$						314.91
1 intercept	90.19016	14.3	1.494	0.29	0.000	1.00
2 dp43$	1.15445	77.5	3.954	0.59	0.212	161.96
3 dgout43$	0.08223	10.5	1.266	0.04	0.340	161.58
4 dgout43$[1]	0.07423	13.5	1.450	0.04	0.305	155.29
5 dgout43$[2]	0.05234	8.9	1.165	0.03	0.216	168.86
6 dgout43$[3]	0.02461	1.3	0.444	0.01	0.102	166.23

Buildings

SEE = 16.06 RSQ = 0.5108 RHO = 0.58 Obser = 13 from 1975.000
SEE+1 = 14.26 RBSQ = 0.0217 DW = 0.83 DoFree = 6 to 1987.000
MAPE = 37.42

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb43$						40.51
1 intercept	-9.01204	0.4	-0.229	-0.22	-0.000	1.00
2 db43$	1.06220	10.1	1.148	1.08	0.020	41.11
3 dgout43$	0.01414	5.8	0.860	0.06	0.300	161.58
4 dgout43$[1]	0.00749	1.9	0.488	0.03	0.158	155.29
5 dgout43$[2]	0.01383	7.5	0.986	0.06	0.293	168.86
6 dgout43$[3]	0.01168	5.5	0.842	0.05	0.247	166.23
7 dgout43$[4]	-0.01848	7.0	-0.947	-0.05	-0.337	101.23

The Rubber industry has been in decline; replacement investment exceeds the gross, and the equations are poor. The opposite holds for the Plastics industry.

44. Rubber

```
                                  Vehicles
SEE    =         1.43 RSQ   = 0.3204 RHO =    0.56 Obser  =   14 from 1974.000
SEE+1  =         1.21 RBSQ  = 0.1165 DW  =    0.88 DoFree =   10 to   1987.000
MAPE   =        15.81
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vv44$                    - - - - - - - - - - - - - - - - - - - - -      7.75
1 intercept                  0.45261     1.3   0.508   0.06   0.000       1.00
2 dv44$                      1.01020   231.7  10.006   0.98   0.227       7.53
3 dgout44$[1]                0.00287     3.1   0.792  -0.01   0.209     -25.22
4 dgout44$[2]                0.00576    12.8   1.648  -0.03   0.434     -40.25

                            Plant and machinery
SEE    =         9.53 RSQ   = 0.4107 RHO =   -0.00 Obser  =   13 from 1975.000
SEE+1  =         9.53 RBSQ  = 0.1160 DW  =    2.01 DoFree =    8 to   1987.000
MAPE   =         9.99
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp44$                    - - - - - - - - - - - - - - - - - - - - -     75.63
1 intercept                -16.23382     7.3  -1.101  -0.21  -0.000       1.00
2 dp44$                      0.99673   156.7   6.687   1.28   0.372      96.98
3 dgout44$[1]                0.04834    13.8   1.534  -0.03   0.448     -42.07
4 dgout44$[2]                0.04068    12.7   1.469  -0.02   0.426     -29.75
5 dgout44$[3]                0.03214     9.2   1.238  -0.02   0.343     -48.28

                                 Buildings
SEE    =         2.90 RSQ   = 0.4856 RHO =    0.28 Obser  =   13 from 1975.000
SEE+1  =         2.82 RBSQ  = 0.1182 DW  =    1.44 DoFree =    7 to   1987.000
MAPE   =        46.97
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vb44$                    - - - - - - - - - - - - - - - - - - - - -      8.16
1 intercept                 -2.16289     3.0  -0.668  -0.27  -0.000       1.00
2 db44$                      0.97126    79.9   4.021   1.48   0.199      12.44
3 dgout44$[1]               -0.00256     0.4  -0.254   0.01  -0.073     -42.07
4 dgout44$[2]                0.00527     3.1   0.675  -0.02   0.170     -29.75
5 dgout44$[3]                0.01295    25.2   2.027  -0.08   0.424     -48.28
6 dgout44$[4]                0.01759    32.7   2.347  -0.13   0.570     -62.22
```

45. Plastics

```
                                  Vehicles
SEE    =         3.36 RSQ   = 0.4507 RHO =    0.45 Obser  =   14 from 1974.000
SEE+1  =         3.12 RBSQ  = 0.2066 DW  =    1.09 DoFree =    9 to   1987.000
MAPE   =        13.40
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vv45$                    - - - - - - - - - - - - - - - - - - - - -     20.16
1 intercept                  2.84073     5.4   1.003   0.14   0.000       1.00
2 dv45$                      1.01358   136.3   6.427   0.77   0.178      15.35
3 dgout45$                   0.00811    34.5   2.698   0.06   0.674     140.47
4 dgout45$[1]                0.00383     7.2   1.157   0.02   0.289     115.56
5 dgout45$[2]                0.00159     1.3   0.482   0.01   0.119     112.67

                            Plant and machinery
SEE    =        17.61 RSQ   = 0.9108 RHO =    0.46 Obser  =   13 from 1975.000
SEE+1  =        16.86 RBSQ  = 0.8471 DW  =    1.07 DoFree =    7 to   1987.000
MAPE   =         7.48
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 vp45$                    - - - - - - - - - - - - - - - - - - - - -    222.41
1 intercept                -17.01583     1.3  -0.433  -0.08  -0.000       1.00
2 dp45$                      1.08763   122.6   5.328   0.92   0.165     187.41
3 dgout45$                   0.08418   106.1   4.826   0.05   0.557     144.21
4 dgout45$[1]                0.12568   163.4   6.528   0.05   0.726      89.37
5 dgout45$[2]                0.09073   124.6   5.385   0.04   0.591      93.83
6 dgout45$[3]                0.03155    19.5   1.754   0.02   0.188     117.28
```

```
                                   Buildings
SEE    =        8.38 RSQ    = 0.3273 RHO =    0.33 Obser   =    13 from 1975.000
SEE+1  =        7.91 RBSQ   = -0.3454 DW  =    1.33 DoFree =     6 to   1987.000
MAPE   =       27.97
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 vb45$                     - - - - - - - - - - - - - - - - - - - - -      27.48
1 intercept                   8.52571    11.2   1.202  0.31    0.000        1.00
2 db45$                       0.96061    51.5   2.817  0.58    0.104       16.63
3 dgout45$                    0.00582     3.4   0.649  0.03    0.222      144.21
4 dgout45$[1]                 0.01495    17.6   1.530  0.05    0.498       89.37
5 dgout45$[2]                 0.00967     9.0   1.076  0.03    0.327       93.83
6 dgout45$[3]                 0.00212     0.5   0.236  0.01    0.073      117.28
7 dgout45$[4]                -0.00451     1.8  -0.473 -0.01   -0.146       78.94
```

The hodgepodge Other manufacturing industry yields indifferent equations.

46. Other Manufacturing

```
                                   Vehicles
SEE    =        3.40 RSQ    = 0.3972 RHO =    0.49 Obser   =    14 from 1974.000
SEE+1  =        3.01 RBSQ   = 0.1293 DW  =    1.01 DoFree =     9 to   1987.000
MAPE   =       26.80
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 vv46$                     - - - - - - - - - - - - - - - - - - - - -      13.83
1 intercept                   0.49752     0.1   0.153  0.04    0.000        1.00
2 dv46$                       1.04389    74.0   4.278  0.93    0.329       12.34
3 dgout46$                    0.00406     7.6   1.196  0.01    0.316       34.30
4 dgout46$[1]                 0.00368     6.2   1.078  0.01    0.287       39.23
5 dgout46$[2]                 0.00391     7.2   1.163  0.01    0.305       44.86
```

```
                              Plant and Machinery
SEE    =       12.24 RSQ    = -0.1652 RHO =    0.66 Obser   =    13 from 1975.000
SEE+1  =       10.23 RBSQ   = -0.7478 DW  =    0.68 DoFree =     8 to   1987.000
MAPE   =       18.34
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 vp46$                     - - - - - - - - - - - - - - - - - - - - -      63.18
1 intercept                  18.48737     3.3   0.752  0.29    0.000        1.00
2 dp46$                       0.76005    18.4   1.826  0.70    0.218       57.85
3 dgout46$[1]                 0.00563     1.2   0.449  0.00    0.175       27.35
4 dgout46$[2]                 0.00162     0.1   0.128  0.00    0.051       44.22
5 dgout46$[3]                 0.01000     3.8   0.802  0.01    0.312       50.10
```

```
                                   Buildings
SEE    =        5.13 RSQ    = 0.3958 RHO =    0.67 Obser   =    13 from 1975.000
SEE+1  =        5.08 RBSQ   = -0.2084 DW  =    0.66 DoFree =     6 to   1987.000
MAPE   =       59.84
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 vb46$                     - - - - - - - - - - - - - - - - - - - - -       9.73
1 intercept                  -8.99118    31.4  -2.108 -0.92   -0.000        1.00
2 db46$                       1.02911   122.9   4.929  1.88    0.141       17.75
3 dgout46$                    0.00735     8.0   1.012  0.02    0.393       27.55
4 dgout46$[1]                 0.00177     1.1   0.365  0.00    0.094       27.35
5 dgout46$[2]                 0.00048     0.1   0.115  0.00    0.026       44.22
6 dgout46$[3]                 0.00365     5.8   0.852  0.02    0.196       50.10
7 dgout46$[4]                 0.00656     8.4   1.034  0.00    0.320        1.16
```

The Construction industry equations yielded negative parameters on changes in output under every specification attempted. The attempt to derive accelerator equations must be judged a complete failure, for which I have no explanation.

47. Construction

```
                                 Vehicles
SEE    =      57.12 RSQ   = 0.1712 RHO =   0.36 Obser  =   16 from 1972.000
SEE+1  =      53.22 RBSQ  = 0.0437 DW  =   1.27 DoFree =   13 to   1987.000
MAPE   =      16.10
  Variable name             Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vv47$                   - - - - - - - - - - - - - - - - - - - - - -   292.03
1 intercept                 4.70236     0.2   0.219   0.02    0.000       1.00
2 dv47$                     1.00114   464.4  20.029   0.99    0.361     288.37
3 dgout47$[1]               0.00321     1.3   0.578  -0.00    0.146    -425.38

                            Plant and machinery
SEE    =      95.67 RSQ   = -0.8340 RHO =   0.85 Obser  =   15 from 1973.000
SEE+1  =      61.90 RBSQ  = -0.9751 DW  =   0.30 DoFree =   13 to   1987.000
MAPE   =      26.33
  Variable name             Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vp47$                   - - - - - - - - - - - - - - - - - - - - - -   343.51
1 intercept                43.60748     5.2   1.180   0.13    0.000       1.00
2 dp47$                     0.97442   237.5  11.664   0.87    0.406     307.78

                                 Buildings
SEE    =      21.95 RSQ   = 0.3016 RHO =   0.58 Obser  =   15 from 1973.000
SEE+1  =      21.73 RBSQ  = 0.1852 DW  =   0.84 DoFree =   12 to   1987.000
MAPE   =      24.71
  Variable name             Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vb47$                   - - - - - - - - - - - - - - - - - - - - - -    67.84
1 intercept                27.01020    51.7   3.952   0.40    0.000       1.00
2 db47$                     0.99613   364.8  15.726   0.59    0.114      39.99
3 rtb$                     -3.05609    30.9  -2.929   0.01   -0.707      -0.32
```

The British Distribution sector has grown consistently through the 1970's and 1980's, and except in vehicles investment, displays a strong investment response to changes in output.

48. Distribution, Hotels, Catering and Repair

```
                                 Vehicles
SEE    =     152.75 RSQ   = 0.0762 RHO =   0.58 Obser  =   16 from 1972.000
SEE+1  =     125.28 RBSQ  = -0.0659 DW  =   0.85 DoFree =   13 to   1987.000
MAPE   =      10.77
  Variable name             Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vv48$                   - - - - - - - - - - - - - - - - - - - - - -  1052.96
1 intercept               165.22932    26.6   2.799   0.16    0.000       1.00
2 dv48$                     0.99404   561.3  23.585   0.82    0.639     867.07
3 dgout48$[1]               0.02525     7.0   1.372   0.02    0.366    1023.10

                            Plant and machinery
SEE    =     210.72 RSQ   = 0.8804 RHO =   0.72 Obser  =   15 from 1973.000
SEE+1  =     177.48 RBSQ  = 0.8139 DW  =   0.55 DoFree =    9 to   1987.000
MAPE   =      10.82
  Variable name             Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 vp48$                   - - - - - - - - - - - - - - - - - - - - - -  1909.74
1 intercept               773.91880   169.3   7.592   0.41    0.000       1.00
2 dp48$                     1.03213   400.4  14.885   0.47    0.350     869.61
3 dgout48$                  0.08410    39.6   2.956   0.05    0.354    1166.68
4 dgout48$[1]               0.06587    33.9   2.705   0.04    0.257    1025.93
5 dgout48$[2]               0.05349    35.6   2.779   0.02    0.201     867.02
6 dgout48$[3]               0.03400     8.9   1.308   0.01    0.124     770.49
```

Buildings

SEE =	145.33	RSQ = 0.8935	RHO = 0.24	Obser =	15	from	1973.000
SEE+1 =	147.60	RBSQ = 0.8136	DW = 1.52	DoFree =	8	to	1987.000
MAPE =	9.42						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb48$	- -					1387.06
1 intercept	635.92969	158.4	6.766	0.46	0.000	1.00
2 db48$	1.03769	148.5	6.460	0.33	0.149	435.51
3 dgout48$	0.09660	70.2	3.911	0.08	0.557	1166.68
4 dgout48$[1]	0.04865	16.0	1.670	0.04	0.260	1025.93
5 dgout48$[2]	0.09075	43.5	2.924	0.06	0.468	867.02
6 dgout48$[3]	0.02532	4.8	0.889	0.01	0.126	770.49
7 dgout48$[4]	0.06527	28.8	2.305	0.03	0.314	588.41

The largely publicly operated Transportation industry shows relatively little investment response to output.

49. Transportation

Vehicles

SEE =	341.06	RSQ = 0.1683	RHO = 0.59	Obser =	16	from	1972.000
SEE+1 =	279.99	RBSQ = -0.0396	DW = 0.82	DoFree =	12	to	1987.000
MAPE =	20.51						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv49$	- -					1407.78
1 intercept	-174.64327	2.2	-0.727	-0.12	-0.000	1.00
2 dv49$	1.01441	133.3	7.306	1.07	0.213	1481.14
3 dgout49$	0.10462	2.4	0.761	0.03	0.214	406.29
4 dgout49$[1]	0.11767	2.2	0.723	0.03	0.203	318.12

Plant and machinery

SEE =	75.42	RSQ = 0.5715	RHO = 0.81	Obser =	15	from	1973.000
SEE+1 =	63.74	RBSQ = 0.4547	DW = 0.38	DoFree =	11	to	1987.000
MAPE =	23.51						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp49$	- -					332.25
1 intercept	103.51290	44.6	3.476	0.31	0.000	1.00
2 dp49$	1.01943	339.7	14.249	0.63	0.316	204.83
3 dgout49$	0.03597	6.0	1.167	0.04	0.245	381.85
4 dgout49$[1]	0.02077	1.4	0.568	0.02	0.119	297.92

Buildings

SEE =	53.06	RSQ = 0.6849	RHO = -0.04	Obser =	15	from	1973.000
SEE+1 =	52.92	RBSQ = 0.3699	DW = 2.09	DoFree =	7	to	1987.000
MAPE =	6.98						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb49$	- -					646.47
1 intercept	88.50448	37.8	2.510	0.14	0.000	1.00
2 db49$	0.99975	747.7	22.296	0.81	0.052	520.70
3 dgout49$	0.10249	42.8	2.700	0.06	0.850	381.85
4 dgout49$[1]	0.02909	4.6	0.815	0.01	0.203	297.92
5 dgout49$[2]	-0.04478	9.6	-1.187	-0.02	-0.307	279.47
6 dgout49$[3]	-0.01515	1.4	-0.441	-0.01	-0.101	262.35
7 dgout49$[4]	0.00211	0.0	0.053	0.00	0.014	254.15
8 rtb$	-17.10378	59.9	-3.305	0.01	-1.099	-0.32

The Postal and telecommunications industry shows strong vehicles and plant and equipment investment responsiveness to output, but anomalously poor building investment response. This may be due to the fact that much of the building investment occurs in the public postal system, but the data is not available to substantiate this.

50. Postal and Telecommunications

Vehicles

SEE = 16.12 RSQ = 0.5071 RHO = 0.63 Obser = 16 from 1972.000
SEE+1 = 13.10 RBSQ = 0.3279 DW = 0.75 DoFree = 11 to 1987.000
MAPE = 43.06

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv50$	- -					42.37
1 intercept	-31.80451	28.9	-2.708	-0.75	-0.000	1.00
2 dv50$	0.99904	348.1	14.557	0.82	0.220	34.69
3 dgout50$	0.05157	15.0	1.891	0.47	0.543	387.57
4 dgout50$[1]	0.01162	0.6	0.354	0.10	0.117	347.05
5 dgout50$[2]	0.04717	12.4	1.713	0.37	0.450	328.48

Plant and machinery

SEE = 281.57 RSQ = 0.3130 RHO = 0.78 Obser = 15 from 1973.000
SEE+1 = 261.70 RBSQ = -0.0687 DW = 0.44 DoFree = 9 to 1987.000
MAPE = 10.47

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp50$	- -					1866.13
1 intercept	93.74056	0.6	0.339	0.05	0.000	1.00 2
dp50$	0.96681	257.6	10.385	0.74	0.509	1423.89
3 dgout50$	0.10545	0.3	0.217	0.02	0.077	381.81
4 dgout50$[1]	0.44603	6.6	1.121	0.09	0.303	363.41
5 dgout50$[2]	0.39598	12.7	1.571	0.07	0.263	327.13
6 dgout50$[3]	0.21239	1.3	0.489	0.03	0.123	300.71

Buildings

SEE = 42.61 RSQ = -0.1865 RHO = 0.57 Obser = 15 from 1973.000
SEE+1 = 37.19 RBSQ = -0.2778 DW = 0.87 DoFree = 13 to 1987.000
MAPE = 19.48

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb50$	- -					206.85
1 intercept	121.78017	185.1	9.629	0.59	0.000	1.00
2 db50$	0.99555	432.7	18.869	0.41	0.321	85.45

The Banking, finance, insurance and business services industry yields a very poor vehicles investment equation. (These equations apply only to investment in assets used by the industry, not assets leased to other industries. Leased assets are distributed as best they can be to the user industries.) The plant and machinery and building equations yield good fits, but the output parameters, which are constrained to follow a cubic polynomial, follow an inverted curve, falling and then rising. This has no theoretical or practical justification, and remains a problem.

51. Banking Etc.

Vehicles

SEE = 181.64 RSQ = 0.7323 RHO = 0.50 Obser = 16 from 1972.000
SEE+1 = 165.28 RBSQ = 0.6654 DW = 1.00 DoFree = 12 to 1987.000
MAPE = 23.29

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv51$	- -					714.24
1 intercept	157.60512	9.1	1.521	0.22	0.000	1.00
2 dv51$	0.98808	679.0	26.879	1.01	1.307	730.66
3 dgout51$	-0.01019	0.1	-0.135	-0.05	-0.062	3200.81
4 dgout51$[1]	-0.04831	1.0	-0.489	-0.19	-0.225	2746.18

Plant and machinery

SEE = 217.53 RSQ = 0.9540 RHO = 0.61 Obser = 15 from 1973.000
SEE+1 = 201.17 RBSQ = 0.9284 DW = 0.79 DoFree = 9 to 1987.000
MAPE = 14.26

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp51$	- -					1641.30
1 intercept	-78.49896	1.1	-0.448	-0.05	-0.000	1.00
2 dp51$	0.97971	363.1	13.697	0.59	0.605	989.51
3 dgout51$	0.10342	6.2	1.085	0.21	0.219	3319.86
4 dgout51$[1]	0.02699	0.3	0.247	0.05	0.044	2836.49
5 dgout51$[2]	0.03530	0.9	0.416	0.05	0.045	2476.75

6	dgout51$[3]	0.10796	5.6	1.028	0.15	0.113	2251.42

Building

SEE =	254.71	RSQ = 0.7424	RHO = 0.41	Obser = 15	from 1973.000
SEE+1 =	247.79	RBSQ = 0.5492	DW = 1.18	DoFree = 8	to 1987.000
MAPE =	9.28				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb51$	- - - - - - - - - -					2205.42
1 intercept	847.74449	55.4	3.368	0.38	0.000	1.00
2 db51$	0.99194	302.0	11.026	0.27	0.212	609.63
3 dgout51$	0.08074	3.4	0.739	0.12	0.345	3319.86
4 dgout51$[1]	-0.04505	1.8	-0.547	-0.06	-0.148	2836.49
5 dgout51$[2]	0.00831	0.1	0.099	0.01	0.021	2476.75
6 dgout51$[3]	0.11961	10.9	1.358	0.12	0.253	2251.42
7 dgout51$[4]	0.16114	14.4	1.572	0.15	0.283	2003.39

The Other services industry equations required considerable fiddling to find a specification that yielded usable parameters, but the data confessed after sufficient torture. The industry is something of a mix, being composed of government services and a mélange of miscellaneous services, and has shown strong growth in the 1980's. The very large parameters in the plant and machinery and building equations reflect the growth of the miscellaneous portion of the industry, as government final and capital expenditures have grown relatively modestly.

53. Other Services

Vehicles

SEE =	20.97	RSQ = 0.5576	RHO = 0.07	Obser = 16	from 1972.000
SEE+1 =	21.00	RBSQ = 0.4895	DW = 1.86	DoFree = 13	to 1987.000
MAPE =	8.22				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vv53$	- - - - - - - - - -					213.67
1 intercept	16.81304	6.6	1.336	0.08	0.000	1.00
2 dv53$	1.00002	10562.4	384.421	0.78	0.537	166.47
3 dgout53$	0.02552	25.3	2.724	0.14	0.503	1190.46

Plant and machinery

SEE =	138.52	RSQ = 0.6909	RHO = 0.76	Obser = 15	from 1973.000
SEE+1 =	91.47	RBSQ = 0.6066	DW = 0.47	DoFree = 11	to 1987.000
MAPE =	10.32				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vp53$	- - - - - - - - - -					1006.47
1 intercept	202.81109	13.1	1.760	0.20	0.000	1.00
2 dp53$	1.01069	639.8	24.383	0.61	0.534	606.51
3 dgout53$	0.12658	14.8	1.875	0.15	0.317	1153.83
4 dgout53$[1]	0.03920	1.4	0.563	0.04	0.095	1138.29

Building

SEE =	744.48	RSQ = 0.3771	RHO = 0.61	Obser = 15	from 1973.000
SEE+1 =	694.97	RBSQ = 0.1280	DW = 0.78	DoFree = 10	to 1987.000
MAPE =	13.14				

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 vb53$	- - - - - - - - - -					4525.85
1 intercept	961.21793	5.7	1.090	0.21	0.000	1.00
2 db53$	0.95924	63.6	4.101	0.31	0.135	1442.03
3 dgout53$	0.77249	22.1	2.220	0.20	0.511	1153.83
4 dgout53$[1]	0.69077	27.6	2.511	0.17	0.444	1138.29
5 dgout53$[2]	0.43938	13.3	1.689	0.11	0.283	1146.49

Investment in dwellings. The Cambridge CMDM models investment in dwellings as a complex function of the relative price of housing and the financial condition of building societies, the British equivalent of the U.S. savings and loan industry. The model works well, but requires a great deal more information about British financial markets than I have available. I chose to estimate a simple regression of dwellings as a function of capital consumption (with its parameter constrained to 1.0), real per capita disposable income and its first difference, the real interest rate on treasury bonds, and a variable, *sdpop*, that measures the average annual change in the British population over the a four-year period, lagged four years. The rationale for including the last variable is that population growth follows from people having children, and that families with young children are likely to be the most important group of homebuyers. Population growth was remarkably closely correlated with British housing investment from the early 1950's to the early 1970's, though the correlation has not been as close since then. The equations fit quite well over the period of estimation and yields quite sensible parameters. It implies that a population increase of one thousand induces about sixteen million pounds' worth of new housing investment, or £16,000 per person; that approximately 4.2% of per capita income — and 2.2% of an increase in income — goes to new housing, and that higher real interest rates slightly depress housing investment. However, the income and interest rate variables are very sensitive to the period of estimation, and the equation performs poorly out of sample if estimated over shorter periods. I therefore conclude that the equation probably represents a reasonable characterization of long-term behavior but may not perform well in forecasts. A superior equation awaits further work.

Investment in Dwellings

```
SEE    =       595.55 RSQ   = 0.9417 RHO =    0.27 Obser  =    33 from 1955.000
SEE+1  =       577.18 RBSQ  = 0.9308 DW  =    1.45 DoFree =    27 to   1987.000
MAPE   =         4.49
  Variable name              Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 vd52$                    - - - - - - - - - - - - - - - - - - - - -  10368.46
1 intercept               -3774.41845    42.4  -5.270  -0.36  -0.000      1.00
2 dd52$                       1.00658    98.3   8.897   0.38   0.523   3892.57
3 sdpop[4]                   16.00031   205.5  15.003   0.30   0.839    197.54
4 pcpdi$[1]                   0.06371     9.3   2.295   1.02   1.017 166537.05
5 pcpdi$[2]                  -0.02192     1.1  -0.786  -0.34  -0.348 162426.97
6 rtb$[1]                   -49.50902     6.5  -1.903   0.00  -0.090     -0.30
```

Section IV.4 Final Demand: Inventory Change

Inventories fluctuate markedly over time, mainly in response to cyclical variations in demand. A rise in demand tends to have two conflicting effects on inventory stocks: on one hand, higher sales run down firms' stocks; on the other, firms raise their stocks in proportion to the higher volume of sales. Empirically, the second effect outweighs the first, as can be seen in the regression below of British aggregate quarterly inventory change on fluctuations of domestic demand plus exports[64] less inventory change (dfs$). The data are seasonally unadjusted and in 1980 constant prices.

Inventory change regressed on change in final expenditure

```
SEE    =     524.82 RSQ   = 0.2608 RHO =    0.36 Obser  =  109 from 1960.100
SEE+1  =     491.08 RBSQ  = 0.2173 DW  =    1.28 DoFree =  102 to   1987.100
MAPE   =     184.30
   Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
 0 dinv$                      - - - - - - - - - - - - - - - - - - - -     253.87
 1 intercept                  -59.18850     0.2  -0.664  -0.23  -0.000       1.00
 2 dfs$                         0.02891     0.2   0.638   0.04   0.110     379.57
 3 dfs$[1]                      0.11026     2.4   2.211   0.20   0.410     451.17
 4 dfs$[2]                      0.19434     8.0   4.129   0.31   0.709     407.91
 5 dfs$[3]                      0.25370    13.0   5.310   0.40   0.923     401.86
 6 dfs$[4]                      0.16737     4.8   3.178   0.24   0.614     367.20
 7 dfs$[5]                      0.02285     0.1   0.482   0.04   0.082     422.51
```

The parameters imply a very small initial inventory response to a change in sales, perhaps so small because of the first effect mentioned above, and a larger effect over several quarters. Over a year and a half, a rise in sales induces a slightly smaller increase in inventories. The parameters are robust to the period of estimation and, remarkably, have a profile very similar to that yielded by a similar equation for the U.S.[65] (the British parameters may imply marginally higher inventory responses). Even the degree of autocorrelation is practically identical, possibly implying similar chaotic behavior. Nevertheless, the equation has a remarkably poor fit — less than half as good a fit as its (also poor) American counterpart. The fit is no better, in fact, than a regression of several lagged values of the dependent variable; though adding these lagged values to this regression does little to improve the fit or mean error, or make the demand parameters more sensible. This is par for the course with inventory change, which is notoriously difficult to forecast.

A similar though rougher pattern appears in the annual data, though the summed coefficients are smaller and the summed elasticities considerably higher because the means are very different:

Inventory change regressed on change in final expenditure

```
SEE    =    1395.38 RSQ   = 0.3323 RHO =    0.39 Obser  =   28 from 1960.000
SEE+1  =    1311.04 RBSQ  = 0.2789 DW  =    1.21 DoFree =   25 to   1987.000
MAPE   =     187.57
Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 dinv$                    - - - - - - - - - - - - - - - - - - - -    1022.57
1 intercept                -647.80888     2.5  -1.132  -0.63  -0.000       1.00
2 dfs$                        0.17928    14.8   2.814   1.19   0.490    6787.71
3 dfs$[1]                     0.06995     2.1   1.034   0.44   0.180    6483.29
```

---

[64] This is referred to in the U.K. as total final expenditure, which is the relevant variable here because sellers need to hold inventories of both imported and exported goods.

[65] See Almon (1989), p.203-4.

(The fifteen-fold disparity between mean annual and quarterly changes in final expenditures is due to the fact that the quarterly changes include large seasonal variations that tend to cancel each other out in the average.)

Despite the poor fit, the equation is perfectly acceptable for inclusion in a macro model; inventory change is, in effect, a stationary adjustment process, fluctuating by as much as 3% of gross domestic product or more in a few quarters, but typically taking values of a few tenths of a percent of GDP. Large mean errors are to be expected for a variable that fluctuates wildly around zero and typically has a small mean value. So long as the parameters are sensible, this inventory change can serve the vital function of acting as a buffer between production and demand. When demand falls, firms continue to accumulate inventories for a period, so that output decreases only with a lag that cushions the impact of the drop in demand. Conversely, as demand picks up again, sellers draw down their accumulated stocks for a time before the upswing turns into new factory orders.

The equation may be useful in an aggregate macro context, but developing 55 such equations for inventory holdings by industry or by commodity would involve a great deal of effort to estimate a set of poor-fitting equations that apply to only a tiny portion of total annual economic activity. Instead, I have developed a set of simple commodity equations based on the idea that firms hold inventory stocks that are a portion of their annual sales (or use) of the commodity, and that they adjust these stocks only with a lag. To explain real inventory change ***dinv*** for commodity ***i*** in year ***t***, we calculate a use variable which is final expenditure less inventory change and less the intermediate use diagonal element (or "commodity own use"). Commodity own use is excluded because it is to a large extent a construction of the data classification and collection process.) The use variable is thus

$$use_{it} = (1 - a_{ii})\ q_{it} + imports_{it} - dinv_{it}$$

Desired stock is thus a fraction of this use

$$dstock_{it} = stpct_i * use_{it}$$

where $stpct_i$ is a commodity-specific ratio of desired stock to use; and actual stock adjusts 60% of the way to this desired stock in one year:

$$dinv_{it} = 0.6\ (dstock_{it} - stock_{it})$$

Relatively detailed stocks are available by holding industry in Britain, but not by commodity. Rather than attempting to calculate commodity stocks, I developed base year stock variables by reversing the process described above, using stock/use ratios from INFORUM's U.S. model:

$$stock_{i84} = stpct_i * \left[\ (1 - a_{ii})\ q_{i84} + imp_{i84}\ \right] - 0.60 * dinv_{i84}$$

The base year stocks thus derived for British commodities, and the stock/use ratios used to derive them, are presented in Table IV.4.1 below. In simulation, the resulting equations have inventories that adjust realistically with a lag to changes in total intermediate and final use.

Table IV.4.1: Inventory change: assumed sales/stock ratios and calculated initial inventory stocks, by commodity (£ million)

Commodity	Stock/Use	Initial stock
1 Agriculture, forestry & fishing	1.000	6657.0
2 Coal, coke & solid fuels	0.250	265.0
3 Oil & natural gas extraction	0.000	0.0
4 Mineral oil processing	0.330	4315.0
5 Electricity production & distribution	0.010	110.0
6 Public gas supply	0.010	44.0
7 Water supply	0.000	0.0
8 Metal ores & minerals N.E.S.	0.250	71.0
9 Stone, clay, sand & gravel	0.250	43.0
10 Iron, steel & steel products	0.250	1343.0
11 Other metals	0.250	658.0
12 Products of stone, clay, etc.	0.250	333.0
13 Basic chemicals	0.150	1514.0
14 Pharmaceuticals	0.250	677.0
15 Soap & toilet preparations	0.250	442.0
16 Man-made fibers	0.200	118.0
17 Other metal products N.E.S.	0.250	253.0
18 Industrial plant & steelwork	0.250	216.0
19 Agricultural machinery	0.250	274.0
20 Machine tools & engineers' tools	0.250	318.0
21 Textile, mining, construction & mechanical handling equipment	0.250	961.0
22 Other machinery N.E.S.	0.250	1930.0
23 Ordnance	0.250	102.0
24 Office machinery & computers	0.250	579.0
25 Basic electrical equipment	0.250	1219.0
26 Electronic equipment	0.250	1698.0
27 Domestic electrical appliances	0.250	262.0
28 Electric lighting equipment	0.250	234.0
29 Motor vehicles & parts	0.200	1681.0
30 Shipbuilding & repairing	0.150	286.0
31 Aerospace engineering	0.200	830.0
32 Other vehicles	0.250	180.0
33 Instrument engineering	0.250	489.0
34 Food	0.250	5234.0
35 Drink	0.250	1240.0
36 Tobacco	0.250	172.0
37 Yarn	0.250	459.0
38 Textiles	0.250	925.0
39 Apparel	0.400	1394.0
40 Leather & footwear	0.250	320.0

Table IV.4.1 (continued): Inventory change: assumed sales/stock ratios and calculated initial inventory stocks, by commodity (£ million)

Commodity	Stock/Use	Initial stock
41 Timber & wood products	0.250	982.0
42 Pulp & paper	0.250	1035.0
43 Printing & publishing	0.200	561.0
44 Rubber	0.250	437.0
45 Plastics	0.250	1039.0
46 Other manufacturing	0.250	504.0
47 Construction	0.000	0.0
48 Distribution, hotels, catering, etc.	0.010	690.0
49 Transportation	0.010	198.0
50 Postal & telecommunications	0.010	96.0
51 Banking, finance, insurance & business services	0.010	525.0
52 Ownership of dwellings	0.000	0.0
53 Other services	0.010	647.0

Section IV.5 Final Demand: Trade

As one would expect of the island nation that spearheaded the Industrial Revolution, the U.K. is extraordinarily dependent on trade; and changes in trade patterns have a broad impact on the country's economic structure and development. Exports accounted for 28.7% of British output in 1984, while imports took 29.0% of domestic demand. Accurate modeling of trade is therefore vital to any exercise in macroeconomic forecasting of the British economy.

The main estimation form. Since this model is intended to be linked into the Inforum system of models, the commodity trade data is derived from the U.N. trade data to provide the international system with as consistent a set of trade links as possible. The commodity trade equations too are based on a nonlinear form adopted by Inforum:

$$X = (a + b\ D)\ P^{\eta}$$

where

X is the volume of trade of the commodity;
D is the volume of relevant demand;
P is the relative price of the traded commodity; and
a , b and η are estimated.

Like the consumption equations, the trade equations are intended to capture basic demand and price effects on trade. The form specifies both a constant price elasticity of trade and a constant marginal unit demand effect at any level of demand, while allowing for a multiplicative relation between demand and prices. As demand increases, therefore, asymptotic quantities of imports depend on prices; if the price elasticity is -1.0, a 5 percent decrease in price leads to a 5 percent increase in demand at any level of demand. Moreover, the price elasticity of the marginal propensity to import is not imposed by the form but falls out of the data. Neither linear nor log-linear forms have this set of properties.

The equations are also specified so as to capture the tendency for relative prices to affect international demand patterns with a distributed lag. This lag results in the well-attested "J-curve": if a country's exchange rate falls, the change in relative prices does not immediately effect either import or export volumes. As a result, the value of imports in foreign currencies rises above its initial level before falling in response to higher import prices (conversely, exports fall and then rise). It is particularly important in multisectoral modeling to capture this response pattern, which varies between commodities. Although Barker and Peterson (1987) report quite short lags in British trade — a year at most, I find these results implausible, given my knowledge of trade flows in the machine tool industry, and given Nyhus' (1975) estimation of a series of lagged price weights for up to six years for a large number of commodities and countries. Accordingly, although Nyhus' weights probably need to be reestimated with more recent data, I have adopted them to calculate the effective relative price that enters as the independent price variable in an equation for any given year.

Time trends. In many cases I have added an *ad hoc* time trend to the equation because for much of British trade, there are clear exogenous trends in the data not correlated with either prices or demand. The trend is significantly positive in all but three import equations, namely food, industrial plant, and other manufacturing; food is the only case with a significant negative trend, and this is easily ascribed to British agricultural policy. In twenty-six out of thirty-eight import equations in which the time trend has been introduced, it is not only significant but increases the t-statistic of the demand term, often turning the demand term from insignificantly negative to significantly positive. While the situation is not quite as clear-cut with the export equations, the time trend is negative in twenty-four of thirty-five equations, and significantly positive in only a handful of equations. For the export equations, then, I have included the time trend only when it increases the fit and the significance of the demand term, or when it reverses the sign of a negative demand term.

I am hesitant to ascribe the time trends to any particular cause. In some cases, such as agricultural goods, food, aerospace engineering and ordnance, positive export trends or negative import trends are most likely due to public aid of some kind. However, for the most part I am inclined to believe that the nearly universal positive import trends are due to improvements in the perceived quality — not reflected in prices, for some reason — of imported goods relative to that of domestically produced goods. The same phenomenon is probably reflected in the pervasive if not universal negative trends for British exports. My sense is that imperfections in factor markets (most likely wage stickiness) have prevented British prices from fully adjusting to changes in perceived relative value of British goods, in both domestic and foreign markets; a sense strengthened by the obvious responsiveness of British wages to changes in consumer prices (see Section IV.8 for a discussion of wage equations and British factor markets). It is not entirely satisfactory to account for such a widespread, possibly non-linear phenomenon with a linear dummy variable without any theoretical justification. However, further work on this awaits a more industrious effort. I will discuss a largely unsuccessful attempt to specify an exponential time trend (to avoid the problem of imports exceeding demand) after describing the equations fully.

Specific forms. The specific form of the equation for merchandise imports for a given commodity i in year t is

$$M_{it} = (a + b\,U_{it} + c\,t)\left[\sum_{i=0}^{5} w_i \left(\frac{p_f}{p_d}\right)_{t-i}\right]^d$$

where

M_{it} is the volume of imports of the commodity;
U_{it} is (generally) the volume of domestic demand;
the w_i's are weights for lagged prices, specific to the commodity, developed by Nyhus (1975);
p_d is the domestic price index for the commodity; and

$$p_f = \sum_{m=1}^{z} s_m\, p_{dm}\, e_m$$ is an import price index where

p_{dm} is the domestic price index of country m in the Inforum model;
s_m is the share of imports from country m of total British imports of the commodity in the base year;
e_m is an index of the sterling price of m's currency; and
a, b, c and d are estimated.

By this formulation, then, the price term is a weighted moving average of the relative import to domestic price ratio, where the import price is a volume-weighted, exchange-rate-adjusted price of foreign exporters. Therefore, if the pound sterling appreciates, the perceived price of imports gradually falls. Unless British domestic prices also decrease, the relative price of imports will decrease.

The form for merchandise exports for a given commodity i in year t is similar but the variables differ somewhat:

$$X_{i\,t} = \left[a + b \sum_{m=1}^{z} \left[v_m \left(\frac{M_{m\,i\,t}}{M_{m\,i\,0}} \right) \right] + c\,t \right] \left[\sum_{i=0}^{5} w_i \left(\frac{p_d}{p_f} \right)_{t-i} \right]^d$$

where

X_{it} is the volume of exports;
v_m is country m's share of British exports of the commodity in the base year;
M_{mit} is country m's constant-price imports of the commodity in year t;
M_{mi0} is country m's constant-price imports of the commodity in the base year;
w_i's are, as before, lagged price weights;
p_d is, as before, the domestic price index for the commodity; and

$p_f = \sum_{m=1}^{z} s_m\, p_{d\,m}\, e_m$ is an import price index where

p_{dm} is the domestic price index of country m in the Inforum model;
s_m is country m's share of total British imports of the commodity in the base year;
e_m is an index of the sterling price of m's currency; and
a, b, c and d are estimated.

By this formulation, the demand term is a weighted sum of import indices of all of Britain's trading partners; each index represents a country's import volume relative to the base year, and the weights represent the countries' relative importance in British export trade in the base year. The price term is a weighted moving average of the relative domestic to foreign price ratio, where the foreign price, a volume-weighted exchange rate-adjusted price of foreign exporters, is precisely analogous to the import price in the import equations. Therefore, if the pound sterling appreciates, the perceived prices of the foreign competition gradually falls. Unless British domestic prices also decrease, the relative price of exports will increase.

Estimation method. In INFORUM's experience, best fits of this form in terms of least squared errors often yield nonsensical (i.e. positive) values for the price parameter. Whatever the data want to tell us, positive price parameters can result in a dynamically unstable model and are therefore unacceptable. I therefore used a method of estimation, developed at INFORUM, that skirts this problem while reducing the computational cost of the estimation. For each commodity, I chose an *a priori* value (-1.0) of the price parameter d and then performed a series of ordinary least squares regressions with different values of the parameter. I then chose the OLS estimation that maximizes a function $\mathcal{L}$

$$\mathcal{L} = \bar{R}^2 - \left(0.05 \times \frac{|d - (-1.0)|}{|-1.0|}\right)$$

which allows for a trade-off between best fit as measured by adjusted R-square and a weighted deviation from the assumed value of the parameter, d. The value 0.05 is a weight that can be varied depending on one's willingness to sacrifice fit for a parameter that conforms to one's prior. A zero value for this weight would be render $\mathcal{L}$ the equivalent to an OLS estimation with no constraint on d; while large values would force d closer to the prior. As a general rule, a nonsensical value of the price elasticity can be replaced by a sensible one with very little effect on the fit.

Problems with the form. The estimation results that actually appear in the model, using these forms, are found in Tables IV.5.1 through IV.5.5 at this end of this section. In general, the form is a very useful one by virtue of the characteristics discussed on the first page of this section. However, it has its weaknesses. One might expect that the import equation should incorporate a capacity utilization effect, on the argument that as pressure on domestic capacity increases during a boom, buyers increasingly turn to imports. Other researchers, including the builders of the Cambridge model, have in fact found capacity utilization effects in British import equations[66], but they are almost invariably negative: as British capacity utilization rises, British imports decline. One might infer from this that British producers are more responsive to demand pressures than their foreign competitors; however, I doubt that this is so. I am more inclined to suspect that the causation is reversed; and that what is being captured is something like the following: when the pound depreciates, raising the price — and reducing the volume — of imports, buyers turn to domestic producers, whose output and capacity utilization rise. Conversely, when the pound appreciates, imports increase and British producers suffer. Therefore, although the capacity utilization effect is found to be significant in equations that are estimated with it included, I suspect that it adds little of importance from a forecasting point of view.

Another potential problem with this functional form is that it is possible for imports to exceed demand in long-run simulations, even when the time trend is not included. One way around this problem is to use as the dependent variable either imports' share of total domestic demand or, as Barker and Peterson (1987) suggest, the import-ratio (the ratio of imports to domestically purchased domestic product). The first case is inviting because it gives very nice fits using time trends and prices as independent variables, but it has the weakness of imposing a demand elasticity of 1.0, where this elasticity is precisely one of the two most important parameters to be estimated. As for the second case, I find it very hard to justify relating the import-ratio to any measure of domestic demand, as the Cambridge group do. What justification can one present for an import-ratio response (positive or negative) to a change in domestic demand?

An alternative logistic form. The linear parameter on the time trend makes it possible for imports to exceed demand also. Seeking to eliminate this problem, I decided to try estimation of an alternative functional form that has the virtue of imposing a logistic curve on the time trend, to see if it yielded any improvement in fit or plausibility of results. This alternative form is

[66] See Barker (1987), p.232.

$$M_{it} = \frac{(a + b_1 U_{it})(\sum_{i=0}^{5} w_i (\frac{p_f}{p_d})_{t-i})^{b_2}}{1 + b_3 e^{b_4 t}} + b_5$$

$$X_{it} = \frac{(a + b_1 D_{it})(\sum_{i=0}^{5} w_i (\frac{p_d}{p_f})_{t-i})^{b_2}}{1 + b_3 e^{b_4 t}} + b_5$$

where the b's are estimated with a non-linear least squares procedure[67]. With this function, as time passes *ceteris paribus* imports rise or fall (depending on the sign of the time parameter) to an asymptote, specifically to the parameter b_5. However, I encountered various problems in developing these estimates. It proved more difficult than I expected to program soft constraints on the parameters in the non-linear least squares procedure. Moreover, the estimates that yielded reasonable price parameters without constraints provided little improvement over the original function in terms of fit, and the asymptotes were often very large. Finally, the time parameters in the original set of functions do not seem so large as to yield inappropriately large results within the time frame of this model.

In truth, I found it hard to choose between equations. A few examples are shown below of the estimated elasticities and adjusted R-square for 1) the original form, estimated with the unconstrained nonlinear algorithm, 2) the original form, estimated through constrained OLS (the equations actually used in the model), and 3) the alternative form, estimated with the unconstrained nonlinear algorithm. The examples show demand, price and time elasticities, all evaluated in the base year, 1984. In 1984, the time trend variable is increasing by slightly more than one percent per year, so the time elasticities show the approximate percentage effect of the time variable on the dependent variable in the base year. Comparison of these estimations reveals some of the difficulties encountered in choosing between forms. While the results of the original INFORUM approach were generally upheld — poor fits remained poor fits with the alternative formulation — it is difficult to use the results to arrive at strong conclusions.

Food Imports

	Original		
	Unconstrained	Constrained	Alternative
Demand elasticity	0.888	0.883	0.471
Price elasticity	-0.979	-0.903	-0.854
Time elasticity	-2.009	-1.699	-0.000
$\bar{R}^2$	0.768	0.792	0.813

For the food import equations, the constrained equation differs little from the unconstrained one; in fact, the constrained equation estimated using ordinary least squares

[67] The program employed the Broyden-Fletcher-Goldfarb-Shannon variable metric minimization variant of the conjugant gradient minimization algorithm.

provides a better fit than the unconstrained equation estimated using nonlinear least squares, probably reflecting a weakness of the particular nonlinear algorithm employed. The alternative equation seems superior in terms of overall fit; however, the demand elasticity is half as large in the original equations, the time elasticity is negligible, and all of the parameters have much higher standard errors (not shown).

Electronic Equipment Imports

	Original		
	Unconstrained	Constrained	Alternative
Demand elasticity	0.804	0.789	0.805
Price elasticity	-0.327	-1.042	-1.710
Time elasticity	2.607	2.502	-0.000
$\bar{R}^2$	0.993	0.991	0.974

For the Electronic equipment import equations, the constrained equation yields a considerably larger — and in my opinion more plausible — price elasticity with essentially no change in fit or in the other parameters. The alternative equation yields a poorer fit, a sharply higher price elasticity, and, as with the food equation, a negligible time elasticity. Again, the parameters in the alternative equation all had high standard errors and low significance, except, in this case, for the demand parameter.

Office Equipment and Computer Exports

	Original		
	Unconstrained	Constrained	Alternative
Demand elasticity	1.543	1.677	1.678
Price elasticity	-0.092	-0.964	-0.965
Time elasticity	-4.246	-4.315	-1.603
$\bar{R}^2$	0.917	0.910	0.950

The constrained Office equipment export equation yields a larger price elasticity than the unconstrained equation with little change either in fit or in the other parameters. The alternative form yields a better fit; the demand and price elasticities are the same as those in the constrained original equation, while the time elasticity is smaller but certainly plausible. However, the standard errors of the parameters were very high. I see no obvious way to choose between equations.

Plastics Exports

	Original		
	Unconstrained	Constrained	Alternative
Demand elasticity	0.997	1.028	0.875
Price elasticity	-0.726	-0.978	-0.691
Time elasticity	-0.238	-0.156	1.137
$\bar{R}^2$	0.962	0.960	0.966

For the plastics export equations, the unconstrained and constrained original equations are very similar. The alternative equation has roughly similar fit and demand and price elasticities, but yields a fairly large positive time elasticity. Again, the standard errors of the parameters are all quite large. As with the previous equation, the choice between alternative forms is not clear cut.

Given the technical problems and difficult judgement calls presented by the alternative nonlinear approach, I chose to use the original constrained equations and leave the development of an alternative for a later date. I still consider the project worth the effort, though I suspect that useful alternative equations will require longer time series than I had available (about 15 data points).

Time trend equations. Using the original form, another problem that required attention was the occasional parameter with the wrong sign. While one would expect the demand coefficient b to be positive for both the import and export equations, it takes the wrong sign in some sectors; again, negative demand coefficients can contribute to instability in the model and are unacceptable. In such cases I dispensed with the demand term altogether and used time trend equations of the form

$$\log X_{i\,t} = a + b\,t + c \log \left(\sum_{i=0}^{5} w_i \left(\frac{p_d}{p_f}\right)_{t-i} \right)$$

Fortunately, these pure time trend equations proved necessary only in the case of eight export equations, for they are quite unsatisfactory for two reasons. It is disconcerting enough to have to include equations with so little theoretical or empirical justification, but moreover these time equation have very poor fits with insignificant parameters. I include them in the model only because I have nothing better for the time being.

Noncompetitive imports. In two import sectors, metal ores and office machinery, imports consistently take more than 88% of the market and can therefore be considered, in this sense, noncompetitive. For these sectors, then, imports are taken to be a constant share of demand, corresponding to the share in the last year of historical data.

Other equations. Finally, there are five sectors where imports are clearly dominated by special considerations. They are Other metals, Ordnance, Coal, Oil and Industrial plant and equipment. It became clear during the process of estimation that in the first two sectors mentioned — Other metals and Ordnance — Britain serves as something of an international clearing house; in these cases I estimated equations with the demand term including exports as well as domestic use.

It also became evident that Coal imports are unrelated to demand but are instead related to domestic supply disruptions. I therefore estimated a coal equation with current and lagged inventory change as the main explanatory variables. The results were as follows:

```
                                 Coal Imports
SEE    =       26.98 RSQ    = 0.9384 RHO =    0.32 Obser   =    12 from 1975.000
SEE+1  =       26.75 RBSQ   = 0.9154 DW  =    1.36 DoFree  =     8 to   1986.000
MAPE   =       18.51
Variable name               Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 rimp2                    - - - - - - - - - - - - - - - - - - - -      194.12
1 intercept               629.15727   283.8  10.481   3.24   0.000        1.00
2 rdstk2                   -0.16881    99.5  -4.883  -0.04  -0.436       46.14
3 rdstk2[1]                -0.18293   117.2  -5.454  -0.02  -0.485       19.73
4 rpi2                   -355.51728   170.5  -7.110  -2.18  -0.636        1.19
```

Similarly, the development of the British domestic oil industry completely dominates the trends in the historical oil import data. Therefore, rather than having a demand- and price-dependent equation for oil, the model has domestic oil output and the world oil price set exogenously, with domestic and export demands responding to price; oil imports are a residual between total demand and domestic output.

Finally, demand for imported Industrial plant clearly responds to heavy demand in the previous year, so that lagged demand proved to be a more appropriate independent variable and was included in the estimation instead of current demand.

Merchandise trade results. The main results for merchandise trade, shown in Tables IV.5.1 through IV.5.5, illustrate the previous discussion. All things considered, the import equations generally have better fits and more plausible parameters than do the export equations. I suspect two causes for this, both related to the data. One is that domestic prices are used in calculating the relative price of exports, and this may be an inappropriate measure of export prices. The other is that I am not entirely comfortable with the distribution of the United Nations trade data between my commodity classifications, so that there may be significant errors in the measures of export demand.

Services results. Trade in services proved to be somewhat more complicated because of the paucity of price and quantity data, and as a consequence the service equations are considerably more *ad hoc* than are the merchandise equations. All service imports are assumed to be a simple proportion of demand and independent of prices, based on imports average share over the early 1980's, as follows:

Distribution, hotels, etc.	0.0455
Transportation	0.3280
Communication	0.0650
Banking, finance, etc.	0.0250
Other services	0.0200

The service export equations relate service exports to total merchandise exports and, in the case of transportation exports, a time trend. The exceptions are Construction service exports, which are calculated *ad hoc* as a fixed percentage of total exports, and Distribution, hotels etc., which is calculated as a fixed 7% share of total exports plus 5% annual growth of the hotels and catering component. The other service export equations are as follows.

Transportation Exports

```
SEE    =      402.90 RSQ   = 0.5695 RHO =   0.16 Obser  =   10 from 1976.000
SEE+1  =      397.52 RBSQ  = 0.4465 DW  =   1.67 DoFree =    7 to   1985.000
MAPE   =        4.44
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta      Mean
0 ukexp55.49p            - - - - - - - - - - - - - - - - - - - - - -  7078.27
1 intercept             21367.98953    72.5   3.718   3.02   0.000      1.00
2 ukxmfgp                   0.02132     0.9   0.363   0.18   0.181  61034.86
3 time                   -193.67953    21.3  -1.818  -2.20  -0.906     80.50
```

Communication Exports

SEE =	55.42	RSQ = 0.8326	RHO = -0.20	Obser = 10	from 1976.000			
SEE+1 =	53.92	RBSQ = 0.8116	DW = 2.40	DoFree = 8	to 1985.000			
MAPE =	11.76							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 ukexp55.50p	- - - - - -	- - -	- - -	- - -	- - -	382.90
1 intercept	-1067.15775	91.7	-4.625	-2.79	-0.000	1.00
2 ukxmfgp	0.02376	144.4	6.307	3.79	0.912	61034.86

Banking, Finance, Etc. Exports

SEE =	316.62	RSQ = 0.5619	RHO = 0.26	Obser = 10	from 1976.000			
SEE+1 =	314.91	RBSQ = 0.5071	DW = 1.48	DoFree = 8	to 1985.000			
MAPE =	5.58							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 ukexp55.51p	- - - - - -	- - -	- - -	- - -	- - -	4511.04
1 intercept	303.63984	0.3	0.230	0.07	0.000	1.00
2 ukxmfgp	0.06893	51.1	3.203	0.93	0.750	61034.86

Other Services Exports

SEE =	39.86	RSQ = 0.4388	RHO = 0.04	Obser = 10	from 1976.000			
SEE+1 =	39.95	RBSQ = 0.3686	DW = 1.91	DoFree = 8	to 1985.000			
MAPE =	3.04							

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 ukexp55.53p	- - - - - -	- - -	- - -	- - -	- - -	1170.85
1 intercept	757.27667	89.8	4.563	0.65	0.000	1.00
2 ukxmfgp	0.00678	33.5	2.501	0.35	0.662	61034.86

Comparison with other studies. It is difficult to compare these results with those of other studies because approaches to trade estimation vary so widely. The Cambridge group, for instance, relate exports to foreign demand and three separate price indices — own-price, foreign competitors' price, and foreign wholesale price — each with only a one year lag. For imports, they relate the ratio of imports to domestically sold domestic production (not the import share of the domestic market) to domestic per capita final demand, capacity utilization and two price indices, the domestic and foreign, each again with only one lag. Granted these obstacles to comparison, however, our results seem not entirely out of line. Barker and Peterson (1987) review a number of studies including their own, which are used in the Cambridge model. For exports, they report a range of aggregate export price elasticities from -0.25 to -3.00, with an average near -1.00. Aggregate demand elasticities range from 0.60 to 1.20, with an average near 0.80. Their own results for manufactured goods, derived using individual commodity elasticities weighted by 1981 exports, are a -0.902 aggregate price elasticity and a 0.755 aggregate demand elasticity. By comparison, ours are approximately -0.83 and 0.74.

For imports, the comparison does not hold up quite as well. Barker and Peterson report a range of aggregate export price elasticities from 0.40 to -6.00, with an average near -1.1. Aggregate demand elasticities range from 1.20 to 2.66, with an average near 1.90. Their own results for manufactured goods, derived using individual commodity elasticities weighted by 1981 exports, are a -1.482 aggregate price elasticity and a 2.795 aggregate demand elasticity. By comparison, ours are approximately -0.8 and 0.9. The main reason for the contrast is that time trends do much to account for rising imports in our equations; without the time trends, our manufactures import equations yield an aggregate price elasticity of about -1.05 and a demand elasticity of about 1.1. However, even without time trends, this demand term for manufactured imports is lower than that of any other documented study that I have seen. The only explanation I can think of is that other estimations generally cover the 1950's through 1970's while ours covers the mid-1970's through mid-1980's.

TABLE IV.5.1: IMPORT REGRESSIONS WITH TIME TREND
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Time (C)	Demand Elasticity	Rbarsq	Imports'84
	1 Agriculture, etc.	0.00	-1.00	-4105.08	-0.121	117.512	-0.508	0.674	4348.
			(-2.95)	(-0.57)	(2.58)				
*	4 Mineral oil processing	-1.00	-1.00	-22846.93	0.157	304.60	20.298	0.900	2421.
			(-6.01)	(2.80)	(7.41)				
	10 Iron & steel	0.00	-1.00	-1705.78	0.019	35.016	0.086	0.359	1697.
			(-0.75)	(0.31)	(1.55)				
*	11 Other metals	-0.50	-1.00	-5072.11	0.756	34.755	1.823	0.833	2423.
			(-4.37)	(8.18)	(2.83)				
*	12 Products of stone,etc.	-0.90	-1.00	-2274.70	0.042	33.571	0.332	0.952	1186.
			(-2.93)	(0.85)	(5.42)				
*	13 Basic chemicals	-1.00	-1.00	-16197.64	0.377	202.361	0.783	0.977	7139.
			(-11.04)	(4.89)	(11.66)				
	14 Pharmaceuticals	-0.80	-1.00	-3352.95	0.001	48.017	0.002	0.970	1005.
			(-6.10)	(0.01)	(5.04)				
*	15 Soap & toilet preparations	-1.00	-1.00	-1423.96	0.161	17.866	0.682	0.995	449.
			(-22.94)	(5.97)	(16.93)				
*	16 Man-made fibers	-0.20	-1.00	-1043.53	0.086	16.026	0.153	0.917	502.
			(-6.77)	(1.87)	(9.75)				
*	17 Other metal products	-0.30	-1.00	-4177.31	0.044	57.695	0.322	0.930	1468.
			(-4.39)	(1.42)	(6.71)				
	18 Industrial plant	-1.00	-1.00	-182.08	0.208	-1.528	2.153	0.699	465.
			(-0.91)	(2.57)	(-0.39)				
*	19 Agricultural machinery	0.00	-1.00	-2072.73	0.113	29.629	0.162	0.78	6545.
			(-3.70)	(1.29)	(5.01)				
	20 Machine tools	-1.00	-1.00	-662.46	0.342	8.994	0.828	0.612	695.
			(-1.06)	(3.44)	(1.43)				
*	21 Textile, mining, etc. mach.	-0.60	-1.00	-5008.75	0.259	67.455	0.562	0.897	2476.
			(-5.15)	(3.45)	(7.57)				
*	22 Other machinery n.e.s.	-0.50	-1.00	-7113.30	0.157	97.198	0.494	0.959	3071.
			(-6.64)	(2.19)	(12.65)				
	23 Ordnance	-1.10	-1.00	-188.12	0.032	3.073	0.384	0.733	124.
			(-1.79)	(2.67)	(2.21)				
*	25 Basic electrical equipment	-1.00	-1.00	-7036.66	0.191	89.729	0.570	0.973	2059.
			(-9.74)	(2.84)	(14.48)				
*	26 Electronic equipment	-1.00	-1.00	-9526.18	0.403	126.169	0.707	0.991	7065.
			(-6.58)	(8.86)	(6.02)				
*	27 Domestic electrical appl.	-1.00	-1.00	-2398.41	0.387	30.121	0.759	0.986	956.
			(-13.85)	(5.80)	(10.23)				
	28 Electric lighting equipment	-1.00	-1.00	-698.67	0.029	10.004	0.154	0.970	268.
			(-9.83)	(0.60)	(8.31)				
*	29 Motor vehicles	0.00	-1.00	-26793.41	0.290	347.770	0.550	0.963	9051.
			(-13.27)	(3.01)	(10.50)				
*	30 Shipbuilding & repairing	0.00	-1.00	-6318.24	1.000	53.351	4.874	0.873	2854.
			(-4.19)	(9.25)	(3.27)				
*	31 Aerospace engineering	0.00	-1.00	-8606.76	0.933	78.575	1.700	0.581	1480.
			(-2.95)	(3.31)	(2.14)				
*	32 Other vehicles	0.00	-1.00	-376.76	0.228	4.324	1.040	0.848	228.
			(-4.56)	(7.15)	(4.25)				
	33 Instrument engineering	-1.00	-1.00	-3783.93	0.205	53.168	0.316	0.951	1689.
			(-3.77)	(0.98)	(3.38)				
*	34 Food	-1.00	-1.00	11795.00	0.168	-134.025	0.950	0.792	6039.
			(5.07)	(2.00)	(-5.98)				

TABLE IV.5.1: IMPORT REGRESSIONS WITH TIME TREND (continued)
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Time (C)	Demand Elasticity	Rbarsq	Imports'84
*	35 Drink	-1.20	-1.00	-2192.39	0.286	20.500	1.348	0.835	1510.
			(-4.24)	(3.41)	(2.82)				
*	36 Tobacco	0.00	-1.00	-787.04	0.170	8.509	1.558	0.400	95.
			(-1.40)	(2.25)	(1.48)				
*	37 Yarn	-1.00	-1.00	-4924.07	0.422	62.225	0.760	0.878	1991.
			(-5.15)	(5.37)	(6.65)				
*	38 Textiles	-0.60	-1.00	-3754.60	0.059	56.240	0.202	0.900	1659.
			(-4.43)	(0.60)	(8.50)				
*	39 Apparel	-1.00	-1.00	-5719.39	0.098	86.418	0.198	0.893	2902.
			(-7.97)	(0.60)	(8.20)				
*	40 Leather & footwear	-0.50	-1.00	-4323.59	0.109	62.932	0.191	0.950	1569.
			(-10.41)	(0.88)	(11.70)				
	41 Timber & wood products	-0.50	-1.00	-3726.26	0.476	27.590	1.665	0.768	2561.
			(-3.10)	(6.30)	(2.74)				
	42 Pulp & paper	-1.00	-1.00	-1290.53	0.316	16.117	0.964	0.862	3615.
			(-1.21)	(4.54)	(1.76)				
	43 Printing & publishing	-0.60	-1.00	-1579.17	0.067	18.795	0.944	0.967	796.
			(-9.23)	(3.71)	(5.47)				
*	44 Rubber	-0.40	-1.00	-1740.56	0.100	24.622	0.319	0.945	701.
			(-5.31)	(1.71)	(8.55)				
*	45 Plastics	-0.30	-1.00	-4803.59	0.117	64.477	0.460	0.966	1844.
			(-9.65)	(2.27)	(7.93)				
	46 Other manufacturing	0.00	-1.00	501.36	0.836	-10.410	1.264	0.745	1896.
			(0.37)	(5.84)	(-0.63)				

TABLE IV.5.2: IMPORT REGRESSIONS WITHOUT TIME TREND

T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Demand Elasticity	Rbarsq	Imports'84
*	1 Agriculture, etc.	-0.70	-1.00	606.1	0.186	0.837	0.583	4348.
			(0.38)	(1.87)				
	4 Mineral oil processing	-1.90	-1.00	4570.4	0.023	0.043	0.681	2421.
			(2.58)	(0.19)				
*	10 Iron & steel	-0.80	-1.00	1341.3	0.003	0.015	0.352	1697.
			(5.46)	(0.11)				
	11 Other metals	-0.60	-1.00	-2276.6	0.753	1.982	0.737	2423.
			(-3.08)	(6.42)				
	12 Products of stone, etc.	-1.50	-1.00	1031.8	-0.025	-0.221	0.924	1186.
			(2.19)	(-0.40)				
	13 Basic chemicals	-1.90	-1.00	-1781.8	0.578	1.364	0.869	7139.
			(-0.75)	(2.91)				
*	14 Pharmaceuticals	-0.90	-1.00	-593.7	0.471	1.761	0.901	1005.
			(-4.49)	(8.48)				
	15 Soap & toilet preparations	-1.40	-1.00	-388.8	0.499	2.088	0.875	449.
			(-3.74)	(5.87)				
	16 Man-made fibers	0.00	-1.00	433.8	-0.192	-0.453	0.148	502.
			(5.64)	(-1.71)				
	17 Other metal products	-1.00	-1.00	1893.1	-0.107	-0.922	0.746	1468.
			(6.49)	(-3.48)				
*	18 Industrial plant	-1.00	-1.00	-241.7	0.184	1.880	0.723	465.
			(-1.97)	(3.79)				
	19 Agricultural machinery	-0.80	-1.00	705.1	-0.201	-0.303	0.451	545.
			(6.58)	(-2.32)				
*	20 Machine tools	-1.20	-1.00	153.9	0.293	0.748	0.641	695.
			(1.23)	(3.96)				
	21 Textile, mining, etc. mach.	-1.50	-1.00	1851.3	-0.066	-0.162	0.613	2476.
			(3.90)	(-0.59)				
	22 Other machinery n.e.s.	-1.70	-1.00	3539.9	-0.168	-0.576	0.668	3071.
			(2.15)	(-0.83)				
*	23 Ordnance	-1.90	-1.00	46.7	0.053	0.629	0.745	124.
			(3.12)	(4.60)				
	25 Basic electrical equipment	-1.90	-1.00	2889.3	-0.385	-1.694	0.648	2059.
			(3.32)	(-2.09)				
	26 Electronic equipment	-1.00	-1.00	-839.2	0.648	1.195	0.969	7065.
			(-3.63)	(16.22)				
	27 Domestic electrical appl.	-1.00	-1.00	-682.9	0.961	1.833	0.884	956.
			(-5.07)	(8.54)				
*	28 Electric lighting equipment	-1.80	-1.00	-84.7	0.281	1.418	0.834	268.
			(-1.27)	(3.39)				
	29 Motor vehicles	-0.70	-1.00	-5810.3	0.924	1.921	0.612	9051.
			(-2.25)	(3.94)				
	30 Shipbuilding	-0.50	-1.00	-1984.2	1.020	9.462	0.755	2854.
			(-4.54)	(7.15)				
	31 Aerospace engineering	-1.00	-1.00	-2371.4	0.995	1.980	0.567	1480.
			(-1.45)	(2.91)				
	32 Other vehicles	-1.00	-1.00	-79.4	0.311	1.866	0.624	228.
			(-1.93)	(5.71)				
*	33 Instrument engineering	-1.00	-1.00	-404.5	0.859	1.359	0.899	1689.
			(-2.52)	(7.50)				
	34 Food	-0.50	-1.00	3262.7	0.073	0.406	0.791	6039.
			(1.66)	(1.08)				

TABLE IV.5.2: IMPORT REGRESSIONS WITHOUT TIME TREND (continued)
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Demand Elasticity	Rbarsq	Imports'84
	35 Drink	-1.50	-1.00	-1496.9	0.468	2.228	0.789	1510.
			(-3.13)	(5.33)				
	36 Tobacco	0.00	-1.00	43.9	0.063	0.565	0.341	95.
			(1.32)	(2.78)				
	37 Yarn	-1.90	-1.00	941.7	0.200	0.405	0.571	1991.
			(2.28)	(1.71)				
	38 Textiles	-1.80	-1.00	2567.2	-0.331	-1.475	0.404	1659.
			(2.57)	(-1.52)				
	39 Apparel	0.00	-1.00	-2405.0	0.990	2.281	0.358	2902.
			(-1.72)	(2.87)				
	40 Leather & footwear	-1.90	-1.00	70.2	0.428	0.935	0.449	1569.
			(0.09)	(1.14)				
*	41 Timber & wood products	-1.00	-1.00	-1484.5	0.482	1.764	0.760	2561.
			(-3.10)	(7.23)				
*	42 Pulp & paper	-1.20	-1.00	-11.6	0.322	1.004	0.865	3615.
			(-0.02)	(4.84)				
*	43 Printing & publishing	-1.00	-1.00	-676.2	0.143	2.041	0.897	796.
			(-4.74)	(8.11)				
	44 Rubber	-1.40	-1.00	826.4	-0.194	-0.707	0.744	701.
			(5.02)	(-2.27)				
	45 Plastics	-1.00	-1.00	-747.4	0.385	1.565	0.812	1844.
			(-2.37)	(5.17)				
*	46 Other manufacturing	0.00	-1.00	-318.3	0.827	1.206	0.761	1896.
			(-1.02)	(6.00)				

TABLE IV.5.3: EXPORT REGRESSIONS WITH TIME TREND
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Time (C)	Demand Elasticity	Rbarsq	Exports'84
	1 Agriculture, etc.	-1.00	-1.00	-6398.62	7.14	84.128	0.511	0.922	1453.8
			(-5.36)	(1.27)	(4.02)				
*	2 Coal & coke	0.00	-1.00	1747.75	4.88	-25.674	2.960	0.654	173.9
			(3.90)	(4.97)	(-3.87)				
	4 Mineral oil processing	-0.20	-1.00	2757.64	9.87	-3.873	0.316	-0.081	4298.4
			(0.85)	(0.69)	(-0.07)				
*	8 Metal ores & minerals	-1.20	-1.00	-5021.99	7.75	63.638	0.706	0.512	1382.2
			(-5.54)	(1.90)	(4.77)				
*	11 Other metals	0.00	-1.00	4611.74	31.40	-70.273	1.746	0.726	1657.4
			(3.57)	(5.33)	(-3.27)				
	12 Products of stone, etc.	-1.00	-1.00	822.31	6.35	-6.432	0.709	0.817	1089.0
			(1.01)	(1.86)	(-0.48)				
	13 Basic chemicals	-1.00	-1.00	-6950.45	50.94	101.337	0.769	0.569	7592.7
			(-0.68)	(1.33)	(0.62)				
	14 Pharmaceuticals	0.00	-1.00	6709.73	29.35	-103.347	3.037	0.884	1132.0
			(2.84)	(3.56)	(-2.73)				
	15 Soap & toilet preparations	-1.00	-1.00	3477.24	18.17	-54.388	2.415	0.843	819.0
			(2.61)	(4.05)	(-2.58)				
	17 Other metal products	-1.50	-1.00	-1103.18	-0.14	25.983	-0.014	0.791	1113.3
			(-2.17)	(-0.06)	(2.97)				
*	18 Industrial plant	-1.60	-1.00	1323.19	3.63	-13.145	0.676	0.850	586.5
			(3.15)	(3.80)	(-2.10)				
*	19 Agricultural machinery	-0.20	-1.00	3658.60	6.47	-43.384	1.045	0.709	719.5
			(5.20)	(2.08)	(-4.99)				
*	20 Machine tools	0.00	-1.00	2458.86	3.83	-28.827	0.982	0.798	457.6
			(9.09)	(2.82)	(-6.57)				
*	21 Textile, mining, etc. mach.	-1.00	-1.00	4907.12	15.58	-53.624	0.852	0.797	2322.4
			(5.67)	(3.68)	(-3.91)				
*	22 Other machinery n.e.s.	-1.00	-1.00	5239.58	25.30	-59.793	0.949	0.730	3190.9
			(3.48)	(3.58)	(-2.30)				
	23 Ordnance	-1.90	-1.00	-1374.82	-3.16	23.939	-0.995	0.595	351.6
			(-2.01)	(-1.17)	(2.19)				
*	24 Office machinery	-1.00	-1.00	9717.12	45.25	-138.601	1.660	0.910	2933.9
			(3.18)	(8.20)	(-3.28)				
	25 Basic electrical equipment	-1.60	-1.00	4018.55	25.53	-57.519	1.438	0.771	1858.5
			(1.22)	(2.73)	(-1.14)				
	26 Electronic equipment	0.00	-1.00	5534.97	47.23	-82.454	1.376	0.862	4431.7
			(0.54)	(1.81)	(-0.54)				
	27 Domestic electrical appl.	-1.00	-1.00	966.43	6.18	-12.801	1.220	0.745	563.7
			(1.04)	(2.18)	(-0.89)				
	28 Electric lighting equipment	-1.90	-1.00	40.20	0.74	0.180	0.594	0.764	151.4
			(0.36)	(1.80)	(0.10)				
*	29 Motor vehicles & parts	-1.10	-1.00	10047.60	17.39	-93.710	0.482	0.696	4065.6
			(2.63)	(1.18)	(-1.50)				
	31 Aerospace engineering	0.00	-1.00	-6547.91	1.94	117.362	0.062	0.608	3984.7
			(-1.04)	(0.10)	(1.17)				
*	32 Other vehicles	-1.90	-1.00	1038.92	0.64	-10.698	0.318	0.877	159.6
			(7.35)	(0.72)	(-4.40)				
	33 Instrument engineering	-0.50	-1.00	-254.97	7.60	7.226	0.701	0.908	1198.6
			(-0.25)	(2.56)	(0.46)				
	36 Tobacco	-1.10	-1.00	-715.88	4.50	9.066	0.899	0.740	485.9
			(-1.67)	(2.17)	(1.23)				

TABLE IV.5.3: EXPORT REGRESSIONS WITH TIME TREND (continued)
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Time (C)	Demand Elasticity	Rbarsq	Exports'84
	37 Yarn	-1.90	-1.00	516.06	5.67	-2.028	0.635	0.307	945.9
			(0.52)	(0.89)	(-0.11)				
*	38 Textiles	-1.10	-1.00	3398.03	11.92	-47.026	1.965	0.657	699.5
			(3.28)	(1.79)	(-2.36)				
	39 Apparel	-1.70	-1.00	2010.87	18.12	-31.114	1.502	0.889	1222.7
			(0.88)	(2.13)	(-0.83)				
	40 Leather & footwear	-1.00	-1.00	2396.32	9.92	-33.762	1.869	0.194	583.0
			(1.02)	(0.96)	(-0.85)				
	41 Timber & wood products	-1.90	-1.00	-257.41	4.12	1.819	1.303	0.614	282.6
			(-0.60)	(2.04)	(0.24)				
*	42 Pulp & paper	-1.90	-1.00	-1890.59	3.95	27.032	0.501	0.792	776.4
			(-6.74)	(2.46)	(5.38)				
	43 Printing & publishing	-0.20	-1.00	1819.17	9.19	-23.485	1.218	0.578	887.5
			(1.59)	(2.08)	(-1.25)				
	44 Rubber	-0.20	-1.00	1296.91	4.59	-14.360	0.859	0.002	610.4
			(1.84)	(1.27)	(-1.14)				
	45 Plastics	-1.00	-1.00	104.86	10.22	-1.845	1.049	0.960	1011.9
			(0.09)	(4.08)	(-0.11)				

TABLE IV.5.4: EXPORT REGRESSION WITHOUT TIME TREND

T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Demand Elasticity	Rbarsq	Exports'84
*	1 Agriculture, etc.	-1.00	-1.00	-1658.17	28.353	2.135	0.833	1453.8
			(-6.01)	(9.34)				
	2 Coal & coke	-1.00	-1.00	-94.26	2.891	1.320	0.255	173.9
			(-1.03)	(3.40)				
*	4 Mineral oil processing	-0.20	-1.00	2535.51	9.001	0.287	0.016	4298.4
			(3.84)	(1.33)				
	8 Metal ores & minerals	0.00	-1.00	180.36	9.511	0.863	0.137	1382.2
			(0.31)	(1.61)				
	11 Other metals	0.00	-1.00	494.66	15.081	0.756	0.486	1657.4
			(1.30)	(3.51)				
*	12 Products of stone, etc.	-1.00	-1.00	435.59	4.900	0.544	0.829	1089.0
			(3.14)	(3.15)				
*	13 Basic chemicals	-1.00	-1.00	-707.85	73.678	1.097	0.592	7592.7
			(-0.85)	(7.32)				
*	14 Pharmaceuticals	0.00	-1.00	257.67	6.971	0.740	0.800	1132.0
			(2.87)	(6.41)				
*	15 Soap & toilet preparations	-1.10	-1.00	31.34	6.945	0.960	0.752	819.0
			(0.44)	(7.97)				
*	17 Other metal products	-1.10	-1.00	578.50	4.400	0.450	0.776	1113.3
			(6.90)	(4.79)				
	18 Industrial plant	-1.90	-1.00	400.71	2.279	0.402	0.848	586.5
			(9.10)	(4.97)				
	19 Agricultural machinery	-1.40	-1.00	695.31	1.669	0.199	0.444	719.5
			(1.70)	(0.43)				
	20 Machine tools	-1.10	-1.00	312.52	1.770	0.412	0.624	457.6
			(2.53)	(1.43)				
	21 Textile, mining, etc. mach.	-1.60	-1.00	1327.44	8.778	0.461	0.658	2322.4
			(3.08)	(2.12)				
	22 Other machinery	-1.40	-1.00	1431.03	14.418	0.536	0.709	3190.9
			(4.43)	(4.18)				
*	23 Ordnance	-1.90	-1.00	108.56	2.233	0.682	0.424	351.6
			(1.03)	(1.73)				
	24 Office machinery & computers	-0.90	-1.00	-271.18	27.292	1.095	0.860	2933.9
			(-1.92)	(11.75)				
*	25 Basic electrical equipment	-1.60	-1.00	269.13	14.938	0.861	0.774	1858.5
			(2.90)	(12.51)				
*	26 Electronic equipment	0.00	-1.00	26.06	33.326	0.993	0.870	4431.7
			(0.09)	(9.04)				
*	27 Domestic electrical appl.	-1.00	-1.00	140.94	3.700	0.741	0.742	563.7
			(4.34)	(8.78)				
*	28 Electric lighting equipment	-1.90	-1.00	51.28	0.777	0.625	0.784	151.4
			(4.06)	(5.15)				
	29 Motor vehicles & parts	-1.50	-1.00	3773.32	4.599	0.120	0.692	4065.6
			(6.52)	(0.71)				
*	31 Aerospace engineering	0.00	-1.00	805.69	24.831	0.782	0.594	3984.7
			(1.63)	(4.31)				
	32 Other vehicles	-1.90	-1.00	451.48	-2.396	-1.021	0.705	159.6
			(5.91)	(-2.69)				
*	33 Instrument engineering	-0.50	-1.00	213.67	8.945	0.823	0.917	1198.6
			(4.64)	(16.16)				

TABLE IV.5.4: EXPORT REGRESSIONS WITHOUT TIME TREND (continued)
T-Statistics in parentheses

	Commodity	Price Elasticities Estimate	A Priori	Constant (A)	Demand (B)	Demand Elasticity	Rbarsq	Exports'84
*	36 Tobacco	-1.00	-1.00	-199.02	6.640	1.382	0.752	485.9
			(-1.90)	(6.04)				
*	37 Yarn	-1.90	-1.00	410.76	5.026	0.564	0.383	945.9
			(2.14)	(2.33)				
	38 Textiles	-1.10	-1.00	967.75	-3.457	-0.577	0.529	699.5
			(6.60)	(-1.99)				
*	39 Apparel	-1.70	-1.00	104.27	11.114	0.918	0.893	1222.7
			(1.16)	(9.92)				
*	40 Leather & footwear	-1.30	-1.00	379.02	1.792	0.327	0.245	583.0
			(3.13)	(1.26)				
*	41 Timber & wood products	-1.90	-1.00	-153.77	4.600	1.454	0.646	282.6
			(-3.53)	(8.99)				
	42 Pulp & paper	-1.00	-1.00	-45.90	7.470	1.063	0.358	776.4
			(-0.43)	(6.05)				
*	43 Printing & publishing	-0.30	-1.00	375.02	3.923	0.529	0.564	887.5
			(5.37)	(4.57)				
*	44 Rubber	-0.60	-1.00	398.01	1.701	0.303	0.012	610.4
			(4.84)	(1.77)				
*	45 Plastics	-1.00	-1.00	-22.46	9.936	1.021	0.964	1011.9
			(-0.70)	(23.17)				

TABLE IV.5.5: EXPORT TIME EQUATIONS
LOG(EXPORTS) = A + (B * TIME) + (C * RELATIVE PRICE)
(T-statistics in parentheses)

	Commodity	Constant	Time	Price elasticity	Rbarsq	Exports
*	9 Stone, clay, sand & gravel	-3.3	0.113	-3.27	-0.025	16.0
	(-0.38)	(0.82)	(-1.11)			
*	10 Iron & steel	5.1	0.056	-2.27	0.128	1931.0
	(4.08)	(1.91)	(-1.93)			
*	16 Man-made fibers	6.6	-0.002	-0.49	-0.025	373.0
	(6.17)	(-0.28)	(-1.16)			
*	30 Shipbuilding & repairing	8.6	-0.002	-2.72	0.404	176.0
	(2.81)	(-0.04)	(-1.64)			
*	34 Food	3.1	0.076	-1.89	0.584	2140.0
	(2.75)	(3.71)	(-3.25)			
*	35 Drink	8.4	-0.006	-0.87	0.438	1341.0
	(16.78)	(-1.09)	(-3.14)			
*	46 Other manufacturing	10.5	-0.020	-1.77	0.139	1039.0
	(4.19)	(-0.45)	(-0.86)			

Section IV.6 Final Demand: Government

British general government final consumption[68] has been remarkably consistent, taking 20% to 22% of gross domestic product for a generation — 20.7% of GDP in 1984. Since 1970, central government has accounted for 60-62% of the total (61.8% in 1984); of this portion, defense and the National Health Service have accounted for about three eighths each, with all other current activities financed out of the remaining quarter. Local government has spent the remaining 38-40% of the total (38.2% in 1984), mainly on education and public housing.

In BRIM, government consumption is set exogenously for these four components — defense, health, other central, and local government. Each of these components has a separate column in the government bridge matrix, whose coefficients represent the pattern of commodity demand by component in 1984. The model thus provides for changing commodity demand patterns in government purchases as spending priorities shift between competing ends.

The stability found in government final consumption is **not** found in the government's receipt and expenditure trends. Total government current expenditures include social security expenditures, which rose from around 6% of gross domestic product in the early 1960's to over 13% in the early 1980's, where they have hovered through most of the decade; they also include interest on the public debt, which rose from under 4% in the early 1960's to 5% in the early 1980's. Interest on the debt fell after 1982 but was still 4.3% of GDP in 1987. Total expenditures also include subsidies to government enterprises and miscellaneous grants; all told, government expenditures rose from about 33% of GDP in the early 1960's to over 42% of GDP in the early 1980's, with considerable fluctuations offsetting the business cycles that occurred during the period. These fluctuations and those in government receipts will be discussed further in Section IV.11, where macro equations covering government activity will be presented.

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[68] Unlike the U.S. National Income and Product Accounts, the British National Accounts take explicit account of government investment in gross domestic fixed capital formation.

Section IV.7 Productivity and Employment

Sectoral productivity growth is ultimately a complex function of factor inputs, production scales, institutional factors, rates of investment in human and physical capital, and research and development. Ideally, therefore, a model should relate productivity growth and labor requirements to all of these variables, and at a minimum should relate productivity to a function of technical change and total factor inputs. BRIM does not achieve this ideal; instead, the model uses measures of sectoral average labor productivity and productivity growth to determine labor requirements. the calculated labor requirements, in turn, enter into wage and unit labor cost calculations and thus into the price side of the model, helping determine value added and prices.

The builders of the Cambridge CMDM model have attempted to incorporate factor inputs and technical change into the model by positing a general neoclassical production function, assuming capital stock adjustment costs.[69] Using Shephard's lemma, they derive a general labor demand function with the standard determining variables: output, input prices, and the level and rate of change of the capital stock. They then specify a log-linear employment equation with time, real output, wages and investment as independent variables, suitable capital stock data being unavailable. They thus bypass altogether the determination of average labor productivity; but in the process, they do manage to relate employment to rates of investment (and, of course, the time trend), and therefore at least make a gesture toward incorporating technological change into the equation.

In contrast to these approaches, researchers at INFORUM have found that in historical and forecasting simulations, fairly simple time trend equations outperform more theoretically attractive equations derived from production functions.[70] This approach has the disadvantage that it is impossible to use the model to gauge the medium- to long-run impact of policy changes that encourage investment on productivity growth rates, since it amounts to assuming that all productivity growth is effectively labor-augmenting. However, the approach seems to work fairly well for medium-term forecasting. Moreover, modeling more complex relations would require more reliable data than was available for this study.

Form of the equation. The equations take a linear form that relates the log of average real sectoral labor productivity — defined here as annual real output per person employed — to two linear time trends and to changes in constant-price sectoral output. It would be preferable to have a measure of output per hour of labor, but detailed British data on average hours worked were prohibitively expensive to gather. Fortunately, fairly good estimates can be derived using the annual data available.

For most sectors, the equations are specified to account for the fact that output's influence on productivity is not symmetric over the business cycle: industry tends to hoard labor during recessions, but it tends to increase hiring only reluctantly during periods of rising output. To allow for this asymmetric influence, the equations contain two output variables, one for increases in output over previous peaks, and one for periods of decreasing output:

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[69] Barker and Peterson (1987), pp. 247-274.

[70] See McCarthy (1991), p.33.

$$\ln\left(\frac{Q_t}{L_t}\right) = a + b\ T1_t + c\ T2_t + d\ QUP_t + e\ QDOWN_t$$

The first time trend, *T1*, is simply the year (i.e. takes the value 84.0 in 1984), while the second, *T2*, takes a value of 0.0 prior to 1981 and begins with a value of 1.0 in 1981. This second variable is intended to capture a noticeable increase in productivity growth during the past decade. The output variables, *QUP* and *QDOWN*, represent deviations from the previous peak output. They are constructed using a third variable, *QPEAK*, as follows:

$$QPEAK_t = Q_t \quad \text{when } Q_t > QPEAK_{t-1}$$
$$= QPEAK_{t-1} \quad \text{when } Q_t < QPEAK_{t-1}$$

$$QUP_t = \ln Q_t - \ln QPEAK_{t-1} \quad \text{when } Q_t > QPEAK_{t-1}$$
$$= 0 \quad \text{when } Q_t \leq QPEAK_{t-1}$$

$$QDOWN_t = \ln Q_t - \ln QPEAK_{t-1} \quad \text{when } Q_t < QPEAK_{t-1}$$
$$= 0 \quad \text{when } Q_t \geq QPEAK_{t-1}$$

QUP is always nonnegative, while *QDOWN* is always nonpositive, and their parameters should take values greater than zero but no greater than 1.0. A zero parameter would imply, implausibly, that employment changes in exact proportion to changes in output. A parameter equal to unity implies no employment response to changes in output; while a parameter value greater than unity implies a reverse employment response: if output increases by one percent, productivity increases by more than one percent, so employment must fall in response to the increase in output. This implausible result would have odd effects in a model, and so the parameters have been constrained to unity or lower in the estimations.

The rationale behind these variables is that employers generally react cautiously to changes in output. If output falls from previous peaks, employers tend to hoard labor, reducing employment less than proportionally to the decline in output. As a result, productivity declines as output falls. Conversely, as output begins to rise at the end of a recession, or as output rises above previous peaks, employers tend to put their hoarded labor to work before hiring new workers, so productivity increases as output rises. This pattern is captured somewhat imperfectly by the form described above, since the form will not necessarily yield a rise in productivity if output rises from a trough but remains below its previous peak.

The basic equation turned out to be applicable to 33 (or two-thirds) of the 52 sectors, with an estimation period of 17 years (from 1971 to 1987). Two other sectors, Oil extraction and Public gas supply, were greatly affected by the development of the British oil industry during the mid-1970's. These equations therefore turned out to be extremely sensitive to changes in the estimation period, and so I estimated the Oil equation for the period 1979-1987, with only one time trend, and Gas for 1976-1987, with much improved results. For nine of the other sectors, one of the two output variables took the wrong sign; and in another, Non-metallic minerals and products, the equation produced results that would have been simply inappropriate in simulation. For the remaining eight, output either peaked in the late 1960's, before the estimation period, or never fell during the period. As a result, either *QUP* or *QDOWN* were zero throughout the period of estimation and therefore inapplicable. For these seventeen sectors, then, I estimated a form with a single, simpler output variable, the change in the log of real output:

$$\ln\left(\frac{Q_t}{L_t}\right) = a + b\ T1_t + c\ T2_t + d\ (\ \ln Q_t - \ln\ Q_{t-1})$$

In addition, one sector, Coal, a dummy was included for 1984 to account for the sharp drop in productivity that accompanied the year-long strike that broke the union.

Aggregate productivity. The following four ordinary least squares regressions illustrate the power of the time trends and output variables in accounting for changes in aggregate labor productivity for the economy as a whole. In these equations, labor productivity is measured as gross domestic product per worker, in contrast to the sectoral equations below, which use sectoral gross output per worker. The first regression uses a single time trend and the simple change in log of output; the second adds the second time trend. The last two regressions substitute ***QUP*** and ***QDOWN*** for the simple output variable. Although the first of these regressions obviously provides a fine fit, with a mean error of only 0.28 percent, inclusion of both time trends and the more complex output variables cuts the error by over a third to 0.18 percent, and completely eliminates the autocorrelation present in the first regression.

All of the estimated parameters are sensible, significant, and robust to changes in specification. The output variables clearly capture the asymmetric response to output over the business cycle, though the difference might be greater if productivity were measured in terms of hours rather than years. The time parameters imply that trend aggregate productivity grew slightly more than 1.2% annually during the 1970's and slightly less than 1.7% annually after 1980. If the effect of cyclical changes in output is taken into account, productivity grew slightly faster, at something like 1.5% and 2.0%. These figures contrast with those of Feinstein and Matthews (1990), who find annual labor productivity growth — measured in terms of person-hours — of 2.2% and 2.8% for the two periods, respectively. However, when these measures are adjusted to factor out the effect of changes in person hours, which declined by 0.8% annually in the 1970's and -0.6% in the 1980's, they come out at 1.6% and 2.2% for the two periods. These figures are closer to the results of the regressions above, but still somewhat higher, and these authors' results point out the difficulties inherent in the relatively rough measures of employment I have used.

Aggregate labor productivity regressed on single trend
and change in log of output

```
SEE    =        0.01 RSQ   = 0.9767 RHO =    0.49 Obser  =    17 from 1971.000
SEE+1  =        0.01 RBSQ  = 0.9734 DW  =    1.01 DoFree =    14 to   1987.000
MAPE   =        0.28
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 lprod                   - - - - - - - - - - - - - - - - - - - -        3.07
1 intercept                  1.99818  1020.8  41.770   0.65   0.000      1.00
2 time                       0.01340   497.6  22.044   0.35   0.912     79.00
3 dq                         0.66924    93.9   6.217   0.00   0.257      0.02
```

Aggregate labor productivity regressed on two trends
and change in log of output

SEE =	0.01 RSQ	= 0.9843 RHO =	0.38 Obser =	17 from 1971.000			
SEE+1 =	0.01 RBSQ	= 0.9806 DW =	1.25 DoFree =	13 to 1987.000			
MAPE =	0.23						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod							3.07
1 intercept		2.17434	647.8	26.722	0.71	0.000	1.00
2 time		0.01107	205.1	10.392	0.29	0.754	79.00
3 time2		0.00595	21.7	2.502	0.00	0.194	1.65
4 dq		0.54114	74.3	5.149	0.00	0.208	0.02

Aggregate labor productivity regressed on single trends
and two change in output variables

SEE =	0.01 RSQ	= 0.9867 RHO =	0.22 Obser =	17 from 1971.000			
SEE+1 =	0.01 RBSQ	= 0.9836 DW =	1.57 DoFree =	13 to 1987.000			
MAPE =	0.22						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod							3.07
1 intercept		1.93990	1326.6	51.312	0.63	0.000	1.00
2 time		0.01425	716.1	29.203	0.37	0.971	79.00
3 qup		0.55662	40.2	3.545	0.00	0.141	0.02
4 qdown		0.50744	52.3	4.140	-0.00	0.167	-0.02

Aggregate labor productivity regressed on two trends
and two change in output variables

SEE =	0.01 RSQ	= 0.9900 RHO =	-0.09 Obser =	17 from 1971.000			
SEE+1 =	0.01 RBSQ	= 0.9867 DW =	2.19 DoFree =	12 to 1987.000			
MAPE =	0.18						
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod							3.07
1 intercept		2.07233	715.6	28.041	0.68	0.000	1.00
2 time		0.01249	281.5	12.752	0.32	0.850	79.00
3 time2		0.00418	15.7	2.018	0.00	0.137	1.65
4 qup		0.49243	40.2	3.402	0.00	0.125	0.02
5 qdown		0.42369	44.2	3.598	-0.00	0.139	-0.02

The detailed results. The regression results for the detailed sectors are shown below, in order of classification. The results are nearly uniformly good, given the data: for the first form, the average adjusted R-square is over 0.86 and the average mean error is just over 1.0%, with the highest mean error being 3.7%. For the second form, the average adjusted R-square is over 0.89, and the worst mean error is less than 2.0%. Taking as a group the regressions actually used in the model, the average adjusted R-square is 0.8565; about 40% have an adjusted R-square of more than 0.95; 60% are over 0.90, and 80% are over 0.80. The average mean error is just over 1%; only three equations have mean errors over 2%, and the highest mean error is 3.7%. (Keep in mind, however, that the equations are in logs: a one percent error in logs of these magnitudes is more like a 3.5% error in actual levels, while for the worst equation, the 3.7% mean error in logs translates to a 12.5% error in levels.)

However, the results — fits, time parameters and output responses — vary widely between industries, illustrating the importance of a detailed approach to modeling productivity change. The output parameters vary sharply between industries, and are quite distinct in most of the equations into which they enter. Even the marked increase in aggregate productivity growth after 1980 is not reflected uniformly when examined on a sectoral basis. In fact, in eleven out of fifty-two industries — more than a fifth of the detailed sectors — productivity growth declined after 1980. In six of these twelve sectors, the parameter is both small in magnitude and insignificant, and might appropriately be pushed to zero or a small positive value with a firm-handed constraint on the equation with effectively no loss of fit. However, in the other five sectors with productivity declines after 1980, the effect does not seem to be a statistical fluke. Be that as it may, even related industries — Pulp and paper and Printing and publishing, for instance — experienced quite different productivity trends during the estimation period.

A summary of the detailed results on the following pages shows the adjusted R-squares for each equation, the mean absolute percentage errors (MAPE's), the rhos, the values of all the parameters (except for the intercepts), and the resulting time trend used for forecasting in the model. The table gives the parameters' mexvals, or marginal explanatory values, instead of the usual t-statistics. For readers unfamiliar with mexvals, in equations estimated over seventeen observations (such as the following) a mexval of about 6.5 is equivalent to a 90% level of significance, and a mexval of about 11 is equivalent to a 95% level of significance.

As with the aggregate equations, the detailed results stand in contrast to the data presented by Feinstein and Matthews. For Agriculture, the trend found here for productivity growth rate is lower by 1.7 percentage points, while for the Energy and Water sectors, the trends presented here are generally quite low, while Feinstein and Matthews measure the aggregate energy and water sectoral annual growth rate at 6.6%. For the manufacturing sector's productivity growth as a whole, the results are similar, as are those for transport, communications and finance. However, at 0.5% the trend in Distribution presented here is only one-quarter as large as that of Feinstein and Matthews, while the trend in Other services, at 0.2%, is much greater than their measure of -1.7%. At least part of the differences can be explained by changes in person hours not captured by the measures of employment used here. The loss of two million jobs in manufacturing during the 1980's was offset almost entirely by increases in employment in the Banking and finance and especially in the miscellaneous services that fall into the Other services category along with education, health, public administration and defence. In these miscellaneous (and generally low wage) services, there was a very large increase in hours worked, explaining part of the great difference in the measures of productivity.

A detailed discussion of each equation is presented after the summary Table.

Table IV.7.1: Summary of Productivity Equations (Mexvals in Parentheses)

Sector	*TIME1*	*TIME2*	TOTAL TREND (%)	*QUP* or Δ *ln Q*	*QDOWN*	$\bar{R}^2$	MAPE	Rho
1. Agriculture, Forestry & Fishing	0.041	-0.016	2.5	0.446	1.000	0.990	0.34	0.333
	(619.21)	(66.255)		(14.564)	*			
2. Coal and Coke	0.017	0.011	2.8	0.027		0.891	1.78	-0.146
	(15.268)	(1.688)		(0.398)				
3. Oil and Gas Extraction	0.010		1.0	0.377	1.000	0.231	0.43	0.485
	(13.492)			(30.494)	*			
4. Mineral Oil Processing	0.100	-0.079	2.1	0.659	0.817	0.335	2.37	0.743
	(36.831)	(11.278)		(8.418)	(14.325)			
5. Electricity	0.030	0.003	3.3	0.747	0.668	0.972	0.35	0.515
	(219.22)	(0.807)		(9.808)	(22.497)			
6. Public Gas Supply	0.034	0.012	4.6	1.000	1.000	0.927	0.67	0.504
	(52.862)	(4.325)		*	*			
7. Water Supply	-0.004	0.026	2.2	1.000	1.000	0.833	1.12	0.442
	(2.054)	(19.546)		*	*			
8. Metal Ores & Minerals N.E.S.	0.025	0.014	3.9	1.000	1.000	0.423	2.21	0.573
				(18.939)	(1.368)		*	*
9. Non-Metallic Ores	-0.020	0.041	2.1	0.316		0.456	1.40	0.152
	(27.071)	(28.459)		(19.826)				
10. Iron, Steel & Steel Products	-0.009	0.120	11.1	0.598		0.972	0.90	0.345
	(14.815)	(258.43)		(64.553)				
11. Other Metals	0.036	0.047	8.3	0.552	0.629	0.945	1.06	0.553
	(57.645)	(43.821)		(10.189)	(12.707)			
12. Non-Metallic Mineral Products	0.020	0.018	3.8	0.498	0.573	0.873	0.70	0.363
	(26.037)	(13.246)		(3.689)	(31.432)			
13. Basic Chemicals	0.033	0.002	3.5	0.855	0.822	0.829	1.05	0.696
	(56.657)	(0.047)		15.146	27.839			
14. Pharmaceuticals	0.035	-0.002	3.3	0.700	0.802	0.936	0.90	0.595
	(129.66)	(0.196)		(16.073)	(6.571)			
15. Soap and Toilet Preparations	0.015	0.028	4.3	0.462		0.918	0.77	0.395
	(40.639)	(32.074)		(19.344)				
16. Man-Made Fibers	0.044	0.053	9.7	0.536		0.972	1.20	0.595
	(116.03)	(48.438)		(49.357)				
17. Other Metal Products, N.E.S.	0.007	0.044	5.1	0.936	0.155	0.902	0.77	0.414
	(4.085)	(86.381)		(6.900)	(2.983)			
18. Industrial Plant & Steelwork	0.046	-0.027	1.9	0.683	1.000	0.832	1.28	0.617
	(125.37)	(15.229)		(1.532)	*			
19. Agricultural Machinery	-0.015	0.103	8.8	0.694	0.605	0.875	1.19	0.510
	(11.185)	(154.53)		(2.993)	(83.305)			
20. Machine Tools & Eng.'s Tools	-0.014	0.022	0.8	0.539		0.679	1.14	0.303
	(32.032)	(19.330)		(78.232)				
21. Textile, Etc. Machinery	0.030	0.012	4.2	0.844	0.663	0.854	0.81	0.577
	(99.716)	(9.587)		(14.857)	(98.159)			
22. Other Machinery N.E.S.	0.012	-0.006	0.6	0.480		0.747	0.73	0.403
	(45.900)	(3.252)		(44.056)				
23. Ordnance	0.123	-0.073	5.0	0.355	0.396	0.852	3.69	0.435
	(115.00)	(12.913)		(5.362)	(3.009)			

* - Mexvals of constrained variables are affected by the strength on the imposed constraint and have no relevance as a measure of explanatory value.

Table IV.7.1: Summary of Productivity Equations (continued) (Mexvals in Parentheses)

Sector	*TIME1*	*TIME2*	TOTAL TREND (%)	*QUP* or $\Delta \ln Q$	*QDOWN*	$\bar{R}^2$	MAPE	Rho
24. Office Machinery & Computers	0.050	0.039	8.9	0.290	1.000	0.903	2.71	0.720
	(61.166)	(10.454)		(3.352)	*			
25. Basic Electrical Equipment	0.007	0.024	3.1	0.680		0.852	0.93	0.588
	(10.866)	(27.264)		(47.008)				
26. Electronic Equipment	0.029	0.057	8.6	0.653	0.885	0.986	0.80	0.375
	(156.43)	(148.89)		(27.317)	(48.325)			
27. Domestic Electr. Appliances	0.025	0.048	7.3	0.407	0.447	0.937	1.45	0.337
	(22.581)	(21.095)		(3.506)	(8.927)			
28. Electrical Lighting Equipment	0.038	0.002	4.0	1.000	0.424	0.985	1.88	0.483
	(45.251)	(0.043)		*	(588.84)			
29. Motor Vehicles & Parts	-0.008	0.075	6.7	0.493		0.955	0.75	0.557
	(15.050)	(157.47)		(30.353)				
30. Shipbuilding and Repairing	0.000	0.078	7.8	0.777		0.971	0.87	0.340
	(0.010)	(236.86)		(91.799)				
31. Aerospace Engineering	0.014	0.040	5.4	0.100	0.954	0.975	0.73	0.284
	(58.770)	(79.307)		(0.326)	(132.49)			
32. Other Vehicles	0.040	0.012	5.2	0.349		0.904	1.82	0.456
	(91.259)	(2.757)		(13.616)				
33. Instrument Engineering	0.015	0.029	4.4	0.311		0.893	1.34	0.688
	(30.614)	(26.774)		(7.790)				
34. Food	0.033	-0.003	3.0	1.000	0.308	0.990	0.26	0.152
	(458.46)	(3.727)		*	(17.546)			
35. Drink	0.055	0.000	5.5	0.571	1.000	0.984	0.41	0.364
	(550.52)	(0.019)		(55.331)	*			
36. Tobacco	0.042	0.033	7.5	0.727	1.000	0.676	1.36	0.681
	(88.262)	(19.368)		(8.822)	*			
37. Yarn	0.031	0.027	5.8	0.514		0.944	1.30	0.608
	(86.858)	(17.187)		(16.764)				
38. Textiles	0.027	-0.005	2.2	0.870		0.972	0.59	0.170
	(170.41)	(1.908)		(91.100)				
39. Apparel	0.038	0.005	4.3	0.358		0.974	1.00	0.523
	(228.15)	(2.011)		(18.397)				
40. Leather and Footwear	0.043	0.005	4.8	1.000	0.595	0.950	0.91	0.344
	(176.30)	(1.667)		*	(115.07)			
41. Timber and Wood Products	0.007	0.008	1.5	0.776	0.107	0.392	1.00	0.448
	(2.479)	(1.711)		(2.169)	(0.515)			
42. Pulp and Paper	0.032	0.019	5.1	1.000	0.450	0.950	0.62	0.295
	(108.20)	(18.354)		*	(32.713)			
43. Printing and Publishing	0.034	-0.020	1.4	0.413	0.772	0.981	0.40	0.151
	(446.66)	(80.720)		(10.852)	(98.757)			
44. Rubber	0.030	0.033	6.3	0.715	0.480	0.969	0.59	0.294
	(140.68)	(84.549)		(1.647)	(64.197)			
45. Plastics	0.029	0.006	3.5	0.562	0.267	0.948	0.74	0.272
	(95.544)	(1.213)		(17.469)	(5.576)			
46. Other Manufacturing	0.094	-0.061	3.3	0.484	0.800	0.986	0.83	0.052
	(600.00)	(169.87)		(25.734)	(291.78)			

* - Mexvals of constrained variables are affected by the strength on the imposed constraint and have no relevance as a measure of explanatory value.

Table IV.7.1: Summary of Productivity Equations (continued) (Mexvals in Parentheses)

Sector	*TIME1*	*TIME2*	TOTAL TREND (%)	*QUP* or $\Delta \ln Q$	*QDOWN*	$\bar{R}^2$	MAPE	Rho
47. Construction	0.003	0.031	3.4	1.000	0.736	0.948	0.48	0.443
	(2.460)	(55.541)		*	(123.14)			
48. Distribution, Hotels, Catering	-0.002	0.007	0.5	0.803	0.503	0.732	0.69	0.480
	(1.704)	(3.102)		(11.144)	(13.680)			
49. Transportation	0.016	0.007	2.3	0.649	0.803	0.838	1.00	0.715
	(28.578)	(1.046)		(4.109)	(5.126)			
50. Postal And Telecommunications	0.042	0.012	6.4	0.620	1.000	0.996	0.36	0.322
	(705.28)	(42.189)		(44.116)	*			
51. Banking, Finance, Etc.	0.019	0.006	2.5	0.523		0.986	0.33	0.425
	(304.59)	(7.433)		(8.704)				
53. Other Services	0.004	-0.003	0.2	-0.294		0.714	0.40	0.609
	(36.669)	(3.983)		(3.317)				

* - Mexvals of constrained variables are affected by the strength on the imposed constraint and have no relevance as a measure of explanatory value.

Discussion of detailed results. For the Agriculture industry equation, two results are notable and significant. Rather than rising, productivity growth declined by over a third after 1980, although as noted the trend is lower than that measured by Feinstein and Matthews using value added data rather than gross output data. Moreover, poor crops have a much stronger effect on productivity than good ones, presumably because farm workers — often family members — tend not to be fired just because the crop was bad. Imposition of the constraint on *QDOWN* has practically no effect on the fit or on any of the other parameters, except that it nearly doubles the magnitude and significance of *QUP*. (The high mexval and t-statistic on the constrained variable are a function of the strength of the imposed constraint. They have no relevance as measures of its explanatory value or statistical significance; at the same time, however, they have no effect on the other variables' mexvals or t-statistics.)

1. Average Labor Productivity: Agriculture, Forestry and Fishing

```
SEE    =      0.01 RSQ   = 0.9924 RHO =    0.33 Obser  =    17 from 1971.000
SEE+1  =      0.01 RBSQ  = 0.9898 DW  =    1.33 DoFree =    12 to   1987.000
MAPE   =      0.34
  Variable name          Reg-Coef  Mexval  t-value  Elas    Beta        Mean
0 lprod1               - - - - - - - - - - - - - - - - - - - - -        3.49
1 intercept              0.28164    18.7    2.212   0.08   0.000        1.00
2 time                   0.04105   619.2   24.672   0.93   1.221       79.00
3 time2                 -0.01593    66.3   -4.601  -0.01  -0.227        1.65
4 qup1                   0.44551    14.6    1.936   0.00   0.053        0.02
5 qdown1                 1.00000 49046.0 1702.466  -0.00   0.097       -0.01
```

One would expect the Coal industry equation to present serious problems because the industry has been in serious decline since the mid-1960's and has been beset by legendary union problems. Nevertheless, despite the inapplicability of the original functional form, the alternative equation yields surprisingly good results.

2. Average Labor Productivity: Coal and Coke

```
SEE    =      0.07 RSQ   = 0.9184 RHO =  -0.15 Obser  =   17 from 1971.000
SEE+1  =      0.07 RBSQ  = 0.8911 DW  =   2.29 DoFree =   12 to   1987.000
MAPE   =      1.78
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod2                  - - - - - - - - - - - - - - - - - - - - -        3.04
1 intercept                  1.75701    27.2   2.726  0.58   0.000        1.00
2 time                       0.01682    15.3   1.986  0.44   0.322       79.00
3 time2                      0.01124     1.7   0.639  0.01   0.103        1.65
4 dlq2                       0.02712     0.4   0.309 -0.00   0.037       -0.04
5 dummy84                   -1.03254   142.9  -7.669 -0.02  -0.949        0.06
```

The Oil and natural gas extraction industry equation presented serious problems because of the variability of output during the early years of development of the industry. For the period after 1978, the equation gave a fairly good fit, and the variables were very significant given the extremely low number of degrees of freedom. Unfortunately, the variable *QDOWN* had an absurdly high parameter of 3.38; and the imposition of a reasonable constraint substantially reduced the fit, greatly increased the autocorrelation, cut the time parameter by about 40%, and reduced the significance of all of the other parameters.

3. Average Labor Productivity: Oil and Natural Gas Extraction

```
SEE    =      0.03 RSQ   = 0.5192 RHO =   0.49 Obser  =    9 from 1979.000
SEE+1  =      0.03 RBSQ  = 0.2308 DW  =   1.03 DoFree =    5 to   1987.000
MAPE   =      0.43
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod3                  - - - - - - - - - - - - - - - - - - - - -        6.51
1 intercept                  5.64237   267.4   7.905  0.87   0.000        1.00
2 time                       0.01012    13.5   1.200  0.13   0.535       83.00
3 qup3                       0.37724    30.5   1.875  0.01   0.835        0.10
4 qdown3                     1.00000 20776.3 466.803 -0.00   0.220       -0.00
```

Although the Mineral oil processing equation does not produce a terribly good fit in terms of adjusted R-square, it has a fairly low mean error. Mineral oil processing also shows a steep drop in productivity growth after 1980, and a stronger effect from downturns than from recoveries.

4. Average Labor Productivity: Mineral Oil Processing

```
SEE    =      0.19 RSQ   = 0.5015 RHO =   0.74 Obser  =   17 from 1971.000
SEE+1  =      0.13 RBSQ  = 0.3353 DW  =   0.51 DoFree =   12 to   1987.000
MAPE   =      2.37
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod4                  - - - - - - - - - - - - - - - - - - - - -        6.31
1 intercept                 -1.25016     1.2  -0.540 -0.20  -0.000        1.00
2 time                       0.10037    36.8   3.235  1.26   1.853       79.00
3 time2                     -0.07868    11.3  -1.691 -0.02  -0.697        1.65
4 qup4                       0.65893     8.4   1.451  0.01   0.355        0.06
5 qdown4                     0.81695    14.3   1.919 -0.04   0.822       -0.34
```

The Electricity sector displays the expected pattern of parameters, although it is questionable whether productivity growth really picked up after 1980 since the parameter on the second time variable is not statistically significantly different from zero.

5. Average Labor Productivity: Electricity

SEE = 0.02	RSQ = 0.9788	RHO = 0.51	Obser = 17	from 1971.000		
SEE+1 = 0.02	RBSQ = 0.9718	DW = 0.97	DoFree = 12	to 1987.000		
MAPE = 0.35						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod5	- - - - - -	- - - -	- - - -	- - -	- - -	4.18
1 intercept	1.84694	170.0	8.689	0.44	0.000	1.00
2 time	0.02957	219.2	10.501	0.56	0.999	79.00
3 time2	0.00252	0.8	0.441	0.00	0.041	1.65
4 qup5	0.74718	9.8	1.571	0.00	0.087	0.01
5 qdown5	0.66823	22.5	2.451	-0.00	0.141	-0.03

The Public gas industry displays a pattern similar to that of Electricity. The imposition of constraints on ***QUP*** and ***QDOWN*** had little effect on the fit or on the other parameters, except that it doubled the size of the second time parameter and increased its significance. The equation with two constrained output variables has a much better fit than the equation with only one.

6. Average Labor Productivity: Public Gas Supply

SEE = 0.03	RSQ = 0.9538	RHO = 0.50	Obser = 12	from 1976.000		
SEE+1 = 0.03	RBSQ = 0.9273	DW = 0.99	DoFree = 7	to 1987.000		
MAPE = 0.67						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod6	- - - - - -	- - - -	- - - -	- - -	- - -	4.22
1 intercept	1.39752	17.0	1.606	0.33	0.000	1.00
2 time	0.03392	52.9	3.059	0.66	0.784	81.50
3 time2	0.01207	4.3	0.787	0.01	0.202	2.33
4 qup6	1.00000	21920.9	582.611	0.01	0.194	0.03
5 qdown6	1.00000	21920.8	582.609	-0.00	0.064	-0.01

Constraints on the output variables did not greatly affect any measure of the fit of the Water industry equation. However, it drastically changed the values of the time parameters, from 0.01361 and 0.00537 to -0.00389 and 0.02610, respectively. I have no independent way of judging the appropriateness of either set of parameters; however, from a forecasting point of view the difference is rather small.

7. Average Labor Productivity: Water Supply

SEE = 0.05	RSQ = 0.8749	RHO = 0.44	Obser = 17	from 1971.000		
SEE+1 = 0.05	RBSQ = 0.8331	DW = 1.12	DoFree = 12	to 1987.000		
MAPE = 1.12						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod7	- - - - - -	- - - -	- - - -	- - -	- - -	3.37
1 intercept	3.73538	175.5	8.895	1.11	0.000	1.00
2 time	-0.00389	2.1	-0.706	-0.09	-0.141	79.00
3 time2	0.02610	19.5	2.269	0.01	0.452	1.65
4 qup7	1.00001	14622.3	509.985	0.01	0.309	0.02
5 qdown7	1.00001	14622.5	509.990	-0.04	0.669	-0.12

The unconstrained Metal ores and minerals sector equation had a relatively poor fit, and several variables were of dubious significance; although distinguishing between increases and decreases in output had a marked effect on the fit, and even improved the significance and marginal explanatory value of the other variables. Constraining the output variables did not greatly affect the fit, but cut the magnitude of the second time parameter by two-thirds and greatly reduced its mexval and significance. This cut the industry's projected long run annual productivity growth from 6.3% to 3.9%.

8. Average Labor Productivity: Metal Ores and Minerals N.E.S.

SEE =	0.10 RSQ	= 0.5676 RHO =	0.57 Obser =	17 from 1971.000				
SEE+1 =	0.09 RBSQ	= 0.4234 DW =	0.86 DoFree =	12 to 1987.000				
MAPE =	2.21							
Variable name		Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 lprod8		- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	3.72	
1 intercept		1.84135	17.4	2.132	0.50	0.000	1.00	
2 time		0.02531	18.9	2.231	0.54	0.825	79.00	
3 time2		0.01360	1.4	0.575	0.01	0.213	1.65	
4 qup8		1.00000	7059.7	247.995	0.00	0.285	0.01	
5 qdown8		1.00004	7060.1	248.008	-0.04	0.916	-0.16	

The Non-metallic minerals sector has a relatively poor fit, and the inclusion of both an increasing and a decreasing output variable produced dubious results. However, the parameters of the alternative equation are all reasonable and have strong marginal explanatory value.

9. Average Labor Productivity: Non-Metallic Minerals

SEE =	0.06 RSQ	= 0.5580 RHO =	0.15 Obser =	17 from 1971.000			
SEE+1 =	0.06 RBSQ	= 0.4560 DW =	1.70 DoFree =	13 to 1987.000			
MAPE =	1.40						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 lprod9	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	3.64	
1 intercept	5.13870	189.3	9.787	1.41	0.000	1.00	
2 time	-0.01953	27.1	-2.827	-0.42	-1.031	79.00	
3 time2	0.04128	28.5	2.907	0.02	1.045	1.65	
4 dlq9	0.31556	19.8	2.380	-0.01	0.464	-0.07	

The Iron and steel sector equation yields a good fit, and illustrates both the serious problems the industry experienced during the 1970's and its strong recovery in the 1980's.

10. Average Labor Productivity: Iron and Steel and Steel Products

SEE =	0.04 RSQ	= 0.9772 RHO =	0.34 Obser =	17 from 1971.000			
SEE+1 =	0.04 RBSQ	= 0.9719 DW =	1.31 DoFree =	13 to 1987.000			
MAPE =	0.90						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 lprod10	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	3.56	
1 intercept	4.11302	243.8	11.862	1.16	0.000	1.00	
2 time	-0.00926	14.8	-2.034	-0.21	-0.166	79.00	
3 time2	0.12005	258.4	12.410	0.06	1.033	1.65	
4 dlq10	0.59823	64.6	4.712	-0.01	0.211	-0.03	

The following three equations, for Other metals, Non-metallic mineral products, and Basic chemicals, all display good fits with plausible parameters.

11. Average Labor Productivity: Other Metals

SEE =	0.05 RSQ	= 0.9589 RHO =	0.55 Obser =	17 from 1971.000			
SEE+1 =	0.04 RBSQ	= 0.9452 DW =	0.89 DoFree =	12 to 1987.000			
MAPE =	1.06						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 lprod11	- - - - - - -	- - - - -	- - - - -	- - - -	- - - -	3.85	
1 intercept	0.98876	9.8	1.571	0.26	0.000	1.00	
2 time	0.03609	57.6	4.222	0.74	0.711	79.00	
3 time2	0.04748	43.8	3.581	0.02	0.449	1.65	
4 qup11	0.55198	10.2	1.603	0.00	0.102	0.01	
5 qdown11	0.62905	12.7	1.801	-0.02	0.191	-0.11	

12. Average Labor Productivity: Non-Metallic Mineral Products

SEE =	0.03 RSQ	= 0.9050 RHO =	0.36 Obser =	17 from 1971.000			
SEE+1 =	0.03 RBSQ	= 0.8733 DW =	1.27 DoFree =	12 to 1987.000			
MAPE =	0.70						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod12	- - - - - -	- - - -	- - - -	- - -	- - -	3.48
1 intercept	1.94727	41.9	3.486	0.56	0.000	1.00
2 time	0.02013	26.0	2.658	0.46	1.037	79.00
3 time2	0.01777	13.2	1.841	0.01	0.439	1.65
4 qup12	0.49843	3.7	0.950	0.00	0.099	0.01
5 qdown12	0.57346	31.4	2.955	-0.03	0.685	-0.16

13. Average Labor Productivity: Basic Chemicals

SEE =	0.05 RSQ	= 0.8718 RHO =	0.70 Obser =	17 from 1971.000
SEE+1 =	0.04 RBSQ	= 0.8291 DW =	0.61 DoFree =	12 to 1987.000
MAPE =	1.05			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod13	- - - - - -	- - - -	- - - -	- - -	- - -	4.06
1 intercept	1.51415	24.3	2.558	0.37	0.000	1.00
2 time	0.03282	56.7	4.177	0.64	1.107	79.00
3 time2	0.00150	0.0	0.106	0.00	0.024	1.65
4 qup13	0.85464	15.1	1.977	0.00	0.246	0.02
5 qdown13	0.82205	27.8	2.759	-0.02	0.376	-0.07

The slight decrease in productivity growth in the Pharmaceuticals industry after 1980 may be spurious; but the inclusion of differentiated output variables rather than a single one clearly improved the fit.

14. Average Labor Productivity: Pharmaceuticals

SEE =	0.04 RSQ	= 0.9517 RHO =	0.60 Obser =	17 from 1971.000
SEE+1 =	0.03 RBSQ	= 0.9356 DW =	0.81 DoFree =	12 to 1987.000
MAPE =	0.90			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod14	- - - - - -	- - - -	- - - -	- - -	- - -	3.50
1 intercept	0.69027	13.4	1.849	0.20	0.000	1.00
2 time	0.03550	129.7	7.162	0.80	0.948	79.00
3 time2	-0.00233	0.2	-0.217	-0.00	-0.030	1.65
4 qup14	0.70021	16.1	2.041	0.01	0.151	0.03
5 qdown14	0.80180	6.6	1.276	-0.00	0.101	-0.01

With two output variables, the Soap and toilet preparations industry equation yielded an insignificant and dubious parameter for *QUP*. The alternative equation, shown here, has a slightly worse fit but considerably better and more significant parameters.

15. Average Labor Productivity: Soap and Toilet Preparations

SEE =	0.04 RSQ	= 0.9335 RHO =	0.39 Obser =	17 from 1971.000
SEE+1 =	0.04 RBSQ	= 0.9182 DW =	1.21 DoFree =	13 to 1987.000
MAPE =	0.77			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod15	- - - - - -	- - - -	- - - -	- - -	- - -	3.87
1 intercept	2.64013	151.1	8.305	0.68	0.000	1.00
2 time	0.01487	40.6	3.566	0.30	0.504	79.00
3 time2	0.02764	32.1	3.111	0.01	0.449	1.65
4 dlq15	0.46244	19.3	2.349	0.00	0.175	0.02

With two output variables, the Soap and toilet preparations industry equation yielded an insignificant and dubious parameter for ***QDOWN***. The alternative equation, shown here, yields a better fit and considerably better and more significant parameters.

16. Average Labor Productivity: Man-Made Fibers

SEE = 0.05	RSQ = 0.9776	RHO = 0.60	Obser = 17 from 1971.000
SEE+1 = 0.04	RBSQ = 0.9724	DW = 0.81	DoFree = 13 to 1987.000
MAPE = 1.20			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod16	- - - -	- - - -	- - - -	- - - -	- - - -	3.62
1 intercept	0.09035	0.1	0.188	0.02	0.000	1.00
2 time	0.04373	116.0	6.904	0.95	0.636	79.00
3 time2	0.05272	48.4	3.955	0.02	0.368	1.65
4 dlq16	0.53558	49.4	4.000	-0.00	0.192	-0.01

The Other metals industry required a difficult judgement call because inclusion of two change in output variables actually resulted in a slightly worse adjusted fit than the alternative equation with only one output variable. However, in this case the two output parameters were markedly different, even if one's significance and mexval were rather low, so I decided to keep this version.

17. Average Labor Productivity: Other Metal Products, N.E.S.

SEE = 0.03	RSQ = 0.9266	RHO = 0.41	Obser = 17 from 1971.000
SEE+1 = 0.03	RBSQ = 0.9022	DW = 1.17	DoFree = 12 to 1987.000
MAPE = 0.77			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod17	- - - -	- - - -	- - - -	- - - -	- - - -	3.13
1 intercept	2.55222	78.8	5.136	0.81	0.000	1.00
2 time	0.00682	4.1	1.000	0.17	0.283	79.00
3 time2	0.04366	86.4	5.448	0.02	0.868	1.65
4 qup17	0.93601	6.9	1.309	0.00	0.113	0.00
5 qdown17	0.15545	3.0	0.852	-0.01	0.190	-0.21

The Industrial plant and steelwork industry apparently experienced a distinct fall in productivity growth after 1980. In the equation with only one change in output variable, the parameter on the second time trend was -0.036, implying an even more marked decrease than is implied by the equation above, and the parameter was a good deal more significant than in the equation above. As with the previous equation, each of the two output variables in this equation is much less significant than the output variable in the alternative estimated form; but the two output parameters are markedly different, even if one's significance and mexval were paltry, so I decided to keep this version. Constraining the output variable ***QDOWN*** did not greatly affect the equation's fit. However, it increased the value of the ***QUP*** parameter from 0.1223 to 0.6833; and it nearly doubled the magnitude of the second time parameter from -0.1503 to -0.2656, while greatly increasing its mexval and significance. This has the effect of decreasing projected annual productivity growth from about 3.1% to 1.9%.

18. Average Labor Productivity: Industrial Plant and Steelwork

SEE = 0.06	RSQ = 0.8743	RHO = 0.62	Obser = 17 from 1971.000
SEE+1 = 0.04	RBSQ = 0.8324	DW = 0.77	DoFree = 12 to 1987.000
MAPE = 1.28			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod18	- - - -	- - - -	- - - -	- - - -	- - - -	3.44
1 intercept	-0.03892	0.0	-0.078	-0.01	-0.000	1.00
2 time	0.04578	125.4	6.996	1.05	1.427	79.00
3 time2	-0.02656	15.2	-1.983	-0.01	-0.397	1.65
4 qup18	0.68333	1.5	0.609	0.00	0.065	0.00
5 qdown18	1.00002	12595.8	439.782	-0.03	0.441	-0.09

Both the Agricultural machinery and Machine tool industries were evidently in serious trouble in the 1970's but experienced sharp rises in productivity growth after 1980. Machine tool output has been in chronic decline since the late 1960's, precluding use of the original equation.

19. Average Labor Productivity: Agricultural Machinery

```
SEE    =       0.05 RSQ    = 0.9064 RHO =    0.51 Obser  =   17 from 1971.000
SEE+1  =       0.05 RBSQ   = 0.8751 DW  =    0.98 DoFree =   12 to   1987.000
MAPE   =       1.19
 Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 lprod19                - - - - - - - - - - - - - - - - - - - - -      3.48
1 intercept                4.75206   127.0   7.058   1.37   0.000       1.00
2 time                    -0.01530    11.2  -1.684  -0.35  -0.434      79.00
3 time2                    0.10272   154.5   8.108   0.05   1.399       1.65
4 qup19                    0.69411     3.0   0.854   0.00   0.084       0.01
5 qdown19                  0.60457    83.3   5.322  -0.07   1.210      -0.40
```

20. Average Labor Productivity: Machine Tools and Engineers' Tools

```
SEE    =       0.04 RSQ    = 0.7390 RHO =    0.30 Obser  =   17 from 1971.000
SEE+1  =       0.04 RBSQ   = 0.6787 DW  =    1.39 DoFree =   13 to   1987.000
MAPE   =       1.14
 Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 lprod20                - - - - - - - - - - - - - - - - - - - - -      2.86
1 intercept                3.93067   237.9  11.638   1.38   0.000       1.00
2 time                    -0.01378    32.0  -3.108  -0.38  -0.859      79.00
3 time2                    0.02172    19.3   2.348   0.01   0.650       1.65
4 dlq20                    0.53875    78.2   5.319  -0.01   0.768      -0.04
```

The Textile, mining, construction and mechanical handling equipment industry yields good results.

21. Average Labor Productivity: Textile, etc. Machinery

```
SEE    =       0.03 RSQ    = 0.8906 RHO =    0.58 Obser  =   17 from 1971.000
SEE+1  =       0.03 RBSQ   = 0.8541 DW  =    0.85 DoFree =   12 to   1987.000
MAPE   =       0.81
 Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 lprod21                - - - - - - - - - - - - - - - - - - - - -      3.21
1 intercept                0.93010    22.8   2.467   0.29   0.000       1.00
2 time                     0.03020    99.7   5.989   0.74   1.519      79.00
3 time2                    0.01217     9.6   1.553   0.01   0.294       1.65
4 qup21                    0.84423    14.9   1.957   0.00   0.207       0.01
5 qdown21                  0.66295    98.2   5.926  -0.04   1.168      -0.20
```

The Other machinery industry, also in chronic decline, apparently did not experience an increase in productivity growth in the 1980's..

22. Average Labor Productivity: Other Machinery N.E.S.

```
SEE    =       0.03 RSQ    = 0.7943 RHO =    0.40 Obser  =   17 from 1971.000
SEE+1  =       0.03 RBSQ   = 0.7469 DW  =    1.19 DoFree =   13 to   1987.000
MAPE   =       0.73
 Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 lprod22                - - - - - - - - - - - - - - - - - - - - -      3.08
1 intercept                2.11580   157.1   8.540   0.69   0.000       1.00
2 time                     0.01248    45.9   3.831   0.32   0.942      79.00
3 time2                   -0.00631     3.3  -0.927  -0.00  -0.229       1.65
4 dlq22                    0.48035    44.1   3.739  -0.00   0.473      -0.02
```

The Ordnance industry apparently did quite well in the 1970's but experienced a sharp fall in productivity growth after 1980. Although neither output variable has high explanatory value, they neatly bracket the value of the single output variable in the alternative equation.

23. Average Labor Productivity: Ordnance

```
SEE   =        0.14 RSQ   = 0.8888 RHO =    0.44 Obser  =    17 from 1971.000
SEE+1 =        0.13 RBSQ  = 0.8518 DW  =    1.13 DoFree =    12 to   1987.000
MAPE  =        3.69
 Variable name              Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod23                  - - - - - - - - - - - - - - - - - - - - -       3.19
1 intercept                 -6.40718    65.5  -4.566  -2.01   -0.000       1.00
2 time                       0.12339   115.0   6.593   3.06    1.418      79.00
3 time2                     -0.07350    12.9  -1.816  -0.04   -0.405       1.65
4 qup23                      0.35495     5.4   1.150   0.01    0.132       0.09
5 qdown23                    0.39615     3.0   0.856  -0.02    0.191      -0.16
```

The unconstrained Office machinery and computers industry equation gave reasonably good results in terms of fit, but some of the parameters were not very robust and are therefore a bit dubious. The *QUP* parameter was suspiciously small and the *QDOWN* parameter too large; furthermore, when only one output variable was introduced in the alternative equation, time trend parameters (0.053 and 0.034) were almost exactly reversed (0.40 and 0.54). However, the equation with two change in output variables had so much a better fit that I decided to include it instead of the alternative. Constraining the parameter on *QDOWN* had essentially no effect on the fit or the magnitude of any of the other parameters. Note that this data is not affected by the sort of price index problem that has arisen in the American data on computer output.

24. Average Labor Productivity: Office Machinery and Computers

```
SEE   =        0.10 RSQ   = 0.9274 RHO =    0.72 Obser  =    17 from 1971.000
SEE+1 =        0.07 RBSQ  = 0.9032 DW  =    0.56 DoFree =    12 to   1987.000
MAPE  =        2.71
 Variable name              Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod24                  - - - - - - - - - - - - - - - - - - - - -       3.10
1 intercept                 -0.85589     4.0  -0.995  -0.28   -0.000       1.00
2 time                       0.04954    61.2   4.378   1.26    0.665      79.00
3 time2                      0.03918    10.5   1.625   0.02    0.252       1.65
4 qup24                      0.28995     3.4   0.904   0.01    0.080       0.07
5 qdown24                    1.00003  7095.9 249.250  -0.01    0.222      -0.05
```

The Basic electrical equipment industry, in persistent decline through the 1970's, experienced some recovery in productivity growth in the 1980's.

25. Average Labor Productivity: Basic Electrical Equipment

```
SEE   =        0.04 RSQ   = 0.8794 RHO =    0.59 Obser  =    17 from 1971.000
SEE+1 =        0.03 RBSQ  = 0.8516 DW  =    0.82 DoFree =    13 to   1987.000
MAPE  =        0.93
 Variable name              Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod25                  - - - - - - - - - - - - - - - - - - - - -       3.08
1 intercept                  2.49781   145.8   8.096   0.81    0.000       1.00
2 time                       0.00700    10.9   1.726   0.18    0.326      79.00
3 time2                      0.02410    27.3   2.838   0.01    0.539       1.65
4 dlq25                      0.67959    47.0   3.885  -0.00    0.378      -0.01
```

The Electronic Equipment industry yields excellent results, with a strong acceleration in productivity growth after 1980.

26. Average Labor Productivity: Electronic Equipment

SEE = 0.03	RSQ = 0.9893	RHO = 0.37	Obser = 17 from 1971.000
SEE+1 = 0.03	RBSQ = 0.9857	DW = 1.25	DoFree = 12 to 1987.000
MAPE = 0.80			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod26	- - - - - -	- - - -	- - - -	- - - -	- - - -	3.02
1 intercept	0.64725	21.7	2.403	0.21	0.000	1.00
2 time	0.02887	156.4	8.180	0.75	0.483	79.00
3 time2	0.05743	148.9	7.895	0.03	0.461	1.65
4 qup26	0.65331	27.3	2.730	0.01	0.093	0.03
5 qdown26	0.88484	48.3	3.795	-0.01	0.135	-0.03

Like the Other metals industry, the Electrical appliance industry equation required a difficult judgement call because inclusion of two output variables actually resulted in a slightly worse fit than the alternative equation with only one output variable. (It is possible for the fit to be worse because the single output variable is not identical to either of the two output variables in the other equation.) Moreover, in this case the two output parameters are quite similar to each other; their t-statistics and mexvals are low; and they are markedly lower (0.41 and 0.45) than the single variable in the alternative equation (0.74). I really have no compelling reason to keep this version.

27. Average Labor Productivity: Domestic Electrical Appliances

SEE = 0.05	RSQ = 0.9529	RHO = 0.34	Obser = 17 from 1971.000
SEE+1 = 0.05	RBSQ = 0.9372	DW = 1.33	DoFree = 12 to 1987.000
MAPE = 1.45			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod27	- - - - - -	- - - -	- - - -	- - - -	- - - -	3.06
1 intercept	1.04647	7.7	1.389	0.34	0.000	1.00
2 time	0.02475	22.6	2.456	0.64	0.521	79.00
3 time2	0.04831	21.1	2.366	0.03	0.488	1.65
4 qup27	0.40678	3.5	0.925	0.00	0.069	0.02
5 qdown27	0.44722	8.9	1.496	-0.01	0.152	-0.07

In the case of the Electrical lighting equipment industry, inclusion of two output variables made the time trend parameters more plausible, increased the adjusted R-square from 0.40 to nearly 0.99 and reduced the mean error from 9.37% to 1.81%. Constraining the parameter on ***QUP*** had practically no effect on either the fit or the other parameter values.

28. Average Labor Productivity: Electrical Lighting Equipment

SEE = 0.08	RSQ = 0.9890	RHO = 0.48	Obser = 17 from 1971.000
SEE+1 = 0.07	RBSQ = 0.9853	DW = 1.03	DoFree = 12 to 1987.000
MAPE = 1.88			

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod28	- - - - - -	- - - -	- - - -	- - - -	- - - -	2.85
1 intercept	-0.00829	0.0	-0.010	-0.00	-0.000	1.00
2 time	0.03849	45.3	3.649	1.07	0.252	79.00
3 time2	0.00205	0.0	0.101	0.00	0.006	1.65
4 qup28	1.00001	8911.5	312.149	0.00	0.028	0.01
5 qdown28	0.42403	588.8	23.609	-0.07	0.851	-0.46

The Motor vehicles and Shipbuilding and repairing industries apparently both reversed their persistent productivity problems during the 1980's. The equations yield similar good fits.

29. Average Labor Productivity: Motor Vehicles and Parts

```
SEE    =        0.03 RSQ   = 0.9631 RHO =    0.56 Obser  =    17 from 1971.000
SEE+1  =        0.03 RBSQ  = 0.9546 DW  =    0.89 DoFree =    13 to   1987.000
MAPE   =        0.75
 Variable name               Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 lprod29                   - - - - - - - - - - - - - - - - - - - - -      3.48
1 intercept                  3.97822   298.3  13.902   1.14    0.000       1.00
2 time                      -0.00776    15.1  -2.051  -0.18   -0.226      79.00
3 time2                      0.07489   157.5   8.554   0.04    1.047       1.65
4 dlq29                      0.49304    30.4   3.015  -0.00    0.197      -0.01
```

30. Average Labor Productivity: Shipbuilding and Repairing

```
SEE    =        0.03 RSQ   = 0.9763 RHO =    0.34 Obser  =    17 from 1971.000
SEE+1  =        0.03 RBSQ  = 0.9709 DW  =    1.32 DoFree =    13 to   1987.000
MAPE   =        0.87
 Variable name               Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 lprod30                   - - - - - - - - - - - - - - - - - - - - -      2.93
1 intercept                  2.81366   232.2  11.424   0.96    0.000       1.00
2 time                       0.00017     0.0   0.051   0.00    0.004      79.00
3 time2                      0.07811   236.9  11.598   0.04    0.966       1.65
4 dlq30                      0.77686    91.8   5.901  -0.01    0.253      -0.03
```

The Aerospace engineering industry also presented a difficult judgement call. Inclusion of two output variables greatly improved the fit and yielded markedly different output parameters, but one's significance and mexval were practically nonexistent. Even so, this equation represents an improvement over the alternative.

31. Average Labor Productivity: Aerospace Engineering

```
SEE    =        0.03 RSQ   = 0.9809 RHO =    0.28 Obser  =    17 from 1971.000
SEE+1  =        0.03 RBSQ  = 0.9746 DW  =    1.43 DoFree =    12 to   1987.000
MAPE   =        0.73
 Variable name               Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 lprod31                   - - - - - - - - - - - - - - - - - - - - -      3.33
1 intercept                  2.24382   181.1   9.102   0.67    0.000       1.00
2 time                       0.01384    58.8   4.272   0.33    0.334      79.00
3 time2                      0.03981    79.3   5.156   0.02    0.461       1.65
4 qup31                      0.10022     0.3   0.280   0.00    0.014       0.01
5 qdown31                    0.95414   132.5   7.271  -0.02    0.341      -0.08
```

The Other vehicles industry equation presented a difficult choice too. Inclusion of two output variables greatly improved the fit compared with the alternative and yielded markedly different output parameters, but one's significance and mexval were practically nonexistent. Furthermore, using the alternative equation yielded much lower and less significant time trend parameters. Even so, the alternative equation parameters seem more plausible.

32. Average Labor Productivity: Other Vehicles

```
SEE    =        0.06 RSQ   = 0.9219 RHO =    0.46 Obser  =    17 from 1971.000
SEE+1  =        0.06 RBSQ  = 0.9039 DW  =    1.09 DoFree =    13 to   1987.000
MAPE   =        1.82
 Variable name               Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 lprod32                   - - - - - - - - - - - - - - - - - - - - -      2.83
1 intercept                 -0.33935     1.6  -0.657  -0.12   -0.000       1.00
2 time                       0.03989    91.3   5.878   1.12    0.895      79.00
3 time2                      0.01202     2.8   0.852   0.01    0.129       1.65
4 dlq32                      0.34922    13.6   1.945  -0.00    0.162      -0.02
```

The results for the Instrument engineering industry were very similar to those for the Other vehicles industry equation, except that the time trend parameters were very robust to changes in equation specification.

33. Average Labor Productivity: Instrument Engineering

```
SEE    =      0.05 RSQ   = 0.9133 RHO =    0.69 Obser  =    17 from 1971.000
SEE+1  =      0.04 RBSQ  = 0.8933 DW  =    0.62 DoFree =    13 to   1987.000
MAPE   =      1.34
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod33                - - - - - - - - - - - - - - - - - - - - -       2.81
1 intercept                1.54000    48.9   3.978   0.55   0.000        1.00
2 time                     0.01539    30.6   3.030   0.43   0.489       79.00
3 time2                    0.02940    26.8   2.810   0.02   0.448        1.65
4 dlq33                    0.31130     7.8   1.451   0.00   0.127        0.00
```

For the Food and Drink industry equations, inclusion of two change in output variables yielded markedly different and highly significant output parameters, while slightly degrading the fit (in the Food case) or barely improving it (in the Drink case) and (in both cases) rendering the parameter on the second time trend insignificant. I decided that these equations represented an improvement over the alternatives because of the high significance and high marginal explanatory value of all the other variables. Constraining the output parameters had essentially no effect on either equation.

34. Average Labor Productivity: Food

```
SEE    =      0.01 RSQ   = 0.9925 RHO =    0.15 Obser  =    17 from 1971.000
SEE+1  =      0.01 RBSQ  = 0.9901 DW  =    1.70 DoFree =    12 to   1987.000
MAPE   =      0.26
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod34                - - - - - - - - - - - - - - - - - - - - -       3.87
1 intercept                1.23720   188.5   9.376   0.32   0.000        1.00
2 time                     0.03340   458.5  19.033   0.68   1.113       79.00
3 time2                   -0.00315     3.7  -0.954  -0.00  -0.050        1.65
4 qup34                    1.00000 24804.2 862.701   0.00   0.112        0.01
5 qdown34                  0.30750    17.5   2.140  -0.00   0.066       -0.03
```

35. Average Labor Productivity: Drink

```
SEE    =      0.02 RSQ   = 0.9882 RHO =    0.36 Obser  =    17 from 1971.000
SEE+1  =      0.02 RBSQ  = 0.9843 DW  =    1.27 DoFree =    12 to   1987.000
MAPE   =      0.41
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod35                - - - - - - - - - - - - - - - - - - - - -       3.97
1 intercept               -0.31196    10.6  -1.637  -0.08  -0.000        1.00
2 time                     0.05510   550.5  22.267   1.10   1.453       79.00
3 time2                    0.00033     0.0   0.068   0.00   0.004        1.65
4 qup35                    0.57135    55.3   4.117   0.00   0.152        0.03
5 qdown35                  1.00000 15586.4 543.382  -0.02   0.485       -0.09
```

In the case of the Tobacco industry equation, inclusion of two output variables yielded markedly different and highly significant output parameters and turned implausible time trend parameters into significant and credible ones. However, one of the output variables was unrealistically large, and constraining it had significant effects on the all the parameters. The constrained equation's fit was poorer in terms of R-square, mean error and rho; and the time parameters fell from 0.05087 and 0.08524 to 0.04232 and 0.03345, respectively, cutting projected annual productivity growth from 13.6% to a more reasonable 7.6%.

36. Average Labor Productivity: Tobacco

SEE =	0.06	RSQ	= 0.7573	RHO =	0.68	Obser =	17 from 1971.000
SEE+1 =	0.05	RBSQ	= 0.6763	DW =	0.64	DoFree =	12 to 1987.000
MAPE =	1.36						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod36	- - -	- - -	- - -	- - -	- - -	3.90
1 intercept	0.65906	5.1	1.119	0.17	0.000	1.00
2 time	0.04232	88.3	5.526	0.86	1.684	79.00
3 time2	0.03345	19.4	2.258	0.01	0.639	1.65
4 qup36	0.72665	8.8	1.487	0.00	0.245	0.02
5 qdown36	1.00003	11560.0	403.900	-0.04	1.682	-0.17

Although the Yarn industry has never recovered to its level of activity of the late 1960's, it has apparently maintained and even accelerated its rate of productivity growth.

37. Average Labor Productivity: Yarn

SEE =	0.05	RSQ	= 0.9548	RHO =	0.61	Obser =	17 from 1971.000
SEE+1 =	0.04	RBSQ	= 0.9443	DW =	0.78	DoFree =	13 to 1987.000
MAPE =	1.30						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod37	- - -	- - -	- - -	- - -	- - -	3.11
1 intercept	0.64650	9.1	1.576	0.21	0.000	1.00
2 time	0.03081	86.9	5.691	0.78	0.663	79.00
3 time2	0.02663	17.2	2.203	0.01	0.275	1.65
4 dlq37	0.51358	16.8	2.173	-0.01	0.148	-0.04

Unlike the Yarn industry, the Textiles industry has apparently <u>not</u> accelerated its rate of productivity growth in the 1980's. While the equation with two change in output variables implies a significant acceleration in productivity; the parameter on the variable ***QUP*** is negative and insignificant, and furthermore the equation does not yield a very good fit. The alternative equation, while implying a slight decline in productivity growth in the 1980's, has a much better fit. This equation is probably a candidate for a bit of firm-handed force-fitting of the second time-trend parameter, but for now I have left it the way it is.

38. Average Labor Productivity: Textiles

SEE =	0.02	RSQ	= 0.9771	RHO =	0.17	Obser =	17 from 1971.000
SEE+1 =	0.02	RBSQ	= 0.9718	DW =	1.66	DoFree =	13 to 1987.000
MAPE =	0.59						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod38	- - -	- - -	- - -	- - -	- - -	2.89
1 intercept	0.75104	35.7	3.308	0.26	0.000	1.00
2 time	0.02724	170.4	9.059	0.74	0.981	79.00
3 time2	-0.00490	1.9	-0.708	-0.00	-0.085	1.65
4 dlq38	0.87022	91.1	5.872	-0.00	0.361	-0.00

The results for the Apparel industry were similar to those for the Textiles industry except that the time trend parameters were more robust to alternative equation specifications.

39. Average Labor Productivity: Apparel

SEE =	0.03	RSQ	= 0.9791	RHO =	0.52	Obser =	17 from 1971.000
SEE+1 =	0.02	RBSQ	= 0.9742	DW =	0.95	DoFree =	13 to 1987.000
MAPE =	1.00						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod39	- - -	- - -	- - -	- - -	- - -	2.53
1 intercept	-0.47853	12.6	-1.865	-0.19	-0.000	1.00
2 time	0.03797	228.2	11.269	1.18	0.939	79.00
3 time2	0.00512	2.0	0.727	0.00	0.061	1.65
4 dlq39	0.35768	18.4	2.285	0.00	0.098	0.01

In the case of the Leather and footwear industry equation, inclusion of two output variables yielded markedly different and highly significant output parameters and turned implausible time trend parameters into significant and credible ones. Constraining the parameter on *QUP* had essentially no effect on the fit or on the values of any of the other parameters.

40. Average Labor Productivity: Leather and Footwear

```
SEE    =        0.03 RSQ    = 0.9621 RHO =    0.34 Obser   =    17 from 1971.000
SEE+1  =        0.03 RBSQ   = 0.9495 DW  =    1.31 DoFree  =    12 to   1987.000
MAPE   =        0.91
  Variable name                 Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod40                     - - - - - - - - - - - - - - - - - - - - -        2.87
1 intercept                    -0.46252      6.6  -1.277  -0.16   -0.000        1.00
2 time                          0.04313    176.3   8.923   1.19    1.315       79.00
3 time2                         0.00496      1.7   0.635   0.00    0.073        1.65
4 qup40                         1.00000  10016.3 350.422   0.00    0.077        0.01
5 qdown40                       0.59519    115.1   6.596  -0.03    0.605       -0.16
```

For the Timber and wood products industry, neither equation was a particularly strong candidate. Inclusion of two output variables yielded markedly different and highly significant output parameters while slightly degrading the fit.

41. Average Labor Productivity: Timber and Wood Products

```
SEE    =        0.04 RSQ    = 0.5439 RHO =    0.45 Obser   =    17 from 1971.000
SEE+1  =        0.04 RBSQ   = 0.3919 DW  =    1.10 DoFree  =    12 to   1987.000
MAPE   =        1.00
  Variable name                 Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod41                     - - - - - - - - - - - - - - - - - - - - -        3.20
1 intercept                     2.64931     54.3   4.073   0.83    0.000        1.00
2 time                          0.00688      2.5   0.776   0.17    0.574       79.00
3 time2                         0.00845      1.7   0.644   0.00    0.338        1.65
4 qup41                         0.77609      2.2   0.725   0.00    0.190        0.01
5 qdown41                       0.10660      0.5   0.352  -0.00    0.152       -0.14
```

In contrast to the Timber and wood products industry, in the case of the Pulp and paper industry both equations were good; but as with Timber, inclusion of two output variables slightly degraded the fit while yielding markedly different and highly significant output parameters. Constraining the parameter on *QUP* had essentially no effect on the fit or on the values of any of the other parameters.

42. Average Labor Productivity: Pulp and Paper

```
SEE    =        0.03 RSQ    = 0.9625 RHO =    0.29 Obser   =    17 from 1971.000
SEE+1  =        0.03 RBSQ   = 0.9500 DW  =    1.41 DoFree  =    12 to   1987.000
MAPE   =        0.62
  Variable name                 Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod42                     - - - - - - - - - - - - - - - - - - - - -        3.60
1 intercept                     1.10588     31.6   2.962   0.31    0.000        1.00
2 time                          0.03196    108.2   6.326   0.70    0.916       79.00
3 time2                         0.01891     18.4   2.193   0.01    0.260        1.65
4 qup42                         1.00000   9451.4 330.853   0.00    0.123        0.01
5 qdown42                       0.45037     32.7   3.022  -0.02    0.248       -0.14
```

The Printing and publishing industry equation has a good fit and significant parameters. However, I am suspicious of the results, even though they are robust to changes in specification. The printers' unions successfully resisted automation until the very early 1980's and then finally caved in on a grand scale; so I can't imagine why productivity growth, already low in the 1970's fell by half in the 1980's.

43. Average Labor Productivity: Printing and Publishing

SEE =	0.01 RSQ	= 0.9857 RHO =	0.15 Obser =	17 from 1971.000			
SEE+1 =	0.02 RBSQ	= 0.9809 DW =	1.70 DoFree =	12 to 1987.000			
MAPE =	0.40						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 lprod43	- - - - - -	- - - -	- - - -	- - - -	- - - -	3.17	
1 intercept	0.55244	53.7	4.044	0.17	0.000	1.00	
2 time	0.03366	446.7	18.617	0.84	1.321	79.00	
3 time2	-0.01954	80.7	-5.215	-0.01	-0.368	1.65	
4 qup43	0.41272	10.9	1.657	0.00	0.073	0.02	
5 qdown43	0.77202	98.8	5.950	-0.01	0.270	-0.03	

Both the Rubber and Plastics equations have good fits and significant parameters, except for ***QUP*** in the case of Rubber, and for the second time trend in the case of Plastics. It might be worthwhile to constrain them to take more plausible values, given their statistical insignificance, but I have not done so.

44. Average Labor Productivity: Rubber

SEE =	0.03 RSQ	= 0.9768 RHO =	0.29 Obser =	17 from 1971.000		
SEE+1 =	0.03 RBSQ	= 0.9691 DW =	1.41 DoFree =	12 to 1987.000		
MAPE =	0.59					
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod44	- - - - - -	- - - -	- - - -	- - - -	- - - -	3.24
1 intercept	0.94387	37.8	3.283	0.29	0.000	1.00
2 time	0.02952	140.7	7.584	0.72	0.856	79.00
3 time2	0.03333	84.5	5.373	0.02	0.463	1.65
4 qup44	0.71542	1.6	0.631	0.00	0.031	0.00
5 qdown44	0.47978	64.2	4.511	-0.03	0.385	-0.18

45. Average Labor Productivity: Plastics

SEE =	0.03 RSQ	= 0.9609 RHO =	0.27 Obser =	17 from 1971.000		
SEE+1 =	0.03 RBSQ	= 0.9479 DW =	1.46 DoFree =	12 to 1987.000		
MAPE =	0.74					
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod45	- - - - - -	- - - -	- - - -	- - - -	- - - -	3.34
1 intercept	1.06284	29.5	2.852	0.32	0.000	1.00
2 time	0.02857	95.5	5.821	0.68	0.855	79.00
3 time2	0.00608	1.2	0.541	0.00	0.087	1.65
4 qup45	0.56174	17.5	2.135	0.01	0.173	0.04
5 qdown45	0.26662	5.6	1.173	-0.00	0.086	-0.04

In the case of the Other manufacturing industry equation, inclusion of two output variables yielded distinct and highly significant output parameters, increased the significance and marginal explanatory value of all the other parameters in the equation, and improved the fit.

46. Average Labor Productivity: Other Manufacturing

SEE =	0.03 RSQ	= 0.9895 RHO =	0.05 Obser =	17 from 1971.000		
SEE+1 =	0.03 RBSQ	= 0.9859 DW =	1.90 DoFree =	12 to 1987.000		
MAPE =	0.83					
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 lprod46	- - - - - -	- - - -	- - - -	- - - -	- - - -	2.98
1 intercept	-4.21419	330.7	-14.513	-1.41	-0.000	1.00
2 time	0.09436	600.0	24.000	2.50	1.787	79.00
3 time2	-0.06114	169.9	-8.683	-0.03	-0.556	1.65
4 qup46	0.48385	25.7	2.640	0.01	0.109	0.04
5 qdown46	0.79978	291.8	13.122	-0.06	0.695	-0.22

Inclusion of two output variables in Construction yielded distinct and significant output parameters and improved the fit markedly, cutting the mean error by half. However, it also cut the significance of the time parameters by half; and though it did not change their aggregate effect (so that forecast productivity growth would be approximately the same with either equation) it greatly affected their specific magnitudes. Constraining the parameter on *QUP* had essentially no effect on the fit or on the values of any of the other parameters.

47. Average Labor Productivity: Construction

```
SEE    =       0.02 RSQ    = 0.9608 RHO =    0.44 Obser  =    17 from 1971.000
SEE+1 =        0.02 RBSQ   = 0.9477 DW  =    1.11 DoFree =    12 to   1987.000
MAPE   =       0.48
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod47                 - - - - - - - - - - - - - - - - - - - - -         3.60
1 intercept                  3.43411   228.5  10.838   0.95    0.000        1.00
2 time                       0.00340     2.5   0.773   0.07    0.155       79.00
3 time2                      0.03105    55.5   4.127   0.01    0.678        1.65
4 qup47                      1.00000 33064.2 1148.84   0.00    0.138        0.01
5 qdown47                    0.73629   123.1   6.910  -0.04    0.724       -0.21
```

Rather like Construction, inclusion of two output variables in both the Distribution and Transportation industry equations yielded distinct and significant output parameters and improved the fit, but drastically reduced the significance of the time parameters. Again, though it did not change their aggregate effect, so that forecast productivity growth would be approximately the same with either equation, inclusion of the output variables greatly affected the time parameters' specific magnitudes in both equations.

48. Average Labor Productivity: Distribution, Hotels, Catering and Repair

```
SEE    =       0.02 RSQ    = 0.7993 RHO =    0.48 Obser  =    17 from 1971.000
SEE+1 =        0.02 RBSQ   = 0.7325 DW  =    1.04 DoFree =    12 to   1987.000
MAPE   =       0.69
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod48                 - - - - - - - - - - - - - - - - - - - - -         2.51
1 intercept                  2.65914   233.2  11.012   1.06    0.000        1.00
2 time                      -0.00203     1.7  -0.642  -0.06   -0.219       79.00
3 time2                      0.00703     3.1   0.869   0.00    0.365        1.65
4 qup48                      0.80340    11.1   1.680   0.01    0.426        0.02
5 qdown48                    0.50259    13.7   1.873  -0.01    0.353       -0.03
```

49. Average Labor Productivity: Transportation

```
SEE    =       0.04 RSQ    = 0.8788 RHO =    0.71 Obser  =    17 from 1971.000
SEE+1 =        0.03 RBSQ   = 0.8384 DW  =    0.57 DoFree =    12 to   1987.000
MAPE   =       1.00
  Variable name              Reg-Coef  Mexval t-value  Elas     Beta        Mean
0 lprod49                 - - - - - - - - - - - - - - - - - - - - -         3.06
1 intercept                  1.75763    51.8   3.954   0.57    0.000        1.00
2 time                       0.01640    28.6   2.800   0.42    0.761       79.00
3 time2                      0.00664     1.0   0.502   0.00    0.148        1.65
4 qup49                      0.64889     4.1   1.003   0.00    0.155        0.02
5 qdown49                    0.80341     5.1   1.123  -0.00    0.150       -0.02
```

The Postal and telecommunications industry equation is excellent. Constraining the parameter on ***QUP*** had essentially no effect on the fit or on the values of any of the other parameters.

50. Average Labor Productivity: Postal and Telecommunications

```
SEE    =       0.01 RSQ   = 0.9969 RHO =    0.32 Obser  =    17 from 1971.000
SEE+1  =       0.01 RBSQ  = 0.9959 DW  =    1.36 DoFree =    12 to   1987.000
MAPE   =       0.36
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod50                 - - - - - - - - - - - - - - - - - - - -         2.85
1 intercept                -0.51117    61.4  -4.390  -0.18  -0.000        1.00
2 time                      0.04206   705.3  27.680   1.16   0.872       79.00
3 time2                     0.01156    42.2   3.502   0.01   0.115        1.65
4 qup50                     0.61991    44.1   3.595   0.01   0.063        0.04
5 qdown50                   1.00000 10656.0 372.585  -0.00   0.017       -0.00
```

The Banking, finance, insurance and business services industry is the only British industry to experience uninterrupted growth during the entire estimation period. It has apparently also enjoyed slow, stable productivity growth, with a minor increase in the pace of growth during the past decade.

51. Average Labor Productivity: Banking Etc.

```
SEE    =       0.01 RSQ   = 0.9887 RHO =    0.43 Obser  =    17 from 1971.000
SEE+1  =       0.01 RBSQ  = 0.9861 DW  =    1.15 DoFree =    13 to   1987.000
MAPE   =       0.33
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod51                 - - - - - - - - - - - - - - - - - - - -         3.24
1 intercept                 1.66587   348.7  15.770   0.51   0.000        1.00
2 time                      0.01946   304.6  14.135   0.47   0.811       79.00
3 time2                     0.00576     7.4   1.416   0.00   0.115        1.65
4 dlq51                     0.52286     8.7   1.537   0.01   0.101        0.06
```

The Other services industry includes government and miscellaneous services. It is in the latter that a large number of low-wage, long-hours, and often self-employed workers found employment during the 1980's, and so, not surprisingly, productivity growth has been negligible. As noted above, productivity growth has been decidedly negative if trends in hours are factored in. The time trend parameters are quite robust to changes in specification, as is the negative parameter on changes in output. The two-output parameter equation gave a quite dubiously large parameter to ***QDOWN***, and therefore was not selected.

53. Average Labor Productivity: Other Services

```
SEE    =       0.01 RSQ   = 0.7679 RHO =    0.61 Obser  =    17 from 1971.000
SEE+1  =       0.01 RBSQ  = 0.7144 DW  =    0.78 DoFree =    13 to   1987.000
MAPE   =       0.40
  Variable name             Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 lprod53                 - - - - - - - - - - - - - - - - - - - -         2.20
1 intercept                 1.85148   397.3  17.564   0.84   0.000        1.00
2 time                      0.00449    36.7   3.359   0.16   1.041       79.00
3 time2                    -0.00268     4.0  -1.028  -0.00  -0.298        1.65
4 dlq53                    -0.29379     3.3  -0.936  -0.00  -0.150        0.02
```

Given these equations for the log of average labor productivity in each industry, the model determines total employment in industry k in year t through the equation

$$L_{k\,t} = e^{\log(\,(Q\,/\,L)_{k\,t}\,)}\;Q_{k\,t}$$

where log $(Q/L)_{kt}$ is the measure of productivity determined in the equations discussed above.

An additional set of equations are required to determine self-employment by industry. Subtracting self-employment from total employment yields what is called in Britain "employees in employment", which is the variable relevant to the value added component called "income from employment", discussed in the next section. The self-employment equations are based mainly on time trends, which proved to be very strong explanatory variables. The equations are important only in the Agriculture sector and in the services industries (numbers 47 through 53). Unfortunately, no data exists on self-employment by sector for these sectors, and I had to construct the data by apportioning the total across industries, though in fact I suspect that most of it should be apportioned to the Other services industry. As a consequence, the equation parameters for all of these sectors were practically identical, and this is a deficiency of the model that will require revision in the future.

Section IV.8 Coefficient Change

At the heart of an input-output model are interindustry transactions — or in the case of a commodity approach, intercommodity transactions: use of commodities as inputs in the production of other commodities. Since a model such as BRIM is intended to be a dynamic macro interindustry model, it is important to include within it some representation of changes in the pattern of interindustry transactions over time. These changes are represented as changes in the input-output coefficients of the A matrix. The coefficients measure the quantities of each commodity needed to produce a unit of each other. In addition, there are significant changes over time in the types of equipment in which industry invests. For instance, in recent years industries have tended to spend more on computers per pound of investment than they did twenty years ago. These patterns are represented in the model by the B matrix, which translates industry-specific investment into commodity-specific investment; and changes in these patterns can be represented by changes in the coefficients of the B matrix.[71].

Since I do not have extensive information on changes in individual input-output coefficients over time, I have used the INFORUM approach to modeling coefficient change, called "across-the-row" coefficient change. This approach involves, for each commodity, fitting logistic time trends to the ratio of historical intermediate use to what intermediate use would have been had the all input-output coefficients remained constant. The estimated trends are projected into the future, yielding annual incremental changes in aggregate unit intermediate use; and each coefficient in a given row is reduced or increased in proportion to the trend. In the case of projected changes in the B matrix, the resulting coefficients must be adjusted to ensure that the matrix columns sum to 1.0 and the matrix balances.

The differential equation for the logistic curve for a coefficient c is

$$\frac{1}{c}\frac{dc}{dt} = b\ (a-c)$$

where

a is the asymptote toward which the coefficient is trending and
b is the ratio between the change in *c* and the difference between *a* and *c*.

The solution to the above equation is

$$c_t = \frac{a}{1 + Ae^{-bat}}$$

where A is the constant of integration.

The logistic trends shown below in Tables IV.8.1 and IV.8.2 were developed as follows. Historical intermediate use and commodity investment series were estimated using

[71] Since the PCE bridge matrix, which translates personal consumption expenditure classifications into input-output classifications, changes over time, one could also investigate and model changes in the PCE matrix.

methods described in the Appendix; and estimates were developed of what intermediate use would have been had the 1984 A-matrix (or B-matrix) coefficients obtained over the entire estimation period. These hypothetical series were derived by multiplying the vector of historical gross output by the 1984 A matrix (or industry investment by the 1984 B matrix). The ratio of historical use to hypothetical 1984-coefficient use gives a proxy for across-the-row coefficient change over the period of estimation, and is the dependent variable used in the equation above.

Although this approach captures general positive or negative trends in intermediate use, it does not allow for price-contingent coefficient change, and therefore leaves a great deal to be desired in terms of usefulness for testing alternative scenarios involving varying assumptions about changes in input prices. (For instance, it renders impossible realistic modeling of the long-term impact of large input-specific taxes or subsidies, such as fossil fuel taxes or carbon taxes.) A more accurate representation of coefficient change might be derived using the logistic equation above with current and lagged relative price parameters in the numerator. However, given the quality and extent of the available data, I do not believe that anything would be gained from attempting to estimate such an equation at present. With an additional input-output table (available in about a year) and some more detailed intermediate use data (available for important inputs such as energy), an attempt to perform such estimations and include them in the model might prove very useful.

Note that coefficient change as represented here is not necessarily the same thing as technological change, though it may include technological change as one of its components. As Almon notes, "[i]t is our impression ... that [these logistic trends] reflect changes in laws, preferences, prices, and product mixes at least as much as they reflect advances in technology." Coal use, for example, declined throughout the period examined here, largely due to the rising costs of domestic coal production and the increasing domestic availability of oil and natural gas. These trends had little to do with changes in available technology.

Most of the trends are estimated over the period 1970-84. Unfortunately, there are rather severe deficiencies in the data, and much of the intermediate use data is of particularly poor quality for the period 1970-74 because of changes in commodity classifications between 1974 and 1979. Furthermore, the estimations produce much better fits for almost every commodity when estimated over the period 1974-84. Nevertheless, the good fits seem to be due largely to factors unique to the period, and I am skeptical that they represent trends that are likely to obtain through the end of the century. The decade 1974-84 saw the rapid appreciation of the pound and tremendous competitive pressure from imports on British producers. This pressure forced producers to cut costs much more rapidly than they had in the past. Perhaps equally importantly, energy prices rose spectacularly during this period, just as Britain became self-sufficient in oil production, and prices fell just as spectacularly thereafter. Since the functional form does not take price changes into account, it is inappropriate to estimate it over a short period in which changes would be dominated by price variation. My skepticism is reinforced by the fact that the model is vastly more difficult (i.e. impossible) to solve if the 1974-84 trends are included, but solves relatively easily with the 1970-84 trends are incorporated. For all of these reasons taken together; I see little reason to believe that the well-fitting trends estimated over the period 1974-84 are likely to continue over the coming decade. In my judgement, the poorer-fitting but less precipitous trends obtained from the longer estimation period are probably better indicators of future trends, even though they too incorporate the same price-induced changes in use that occured in 1974-84.

Despite the problems with trends from the period 1974-84, for about one-quarter of the commodities they seem more realistic than those estimated over a longer period. For these commodities, I incorporated the 1974-84 trends into the model. Working with such a limited sample leaves me somewhat skeptical that the results are very reliable, but this is the best one can do at present.

The Tables below show projected the projected coefficients for both sets of estimations for 1984, 1985, 1990, 1995 and 2000, and the average annual percent change in the coefficients in the intervening periods. Although the few sectors that show rapidly growing coefficients — Electricity, Industrial plant, Electronic equipment, Office machinery, and Banking and finance — seem to be reasonable, I find the rest of the results generally disappointing from a forecasting point of view. Three sectors yield nonsense results — Ordnance, Domestic electrical appliances, and Tobacco — but turn out to be insignificant in intermediate use; I have therefore left their coefficients unchanged in the model. For over half of the commodities, however, the equations yield average annual decreases in intermediate use (per unit of gross output) of at least 2.0% for the fifteen-year period 1984-2000; and nearly one-third of the equations project average annual decreases of over 3.0%. I believe that such large reductions in intermediate use show up in the estimations because the period for which data is fairly reliable, 1974-84, saw unprecedented changes in British manufacturing as firms struggled to cope with the oil crises and the impact of the Pound's appreciation on industrial competitiveness.. I find it implausible that such large increases in efficiency of input use are likely to continue to occur over the next decade. I therefore include these equations in the model with the qualification that they most likely represent an overstatement of the potential for rationalization of input use in British industry over the coming decade. In some cases, the implied efficiency increases were obviously absurd: the equation for oil suggests that intermediate oil product use will decline by an average of 5.2% per year between 1984 and 2000. For this equation I have substituted into the model an alternative equation derived using a longer and somewhat differently specified time series. The alternative equation yields a more plausible -1.2% average annual decrease in intermediate oil use per unit of output. A more comprehensive treatment of intermediate use coefficient change awaits better and longer time series on intermediate use.

The B matrix coefficient projections seem more reliable: the equations project significant decreases in investment spending on Shipbuilding, Domestic electric appliances, Agricultural machinery, Machine tools and Other vehicles; and increases in Office machinery, Timber and wood products, Basic electrical equipment, Construction, Aerospace engineering, and Motor vehicles.

Table IV.8.1: A Matrix Across-the-Row Coefficient Change Coefficients (1984 = 100) and Average Annual Change, Selected Years

Sector	1984	1985	1990	1995	2000	84-85	85-90	90-95	90-00
1. Agriculture etc	1.000	1.008	1.038	1.055	1.064	0.8%	0.6%	0.3%	0.2%
2. Coal and Coke	1.000	0.920	0.658	0.512	0.419	-8.0%	-6.5%	-4.9%	-3.9%
3. Oil and Gas Extraction	1.000	0.980	0.893	0.820	0.758	-2.0%	-1.8%	-1.7%	-1.6%
4. Mineral Oil Processing	1.000	0.914	0.639	0.492	0.400	-8.6%	-6.9%	-5.1%	-4.0%
5. Electricity	1.000	1.020	1.107	1.168	1.210	2.0%	1.6%	1.1%	0.7%
6. Public Gas Supply	1.000	0.959	0.824	0.754	0.713	-4.1%	-3.0%	-1.8%	-1.1%
7. Water Supply	1.000	0.980	0.893	0.820	0.758	-2.0%	-1.9%	-1.7%	-1.6%
8. Metal Ores etc.	1.000	0.966	0.825	0.720	0.639	-3.4%	-3.1%	-2.7%	-2.4%
9. Non-metallic Ores	1.000	0.959	0.796	0.681	0.595	-4.1%	-3.7%	-3.1%	-2.7%
10. Iron and Steel	1.000	0.962	0.808	0.697	0.613	-3.8%	-3.4%	-2.9%	-2.5%
11. Other Metals	1.000	0.975	0.868	0.782	0.711	-2.5%	-2.3%	-2.1%	-1.9%
12. Non-Met. Min. Prod.'s	1.000	0.967	0.832	0.730	0.651	-3.3%	-3.0%	-2.6%	-2.3%
13. Basic Chemicals	1.000	0.977	0.875	0.792	0.724	-2.3%	-2.2%	-2.0%	-1.8%
14. Pharmaceuticals	1.000	0.942	0.730	0.596	0.504	-5.8%	-5.0%	-4.0%	-3.3%
15. Soap and Toilet Prep.'s	1.000	0.971	0.849	0.755	0.679	-2.9%	-2.6%	-2.3%	-2.1%
16. Man-made Fibres	1.000	0.955	0.780	0.659	0.571	-4.5%	-4.0%	-3.3%	-2.8%
17. Other Metal Products	1.000	0.946	0.746	0.616	0.525	-5.4%	-4.6%	-3.8%	-3.2%
18. Industrial Plant etc.	1.000	1.014	1.085	1.156	1.226	1.4%	1.4%	1.3%	1.2%
19. Agricultural Machinery	1.000	1.002	1.012	1.022	1.031	0.2%	0.2%	0.2%	0.2%
20. Machine Tools	1.000	0.941	0.727	0.593	0.500	-5.9%	-5.0%	-4.0%	-3.3%
21. Textile etc. Machinery	1.000	0.985	0.938	0.918	0.909	-1.5%	-1.0%	-0.4%	-0.2%
22. Other Machinery	1.000	0.969	0.840	0.742	0.664	-3.1%	-2.8%	-2.5%	-2.2%
23. Ordnance	1.000	1.000	1.000	1.000	1.000	0.0%	0.0%	0.0%	0.0%
24. Office Machinery	1.000	1.051	1.302	1.532	1.723	5.1%	4.4%	3.3%	2.4%
25. Basic Electrical Equip.	1.000	0.951	0.763	0.637	0.547	-4.9%	-4.3%	-3.5%	-3.0%
26. Electronic Equipment	1.000	1.046	1.272	1.477	1.647	4.6%	4.0%	3.0%	2.2%
27. Domestic Electr. Appl.	1.000	1.000	1.000	1.000	1.000	0.0%	0.0%	0.0%	0.0%
28. Elect. Lighting Equip.	1.000	0.951	0.764	0.639	0.549	-4.9%	-4.3%	-3.5%	-3.0%
29. Motor Vehicles	1.000	0.965	0.835	0.753	0.698	-3.5%	-2.8%	-2.0%	-1.5%
30. Shipbuilding etc.	1.000	0.947	0.750	0.621	0.530	-5.3%	-4.6%	-3.7%	-3.1%
31. Aerospace Eng.	1.000	0.953	0.772	0.653	0.567	-4.7%	-4.1%	-3.3%	-2.8%
32. Other Vehicles	1.000	0.961	0.804	0.692	0.607	-3.9%	-3.5%	-3.0%	-2.6%
33. Instrument Engineering	1.000	0.973	0.857	0.767	0.695	-2.7%	-2.5%	-2.2%	-1.9%
34. Food	1.000	0.981	0.898	0.827	0.767	-1.9%	-1.8%	-1.6%	-1.5%
35. Drink	1.000	0.993	0.963	0.944	0.932	-0.7%	-0.6%	-0.4%	-0.3%
36. Tobacco	1.000	1.000	1.000	1.000	1.000	0.0%	0.0%	0.0%	0.0%
37. Yarn	1.000	0.968	0.835	0.734	0.655	-3.2%	-2.9%	-2.5%	-2.3%
38. Textiles	1.000	0.968	0.836	0.735	0.656	-3.2%	-2.9%	-2.5%	-2.2%
39. Apparel	1.000	1.025	1.095	1.120	1.128	2.5%	1.3%	0.4%	0.1%
40. Leather and Footwear	1.000	0.981	0.898	0.827	0.767	-1.9%	-1.8%	-1.6%	-1.5%
41. Timber and Wood Prd.	1.000	0.971	0.869	0.809	0.771	-2.9%	-2.2%	-1.4%	-0.9%
42. Pulp and Paper	1.000	0.964	0.817	0.709	0.627	-3.6%	-3.3%	-2.8%	-2.4%
43. Printing and Publishing	1.000	0.985	0.914	0.852	0.799	-1.6%	-1.5%	-1.4%	-1.3%
44. Rubber	1.000	0.960	0.799	0.685	0.600	-4.0%	-3.6%	-3.0%	-2.6%
45. Plastics	1.000	1.004	1.024	1.044	1.064	0.4%	0.4%	0.4%	0.4%

(Continued)

Table IV.8.1: A Matrix Across-the-Row Coefficient Change (Continued)
Coefficients (1984 = 100) and Average Annual Change, Selected Years

Sector	1984	1985	1990	1995	2000	84-85	85-90	90-95	90-00
46. Other Manufacturing	1.000	0.975	0.866	0.780	0.709	-2.5%	-2.3%	-2.1%	-1.9%
47. Construction	1.000	0.959	0.795	0.680	0.594	-4.1%	-3.7%	-3.1%	-2.7%
48. Distrib., Hotels etc.	1.000	0.950	0.761	0.635	0.545	-5.0%	-4.3%	-3.6%	-3.0%
49. Transportation	1.000	0.979	0.904	0.860	0.833	-2.1%	-1.6%	-1.0%	-0.6%
50. Postal and Telecom.	1.000	0.999	0.992	0.985	0.978	-0.1%	-0.1%	-0.1%	-0.1%
51. Banking, Finance etc.	1.000	1.093	1.482	1.697	1.790	9.3%	6.3%	2.7%	1.1%
53. Other Services	1.000	0.942	0.757	0.662	0.606	-5.8%	-4.3%	-2.7%	-1.8%

Table IV.8.2: B Matrix Across-the-Row Coefficient Change
Coefficients (1984 = 100) and Average Annual Change, Selected Years

Sector	1984	1985	1990	1995	2000	84-85	85-90	90-95	90-00
17. Other Metal Products	1.000	1.025	1.088	1.105	1.109	2.5%	1.2%	0.3%	0.1%
18. Industrial Plant etc.	1.000	0.995	0.972	0.951	0.930	-0.5%	-0.5%	-0.5%	-0.4%
19. Agricultural Mach.	1.000	0.965	0.819	0.712	0.630	-3.6%	-3.2%	-2.8%	-2.4%
20. Machine Tools	1.000	0.969	0.837	0.737	0.659	-3.1%	-2.9%	-2.5%	-2.2%
21. Textile etc. Machinery	1.000	1.015	1.075	1.116	1.141	1.5%	1.2%	0.7%	0.5%
22. Other Machinery	1.000	1.008	1.045	1.080	1.114	0.8%	0.7%	0.7%	0.6%
24. Office Machinery	1.000	1.072	1.432	1.752	1.993	7.2%	6.0%	4.1%	2.6%
25. Basic Electrical Equip.	1.000	1.028	1.170	1.309	1.439	2.8%	2.6%	2.3%	1.9%
26. Electronic Equipment	1.000	0.998	0.987	0.976	0.966	-0.2%	-0.2%	-0.2%	-0.2%
27. Domestic Electr. App.	1.000	0.949	0.757	0.630	0.540	-5.1%	-4.4%	-3.6%	-3.1%
28. Electric Light. Equip.	1.000	1.079	1.178	1.183	1.183	7.9%	1.8%	0.1%	0.0%
29. Motor Vehicles	1.000	1.015	1.076	1.117	1.144	1.5%	1.2%	0.8%	0.5%
30. Shipbuilding etc.	1.000	0.947	0.750	0.621	0.530	-5.3%	-4.6%	-3.7%	-3.1%
31. Aerospace Engineering	1.000	1.029	1.149	1.231	1.283	2.9%	2.2%	1.4%	0.8%
32. Other Vehicles	1.000	0.977	0.876	0.794	0.726	-2.3%	-2.2%	-1.9%	-1.8%
33. Instrument Engineering	1.000	1.017	1.098	1.177	1.250	1.7%	1.6%	1.4%	1.2%
41. Timber and Wood Prd.	1.000	1.066	1.399	1.707	1.954	6.6%	5.6%	4.1%	2.7%
47. Construction	1.000	1.023	1.140	1.258	1.373	2.3%	2.2%	2.0%	1.8%

Section IV.9 Value Added: Income From Employment

Income from employment comprised 56% of production costs in Britain in 1984, or 65% if indirect business taxes are omitted from value added. The wage and salary income included in this component of the National Accounts comprises not only the majority of production costs but also the preponderance of personal income, which finances personal consumption expenditures. The growth of wages thus finances the growth of domestic spending.

For the economy as a whole during the past two decades, the growth of average annual real wages has tended to track aggregate real labor productivity growth, each rising an average of 1.7% per year. However, the pattern has varied considerably across sectors of the economy. Manufacturing sector productivity and real wage growth rates have both outpaced those of the nonmanufacturing sector. Real wages in the manufacturing sector have grown at about two-thirds of the rate of productivity growth in the sector — about 2.4% versus 3.7% annually — while nonmanufacturing wages have grown at about the same rate as nonmanufacturing productivity, or perhaps slightly faster — 1.3% versus 1.2%. It is thus important to represent wage growth in the two sectors separately.

Furthermore, nominal wages have grown very rapidly over the past twenty years as British workers, a majority of whom were union members over the period in question, consistently have bargained for and won wage increases commensurate with recent price inflation. Nominal wage growth thus clearly plays a role in Britain's chronic price inflation, and accurate determination of nominal wage growth is therefore crucial to modeling of the British price formation process.

The Cambridge CMDM model incorporates a set of industry-specific wage equations intended, first, to reflect the real wage resistance hypothesis; second, to account for the effect of changes in the unemployment rate on wage growth; and third, to account for the impact of government incomes policies intended to restrict wage inflation (the latter being the model's main focus). The real wage resistance hypothesis suggests that employees attempt to maintain steady growth of their real wages; and British real wages have in fact tended to grow at a fairly constant rate in the postwar era. Successive governments' attempts to control wage growth through incomes policies during the 1970's were usually followed by a burst of relatively large real-wage demands. These wage demand bursts, in which wages or earnings seemed to 'catch up' lost ground, gave rise to the interpretation that workers have in mind a target level of real earnings growth.[72]

To account for real wage resistance, unemployment effects and the impact of incomes policies, the Cambridge equation relates the change in the aggregate average annual wage to the change in the current consumer price index, a measure of target wage growth, the current unemployment rate, and variables intended to capture the magnitude of incomes policies and the strength of the "catch-up" response of wages once these incomes policies are relaxed. The equations yield good fits, especially considering that they are essentially difference equations. Lawson, describing the Cambridge research in Barker and Peterson (1987), uses them to arrive at several general conclusions. First, he argues that the results support the real wage

[72] Lawson in Barker and Peterson (1987), pp.342-3.

hypothesis; the British aggregate real wage has been growing at just under two percent per annum, which is not very different from trend productivity growth. Furthermore, there are generally significant differences between sectoral trend growth rates. (Though the Cambridge modelers do not mention it, higher rates do not seem as a rule to obtain in sectors with higher productivity growth rates.) Lawson notes that

> [t]he estimates ... suggest that, for formulations based on annual data points, nominal earnings adjust extremely rapidly both to changes in prices ... with the result that the hypothesis of complete adjustment within a year cannot on statistical grounds be easily rejected.[73]

Second, wage responses to changes in unemployment seem to be small and generally statistically insignificant. Third, wage growth responds weakly (though significantly) to incomes policies in the short run; but lost real wages are recouped rather quickly once these policies are relaxed, although the speed of adjustment varies significantly between industries.

My approach to modeling wages in Britain has drawn both on the Cambridge work and on work done on similar models of other countries by researchers in the INFORUM group. In the initial stages of my work, I drew mainly on the Cambridge model to relate wage growth to price inflation, unemployment, and productivity growth, though I abandoned the real wage resistance hypothesis. In later work on the wage equations, I adopted the INFORUM approach of adding monetary variables directly into the equation as a way of introducing inflationary effects into the model, but I finally abandoned this effort and returned to a relatively simple equation relating real wage growth to productivity growth. The next few pages describe this work and the conclusions that I drew from it.

Choice of inflation term. Although the Cambridge conclusions may be warranted, I have had several reservations about the applicability of their analysis to long-term modeling, and took alternative approaches on several fronts. In discussions with British government officials familiar with union bargaining processes, I learned that wage negotiations are staggered throughout the year, taking place at different times in different unions and industries. Furthermore, as the real wage resistance hypothesis suggests, unions generally demand (though they do not necessarily receive) pay hikes that are slightly greater than the current rate of increase in the GDP deflator — not, as one might expect and nearly all modelers assume, the consumer price index, which unions claim is not representative of their members' true living costs. These probably somewhat stylized facts seemed to imply that the average negotiation — and thus the average wage increase — occurs in the middle of the year, when the relevant increase in the inflation index is likely to be midway between its current and lagged values. I therefore decided to include a variable in the aggregate wage equation that was an average of the current and lagged values of the change in the GDP deflator; I also included its lagged value.

This approach also had the virtue of helping avoid the problem of simultaneity between current wage growth and current consumer price inflation in the equations, which arises because wage inflation contributes directly to changes in consumer prices. Lawson notes the potential difficulty, stating:

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[73] Lawson in Barker and Peterson (1987), p.357.

> There may be problems of simultaneity involved in reaching these conclusions which ... ought to be examined further. Consequently the [aggregate] equation was re-estimated using a two-stage least-squares procedure, employing as instruments price indices on imports of goods and services and on materials and fuels purchased by manufacturing industries. The ... coefficient estimates which were obtained provide no obvious grounds for disputing the adopted restrictions [constraining wages to complete adjustment to inflation within a year].[74]

I considered unconvincing the assumption that these import, materials and fuels price indices are appropriate instruments for a 2SLS approach. Even the import price index, which is measured in pounds, tends to be so affected by changes in more general price indices that I saw little reason to assume that simultaneity between these variables and changes in wages will not be substantial. Be that as it may, I did not believe that simultaneous determination of wage and price inflation is an appropriate way to model the causal mechanism involved; in contrast, imposing an effective half-year lag seems to alleviate the problem while remaining faithful to the underlying reality.

Unemployment. There are good prior reasons for including the unemployment rate in the wage equation. Certainly one would expect that if unemployment reached catastrophic proportions, wage growth would begin to moderate. Equally importantly, in the absence of any other constraint to the growth of employment in the model, an unemployment term with a positive parameter in this equation will keep employment from outpacing the workforce because as unemployment falls, wages (and thus domestic prices) will rise very quickly, choking off demand for domestically produced goods and increasing the demand for imports. I chose to use the reciprocal of the unemployment rate for this variable because it rises very quickly as unemployment falls. Though not directly suggested by any theoretical model, this approach does not seem unrealistic.

Wage resistance or productivity? In addition to handling inflation and unemployment differently, I was not entirely convinced that the wage resistance hypothesis is appropriate for long run modeling, even though I believe that it probably applied to Britain in the past and may well apply to much of industry today. A model with slow productivity growth and rigid wage demands may yield long-term solutions that involve permanent high unemployment rates. Of course, that is precisely what happened in Britain during the past decade, and the combination of low productivity growth and rigid wage demands probably played an important role in bringing this about. Nevertheless, in the long run wage growth is necessarily constrained by productivity growth. Moreover, my discussions with British officials left me with the impression that British workers may be increasingly aware of the problem and thus increasingly willing to accept wage growth in line with productivity growth. This has apparently happened in some industries in which foreign (mainly Japanese) investors have opened plants in Britain, and I suspected the trend might spread, given the poor employment prospects that still obtain in large parts of the country. It thus seems likely that the British economy is in a transition stage in which the relative power of unions in the manufacturing sector is in decline and will cease to be an important force in determining wages within a decade or two. If this is the case, it would make sense to model real wage growth as driven primarily by productivity increases rather than real wage resistance. Furthermore, if one

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[74] Ibid.

models wage growth as responding mainly to productivity trends, one is assured of more stable long-run solutions.

Manufacturing vs. non-manufacturing. As noted in Section IV.7, nearly two million jobs disappeared in manufacturing during the 1980's, offset almost entirely by increases in employment in the Banking and finance sector and especially in the miscellaneous services that fall, along with education, health, public administration and defence, into the Other services sector. These service industries are less unionized and generally pay lower wages than manufacturing industries; and productivity and real wage growth trends were considerably lower in services than in manufacturing during the period of estimation. Furthermore, in general the two sectors have different wage responses to inflation. I tried estimating an economy-wide aggregate wage equation, but the difficulties I ran into persuaded me to estimate separate aggregate wage equations for the manufacturing and non-manufacturing sectors.

Equation form. For the model I initially chose an equation that embodies the hypothesis that real wage growth is driven partly by underlying productivity growth trends. The equation relates the rate of change in the average nominal wage in the sector to two smoothed inflation variables, a smoothed productivity growth term, and the reciprocal of the economy-wide unemployment rate:

$$(1)\quad \Delta\ln\left(\frac{IE_t}{EE_t}\right) = a\,\frac{1}{2}(\Delta\ln GDPD_t + \Delta\ln GDPD_{t-1}) + b\,\frac{1}{2}(\Delta\ln GDPD_{t-1} + \Delta\ln GDPD_{t-2}) + c\,\frac{1}{3}\left(\Delta\ln\frac{RQ_t}{TE_t} + \Delta\ln\frac{RQ_{t-1}}{TE_{t-1}} + \Delta\ln\frac{RQ_{t-2}}{TE_{t-2}}\right) + d\left(\frac{labfor_t}{unemp_t}\right)$$

where

IE_t is annual total income from employment in year t in the sector;
EE_t is annual total employees in employment in the sector;
$GDPD_t$ is the gross domestic product deflator;
RQ_t is constant-price output in year t in the sector;
TE_t is total employment in the sector;
$labfor_t$ is the total labor force; and
$unemp_t$ is the number of unemployed workers in the labor force.

I have not included an intercept because the equation produces much worse out-of-sample projections when an intercept is included.

Manufacturing. The results for the equation described above estimated over the period 1973-86 are shown below. The equation implies nearly complete catch-up on recent inflation (1.42904 - 0.55842 = 0.87062 or 87% catch-up) and about 56% catch-up on the acceleration of inflation. It also implies that in the absence of inflation and at the average level of unemployment during the period of estimation (about 7%), real wages grow at about 3.1% annually — 0.4 times 3.7% plus 0.00113 divided by 7% — while in fact real wages grew at about 2.4% annually. This overestimate of real wage growth is offset in the presence of inflation, since the equation does not permit complete catch-up.

Δ log Manufacturing Wage 1973-86

```
SEE    =        0.02 RSQ   = 0.8349 RHO =  -0.37 Obser  =   14 from 1973.000
SEE+1  =        0.02 RBSQ  = 0.7853 DW  =   2.73 DoFree =   10 to   1986.000
MAPE   =       17.24
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 dlnvpwm	- - - - - -	- - -	- - -	- - -	- - -	0.13
1 sdgdpd	1.42904	108.3	5.777	1.17	1.182	0.11
2 sdgdpd[1]	-0.55842	27.6	-2.507	-0.47	-0.436	0.11
3 sdlagprodm	0.40910	6.9	1.198	0.11	0.106	0.04
4 runrat	0.00113	13.8	1.720	0.17	0.249	20.03

Tested out of sample, this equation yields very similar parameters and has a lower mean error in sample. Although the mean error is considerably higher out of sample, it is fairly good for a equation on first differences.

Δ log Manufacturing Wage 1973-83

```
SEE    =        0.02 RSQ   = 0.7896 RHO =  -0.41 Obser  =   11 from 1973.000
SEE+1  =        0.02 RBSQ  = 0.6994 DW  =   2.81 DoFree =    7 to   1983.000
MAPE   =       13.90 Test period:   SEE     0.02 MAPE    29.40 end  1986.000
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 dlnvpwm	- - - - - -	- - -	- - -	- - -	- - -	0.15
1 sdgdpd	1.40955	116.8	5.089	1.18	1.065	0.13
2 sdgdpd[1]	-0.54072	28.2	-2.123	-0.46	-0.381	0.13
3 sdlagprodm	0.39879	2.5	0.591	0.09	0.101	0.03
4 runrat	0.00115	11.0	1.273	0.18	0.273	23.10

Non-manufacturing. The manufacturing wage regression also implies nearly complete catch-up on recent inflation (1.56355 - 0.74114 = 0.82241 or 82% catch-up) and about 74% catch-up on the acceleration of inflation. It implies that in the absence of inflation and at the average level of unemployment during the period of estimation, real wages grow at about 3.0% annually — 0.9 times 1.2% plus 0.00138 divided by 7% — while in fact real wages grew at about 1.3% annually. As with the manufacturing wage equation, this overestimate of real wage growth is offset by inflation because the equation does not permit complete catch-up. At the average level of inflation during the period of estimation (11% per year), incomplete catch-up reduces real wage growth to historical levels.

Δ log Non-manufacturing Wage 1973-86

```
SEE    =        0.02 RSQ   = 0.8929 RHO =   0.14 Obser  =   14 from 1973.000
SEE+1  =        0.02 RBSQ  = 0.8607 DW  =   1.72 DoFree =   10 to   1986.000
MAPE   =       14.92
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 dlnvpwnm	- - - - - -	- - -	- - -	- - -	- - -	0.12
1 sdgdpd	1.56355	158.1	7.523	1.39	1.382	0.11
2 sdgdpd[1]	-0.74114	63.6	-4.096	-0.68	-0.618	0.11
3 sdlagprodnm	0.90272	24.4	2.341	0.05	0.255	0.01
4 runrat	0.00138	41.4	3.161	0.23	0.325	20.03

The estimation shows little sensitivity to the period of estimation and does quite will in out-of-sample forecasting, as shown below:

Δ log Non-manufacturing Wage 1973-83

```
SEE    =        0.02 RSQ   = 0.8638 RHO =   0.32 Obser  =   11 from 1973.000
SEE+1  =        0.02 RBSQ  = 0.8054 DW  =   1.36 DoFree =    7 to   1983.000
MAPE   =       13.75 Test period:   SEE     0.01 MAPE    21.04 end  1986.000
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 dlnvpwnm	- - - - - -	- - -	- - -	- - -	- - -	0.14
1 sdgdpd	1.59052	165.2	6.499	1.44	1.278	0.13
2 sdgdpd[1]	-0.76094	69.8	-3.630	-0.70	-0.570	0.13

3 sdlagprodnm	0.99974	20.4	1.775	0.02	0.289	0.00
4 runrat	0.00135	43.8	2.736	0.23	0.341	23.10

Incorporating monetary variable into the wage equations. Unfortunately, the approach of trying to model inflation as rising endogenously through the wage formation process did not work in simulation of the whole model; the model would not solve in dynamic simulation with the equations described above. In later stages of work, therefore, I decided to follow the INFORUM approach and integrate monetary variables directly into the equations, so that wage inflation is a direct response to monetary growth.

While there may not seem to be any compelling theoretical justification for this approach, there is a reasonably sound practical justification for having money affect wages directly. The influence of money and expansionary monetary policy on the real economy is extraordinarily complex, involving interest rate and exchange rate effects on prices and aggregate demand, as well as expectations effects on wages, prices and interest rates. Furthermore, while the effects of changes in monetary policy on interest and exchange rates tend to be relatively rapid, the effects on wages and commodity prices tend to be slower, and trickle into the real economy through myriad channels.[75] No model can capture all of these channels, and the transmission of money into prices must therefore be effected in a stylized manner in any model. All existing models of Britain, however, include a fairly rapid response of wages and prices to changes in the money supply. Taking into consideration that in the British economy 1) most monetary aggregates have grown more than ten percent annually since 1970, even during the Thatcher era, 2) imports account for at most a quarter of total domestic expenditure and only about one-eighth of consumer demand, and 3) wage inflation seems to lag monetary growth by at most a couple of years, it does not seem unrealistic to represent the transmission of monetary growth to prices through wages directly, with a slight lag. Furthermore, this approach has worked well in a number of other INFORUM models of countries that do not suffer the chronic price inflation that Britain has experienced for two decades. That having been said, I should also note that the approach does not succeed unambiguously when used for Britain, as I show below, and it may well be that incorporating monetary effects on exchange rates and import prices would go a long way toward improving it. Including simple changes in the exchange rate, however, does not improve the wage equation.

In adapting the INFORUM wage equation for manufacturing, I adopted the productivity growth hypothesis. In these equations, wage growth is related, first, to a variable measuring the recent growth of the British money supply relative to the growth of real output.[76] The rationale for including this variable is the monetarist hypothesis that monetary

---

[75] A number of British model incorporate an exchange rate mechanism to account for most of the transmission of monetary growth to prices. In these models, monetary stimulus results in an expectations-driven fall in the exchange rate, raising import prices, consumer prices, and hence wages and domestic prices. I believe that this is a very realistic and useful additional transmission mechanism; however, as yet the INFORUM models do not integrate endogenous exchange rates, and it will not be practical to do so until I have made considerably more progress in developing the financial side of the model.

[76] M5 was chosen because it has had the most stable relation to nominal output of any of the myriad measures of the money supply over the past two decades (that is, M5 velocity has been

growth in excess of that necessary to support expanding output ultimately contributes only to price inflation, though perhaps with a lag. The second variable measures the difference between the previous year's inflation, as measured by the gross domestic product deflator, and that implied by the lagged value of the first variable, and is intended to account for some portion of whatever inflation expected under the monetarist hypothesis is not captured by the first variable. Admittedly, this variable is quite *ad hoc*, since any difference — positive or negative — between actual past inflation and that expected from monetary growth shows up in this purportedly "explanatory" variable, without any explanation of how or why the difference appears. The variable thus assures that the equations relate wage inflation directly to general price inflation — as did the previous set of equations — even when the price trends are entirely unrelated to monetary trends.

The productivity variable is an average of annual aggregate productivity growth rate over the current and past two years. Finally, the last variable in the equation involves the reciprocal of the unemployment rate, as in the previous equations, though in this case it measures lagged changes in the reciprocal. (I have also appended a dummy variable to account for the massive inflation of 1975.)

The equation is

$$\Delta\ln\left(\frac{IE_t}{EE_t}\right) = a\ MOG_t + b\ SDAGPRM_t + c\ DIFP_t + d\ SDRUNRAT_t$$

where

$$MOG_t = 0.23\ \Delta\ln\left(\frac{M_t}{RGDP_t}\right) + 0.42\ \Delta\ln\left(\frac{M_{t-1}}{RGDP_{t-1}}\right) + 0.35\ \Delta\ln\left(\frac{M_{t-2}}{RGDP_{t-2}}\right)$$

is a weighted sum of the annual change in the ratio of M5 to real gross national product, where the weights were arrived at through experimentation with various forms;

$$DIFP_{t-1} = \Delta\ GDPD_{t-1} - MOG_{t-1}$$

is the difference between last year's inflation (the change in the gross domestic product deflator) and the inflation implied by the first variable; and

---

more nearly constant than that of any other money supply constant). Most economies display a tendency for some monetary aggregate to have a fairly constant velocity (a linear relation between money and nominal output), and for deviations in that relation to be accompanied by significant changes in price trends. Because of differences in financial institutions, the aggregate varies between countries: in the U.S., it is M2, in Japan it is M1, in Italy it is M3, and in Britain it appears to be the very broad aggregate M5.

$$SDRUNRAT_t = 1/2 \left(\Delta \ln \left(\frac{unemp_t}{labfor_t} \right) + \Delta \ln \left(\frac{unemp_{t-1}}{labfor_{t-1}} \right) \right)$$

is the smoothed change in the reciprocal of the unemployment rate. $SDAGPRM_t$ is, as mentioned above, the average rate of annual aggregate productivity growth over the current and past two years. In both equations, the monetary variable is constrained to take a value near 1.0. Note also that the inflation variable refers to the previous year's inflation, not an average of the current and previous years' inflation as with the previous set of regressions.

Manufacturing. The results are not very promising. Without a dummy variable for 1975, the regressions yield uniformly poor results. With the dummy included, the equation has a good fit but a completely insignificant productivity parameter, suggesting no relation between wages and productivity. Nevertheless the productivity term can be constrained to its historical value of approximately 0.60 with almost no effect either on the fit or on the other parameters, and the resulting regression does reasonably well out of sample, as shown below.

According to the *DIFP* variable, about three-quarters to four-fifths of price inflation not accounted for by money growth shows up as wage growth. The unemployment parameter implies that at a 5% unemployment rate, a percentage point decrease in the rate leads to a three percentage point increase in the rate of wage inflation; while at a 10% unemployment rate, a percentage point decrease in the rate leads to a 1.7 percentage point increase in the rate of wage inflation. While these results may seem reasonable, the regression parameters are sensitive to the period of estimation and yield poor out-of-sample forecasts, as shown below.

Δ log Manufacturing Wage: Productivity Response Hyp. 1973-86

```
SEE    =        0.02 RSQ   = 0.9264 RHO =  -0.05 Obser  =   14 from 1973.000
SEE+1  =        0.02 RBSQ  = 0.8937 DW  =   2.11 DoFree =    9 to   1986.000
MAPE   =       13.19
  Variable name           Reg-Coef  Mexval t-value  Elas     Beta         Mean
0 dlnvpwm               - - - - - - - - - - - - - - - - - - - - -         0.13
1 smog5                    1.00041  6235.4 190.104   0.82   0.250         0.11
2 sdlagprodm               0.60002  3688.2 113.646   0.17   0.155         0.04
3 difp5[1]                 0.84498   155.4   7.053   0.00   0.786         0.00
4 sdrunrat                 0.15931    86.1   4.711  -0.12   0.473        -0.10
5 dummy75                  0.18678   218.2   9.066   0.10   0.824         0.07
```

Δ log Manufacturing Wage: Productivity Response Hyp. 1973-83

```
SEE    =        0.01 RSQ   = 0.9315 RHO =   0.24 Obser  =   11 from 1973.000
SEE+1  =        0.01 RBSQ  = 0.8859 DW  =   1.52 DoFree =    6 to   1983.000
MAPE   =        8.36 Test period:   SEE     0.02 MAPE     33.70 end 1986.000
  Variable name           Reg-Coef  Mexval t-value  Elas     Beta         Mean
0 dlnvpwm               - - - - - - - - - - - - - - - - - - - - -         0.15
1 smog5                    1.00065  6962.8 173.172   0.76   0.261         0.11
2 sdlagprodm               0.60012  4120.0 103.451   0.13   0.152         0.03
3 difp5[1]                 0.75691   140.6   5.367   0.07   0.748         0.01
4 sdrunrat                 0.14213    89.1   3.936  -0.11   0.498        -0.12
5 dummy75                  0.18477   287.3   9.176   0.11   0.978         0.09
```

Non-manufacturing. With the monetary variable's parameter constrained to take a value of 1.0, the regression performs well out of sample; but the productivity parameter insignificant and strongly negative. Constraining the parameter to take a value near 1.0 markedly reduces the fit and out-of-sample performance.

Δ log Non-manufacturing Wage: Productivity Response Hyp. 1973-86

```
SEE    =        0.03 RSQ   = 0.7198 RHO =  -0.12 Obser  =   14 from 1973.000
SEE+1  =        0.03 RBSQ  = 0.5953 DW  =   2.23 DoFree =    9 to   1986.000
MAPE   =       16.96
  Variable name           Reg-Coef  Mexval t-value  Elas     Beta         Mean
0 dlnvpwnm              - - - - - - - - - - - - - - - - - - - - -         0.12
1 smog5                    1.00080  3372.0 104.159   0.89   0.267         0.11
2 sdlagprodnm              0.99986  3356.0 103.676   0.05   0.282         0.01
3 difp5[1]                 0.69927    46.1   3.197   0.00   0.695         0.00
4 sdrunrat                 0.13608    24.1   2.204  -0.11   0.431        -0.10
5 dummy75                  0.18997    95.7   5.050   0.11   0.895         0.07
```

Δ log Non-manufacturing Wage: Productivity Response Hyp. 1973-83

```
SEE    =        0.03 RSQ   = 0.6307 RHO =  -0.14 Obser  =   11 from 1973.000
SEE+1  =        0.03 RBSQ  = 0.3844 DW  =   2.28 DoFree =    6 to   1983.000
MAPE   =       14.64 Test period:   SEE     0.02 MAPE     36.96 end 1986.000
  Variable name           Reg-Coef  Mexval t-value  Elas     Beta         Mean
0 dlnvpwnm              - - - - - - - - - - - - - - - - - - - - -         0.14
1 smog5                    1.00128  3139.5  79.380   0.82   0.278         0.11
2 sdlagprodnm              0.99990  3121.0  78.928   0.02   0.289         0.00
3 difp5[1]                 0.56580    25.0   1.838   0.06   0.595         0.01
4 sdrunrat                 0.11141    15.4   1.413  -0.10   0.415        -0.12
5 dummy75                  0.18718   100.4   4.258   0.12   1.054         0.09
```

Non-manufacturing wages following manufacturing wages. There is yet another alternative for estimating non-manufacturing wages, chosen by several researchers including the INFORUM group[77], which is simply to have non-manufacturing wages be a function of

[77] In INFORUM's LIFT model of the U.S.

manufacturing wages. A similar regression for Britain yields nearly as good a fit as the regressions above, and suggests that non-manufacturing wages have been growing at about 90% of the pace of manufacturing wages.

Δ log Non-manufacturing Wage: Function of Manufacturing Wage 1972-86

```
SEE    =        0.02 RSQ    = 0.8463 RHO =   -0.06 Obser  =    15 from 1972.000
SEE+1  =        0.02 RBSQ   = 0.8207 DW  =    2.12 DoFree =    12 to   1986.000
MAPE   =       16.14
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 dlnvpwnm               - - - - - - - - - - - - - - - - - - - - -      0.12
1 intercept                 0.00103     0.0   0.056   0.01   0.000       1.00
2 dlnvpwm                   0.83503   129.9   7.170   0.92   0.892       0.13
3 dlnvpwm[1]                0.05976     1.0   0.501   0.07   0.062       0.14
```

Moreover, the regression is insensitive to the period of estimation and does reasonably well out of sample. In addition, the regression gives very good results when performed using as the independent variable the predicted values of manufacturing wages from the regression of choice from the first set of manufacturing wage equations.

Δ log Non-manufacturing Wage: Function of Manufacturing Wage 1972-83

```
SEE    =        0.02 RSQ    = 0.8165 RHO =    0.01 Obser  =    12 from 1972.000
SEE+1  =        0.02 RBSQ   = 0.7757 DW  =    1.99 DoFree =     9 to   1983.000
MAPE   =       13.36 Test period:   SEE       0.02 MAPE     28.16 end  1986.000
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 dlnvpwnm               - - - - - - - - - - - - - - - - - - - - -      0.14
1 intercept                 0.00461     0.1   0.162   0.03   0.000       1.00
2 dlnvpwm                   0.86155   130.1   6.218   0.95   0.901       0.15
3 dlnvpwm[1]                0.01204     0.0   0.083   0.01   0.012       0.15
```

General discussion. The results presented above are not particularly satisfying. Even though one might expect the combination of the monetary variable and the ***DIFP*** variable to account for much the same variation in wage growth as the simple inflation variables in the first set of regressions, there seems to be a tradeoff between a set of equations that rather nicely captures the transmission of price inflation to wage inflation, and a set that incorporates a variable representing monetary trends. Even so, as a first step in integrating monetary phenomena into the model, I have decided to use the manufacturing wage regression with money in the model, despite its problems, because it yielded a stable model. Although I feel that the real wage hypothesis may be a more accurate representation of the wage formation process in British manufacturing, I have chosen to use the equation with a productivity parameter constrained to its historical value of 0.60. For modeling purposes, I wish to for the time being to relate long-run wage growth to productivity growth. I also have chosen to relate non-manufacturing wages to manufacturing wages, since the second set of equations provide no support for the inclusion of a productivity variable in this sector.

The detailed equations: sectoral/aggregate ratios. After several false starts, I chose to develop a set of sectoral equations which use as a dependent variable the ratio of a given sectoral wage to the aggregate wage. The mean values of these industry-specific relative wages over the period 1973-86 have ranged from 60% of the aggregate wage for the apparel industry to 145% of the aggregate for the oil extraction industry; and many industries have experienced significant upward or downward trends during the period. The independent variables in these equations are the average annual percentage change in industry output and employment over the current and previous year, and a time trend.

$$\frac{(IE_{kt} / L_{kt})}{(IE_t / L_t)} = a + b \, ½ \left[\Delta \ln (Q_{kt}) + \Delta \ln (Q_{k(t-1)})\right] + c \, ½ \left[\Delta \ln (E_{kt}) + \Delta \ln (E_{k(t-1)})\right] + d \, t$$

Economic theory does not unambiguously predict the sign of the output and employment parameters. A demand-driven increase in output (with no change in employment levels) might be accompanied by an increase in the value of the marginal product of labor and the industry average wage; while similar increases in output accompanied by high productivity gains from capital investment could conceivably be accompanied by a fall in average industry wages. Likewise, an increase in employment levels (with output constant) might seem to imply lower productivity for the marginal worker and thus a lower average wage, but these workers might have to be bid away from higher wage industries. The high level of unionization in British industry may also give workers enough negotiating power to move industry wages significantly away from equilibrium levels of extended periods, and changes in the relative power of unions in an industry could contribute to a decline in relative wages unrelated to any other economic phenomena. There are thus perfectly valid economic reasons to expect any sign for the output, employment and time trend parameters.

These expectations are borne out by the results of these regressions. As shown on the following pages, the parameter estimates range greatly in sign and magnitude. The change in output parameters range from -1.6 for the natural gas industry to 0.93 for water supply. These extremes imply that a one percent average annual change in output over a two-year period leads to a 0.016 decline in the relative wage ratio (i.e. from, say, 1.2 to 1.184) in the natural gas industry, but leads to a 0.0093 increase in the ratio for the water industry. However, 42 of 52 output parameters are positive, and only a handful — Agriculture, Electricity, Public Gas Supply, and Postal and Telecommunications — have strongly negative parameters. These results imply that increasing output leads as a rule to higher average wages. Notably, the important exceptions listed above are all regulated industries with high capital/output ratios and high levels of investment.

The change in employment parameters show greater ambiguity of sign, with thirty-two negative and twenty positive parameters, and wider variation in magnitude than the output parameters — from -2.1 for Industrial plant and steelwork to 2.81 for the Transportation industry. Though seemingly large, these parameters imply that a one percent average annual change in the given industry's level of employment over a two-year period leads to a 0.021 decline in the relative wage ratio in the Industrial plant and steelwork industry, but leads to a 0.0281 increase in the ratio for the Transportation industry. The slight predominance of negative parameters — and relatively small size of many of the positive ones — may imply that as a rule, rising (falling) employment in the absence of rising output leads to lower (higher) marginal product and average wage; but it amy simply be that the period of estimation saw significant declines in both employment and output, and the decline in employment was accompanied by higher productivity as industries sloughed off redundant labor and upgraded their production processes.

There is no obvious pattern across industries in the employment parameters; but it may be noteworthy that a number of the industries with large and significant positive employment parameters — for instance, the Coal, Public gas supply, Iron and steel, Agricultural machinery, Motor vehicles, and Transportation — are highly unionized. It may be that periods of rising employment in these industries are also periods when unions capitalize on their bargaining strength and negotiate higher wage increases.

The time trends show very wide variation, from -0.019 for the Non-metallic ores industry to 0.028 for the Oil and gas extraction industry. These parameters imply, for example, a decline from, say, 1.2 to 1.01 for the Non-metallic ores industry over a decade; while the Oil industry trend implies that the industry could rise from, say 1.2 to 1.48 over a decade. Surprisingly, 33 of 52 time parameters imply time trends of more than 1% annually; 29 are negative and 33 positive. Most of the negative trends are concentrated in heavy manufacturing, but the magnitude of both the positive and negative trends show no obvious pattern. The size of these trends is somewhat worrisome because it is not obvious that such large trends will continue over an extended period of time; further experience with the model will be necessary to determine their applicability. In all, the equations yield fairly reasonable results that merit inclusion in this first stage of model development.

Table IV.9.1: Summary of Relative Wage Equations
(Mexvals in Italics)

Sector	Inter-cept	Δ Out-put	Δ Emp-loyment	Time	$\bar{R}_2$	MAPE	Rho
1. Agriculture, Forestry & Fishing	1.61	-0.48	-0.51	-0.01	0.90	2.16	0.03
	374.42	*15.12*	*4.95*	*204.09*			
2. Coal and Coke	0.19	0.44	2.77	0.02	0.91	32.38	0.04
	0.69	*16.55*	*39.07*	*24.43*			
3. Oil and Gas Extraction	-0.76	0.13	-0.80	0.03	0.66	7.67	-0.07
	2.02	*26.43*	*9.37*	*19.21*			
4. Mineral Oil Processing	1.38	0.11	-1.23	0.00	0.78	2.24	0.34
	62.82	*5.14*	*94.34*	*0.02*			
5. Electricity	0.16	-1.63	0.45	0.02	0.77	2.37	0.57
	2.27	*38.14*	*1.48*	*86.72*			
6. Public Gas Supply	0.96	-0.50	1.56	0.00	0.62	2.94	-0.32
	19.83	*3.89*	*15.03*	*3.50*			
7. Water Supply	0.88	0.93	-0.56	0.00	0.69	3.44	0.26
	35.96	*62.71*	*21.61*	*0.02*			
8. Metal Ores & Minerals N.E.S.	1.91	0.23	0.80	-0.01	0.34	5.96	0.37
	35.54	*1.10*	*11.38*	*6.02*			
9. Non-Metallic Ores	2.47	0.36	-0.13	-0.02	0.92	2.38	-0.09
	260.04	*23.06*	*3.48*	*129.57*			
10. Iron, Steel & Steel Products	1.75	-0.01	0.35	-0.01	0.68	2.68	0.11
	114.62	*0.01*	*6.71*	*22.60*			
11. Other Metals	2.05	0.21	0.28	-0.01	0.75	2.93	0.49
	140.98	*3.00*	*3.39*	*46.18*			
12. Non-Metallic Mineral Products	1.36	-0.03	0.01	0.00	0.48	1.41	0.31
	304.18	*0.11*	*0.01*	*36.18*			
13. Basic Chemicals	1.57	0.06	-0.07	0.00	0.70	0.78	-0.10
	459.87	*2.92*	*1.03*	*56.29*			
14. Pharmaceuticals	-0.49	-0.08	-0.35	0.02	0.97	1.17	0.60
	99.63	*2.22*	*7.83*	*418.94*			
15. Soap and Toilet Preparations	0.09	-0.07	-0.18	0.01	0.73	2.24	0.43
	0.83	*0.40*	*1.11*	*56.14*			
16. Man-Made Fibers	1.08	0.21	-0.33	0.00	0.35	2.02	-0.36
	74.17	*6.92*	*14.94*	*1.39*			
17. Other Metal Products, N.E.S.	0.89	0.42	-0.25	0.00	0.30	1.93	0.32
	108.68	*17.48*	*5.43*	*0.26*			
18. Industrial Plant & Steelwork	-0.40	0.75	-2.10	0.02	0.72	3.82	0.36
	3.88	*7.62*	*51.95*	*55.98*			
19. Agricultural Machinery	1.80	0.82	0.91	-0.01	0.92	3.76	-0.18
	59.14	*82.38*	*34.87*	*13.55*			
20. Machine Tools & Eng.'s Tools	2.24	0.26	-0.09	-0.02	0.93	1.73	0.21
	500.43	*25.79*	*1.22*	*264.78*			
21. Textile, Etc. Machinery	1.59	-0.17	0.38	-0.01	0.78	1.52	0.24
	297.73	*6.93*	*9.86*	*78.70*			
22. Other Machinery N.E.S.	1.97	0.08	0.34	-0.01	0.88	1.50	0.06
	395.51	*0.73*	*3.02*	*158.96*			
23. Ordnance	1.82	-0.03	-0.12	-0.01	0.51	1.75	-0.23
	130.82	*3.22*	*2.64*	*41.33*			
24. Office Machinery & Computers	1.35	0.19	0.10	-0.01	0.35	4.35	0.13
	36.87	*11.55*	*0.15*	*9.94*			
25. Basic Electrical Equipment	1.04	0.36	0.05	0.00	0.37	1.90	-0.07
	125.39	*12.91*	*0.17*	*3.88*			
26. Electronic Equipment	0.59	0.20	0.16	0.00	0.55	1.80	-0.21
	47.62	*5.21*	*1.68*	*19.56*			

Table IV.9.1: Summary of Relative Wage Equations (Continued)
(Mexvals in Italics)

Sector	Intercept	Δ Output	Δ Employment	Time	$\bar{R}_2$	MAPE	Rho
27. Domestic Electr. Appliances	1.78	0.02	-0.16	-0.01	0.75	2.45	-0.34
	236.74	*0.09*	*4.57*	*93.64*			
28. Electrical Lighting Equipment	0.51	0.35	-0.57	0.00	0.41	4.44	0.26
	17.39	*14.02*	*22.66*	*5.70*			
29. Motor Vehicles & Parts	2.34	0.25	0.40	-0.01	0.97	0.79	-0.22
	662.97	*30.22*	*45.73*	*254.28*			
30. Shipbuilding and Repairing	0.43	0.36	-0.86	0.01	0.73	3.36	0.23
	4.16	*5.63*	*17.65*	*6.59*			
31. Aerospace Engineering	0.58	0.36	-1.24	0.01	0.60	3.07	0.48
	17.12	*7.97*	*28.17*	*16.60*			
32. Other Vehicles	1.03	0.40	-1.27	0.00	0.75	1.83	0.08
	110.44	*22.29*	*63.64*	*4.47*			
33. Instrument Engineering	1.13	0.47	-0.61	0.00	0.50	1.72	-0.06
	193.57	*32.67*	*21.86*	*30.06*			
34. Food	-0.11	0.44	0.46	0.01	0.62	3.25	0.14
	0.99	*2.65*	*1.48*	*60.66*			
35. Drink	1.93	0.24	-0.67	-0.01	0.67	2.20	0.29
	108.71	*5.43*	*6.27*	*32.43*			
36. Tobacco	-1.04	0.31	-0.65	0.03	0.98	1.20	-0.50
	49.71	*13.55*	*41.27*	*145.91*			
37. Yarn	1.04	0.62	-0.26	0.00	0.82	1.32	-0.32
	333.46	*124.53*	*43.03*	*54.20*			
38. Textiles	1.30	0.51	-0.10	-0.01	0.93	1.18	0.03
	572.02	*96.71*	*5.35*	*206.63*			
39. Apparel	0.46	0.15	-0.14	0.00	0.39	1.26	0.21
	153.02	*6.89*	*5.23*	*21.29*			
40. Leather and Footwear	1.02	0.24	-0.04	0.00	0.82	1.09	-0.13
	438.70	*67.92*	*0.85*	*78.58*			
41. Timber and Wood Products	1.77	0.25	-0.47	-0.01	0.83	1.78	0.37
	352.19	*5.95*	*25.13*	*136.88*			
42. Pulp and Paper	-0.33	0.57	-0.33	0.02	0.87	2.11	0.62
	10.78	*31.47*	*4.21*	*128.57*			
43. Printing and Publishing	0.92	0.62	-0.85	0.00	0.46	1.48	0.56
	112.20	*34.12*	*11.78*	*5.28*			
44. Rubber	0.93	0.31	0.17	0.00	0.10	3.72	0.34
	15.93	*1.80*	*0.12*	*0.70*			
45. Plastics	0.88	0.25	-0.67	0.00	0.71	1.31	0.24
	207.69	*15.80*	*64.21*	*9.20*			
46. Other Manufacturing	0.09	0.63	-0.43	0.01	0.59	5.96	0.32
	0.30	*40.74*	*1.62*	*12.50*			
47. Construction	1.34	0.26	-0.37	0.00	0.27	1.33	0.37
	184.19	*15.69*	*10.40*	*12.66*			
48. Distribution, Hotels, Catering	0.77	0.07	-0.32	0.00	0.05	1.60	0.70
	120.41	*0.45*	*2.26*	*0.60*			
49. Transportation	2.04	0.07	2.82	-0.01	0.82	1.62	-0.08
	283.01	*0.16*	*68.67*	*63.69*			
50. Postal And Telecommunications	-0.31	-0.44	0.62	0.02	0.91	1.41	0.09
	17.71	*6.54*	*4.84*	*215.81*			
51. Banking, Finance, Etc.	0.26	0.34	0.89	0.01	0.82	1.66	0.08
	4.06	*0.28*	*2.68*	*36.53*			
53. Other Services	1.38	0.10	0.18	0.00	0.70	0.90	0.38
	340.06	*0.07*	*0.55*	*47.75*			

1. Industry Relatve Wage: Agriculture, Forestry and Fishing

SEE =	0.02	RSQ = 0.8988	RHO = 0.03	Obser =	14	from	1973.000
SEE+1 =	0.02	RBSQ = 0.8684	DW = 1.93	DoFree =	10	to	1986.000
MAPE =	2.16						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage1						0.63
1 intercept	1.60775	374.4	14.665	2.54	0.000	1.00
2 dgout1	-0.47505	15.1	-1.804	-0.01	-0.190	0.01
3 demp1	-0.50787	4.9	-1.007	0.01	-0.106	-0.02
4 time	-0.01231	204.1	-9.081	-1.55	-0.920	79.50

2. Industry Relative Wage: Coal and Coke

SEE =	0.06	RSQ = 0.9101	RHO = 0.32	Obser =	14	from	1973.000
SEE+1 =	0.06	RBSQ = 0.8702	DW = 1.35	DoFree =	9	to	1986.000
MAPE =	4.06						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage2						1.29
1 intercept	0.19287	0.7	0.354	0.15	0.000	1.00
2 dgout2	0.43787	16.6	1.796	-0.01	0.395	-0.02
3 demp2	2.76991	39.1	2.899	-0.09	0.471	-0.04
4 time	0.01584	24.4	2.221	0.97	0.301	79.50
5 dummy84	-0.47385	32.3	-2.597	-0.03	-0.574	0.07

3. Industry Relative Wage: Oil and Natural Gas Extraction

SEE =	0.12	RSQ = 0.6637	RHO = -0.07	Obser =	14	from	1973.000
SEE+1 =	0.12	RBSQ = 0.5628	DW = 2.15	DoFree =	10	to	1986.000
MAPE =	7.67						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage3						1.45
1 intercept	-0.75511	2.0	-0.639	-0.52	-0.000	1.00
2 dgout3	0.12719	26.4	2.447	0.04	0.486	0.47
3 demp3	-0.79865	9.4	-1.400	-0.09	-0.379	0.17
4 time	0.02873	19.2	2.052	1.57	0.539	79.50

4. Industry Relative Wage: Mineral Oil Processing

SEE =	0.04	RSQ = 0.7806	RHO = 0.34	Obser =	14	from	1973.000
SEE+1 =	0.04	RBSQ = 0.7148	DW = 1.32	DoFree =	10	to	1986.000
MAPE =	2.24						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage4						1.40
1 intercept	1.37585	62.8	4.063	0.98	0.000	1.00
2 dgout4	0.10696	5.1	1.027	0.00	0.206	0.00
3 demp4	-1.23223	94.3	-5.270	0.03	-0.855	-0.03
4 time	-0.00024	0.0	-0.055	-0.01	-0.012	79.50

5. Industry Relative Wage: Electricity

SEE =	0.04	RSQ = 0.7738	RHO = 0.57	Obser =	14	from	1973.000
SEE+1 =	0.03	RBSQ = 0.7059	DW = 0.87	DoFree =	10	to	1986.000
MAPE =	2.37						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage5						1.34
1 intercept	0.16237	2.3	0.677	0.12	0.000	1.00
2 dgout5	-1.63429	38.1	-3.014	-0.01	-0.457	0.01
3 demp5	0.44695	1.5	0.546	-0.01	0.084	-0.02
4 time	0.01520	86.7	4.987	0.90	0.765	79.50

6. Industry Relative Wage: Public Gas Supply

SEE = 0.04	RSQ = 0.6239	RHO = -0.32	Obser = 14	from 1973.000			
SEE+1 = 0.04	RBSQ = 0.5111	DW = 2.65	DoFree = 10	to 1986.000			
MAPE = 2.94							
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage6	- -					1.29	
1 intercept	0.96154	19.8	2.088	0.75	0.000	1.00	
2 dgout6	-0.50257	3.9	-0.891	-0.02	-0.318	0.05	
3 demp6	1.56287	15.0	1.798	-0.02	0.466	-0.02	
4 time	0.00474	3.5	0.844	0.29	0.273	79.50	

7. Industry Relative Wage: Water Supply

SEE = 0.04	RSQ = 0.6861	RHO = 0.26	Obser = 14	from 1973.000			
SEE+1 = 0.04	RBSQ = 0.5920	DW = 1.49	DoFree = 10	to 1986.000			
MAPE = 3.44							
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage7	- -					0.86	
1 intercept	0.88011	36.0	2.913	1.02	0.000	1.00	
2 dgout7	0.93412	62.7	4.059	0.01	0.774	0.01	
3 demp7	-0.55615	21.6	-2.189	-0.01	-0.480	0.01	
4 time	-0.00022	0.0	-0.057	-0.02	-0.013	79.50	

8. Industry Relative Wage: Metal Ores and Minerals N.E.S.

SEE = 0.09	RSQ = 0.3407	RHO = 0.37	Obser = 14	from 1973.000			
SEE+1 = 0.09	RBSQ = 0.1430	DW = 1.25	DoFree = 10	to 1986.000			
MAPE = 5.96							
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage8	- -					1.16	
1 intercept	1.90705	35.5	2.893	1.65	0.000	1.00	
2 dgout8	0.22554	1.1	0.470	-0.00	0.143	-0.00	
3 demp8	0.79655	11.4	1.551	-0.02	0.399	-0.02	
4 time	-0.00923	6.0	-1.114	-0.64	-0.339	79.50	

9. Industry Relative Wage: Non-Metallic Minerals

SEE = 0.03	RSQ = 0.9239	RHO = -0.09	Obser = 14	from 1973.000			
SEE+1 = 0.03	RBSQ = 0.9010	DW = 2.18	DoFree = 10	to 1986.000			
MAPE = 2.38							
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage9	- -					0.95	
1 intercept	2.46742	260.0	10.938	2.61	0.000	1.00	
2 dgout9	0.35880	23.1	2.268	-0.03	0.414	-0.07	
3 demp9	-0.12816	3.5	-0.841	0.01	-0.158	-0.07	
4 time	-0.01893	129.6	-6.535	-1.59	-0.773	79.50	

10. Industry Relative Wage: Iron and Steel and Steel Products

SEE = 0.03	RSQ = 0.6761	RHO = 0.11	Obser = 14	from 1973.000			
SEE+1 = 0.03	RBSQ = 0.5789	DW = 1.78	DoFree = 10	to 1986.000			
MAPE = 2.68							
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage10	- -					1.04	
1 intercept	1.74927	114.6	6.005	1.68	0.000	1.00	
2 dgout10	-0.00930	0.0	-0.046	0.00	-0.008	-0.03	
3 demp10	0.35462	6.7	1.178	-0.02	0.302	-0.07	
4 time	-0.00860	22.6	-2.243	-0.66	-0.578	79.50	

11. Industry Relative Wage: Other Metals

SEE =	0.04 RSQ	= 0.7459 RHO =	0.49 Obser =	14 from 1973.000			
SEE+1 =	0.03 RBSQ	= 0.6696 DW =	1.03 DoFree =	10 to 1986.000			
MAPE =	2.93						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage11	- -					1.01	
1 intercept	2.04638	141.0	6.933	2.02	0.000	1.00	
2 dgout11	0.20846	3.0	0.780	0.00	0.134	0.00	
3 demp11	0.27924	3.4	0.831	-0.01	0.173	-0.05	
4 time	-0.01286	46.2	-3.372	-1.01	-0.691	79.50	

12. Industry Relative Wage: Non-Metallic Mineral Products

SEE =	0.02 RSQ	= 0.4802 RHO =	0.38 Obser =	14 from 1973.000			
SEE+1 =	0.02 RBSQ	= 0.3243 DW =	1.24 DoFree =	10 to 1986.000			
MAPE =	1.41						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage12	- -					1.04	
1 intercept	1.36243	304.2	12.384	1.31	0.000	1.00	
2 dgout12	-0.02904	0.1	-0.148	0.00	-0.046	-0.02	
3 demp12	0.01298	0.0	0.054	-0.00	0.017	-0.03	
4 time	-0.00407	36.2	-2.923	-0.31	-0.687	79.50	

13. Industry Relative Wage: Basic Chemicals

SEE =	0.01 RSQ	= 0.6994 RHO =	-0.10 Obser =	14 from 1973.000			
SEE+1 =	0.01 RBSQ	= 0.6092 DW =	2.21 DoFree =	10 to 1986.000			
MAPE =	0.78						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage13	- -					1.23	
1 intercept	1.57243	459.9	17.420	1.28	0.000	1.00	
2 dgout13	0.05584	2.9	0.769	0.00	0.143	0.01	
3 demp13	-0.07383	1.0	-0.456	0.00	-0.093	-0.02	
4 time	-0.00436	56.3	-3.798	-0.28	-0.819	79.50	

14. Industry Relative Wage: Pharmaceuticals

SEE =	0.01 RSQ	= 0.9668 RHO =	0.60 Obser =	14 from 1973.000			
SEE+1 =	0.01 RBSQ	= 0.9569 DW =	0.80 DoFree =	10 to 1986.000			
MAPE =	1.17						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage14	- -					0.96	
1 intercept	-0.49366	99.6	-5.464	-0.52	-0.000	1.00	
2 dgout14	-0.08241	2.2	-0.671	-0.00	-0.039	0.03	
3 demp14	-0.34912	7.8	-1.276	0.00	-0.077	-0.00	
4 time	0.01828	418.9	16.103	1.52	0.958	79.50	

15. Industry Relative Wage: Soap and Toilet Preparations

SEE =	0.03 RSQ	= 0.7323 RHO =	0.43 Obser =	14 from 1973.000			
SEE+1 =	0.03 RBSQ	= 0.6520 DW =	1.13 DoFree =	10 to 1986.000			
MAPE =	2.24						
Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean	
0 relwage15	- -					0.90	
1 intercept	0.08592	0.8	0.407	0.10	0.000	1.00	
2 dgout15	-0.07198	0.4	-0.283	-0.00	-0.063	0.02	
3 demp15	-0.18102	1.1	-0.472	0.00	-0.119	-0.01	
4 time	0.01023	56.1	3.792	0.91	0.790	79.50	

16. Industry Relative Wage: Man-Made Fibers

```
SEE    =      0.03 RSQ    = 0.3487 RHO =  -0.36 Obser  =   14 from 1973.000
SEE+1 =       0.03 RBSQ   = 0.1533 DW  =   2.72 DoFree =   10 to   1986.000
MAPE  =       2.02
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage16               - - - - - - - - - - - - - - - - - - - - -    1.23
1 intercept                 1.07567    74.2   4.509  0.87   0.000       1.00
2 dgout16                   0.21366     6.9   1.197 -0.00   0.432      -0.02
3 demp16                   -0.33268    14.9  -1.792  0.02  -0.705      -0.09
4 time                      0.00162     1.4   0.529  0.11   0.152      79.50
```

17. Industry Relative Wage: Other Metal Products, N.E.S.

```
SEE    =      0.02 RSQ    = 0.3001 RHO =   0.32 Obser  =   14 from 1973.000
SEE+1 =       0.02 RBSQ   = 0.0901 DW  =   1.36 DoFree =   10 to   1986.000
MAPE  =       1.93
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage17               - - - - - - - - - - - - - - - - - - - - -    0.93
1 intercept                 0.88717   108.7   5.792  0.96   0.000       1.00
2 dgout17                   0.41535    17.5   1.950 -0.01   0.679      -0.02
3 demp17                   -0.25036     5.4  -1.056  0.01  -0.410      -0.04
4 time                      0.00045     0.3   0.230  0.04   0.070      79.50
```

18. Industry Relative Wage: Industrial Plant and Steelwork

```
SEE    =      0.07 RSQ    = 0.7247 RHO =   0.36 Obser  =   14 from 1973.000
SEE+1 =       0.07 RBSQ   = 0.6422 DW  =   1.29 DoFree =   10 to   1986.000
MAPE  =       3.82
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage18               - - - - - - - - - - - - - - - - - - - - -    1.37
1 intercept                -0.40439     3.9  -0.889 -0.30  -0.000       1.00
2 dgout18                   0.75030     7.6   1.257 -0.00   0.219      -0.00
3 demp18                   -2.10256    51.9  -3.618  0.04  -0.620      -0.03
4 time                      0.02155    56.0   3.785  1.25   0.650      79.50
```

19. Industry Relative Wage: Agricultural Machinery

```
SEE    =      0.05 RSQ    = 0.9181 RHO =  -0.18 Obser  =   14 from 1973.000
SEE+1 =       0.04 RBSQ   = 0.8935 DW  =   2.35 DoFree =   10 to   1986.000
MAPE  =       3.76
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage19               - - - - - - - - - - - - - - - - - - - - -    0.94
1 intercept                 1.80332    59.1   3.915  1.93   0.000       1.00
2 dgout19                   0.82270    82.4   4.823 -0.04   0.478      -0.04
3 demp19                    0.90907    34.9   2.862 -0.04   0.438      -0.04
4 time                     -0.01005    13.5  -1.701 -0.85  -0.255      79.50
```

20. Industry Relative Wage: Machine Tools and Engineers' Tools

```
SEE    =      0.02 RSQ    = 0.9309 RHO =   0.21 Obser  =   14 from 1973.000
SEE+1 =       0.02 RBSQ   = 0.9101 DW  =   1.58 DoFree =   10 to   1986.000
MAPE  =       1.73
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage20               - - - - - - - - - - - - - - - - - - - - -    0.90
1 intercept                 2.23885   500.4  18.722  2.48   0.000       1.00
2 dgout20                   0.25909    25.8   2.413 -0.01   0.257      -0.03
3 demp20                   -0.08562     1.2  -0.496  0.00  -0.053      -0.03
4 time                     -0.01675   264.8 -11.093 -1.47  -0.935      79.50
```

21. Industry Relative Wage: Textile, etc. Machinery

```
SEE   =      0.02 RSQ   = 0.7758 RHO =   0.24 Obser  =   14 from 1973.000
SEE+1 =      0.02 RBSQ  = 0.7085 DW  =   1.51 DoFree =   10 to   1986.000
MAPE  =      1.52
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage21						0.95
1 intercept	1.58920	297.7	12.173	1.67	0.000	1.00
2 dgout21	-0.16535	6.9	-1.198	0.00	-0.249	-0.01
3 demp21	0.38160	9.9	1.439	-0.01	0.320	-0.04
4 time	-0.00786	78.7	-4.684	-0.66	-0.783	79.50

22. Industry Relative Wage: Other Machinery N.E.S.

```
SEE   =      0.02 RSQ   = 0.8823 RHO =   0.06 Obser  =   14 from 1973.000
SEE+1 =      0.02 RBSQ  = 0.8469 DW  =   1.88 DoFree =   10 to   1986.000
MAPE  =      1.50
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage22						0.98
1 intercept	1.96793	395.5	15.347	2.01	0.000	1.00
2 dgout22	0.08383	0.7	0.382	-0.00	0.063	-0.01
3 demp22	0.33579	3.0	0.784	-0.01	0.131	-0.02
4 time	-0.01233	159.0	-7.554	-1.00	-0.865	79.50

23. Industry Relative Wage: Ordnance

```
SEE   =      0.02 RSQ   = 0.5052 RHO =  -0.23 Obser  =    8 from 1979.000
SEE+1 =      0.02 RBSQ  = 0.1340 DW  =   2.45 DoFree =    4 to   1986.000
MAPE  =      1.75
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage23						0.95
1 intercept	1.81939	130.8	4.161	1.92	0.000	1.00
2 dgout23	-0.03092	3.2	-0.512	-0.00	-0.231	0.05
3 demp23	-0.11861	2.6	-0.463	0.00	-0.194	-0.02
4 time	-0.01057	41.3	-1.997	-0.92	-0.823	82.50

24. Industry Relative Wage: Office Machinery and Computers

```
SEE   =      0.04 RSQ   = 0.3468 RHO =   0.13 Obser  =   14 from 1973.000
SEE+1 =      0.04 RBSQ  = 0.1508 DW  =   1.74 DoFree =   10 to   1986.000
MAPE  =      4.35
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage24						0.71
1 intercept	1.35481	36.9	2.955	1.92	0.000	1.00
2 dgout24	0.19225	11.5	1.563	0.02	0.441	0.07
3 demp24	0.10284	0.1	0.173	-0.00	0.077	-0.01
4 time	-0.00831	9.9	-1.445	-0.93	-0.677	79.50

25. Industry Relative Wage: Basic Electrical Equipment

```
SEE   =      0.02 RSQ   = 0.3698 RHO =  -0.07 Obser  =   14 from 1973.000
SEE+1 =      0.02 RBSQ  = 0.1808 DW  =   2.15 DoFree =   10 to   1986.000
MAPE  =      1.90
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage25						0.89
1 intercept	1.04378	125.4	6.387	1.17	0.000	1.00
2 dgout25	0.36031	12.9	1.658	-0.00	0.447	-0.01
3 demp25	0.04822	0.2	0.183	-0.00	0.053	-0.03
4 time	-0.00186	3.9	-0.889	-0.17	-0.258	79.50

26. Industry Relative Wage: Electronic Equipment

```
SEE    =       0.02 RSQ   = 0.5504 RHO =  -0.21 Obser  =    14 from 1973.000
SEE+1  =       0.02 RBSQ  = 0.4155 DW  =   2.41 DoFree =    10 to   1986.000
MAPE   =       1.80
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage26						0.97
1 intercept	0.59279	47.6	3.434	0.61	0.000	1.00
2 dgout26	0.19877	5.2	1.034	0.01	0.276	0.03
3 demp26	0.15645	1.7	0.583	-0.00	0.141	-0.02
4 time	0.00465	19.6	2.072	0.38	0.577	79.50

27. Industry Relative Wage: Domestic Electrical Appliances

```
SEE    =       0.03 RSQ   = 0.7472 RHO =  -0.34 Obser  =    14 from 1973.000
SEE+1  =       0.02 RBSQ  = 0.6714 DW  =   2.67 DoFree =    10 to   1986.000
MAPE   =       2.45
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage27						0.86
1 intercept	1.77913	236.7	10.168	2.08	0.000	1.00
2 dgout27	0.02240	0.1	0.138	0.00	0.024	0.01
3 demp27	-0.16068	4.6	-0.967	0.01	-0.183	-0.03
4 time	-0.01169	93.6	-5.244	-1.09	-0.914	79.50

28. Industry Relative Wage: Electrical Lighting Equipment

```
SEE    =       0.04 RSQ   = 0.4071 RHO =   0.26 Obser  =    14 from 1973.000
SEE+1  =       0.04 RBSQ  = 0.2293 DW  =   1.49 DoFree =    10 to   1986.000
MAPE   =       4.44
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage28						0.82
1 intercept	0.51238	17.4	1.944	0.63	0.000	1.00
2 dgout28	0.35197	14.0	1.732	0.01	0.453	0.03
3 demp28	-0.57448	22.7	-2.246	0.02	-0.574	-0.02
4 time	0.00356	5.7	1.083	0.35	0.271	79.50

29. Industry Relative Wage: Motor Vehicles and Parts

```
SEE    =       0.01 RSQ   = 0.9674 RHO =  -0.22 Obser  =    14 from 1973.000
SEE+1  =       0.01 RBSQ  = 0.9576 DW  =   2.43 DoFree =    10 to   1986.000
MAPE   =       0.79
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage29						1.24
1 intercept	2.33851	663.0	23.919	1.88	0.000	1.00
2 dgout29	0.24947	30.2	2.638	-0.00	0.191	-0.01
3 demp29	0.40177	45.7	3.352	-0.01	0.270	-0.04
4 time	-0.01352	254.3	-10.748	-0.86	-0.824	79.50

30. Industry Relative Wage: Shipbuilding and Repairing

```
SEE    =       0.04 RSQ   = 0.7307 RHO =   0.24 Obser  =    14 from 1973.000
SEE+1  =       0.04 RBSQ  = 0.6499 DW  =   1.51 DoFree =    10 to   1986.000
MAPE   =       3.36
```

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage30						1.03
1 intercept	0.42836	4.2	0.922	0.41	0.000	1.00
2 dgout30	0.35731	5.6	1.076	-0.01	0.202	-0.03
3 demp30	-0.85574	17.7	-1.960	0.05	-0.601	-0.06
4 time	0.00715	6.6	1.167	0.55	0.367	79.50

31. Industry Relative Wage: Aerospace Engineering

```
SEE    =      0.05 RSQ   = 0.6018 RHO =    0.48 Obser  =   14 from 1973.000
SEE+1  =      0.04 RBSQ  = 0.4823 DW  =    1.03 DoFree =   10 to   1986.000
MAPE   =      3.07
 Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage31                - - - - - - - - - - - - - - - - - - - - -      1.19
1 intercept                   0.57811    17.1   1.928  0.49   0.000       1.00
2 dgout31                     0.35624     8.0   1.288  0.00   0.283       0.01
3 demp31                     -1.23812    28.2  -2.535  0.02  -0.556      -0.02
4 time                        0.00724    16.6   1.896  0.49   0.406      79.50
```

32. Industry Relative Wage: Other Vehicles

```
SEE    =      0.02 RSQ   = 0.7493 RHO =    0.08 Obser  =   14 from 1973.000
SEE+1  =      0.02 RBSQ  = 0.6741 DW  =    1.84 DoFree =   10 to   1986.000
MAPE   =      1.83
 Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage32                - - - - - - - - - - - - - - - - - - - - -      0.92
1 intercept                   1.03187   110.4   5.855  1.12   0.000       1.00
2 dgout32                     0.40098    22.3   2.226 -0.01   0.661      -0.03
3 demp32                     -1.26562    63.6  -4.096  0.08  -1.486      -0.06
4 time                       -0.00223     4.5  -0.956 -0.19  -0.216      79.50
```

33. Industry Relative Wage: Instrument Engineering

```
SEE    =      0.02 RSQ   = 0.5032 RHO =   -0.06 Obser  =   14 from 1973.000
SEE+1  =      0.02 RBSQ  = 0.3541 DW  =    2.11 DoFree =   10 to   1986.000
MAPE   =      1.72
 Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage33                - - - - - - - - - - - - - - - - - - - - -      0.80
1 intercept                   1.13266   193.6   8.728  1.42   0.000       1.00
2 dgout33                     0.47395    32.7   2.757  0.00   0.793       0.00
3 demp33                     -0.60669    21.9  -2.202  0.01  -0.581      -0.02
4 time                       -0.00436    30.1  -2.630 -0.43  -0.688      79.50
```

34. Industry Relative Wage: Food

```
SEE    =      0.04 RSQ   = 0.6178 RHO =    0.14 Obser  =   14 from 1973.000
SEE+1  =      0.04 RBSQ  = 0.5031 DW  =    1.72 DoFree =   10 to   1986.000
MAPE   =      3.25
 Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage34                - - - - - - - - - - - - - - - - - - - - -      0.90
1 intercept                  -0.11262     1.0  -0.446 -0.13  -0.000       1.00
2 dgout34                     0.43811     2.6   0.733  0.00   0.165       0.01
3 demp34                      0.46168     1.5   0.546 -0.01   0.127      -0.02
4 time                        0.01280    60.7   3.976  1.13   0.818      79.50
```

35. Industry Relative Wage: Drink

```
SEE    =      0.03 RSQ   = 0.6731 RHO =    0.29 Obser  =   14 from 1973.000
SEE+1  =      0.03 RBSQ  = 0.5750 DW  =    1.41 DoFree =   10 to   1986.000
MAPE   =      2.20
 Variable name               Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage35                - - - - - - - - - - - - - - - - - - - - -      1.01
1 intercept                   1.93477   108.7   5.793  1.91   0.000       1.00
2 dgout35                     0.23579     5.4   1.056  0.00   0.255       0.02
3 demp35                     -0.66678     6.3  -1.138  0.02  -0.365      -0.02
4 time                       -0.01183    32.4  -2.746 -0.93  -0.913      79.50
```

36. Industry Relative Wage: Tobacco

SEE =	0.02	RSQ =	0.9790	RHO =	-0.50	Obser =	14 from 1973.000
SEE+1 =	0.01	RBSQ =	0.9727	DW =	2.99	DoFree =	10 to 1986.000
MAPE =	1.20						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage36						1.12
1 intercept	-1.03512	49.7	-3.523	-0.92	-0.000	1.00
2 dgout36	0.31286	13.5	1.701	-0.00	0.181	-0.02
3 demp36	-0.64608	41.3	-3.155	0.02	-0.240	-0.04
4 time	0.02692	145.9	7.104	1.90	0.946	79.50

37. Industry Relative Wage: Yarn

SEE =	0.01	RSQ =	0.8221	RHO =	-0.32	Obser =	14 from 1973.000
SEE+1 =	0.01	RBSQ =	0.7688	DW =	2.63	DoFree =	10 to 1986.000
MAPE =	1.32						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage37						0.75
1 intercept	1.04117	333.5	13.337	1.39	0.000	1.00
2 dgout37	0.61945	124.5	6.357	-0.03	1.287	-0.03
3 demp37	-0.26470	43.0	-3.234	0.03	-0.629	-0.08
4 time	-0.00366	54.2	-3.712	-0.39	-0.541	79.50

38. Industry Relative Wage: Textiles

SEE =	0.01	RSQ =	0.9265	RHO =	0.03	Obser =	14 from 1973.000
SEE+1 =	0.01	RBSQ =	0.9044	DW =	1.93	DoFree =	10 to 1986.000
MAPE =	1.18						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage38						0.73
1 intercept	1.30322	572.0	21.014	1.78	0.000	1.00
2 dgout38	0.50658	96.7	5.357	-0.01	0.611	-0.01
3 demp38	-0.10248	5.3	-1.048	0.01	-0.120	-0.04
4 time	-0.00717	206.6	-9.166	-0.78	-0.791	79.50

39. Industry Relative Wage: Apparel

SEE =	0.01	RSQ =	0.3891	RHO =	0.29	Obser =	14 from 1973.000
SEE+1 =	0.01	RBSQ =	0.2058	DW =	1.42	DoFree =	10 to 1986.000
MAPE =	1.26						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage39						0.60
1 intercept	0.46032	153.0	7.350	0.76	0.000	1.00
2 dgout39	0.15428	6.9	1.194	0.00	0.543	0.00
3 demp39	-0.13566	5.2	-1.036	0.01	-0.471	-0.04
4 time	0.00171	21.3	2.171	0.23	0.537	79.50

40. Industry Relative Wage: Leather and Footwear

SEE =	0.01	RSQ =	0.8222	RHO =	-0.13	Obser =	14 from 1973.000
SEE+1 =	0.01	RBSQ =	0.7689	DW =	2.25	DoFree =	10 to 1986.000
MAPE =	1.09						

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage40						0.73
1 intercept	1.02292	438.7	16.739	1.39	0.000	1.00
2 dgout40	0.23860	67.9	4.266	-0.00	0.676	-0.01
3 demp40	-0.04453	0.9	-0.413	0.00	-0.066	-0.04
4 time	-0.00361	78.6	-4.679	-0.39	-0.628	79.50

41. Industry Relative Wage: Timber and Wood Products

```
SEE    =        0.02 RSQ    = 0.8266 RHO =    0.37 Obser  =    14 from 1973.000
SEE+1  =        0.02 RBSQ   = 0.7746 DW  =    1.26 DoFree =    10 to   1986.000
MAPE   =        1.78
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage41             - - - - - - - - - - - - - - - - - - - - -     0.91
1 intercept               1.77368   352.2  13.945  1.94   0.000       1.00
2 dgout41                 0.25365     6.0   1.107 -0.00   0.181      -0.01
3 demp41                 -0.47325    25.1  -2.379  0.01  -0.391      -0.01
4 time                   -0.01086   136.9  -6.791 -0.94  -0.919      79.50
```

42. Industry Relative Wage: Pulp and Paper

```
SEE    =        0.03 RSQ    = 0.8651 RHO =    0.62 Obser  =    14 from 1973.000
SEE+1  =        0.03 RBSQ   = 0.8247 DW  =    0.76 DoFree =    10 to   1986.000
MAPE   =        2.11
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage42             - - - - - - - - - - - - - - - - - - - - -     1.13
1 intercept              -0.32858    10.8  -1.507 -0.29  -0.000       1.00
2 dgout42                 0.56567    31.5   2.699 -0.00   0.361      -0.01
3 demp42                 -0.33468     4.2  -0.928  0.01  -0.136      -0.04
4 time                    0.01824   128.6   6.499  1.28   0.838      79.50
```

43. Industry Relative Wage: Printing and Publishing

```
SEE    =        0.02 RSQ    = 0.4578 RHO =    0.56 Obser  =    14 from 1973.000
SEE+1  =        0.02 RBSQ   = 0.2951 DW  =    0.88 DoFree =    10 to   1986.000
MAPE   =        1.48
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage43             - - - - - - - - - - - - - - - - - - - - -     1.10
1 intercept               0.91795   112.2   5.918  0.84   0.000       1.00
2 dgout43                 0.62488    34.1   2.826  0.01   0.757       0.02
3 demp43                 -0.84843    11.8  -1.580  0.00  -0.428      -0.01
4 time                    0.00201     5.3   1.041  0.15   0.248      79.50
```

44. Industry Relative Wage: Rubber

```
SEE    =        0.05 RSQ    = 0.0964 RHO =    0.38 Obser  =    14 from 1973.000
SEE+1  =        0.05 RBSQ   = -0.1747 DW  =    1.25 DoFree =    10 to   1986.000
MAPE   =        3.72
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage44             - - - - - - - - - - - - - - - - - - - - -     1.12
1 intercept               0.93153    15.9   1.855  0.83   0.000       1.00
2 dgout44                 0.30991     1.8   0.603 -0.00   0.256      -0.01
3 demp44                  0.16793     0.1   0.157 -0.01   0.100      -0.05
4 time                    0.00255     0.7   0.375  0.18   0.198      79.50
```

45. Industry Relative Wage: Plastics

```
SEE    =        0.02 RSQ    = 0.7120 RHO =    0.24 Obser  =    14 from 1973.000
SEE+1  =        0.01 RBSQ   = 0.6256 DW  =    1.52 DoFree =    10 to   1986.000
MAPE   =        1.31
  Variable name          Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 relwage45             - - - - - - - - - - - - - - - - - - - - -     1.02
1 intercept               0.88084   207.7   9.202  0.86   0.000       1.00
2 dgout45                 0.25444    15.8   1.847  0.01   0.506       0.03
3 demp45                 -0.67258    64.2  -4.119  0.00  -1.130      -0.00
4 time                    0.00167     9.2   1.387  0.13   0.236      79.50
```

46. Industry Relative Wage: Other Manufacturing

SEE =	0.06	RSQ =	0.5928	RHO =	0.32	Obser =	14	from	1973.000
SEE+1 =	0.06	RBSQ =	0.4707	DW =	1.37	DoFree =	10	to	1986.000
MAPE =	5.96								

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	relwage46	- - - - - - - -	- - - -	- - - -	- - - -	- - - -	0.71
1	intercept	0.08967	0.3	0.245	0.13	0.000	1.00
2	dgout46	0.62994	40.7	3.132	0.02	0.890	0.02
3	demp46	-0.43181	1.6	-0.572	0.02	-0.158	-0.03
4	time	0.00742	12.5	1.630	0.83	0.342	79.50

47. Industry Relative Wage: Construction

SEE =	0.02	RSQ =	0.2744	RHO =	0.37	Obser =	14	from	1973.000
SEE+1 =	0.02	RBSQ =	0.0567	DW =	1.26	DoFree =	10	to	1986.000
MAPE =	1.33								

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	relwage47	- - - - - - - -	- - - -	- - - -	- - - -	- - - -	1.08
1	intercept	1.34447	184.2	8.412	1.24	0.000	1.00
2	dgout47	0.26183	15.7	1.839	-0.00	0.678	-0.02
3	demp47	-0.37191	10.4	-1.480	0.01	-0.560	-0.02
4	time	-0.00332	12.7	-1.641	-0.24	-0.696	79.50

48. Industry Relative Wage: Distribution, Hotels, Catering and Repair

SEE =	0.01	RSQ =	0.0493	RHO =	0.70	Obser =	14	from	1973.000
SEE+1 =	0.01	RBSQ =	-0.2359	DW =	0.59	DoFree =	10	to	1986.000
MAPE =	1.60								

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	relwage48	- - - - - - - -	- - - -	- - - -	- - - -	- - - -	0.73
1	intercept	0.77312	120.4	6.211	1.06	0.000	1.00
2	dgout48	0.06539	0.5	0.301	0.00	0.139	0.01
3	demp48	-0.31835	2.3	-0.676	-0.00	-0.313	0.01
4	time	-0.00054	0.6	-0.347	-0.06	-0.150	79.50

49. Industry Relative Wage: Transportation

SEE =	0.03	RSQ =	0.8199	RHO =	-0.08	Obser =	14	from	1973.000
SEE+1 =	0.03	RBSQ =	0.7659	DW =	2.15	DoFree =	10	to	1986.000
MAPE =	1.62								

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	relwage49	- - - - - - - -	- - - -	- - - -	- - - -	- - - -	1.28
1	intercept	2.03723	283.0	11.692	1.59	0.000	1.00
2	dgout49	0.06584	0.2	0.177	0.00	0.024	0.01
3	demp49	2.81764	68.7	4.295	-0.03	0.592	-0.01
4	time	-0.00906	63.7	-4.098	-0.56	-0.565	79.50

50. Industry Relative Wage: Postal and Telecommunications

SEE =	0.02	RSQ =	0.9097	RHO =	0.09	Obser =	14	from	1973.000
SEE+1 =	0.02	RBSQ =	0.8826	DW =	1.82	DoFree =	10	to	1986.000
MAPE =	1.41								

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	relwage50	- - - - - - - -	- - - -	- - - -	- - - -	- - - -	1.22
1	intercept	-0.30769	17.7	-1.963	-0.25	-0.000	1.00
2	dgout50	-0.44278	6.5	-1.163	-0.01	-0.129	0.04
3	demp50	0.61548	4.8	0.996	-0.01	0.111	-0.01
4	time	0.01949	215.8	9.473	1.27	1.005	79.50

51. Industry Relative Wage: Banking Etc.

SEE =	0.03	RSQ = 0.8178	RHO = 0.08	Obser = 14	from 1973.000	
SEE+1 =	0.03	RBSQ = 0.7632	DW = 1.83	DoFree = 10	to 1986.000	
MAPE =	1.66					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage51	- -					1.26
1 intercept	0.25899	4.1	0.910	0.20	0.000	1.00
2 dgout51	0.34235	0.3	0.239	0.01	0.089	0.06
3 demp51	0.89174	2.7	0.737	0.02	0.190	0.03
4 time	0.01205	36.5	2.939	0.76	0.739	79.50

53. Industry Relative Wage: Other Services

SEE =	0.01	RSQ = 0.7016	RHO = 0.38	Obser = 14	from 1973.000	
SEE+1 =	0.01	RBSQ = 0.6120	DW = 1.24	DoFree = 10	to 1986.000	
MAPE =	0.90					

Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0 relwage53	- -					1.05
1 intercept	1.37782	340.1	13.552	1.31	0.000	1.00
2 dgout53	0.10402	0.1	0.117	0.00	0.041	0.02
3 demp53	0.18174	0.5	0.332	0.00	0.112	0.02
4 time	-0.00413	47.7	-3.439	-0.31	-0.742	79.50

Section IV.10 Value Added: Capital Consumption

In the course of production, a portion of productive capital is worn out and must be replaced if an economy is to maintain its current level of productive capacity. National income accounting conventions incorporate a measure of this capital consumption to distinguishing the portion of gross investment which simply maintains current productive wealth from that which augment society's material wealth.

For many countries, detailed capital consumption broken down by industry and asset is not available; to develop series for these countries, interindustry forecasting modelers often use a technique in which past investment is cumulated in stock variables (or "buckets"), which are consumed (or "spilled") at a constant rate to develop capital consumption series. The technique can involve a series of buckets to gain greater realism. However, the British Government Statistical Office estimates and provides detailed capital consumption data for Britain, and so I was saved the effort of estimating them through this technique. The British data is calculated using a perpetual inventory method that is very similar to the cumulation technique described above. In consequence, as the Government puts it[78],

> they depend to a great extent on assumptions about the asset lives for different categories of asset; there is very little hard information available to support these assumptions.

Nevertheless the data is certainly better than any I could develop alone.

The United Kingdom National Accounts define capital consumption as "a measure of fixed capital resources used up in the process of production during the year. Capital consumption is not an identifiable set of transactions; it is an imputed transaction which can be measured only by a system of conventions." In contrast to accountants who measure depreciation for tax purposes, the makers of the National Accounts appraise capital consumption for economic purposes using a perpetual inventory method similar to that used in producing the U.S. National Income and Product Accounts. They evaluate existing capital at constant cost and, using fairly realistic measures of capital service lives, attempt to assess the constant price value of the portion of existing capital consumed in the process of production during a given period. Capital consumption, thus measured, accounted for 12.1% of British gross domestic product in 1984, an amount equal to roughly 70% of British gross domestic fixed capital formation.

The National Accounts provide measures of net capital formation, which is simply the difference between gross investment and capital consumption, and net capital stock, which is simply cumulated net investment, measured in constant terms. At around 38 billion pounds in 1984, capital consumption was measured as 4.2% of the net capital stock, which was valued at 927 billion pounds. (The Accounts also provide measures of gross capital stock, defined as the replacement cost of all unretired capital, including the portion deemed already to be consumed, and of retirements. Some observers believe that these alternative measures of changes in the capital stock are more relevant to economic productivity; however, they have not been incorporated into BRIM.)

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[78] U.K. Central Statistical Office. ***United Kingdom National Accounts (1991)***, p.139.

The National Accounts' compilers recognize that rapid technological change may reduce the value and shorten the useful service life of existing capital, and that some such process may have occurred in Britain in recent years. They also acknowledge that British industry probably scrapped existing capital at a significantly higher rate during the early 1980's than in previous years, as manufacturing firms sloughed off nearly a third of their workforce and struggled to cope with rapidly innovating foreign competitors. However, the compilers have not yet revised their practices to account for these developments. This means that the data used in this study may significantly understate British rates of capital consumption during the past decade and therefore may overstate the value of the net capital stock. No attempt will be made to do revise the data here.

The capital consumption equations in BRIM were developed using detailed unpublished National Accounts data, which is described in the Appendix. Since the unpublished data is often at a higher level of aggregation than BRIM, I disaggregated them to the BRIM sectoral classification where necessary by apportioning the aggregate base year net stock and the consumption series, using as proportions each BRIM industry's average share of total National Accounts sectoral investment during the earliest decade for which data was available. Net stock was then calculated by subtracting capital consumption from gross investment and cumulating the resulting net investment series. (See the Appendix for more detail.) As a consequence, capital consumption rates are the same for BRIM industries in the same National Accounts sector.

The capital consumption rates were derived by regressing the capital consumption series on the lagged net stock series, with the intercept constrained to zero. The results are shown in Tables IV.10.1 through IV.10.3 below. The fits are generally good; the mean average percent errors are fairly small, and the parameter results are quite reasonable. Capital consumption rates are about 20% for vehicles, implying a 5-year service life; 5-12% for plant and machinery, implying 8-20 year service lives; and 1.5-5% for new buildings, implying 20-66 year service lives. Dwellings, too, come out with 66-year service lives.

Only one problem stands out from these results: the rho's are uniformly very high, indicating a high degree of autocorrelation in the errors. This results from the fact that net investment was relatively high in the 1950's and 1960's compared to the 1970's and 1980's, so that depreciation rates rose during the latter period as a relatively large quantity of older capital was consumed while the net stock grew relatively slowly, or even shrank. The result is that the equations tend to understate depreciation rates for the earlier period and overstate them in the latter. While this may seem to be a major problem, I believe that it is in large part resolved by the way the rho's are handled when the equations are solved in the model, as discussed in section IV.1. The equations are not corrected for autocorrelation, but when the model is run, the equations are solved for the last year for which data exists for the dependent variable. For the succeeding year, the equation's error in the last year, times the rho, is added to the forecast value; and for the next year, the error times the rho squared is added; and so on. For very large positive rho's such as the ones in these equations, the forecast depreciation levels will in fact be higher than those implied by the parameters, and the rates will only gradually converge to the implied rates, which may best be considered long-run rates.

The constant-price depreciation from these equations is converted to current prices by using domestic price indices weighted by the appropriate row totals of the bridge matrix.

Table IV.10.1: Capital Consumption Equations, Vehicles

BRIM #	Natl. Accnts. sector	Cap.Cons. % Stock	Mexval	T-statistic	R^2	Rho	MAPE
1	Agriculture etc.	0.15552	2147.5	116.670	0.7750	0.90	3.81
2	Coal, coke etc.	0.24202	553.5	33.555	0.9462	0.90	33.73
3	Oil and gas extraction	0.08003	406.6	25.803	0.9389	0.09	10.05
4	Mineral oil processing	0.19373	1211.1	67.930	0.9044	0.84	7.04
5	Electricity	0.19624	1537.0	84.900	0.9021	0.72	4.71
6	Public gas supply	0.19142	1227.2	68.767	0.9361	0.70	7.23
7	Water supply	0.17359	1485.8	82.235	0.9940	0.58	7.87
8,10,11	Metals	0.20113	1394.7	61.489	0.8559	0.92	6.82
9,12	Other minerals	0.20357	2289.8	98.449	0.8825	0.72	3.75
13-16	Chemicals	0.19912	3442.9	146.020	0.3608	0.79	2.41
17	Metal goods n.e.s.	0.19617	2062.4	112.244	0.9672	0.90	3.86
18-23	Mechanical engineering	0.19668	1645.0	71.829	0.7312	0.92	5.12
24	Office mach., computers	0.18489	631.6	37.660	0.9417	0.54	17.45
25-28,33	Electrical, instr. eng.	0.19752	2161.9	93.171	0.7668	0.83	3.89
29	Motor vehicles	0.19307	1766.2	96.831	0.9634	0.55	4.28
30-32	Other vehicles	0.19542	2587.1	110.714	0.8985	0.54	3.14
34	Food	0.06119	555.5	33.660	-0.3038	0.99	13.80
35-36	Drink and tobacco	0.19984	2337.8	100.428	0.6899	0.92	3.52
37-38	Textiles	0.19932	1499.9	65.838	0.7780	0.92	6.04
39-40	Clothing, leather, ftw.	0.19761	1784.1	77.575	0.7631	0.86	4.63
41	Timber & wood prod.	0.19614	1420.7	78.847	0.9460	0.87	5.55
42-43	Paper, printng, publish.	0.19553	3320.1	140.955	0.9520	0.78	2.49
44-45	Rubber & plastics	0.19718	2098.8	90.565	0.8258	0.88	4.06
46	Other manufacturing	0.19494	1199.3	67.311	0.9625	0.96	6.23
47	Construction	0.19632	1920.0	104.833	0.9563	0.90	4.67
48	Distribution, hotels, etc.	0.19393	2334.5	126.394	0.9827	0.90	4.00
49	Transportation	0.13188	414.3	26.211	-1.0764	0.99	19.01
50	Postal & telecommun.	0.19506	954.3	54.534	0.9000	0.82	8.02
51	Banking, finance, etc.	0.18017	1469.6	81.394	0.9919	0.79	4.62
53	Other services	0.19291	2268.1	122.942	0.9875	0.89	3.82

Table IV.10.2: Capital Consumption Equations, Plant and Machinery

BRIM #	Natl. Accnts. sector	Cap.Cons. % Stock	Mexval	T-statistic	R^2	Rho	MAPE
1	Agriculture etc.	0.06505	1327.1	73.974	0.3265	0.74	5.69
2	Coal, coke etc.	0.11272	1527.1	84.386	0.7785	0.96	4.78
3	Oil and gas extraction	0.15131	3373.7	180.424	0.9986	0.72	8.51
4	Mineral oil processing	0.08778	976.2	55.681	0.8592	0.98	10.15
5	Electricity	0.04462	1511.1	83.551	0.8682	0.98	4.98
6	Public gas supply	0.12090	409.5	25.958	0.6254	0.96	20.88
7	Water supply	0.06604	940.2	53.800	0.8545	0.97	7.63
8,10,11	Metals	0.07354	825.7	37.945	0.0325	0.98	9.80
9,12	Other minerals	0.07285	1414.0	62.286	0.7669	0.98	6.30
13-16	Chemicals	0.06117	958.4	43.442	0.5246	0.98	8.52
17	Metal goods n.e.s.	0.07063	857.5	49.481	0.7944	0.99	10.42
18-23	Mechanical engineering	0.07293	1512.9	66.374	0.7983	0.98	5.50
24	Office mach., computers	0.06819	1267.0	70.841	0.9779	0.96	10.80
25-28,33	Electrical, instr. eng.	0.07112	1891.6	82.012	0.9472	0.98	5.01
29	Motor vehicles	0.07114	2747.6	147.876	0.9661	0.91	3.23
30-32	Other vehicles	0.07586	4738.6	199.457	0.1052	0.89	1.55
34	Food	0.09198	566.6	34.248	0.8019	0.99	18.72
35-36	Drink and tobacco	0.06770	1086.6	48.749	0.8608	0.98	8.35
37-38	Textiles	0.06761	618.2	29.322	-3.7280	0.98	12.57
39-40	Clothing, leather, ftw.	0.07844	1543.4	67.633	0.6924	0.97	5.66
41	Timber & wood prod.	0.07609	1094.0	61.823	0.9552	0.97	10.35
42-43	Paper, printng, publish.	0.05489	1262.9	56.042	0.8535	0.98	6.93
44-45	Rubber & plastics	0.07381	672.1	31.566	-0.2123	0.98	12.35
46	Other manufacturing	0.07493	939.9	53.783	0.8778	0.98	10.31
47	Construction	0.06666	1082.5	61.224	0.9382	0.98	8.99
48	Distribution, hotels, etc.	0.05666	7022.0	370.032	0.9989	0.89	1.59
49	Transportation	0.09820	1822.3	99.749	0.9664	0.95	5.73
50	Postal & telecommun.	0.09041	1195.3	67.107	0.9574	0.97	6.24
51	Banking, finance, etc.	0.07412	2500.7	135.038	0.9974	0.95	17.50
53	Other services	0.09211	1519.9	84.010	0.9827	0.97	6.64

Table IV.10.3: Capital Consumption Equations, New Buildings

BRIM #	Natl. Accnts. sector	Cap.Cons. % Stock	Mexval	T-statistic	R^2	Rho	MAPE
1	Agriculture etc.	0.05316	1695.6	93.157	0.9710	0.98	5.07
2	Coal, coke etc.	0.04781	1730.3	94.962	0.6252	0.97	5.01
3	Oil and gas extraction	0.10006	3515.0	187.767	0.9986	0.69	9.45
4	Mineral oil processing	0.02524	893.1	51.342	0.7102	0.98	9.21
5	Electricity	0.04659	1271.1	71.057	0.8597	0.98	6.12
6	Public gas supply	0.03848	1896.1	103.593	0.9733	0.95	5.30
7	Water supply	0.02001	5561.4	294.127	0.9834	0.85	1.51
8,10,11	Metals	0.02931	2321.9	99.770	-0.5143	0.96	3.53
9,12	Other minerals	0.02634	2019.8	87.305	0.2714	0.98	4.12
13-16	Chemicals	0.02748	2540.8	108.805	0.6514	0.97	3.26
17	Metal goods n.e.s.	0.02895	1352.0	75.271	0.5830	0.99	5.96
18-23	Mechanical engineering	0.02834	1816.1	78.895	0.2606	0.98	4.40
24	Office mach., computers	0.02377	2422.1	130.947	0.9888	0.75	4.08
25-28,33	Electrical, instr. eng.	0.02789	1862.2	80.800	0.4610	0.98	4.52
29	Motor vehicles	0.02764	877.4	50.521	0.5977	0.99	9.50
30-32	Other vehicles	0.03204	967.3	43.812	-3.5843	0.98	8.18
34	Food	0.03971	1276.3	71.325	0.7764	0.98	6.42
35-36	Drink and tobacco	0.02499	3006.1	128.001	0.9043	0.95	2.49
37-38	Textiles	0.03388	7145.4	298.707	0.9733	0.88	1.20
39-40	Clothing, leather, ftw.	0.03553	3373.9	143.174	0.6179	0.96	2.61
41	Timber & wood prod.	0.02826	5115.9	270.977	0.9863	0.92	1.68
42-43	Paper, printng, publish.	0.02942	2297.4	98.762	-0.9424	0.98	3.73
44-45	Rubber & plastics	0.02413	1719.5	74.905	0.7897	0.97	4.79
46	Other manufacturing	0.03553	3529.7	188.532	0.6829	0.87	2.31
47	Construction	0.01803	3511.3	187.575	0.9856	0.94	2.38
48	Distribution, hotels, etc.	0.01754	2647.4	142.665	0.9876	0.98	4.50
49	Transportation	0.02733	2082.1	113.265	0.0015	0.99	4.05
50	Postal & telecommun.	0.02438	2399.8	129.787	0.9874	0.97	5.23
51	Banking, finance, etc.	0.01732	2691.7	144.966	0.9898	0.99	4.64
53	Other services	0.01255	1378.5	76.650	0.9277	0.99	7.43
52	Dwellings	0.01552	309.6	24.158	0.5609	0.39	4.43

Section IV.11 Value Added: Gross Profits and Other Income

Gross profits and other income comprised 29.7% of British value added; 34.6%, if indirect business taxes are excluded. This component of value added is something of a catch-all category; it includes income from self-employment, gross trading profits of companies, the gross trading surpluses of public corporations (that is, government-owned enterprises) and general government, rental income including imputed rent from the ownership of dwellings, consumption of non-trading capital, and charges for stock appreciation. Partly as a result of its hodgepodge nature, the gross profits component of value added is quite volatile and very difficult to forecast. It would be preferable to disaggregate it into some of its components, but data limitations make this impossible at the detailed industry level at present.

Profit and other income rise and fall in response to changes in demand, and thus play an important role in determining the rate of growth of prices over the business cycle. Because of this cyclical response to demand, this component of value added also plays a stabilizing role both in the economy and in a realistic model. Companies retain most profit income rather than distributing it in dividends, and dividends fluctuate less than do profits. Personal income therefore does not respond as strongly to swings in demand as does total value added. In an upturn, profits and prices rise faster than income, moderating the boom; in a downturn, they fall more than income, helping temper or even reverse the slowdown. The effect is likely to vary by industry, however, and it is useful to capture these differences in an interindustry model.

Profits in the Cambridge CMDM model. Early on in the Cambridge Growth Project, the builders of the Cambridge model developed gross profit equations to determine this component of value added. However, in recent years the Cambridge group has replaced industry profit equations with price equations, allowing profits to be determined as a residual. The authors present several reasons for using such an approach, the main one being the hypothesis that firms set prices using various rules and targets, generally with some sense of a target rate of return given a "normal" level of output. The authors also take the view that errors in profits data are likely to be larger than those in price indices; however, they do not offer any substantiation to this view.[79]

The Cambridge model's price equations relate the log of "home sale" prices (wholesale prices of domestic commodities sold domestically) to a number of variables intended to capture cost effects, import competition effects, and general inflation effects. These include

- current and lagged unit costs;
- current and lagged import prices;
- lagged home sale prices;
- current consumer prices;
- current and lagged cyclical variables; and
- a nine-year time trend that captures the general upward trend in prices between 1975 and 1984, but has no theoretical or practical rationale.

The sum of the unit cost, import price and lagged own price effects are constrained to sum to

[79] Barker and Peterson (1987), pp. 294-307.

unity in an effort to impose price homogeneity.

Profits in the INFORUM model. In examining profits in the context of a DMI, Monaco (1991) argues that industry-specific profit functions should relate profits to material input costs, labor costs, and demand. The underlying model sees profits as a mark-up on costs. Firms raise their mark-up during periods of high demand and reduce it during downturns, with a lag. Likewise, adjustment lags occur when material and labor costs rise, so that these input price increases tend to reduce profits in the short run.

Monaco contends that the dependent variable should be defined in real terms, normalized across industries, and nonstationary; and she suggests as an appropriate variable the first difference of the industry profit margin, defined as the ratio of real profits to real output. For the explanatory variables, she suggests changes in real output, both current and lagged, and material inputs' and wages' shares of output, defined analogously to the profit margin above. To eliminate the potential simultaneity problem that arises from deflating profits by current prices (which are themselves partially determined by profits), she suggests deflating profits by the previous year's prices. The estimated equation thus takes the form

$$\Delta \ln profm_{i\,t} = a + b \, \Delta \ln \left(\frac{q_{i\,t}}{ppi_t} \right) + c \, \Delta \ln \left(\frac{q_{i\,t-1}}{ppi_{t-1}} \right) + d \, \Delta \ln labshr_{i\,t} + e \, \Delta \ln matshr_{i\,t}$$

The dependent variable, the change in the profit margin in industry i in year t, is

$$\Delta \ln profm_{i\,t} = \ln \left[\left(\frac{prof_{i\,t}}{ppi_{t-1}} \right) / \left(\frac{q_{i\,t}}{ppi_t} \right) \right] - \ln \left[\left(\frac{prof_{t-1}}{ppi_{t-2}} \right) / \left(\frac{q_{i\,t-1}}{ppi_{t-1}} \right) \right]$$

where

$prof_{it}$ is profits of industry i in year t,
ppi_t is the relevant price index in year t, and
q_{it} is industry gross output in year t.

The labor and material cost share variables are constructed analogously:

$$\Delta \ln labshr_{i\,t} = \ln\left[\left(\frac{lab\ income_{i\,t}}{ppi_{t-1}}\right) / \left(\frac{q_{i\,t}}{ppi_t}\right)\right] - \ln\left[\left(\frac{lab\ income_{i\,t-1}}{ppi_{t-2}}\right) / \left(\frac{q_{i\,t-1}}{ppi_{t-1}}\right)\right]$$

$$\Delta \ln matshr_{i\,t} = \ln\left[\left(\frac{mat\ costs_{i\,t}}{ppi_{t-1}}\right) / \left(\frac{q_{i\,t}}{ppi_t}\right)\right] - \ln\left[\left(\frac{mat\ costs_{i\,t-1}}{ppi_{t-2}}\right) / \left(\frac{q_{i\,t-1}}{ppi_{t-1}}\right)\right]$$

where material costs are simply the difference between gross output and value added.

The estimation results using this form on British data from 1974 to 1986 are shown in Table IV.11.1 following the text of this section. The results are disappointing. The aggregate equation has a very poor fit and only the labor share parameter takes the expected sign. The parameters all take the expected sign in only three of the industry equations, Oil extraction (3), Machine tools (20) and Construction (47). The other equations would produce perverse results if they were included in a dynamic model. Either the approach does not apply to the British economy, or the data is not sufficiently accurate to yield appropriate results.

One possible difficulty with applying this approach to the British industry data is that the inflation rate has at times reached as high as 25% per annum. Deflating the numerators of the profit, materials costs and wages ratios by the previous year's price deflator might introduce more distortions than the potential simultaneity bias stemming from using the current year's deflator. Indeed, applying the current price deflator does produce better results, shown in Table IV.11.2. Using this specification, the aggregate equation yields a very good fit, though the labor share and material cost effects far outweigh the output effect, which takes the wrong sign in the lagged parameter. Nearly all of the equations have very good fits but relatively large mean percentage errors, as one would expect from regressions on first differences of stationary variables. In seven of the equations, all of the parameters take the correct sign; in sixteen more, the total output effect is positive and the other parameters are negative; and in several others, the output parameters could be constrained to be positive or zero with no perceptible effect on the fit. However, many of the equations would yield perverse results if they were included in a model. Furthermore, including these equations in the model would greatly complicate the solution process, because materials costs in a given industry equation depend on the prices of other industries' products.

Given the difficulties involved in the method described above, I have chosen a simpler approach in which profit and other income is determined as a share of value added rather than of sales, and is determined simply by changes in industry gross output, changes in the industry-specific real average annual wage, and changes in imports' share of domestic demand: In this approach, profits and other non-wage income can be still be thought of as a mark-up on material and labor costs; the mark-up fluctuates with the business cycle and declines during periods in which labor secures a larger share of value added and thus higher real wage growth. Producers also reduce their mark-ups as import penetration reduces their market share.

Table IV.11.3 shows results for equations including output and labor cost variables. The results are rather mediocre: all the parameters take reasonable signs and magnitudes in the aggregate equation, but in only about half of the sectoral equations.

Table IV.11.4 shows the parameters finally introduced in the model. Adding import penetration variables is useful in many cases; but on the whole the equations leave a great deal to be desired. All three variable take more or less appropriate signs in only twenty-four of fifty-one equations, and these include equations in which the current or lagged parameter takes the wrong sign but is considerably outweighed by an appropriate sign in the other parameter. Six equations include output and import variables; five output and wage variables, and eight output variables only. In many of the equations, several of the parameters have very low marginal explanatory value. Finally, seven sectors produce nonsense parameters for all variables; in these cases I have simply used profits' share in the last year of historical data. In all, I judge the attempt to develop these equations at best a modest success. In retrospect, I believe that the Cambridge group is on the right track by using price equations in the model and allowing profits to fall out of the model solution as a residual. Such a development in BRIM awaits further work.

Table IV.11.1: Change in profit margin using previous year's deflators (Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
Aggregate (change in gross output)								
	1.10888	-0.18351	-0.11476	-0.12099	0.22927	-0.4548	-0.46	133.64
	3.2	0.5	0.2	0.8	3.1			
1 Agriculture	2.46279	2.13199	-2.75700	0.91914	0.95959	0.5053	-0.08	74.67
	3.8	23.0	51.7	23.0	10.0			
2 Coal	8.71195	-1.97576	-1.31485	1.87353	0.00104	0.5218	-0.29	157.85
	4.4	9.8	4.0	20.8	0.0			
3 Oil	-6.81785	0.80590	-0.08586	1.02485	0.18744	0.9845	0.39	72.28
	10.3	32.2	3.8	53.5	3.7			
4 OilProcessing	11.13105	0.77996	0.56942	1.79497	-1.03372	0.5624	0.25	473.46
	7.5	2.8	13.0	20.3	9.0			
5 Electricity	1.41408	-4.45404	6.74686	0.88602	-1.92515	0.3135	0.01	142.26
	0.2	10.8	16.3	2.7	48.2			
6 Gas	21.57906	2.18948	-4.75841	2.63557	-1.32285	0.2436	0.02	210.96
	7.4	10.6	10.3	25.0	31.5			
7 Water	-5.35908	-0.42330	0.93871	0.98158	-0.73164	0.7291	-0.48	270.05
	19.1	3.4	23.9	38.9	69.0			
8 MetalOres	0.49819	0.62863	-0.17348	0.57069	-2.10538	0.4865	-0.24	185.41
	0.0	4.1	0.2	4.6	64.2			
9 NonMetalOres	6.63942	0.03561	0.10361	0.69920	-1.29841	-0.1462	-0.50	104.08
	3.7	0.0	0.3	10.6	9.8			
10 IronSteel	114.49406	24.88463	-20.95622	37.86659	6.28568	0.2509	0.31	223.60
	4.3	8.6	11.0	20.4	1.4			
11 OtherMetals	-5.83341	-28.06553	-4.48548	-1.15807	-0.80962	0.1435	0.07	261.92
	0.0	16.3	0.7	0.1	0.1			
12 MineralProducts	4.02278	-0.16264	-0.41726	2.59661	-3.17104	0.3771	-0.12	616.95
	1.8	0.0	0.2	21.0	56.9			
13 BasicChemicals	-5.18634	2.18852	1.05464	0.27101	-1.09596	0.1659	0.17	78.95
	7.1	7.3	18.7	0.2	10.2			
14 Pharmaceuticals	-15.10169	5.87883	-1.54162	3.13095	-1.60984	0.3957	-0.33	1497.76
	15.3	23.9	4.8	26.8	23.0			
15 SoapToiletries	-4.04921	2.47633	0.55240	1.06462	-2.11073	0.4176	-0.37	282.09
	2.3	19.5	1.7	6.3	53.3			
16 ManMadeFibers	47.97960	-2.81411	16.97775	9.59386	-5.76701	-0.1314	-0.44	187.79
	0.4	0.1	5.7	1.3	1.1			
17 MetalGoodsNES	9.56821	4.23306	-0.00103	2.41823	-2.42459	0.0758	-0.05	168.21
	7.9	28.1	0.0	12.7	13.6			
18 Industr.Plant	-10.54367	5.01828	3.17991	0.07360	-5.16353	0.4953	0.18	82.79
	6.0	15.2	15.8	0.0	25.4			
19 Agric.Machry.	-63.35458	-21.77228	12.25532	7.35302	6.28554	0.1825	-0.65	654.49
	1.5	9.8	3.5	1.6	0.7			
20 MachineTools	4.92011	3.31662	0.11886	-2.87594	-0.34122	0.5138	-0.22	80.32
	0.9	27.2	0.1	10.7	0.5			
21 Text.Etc.Mach.	-0.68231	4.40012	-3.41618	-0.24912	-0.61690	0.8349	0.07	41.71
	0.1	111.1	53.9	0.3	2.9			

(continued)

Table IV.11.1: Change in profit margin using previous year's deflators (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
22 OtherMachinery	2.25441	2.03087	-0.64585	-0.59421	-1.67534	0.2126	-0.35	168.52
	0.9	10.1	1.1	0.4	24.8			
23 Ordnance	-98.33885	-0.87993	4.65473	-23.99665	8.80462	0.3238	-0.38	2215.79
	3.7	0.2	3.0	25.7	2.6			
24 Off.Mach.Cmptrs	-0.68859	-0.29696	0.84016	-0.21259	-1.03909	0.3015	0.01	76.64
	0.1	1.6	13.8	0.8	45.4			
25 Bas.Elect.Eq.	7.70484	4.76719	-7.35194	-1.07882	2.81860	-0.2229	-0.61	121.80
	1.2	4.7	9.3	0.6	6.8			
26 Electr.Equip.	-1.42369	0.40063	0.18164	-1.50292	1.02916	-0.1449	-0.10	163.20
	0.1	0.4	0.1	7.0	4.1			
27 Dom.Electr.App.	7.95269	-26.49001	16.22047	15.76933	-21.75778	0.1370	-0.65	216.85
	0.0	6.3	3.0	5.0	11.8			
28 Elect.Light.	-7.76190	-0.91112	-1.56970	-7.24292	0.30432	0.5140	-0.29	400.19
	5.3	2.2	16.4	64.3	1.4			
29 MotorVehicles	9.52803	-34.20737	43.75910	-14.56726	3.87806	0.2144	-0.44	1173.01
	0.0	5.1	15.3	0.6	0.2			
30 Shipbuilding	-91.00843	-64.93127	76.47966	-17.05461	-5.86385	0.6741	0.18	22.00
	6.3	74.7	100.0	18.8	2.1			
31 Aerospace	-110.70878	-13.82556	7.13557	-23.46955	9.36445	-0.4808	-0.75	49.55
	2.0	1.1	0.4	2.3	0.6			
32 Oth.Vehicles	-114.38588	-4.09094	-18.97275	11.52650	-11.57757	0.1584	-0.19	100.45
	17.0	1.4	26.2	5.3	4.0			
33 Instr.Eng.	-1.61867	3.46662	-1.99573	-1.87371	1.43275	0.0921	-0.31	233.25
	0.1	7.2	4.6	0.8	2.2			
34 Food	-2.74062	-0.93336	-0.41130	-1.28306	-0.60745	0.0825	0.33	81.20
	3.1	2.8	0.8	12.7	7.6			
35 Drink	-1.45709	-0.82237	1.87031	0.26634	-1.47716	0.6433	-0.14	364.27
	1.0	7.7	45.5	1.6	84.3			
36 Tobacco	-4.99267	-1.13470	1.37559	1.53424	-2.18105	0.7627	0.46	81.06
	5.5	4.1	7.9	30.0	130.9			
37 Yarn	-5.04336	2.53998	-2.06469	0.88219	-0.92872	-0.3023	0.25	91.54
	0.8	8.6	6.3	1.7	3.0			
38 Textiles	1.64128	-1.30876	4.07716	-5.93013	-1.94315	0.5117	0.29	125.91
	0.5	5.7	48.3	47.7	33.9			
39 Apparel	-2.22783	2.30539	0.63236	0.31873	-0.82383	0.2731	-0.20	82.70
	1.7	21.8	2.9	0.5	6.8			
40 LeatherFootwear	1.92983	0.88430	1.96727	0.65604	-3.16035	0.3994	0.16	67.74
	0.5	1.3	9.5	1.1	45.7			
41 TimberWood	2.47462	2.13870	4.05281	0.09214	-3.32900	-0.1207	-0.28	167.37
	0.3	4.2	10.4	0.0	18.3			
42 PulpPaper	-2.88403	0.66365	1.21441	-1.88084	0.40710	0.1974	-0.38	179.73
	1.2	2.4	7.8	11.4	2.0			
43 Print.Publish.	-1.44184	-0.60677	2.07782	0.32992	-2.58598	0.3207	-0.33	95.17
	0.3	0.8	10.9	0.3	42.0			

(continued)

Table IV.11.1: Change in profit margin using previous year's deflators (continued) (Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
44 Rubber	18.53587	2.88475	1.89555	5.36705	-1.55111	0.1985	-0.31	62.18
	11.8	7.5	3.1	35.5	10.0			
45 Plastic	-6.86927	1.90714	0.40612	0.57295	-0.51141	-0.0701	0.13	113.36
	6.4	11.9	1.2	0.6	2.7			
46 Oth.Manufact.	1.39687	1.62528	-1.47082	-1.33404	-4.02587	0.3913	-0.11	317.73
	0.0	4.5	4.9	1.4	19.6			
47 Construction	-0.30231	0.89231	0.75105	-0.76290	-0.13791	0.8583	0.33	84.38
	0.3	107.3	41.1	23.7	2.2			
48 Distribution	-3.42117	1.57233	0.26470	0.08706	0.73392	0.0007	0.07	92.29
	6.2	5.1	0.3	0.1	8.7			
49 Transportation	2.82368	0.12583	-1.69572	-0.69680	0.88039	0.0672	-0.08	178.36
	8.0	0.1	17.4	14.2	19.2			
50 Communications	l2.16239	-1.46329	-1.47574	0.75442	0.23202	-0.0524	-0.06	115.51
	2.6	1.1	0.3	1.8	0.8			
51 Bank.Fin.Etc.	7.22068	-0.31661	-1.56120	-0.13027	0.63560	-0.0541	-0.57	91.61
	2.5	0.1	2.8	0.3	16.6			
53 OtherServices	-2.50360	0.77756	0.98654	0.45820	0.33427	0.4300	0.40	103.24
	2.8	1.3	4.9	10.0	4.1			

Table IV.11.2: Change in profit margin using current year's deflators (Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
Aggregate (Change in gross output)								
	0.15244	0.05273	-0.10779	-1.97008	-2.81321	0.9871	-0.18	10.91
	3.9	3.1	18.3	683.0	678.378			
1 Agriculture	0.08059	-0.03791	0.00391	-0.41544	-2.16115	0.9992	-0.25	23.76
	6.2	14.0	0.1	823.3	3393.7			
2 Coal	0.43515	-1.63175	0.81802	-3.33730	-0.48978	0.5218	0.25	155.82
	0.0	8.9	1.5	4.1	6.4			
3 Oil	-1.84810	0.04510	0.04635	-0.12619	-0.06324	0.9818	-0.22	62.44
	41.7	4.0	70.5	33.4	20.2			
4 OilProcessing	2.33788	0.05676	0.28181	0.31343	-6.55488	0.9226	-0.18	61.64
	1.4	0.1	14.2	2.5	127.7			
5 Electricity	0.53694	-0.21053	1.07760	-1.72035	-3.47492	0.9381	0.11	83.86
	0.2	0.4	8.6	56.7	391.5			
6 Gas	-9.05137	-1.01013	1.71826	-2.02352	-2.57017	0.7909	0.36	58.10
	8.0	6.5	8.9	28.0	169.7			
7 Water	-0.45480	-0.50517	0.18629	-0.70570	-1.09203	0.9809	-0.09	19.63
	1.7	62.2	13.5	71.8	570.7			
8 MetalOres	-0.10997	-0.08443	0.20471	-1.42524	-2.18408	0.9584	-0.36	50.16
	0.0	1.1	4.5	125.3	489.2			
9 NonMetalOres	-1.17265	0.08227	0.08781	-1.15299	-3.55004	0.9552	-0.16	30.68
	3.5	5.8	7.5	200.2	489.1			
10 IronSteel	93.91238	13.65428	7.00075	11.86249	27.61960	0.3005	0.34	111.36
	12.4	13.5	13.2	15.6	32.5			
11 OtherMetals	-9.91070	-9.96239	-0.52243	4.14678	14.09064	0.7749	0.01	89.73
	1.9	55.5	0.2	28.4	56.4			
12 Miner.Products	-2.14483	-0.60462	-0.10192	-3.39869	-6.59118	0.9659	-0.09	81.12
	8.0	13.8	0.4	118.8	553.4			
13 BasicChemicals	0.50842	0.20178	0.23050	-1.46478	-5.25210	0.9278	-0.24	40.59
	0.7	0.6	10.3	44.7	356.7			
14 Pharmaceuticals	-7.08662	1.94477	-0.59475	0.04107	-3.68580	0.7975	-0.36	80.03
	9.3	15.9	5.5	0.0	116.8			
15 SoapToiletries	-2.30212	0.74020	-0.46504	-0.23070	-5.42819	0.8703	0.06	50.15
	2.8	5.5	5.0	1.0	212.8			
16 ManMadeFibers	12.20071	-7.30602	12.96826	-0.70178	-16.87848	-0.0423	-0.39	131.26
	0.1	3.4	20.2	0.1	7.8			
17 MetalGoodsNES	2.59796	0.66503	-0.05415	-4.99499	-9.74018	0.9521	-0.00	40.04
	11.8	11.0	0.4	178.7	425.7			
18 IndustrialPlant	-2.27802	-0.23894	0.57345	-6.35576	-10.65519	0.8531	0.09	35.38
	0.9	0.1	2.1	44.7	170.4			
19 Agric.Machinery	23.53520	-1.86655	0.57700	8.20403	10.10443	0.1966	-0.17	219.29
	1.4	0.4	0.1	9.0	6.3			
20 MachineTools	0.45515	-0.11239	0.47622	-7.32683	-6.13177	0.8745	-0.24	37.56
	0.0	0.1	3.9	106.7	115.4			
21 Text.Etc.Mach.	0.48975	2.13793	-1.82444	-3.53363	-5.29393	0.9558	-0.26	17.05
	0.1	50.5	41.7	64.0	97.6			

(continued)

Table IV.11.2: Change in profit margin using current year's deflators (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
22 OtherMachinery	-0.18384	-0.09895	0.01047	-5.62180	-8.12912	0.9771	-0.04	19.45
	0.2	0.6	0.0	289.9	627.9			
23 Ordnance	65.28209	-4.71289	-2.74918	-26.55636	-67.30494	0.8042	-0.33	530.96
	4.4	14.4	3.3	84.1	67.8			
24 Off.Mach.Cmptrs	-0.41803	0.12923	0.05052	-0.80902	-2.06334	0.8588	-0.45	45.12
	0.1	1.7	0.4	29.2	204.6			
25 BasicElect.Equip	-2.31013	-1.17850	0.00004	-6.60293	-11.17049	0.8599	-0.33	50.32
	0.9	3.4	0.0	155.3	130.9			
26 Electron.Equip	-0.07225	-0.11017	-0.33557	-5.31202	-6.24854	0.9379	0.06	35.83
	0.0	0.7	7.2	342.7	250.7			
27 Dom.Electr.App.	12.69317	-3.87442	3.57274	12.16713	-12.81140	0.1179	-0.65	107.28
	0.5	0.3	1.1	6.4	8.8			
28 Electr.Lighting	0.66822	0.24689	0.05331	-3.63291	-5.50700	0.9677	-0.06	80.94
	0.6	2.7	0.3	362.3	534.6			
29 MotorVehicles	34.36191	-8.32047	16.71504	1.04009	-4.81411	0.1116	-0.51	275.50
	1.5	2.4	18.4	0.0	1.2			
30 Shipbuilding	-43.90535	-35.11901	43.79792	-9.08411	-4.81266	0.4462	-0.25	20.72
	3.0	50.0	40.6	6.7	2.4			
31 Aerospace	-36.40213	2.75307	-7.43540	-0.12369	17.48003	-0.4917	-0.82	56.81
	0.6	0.1	0.9	0.0	2.5			
32 OtherVehicles	-72.57025	-2.61111	-11.19881	2.64896	-16.92641	0.3658	-0.18	41.56
	31.8	4.0	43.3	1.1	22.1			
33 Instr.Engin.	-3.07714	0.13762	-0.16614	-8.55940	-9.76607	0.9183	-0.17	30.38
	3.3	0.2	0.3	189.8	185.7			
34 Food	0.24405	-0.08681	-0.01963	-1.86326	-9.64703	0.9891	-0.58	10.33
	1.4	1.5	0.1	484.9	1068.0			
35 Drink	-0.75438	-0.04969	0.30592	-1.12385	-3.40754	0.9777	-0.23	20.11
	3.3	0.5	38.9	124.6	723.5			
36 Tobacco	-0.53835	-0.01483	-0.01933	-0.56057	-1.87517	0.9668	-0.44	24.47
	0.6	0.0	0.0	16.7	524.0			
37 Yarn	2.15985	0.69122	-0.45219	-4.18169	-12.19437	0.9096	-0.43	33.65
	2.4	8.7	4.4	161.8	300.8			
38 Textiles	2.12659	-0.16741	0.40582	-4.57703	-8.22173	0.9358	-0.16	39.86
	5.8	0.9	7.8	217.9	380.9			
39 Apparel	0.51607	-0.12209	0.29025	-4.50446	-7.10211	0.9790	0.03	19.06
	3.2	1.6	31.5	376.4	578.4			
40 LeatherFootwear	-0.05240	-0.06796	0.17975	-5.17951	-9.65198	0.9693	0.12	49.41
	0.0	0.2	2.7	221.4	506.2			
41 TimberWood	1.49461	0.56314	0.05776	-4.96911	-9.71457	0.9625	-0.22	18.11
	2.9	8.1	0.1	239.5	539.6			
42 PulpPaper	0.81738	-0.24184	0.04398	-3.62542	-9.69489	0.9596	-0.06	29.38
	1.9	6.1	0.5	328.9	405.0			
43 Print.Publish.	0.59954	-0.00029	0.04371	-3.92621	-5.43172	0.9932	-0.03	10.02
	4.9	0.0	1.0	585.4	1392.3			

(continued)

Table IV.11.2: Change in profit margin using current year's deflators (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Labor Share	Material Share	Adj.R^2	Rho	MAPE
44 Rubber	-4.03815	0.28433	-1.31820	-6.48007	-8.02347	0.9447	-0.06	78.19
	8.0	1.4	19.1	202.9	417.6			
45 Plastic	0.97919	-0.05791	-0.02178	-3.36094	-6.55000	0.9960	0.22	11.89
	26.2	2.7	1.3	906.4	1630.6			
46 Oth.Manufctrng	13.87340	0.74245	-2.70195	-6.90211	-12.08660	0.4197	-0.09	430.02
	2.0	0.7	18.5	9.0	23.9			
47 Construction	-0.42297	-0.03100	-0.05313	-1.51246	-3.82571	0.9908	0.29	21.61
	7.5	1.3	3.2	351.3	832.4			
48 Distribution	0.41342	-0.02674	0.04784	-2.17505	-2.75672	0.9820	0.49	40.48
	5.6	0.2	1.2	528.0	506.1			
49 Transportation	-0.41103	0.00380	-0.10922	-2.77133	-4.16613	0.9945	0.18	24.50
	15.8	0.0	7.0	1182.6	842.4			
50 Communications	0.82096	-0.09822	-0.14482	-1.72057	-1.02984	0.9877	-0.02	14.80
	5.1	2.2	2.3	701.0	572.5			
51 Bank.Fin.Etc.	0.39204	-0.00556	-0.09792	-0.96609	-1.06891	0.9963	-0.43	6.45
	5.1	0.0	7.7	1498.1	1374.2			
53 OtherServices	-0.19093	0.00987	0.08208	-6.39329	-0.37230	0.9961	-0.07	90.24
	5.4	0.1	10.1	1636.7	418.1			

Table IV.11.3: Change in profit share of value added (Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Change in Real wage Current	Change in Real wage Lagged	Adj.R²	Rho	MAPE
Aggregate	32.06858	0.43096	0.07056			0.3311	0.77	3.92
	1752.5	28.2	0.9					
	32.65069	0.46117	0.13447	-0.06044	-0.34348	0.4261	0.86	3.46
	1677.7	40.5	4.1	0.6	16.5			
1 Agriculture	70.56544	0.41671	0.00524			0.4768	0.33	1.56
	4397.0	52.4	0.0					
	70.74238	0.46135	-0.07952	0.11805	-0.06596	0.4907	0.26	1.29
	4839.6	47.6	1.8	9.4	3.0			
2 Coal	11.70666	-0.36954	-0.47499			0.7988	0.08	30.82
	189.0	20.3	35.7					
	9.85811	-0.88831	-0.54504	0.47679	-0.12988	0.8872	-0.23	20.56
	158.6	82.9	66.5	43.0	6.6			
3 Oil	97.39507	0.00424	-0.00439			0.5645	0.12	0.23
	26243.4	1.0	12.7					
	97.10664	0.03156	-0.01196	0.01043	0.02330	0.9650	-0.11	0.05
	69679.2	122.0	179.3	146.7	226.2			
4 OilProcessing	81.34637	-0.12894	-0.03228			0.1564	0.60	4.29
	1812.5	19.1	1.4					
	82.77844	-0.09587	0.00000	-0.23677	-0.25378	0.1462	0.28	3.77
	1667.4	12.2	0.0	6.1	7.1			
5 Electricity	52.73414	-0.17245	-0.34955			-0.1669	-0.26	8.73
	830.3	0.5	2.0					
	55.29780	-0.37313	-0.42093	-0.55741	-0.18960	-0.2802	-0.27	7.14
	516.9	2.2	3.2	8.0	1.1			
6 Gas	44.45007	0.64874	0.21078			0.1727	0.18	7.69
	553.8	16.6	1.9					
	45.14943	0.64466	0.21562	-0.04206	-0.19223	-0.0337	0.17	7.62
	404.4	9.9	0.5	0.0	1.0			
7 Water	54.49934	-0.28924	0.16258			0.0856	0.38	4.72
	1757.8	14.8	5.8					
	55.00645	-0.20235	0.16413	-0.13756	-0.18902	0.1560	0.17	3.71
	1996.6	8.5	6.8	6.6	13.6			
8 MetalOres	46.26662	-0.03460	-0.12977			-0.1443	0.04	8.00
	771.5	0.2	2.7					
	47.84785	0.15797	0.16112	-0.31699	-0.31171	-0.1859	0.13	8.43
	733.2	1.6	1.8	2.9	3.9			
9 NonMetalOres	42.16133	-0.23433	-0.25332			0.3520	0.15	12.70
	468.8	14.5	18.6					
	42.06263	-0.33804	-0.28743	0.55967	0.92159	0.3870	0.27	10.81
	554.8	30.7	29.5	6.8	16.3			
10 IronSteel	10.38445	1.23228	0.89195			0.1942	0.39	100.56
	14.9	18.8	11.4					
	7.58132	0.90871	0.77655	1.00659	0.15204	0.0299	0.32	104.87
	6.3	5.3	5.9	3.3	0.0			

(continued)

Table IV.11.3: Change in profit share of value added (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Change in Real wage Current	Change in Real wage Lagged	Adj.R^2	Rho	MAPE
11 OtherMetals	15.68784	0.91221	0.98990			0.1791	0.60	49.79
	50.0	12.3	14.4					
	16.88970	1.02024	1.14093	-1.06385	-0.62976	0.0635	0.57	53.87
	59.1	16.5	19.8	5.2	1.7			
12 MineralProducts	28.20026	0.32301	0.08066			-0.1390	0.85	22.27
	322.0	2.8	0.2					
	29.87265	0.47227	0.05772	-0.65094	-0.29389	-0.3196	0.72	20.61
	251.7	5.8	0.1	5.3	1.1			
13 BasicChemicals	40.00682	0.45847	0.43131			0.4104	0.56	9.73
	753.7	29.6	30.5					
	41.51724	0.52211	0.50356	-0.35419	-0.50423	0.3177	0.56	9.33
	548.6	35.4	32.9	1.9	4.5			
14 Pharmaceuticals	40.71823	0.62387	-0.02611			-0.0672	0.77	17.45
	336.1	7.0	0.0					
	50.09499	0.49032	0.11594	-1.00466	-1.39732	0.0368	0.63	14.71
	208.7	6.0	0.5	8.7	18.0			
15 SoapToiletries	45.34941	0.26726	0.32130			-0.0654	0.80	14.48
	471.5	2.5	3.4					
	42.41415	0.15160	0.65210	0.18853	0.98780	0.2388	0.41	11.79
	443.3	1.3	19.8	1.1	34.1			
16 ManMadeFibers	13.53194	1.77805	0.84076			0.6419	0.12	280.13
	34.4	76.8	30.1					
	19.73865	1.88733	0.54830	-1.77719	-2.14891	0.8307	0.33	171.59
	115.8	172.6	21.4	30.2	63.1			
17 MetalGoodsNES	17.69123	0.27542	0.29778			0.5689	0.49	10.17
	735.7	37.9	46.2					
	18.09703	0.30055	0.29550	-0.09477	-0.04688	0.4621	0.50	9.89
	377.9	31.3	37.3	1.4	0.2			
18 IndustrialPlant	14.75570	0.20089	0.40927			0.1807	-0.02	31.65
	291.0	4.8	19.4					
	13.18500	0.18578	0.06656	-0.05406	0.44494	0.2096	-0.17	21.8
	167.9	2.8	0.3	0.3	15.2			
19 Agricult.Machinery	18.61731	0.54085	-0.14433			0.0586	0.22	108.48
	109.2	12.3	1.0					
	19.33401	0.68776	-0.13004	-0.35968	0.00889	-0.0758	0.18	92.9
	116.7	15.4	0.8	5.9	0.0			
20 MachineTools	14.23534	0.29933	0.18149			0.2890	0.66	33.95
	223.9	18.2	9.7					
	15.40195	0.39541	0.29703	-0.47492	-0.27049	0.1962	0.61	31.91
	193.0	25.9	14.4	5.6	4.0			
21 Text.Etc.Machinery	17.50707	0.57232	0.10734			0.5115	0.64	19.64
	357.5	53.6	2.6					
	19.07771	0.62456	0.25918	-0.20705	-0.40991	0.4409	0.72	18.87
	224.0	55.2	8.3	1.4	6.0			

(continued)

Table IV.11.3: Change in profit share of value added (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Change in Real wage Current	Change in Real wage Lagged	Adj.R^2	Rho	MAPE
22 OtherMachinery	16.09150	0.09550	-0.23758			-0.0276	0.50	13.23
	521.0	1.2	8.9					
	17.48996	0.45695	-0.23461	-0.58894	-0.36646	0.0901	0.44	12.15
	422.8	15.0	10.5	20.5	6.9			
23 Ordnance	14.33367	0.16492	0.00148			-0.0433	0.88555.91	
	74.8	7.7	0.0					
	13.04706	0.25227	-0.34915	0.21410	0.61891	0.3902	0.34450.45	
	115.3	20.4	29.4	8.8	47.6			
24 Office Mach.	47.47570	0.23386	-0.08355			0.1420	0.50	10.00
	699.4	19.3	2.2					
	47.57760	0.28446	0.04610	-0.29334	-0.17566	0.0608	0.53	9.40
	757.6	27.6	0.5	7.1	5.1			
25 BasicElect.Equip.	15.57746	0.57261	-0.22238			0.1324	0.12	25.78
	296.9	16.2	5.6					
	14.95500	1.01467	-0.74802	-0.24733	0.62766	0.3916	-0.03	19.58
	296.2	43.4	41.1	5.1	29.7			
26 ElectronicEquip.	17.40143	0.40550	0.54352			0.7491	0.32	7.12
	502.8	44.8	74.4					
	17.59752	0.42504	0.52991	-0.06454	-0.01931	0.6795	0.35	7.24
	327.2	36.6	55.6	0.3	0.0			
27 Dom.ElectricalAppl.	11.05586	1.00008	0.54116			0.6473	-0.02	50.55
	129.5	49.6	24.6					
	11.25596	1.04330	0.54407	-0.05225	-0.18802	0.5673	0.02	52.82
	130.2	50.2	20.1	0.1	1.7			
28 ElectricLighting	22.07818	0.13575	-0.01690			-0.1461	-0.30	14.45
	410.9	3.0	0.1					
	23.24837	0.08542	0.20570	-0.41604	-0.17671	0.5054	-0.50	9.16
	755.0	3.3	17.6	72.3	20.1			
29 MotorVehicles	13.46186	0.68423	0.35077			0.2120	0.64	66.49
	88.7	18.0	3.5					
	14.46401	0.80039	0.44213	-0.32126	-0.22705	-0.0058	0.64	66.28
	40.0	10.0	2.9	0.3	0.2			
30 Shipbuilding	-17.23875	0.39974	-1.95610			0.1306	0.62	475.43
	36.4	0.8	18.4					
	-31.03267	-0.85640	-1.95222	0.82869	2.14598	0.4113	0.37	269.70
	74.1	4.6	28.3	6.2	37.2			
31 Aerospace	-8.26007	0.94707	-0.02362			0.0225	0.68356.37	
	19.4	11.7	0.0					
	-14.16413	1.28547	-0.88216	0.40867	1.66365	0.0495	0.43	555.78
	30.1	22.6	6.4	1.0	14.3			
32 OtherVehicles	-7.09048	-0.43894	-0.18221			-0.1041	0.83	980.69
	11.9	4.1	0.7					
	-6.26668	-0.79233	0.11360	1.36254	-1.39006	-0.1486	0.61	322.00
	6.9	12.2	0.3	7.5	8.2			

(continued)

Table IV.11.3: Change in profit share of value added (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output Current	Change in Output Lagged	Change in Real wage Current	Change in Real wage Lagged	Adj.R^2	Rho	MAPE
33 Instr.Engnrng.	13.17416	0.52185	0.23888			0.4265	0.47	23.87
	296.9	44.3	9.4					
	14.07781	0.53855	0.27607	-0.15903	-0.32212	0.3484	0.59	23.41
	249.4	48.5	12.8	1.4	6.0			
34 Food	33.22577	-0.05388	0.14725			-0.1768	0.44	6.95
	1106.6	0.2	1.7					
	36.29503	0.20575	-0.30401	-0.55648	-0.46819	-0.1102	0.50	6.18
	520.4	3.2	2.8	9.2	15.1			
35 Drink	49.55627	0.02592	0.12822			-0.0929	0.31	5.52
	1377.8	0.1	5.2					
	49.04853	-0.14038	0.15222	0.42972	0.62170	0.2511	0.32	4.08
	1770.7	5.0	7.6	11.4	36.5			
36 Tobacco	58.15135	0.63261	-0.14348			0.0843	0.25	9.09
	786.7	15.3	1.5					
	65.49887	0.76012	-0.14288	-0.57508	-1.03505	0.0422	0.19	8.15
	264.6	24.3	1.8	3.3	10.7			
37 Yarn	16.65271	0.33857	0.13760			0.4908	0.53	14.70
	487.9	32.2	5.5					
	16.04711	0.31673	0.08550	-0.03170	0.15156	0.3903	0.55	13.65
	268.9	14.8	1.5	0.1	2.8			
38 Textiles	15.98472	0.03776	0.32461			0.2953	-0.15	12.70
	560.3	0.4	28.2					
	16.24074	0.03206	0.39894	0.08229	-0.11560	0.1414	-0.18	12.57
	393.4	0.2	27.1	0.6	1.8			
39 Apparel	17.75925	0.14743	0.30063			0.4840	0.59	8.45
	833.5	10.1	38.1					
	18.79002	0.16754	0.31646	-0.12543	-0.26375	0.4431	0.52	7.63
	499.5	13.8	32.2	0.8	7.2			
40 LeatherFootwear	16.97940	-0.12167	0.33673			0.3713	-0.21	11.61
	664.1	5.5	35.7					
	17.68511	-0.10001	0.39319	0.13338	-0.38104	0.6910	-0.56	7.17
	809.2	6.4	89.1	3.9	44.0			
41 TimberWood	16.82049	-0.11042	-0.08521			-0.1976	0.45	23.81
	256.9	0.8	0.5					
	16.96724	-0.09791	0.01294	0.24588	-0.08090	-0.5143	0.47	23.06
	210.1	0.6	0.0	0.7	0.2			
42 PulpPaper	23.05660	0.30369	0.21956			0.0908	0.77	22.68
	352.5	12.1	7.2					
	31.97225	0.76358	0.34446	-1.27989	-1.08475	0.6367	0.36	10.63
	386.2	94.9	27.3	58.0	53.3			
43 PrintingPublishing	18.85258	0.10132	0.20608			0.0562	0.49	10.45
	588.9	2.7	11.0					
	18.56487	0.12214	0.25806	0.20294	-0.07984	-0.0598	0.28	10.63
	414.5	2.3	16.7	2.8	0.4			

(continued)

Table IV.11.3: Change in profit share of value added (continued)
(Mexvals shown below parameters)

Industry	Intercept	Change in Output		Change in Real wage		Adj.R^2	Rho	MAPE
		Current	Lagged	Current	Lagged			
44 Rubber	18.23923	0.30842	0.26744			0.1787	-0.36	20.8
	367.0	7.6	7.0					
	21.01435	0.63770	0.46172	-0.13635	-0.65568	0.5371	-0.38	13.84
	397.4	33.0	35.3	2.7	47.5			
45 Plastic	24.45439	0.13397	0.08100			-0.0420	0.48	9.69
	692.9	7.4	3.1					
	25.22306	0.13078	0.07702	-0.07875	-0.26140	-0.2086	0.48	9.13
	489.0	7.7	1.9	0.3	5.2			
46 Other Mfg.	18.81469	0.30579	0.11491			0.6466	-0.03	54.88
	401.7	68.6	12.5					
	18.26913	0.33728	0.00115	-0.04306	0.19718	0.6603	-0.27	37.27
	415.6	55.2	0.0	0.6	15.6			
47 Construction	40.82370	0.18340	0.25005			0.1296	0.85	7.70
	963.7	4.8	8.5					
	40.30863	0.22973	0.29099	0.36421	0.19282	0.0568	0.73	6.39
	964.1	8.2	12.9	4.4	1.7			
48 Distribution	29.68748	0.17126	0.37815			0.1597	0.55	7.67
	1057.1	3.1	14.2					
	29.79717	0.19971	0.35605	-0.15299	0.01237	-0.0624	0.57	7.38
	729.3	2.6	8.3	0.8	0.0			
49 Transportation	26.62013	0.48073	0.04077			0.1348	0.42	5.50
	1279.5	18.5	0.2					
	26.60848	0.45052	0.01332	0.03678	0.02824	-0.1032	0.39	5.45
	1279.0	12.9	0.0	0.2	0.1			
50 Communications	38.02664	0.76625	-1.04644			0.4746	0.00	5.34
	812.5	26.8	48.6					
	39.09849	0.47809	-0.83837	-0.00763	-0.25199	0.4670	0.26	4.68
	807.1	6.9	14.2	0.0	10.3			
51 BankingFinanceEt	63.02660	-0.47626	-0.20696			-0.0118	0.31	4.20
	521.4	4.1	0.6					
	51.34802	-0.05960	-0.08250	-0.53107	-0.25220	0.0300	0.47	3.21
	516.7	0.1	0.1	15.2	3.2			
53 OtherServices	13.85198	-0.19309	0.01656			-0.0763	0.66	3.62
	916.2	6.5	0.1					
	13.86698	-0.15472	0.03665	-0.03897	-0.11785	0.2988	0.69	2.40
	1303.1	8.0	0.4	3.1	28.5			

Table IV.11.4: Change in profit share of value added: Equations in Model (Mexvals in Parentheses)

Industry	Intercept	Output Current	Output Lagged	Real Wage Current	Real Wage Lagged	Imports' Share Current	Imports' Share Lagged	Adj.R²	Rho	MAPE
1 Agriculture	70.6032									
2 Coal	13.3553	0.2049	0.0901					0.68	0.58	0.91
	(137.8)	(15.4)	(6.7)							
4 Mineral Oil Processing	88.4151									
5 Electricity	56.2998									
6 Natural Gas Supply	45.8805	0.4440	0.5374	-0.3703	-0.2630			0.02	0.16	7.62
	(490.4)	(7.2)	(5.8)	(3.1)	(3.2)					
7 Water	56.8711									
8 Metal Ores	48.5664	0.0251	0.1687	-0.3656	-0.1403	-0.0634	-0.1446	0.15	0.02	6.21
	(937.3)	(0.1)	(3.6)	(14.1)	(1.2)	(4.0)	(26.2)			
9 Non-metallic Ores	60.1811									
10 Iron & Steel	32.3982									
11 Other Metals	17.2623	0.4406	1.5004			0.6489	-0.4868	0.34	0.31	39.81
	(78.6)	(3.5)	(34.1)			(17.9)	(10.9)			
12 Mineral Products	40.5032	0.2814	0.6558	-0.6955	-0.6737	-0.4739	-0.2843	0.02	0.52	15.52
	(196.7)	(1.8)	(11.0)	(6.6)	(6.6)	(31.7)	(8.5)			
13 Basic Chemicals	40.6787	0.3795	0.4173					0.30	0.57	10.41
	(715.5)	(18.8)	(23.8)							
14 Pharmaceuticals	57.8034	0.5376	-0.9279			-0.8797	-0.8108	0.48	0.55	9.64
	(303.7)	(7.5)	(26.7)			(33.7)	(36.5)			
15 Soap & Toiletries	63.7962	-0.0313	0.3519			-0.7640	-0.6345	0.33	0.58	11.46
	(228.8)	(0.1)	(6.6)			(26.4)	(19.4)			
16 Man-Made Fibers	35.9807	0.4770	0.9849	-1.0742	-2.2543	-1.6744	-0.5541	0.68	-0.04	60.05
	(102.6)	(4.0)	(15.3)	(6.7)	(34.6)	(42.8)	(5.3)			
17 Metal Goods NES	22.0780	0.3279	0.4253	-0.2683	-0.3045	-0.2403	-0.0181	0.47	0.29	9.70
	(298.7)	(34.6)	(53.1)	(7.5)	(8.0)	(20.9)	(0.1)			
18 Industrial Plant	14.6335	0.2214	0.4025					0.19	-0.13	30.07
	(297.6)	(6.1)	(18.7)							
19 Agricultural Machinery	30.1641	1.0411	-0.2118	-0.8267	-1.0264	-0.5262	-0.6354	-0.01	0.37	78.80
	(60.5)	(33.4)	(1.9)	(13.8)	(14.1)	(8.2)	(11.5)			
20 Machine Tools	14.2103	0.1750	0.2037	-0.2182	0.6366	-0.0236	0.0031	0.06	0.62	26.63
	(188.6)	(3.0)	(9.9)	(1.0)	(6.3)	(0.2)	(0.0)			
21 Textile Machinery, Etc.	21.0608	0.5890	0.1016	-0.3061	-0.2053	-0.2581	-0.2460	0.43	0.77	16.87
	(188.9)	(49.9)	(2.8)	(3.0)	(1.5)	(13.1)	(8.5)			
22 Other Machinery	17.0655	0.1038	-0.1369	-0.4318	-0.0246			-0.26	0.75	14.26
	(282.1)	(0.6)	(2.5)	(3.4)	(0.0)					
23 Ordnance	16.3494	0.0545	-0.0249			-0.0954	-0.0390	-0.11	0.25	
	(82.8)	(0.6)	(0.1)			(5.5)	(0.8)			
24 Office Machinery	54.5921	0.0989	0.0638	-0.4309	-0.1150	-0.8198	-0.3113	0.09	0.69	8.58
	(379.5)	(2.4)	(0.6)	(9.0)	(0.7)	(18.2)	(3.2)			
25 Basic Electrical Equip.	16.5779	0.8851	-0.3970	-0.2797	0.3781			0.03	0.34	23.60
	(227.1)	(17.3)	(10.8)	(2.8)	(8.2)					
26 Electronic Equipment	19.3669	0.3090	0.5253	-0.0943	-0.0911	-0.0704	-0.0127	0.17	0.54	11.97
	(52.3)	(8.4)	(28.4)	(0.1)	(0.2)	(0.2)	(0.0)			
27 Domestic Electrical App	22.0865	0.1978	0.4220	-0.3513	-0.3615	-0.6949	-0.5259	0.71	0.03	28.04
	(91.3)	(1.2)	(16.3)	(5.6)	(7.8)	(18.2)	(31.1)			
28 Electric Lighting	21.6144	0.0226	0.2615	-0.1999	-0.0071	-0.0916	0.2620	0.44	0.21	8.39
	(263.4)	(0.2)	(21.7)	(9.1)	(0.0)	(5.6)	(20.9)			
29 Motor Vehicles	13.1014	0.7042	0.2703					0.22	0.65	64.30
	(96.0)	(19.3)	(3.1)							

(Continued)

Table IV.11.4: Change in profit share of value added: Equations in Model (Continued) (Mexvals in Parentheses)

Industry	Intercept	Output Current	Output Lagged	Real Wage Current	Real Wage Lagged	Imports' Share Current	Imports' Share Lagged	Adj.R^2	Rho	MAPE
30 Shipbuilding	-15.47									
31 Aerospace	-3.9273	2.0793	-0.2681	-1.3338	0.9231	-0.0867	-0.3560	0.28	0.35	186.15
	(3.5)	(56.8)	(0.8)	(13.5)	(6.6)	(0.9)	(17.8)			
32 Other Vehicles	-7.14									
33 Instrument Engineering	16.5822	0.4663	0.2208	-0.1871	-0.3500	-0.1125	-0.1061	0.41	0.61	22.16
	(219.5)	(26.7)	(6.6)	(2.0)	(7.2)	(6.2)	(6.0)			
34 Food	36.4687	0.1094	-0.1347	-0.3941	-0.5953	-0.0970	0.0317	-0.01	0.45	5.29
	(718.9)	(1.0)	(1.1)	(32.5)	(23.4)	(2.7)	(0.3)			
35 Drink	50.5900	0.1542	0.0292					-0.14	0.37	6.67
	(1042.9)	(2.4)	(0.2)							
36 Tobacco	66.0324	0.8743	-0.3181	-0.7016	-1.1615	0.0883	-0.0765	0.38	-0.05	5.63
	(365.7)	(36.3)	(8.1)	(8.7)	(14.1)	(6.7)	(4.4)			
37 Yarn	23.3760	0.7481	-0.3594	-0.8710	0.1129	-0.4718	-0.5250	0.62	0.49	11.14
	(259.8)	(46.9)	(13.0)	(26.1)	(1.8)	(59.9)	(28.2)			
38 Textiles	18.1584	0.8566	0.3730	-0.4123	-0.8834	-0.2184	0.3906	0.57	-0.39	9.17
	(445.7)	(58.9)	(37.9)	(18.1)	(61.2)	(27.1)	(34.0)			
39 Apparel	18.7958	0.1575	0.3507	-0.0997	-0.6260	-0.0020	0.1171	0.62	0.05	5.82
	(420.3)	(14.1)	(69.1)	(0.8)	(25.5)	(0.0)	(12.1)			
40 Leather & Footwear	18.5178	-0.2136	0.3776	0.1501	-0.2771	-0.0487	-0.1289	0.45	0.07	9.03
	(338.0)	(15.9)	(57.3)	(2.8)	(12.1)	(1.6)	(8.4)			
41 Timber & Wood	17.6760	0.3775	0.2150	0.1094	-0.8359			-0.19	0.46	16.95
	(363.3)	(10.6)	(3.3)	(0.2)	(15.9)					
42 Pulp & Paper	29.6764	0.6157	0.4157	-0.4731	-1.4069	-0.1584	0.0854	0.71	0.42	7.74
	(357.1)	(24.9)	(37.6)	(7.9)	(90.3)	(5.5)	(0.3)			
43 Printing & Publishing	19.3083	0.1014	0.2181					0.02	0.54	11.63
	(502.9)	(1.9)	(8.5)							
44 Rubber	22.6818	-0.3239	0.8660			-0.5371	-0.0066	0.60	0.02	14.79
	(267.8)	(4.9)	(57.5)			(40.8)	(0.0)			
45 Plastics	25.4127	0.1261	0.0532	-0.0999	-0.2866			-0.12	0.50	9.09
	(464.8)	(7.2)	(1.0)	(0.5)	(5.7)					
46 Other Manufacturing	19.0218	0.3424	0.0911			-0.0039	-0.0599	0.59	-0.12	46.86
	(432.3)	(62.2)	(6.3)			(0.0)	(3.4)			
47 Construction	41.6012	0.2322	0.2870					0.16	0.86	8.42
	(875.9)	(5.6)	(8.2)							
48 Distribution	29.9240	0.2513	0.4625					0.27	0.58	8.17
	(938.0)	(5.4)	(16.9)							
49 Transportation	26.6779	0.4002	0.1373	-0.0530	-0.0353	0.0492	-0.1807	-0.12	0.41	5.83
	(1153.7)	(7.5)	(1.3)	(0.3)	(0.2)	(0.6)	(3.5)			
50 Communications	40.1118	0.1024	0.1563	-0.3268	-0.6423	-0.0159	-0.2460	0.53	0.39	3.73
	(801.1)	(0.3)	(0.4)	(6.3)	(34.6)	(0.2)	(35.6)			
51 Banking & Finance	47.6743	1.0408	-0.2109	-0.8856	-0.5344	0.1093	0.1380	0.60	-0.17	1.87
	(677.4)	(23.3)	(2.4)	(73.5)	(27.3)	(42.1)	(24.3)			
53 Other Services	13.6699	-0.1068	0.1255	0.0903	-0.2354	0.0101	-0.0447	0.25	0.15	2.74
	(973.5)	(2.6)	(3.4)	(9.4)	(50.8)	(1.8)	(21.2)			

Section IV.12 Macroeconomic Equations

In its cycle of calculation, BRIM's macroeconomic accounting scheme follows that of the National Accounts. The real side of the model develops projections for detailed components of constant-price final demand, which are summed to arrive at the constant-price aggregates of gross domestic product shown in Section 1 of Table IV.12.1 below. After calculating commodity and industry gross outputs, the model also develops detailed projections of three components of value added, measured in current prices: Income from employment, Gross profits, etc., and Net taxes on expenditure (or expenditure taxes less subsidies). These value added components are then distributed to the four subsectors of the National Accounts, the Personal, Corporate, Government and External sectors — also shown in Table IV.12.1 — and the financial interactions between these subsectors are calculated. Personal disposable income in the Personal sector is used to determine Personal savings and aggregate Personal consumption expenditures. Disposable income minus savings is then used to calculate the detailed components of consumption demand on the real side of the model, closing the calculation loop and ensuring consistency among components of the economy.

Once the aggregate components of final demand and value added have been determined, the accounting portion of the model (aptly named the Accountant) begins by calculating the various components of value added that are lumped together under Gross Profits, etc. in the determination of industry and commodity value added. These components include Income from self-employment, various types of Rental income, Gross profits of the corporate sector and Gross trading surpluses of government enterprises.

Table IV.12.1: U.K. Sectoral Accounts

1. National Accounts (Expend.)	NA Code	BRIM Code	1984
Consumers' expenditure	AIIK	CPCE	195912
General government final consumpt.	AAXI	CGOV	69887
Central government	ACHC	CCGOV	43220
Local government	CSBA	CLGOV	26667
Gross domestic fixed capital formation	DFDC	CGDFCF	55108
Change in inventories	DHBF	CINV	116
Equals:			
Total domestic expenditure	CTGQ		321023
Plus:			
Exports	DJAD	CEXP	91967
Equals:			
Total final expenditure	DJAK		412990
Minus:			
Imports	DJAG	CIMP	92870
Equals:			
Gross domestic product (expend.) (at market prices)	DJAF	CGDP	320120

Table IV.12.1: U.K. Sectoral Accounts (Continued)

2. National Accounts (Income)	NA Code	BRIM Code	1984
Income from Employment	DJAO	CWAS	180053
Income from self-employment	CFAN	CISE	27716
Gross profits, etc.	GICA	CGPE	55006
Gross trading surplus	DJAQ	CGGTS	-71
Rent	CDDF	CRENT	19638
Capital consump., non-trading	DIDT	CCCN	2604
Equals:			
Total domestic income	DJAU	CTDI	284946
Minus:			
Stock appreciation	DJAT	CSTKAP	5260
Equals:			
Gross domestic product (income)	DJAL	CGDPI	279686
Plus:			
Residual error	DJAS	CRESID	-4549
Equals:			
Gross domestic product (expend.) (at factor cost)	DJAE	CGDPE	275137

3. Personal Sector

Income from Employment	DJAO	CWAS	180053
Income from self-employment	CFAN	CISE	27716
Imputed rent	CDDF	CPIMR	11759
Other rent	GICR-CDDF	CPOTR	2416
Interest and dividends	GIXA	CPIDR	27049
Credit for corporate tax	DBAI	CCCT	2058
Social security benefits	AUAA	CSSB	34515
Other government grants	GTAB	COGG	8466
Other current transfers	CFBR	COCT	1720
Capital consumption by NPMB's	CFBM	CCCCN	432
Minus:			
Interest payments	CAMZ	CPIDP	16908
Equals:			
Total personal income	AIIA	CPTPI	279276
Minus:			
Personal income taxes	AIIG	CPITX	34681
Social security contributions	AIIH	CSSC	22301
Other current transfers*	AIJC	COCP	1583
Equals:			
Personal disposable income	AIIJ	CPDI	220711
Of which:			
Personal consumption expenditures	AIIK	CPCE	195912
Saving	AAAU	CSAV	24799

Table IV.12.1: U.K. Sectoral Accounts (Continued)

4. Corporate Sector	NA Code	BRIM Code	1984
Gross profits, etc.	GICA	CGPE	55006
Interest and dividends	CIHM+GISJ	CCIDR	22201
Rent	GICB-CIHM-GISJ	CCRENT	2557
Income from abroad	GICD	CCIA	14109
Minus:			
Interest and dividends	GICF	CCIDP	25330
Transfers to charities	CIBA	CCTC	102
Profits due abroad	CIBU	CCPDA	6264
Corporate income taxes	GICI	CCITX	14172
Royalties etc. on oil and gas	GICJ	CCROG	2459
Equals:			
Undistributed profits	GICK	CCUPRF	45546
5. Government Sector			
Personal income taxes	AIIG	CPITX	34681
Corporate income taxes	GICI	CCITX	14172
Minus:			
Credit for corporate tax	DBAI	CCCT	2058
Plus:			
Taxes on expenditures	AAXC	CEXPT	52538
Minus:			
Subsidies	AAXJ	CSUB	7555
Plus:			
Social security contributions	AIIH	CSSC	22301
Gross trading surplus	DJAQ	CGGTS	-71
Rent	GTBG+CTMU	CGRNT	2906
Royalties etc. on oil and gas	GICJ	CCROG	2459
Interest and dividends	ATAC	CGIDR	5117
Misc. current transfers (personal)	ACGX	CGMT	226
Capital consump., non-trading cap.	AAXG	CGCCN	2172
Minus:			
Final consumption	AAXI	CGOV	69887
Social security benefits	AUAA	CSSB	34515
Other government grants to pers.	GTAB	COGG	8466
Net external transfers	HDKD-CGGJ	CNGXT	2100
Debt interest	AAXL	CGIDT	15758
Equals:			
Current surplus	AAXM	CGSURP	-3838

* - Includes newly instituted Community Charge (ADBH) after 1989.

Table IV.12.1: U.K. Sectoral Accounts (Continued)

6. External Sector	NA Code	BRIM Code	1984
Exports	CGJP+CGJZ	CEXP	91967
Property income net of taxes	CGJS	CXPINT	51451
Transfers to persons	CGJV	CXTTP	1618
Transfers to government	HDKD	CXTTG	2392
Minus:			
Imports	CGGL+CGGZ	CIMP	92870
Property income net of taxes	CGGK	CMPINT	47235
Transfers from persons	CGGV	CMTFP	1357
Transfers from government	CGGJ	CMTFG	4492
Equals:			
Net investment abroad	AABI	CNVA	1474

Savings. The first macroeconomic variable determined in the model is the savings rate, which is used to determine the shares of savings and aggregate consumption out of disposable income. The savings equation adopted here determines the savings rate as a percentage of personal disposable income, and relates the rate to its lagged value, logged changes in real personal disposable income, the inflation rate, the real interest rate, and the share in personal consumption of automobile purchases.

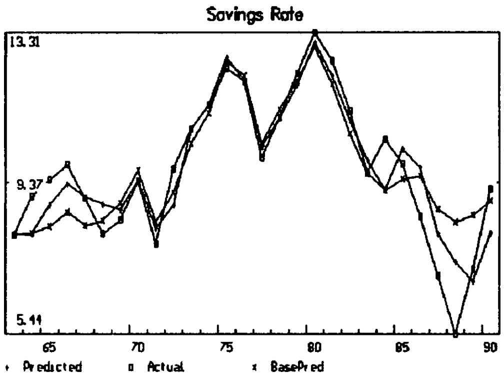
$$\frac{S_t}{Y_t} = a_0 + a_1\left(\frac{S_{t-1}}{Y_{t-1}}\right) + a_2\Delta\ln\left(\frac{Y_t}{CPI_t}\right) + a_3\Delta\ln\left(\frac{GDP_t}{GDP\$_t}\right) + a_4 RTB\$ + a5\left(\frac{AUTO_t}{Y_t}\right)$$

It is similar to (though simpler than) the form adopted by Almon (1989) except that like the CMDM savings equations, it includes a lagged value of the dependent variable. As a general rule, use of a lagged value of the dependent variable is inadvisable in equations used in simultaneous equation models.[80] In the case of a savings equation, however, I believe that the use of a lagged dependent variable can be justified on both theoretical and empirical grounds. Assuming a life-cycle model of savings, the lagged savings rate reflects all information about income trends and other relevant variables known to consumers in the previous period. This information is modified by developments in the current period, and the value of past information "decays", having increasingly less influence over time (so that the parameter for the lagged dependent variable should be less than unity). In addition, a regression incorporating this lagged dependent variable produces a very accurate backcast when the *predicted* values of the lagged dependent variable are used to determine the predicted savings rate (see the graph below). That is, the equation performs well over the period of estimation when it uses the actual values of the other parameters only, and uses the *predicted* savings rate as the independent variable for the lagged savings rate. I take this good performance to

[80] For a description of the problems associated with use of lagged values of the dependent variable in equations that are intended to capture structural relationships, see Almon (1989), pp.118-124.

indicate that the equation is in fact a useful measure of the structural influences on savings.

The other variables represent fairly straightforward influences on current saving. An increase in income yields a more than proportionate increase in savings, so that the savings rate increases (decreases) when real income rises (falls). The equation below indicates that even with economic activity otherwise constant, a one percent increase in income yields a nearly 0.1% increase in the savings rate. This tends to have a stabilizing effect in a structural model by dampening economic booms. Similarly, higher inflation raises the savings rate, tending to stabilize the model during period of high demand. The equation suggests that a three-point increase in the inflation rate raises savings by one percentage point. An increase in the real rate of interest on short-term Treasury bonds, a proxy for real interest rates in general, also has a small but significant positive influence on savings, with a one-point increase in real interest rates raising savings by about a quarter of a percentage point. Finally, an increase in the share of income spent on automobiles — the purchase of which may more appropriately be thought of as investment rather than current consumption — has a strong negative effect on savings. (The parameter has been constrained to near -1.0 because it took an implausibly high value of nearly -1.5 in an unconstrained equation.) The equation has a very good fit; the Durbin H statistic (the appropriate statistic for testing autocorrelation in the presence of lagged dependent variables) takes a significant value; the parameters seem reasonable; and finally, as discussed above, the equation performs well over the period of estimation when it uses the *predicted* savings rate in the previous period as the independent variable for the lagged savings rate.



Personal Savings Rate, 1963-1990

SEE =	0.69	RSQ =	0.8609	RHO =	0.33	Obser =	28 from 1963.000
SEE+1 =	0.66	RBSQ =	0.8293	DurH =	2.18	DoFree =	22 to 1990.000
MAPE =	5.98						

Variable name	Reg-Coef	Mexval	t-value	Elas	NorRes	Mean
0 savrat						9.73
1 intercept	4.47431	29.3	3.868	0.46	9.19	1.00
2 savrat[1]	0.58803	50.3	5.296	0.59	4.74	9.69
3 dpcdi$	0.31058	33.2	4.153	0.08	4.46	2.48
4 dgdpd	0.32307	53.1	5.468	0.28	3.91	8.51
5 rtb$	0.24230	30.2	3.930	0.02	3.88	0.66
6 auto	-1.07348	97.0	-8.006	-0.42	1.00	3.84

Income from self-employment — a hodgepodge category composed of types of income as different as law partners' profits to shoeshine boys' earnings — turns out to be a very important component of the model for several reasons. First, although it is calculated as a portion of Gross profits, as distinct from Income from employment, it is in fact a type of wage income, and unlike most income in Gross Profits it goes directly into Personal income along with Income from employment. Unfortunately, it is not available separately for most industries, and must be calculated as an aggregate. Second, the share of income from self-employment in total wage income has expanded considerably over the past fifteen years as large numbers of workers were pushed out of manufacturing and found their way into (often low-paying) service sector jobs, with significant effects on its composition. It is very important to capture this transition in the model, and to do so in a way that relates the trend to real changes in the economy.

I have chosen to model income from self-employment as a function of the number of self-employed workers and their average real wage, which I take as a function of the real wage of employees in employment, the share of the self-employed in total employment, and the unemployment rate. The equation captures several crucial aspects of self-employment: on average, wages are higher than for employees in employment, but they tend to fall if unemployment rises or if self-employment becomes more widespread (and fewer workers are taken on by employers). If the equation is estimated only over the period during which most of the transition occurred (the seventies and early eighties), the estimation yields parameters that perform very poorly out of sample. The estimation also yields a parameter on the employee real wage that is too high, and produces poor results in simulation — growing real wages in manufacturing lead to rising self-employment income that quickly swamps Gross profits; as a result, personal income grows too quickly, producing a consumption boom that blows up the model. However, if the equation is estimated over a longer time period, the parameters become more reasonable, and the equation produces good results out of sample (as shown below) and yields realistic results in simulation in the model. Including a dummy variable for the years 1973 and 1974, during which British inflation jumped to unprecedented levels, greatly improves the fit and simulation properties of the equation.

Real Wage, Income from Self-Employment, 1970-86

```
SEE    =        0.58 RSQ   = 0.6958 RHO =   0.16 Obser  =   17 from 1970.000
SEE+1  =        0.58 RBSQ  = 0.6256 DW  =   1.68 DoFree =   13 to   1986.000
MAPE   =        3.60
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 rwse                   - - - - - - - - - - - - - - - - - - - - -      12.00
1 intercept                1.44795     0.5   0.350   0.12   0.000        1.00
2 rw                       2.08098    56.4   4.336   1.36   1.231        7.85
3 semprat                 -0.42756     6.0  -1.266  -0.28  -0.284        8.00
4 unrat                   -0.37933    47.9  -3.929  -0.20  -1.294        6.22
```

Real Wage, Income from Self-Employment, 1963-89

```
SEE    =        0.49 RSQ   = 0.7792 RHO =   0.19 Obser  =   27 from 1963.000
SEE+1  =        0.48 RBSQ  = 0.7504 DW  =   1.62 DoFree =   23 to   1989.000
MAPE   =        2.84
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 rwse                   - - - - - - - - - - - - - - - - - - - - -      11.71
1 intercept                5.63703    61.6   6.086   0.48   0.000        1.00
2 rw                       1.69194   107.0   8.691   1.08   1.971        7.50
3 semprat                 -0.63073    31.9  -4.128  -0.43  -0.745        8.01
4 unrat                   -0.29870    64.9  -6.286  -0.13  -1.053        5.27
```

Real Wage, Income from Self-Employment, 1963-84

```
SEE    =        0.53 RSQ   = 0.7732 RHO =   0.18 Obser  =   22 from 1963.000
SEE+1  =        0.52 RBSQ  = 0.7354 DW  =   1.64 DoFree =   18 to   1984.000
MAPE   =        3.16 Test period:  SEE      0.32 MAPE      2.13 end  1989.000
  Variable name            Reg-Coef  Mexval t-value  Elas    Beta        Mean
0 rwse                   - - - - - - - - - - - - - - - - - - - - -      11.67
1 intercept                5.04438    14.8   2.389   0.43   0.000        1.00
2 rw                       1.70056   106.1   7.645   1.04   1.534        7.12
3 semprat                 -0.54742     7.5  -1.672  -0.35  -0.302        7.51
4 unrat                   -0.32232    51.0  -4.799  -0.12  -0.933        4.29
```

Rental income. In addition to Income from self-employment, the model must determine rental income from both dwellings and other structures. These rents are calculated primarily as real rates of return on the existing real stocks of residential and non-residential structures, respectively (government rental income is projected as declining by 3% annually as the government sells off council housing). As shown in the next two regression results, the equations yield good fits, albeit over rather short estimation periods. The low return on the non-residential building stock is probably due to the fact that the rents in question include land rents, while the "land stock" is unavailable and therefore not included in the independent variable. Since the returns in question are a relatively small component of value added, however, the omission is probably not important for our general purposes. Improvements in modeling returns to land and structures await further work.

Real Rental Income from Dwellings, 1970-86

```
SEE    =      706.42 RSQ    = 0.9178 RHO =    0.48 Obser  =    21 from 1970.000
SEE+1  =      662.49 RBSQ   = 0.9135 DW  =    1.04 DoFree =    19 to   1990.000
MAPE   =        3.19
  Variable name              Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 rodrent                  - - - - - - - - - - - - - - - - - - - - -  16039.55
1 intercept               -1458.08956     3.7  -1.203  -0.09   12.16       1.00
2 nsd52$                      0.05636   248.7  14.563   1.09    1.00 310439.93
```

Other Real Rental Income, 1970-86

```
SEE    =      418.24 RSQ    = 0.8366 RHO =    0.88 Obser  =    21 from 1970.000
SEE+1  =      232.53 RBSQ   = 0.8280 DW  =    0.24 DoFree =    19 to   1990.000
MAPE   =       13.17
  Variable name              Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 rotrent                  - - - - - - - - - - - - - - - - - - - - -   3105.82
1 intercept              -3203.84404    51.3  -4.952  -1.03    6.12       1.00
2 nsb$                       0.02097   147.4   9.861   2.03    1.00 300827.84
```

Personal sector rental income. The two components of personal sector rent, Imputed rent from owner-occupied housing and Other personal sector rent, are each partly composed of the rental income from dwellings determined above less the rent from government housing. These latter two are distributed between the former according to the results of a pair of simultaneously estimated regressions shown below. The first two regressions are independent; comparison of these with the second, simultaneously estimated pair of regressions shows that simultaneous estimation does not radically alter either the parameters or the fits.

Imputed Real Rental Income From Owner-Occupied Housing, and
Other Real Personal Rental Income, 1970-86 (Independent Estimations)

```
SEE    =      229.74 RSQ    = 0.9836 RHO =    0.85 Obser  =    17 from 1970.000
SEE+1  =      151.96 RBSQ   = 0.9825 DW  =    0.31 DoFree =    15 to   1986.000
MAPE   =        2.25
  Variable name              Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rpimr                    - - - - - - - - - - - - - - - - - - - - -   9742.15
1 rodrent                     0.89837   984.6  41.829   1.40   0.876  15140.74
2 rgrnt                      -1.06372   221.8 -11.848  -0.39  -0.302   3610.09

SEE    =      140.86 RSQ    = 0.6338 RHO =    0.84 Obser  =    17 from 1970.000
SEE+1  =      103.85 RBSQ   = 0.6094 DW  =    0.31 DoFree =    15 to   1986.000
MAPE   =        5.25
  Variable name              Reg-Coef  Mexval t-value  Elas    Beta       Mean
0 rpotr                    - - - - - - - - - - - - - - - - - - - - -   2120.03
1 rodrent                     0.16137   231.8  12.254   1.15   1.213  15140.74
2 rgrnt                      -0.09269     9.0  -1.684  -0.16  -0.203   3610.09
```

Imputed Real Rental Income From Owner-Occupied Housing, and
Other Real Personal Rental Income, 1970-90 (Independent Estimations)

```
SEE    =      212.04 RSQ   = 0.9934 RHO =    0.83 Obser  =    21 from 1970.000
SEE+1  =      144.07 RBSQ  = 0.9931 DW  =    0.33 DoFree =    19 to   1990.000
MAPE   =        1.92
  Variable name            Reg-Coef  Mexval t-value  Elas    NorRes      Mean
0 rpimr                   - - - - - - - - - - - - - - - - - - - - -  10711.15
1 rodrent                   0.88913  1761.7  81.032   1.33    22.34  16039.55
2 rgrnt                    -1.02778   372.7 -20.136  -0.33     1.00   3439.28

SEE    =      193.14 RSQ   = 0.8972 RHO =    0.78 Obser  =    21 from 1970.000
SEE+1  =      144.85 RBSQ  = 0.8918 DW  =    0.43 DoFree =    19 to   1990.000
MAPE   =        6.86
  Variable name            Reg-Coef  Mexval t-value  Elas    NorRes      Mean
0 rpotr                   - - - - - - - - - - - - - - - - - - - - -   2385.94
1 rodrent                   0.20631   384.0  20.642   1.39     2.78  16039.55
2 rgrnt                    -0.27069    66.9  -5.822  -0.39     1.00   3439.28
```

Imputed Real Rental Income From Owner-Occupied Housing, and Other Real Personal Rental Income, 1970-86 (Simultaneous Estimation)

```
SEE    =      350.18 RSQ   = 0.9619 RHO =    0.94 Obser  =    34 from 1970.000
SEE+1  =      138.61 RBSQ  = 0.9594 DW  =    0.12 DoFree =    30 to   1986.000
MAPE   =        3.50 SEESUR =       1.38
  Variable name            Reg-Coef  Mexval t-value  Elas     Beta       Mean
0 rpimr                   - - - - - - - - - - - - - - - - - - - - -   9742.15
1 rodrent                   0.85500   910.1   0.308   1.33    0.833  15140.74
2 rgrnt                    -0.95003   185.3  -0.082  -0.35   -0.270   3610.09

SEE    =      172.38 RSQ   = 0.4516 RHO =    0.89 Obser  =    34 from 1970.000
SEE+1  =      114.99 RBSQ  = 0.4150 DW  =    0.22 DoFree =    30 to   1986.000
MAPE   =        6.40 SEESUR =       1.38
  Variable name            Reg-Coef  Mexval t-value  Elas     Beta       Mean
3 rpotr                   - - - - - - - - - - - - - - - - - - - - -   2120.03
1 rodrent                   0.14507    97.7   0.106   1.04    1.091  15140.74
2 rgrnt                    -0.04995     1.0  -0.009  -0.09   -0.109   3610.09
```

Imputed Real Rental Income From Owner-Occupied Housing, and Other Real Personal Rental Income, 1970-90 (Simultaneous Estimation)

```
SEE    =      397.49 RSQ   = 0.9768 RHO =    0.96 Obser  =   42 from 1970.000
SEE+1  =      139.11 RBSQ  = 0.9756 DW  =    0.08 DoFree =   38 to   1990.000
MAPE   =        3.53 SEESUR =         1.82
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes     Mean
0 rpimr                   - - - - - - - - - - - - - - - - - - - - -  10711.15
1 rodrent                   0.83703   915.4   0.403   1.25 4126.92  16039.55
2 rgrnt                    -0.86465   145.7  -0.090  -0.28    1.00   3439.28

SEE    =      339.31 RSQ   = 0.6827 RHO =    0.93 Obser  =   42 from 1970.000
SEE+1  =      163.98 RBSQ  = 0.6660 DW  =    0.14 DoFree =   38 to   1990.000
MAPE   =        9.29 SEESUR =         1.82
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes     Mean
3 rpotr                   - - - - - - - - - - - - - - - - - - - - -   2385.94
1 rodrent                   0.16308   120.8   0.092   1.10    1.12  16039.55
2 rgrnt                    -0.13534     6.0  -0.016  -0.20    1.00   3439.28
```

Minor transfers. The next set of variables are relatively minor transfers between the Personal, Government and External subsectors of the economy. I have at present no grounds for predicting any of these transfers from economic principles; so I have estimated them as time trends. Given their relatively small size and the goodness of fits on trends, I suspect that this approach is acceptable for our purposes, though improvement would be desirable.

Social Security tax payments. Contributions to social security as a share of wage income have grown steadily over the past thirty years at about 0.17 percentage points annually, as shown in the regression below. One might think it appropriate to forecast such a trend to continue through the end of the century, since it will take half a millennium at this rate before contributions take all of wages; nevertheless a constant share turned out to be more stable in simulation.

Social Security Contributions as a Share of Wage Income, 1963-90

```
SEE    =        0.54 RSQ   = 0.8595 RHO =    0.74 Obser  =   28 from 1963.000
SEE+1  =        0.39 RBSQ  = 0.8541 DW  =    0.52 DoFree =   26 to   1990.000
MAPE   =        4.29
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes     Mean
0 pctssc                  - - - - - - - - - - - - - - - - - - - - -      8.72
1 intercept                -3.94629    26.0  -3.907  -0.45    7.12      1.00
2 time                      0.16562   166.8  12.614   1.45    1.00     76.50
```

Social Security tax benefits. Like contributions to Social Security, real per capita benefits from both Social Security and other government transfer programs have grown remarkably steadily over the past twenty-five years, even during the Thatcher era. The regressions shown below imply that Social Security benefits and other government benefits have grown by about £16 per year per capita and £4 per year per capita, respectively. Social Security benefits rise further during recessions as more unemployed workers receive benefits. Furthermore, certain types of benefits were transferred from the Social Security to other accounts in 1983, so the shift must be accounted for by a dummy variable for the years up to (or after) 1983. When projected out over the next twenty years or so, the resulting trends seem quite plausible.

Real Social Security Benefits Per Capita, 1970-90

```
SEE    =         0.01 RSQ   = 0.9957 RHO =   0.21 Obser  =   21 from 1970.000
SEE+1  =         0.01 RBSQ  = 0.9950 DW  =   1.58 DoFree =   17 to   1990.000
MAPE   =         1.42
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes       Mean
0 rpcssb                  - - - - - - - - - - - - - - - - - - - - -       0.50
1 intercept                 -0.87123   312.4 -16.495  -1.73  233.07       1.00
2 time                       0.01580   505.3  24.615   2.51   16.25      80.00
3 unrat                      0.01383   301.3  16.024   0.18    2.26       6.48
4 dummy83                    0.03443    50.2   4.620   0.04    1.00       0.62
```

Other Real Government Benefits Per Capita, 1963-90

```
SEE    =         0.00 RSQ   = 0.9919 RHO =   0.45 Obser  =   28 from 1963.000
SEE+1  =         0.00 RBSQ  = 0.9909 DW  =   1.11 DoFree =   24 to   1990.000
MAPE   =         4.43
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes       Mean
0 rpcogg                  - - - - - - - - - - - - - - - - - - - - -       0.09
1 intercept                 -0.19026   158.3 -11.665  -2.07  124.04       1.00
2 time                       0.00397   294.0  18.670   3.30    6.39      76.50
3 unrat                      0.00051     2.8   1.167   0.03    5.72       5.28
4 dummy83                   -0.03350   139.2 -10.646  -0.26    1.00       0.71
```

External transfers to and from the Personal and Government sectors are both difficult to model and relatively insignificant in size. I attempted to model them as log time trends (see below), but this approach has no economic justification and furthermore produced parameters that were sensitive to the period of estimation. I finally modeled these flows as constant shares of nominal GDP. To be accurately represented, they should be derived as payments from nominal asset stocks.

External Transfers to Persons, 1970-90

```
SEE    =       113.39 RSQ   = 0.6469 RHO =   0.66 Obser  =   21 from 1970.000
SEE+1  =        87.77 RBSQ  = 0.6283 DW  =   0.67 DoFree =   19 to   1990.000
MAPE   =         6.53
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes       Mean
0 rxttp                   - - - - - - - - - - - - - - - - - - - - -    1305.89
1 intercept              -7538.49085    52.7  -5.028  -5.77    2.83       1.00
2 ltime                   2019.65940    68.3   5.900   6.77    1.00       4.38
```

External Transfers to Governments, 1970-90

```
SEE    =       453.44 RSQ   = 0.5231 RHO =   0.73 Obser  =   17 from 1974.000
SEE+1  =       319.71 RBSQ  = 0.4913 DW  =   0.53 DoFree =   15 to   1990.000
MAPE   =        30.52
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes       Mean
0 rxttg                   - - - - - - - - - - - - - - - - - - - - -    1480.33
1 intercept             -33447.88177    41.6  -3.884 -22.59    2.10       1.00
2 ltime                   7929.34814    44.8   4.056  23.59    1.00       4.40
```

External Transfers from Persons, 1960-90

```
SEE    =       141.08 RSQ   = 0.8055 RHO =   0.69 Obser  =   31 from 1960.000
SEE+1  =       104.37 RBSQ  = 0.7988 DW  =   0.63 DoFree =   29 to   1990.000
MAPE   =         9.99
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes       Mean
0 rmtfp                   - - - - - - - - - - - - - - - - - - - - -    1235.71
1 intercept              -9037.06914   105.0  -9.637  -7.31    5.14       1.00
2 ltime                   2383.31861   126.7  10.959   8.31    1.00       4.31
```

External Transfers from Governments, 1977-90

```
SEE    =      334.74 RSQ    = 0.7245 RHO =   -0.10 Obser  =    14 from 1977.000
SEE+1  =      327.62 RBSQ   = 0.7015 DW  =    2.21 DoFree =    12 to   1990.000
MAPE   =        6.93
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 rmtfg                   - - - - - - - - - - - - - - - - - - - - -   4243.35
1 intercept             -45413.58813    78.9  -5.137 -10.70    3.63      1.00
2 ltime                  11225.25909    90.5   5.617  11.70    1.00      4.42
```

Non-trading capital consumption. Another set of minor activities that appear in the Accounts but that are not easily related to other available economic data in the model are consumption of non-trading capital in the Personal and Government sectors. I have chosen to leave Personal sector capital consumption constant in real terms and to relate the Government sector consumption to a time trend that has it growing by less than one percent annually; this is a fair approximation of the trend over the past two decades, as shown below.

Government Non-trading Capital Consumption, 1974-86

```
SEE    =       87.09 RSQ    = 0.7942 RHO =    0.77 Obser  =    17 from 1974.000
SEE+1  =       56.49 RBSQ   = 0.7805 DW  =    0.46 DoFree =    15 to   1990.000
MAPE   =        3.16
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 rgccn                   - - - - - - - - - - - - - - - - - - - - -   2268.30
1 intercept               -595.26375     8.0  -1.579  -0.26    4.86      1.00
2 time                      34.92154   120.4   7.608   1.26    1.00     82.00
```

Stock appreciation — the increase in value of companies' inventories of materials, intermediate inputs and finished goods — must be subtracted from domestic income to derive current price gross domestic product. I have modeled stock appreciation as a percentage increase in the current price value of stocks, and related it to the current rate of inflation. The fit is not terribly good, particularly in terms of mean error, as could be expected from an inventory variable. In fact, stock appreciation nearly perfectly anticipates (on a smaller scale) next year's inflation rather than following this year's. Nevertheless, as a first approximation this equation does reasonably well in simulation.

Stock Appreciation (Percentage Change), 1965-90

```
SEE    =        1.06 RSQ    = 0.6600 RHO =   -0.03 Obser  =    36 from 1955.000
SEE+1  =        1.06 RBSQ   = 0.6600 DW  =    2.05 DoFree =    35 to   1990.000
MAPE   =      157.24
  Variable name             Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 pctstka                 - - - - - - - - - - - - - - - - - - - - -      2.07
1 infl                       0.27636   159.5  14.165   0.99    1.00      7.42
```

Intersectoral payments. Each subsector in the economy makes and receives payments with each of the others, a sector's payments being related to interest rates and the stocks of debt it owes to each of the others. A fully prescribed model would incorporate such stocks and rates and solve for such transactions on their basis. Unfortunately, I do not currently have sufficient financial detail to relate these transactions to debt stocks. Instead, I have chosen to relate these interest and dividend payments to the income levels of the paying sector. This raises an additional simultaneity problem in the model, since in most cases the income (and therefore payments) of a given sector are thus dependent on the income it receives from the sectors to which it is making payments. This is clearly an unsatisfactory state of affairs, but the only useful way to improve it is to relate these flows to sectoral asset stocks. This would require a significant effort to develop the relevant asset accounts from National Accounts data, an effort that will be undertaken in the future.

For a first approximation, I have kept personal interest payments a constant share of wage and salary income, government debt interest payments a constant portion of gross domestic product, total payments by foreigners and corporate income from abroad constant in real terms, and sectoral shares of interest and dividend receipts constant at 1984 levels. This leaves corporate interest and dividend payments and corporate payments abroad to be calculated in the model.

Theory and common sense suggest that interest and dividends should be related to after-tax economic profits. However, the model currently solves for total profits and taxes after solving for corporate interest and dividend payments. To deal with the simultaneity problem, therefore, I use constant-price Gross profits of enterprises as a proxy for after-tax profits (the two series have had a very nearly linear relation for thirty years). Again, this is a temporary solution to the broader problem of relating intersectoral transactions to stocks of accumulated debt.

More specifically, I relate the share of interest and dividend payments in gross profits — which has ranged from 35% to 60% over the past twenty-five years — to gross profits' share in gross domestic product — which has ranged from 13% to 17% over the same period. The regression is not extremely successful, but manages to capture the broad movements of the interest and dividend share over the estimation period. The equation suggests that a percentage point decrease in gross profits' share of output leads to a ten percentage point decline in the interest and dividend share of profits. While the regression does not provide a very good fit, the predicted levels of interest and dividend payments that result from using the resulting predicted shares track the actual levels rather well.

This approach allows Corporate interest and dividend payments to play a significant role in stabilizing the model by forming a moderating buffer between output and income. During periods of rising output, profits tend to rise; but interest and dividend payments tend to rise less quickly and to decline as a share of profits. This moderated response of interest and dividend payments to profits feeds into personal income, limiting the growth of consumption during booms and, conversely, limiting the decline in income during recessions.

Share of Interest and Dividend Payments in Gross Profits of Enterprises, 1960-90

```
SEE    =       0.10 RSQ   = 0.5568 RHO =   0.58 Obser  =   31 from 1960.000
SEE+1  =       0.09 RBSQ  = 0.5415 DW  =   0.83 DoFree =   29 to   1990.000
MAPE   =      12.92
  Variable name            Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 pctcidp                 - - - - - - - - - - - - - - - - - - - - -     0.54
1 intercept                 2.07796    81.3   8.145   3.83    2.26      1.00
2 pctgpe                  -10.48110    50.2  -6.036  -2.83    1.00      0.15
```

As a simple first-step approach to modeling them, real Corporate profits due abroad are related linearly related to Gross profits.

Corporate Profits Due Abroad, 1965-90

```
SEE    =     961.56 RSQ   = 0.7772 RHO =   0.66 Obser  =   26 from 1965.000
SEE+1  =     728.39 RBSQ  = 0.7679 DW  =   0.69 DoFree =   24 to   1990.000
MAPE   =      20.73
  Variable name            Reg-Coef  Mexval t-value  Elas   NorRes      Mean
0 rcpda                   - - - - - - - - - - - - - - - - - - - - -  3923.37
1 intercept             -6655.59353    53.0  -5.675  -1.70    4.49      1.00
2 rgpe                      0.23016   111.9   9.150   2.70    1.00  45963.97
```

With the variables above determined, the model can calculate the National Accounts and sectoral accounts aggregates that comprise the standard tables shown in Chapters 1 and 3 of the United Kingdom National Accounts, as well as some of the auxiliary tables necessary to show such aggregates as employment, productivity and inflation. These tables will be shown in the following chapter, where various model simulations will be discussed.

To understand the workings of the model as shown in the next chapter, it is important to note the important economic influences that are *not* included in the model at this time. Although the model incorporates a monetary aggregate that influences prices through wage inflation, there are no interest rate effects. Although the model calculates real and nominal capital stocks as well as real and nominal depreciation levels, there are no sectoral financial asset accounts, and thus no wealth effects. Similarly, there are no exchange rate changes or international capital flows; rather, trade flows are determined by relative domestic and foreign prices whose numeraires are 1984 prices for each commodity. The absence of these financial stocks and flows is an important weakness of the model in its current form and presents a challenge to be addressed in the future.

Exchange rate. As mentioned above, at present BRIM has no exchange rate dynamics: domestic inflation does not lead to a depreciation of the pound on international markets and thus to a decrease in British consumers' purchasing power in terms of foreign goods; rather, inflation affects international trade by raising the 1984-based price indices for British commodities above the (unchanged) price indices of imports, thus raising the relative price of British commodities on international markets, reducing foreign demand for British exports, making foreign commodities more attractive but lowering overall demand by reducing total domestic income in Britain.

Introducing exchange rate fluctuations into a macroeconometric model, however, is no trivial matter, even though macro modelers have adopted equations relatively straightforwardly based on theory. As Isard (1988) has succinctly stated: "a strong conceptual understanding of the exogenous sources of variability in the equilibrium long-run real exchange rate or the exchange risk premium does not yet exist."[81] Macro models using equations based on the most common models of exchange rate determination — assumptions of purchasing power parity (arbitrage pushes exchange rates to levels that equate the prices of internationally traded commodities), or of uncovered interest rate parity (arbitrage pushes exchange rates to levels that equate real interest rates across countries, given expectations of future exchange rate movements the prices of internationally traded commodities) — have in general failed to outperform a random walk in forecasting exchange rate developments. Isard maintains that realistic modeling of exchange rates requires a model that includes "a menu of internationally traded assets that distinguishes at a minimum between claims against the residents of different countries" and that supplements "the traditional emphasis on the financial characteristics of assets with an emphasis on the prospective real income streams associated with claims on physical capital in different countries."[82] Similarly, in discussing models of British exchange

[81] Isard in Bryant et al. (1988), p.188.

[82] Isard in Bryant et al. (1988), p.198.

rate trends Fisher et al.[83] suggest that a realistic exchange rate equation should be based on the uncovered interest parity assumption expressed in real terms, modified to reflect exchange risk premia. They present such an exchange rate equation that relate the level real exchange rates in log terms to the log of the expected future exchange rate, logged real interest rate differentials, and the log of the current account balance as a share of GDP (as a proxy for risk):

$$\rho_t = \hat{\rho}_{t+1} + (i_t - i_t^*) + \alpha\ (CB/GDP)_t$$

(In the presence of balanced trade, zero inflation and equalized real interest rates, of course, this equation simply reflects the purchasing power parity assumption.) However, continued current account surpluses or deficits, differences in real interest rates between countries, or expectations of either of these or of changes in either country's price level will bring about an exchange rate movement.

Unfortunately, the development and implementation of such comprehensive models of exchange rate determination require not only the introduction of forward-looking expectations but also a representation of interest rate formation, which, in turn, would require modeling of asset stocks and portfolio choices. It is not currently feasible for me to develop such a model.

In contrast to the data-intensive adopted by Fisher et al., Almon's (1989) approach to modeling exchange rate fluctuations has proved simple but relatively effective for the U.S. economy over the period 1977-1992. Rather than dealing directly with the exchange rate and with the effect of expectations and capital flows on international demand for the dollar, Almon modeled changes in the ratio of the domestic price level to the price level of non-petroleum imports, using as independent variables lagged values of real long-term interest rates and lagged values of the trade balance, defined as the ratio of net exports to total trade (the sum of exports plus imports). More recently, he has used more complex forms of the equation, but terms of trade still depend primarily on real interest rates and the trade balance in the Almon model.

The builders of the Cambridge model have adopted an approach similar to Almon's for measuring the effective sterling exchange rate, though with several additional variables. Their equation relates the effective rate to the ratio of the balance of payments to nominal GDP, international differences between nominal short-term interest rates, changes in the real M3 money supply (M3 divided by the GDP deflator), and changes in the real value of British oil reserves.

For the purposes of long-term macroeconomic modeling, approaches such as Almon's and CMDM's have the virtues of at least making a nod toward the importance of capital flows in exchange rate determination, and also of preventing the model from drifting into permanent current account surplus or deficit. It would therefore be useful to include a simple UIP exchange rate mechanism into BRIM for the purpose of forecasting developments over the next decade. Nevertheless I have decided to leave this project to another date.

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[83] Fisher, Tanna, Turner, Wallis and Whitley (1990), p.1239.

CHAPTER V. SIMULATIONS WITH BRIM

Backcasting through 1990. A good test of the accuracy and utility of a simultaneous equations dynamic model such as BRIM is its ability to backcast — to simulate accurately a period of economic activity for which historical data is available. I have used the fairly detailed data available for the period 1986-1990 to test BRIM's ability to backcast British economic activity.

The following tables and graphs show historical data for the British economy and the corresponding results of backcasts using BRIM. Table V.1 shows the macroeconomic aggregates as given by the 1987 and 1991 editions of the *United Kingdom National Accounts* (for the years 1984-85 and 1986-90, respectively).[84] As Table V.1 shows, British real gross domestic product grew at annual rates of 4% to 5% from 1984 to 1988, after which growth slowed markedly, with the economy going into recession in 1991-92. The components of GDP all followed patterns similar to that of GDP, with two exceptions: exports, which stagnated in 1988, recovered in 1989-90, and then fell markedly in 1991; and investment continued to show stronger growth in 1989 and 1990 than might be expected so late in a business cycle. On the income side of the ledger, nominal Income from Employment grew between 8% and 12% throughout the period, while the growth of nominal Gross Profits, Etc. varied between 4% and 12%.

Table V.2 shows the very similar results that obtain when BRIM is run with constraints (or "fixes") on variables to take into account all the historical data currently available. Most of the differences are due to minor differences in price levels that result from the distribution of output between commodities, which is not constrained to actual values within the model because I do not have the historical output and price series through 1990. Chart V.1 shows the same data in graphic form, along with corresponding results for the backcasts discussed below.

Table V.3 shows the results of allowing the model to run with as many equations operating as feasible; that is, with as many variables as possible determined endogenously. This simulation and all of the other backcasts discussed below take as exogenous the following data through 1990:

- real government spending broken down into four components, and miscellaneous government transfers to the personal sector;
- tax rates for expenditure, indirect business, income and social security taxes;

[84] The available British data for prices and constant price quantities is based in years ending in 0 or 5. However, I have rebased all the available constant price data to 1984, the year for which I have a set of input-output tables. Where I do not have disaggregated data, such as for government spending and trade, I have rebased the aggregates to 1984. Thus the constant price data presented in these and the following graphs suffers from an index number problem. However, the error associated with this rebasing by one year is in general smaller than the regular revisions that have rendered obsolete some of the data used for the estimations.

- real crude oil output;
- real personal consumption expenditures by foreign tourists in the U.K.;
- real exports of crude oil and construction services;
- nominal price levels of crude and refined oil, natural gas, ores (all following world prices); and prices of owner-owned housing rents, used goods, and expenditure taxes (all following the GDP deflator determined from other prices);
- money supply growth (M5) and real interest rates; and
- nominal interest and dividend payments by the personal and corporate sectors, and property income paid by and to the external sector.

The results shown in Table V.3 and Chart V.1 bring to light at least three major problems that the full model displays over the simulation period. First and most importantly, export trends are simulated very poorly, a property I believe results from the fact that I am using an outdated INFORUM forecast of foreign demand for exports as the demand variables for the export equations. This property severely affects the quality of the entire simulation, especially in 1989.

With aggregate real exports exogenously fixed and distributed in proportion to the sectoral exports calculated by the export equations, the model does markedly better, as shown in Table V.4 and Chart V.1. With exports fixed, however, the two other important failings of the model become more apparent. The first is that the model fails to capture a major investment rally that began late in the business cycle at the end of 1988 and continued into 1990. Given that the investment equations seem to be relatively good predictors in the aggregate over the period of estimation of the equations, I suspect that the failure of the equations to capture this investment rally is attributable to one or both of two possible reasons. One possible explanation is that the accelerator effect varies with the direction of changes in output. Thus the equations underpredict the accelerator effect that obtained during the late 1980's simply because the equations were estimated mainly over a period of stagnant or declining output in many industries, while the late 1980's were a period of fairly buoyant demand compared with the 1970's and early 1980's. An alternative explanation is that the investment boom may have been larger than would be predicted by accelerator equations simply because it was generated by high expectations, perhaps in anticipation of the expansion of markets after the 1992 changes in the European Commission. If the latter explanation is the case, the failure of BRIM to capture this development provides ammunition to the argument than accurate forecasting requires a representation of expectations that is more comprehensive that the adaptive expectations captured in accelerator equations.

Whatever the explanation, the model generates a considerably better backcast over the period if investment levels for vehicles, equipment and structures are constrained to be 15% to 30% higher in 1988-90. Nevertheless, even with these export and investment fixes on the real side of the model, the model shows severe weaknesses in its ability to predict sectoral and aggregate levels of non-wage income encompassed in the Gross Profits, Etc. component of value added. As expected, the equations for this portion of value added perform extremely poorly in simulation. The model consistently underpredicts and misallocates Gross Profits throughout the backcast, with the most glaring errors showing up in the service sectors (for which I have more value added detail than for the manufacturing sectors). Furthermore, the errors vary from year to year in both magnitude and direction in most sectors, so that there is no obvious easy set of fixes to remedy the problem. I therefore chose to impose multiplicative fixes on profits in each sector that were equal to the average error for the sector over the entire backcast period. The significant sectoral profit fixes are a 45% increase in profits in the Construction industry, a 15% increase in the Distribution sector, a 25% increase in both Transport and Telecommunications, and a 25% decrease in Business Services profits (which alone accounted for 20% of all profits in 1990). These fixes amount to the simplest set of adjustments that make the model work reasonably well.

The results of imposing aggregate fixes on exports and 1988-90 investment and the more detailed fixes on sectoral gross profits are shown in Table V.5 and, again, Chart V.1. With these fixes in place, the model performs quite well on the real side. The growth of all major expenditure components of GDP are fairly well simulated, and the growth of sectoral output (not shown here) is fairly accurate in most sectors. Three other problems appear on the price or income side of the model, however. First, the model overpredicts inflation in both 1986 and 1987 because it overpredicts profits in 1986 (due to the broad fix on profits described above). Second, even though sectoral output and labor productivity trends (not shown) are generally captured well, they are sufficiently off in 1989 and 1990 that aggregate labor productivity diverges from historical values by 3.5% by 1990, with the result that predicted employment is somewhat lower than its historical values.

Third, the savings equation completely misses a nearly 50% decline in the savings rate between 1985 and 1988 and a rebound of similar magnitude between 1988 and 1990. Instead of capturing this erratic behavior, simulated savings trend gently down from about 10% to about 8% over the period, calling into question the accuracy of the equation. In spite of this problem, however, the model does a remarkably good job of simulating the economy during the backcast period.

Chart V.2 shows the detailed consumption results for the final backcast described above. The equations display a pattern of errors that is extremely similar to the errors found over the last years of the equation estimations shown in Chapter 3.2, which cover the years of the backcast. This similarity in errors is reassuring because it implies that the sectoral relative price trends simulated by the model in this backcast are relatively accurate. About half of the equations are very accurate, including (1) Food, (7) Rental Housing and Household Repairs, (14) Major Appliances, (19) Motor Vehicles, (22) Other Vehicle Running Costs, (31) Medical Goods and Services and (35) Catering. These seven groups account together for about 40% of total consumption. Meanwhile, particularly poor performances are turned in by the equations for (2) Alcohol, (6) Owner-occupied Housing, the Energy commodities (8 through 11) including (21) Petrol, (18) Domestic Services, (25) Other Durables, (27 and 28) Recreational Goods and Services, and (30) Education, accounting together for about 30% of total consumption.

Table V.1: U.K. National Accounts, 1984-1990

	1984	1985	1986	1987	1988	1989	1990
Constant 1984 Prices							
Consumers' expenditure	195.91	206.44	219.32	230.83	247.96	256.74	259.25
General government final consump.	69.89	69.77	71.00	71.88	72.31	72.97	75.04
Central government	43.22	43.27	44.03	44.10	44.27	44.67	45.66
Local government	26.67	26.50	26.97	27.79	28.03	28.30	29.37
Gross domestic fixed capital for.	55.11	57.16	58.55	64.17	72.60	77.52	75.67
Value of physical increase in stocks and work in progress	0.12	0.98	0.88	1.38	4.82	3.19	-0.84
Exports of goods and services	91.97	97.26	101.87	107.62	107.67	112.22	117.66
0 Total Final Expenditure	412.99	431.61	451.62	475.89	505.36	522.63	526.77
less Imports of goods & services	92.85	95.05	101.58	109.51	123.02	132.08	133.75
Gross domestic product (mkt.prices)	320.14	336.57	350.04	366.37	382.34	390.55	393.02
Net property income from abroad	4.22	2.54	5.12	3.99	4.97	3.78	3.65
Gross national product (mkt.prices)	324.36	339.11	355.16	370.37	387.31	394.34	396.67
Current Prices							
Consumers' expenditure	196.39	217.62	241.27	264.88	298.80	326.49	349.42
General government final consump.	69.91	73.81	79.38	85.35	91.73	99.03	109.50
Central government	43.23	45.88	48.80	52.04	55.61	60.53	66.86
Local government	26.68	27.93	30.58	33.31	36.12	38.50	42.64
Gross domestic fixed capital for.	55.10	60.35	64.51	74.08	88.96	101.84	105.20
Value of physical increase in stocks and work in progress	0.12	0.82	0.72	1.39	4.80	3.16	-0.72
Exports of goods and services	91.95	102.21	98.32	107.03	107.83	122.79	134.11
0 Total Final Expenditure	413.47	454.81	484.20	532.73	592.12	653.31	697.50
less Imports of goods & services	92.85	98.87	101.07	111.87	124.88	142.70	147.58
Gross domestic product (mkt.prices)	320.17	355.94	383.13	420.86	467.23	510.60	549.92
Net property income from abroad	4.22	2.65	5.10	4.08	5.05	4.09	4.03
Gross national product (mkt.prices)	324.39	358.59	388.23	424.94	472.28	514.69	553.95
less Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
0Gross national product (fact. cost)	279.40	309.22	331.47	362.03	401.71	439.46	481.10
less Capital consumption	35.57	41.88	45.08	48.15	52.83	56.34	61.16
0National income	243.84	270.07	288.70	304.81	343.78	391.34	438.02
Factor incomes							
Income from employment	180.05	195.71	211.73	229.53	255.36	283.59	316.41
Income from self-employment	27.72	30.12	34.77	39.38	44.83	51.60	57.66
Corporate gross profits, etc.	54.98	58.89	55.11	66.12	71.30	72.62	67.18
Gross trading surplus of pub.	-0.07	0.27	0.16	-0.08	-0.03	0.20	0.02
Rent	19.64	21.79	23.83	25.77	29.29	32.09	38.43
Capital consump., non-trading	2.61	2.83	3.07	3.31	3.63	4.01	4.28
Equals:							
Total domestic income	284.93	309.60	328.66	364.04	404.39	444.11	483.98
Minus:							
Stock appreciation	5.26	2.74	1.79	4.72	6.21	7.29	6.39
Equals:							
Gross domestic product (income)	279.67	306.86	326.87	359.31	398.18	436.81	477.59
Plus:							
Residual error	-4.55	-0.29	-0.49	-1.36	-1.52	-1.45	-0.52
Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
Equals:							
0 Gross domestic product (exp.mkt.)	320.10	355.94	383.14	420.86	467.23	510.60	549.92
Addenda:							
Gross profits, etc. from I-O	113.41	125.89	131.80	145.98	160.97	177.19	187.40
Adj. financial services	13.79	15.03	17.15	17.56	19.67	25.40	26.74
Personal Sector							
Income from Employment	180.05	195.17	211.73	229.53	255.36	283.59	316.41
Income from self-employment	27.72	30.12	34.77	39.38	44.84	51.61	57.66
Imputed rent	11.76	12.88	14.00	15.29	17.32	19.05	23.53
Other rent	2.42	2.65	3.15	3.28	3.96	4.76	5.68
Interest and dividends	27.05	33.53	36.06	39.12	46.24	60.12	70.53
Credit for corporate tax	2.06	2.69	3.11	3.51	4.45	5.36	6.33
Social security benefits	34.58	37.61	40.86	41.96	43.06	44.96	48.81
Other government grants	8.49	9.20	10.12	10.53	11.03	11.84	13.17
Other current transfers	1.72	1.89	1.88	1.83	1.92	2.03	2.07
Capital consumption by NPMB's	0.43	0.46	0.49	0.50	0.52	0.56	0.59
Minus:							
Interest payments	16.91	21.70	23.68	26.17	29.96	42.83	51.68
Equals:							
Total personal income	279.37	305.04	332.47	358.76	398.73	441.04	493.09
Minus:							
Personal income taxes	34.68	37.77	40.81	43.39	48.29	53.52	62.12
Social security contributions	22.30	24.21	26.17	28.64	32.11	33.03	34.78
Other current transfers	1.58	1.68	1.91	2.13	2.35	3.06	11.38
Equals:							
Personal disposable income	220.80	241.37	263.59	284.61	315.98	351.44	384.81
Of which:							
Personal consumption expenditures	196.39	217.62	241.27	264.88	298.80	326.49	349.42
Saving	24.80	23.75	22.32	19.73	17.19	24.95	35.39
Real personal disposable income	220.27	228.97	239.61	248.02	262.22	276.35	285.50
Personal savings rate	11.24	9.84	8.47	6.93	5.44	7.10	9.20

Table V.1: U.K. National Accounts, 1984-1990 (Continued)

	1984	1985	1986	1987	1988	1989	1990
Corporate Sector							
Corporate gross profits, etc.	54.98	58.89	55.11	66.12	71.30	72.62	67.18
Interest and dividends	22.20	27.02	28.15	30.05	33.25	45.40	53.73
Rent	2.56	3.12	3.52	4.00	4.72	4.93	5.68
Income from abroad	14.11	14.96	15.35	17.86	21.82	26.90	30.13
Minus:							
Interest and dividends	25.33	32.44	34.32	37.98	46.09	65.06	79.49
Transfers to charities	0.10	0.12	0.16	0.18	0.23	0.32	0.31
Profits due abroad	6.26	7.50	5.19	6.82	8.28	8.80	7.12
Corporate income taxes	14.17	16.56	14.54	15.82	18.01	22.12	21.47
Royalties etc. on oil and gas	2.46	2.37	0.94	1.15	0.82	0.56	0.65
Equals:							
Undistributed profits	45.52	45.01	46.98	56.07	57.65	52.98	47.67
Corp.gr.pr. share of IO Gross Pr.	48.48	46.78	41.81	45.29	44.30	40.99	35.85
Government Sector							
Personal income taxes	34.68	37.77	40.81	43.39	48.29	53.52	62.12
Corporate income taxes	14.17	16.56	14.54	15.82	18.01	22.12	21.47
Minus:							
Credit for corporate tax	2.06	2.69	3.11	3.51	4.45	5.36	6.33
Plus:							
Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
Social security contributions	22.30	24.21	26.17	28.64	32.11	33.03	34.78
Gross trading surplus	-0.07	0.27	0.16	-0.08	-0.03	0.20	0.02
Rent	2.91	3.14	3.16	3.20	3.29	3.35	3.55
Royalties and fees from oil	2.46	2.37	0.94	1.15	0.82	0.56	0.65
Interest and dividends	5.12	6.24	5.89	6.02	6.24	7.07	6.49
Misc. current transfers(personal)	0.23	0.23	0.27	0.36	0.39	1.05	9.31
Cap. consump., non-trading cap.	2.17	2.37	2.58	2.80	3.11	3.45	3.69
Minus:							
General government final consump.	69.91	73.81	79.38	85.35	91.73	99.03	109.50
Social security benefits	34.58	37.61	40.86	41.96	43.06	44.96	48.81
Other government grants	8.49	9.20	10.12	10.53	11.03	11.84	13.17
Net external transfers	-2.10	3.43	2.23	3.28	3.25	4.28	4.64
Debt interest	15.76	17.48	17.16	18.00	18.17	18.71	18.54
Equals:							
Current surplus	-3.95	-1.69	-1.60	1.59	11.13	15.40	13.95
External Sector							
Exports	91.95	102.21	98.32	107.03	107.83	122.79	134.11
Property income net of taxes	51.45	52.27	47.69	48.07	56.72	74.17	81.29
Transfers to persons	1.62	1.78	1.73	1.67	1.72	1.75	1.80
Transfers to government	2.39	1.76	2.14	2.28	2.12	2.14	2.19
Minus:							
Imports	92.85	98.87	101.07	111.87	124.88	142.70	147.58
Property income net of taxes	47.24	49.62	42.60	43.99	51.67	70.08	77.26
Transfers from persons	1.36	1.46	1.66	1.79	1.99	2.05	2.10
Transfers from government	4.49	5.19	4.37	5.56	5.36	6.42	6.83
Equals:							
Net investment abroad	1.48	2.88	0.19	-4.16	-15.52	-20.40	-14.38
Addenda:							
Home population	56.46	56.62	56.76	56.93	57.06	57.24	57.41
Total working population	27.24	27.72	27.80	27.99	28.25	28.43	28.44
0 Total employed	24.21	24.51	24.54	25.05	25.92	26.68	26.88
Her Majesty's Forces	0.33	0.33	0.32	0.32	0.32	0.31	0.30
Government training programs	0.17	0.18	0.23	0.31	0.34	0.46	0.42
Employees in employment	21.22	21.40	21.37	21.56	22.26	22.66	22.86
Self-employed	2.50	2.61	2.63	2.86	3.00	3.25	3.30
Unemployed	3.03	3.18	3.23	2.91	2.34	1.74	1.56
Unemployment rate	11.12	11.47	11.62	10.38	8.29	6.13	5.47
Aggregate labor productivity	13.22	13.72	14.25	14.61	14.75	14.64	14.62
Real income from employment	8.48	8.67	9.00	9.27	9.52	9.84	10.27
Real income from self-employment	10.97	10.93	12.00	11.96	12.41	12.47	12.97
Average wage	8.49	9.39	10.26	11.00	11.89	12.93	14.30
Price index, PCE	1.00	1.05	1.10	1.15	1.21	1.27	1.35
Price index, GDP	1.00	1.06	1.09	1.15	1.22	1.31	1.40

Table V.2: BRIM National Accounts, 1984-1990

	1984	1985	1986	1987	1988	1989	1990
Constant 1984 Prices							
Consumers' expenditure	195.91	206.44	219.31	230.83	247.95	256.73	259.24
General government final consump.	69.89	69.77	71.01	71.90	72.33	72.99	75.07
Central government	43.22	43.27	44.04	44.11	44.30	44.70	45.69
Local government	26.67	26.50	26.97	27.79	28.03	28.30	29.37
Gross domestic fixed capital for.	55.11	56.99	59.29	65.32	74.91	79.78	78.03
Value of physical increase in stocks and work in progress	0.12	0.98	0.88	1.38	4.82	3.19	-0.84
Exports of goods and services	91.97	98.15	102.88	108.77	108.89	113.48	119.04
0 Total Final Expenditure	412.99	432.33	453.37	478.20	508.90	526.17	530.53
less Imports of goods & services	92.85	95.44	101.58	109.51	123.02	132.07	133.65
Gross domestic product (mkt.prices)	320.14	336.89	351.79	368.69	385.88	394.10	396.88
Net property income from abroad	4.22	2.51	4.70	3.60	4.21	3.16	2.89
Gross national product (mkt.prices)	324.36	339.40	356.49	372.29	390.09	397.25	399.78
Current Prices							
Consumers' expenditure	196.39	216.81	238.53	259.53	289.79	323.31	354.24
General government final consump.	69.91	74.59	79.74	85.13	90.97	98.05	107.85
Central government	43.23	46.09	49.01	51.69	54.86	59.18	64.87
Local government	26.68	28.50	30.73	33.44	36.11	38.87	42.98
Gross domestic fixed capital for.	55.10	59.45	65.54	74.78	88.18	100.18	107.88
Value of physical increase in stocks and work in progress	0.12	0.96	0.96	1.50	5.29	3.62	-1.34
Exports of goods and services	91.95	100.89	100.62	110.48	111.61	125.24	141.90
0 Total Final Expenditure	413.47	452.71	485.38	531.43	585.83	650.40	710.54
less Imports of goods & services	92.85	96.75	104.55	114.61	122.45	139.11	158.21
Gross domestic product (mkt.prices)	320.20	355.79	381.35	417.40	462.60	510.17	552.52
Net property income from abroad	4.22	2.65	5.09	4.08	5.05	4.09	4.03
Gross national product (mkt.prices)	324.41	358.44	386.45	421.48	467.65	514.26	556.55
less Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
0Gross national product (fact. cost)	279.43	309.07	329.69	358.58	397.08	439.02	483.70
less Capital consumption	35.57	37.96	40.28	42.71	44.61	48.67	54.74
0National income	243.86	271.11	289.41	315.87	352.47	390.35	428.96
Factor incomes							
Income from employment	180.05	195.71	211.73	229.53	255.36	283.58	316.41
Income from self-employment	27.72	30.12	34.77	39.38	44.83	51.60	57.66
Corporate gross profits, etc.	55.00	59.17	55.94	66.82	73.28	74.50	71.75
Gross trading surplus of pub.	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	19.64	21.78	23.24	25.13	27.50	30.66	34.06
Capital consump., non-trading	2.61	2.83	2.97	3.17	3.42	3.76	4.10
Equals:							
Total domestic income	284.95	309.60	328.65	364.04	404.39	444.11	483.98
Minus:							
Stock appreciation	5.26	2.74	1.79	4.72	6.21	7.29	6.39
Equals:							
Gross domestic product (income)	279.68	306.86	326.86	359.31	398.18	436.81	477.59
Plus:							
Residual error	-4.55	-0.29	-0.49	-1.36	-1.52	-1.45	-0.52
Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
Equals:							
0 Gross domestic product (exp.mkt.)	320.12	355.94	383.14	420.86	467.23	510.60	549.92
Gross domestic product (expend.)	320.20	355.79	381.35	417.40	462.60	510.17	552.52
0 Difference	0.08	-0.15	-1.78	-3.46	-4.63	-0.43	2.60
Addenda:							
Gross profits, etc. from I-O	113.43	126.18	132.29	147.33	162.49	178.63	187.92
Adj. financial services	13.79	15.03	17.15	17.56	19.67	25.40	26.74
Personal Sector							
Income from Employment	180.05	195.71	211.73	229.53	255.36	283.58	316.41
Income from self-employment	27.72	30.12	34.77	39.38	44.83	51.60	57.66
Imputed rent	11.76	13.14	14.06	15.19	16.61	18.51	20.58
Other rent	2.42	2.69	2.86	3.08	3.35	3.73	4.13
Interest and dividends	27.05	35.79	36.43	39.67	46.63	61.37	71.82
Credit for corporate tax	2.06	2.69	3.11	3.56	4.49	5.42	6.14
Social security benefits	34.58	37.46	40.38	41.09	41.75	44.55	49.50
Other government grants	8.49	9.09	9.66	10.27	10.96	12.15	13.54
Other current transfers	1.72	1.89	2.02	2.20	2.44	2.68	2.90
Capital consumption by NPMB's	0.43	0.46	0.47	0.49	0.52	0.56	0.61
Minus:							
Interest payments	16.91	21.70	23.68	26.17	29.96	42.83	51.68
Equals:							
Total personal income	279.37	307.34	331.80	358.30	396.98	441.32	491.62
Minus:							
Personal income taxes	34.68	37.82	40.80	44.03	48.72	54.11	60.26
Social security contributions	22.30	24.21	26.18	28.64	32.12	33.02	34.79
Other current transfers	1.58	2.01	2.17	2.45	2.71	3.60	12.08
Equals:							
Personal disposable income	220.80	243.31	262.65	283.18	313.44	350.60	384.49
Of which:							
Personal consumption expenditures	196.39	216.81	238.53	259.53	289.79	323.31	354.24
Saving	24.80	23.94	22.25	19.62	17.05	24.89	35.37
Real personal disposable income	220.27	231.67	241.49	251.86	268.19	278.40	281.37
Personal savings rate	11.24	9.84	8.47	6.93	5.44	7.10	9.20

Table V.2: BRIM National Accounts, 1984-1990 (Continued)

	1984	1985	1986	1987	1988	1989	1990
Corporate Sector							
Gross profits, etc.	55.00	59.17	55.94	66.82	73.28	74.50	71.75
Interest and dividends	22.20	27.53	28.02	30.52	35.87	47.20	55.25
Rent	2.56	2.97	3.36	3.85	4.45	5.19	5.98
Income from abroad	14.11	18.29	16.69	16.82	19.85	25.96	28.45
Minus:							
Interest and dividends	25.33	32.04	34.85	38.36	47.34	66.75	84.88
Transfers to charities	0.10	0.11	0.11	0.12	0.12	0.13	0.14
Profits due abroad	6.27	6.77	5.78	7.93	8.95	8.57	7.28
Corporate income taxes	14.17	16.30	15.70	17.82	20.15	23.08	24.37
Royalties etc. on oil and gas	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Equals:							
Undistributed profits	45.54	49.90	46.03	52.15	55.72	53.08	43.33
Corp.gr.pr. share of IO Gross Pr.	48.49	46.89	42.29	45.35	45.10	41.71	38.18
Government Sector							
Personal income taxes	34.68	37.82	40.80	44.03	48.72	54.11	60.26
Corporate income taxes	14.17	16.30	15.70	17.82	20.15	23.08	24.37
Minus:							
Credit for corporate tax	2.06	2.69	3.11	3.56	4.49	5.42	6.14
Plus:							
Net taxes on expenditure	44.99	49.37	56.76	62.90	70.57	75.23	72.85
Social security contributions	22.30	24.21	26.18	28.64	32.12	33.02	34.79
Gross trading surplus	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	2.91	2.98	2.96	3.00	3.08	3.23	3.37
Royalties and fees from oil	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Interest and dividends	5.12	-2.82	5.04	7.89	9.30	10.16	16.66
Misc. current transfers(personal)	0.23	0.23	0.27	0.36	0.39	1.05	9.31
Cap. consump., non-trading cap.	2.17	2.37	2.50	2.68	2.90	3.19	3.50
Minus:							
Final consumption	69.91	74.59	79.74	85.13	90.97	98.05	107.85
Social security benefits	34.58	37.46	40.38	41.09	41.75	44.55	49.50
Other government grants to pers.	8.49	9.09	9.66	10.27	10.96	12.15	13.54
Net external transfers	-2.10	-1.78	-1.91	-2.09	-2.31	-2.55	-2.76
Debt interest	15.76	15.65	16.78	18.37	20.35	22.45	24.31
Equals:							
Current surplus	-3.95	-7.97	0.19	8.47	17.57	19.15	22.42
External Sector							
Exports	91.95	100.89	100.62	110.48	111.61	125.24	141.90
Property income net of taxes	51.45	52.27	47.69	48.07	56.72	74.17	81.29
Transfers to persons	1.62	1.78	1.91	2.09	2.31	2.55	2.76
Transfers to government	2.39	2.13	2.29	2.50	2.78	3.06	3.32
Minus:							
Imports	92.85	96.75	104.55	114.61	122.45	139.11	158.21
Property income net of taxes	47.24	49.62	42.60	43.99	51.67	70.08	77.26
Transfers from persons	1.36	1.78	1.91	2.09	2.31	2.55	2.76
Transfers from government	4.49	3.91	4.19	4.59	5.09	5.61	6.08
Equals:							
Net investment abroad	1.48	5.00	-0.74	-2.14	-8.11	-12.33	-15.04
Addenda:							
Home population	56.46	56.62	56.76	56.93	57.06	57.24	57.41
Total working population	27.24	27.72	27.80	27.99	28.25	28.43	28.44
0 Total employed	24.21	24.51	25.00	25.65	25.92	26.68	26.88
Her Majesty's Forces	0.33	0.33	0.32	0.32	0.32	0.31	0.30
Government training programs	0.17	0.18	0.23	0.31	0.34	0.46	0.42
Employees in employment	21.22	21.40	21.82	22.25	22.26	22.66	22.86
Self-employed	2.50	2.61	2.63	2.78	3.00	3.25	3.30
Unemployed	3.03	3.20	2.80	2.34	2.34	1.74	1.56
Unemployment rate	11.12	11.56	10.08	8.35	8.28	6.13	5.47
Aggregate labor productivity	13.22	13.74	14.07	14.37	14.89	14.77	14.76
Real income from employment	8.48	8.66	8.95	9.11	9.57	9.67	9.94
Real income from self-employment	10.97	11.10	11.81	12.07	12.28	12.27	12.69
Average wage	8.49	9.14	9.70	10.32	11.47	12.51	13.84
Price index, PCE	1.00	1.05	1.09	1.12	1.17	1.26	1.37
Price index, GDP	1.00	1.06	1.08	1.13	1.20	1.29	1.39

Table V.3: BRIM Model Backcast With All Equations

	1984	1985	1986	1987	1988	1989	1990
Constant 1984 Prices							
Consumers' expenditure	195.91	206.44	214.12	230.93	250.30	245.43	252.73
General government final consump.	69.89	69.77	71.01	71.90	72.33	72.99	75.07
Central government	43.22	43.27	44.04	44.11	44.30	44.70	45.69
Local government	26.67	26.50	26.97	27.79	28.03	28.30	29.37
Gross domestic fixed capital for.	55.11	56.99	59.73	62.19	69.23	61.90	65.63
Value of physical increase in stocks and work in progress	0.12	0.98	2.23	1.94	2.44	-0.40	-0.22
Exports of goods and services	91.97	98.15	101.03	106.54	111.40	109.39	114.30
0 Total Final Expenditure	412.99	432.33	448.12	473.50	505.70	489.31	507.50
less Imports of goods & services	92.85	95.44	100.94	107.73	118.84	117.18	122.14
Gross domestic product (mkt.prices)	320.14	336.89	347.18	365.77	386.86	372.13	385.36
Net property income from abroad	4.22	2.51	4.48	3.46	4.14	3.06	2.86
Gross national product (mkt.prices)	324.36	339.40	351.69	368.46	390.68	376.07	387.74
Current Prices							
Consumers' expenditure	196.39	216.81	242.70	266.10	296.87	320.45	349.59
General government final consump.	69.91	74.59	82.13	90.60	92.88	98.50	113.11
Central government	43.23	46.09	50.60	54.78	56.07	59.70	67.75
Local government	26.68	28.50	31.53	35.83	36.82	38.80	45.36
Gross domestic fixed capital for.	55.10	59.45	67.83	71.88	80.72	79.17	85.96
Value of physical increase in stocks and work in progress	0.12	0.96	2.50	2.11	2.60	-0.57	-0.51
Exports of goods and services	91.95	100.89	104.34	111.50	116.95	127.11	139.55
0 Total Final Expenditure	413.47	452.71	499.51	542.20	590.03	624.66	687.70
less Imports of goods & services	92.85	96.75	104.12	112.37	117.51	123.18	143.97
Gross domestic product (mkt.prices)	320.20	355.79	394.84	429.61	470.86	498.89	542.88
Net property income from abroad	4.22	2.65	5.09	4.08	5.05	4.09	4.03
Gross national product (mkt.prices)	324.41	358.44	399.94	433.69	475.91	502.97	546.91
less Net taxes on expenditure	44.99	49.37	56.77	61.50	68.05	74.04	80.26
0Gross national product (fact. cost)	279.43	309.07	343.17	372.18	407.85	428.94	466.64
less Capital consumption	35.57	37.96	41.18	43.16	44.11	49.22	51.59
0National income	243.86	271.11	302.00	329.02	363.74	379.72	415.05
Factor incomes							
Income from employment	180.05	195.71	214.25	241.71	270.63	274.84	305.95
Income from self-employment	27.72	30.12	33.61	39.62	46.65	47.16	53.81
Corporate gross profits, etc.	55.00	59.17	68.33	60.29	57.82	79.55	71.63
Gross trading surplus of pub.	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	19.64	21.78	24.37	26.10	27.94	31.63	34.43
Capital consump., non-trading	2.61	2.83	3.12	3.30	3.48	3.88	4.16
Equals:							
Total domestic income	284.95	309.60	343.67	371.02	406.52	437.06	469.98
Minus:							
Stock appreciation	5.26	2.74	7.16	3.52	3.85	11.56	6.98
Equals:							
Gross domestic product (income)	279.68	306.86	336.51	367.50	402.67	425.50	463.00
Plus:							
Residual error	-4.55	-0.29	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	44.99	49.37	56.77	61.50	68.05	74.04	80.26
Equals:							
0 Gross domestic product (exp.mkt.)	320.12	355.94	393.28	429.01	470.72	499.53	543.27
Gross domestic product (expend.)	320.20	355.79	394.84	429.61	470.86	498.89	542.88
0 Difference	0.08	-0.15	1.57	0.60	0.14	-0.65	-0.39
Addenda:							
Gross profits, etc. from I-O	113.43	126.18	143.45	142.41	147.68	172.27	177.92
Adj. financial services	13.79	15.03	21.19	16.62	15.64	21.61	20.87
Personal Sector							
Income from Employment	180.05	195.71	214.25	241.71	270.63	274.84	305.95
Income from self-employment	27.72	30.12	33.61	39.62	46.65	47.16	53.81
Imputed rent	11.76	13.14	14.75	15.79	16.88	19.14	20.87
Other rent	2.42	2.69	3.00	3.20	3.41	3.85	4.19
Interest and dividends	27.05	35.79	39.95	38.04	42.30	62.96	71.59
Credit for corporate tax	2.06	2.69	3.18	3.69	4.65	5.31	5.97
Social security benefits	34.58	37.46	42.05	42.25	42.42	46.03	50.21
Other government grants	8.49	9.09	10.06	10.55	11.14	12.55	13.74
Other current transfers	1.72	1.89	2.09	2.27	2.48	2.63	2.86
Capital consumption by NPMB's	0.43	0.46	0.49	0.51	0.53	0.58	0.61
Minus:							
Interest payments	16.91	21.70	23.68	26.17	29.96	42.83	51.68
Equals:							
Total personal income	279.37	307.34	339.75	371.47	411.14	432.22	478.12
Minus:							
Personal income taxes	34.68	37.82	41.78	45.65	50.46	52.99	58.61
Social security contributions	22.30	24.21	26.32	29.96	33.95	31.72	33.46
Other current transfers	1.58	2.01	2.24	2.51	2.75	3.54	12.03
Equals:							
Personal disposable income	220.80	243.31	269.41	293.35	323.98	343.97	374.03
Of which:							
Personal consumption expenditures	196.39	216.81	242.70	266.10	296.87	320.45	349.59
Saving	24.80	23.94	26.86	26.41	26.74	24.63	23.77
Real personal disposable income	220.27	231.67	237.83	253.78	272.81	264.35	269.88
Personal savings rate	11.24	9.84	9.97	9.00	8.25	7.16	6.35

Table V.3: BRIM Model Backcast With All Equations (Continued)

	1984	1985	1986	1987	1988	1989	1990
Corporate Sector							
Gross profits, etc.	55.00	59.17	68.33	60.29	57.82	79.55	71.63
Interest and dividends	22.20	27.53	30.73	29.26	32.54	48.43	55.07
Rent	2.56	2.97	3.51	3.99	4.52	5.29	5.95
Income from abroad	14.11	18.29	16.69	16.82	19.85	25.96	28.45
Minus:							
Interest and dividends	25.33	32.04	42.57	34.61	37.35	71.28	84.74
Transfers to charities	0.10	0.11	0.12	0.12	0.12	0.14	0.14
Profits due abroad	6.27	6.77	8.29	6.13	5.26	9.45	7.13
Corporate income taxes	14.17	16.30	18.00	16.66	17.32	24.04	24.32
Royalties etc. on oil and gas	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Equals:							
Undistributed profits	45.54	49.90	48.74	51.20	53.50	53.09	43.34
Corp.gr.pr. share of IO Gross Pr.	48.49	46.89	47.63	42.34	39.15	46.18	40.26
Government Sector							
Personal income taxes	34.68	37.82	41.78	45.65	50.46	52.99	58.61
Corporate income taxes	14.17	16.30	18.00	16.66	17.32	24.04	24.32
Minus:							
Credit for corporate tax	2.06	2.69	3.18	3.69	4.65	5.31	5.97
Plus:							
Net taxes on expenditure	44.99	49.37	56.77	61.50	68.05	74.04	80.26
Social security contributions	22.30	24.21	26.32	29.96	33.95	31.72	33.46
Gross trading surplus	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	2.91	2.98	3.11	3.12	3.13	3.34	3.41
Royalties and fees from oil	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Interest and dividends	5.12	-2.82	9.64	5.76	3.64	12.25	16.36
Misc. current transfers(personal)	0.23	0.23	0.27	0.36	0.39	1.05	9.31
Cap. consump., non-trading cap.	2.17	2.37	2.63	2.79	2.95	3.30	3.54
Minus:							
Final consumption	69.91	74.59	82.13	90.60	92.88	98.50	113.11
Social security benefits	34.58	37.46	42.05	42.25	42.42	46.03	50.21
Other government grants to pers.	8.49	9.09	10.06	10.55	11.14	12.55	13.74
Net external transfers	-2.10	-1.78	-1.97	-2.15	-2.35	-2.49	-2.71
Debt interest	15.76	15.65	17.37	18.90	20.72	21.95	23.89
Equals:							
Current surplus	-3.95	-7.97	3.27	-0.69	6.90	17.14	21.08
External Sector							
Exports	91.95	100.89	104.34	111.50	116.95	127.11	139.55
Property income net of taxes	51.45	52.27	47.69	48.07	56.72	74.17	81.29
Transfers to persons	1.62	1.78	1.97	2.15	2.35	2.49	2.71
Transfers to government	2.39	2.13	2.37	2.58	2.83	2.99	3.26
Minus:							
Imports	92.85	96.75	104.12	112.37	117.51	123.18	143.97
Property income net of taxes	47.24	49.62	42.60	43.99	51.67	70.08	77.26
Transfers from persons	1.36	1.78	1.97	2.15	2.35	2.49	2.71
Transfers from government	4.49	3.91	4.34	4.73	5.18	5.49	5.97
Equals:							
Net investment abroad	1.48	5.00	3.34	1.05	2.13	5.53	-3.11
Addenda:							
Home population	56.46	56.62	56.76	56.93	57.06	57.24	57.41
Total working population	27.24	27.72	27.80	27.99	28.25	28.43	28.44
Total employed	24.21	24.51	24.73	25.31	26.12	25.49	25.38
Her Majesty's Forces	0.33	0.33	0.32	0.32	0.32	0.31	0.30
Government training programs	0.17	0.18	0.23	0.31	0.34	0.46	0.42
Employees in employment	21.22	21.40	21.59	21.93	22.50	21.73	21.56
Self-employed	2.50	2.61	2.59	2.75	2.96	2.98	3.09
Unemployed	3.03	3.20	3.07	2.68	2.13	2.94	3.06
Unemployment rate	11.12	11.56	11.04	9.57	7.55	10.34	10.76
Aggregate labor productivity	13.22	13.74	14.04	14.45	14.81	14.60	15.19
Real income from employment	8.48	8.66	8.73	9.38	9.88	9.44	10.07
Real income from self-employment	10.97	11.10	11.39	12.27	12.94	11.79	12.34
Average wage	8.49	9.14	9.93	11.04	12.03	12.62	14.21
Price index, PCE	1.00	1.05	1.13	1.16	1.19	1.30	1.39
Price index, GDP	1.00	1.06	1.14	1.18	1.22	1.34	1.41

Table V.4: BRIM Backcast With Exports Fixed

	1984	1985	1986	1987	1988	1989	1990
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Constant 1984 Prices							
Consumers' expenditure	195.91	206.44	216.42	234.24	247.58	251.25	258.97
General government final consump.	69.89	69.77	71.01	71.90	72.33	72.99	75.07
Central government	43.22	43.27	44.04	44.11	44.30	44.70	45.69
Local government	26.67	26.50	26.97	27.79	28.03	28.30	29.37
Gross domestic fixed capital for.	55.11	56.99	61.33	64.23	67.24	64.93	67.92
Value of physical increase in stocks and work in progress	0.12	0.98	2.55	2.19	1.67	0.32	0.53
Exports of goods and services	91.97	98.15	102.88	108.74	108.86	113.45	119.00
0 Total Final Expenditure	412.99	432.33	454.20	481.30	497.69	502.94	521.49
less Imports of goods & services	92.85	95.44	102.47	109.23	115.73	121.26	126.33
Gross domestic product (mkt.prices)	320.14	336.89	351.72	372.08	381.95	381.68	395.16
Net property income from abroad	4.22	2.51	4.50	3.46	4.10	3.08	2.87
Gross national product (mkt.prices)	324.36	339.40	356.08	375.03	386.38	385.47	397.77
Current Prices							
Consumers' expenditure	196.39	216.81	244.18	269.99	297.15	325.68	356.87
General government final consump.	69.91	74.59	82.24	90.73	92.81	99.72	112.60
Central government	43.23	46.09	50.63	54.85	56.12	60.26	67.41
Local government	26.68	28.50	31.60	35.88	36.70	39.46	45.19
Gross domestic fixed capital for.	55.10	59.45	69.15	74.20	79.57	81.53	89.18
Value of physical increase in stocks and work in progress	0.12	0.96	2.83	2.41	1.82	0.25	0.47
Exports of goods and services	91.95	100.89	106.15	114.40	115.95	130.18	144.74
0 Total Final Expenditure	413.47	452.71	504.55	551.73	587.30	637.36	703.85
less Imports of goods & services	92.85	96.75	105.61	114.10	114.96	127.11	148.65
Gross domestic product (mkt.prices)	320.20	355.79	398.46	437.40	470.52	508.19	554.49
Net property income from abroad	4.22	2.65	5.09	4.08	5.05	4.09	4.03
Gross national product (mkt.prices)	324.41	358.44	403.56	441.47	475.56	512.28	558.52
less Net taxes on expenditure	44.99	49.37	57.11	62.43	68.29	74.96	81.70
0Gross national product (fact. cost)	279.43	309.07	346.45	379.05	407.27	437.32	476.83
less Capital consumption	35.57	37.96	40.95	43.21	44.80	48.44	51.95
0National income	243.86	271.11	305.50	335.84	362.47	388.88	424.88
Factor incomes							
Income from employment	180.05	195.71	216.98	246.28	267.55	283.42	314.12
Income from self-employment	27.72	30.12	34.35	40.94	45.88	49.37	56.20
Corporate gross profits, etc.	55.00	59.17	67.87	61.62	62.13	75.26	71.38
Gross trading surplus of pub.	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	19.64	21.78	24.30	26.14	28.26	31.50	34.37
Capital consump., non-trading	2.61	2.83	3.11	3.30	3.51	3.86	4.14
Equals:							
Total domestic income	284.95	309.60	346.61	378.29	407.34	443.40	480.21
Minus:							
Stock appreciation	5.26	2.74	6.88	3.97	5.05	9.58	7.38
Equals:							
Gross domestic product (income)	279.68	306.86	339.73	374.31	402.30	433.82	472.83
Plus:							
Residual error	-4.55	-0.29	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	44.99	49.37	57.11	62.43	68.29	74.96	81.70
Equals:							
0 Gross domestic product (exp.mkt.)	320.12	355.94	396.84	436.74	470.59	508.78	554.52
Gross domestic product (expend.)	320.20	355.79	398.46	437.40	470.52	508.19	554.49
0 Difference	0.08	-0.15	1.62	0.65	-0.07	-0.58	-0.03
Addenda:							
Gross profits, etc. from I-O	113.43	126.18	143.71	145.18	151.57	170.46	179.97
Adj. financial services	13.79	15.03	20.96	17.15	16.83	20.06	21.26
Personal Sector							
Income from Employment	180.05	195.71	216.98	246.28	267.55	283.42	314.12
Income from self-employment	27.72	30.12	34.35	40.94	45.88	49.37	56.20
Imputed rent	11.76	13.14	14.70	15.80	17.06	19.04	20.80
Other rent	2.42	2.69	2.99	3.20	3.45	3.83	4.18
Interest and dividends	27.05	35.79	39.88	38.50	43.50	61.54	71.65
Credit for corporate tax	2.06	2.69	3.21	3.75	4.63	5.42	6.10
Social security benefits	34.58	37.46	41.90	42.21	42.83	45.72	49.97
Other government grants	8.49	9.09	10.03	10.55	11.25	12.47	13.67
Other current transfers	1.72	1.89	2.11	2.31	2.48	2.68	2.92
Capital consumption by NPMB's	0.43	0.46	0.49	0.51	0.54	0.58	0.61
Minus:							
Interest payments	16.91	21.70	23.68	26.17	29.96	42.83	51.68
Equals:							
Total personal income	279.37	307.34	342.95	377.88	409.20	441.23	488.54
Minus:							
Personal income taxes	34.68	37.82	42.17	46.44	50.22	54.10	59.89
Social security contributions	22.30	24.21	26.69	30.59	33.54	32.78	34.44
Other current transfers	1.58	2.01	2.26	2.55	2.75	3.59	12.09
Equals:							
Personal disposable income	220.80	243.31	271.83	298.30	322.70	350.76	382.13
Of which:							
Personal consumption expenditures	196.39	216.81	244.18	269.99	297.15	325.68	356.87
Saving	24.80	23.94	27.57	27.76	25.88	25.99	24.89
Real personal disposable income	220.27	231.67	240.85	258.28	269.17	271.35	277.01
Personal savings rate	11.24	9.84	10.14	9.31	8.02	7.41	6.51

Table V.4: BRIM Backcast With Exports Fixed (Continued)

	1984	1985	1986	1987	1988	1989	1990
Corporate Sector							
Gross profits, etc.	55.00	59.17	67.87	61.62	62.13	75.26	71.38
Interest and dividends	22.20	27.53	30.68	29.62	33.46	47.34	55.12
Rent	2.56	2.97	3.52	4.02	4.58	5.31	6.00
Income from abroad	14.11	18.29	16.69	16.82	19.85	25.96	28.45
Minus:							
Interest and dividends	25.33	32.04	42.28	35.37	40.14	67.43	84.44
Transfers to charities	0.10	0.11	0.12	0.12	0.13	0.14	0.14
Profits due abroad	6.27	6.77	8.21	6.44	6.17	8.52	7.11
Corporate income taxes	14.17	16.30	17.93	16.92	18.12	23.23	24.30
Royalties etc. on oil and gas	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Equals:							
Undistributed profits	45.54	49.90	48.68	51.59	54.30	53.32	43.52
Corp.gr.pr. share of IO Gross Pr.	48.49	46.89	47.23	42.45	40.99	44.15	39.66
Government Sector							
Personal income taxes	34.68	37.82	42.17	46.44	50.22	54.10	59.89
Corporate income taxes	14.17	16.30	17.93	16.92	18.12	23.23	24.30
Minus:							
Credit for corporate tax	2.06	2.69	3.21	3.75	4.63	5.42	6.10
Plus:							
Net taxes on expenditure	44.99	49.37	57.11	62.43	68.29	74.96	81.70
Social security contributions	22.30	24.21	26.69	30.59	33.54	32.78	34.44
Gross trading surplus	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	2.91	2.98	3.10	3.12	3.17	3.32	3.40
Royalties and fees from oil	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Interest and dividends	5.12	-2.82	9.55	6.36	5.21	10.39	16.44
Misc. current transfers(personal)	0.23	0.23	0.27	0.36	0.39	1.05	9.31
Cap. consump., non-trading cap.	2.17	2.37	2.62	2.79	2.98	3.28	3.53
Minus:							
Final consumption	69.91	74.59	82.24	90.73	92.81	99.72	112.60
Social security benefits	34.58	37.46	41.90	42.21	42.83	45.72	49.97
Other government grants to pers.	8.49	9.09	10.03	10.55	11.25	12.47	13.67
Net external transfers	-2.10	-1.78	-1.99	-2.19	-2.35	-2.54	-2.77
Debt interest	15.76	15.65	17.53	19.25	20.70	22.36	24.40
Equals:							
Current surplus	-3.95	-7.97	4.07	1.98	8.52	16.11	24.91
External Sector							
Exports	91.95	100.89	106.15	114.40	115.95	130.18	144.74
Property income net of taxes	51.45	52.27	47.69	48.07	56.72	74.17	81.29
Transfers to persons	1.62	1.78	1.99	2.19	2.35	2.54	2.77
Transfers to government	2.39	2.13	2.39	2.62	2.82	3.05	3.33
Minus:							
Imports	92.85	96.75	105.61	114.10	114.96	127.11	148.65
Property income net of taxes	47.24	49.62	42.60	43.99	51.67	70.08	77.26
Transfers from persons	1.36	1.78	1.99	2.19	2.35	2.54	2.77
Transfers from government	4.49	3.91	4.38	4.81	5.18	5.59	6.10
Equals:							
Net investment abroad	1.48	5.00	3.64	2.19	3.69	4.61	-2.66
Addenda:							
Home population	56.46	56.62	56.76	56.93	57.06	57.24	57.41
Total working population	27.24	27.72	27.80	27.99	28.25	28.43	28.44
Total employed	24.21	24.51	24.96	25.69	25.98	25.83	25.86
Her Majesty's Forces	0.33	0.33	0.32	0.32	0.32	0.31	0.30
Government training programs	0.17	0.18	0.23	0.31	0.34	0.46	0.42
Employees in employment	21.22	21.40	21.79	22.27	22.37	22.03	21.98
Self-employed	2.50	2.61	2.62	2.79	2.94	3.03	3.16
Unemployed	3.03	3.20	2.84	2.30	2.28	2.60	2.58
Unemployment rate	11.12	11.56	10.20	8.20	8.07	9.15	9.06
Aggregate labor productivity	13.22	13.74	14.09	14.48	14.70	14.78	15.28
Real income from employment	8.48	8.66	8.79	9.40	9.71	9.67	10.18
Real income from self-employment	10.97	11.10	11.56	12.46	12.65	12.24	12.68
Average wage	8.49	9.14	9.96	11.07	11.95	12.85	14.30
Price index, PCE	1.00	1.05	1.13	1.15	1.20	1.29	1.38
Price index, GDP	1.00	1.06	1.13	1.18	1.23	1.33	1.40

Table V.5: BRIM Backcast With Exports, Investment and Profits Fixed

	1984	1985	1986	1987	1988	1989	1990
Constant 1984 Prices							
Consumers' expenditure	195.91	206.44	217.67	235.91	252.48	260.95	267.39
General government final consump.	69.89	69.77	71.01	71.90	72.33	72.99	75.07
Central government	43.22	43.27	44.04	44.11	44.30	44.70	45.69
Local government	26.67	26.50	26.97	27.79	28.03	28.30	29.37
Gross domestic fixed capital for.	55.11	56.99	61.82	64.49	74.98	80.02	77.60
Value of physical increase in stocks and work in progress	0.12	0.98	2.57	2.17	2.74	2.44	1.57
Exports of goods and services	91.97	98.15	102.88	108.74	108.86	113.45	119.00
0 Total Final Expenditure	412.99	432.33	455.94	483.20	511.39	529.85	540.63
less Imports of goods & services	92.85	95.44	102.85	109.56	119.67	129.74	132.73
Gross domestic product (mkt.prices)	320.14	336.89	353.09	373.64	391.72	400.11	407.90
Net property income from abroad	4.22	2.49	4.49	3.46	4.09	3.05	2.80
Gross national product (mkt.prices)	324.36	339.38	357.34	376.66	395.96	403.83	411.60
Current Prices							
Consumers' expenditure	196.39	217.59	245.73	271.72	303.06	339.68	377.28
General government final consump.	69.91	74.93	82.07	89.97	92.86	100.49	113.96
Central government	43.23	46.29	50.57	54.48	56.16	60.72	68.32
Local government	26.68	28.64	31.50	35.49	36.69	39.77	45.64
Gross domestic fixed capital for.	55.10	60.04	70.29	76.13	89.68	102.34	106.68
Value of physical increase in stocks and work in progress	0.12	0.96	2.84	2.37	3.03	2.88	1.97
Exports of goods and services	91.95	101.15	105.92	113.86	115.43	129.91	147.11
0 Total Final Expenditure	413.47	454.68	506.85	554.05	604.06	675.30	747.00
less Imports of goods & services	92.85	96.75	105.95	114.45	118.98	136.52	157.10
Gross domestic product (mkt.prices)	320.20	357.76	400.30	439.33	483.20	536.36	588.57
Net property income from abroad	4.22	2.65	5.09	4.08	5.05	4.09	4.03
Gross national product (mkt.prices)	324.41	360.40	405.39	443.41	488.25	540.45	592.59
less Net taxes on expenditure	44.99	49.37	57.29	62.60	69.70	78.38	86.37
0Gross national product (fact. cost)	279.43	311.04	348.10	380.81	418.55	462.07	506.22
less Capital consumption	35.57	38.29	41.47	44.22	45.45	49.72	54.70
0National income	243.86	272.74	306.63	336.59	373.11	412.36	451.53
Factor incomes							
Income from employment	180.05	195.71	218.74	247.89	274.86	300.32	333.13
Income from self-employment	27.72	30.12	34.74	41.36	47.79	53.84	61.07
Corporate gross profits, etc.	55.00	60.70	66.81	61.14	64.27	79.30	78.89
Gross trading surplus of pub.	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	19.64	21.90	24.33	26.16	28.35	31.81	35.39
Capital consump., non-trading	2.61	2.85	3.11	3.30	3.52	3.88	4.24
Equals:							
Total domestic income	284.95	311.27	347.74	379.85	418.79	469.15	512.72
Minus:							
Stock appreciation	5.26	2.74	6.45	3.88	5.40	10.84	10.54
Equals:							
Gross domestic product (income)	279.68	308.53	341.29	375.97	413.38	458.31	502.19
Plus:							
Residual error	-4.55	-0.29	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	44.99	49.37	57.29	62.60	69.70	78.38	86.37
Equals:							
0 Gross domestic product (exp.mkt.)	320.12	357.61	398.58	438.56	483.08	536.68	588.56
Gross domestic product (expend.)	320.20	357.76	400.30	439.33	483.20	536.36	588.57
0 Difference	0.08	0.15	1.72	0.77	0.12	-0.32	0.01
Addenda:							
Gross profits, etc. from I-O	113.43	127.85	143.16	145.24	155.82	179.73	194.21
Adj. financial services	13.79	15.03	20.62	17.16	17.30	21.74	25.15
Personal Sector							
Income from Employment	180.05	195.71	218.74	247.89	274.86	300.32	333.13
Income from self-employment	27.72	30.12	34.74	41.36	47.79	53.84	61.07
Imputed rent	11.76	13.22	14.71	15.80	17.10	19.18	21.37
Other rent	2.42	2.70	2.99	3.20	3.45	3.86	4.29
Interest and dividends	27.05	36.19	39.61	38.41	44.28	63.40	75.51
Credit for corporate tax	2.06	2.70	3.23	3.77	4.75	5.72	6.48
Social security benefits	34.58	37.60	41.94	42.17	42.86	45.94	50.98
Other government grants	8.49	9.13	10.04	10.54	11.26	12.53	13.95
Other current transfers	1.72	1.90	2.12	2.32	2.54	2.82	3.09
Capital consumption by NPMB's	0.43	0.46	0.49	0.51	0.54	0.58	0.63
Minus:							
Interest payments	16.91	21.70	23.68	26.17	29.96	42.83	51.68
Equals:							
Total personal income	279.37	308.02	344.93	379.79	419.47	465.35	518.80
Minus:							
Personal income taxes	34.68	37.90	42.42	46.68	51.48	57.05	63.59
Social security contributions	22.30	24.21	26.92	30.81	34.52	34.88	36.66
Other current transfers	1.58	2.02	2.27	2.56	2.81	3.73	12.26
Equals:							
Personal disposable income	220.80	243.89	273.33	299.75	330.65	369.68	406.29
Of which:							
Personal consumption expenditures	196.39	217.59	245.73	271.72	303.06	339.68	377.28
Saving	24.80	24.00	27.41	27.55	27.71	30.78	30.04
Real personal disposable income	220.27	231.39	241.93	259.79	275.58	284.65	288.73
Personal savings rate	11.24	9.84	10.03	9.19	8.38	8.33	7.39

Table V.5: BRIM Backcast With Exports, Investment and Profits Fixed (Continued)

	1984	1985	1986	1987	1988	1989	1990
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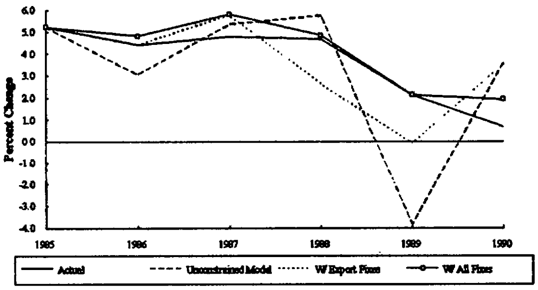
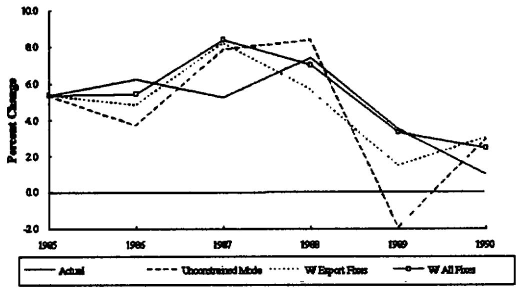
Corporate Sector							
Gross profits, etc.	55.00	60.70	66.81	61.14	64.27	79.30	78.89
Interest and dividends	22.20	27.84	30.47	29.54	34.06	48.77	58.09
Rent	2.56	2.99	3.52	4.03	4.62	5.42	6.25
Income from abroad	14.11	18.29	16.69	16.82	19.85	25.96	28.45
Minus:							
Interest and dividends	25.33	32.87	41.62	35.10	41.52	71.05	93.32
Transfers to charities	0.10	0.11	0.12	0.12	0.13	0.14	0.15
Profits due abroad	6.27	7.09	7.96	6.33	6.65	9.39	8.61
Corporate income taxes	14.17	16.58	17.74	16.84	18.54	24.07	25.92
Royalties etc. on oil and gas	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Equals:							
Undistributed profits	45.54	50.33	48.52	51.51	54.80	53.57	42.26
Corp.gr.pr. share of IO Gross Pr.	48.49	47.48	46.67	42.10	41.25	44.12	40.62
Government Sector							
Personal income taxes	34.68	37.90	42.42	46.68	51.48	57.05	63.59
Corporate income taxes	14.17	16.58	17.74	16.84	18.54	24.07	25.92
Minus:							
Credit for corporate tax	2.06	2.70	3.23	3.77	4.75	5.72	6.48
Plus:							
Net taxes on expenditure	44.99	49.37	57.29	62.60	69.70	78.38	86.37
Social security contributions	22.30	24.21	26.92	30.81	34.52	34.88	36.66
Gross trading surplus	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
Rent	2.91	2.99	3.10	3.12	3.17	3.34	3.49
Royalties and fees from oil	2.46	2.85	1.54	1.65	1.18	1.24	1.42
Interest and dividends	5.12	-2.29	9.20	6.23	6.23	12.83	21.49
Misc. current transfers(personal)	0.23	0.23	0.27	0.36	0.39	1.05	9.31
Cap. consump., non-trading cap.	2.17	2.38	2.62	2.79	2.98	3.30	3.62
Minus:							
Final consumption	69.91	74.93	82.07	89.97	92.86	100.49	113.96
Social security benefits	34.58	37.60	41.94	42.17	42.86	45.94	50.98
Other government grants to pers.	8.49	9.13	10.04	10.54	11.26	12.53	13.95
Net external transfers	-2.10	-1.79	-2.00	-2.20	-2.42	-2.68	-2.94
Debt interest	15.76	15.74	17.61	19.33	21.26	23.60	25.90
Equals:							
Current surplus	-3.95	-7.66	4.20	3.09	12.80	25.19	37.67
External Sector							
Exports	91.95	101.15	105.92	113.86	115.43	129.91	147.11
Property income net of taxes	51.45	52.27	47.69	48.07	56.72	74.17	81.29
Transfers to persons	1.62	1.79	2.00	2.20	2.42	2.68	2.94
Transfers to government	2.39	2.15	2.40	2.64	2.90	3.22	3.53
Minus:							
Imports	92.85	96.75	105.95	114.45	118.98	136.52	157.10
Property income net of taxes	47.24	49.62	42.60	43.99	51.67	70.08	77.26
Transfers from persons	1.36	1.79	2.00	2.20	2.42	2.68	2.94
Transfers from government	4.49	3.94	4.40	4.83	5.32	5.90	6.47
Equals:							
Net investment abroad	1.48	5.25	3.06	1.29	-0.92	-5.21	-8.91
Addenda:							
Home population	56.46	56.62	56.76	56.93	57.06	57.24	57.41
Total working population	27.24	27.72	27.80	27.99	28.25	28.43	28.44
0 Total employed	24.21	24.51	25.04	25.79	26.40	26.72	26.68
Her Majesty's Forces	0.33	0.33	0.32	0.32	0.32	0.31	0.30
Government training programs	0.17	0.18	0.23	0.31	0.34	0.46	0.42
Employees in employment	21.22	21.40	21.86	22.35	22.75	22.81	22.70
Self-employed	2.50	2.61	2.63	2.81	2.99	3.14	3.25
Unemployed	3.03	3.20	2.76	2.20	1.85	1.71	1.75
Unemployment rate	11.12	11.56	9.93	7.86	6.56	6.00	6.17
Aggregate labor productivity	13.22	13.74	14.10	14.49	14.84	14.97	15.29
Real income from employment	8.48	8.61	8.83	9.43	9.80	9.83	10.18
Real income from self-employment	10.97	11.03	11.65	12.54	12.94	12.80	13.01
Average wage	8.49	9.14	10.01	11.10	12.08	13.15	14.65
Price index, PCE	1.00	1.05	1.13	1.15	1.20	1.30	1.41
Price index, GDP	1.00	1.06	1.13	1.18	1.23	1.34	1.44

Chart V.1: BRIM Backcast, 1985-1990

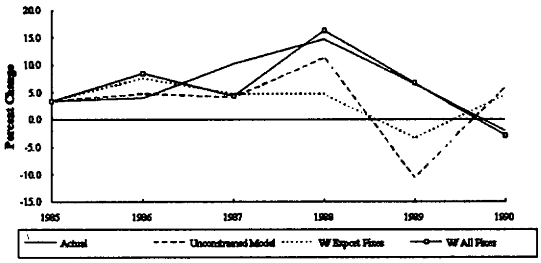
Gross Domestic Product (1984 £)



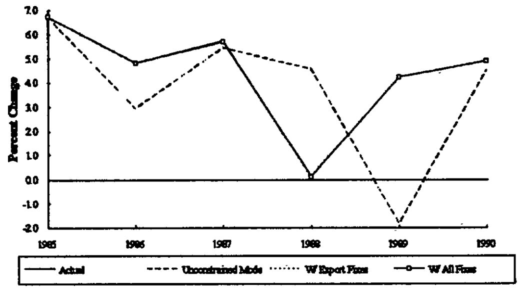
Personal Consumption (1984 £)



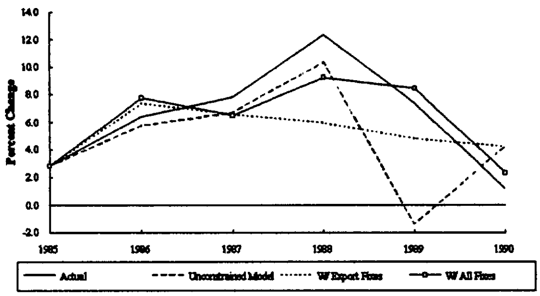
Gross Domestic Fixed Capital Formation (1984 £)



Exports (1984 £)



Imports (1984 £)



Personal Disposable Income. (1984 £)

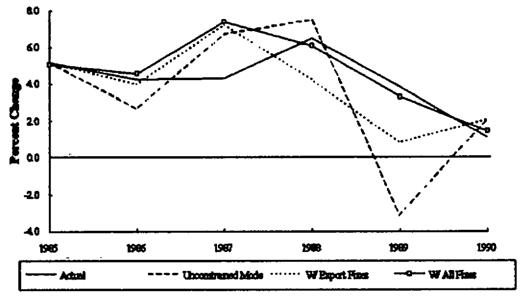
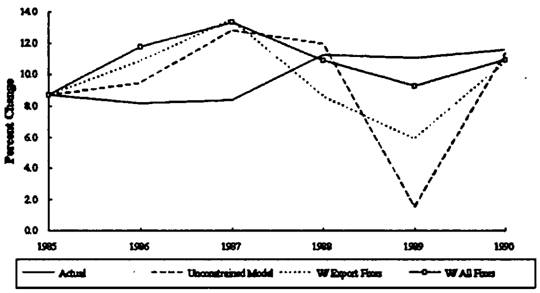
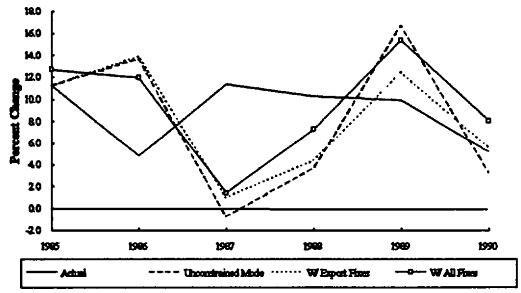


Chart V.1: BRIM Backcast, 1985-90 (Continued)

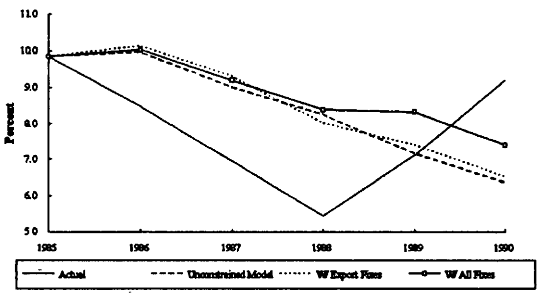
Income From Employment (Current £)



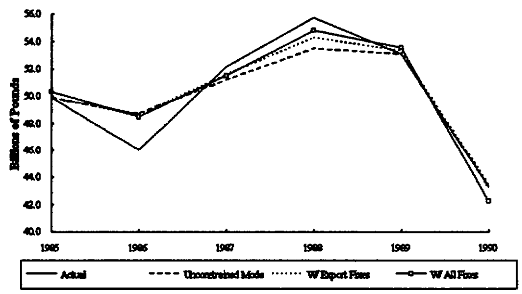
Gross Profits, Etc. (Current £)



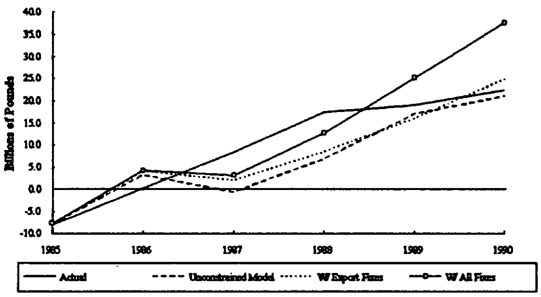
Personal Savings Rate



Corporate Undistributed Profits (Current £)



Government Surplus (Current £)



Unemployment Rate

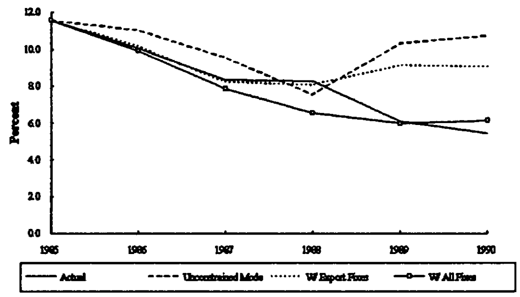
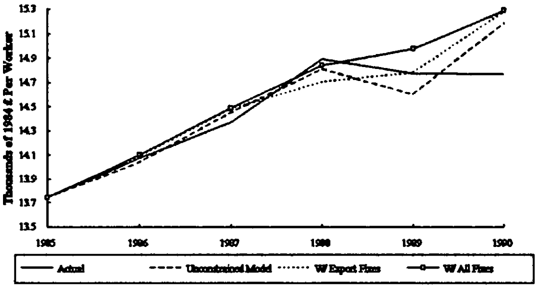


Chart V.1: BRIM Backcast, 1985-1990 (Continued)

Labor Productivity



Inflation Rate

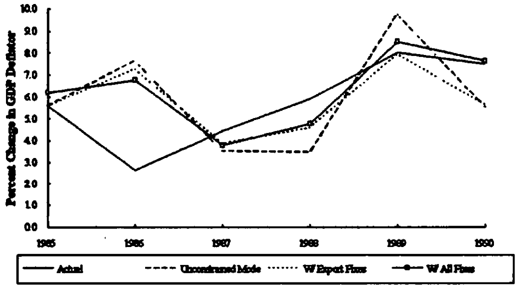


Chart V.2: BRIM Backcast of Personal Consumption ExpendituresCrosses - Historical; Squares - Predicted

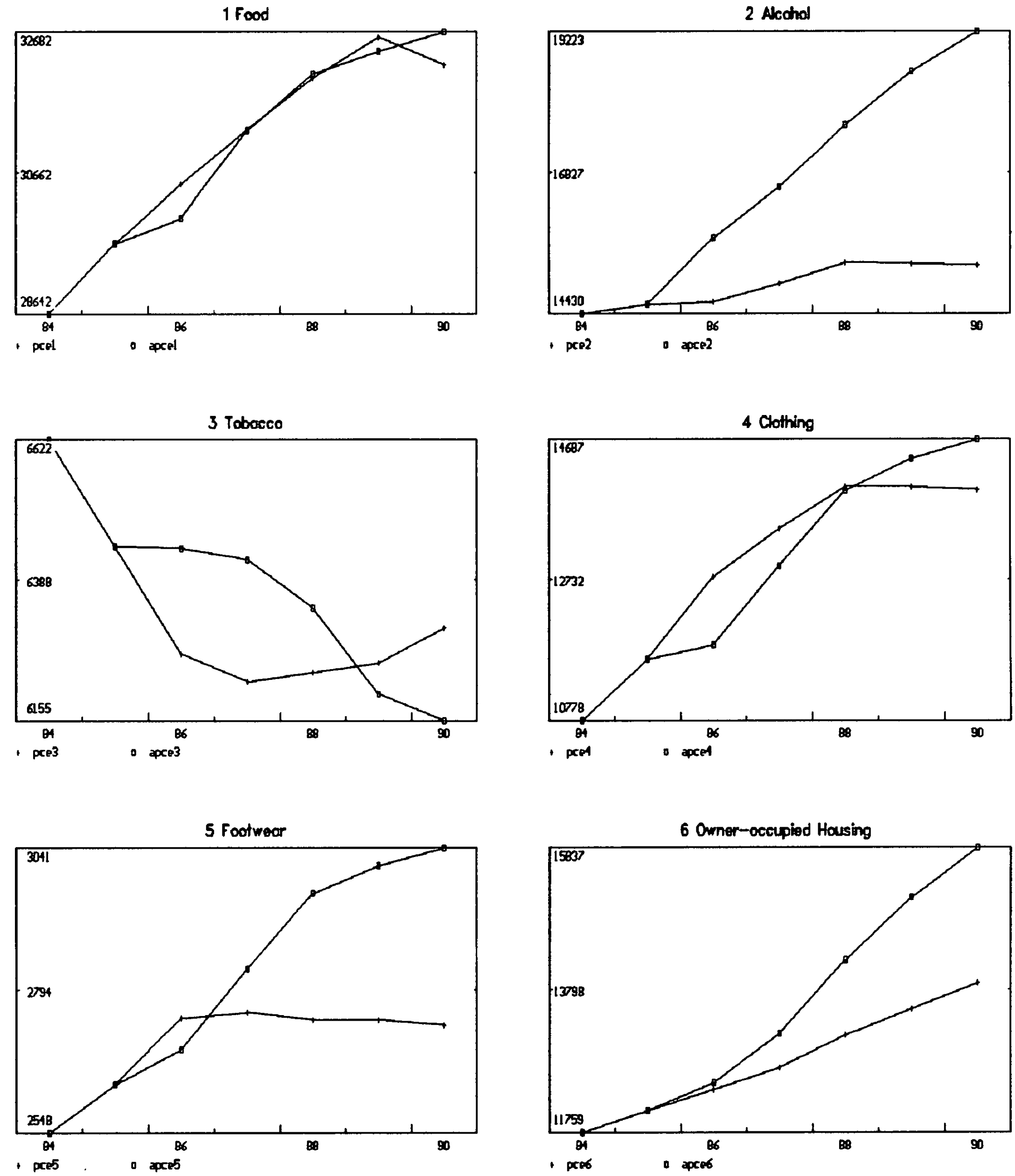


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)
Crosses - Historical; Squares - Predicted

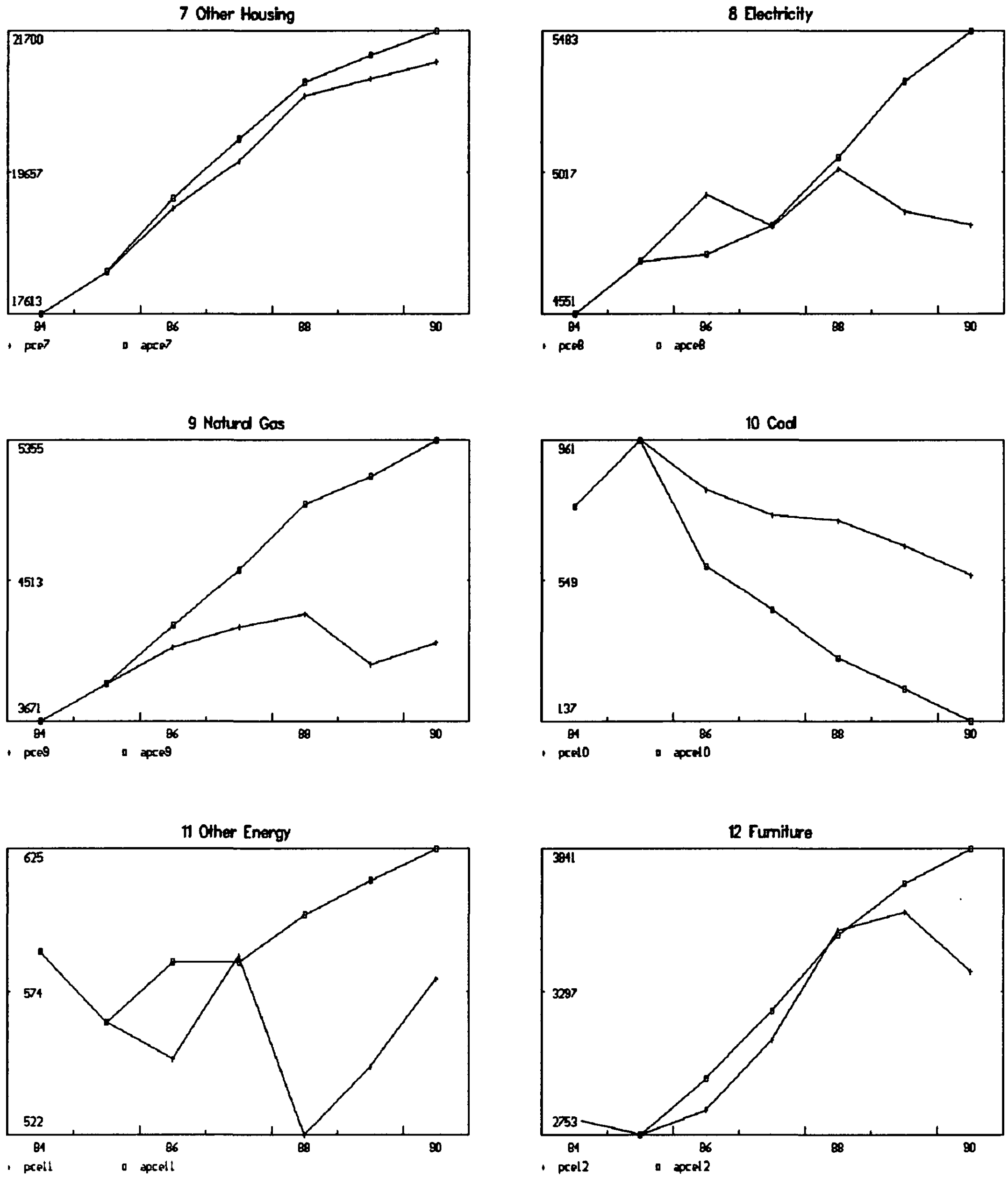


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)
Crosses - Historical; Squares - Predicted

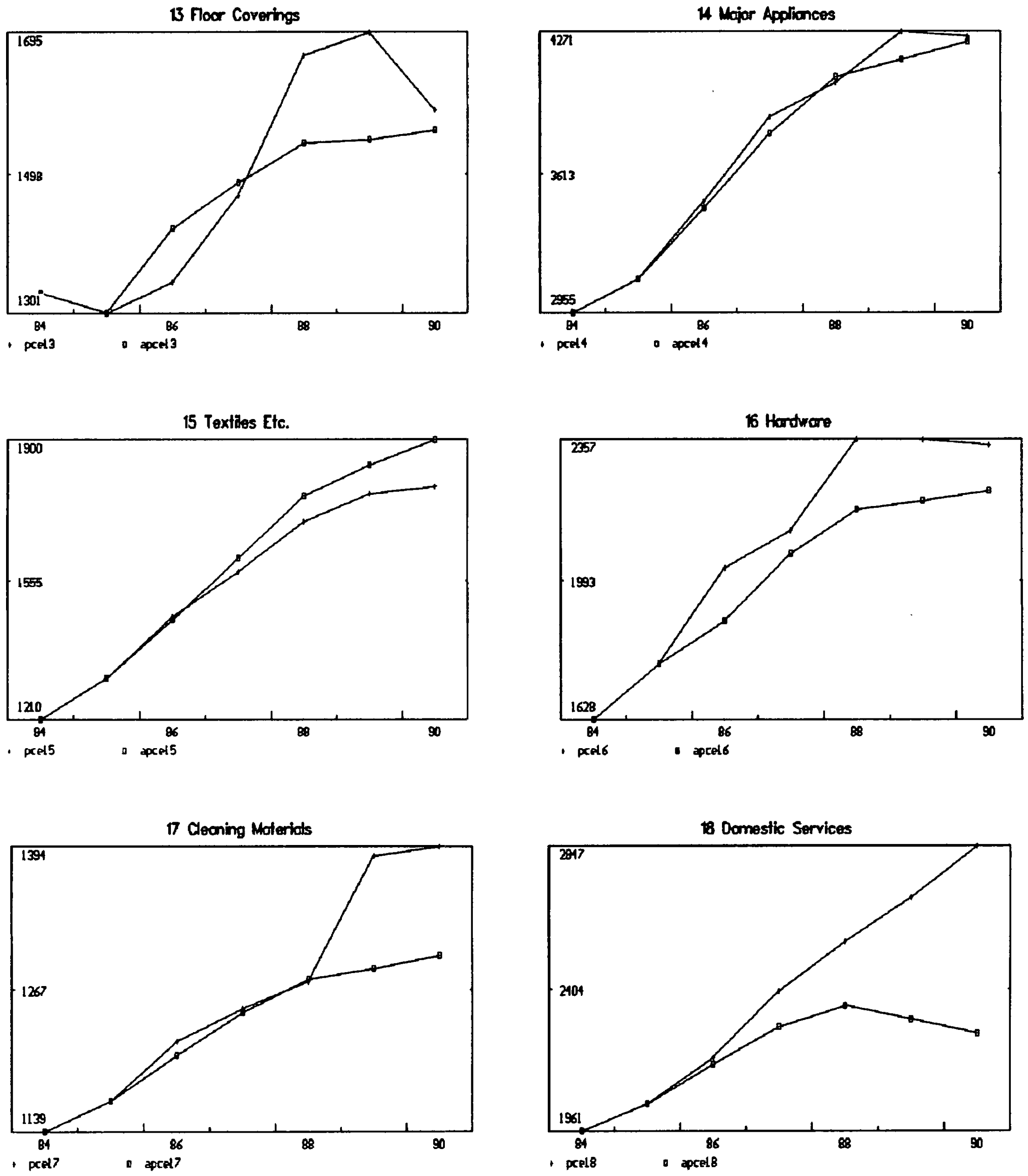
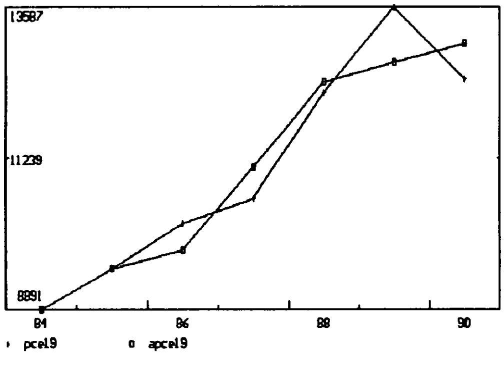
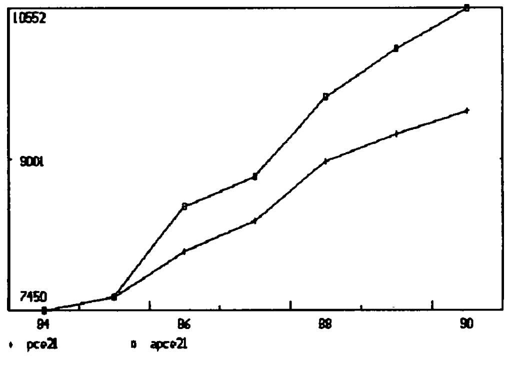


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)
Crosses - Historical; Squares - Predicted

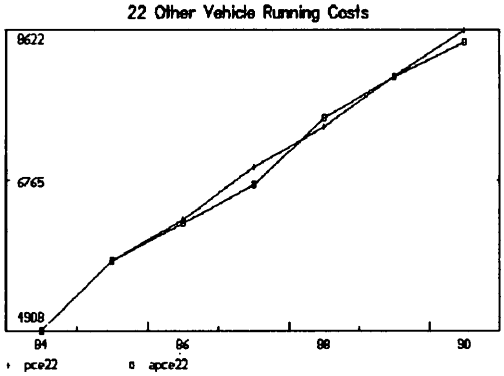
19 Motor Vehicles



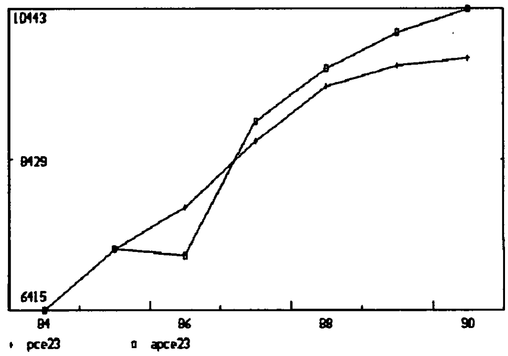
21 Petrol



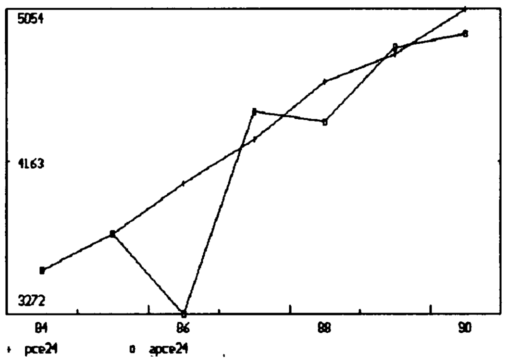
22 Other Vehicle Running Costs



23 Travel



24 Post & Telecomm.



25 Other Durables

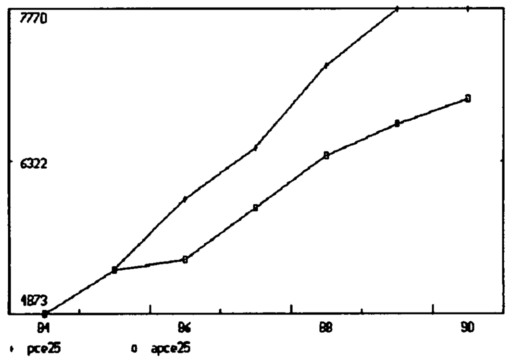


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)Crosses - Historical; Squares - Predicted

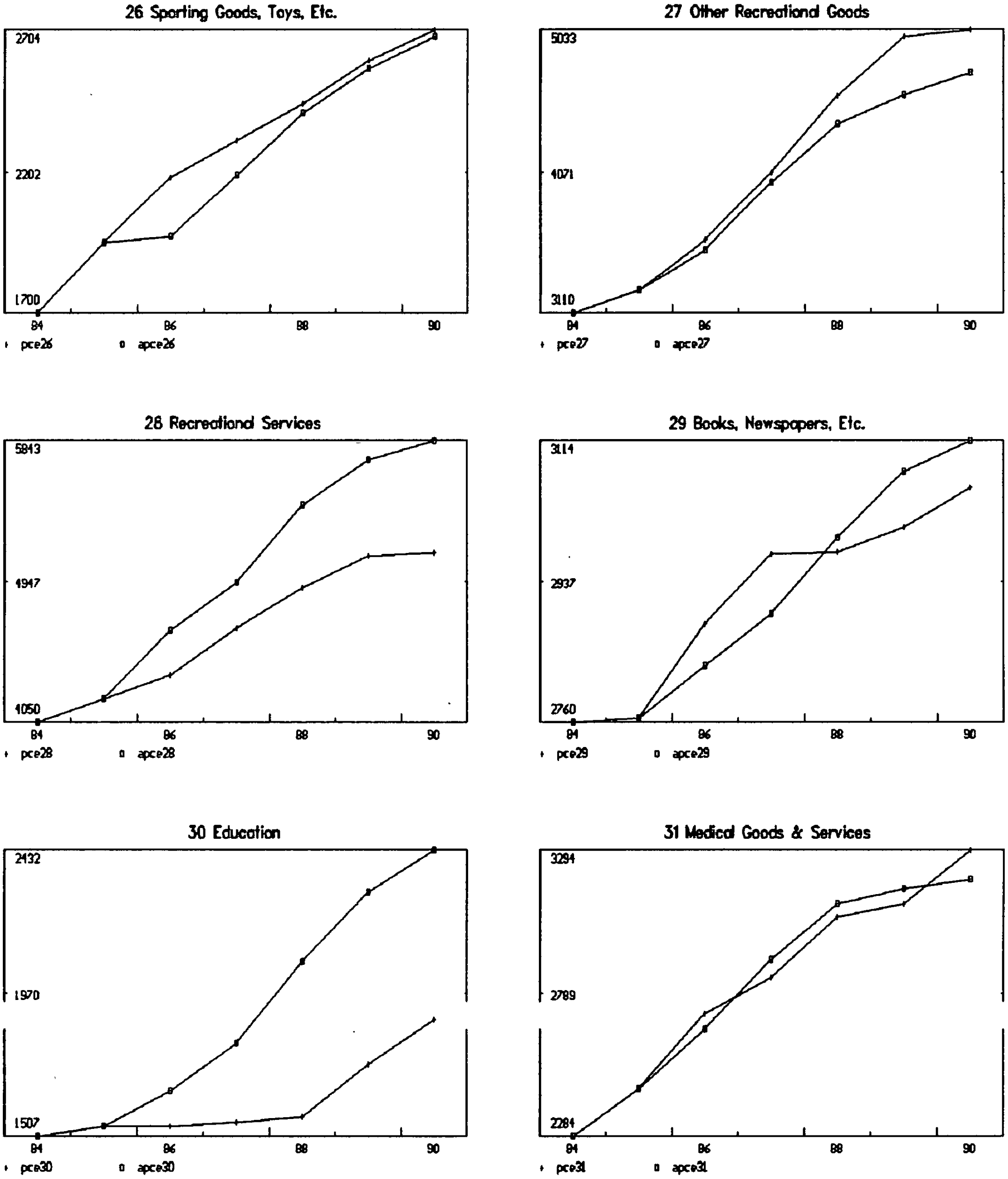


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)
Crosses - Historical; Squares - Predicted

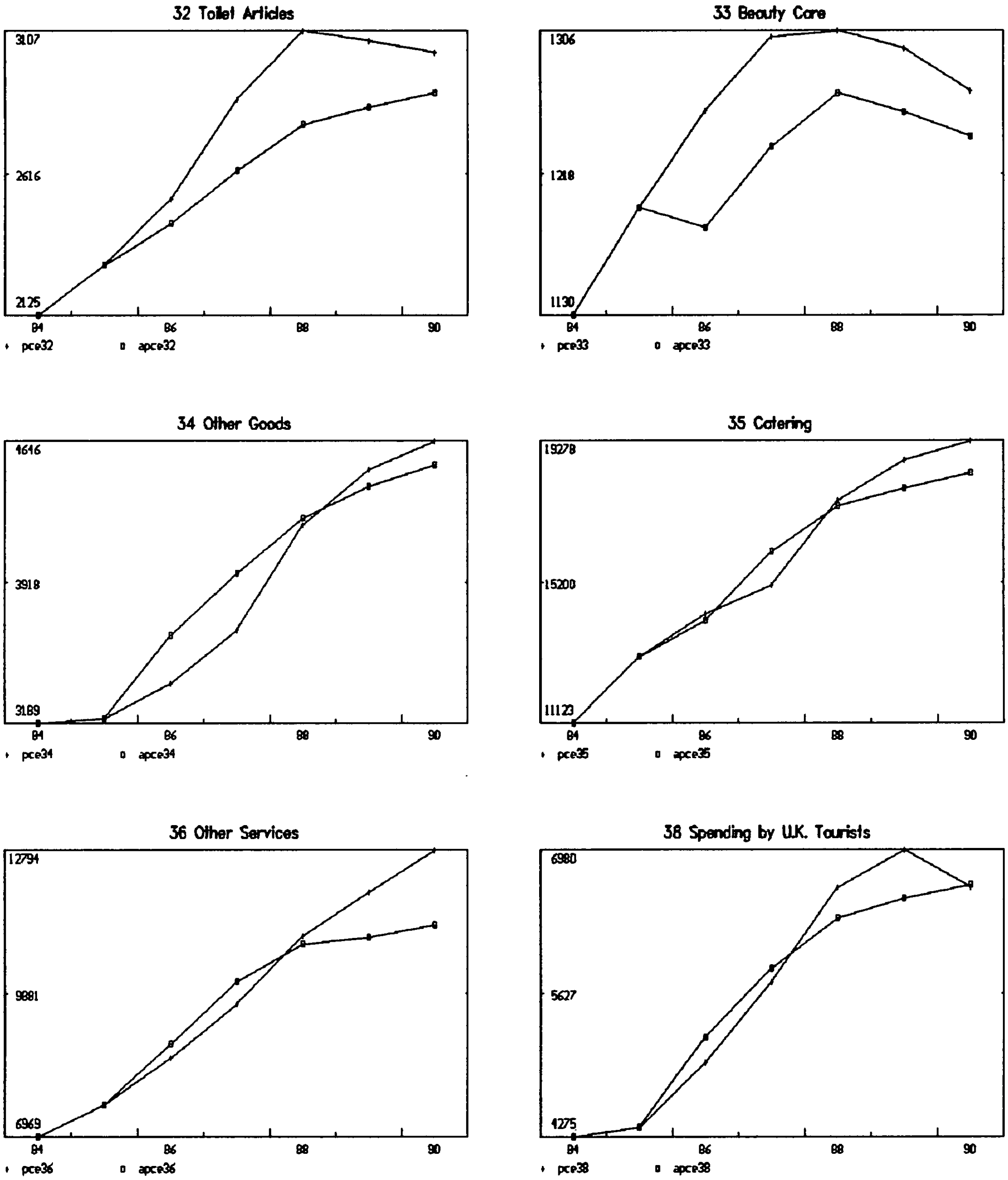
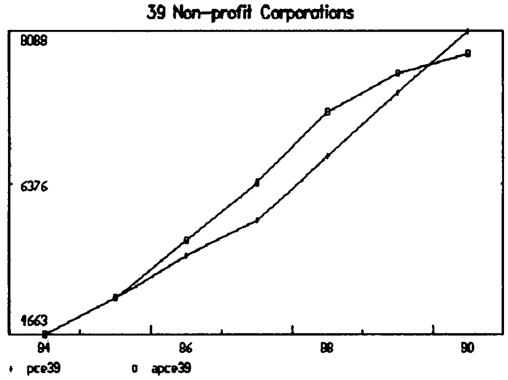


Chart V.2: BRIM Backcast of Personal Consumption Expenditures (Continued)
Crosses - Historical; Squares - Predicted



Forecasting through 2000. Table V.6 and Chart V.3 show the basic BRIM forecast through the year 2000 with sectoral gross profits adjusted as described in the previous section on backcasting, and with total real export growth constrained to its actual value for 1991. Government spending is generally constrained to grow at its levels over the 1980's: defense spending falls by 1% per year, spending on health rises by 1.2% annually, other central government expenditures 2%, and local government spending 1.3%. M5 money supply grows by 6.2% in 1991, 3.2% in 1992 (historical levels), 6.2% in 1993, and 14% thereafter — its average growth rate during the 1980's.

The model captures the 1991 recession; however, because it fails to simulate a rise in savings in the face of declining personal income, the model fails to measure the decline in personal consumption expenditures that actually took place and therefore fails to gauge the recession's severity accurately. Even so, investment falls by considerably more than was actually the case in 1991, and because labor productivity continues to grow at a relatively fast pace, unemployment jumps above 10% rather than just over 8% as actually occurred. (Unemployment did not reach 10% until well into 1992.) Nevertheless in broad outline the model reflects the development of the 1991 recession rather well.

In the forecast for 1992, however, the economy is pulled out of recession by an 8% jump in exports which, in fact, did not happen. (As with the backcast exercise, the forecast relies on an outdated INFORUM forecast of foreign demand.) Rather than adjust 1992 export growth to its historical value, I have left this anomaly in the forecast to call attention to just how dependent the model is on an accurate forecast of foreign demand. An examination of the graphs of the expenditure components of GDP in Chart V.3 shows that the growth patterns of GDP and all of its non-Government components are nearly mirror images of the growth trend in exports. This, I believe, is an accurate reflection of just how dependent the British economy is on international trade.

This dependence on trade, however, raises several important modeling issues. First, it emphasizes the importance of embedding British economic models in an international system — such as the INFORUM system — that yields mutually interdependent macroeconomic forecasts of the country's major trading partners. Second, it underscores the importance of forecasting exchange rate movements and, therefore, forecasting international capital asset flows in response to current and expected British and foreign real, financial and monetary developments. At present, however, BRIM has no exchange rate; inflation affects international trade by raising the 1984-based price indices for British commodities above the (unchanged) price indices of imports, thus raising the relative price of British commodities on international markets, reducing foreign demand for British exports, making foreign commodities more attractive but lowering overall demand by reducing total domestic income in Britain. This approach makes no allowance for exchange rate movements motivated by even rather general trends toward purchasing power parity, interest rate parity, or long-run rate-of-return parity. This is a problem with the model that needs to be addressed.

Another serious problem with the forecast is that the savings equation is a complete failure. Model savings simply trend downwards and would quickly turn negative if I had not imposed a simple constraint. The problem evidently is that the estimated equation fails to maintain a constant savings rate in the absence of a shock; with constant output, income, prices and automobile purchases, savings fall to zero within a few years. This failure is surprising, given how well the equation performs over the historical period, but it is an interesting example of how an apparently useful equation, on close inspection, does not represent structural features of the economy as well as one initially thought.

Leaving aside these modeling issues, the most interesting thing about the base forecast is that it predicts an extended period of unemployment rates in excess of 10%, as the British economy experienced during the early- and mid-1980's. If the model is at all accurate in this respect, it suggests that the British economy simply will not be capable of expanding rapidly enough to continue to absorb the net increase in the labor force over the coming decade.

Policy simulations: Government spending cut. I have implemented three policy simulations in the model, examining the effects of changes in government spending, income taxation, and monetary policy. The first simulation, shown in Table V.7, shows the effect of a 10% cut in total government spending in 1991, followed by a resumption of the growth rates described above for the components of government spending. The cut in spending triggers a recession from which the economy does not recover until 1994; employment, personal income and consumption remain below the base forecast throughout the demand. Because inflation declines dramatically, exports fare quite well, and investment and GDP rise above baseline by the end of the decade. By 2000, GDP is about 1% higher than in the base case. Because the cut in government spending falls largely on low-productivity government services, productivity rises relative to the base case. The government deficit *increases* relative to baseline despite the reduction in spending, because tax revenues fall by even more than spending. (Remember however that the model has government interest payment on the debt gradually rising in real terms but not actually reflecting the stock of government debt.)

The trade effects work in the direction that theory would suggest: in the short run, a fiscal contraction would be expected to lead to lower income and a capital outflow, resulting in an exchange rate depreciation and a trade surplus (while in the longer run, lower foreign debt service would lead to an appreciation and trade surplus relative to the base case). In BRIM, in the absence of exchange rate effects, the deflation resulting from the contraction leads to a lower relative export price and an increase in real exports.

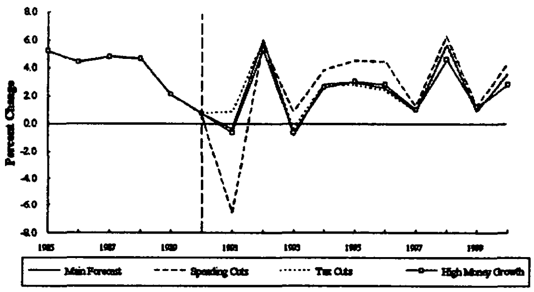
Income tax cut. The second simulation, shown in Table V.8, models the effect of a permanent 10% cut in both personal and corporate income taxes. In this case, the economy expands above baseline throughout the decade, with all components of GDP exceeding their base case levels except for exports, which fall very slightly because slightly higher inflation rates keep their price slightly higher relative to the baseline. Unemployment falls relative to the baseline by one to two percentage points, and the government surplus consistently remains about £5 billion higher in current terms relative to the baseline. The overall trade effects work in the right direction but seem quite small relative to what intuition would expect from such a large tax cut.

Monetary expansion. The third simulation, shown in Table V.9, models the effect of an increase in the rate of growth of the M5 money supply from 14% to 18% for the entire decade. Higher money growth leads to considerably higher inflation — the price level rises nearly twice as much over the decade as it does in the base forecast — but the only noticeable effects on real activity are an increase in real disposable income and consumption, due to an increase in labor's share of total income, and a decrease in exports, due to an increase in their price relative to that of foreign commodities. The trade effects, however, are not consistent with theory: although the short-run effects of a monetary expansion are ambiguous, the long-run effects should be fairly neutral since the rising price level should lead to a roughly equivalent exchange rate depreciation. In BRIM, in contrast, exports are reduced significantly as their price level is driven above that of foreign competitors'.

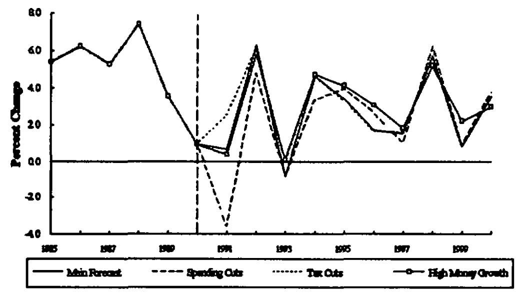
As a first approximation to long-run trends, then, the results of these simulations are fairly good, though further attention needs to paid to the international sector.

Chart V.2: BRIM Forecasts to 2000

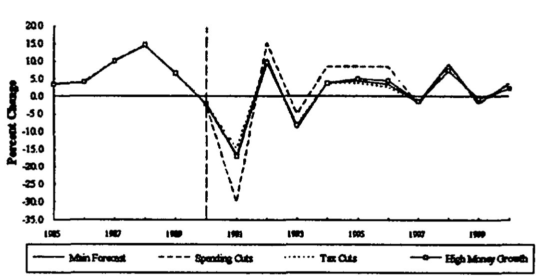
Gross Domestic Product (1984 £)



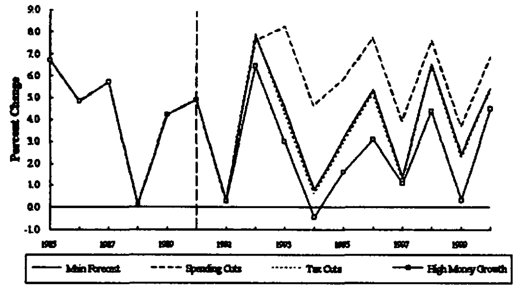
Personal Consumption (1984 £)



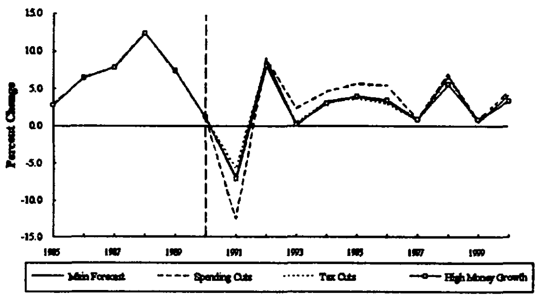
Gross Domestic Fixed Capital Formation (1984 £)



Exports (1984 £)



Imports (1984 £)



Personal Disposable Income (1984 £)

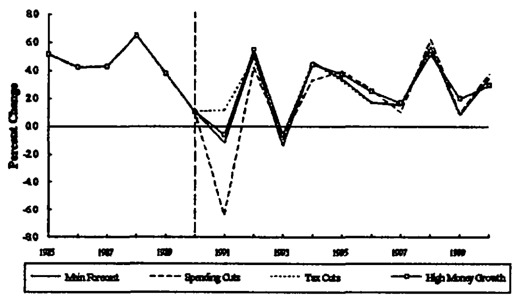
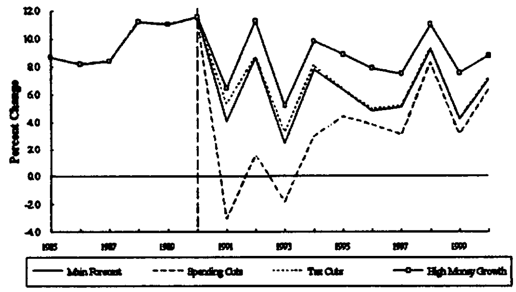
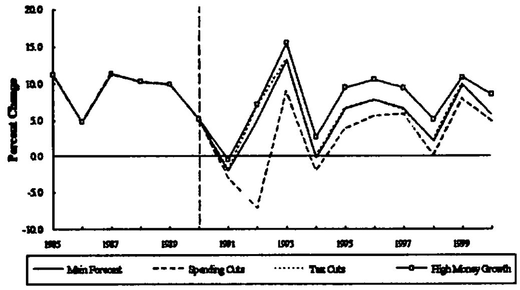


Chart V.2: BRIM Forecasts to 2000 (Continued)

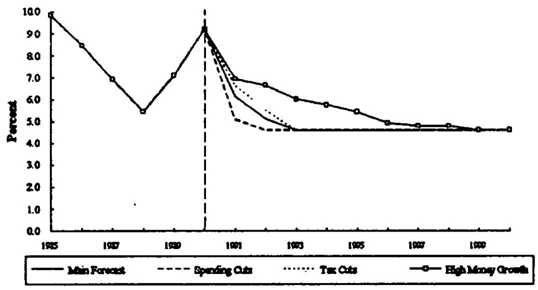
Income From Employment (Current £)



Gross Profits, Etc. (Current £)

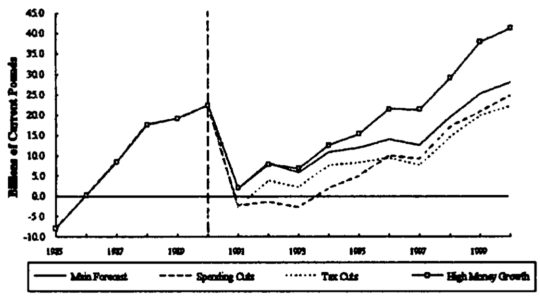


Personal Savings Rate



Corporate Undistributed Profits (Current £)

Government Surplus (Current £)



Unemployment Rate

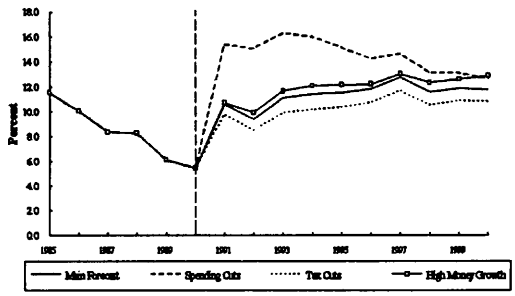
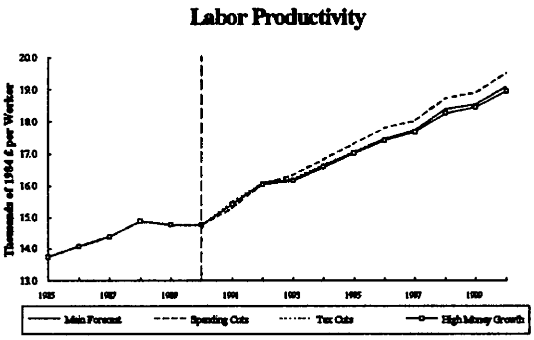


Chart V.2: BRIM Forecasts to 2000 (Continued)



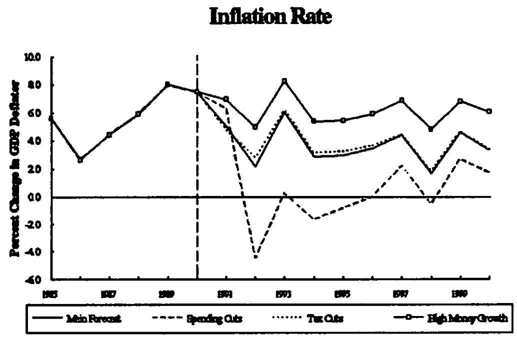


Table V.6: BRIM Forecast With Profits Adjusted

	1990	1991	1992	1993	1994	1995	2000
Constant 1984 Prices							
Consumers' expenditure	259.24	261.04	277.51	275.23	287.93	297.73	339.29
General government final consump.	75.07	75.74	76.44	77.14	77.86	78.60	82.50
Central government	45.69	45.99	46.29	46.61	46.93	47.27	49.08
Local government	29.37	29.76	30.14	30.54	30.93	31.33	33.42
Gross domestic fixed capital for.	78.03	65.12	72.12	65.65	68.30	71.42	80.93
Value of physical increase in							
stocks and work in progress	-0.84	-1.51	-0.06	-1.38	-2.07	-1.71	-2.50
Exports of goods and services	119.04	119.37	128.69	134.61	135.66	139.91	171.92
0 Total Final Expenditure	530.53	519.77	554.69	551.26	567.69	585.95	672.14
less Imports of goods & services	133.65	124.37	135.38	135.41	139.91	145.40	168.84
Gross domestic product (mkt.prices)	396.88	395.39	419.31	415.85	427.78	440.55	503.30
Net property income from abroad	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Gross national product (mkt.prices)	399.78	398.60	421.16	418.82	430.22	443.55	505.55
Current Prices							
Consumers' expenditure	354.24	376.67	409.51	431.18	463.95	494.95	674.14
General government final consump.	107.85	117.89	126.31	130.21	136.32	146.00	192.72
Central government	64.87	70.64	75.27	77.55	80.96	86.22	112.11
Local government	42.98	47.25	51.04	52.67	55.36	59.79	80.61
Gross domestic fixed capital for.	107.88	93.18	103.10	101.22	105.44	113.91	150.18
Value of physical increase in							
stocks and work in progress	-1.34	-2.30	-0.48	-2.45	-3.63	-3.18	-5.58
Exports of goods and services	141.90	153.50	168.48	188.01	194.64	205.22	297.53
0 Total Final Expenditure	710.54	738.93	806.93	848.18	896.71	956.90	1308.98
less Imports of goods & services	158.21	161.49	184.29	191.02	202.87	222.19	321.93
Gross domestic product (mkt.prices)	552.52	578.59	625.04	658.91	696.08	739.05	999.64
Net property income from abroad	4.03	4.23	4.32	4.58	4.71	4.85	5.76
Gross national product (mkt.prices)	556.55	582.82	629.36	663.49	700.80	743.90	1005.40
less Net taxes on expenditure	72.85	85.76	92.47	98.03	104.39	110.62	149.27
0Gross national product (fact. cost)	483.70	497.06	536.90	565.46	596.40	633.28	856.12
less Capital consumption	54.74	57.83	59.12	64.56	65.87	68.88	88.24
0National income	428.96	439.23	477.77	500.90	530.54	564.40	767.89
Factor incomes							
Income from employment	316.41	329.34	357.92	366.82	395.43	420.64	566.01
Income from self-employment	57.66	59.48	67.20	68.97	76.51	83.59	126.04
Corporate gross profits, etc.	71.75	69.37	67.44	87.07	74.90	76.58	94.59
Gross trading surplus of pub.							
Rent	34.06	36.90	38.98	42.54	45.05	47.73	65.61
Capital consump., non-trading	4.10	4.37	4.53	4.87	5.07	5.28	6.61
Equals:							
Total domestic income	483.98	499.47	536.07	570.27	596.95	633.81	858.87
Minus:							
Stock appreciation	6.39	6.83	3.17	9.31	4.56	5.08	7.75
Equals:							
Gross domestic product (income)	477.59	492.64	532.90	560.95	592.40	628.73	851.12
Plus:							
Residual error	-0.52	0.00	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	72.85	85.76	92.47	98.03	104.39	110.62	149.27
Equals:							
0 Gross domestic product (exp.mkt.)	549.92	578.39	625.36	658.98	696.79	739.35	1000.39
Gross domestic product (expend.)	552.52	578.59	625.04	658.91	696.08	739.05	999.64
0 Difference	2.60	0.19	-0.32	-0.07	-0.71	-0.30	-0.75
Addenda:							
Gross profits, etc. from I-O	187.92	183.98	193.12	218.57	217.97	232.41	316.92
Adj. financial services	26.74	20.67	18.15	24.43	21.00	24.31	31.81
Personal Sector							
Income from Employment	316.41	329.34	357.92	366.82	395.43	420.64	566.01
Income from self-employment	57.66	59.48	67.20	68.97	76.51	83.59	126.04
Imputed rent	20.58	22.37	23.68	26.00	27.66	29.43	41.20
Other rent	4.13	4.48	4.73	5.18	5.50	5.85	8.13
Interest and dividends	71.82	63.46	68.08	70.30	75.39	79.55	104.48
Credit for corporate tax	6.14	6.40	6.92	7.21	7.76	8.26	11.25
Social security benefits	49.50	59.18	61.09	68.22	72.52	76.47	102.67
Other government grants	13.54	14.66	15.46	16.78	17.73	18.71	25.13
Other current transfers	2.90	3.04	3.28	3.46	3.65	3.87	5.20
Capital consumption by NPMB's	0.61	0.64	0.65	0.69	0.71	0.73	0.86
Minus:							
Interest payments	51.68	50.55	55.27	56.65	61.35	65.55	89.97
Equals:							
Total personal income	491.62	512.49	553.74	576.96	621.50	661.54	901.03
Minus:							
Personal income taxes	60.26	62.82	67.88	70.72	76.18	81.09	110.45
Social security contributions	34.79	36.16	39.54	40.53	43.89	46.89	64.36
Other current transfers	12.08	12.68	13.12	13.89	14.38	14.92	18.30
Equals:							
Personal disposable income	384.49	400.83	433.20	451.82	487.05	518.64	707.91
Of which:							
Personal consumption expenditures	354.24	376.67	409.51	431.18	463.95	494.95	674.14
Saving	35.37	24.56	22.27	20.78	22.40	23.85	32.55
Real personal disposable income	281.37	278.09	292.54	288.50	301.81	312.08	355.64
Personal savings rate	9.20	6.13	5.14	4.60	4.60	4.60	4.60

Table V.6: BRIM Forecast With Profits Adjusted (Continued)

	1990	1991	1992	1993	1994	1995	2000
Corporate Sector							
Gross profits, etc.	71.75	69.37	67.44	87.07	74.90	76.58	94.59
Interest and dividends	55.25	48.82	52.37	54.08	57.99	61.19	80.37
Rent	5.98	6.62	7.16	7.86	8.40	8.96	12.73
Income from abroad	28.45	29.88	30.54	32.38	33.29	34.28	40.64
Minus:							
Interest and dividends	84.88	57.52	64.40	61.02	71.76	76.56	103.49
Transfers to charities	0.14	0.15	0.15	0.16	0.17	0.17	0.20
Profits due abroad	7.28	6.26	5.59	9.51	6.41	6.48	8.55
Corporate income taxes	24.37	23.35	23.78	27.38	26.36	27.33	34.47
Royalties etc. on oil and gas	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Equals:							
Undistributed profits	43.33	65.91	62.05	81.76	68.35	68.91	80.14
Corp.gr.pr. share of IO Gross Pr.	38.18	37.71	34.92	39.83	34.36	32.95	29.85
Government Sector							
Personal income taxes	60.26	62.82	67.88	70.72	76.18	81.09	110.45
Corporate income taxes	24.37	23.35	23.78	27.38	26.36	27.33	34.47
Minus:							
Credit for corporate tax	6.14	6.40	6.92	7.21	7.76	8.26	11.25
Plus:							
Net taxes on expenditure	72.85	85.76	92.47	98.03	104.39	110.62	149.27
Social security contributions	34.79	36.16	39.54	40.53	43.89	46.89	64.36
Gross trading surplus							
Rent	3.37	3.43	3.40	3.50	3.49	3.49	3.55
Royalties and fees from oil	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Interest and dividends	16.66	1.85	6.10	4.01	8.19	10.95	26.26
Misc. current transfers(personal)	9.31	9.78	10.00	10.60	10.90	11.22	13.31
Cap. consump., non-trading cap.	3.50	3.74	3.88	4.18	4.36	4.55	5.75
Minus:							
Final consumption	107.85	117.89	126.31	130.21	136.32	146.00	192.72
Social security benefits	49.50	59.18	61.09	68.22	72.52	76.47	102.67
Other government grants to pers.	13.54	14.66	15.46	16.78	17.73	18.71	25.13
Net external transfers	-2.76	-2.89	-3.13	-3.29	-3.48	-3.70	-5.00
Debt interest	24.31	25.46	27.50	28.99	30.63	32.52	43.98
Equals:							
Current surplus	22.42	1.93	8.17	5.79	10.86	12.03	28.13
External Sector							
Exports	141.90	153.50	168.48	188.01	194.64	205.22	297.53
Property income net of taxes	81.29	85.38	87.26	92.50	95.11	97.93	116.12
Transfers to persons	2.76	2.89	3.13	3.29	3.48	3.70	5.00
Transfers to government	3.32	3.47	3.75	3.95	4.18	4.43	6.00
Minus:							
Imports	158.21	161.49	184.29	191.02	202.87	222.19	321.93
Property income net of taxes	77.26	81.14	82.93	87.92	90.40	93.08	110.37
Transfers from persons	2.76	2.89	3.13	3.29	3.48	3.70	5.00
Transfers from government	6.08	6.36	6.88	7.25	7.66	8.13	11.00
Equals:							
Net investment abroad	-15.04	-6.65	-14.60	-1.73	-7.00	-15.81	-23.65
Addenda:							
Home population	57.41	57.53	57.72	57.90	58.09	58.28	59.05
Total working population	28.44	28.64	28.74	28.89	29.04	29.19	29.87
0 Total employed	26.88	25.60	26.04	25.67	25.72	25.82	26.34
Her Majesty's Forces	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Government training programs	0.42	0.40	0.40	0.40	0.40	0.40	0.40
Employees in employment	22.86	21.66	21.92	21.50	21.40	21.37	21.22
Self-employed	3.30	3.23	3.42	3.48	3.61	3.75	4.42
Unemployed	1.56	3.04	2.70	3.22	3.33	3.37	3.53
Unemployment rate	5.47	10.61	9.39	11.14	11.46	11.55	11.82
Aggregate labor productivity	14.76	15.45	16.10	16.20	16.63	17.06	19.11
Real income from employment	9.94	10.39	10.95	10.77	11.35	11.73	13.42
Real income from self-employment	12.69	12.57	13.17	12.52	13.02	13.28	14.36
Average wage	13.84	15.19	16.36	17.06	18.49	19.68	26.69
Price index, PCE	1.37	1.44	1.48	1.57	1.61	1.66	1.99
Price index, GDP	1.39	1.46	1.49	1.58	1.63	1.68	1.99

Table V.7: BRIM Forecast With Spending Cut

	1990	1991	1992	1993	1994	1995	2000
	----	----	----	----	----	----	----
Constant 1984 Prices							
Consumers' expenditure	259.24	249.89	261.80	259.85	268.47	279.14	321.99
General government final consump.	75.07	67.56	68.17	68.79	69.43	70.08	73.52
Central government	45.69	41.12	41.39	41.66	41.95	42.24	43.83
Local government	29.37	26.44	26.78	27.13	27.48	27.84	29.70
Gross domestic fixed capital for.	78.03	54.59	62.86	59.79	64.89	70.46	82.53
Value of physical increase in							
stocks and work in progress	-0.84	-3.70	-1.87	-1.65	-1.24	-0.38	-1.29
Exports of goods and services	119.04	119.37	128.42	139.00	145.43	153.95	205.41
0 Total Final Expenditure	530.53	487.71	519.39	525.78	546.98	573.24	682.16
less Imports of goods & services	133.65	116.92	127.43	130.43	136.42	144.18	172.84
Gross domestic product (mkt.prices)	396.88	370.79	391.96	395.35	410.56	429.07	509.33
Net property income from abroad	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Gross national product (mkt.prices)	399.78	374.57	394.15	398.24	412.72	431.47	511.41
Current Prices							
Consumers' expenditure	354.24	365.08	370.37	370.62	380.86	396.39	504.05
General government final consump.	107.85	104.01	105.76	104.73	104.89	109.54	132.51
Central government	64.87	62.82	63.66	62.72	62.80	65.20	77.91
Local government	42.98	41.18	42.10	42.01	42.10	44.34	54.60
Gross domestic fixed capital for.	107.88	81.51	86.77	87.10	91.29	99.42	125.32
Value of physical increase in							
stocks and work in progress	-1.34	-5.41	-2.78	-2.49	-1.83	-0.52	-1.44
Exports of goods and services	141.90	155.62	162.77	179.62	187.20	197.43	288.69
0 Total Final Expenditure	710.54	700.80	722.88	739.58	762.43	802.26	1049.13
less Imports of goods & services	158.21	151.78	173.45	183.99	197.84	220.30	329.91
Gross domestic product (mkt.prices)	552.52	550.04	553.04	560.44	571.91	592.97	748.08
Net property income from abroad	4.03	4.28	4.09	4.10	4.04	4.00	4.26
Gross national product (mkt.prices)	556.55	554.33	557.13	564.55	575.95	596.97	752.34
less Net taxes on expenditure	72.85	82.72	82.65	83.31	85.10	87.63	109.13
0Gross national product (fact. cost)	483.70	471.60	474.48	481.23	490.85	509.35	643.21
less Capital consumption	54.74	59.72	56.51	59.90	58.93	60.04	73.26
0National income	428.96	411.88	417.97	421.33	431.91	449.30	569.96
Factor incomes							
Income from employment	316.41	306.78	311.54	305.93	315.00	329.01	418.64
Income from self-employment	57.66	52.90	55.64	54.94	58.29	63.05	91.94
Corporate gross profits, etc.	71.75	74.27	56.52	73.67	67.91	67.10	75.73
Gross trading surplus of pub.							
Rent	34.06	37.16	36.52	37.58	38.00	38.69	47.62
Capital consump., non-trading	4.10	4.43	4.29	4.35	4.34	4.36	4.89
Equals:							
Total domestic income	483.98	475.53	464.51	476.48	483.54	502.21	638.82
Minus:							
Stock appreciation	6.39	8.14	-6.00	0.29	-2.22	-1.30	2.91
Equals:							
Gross domestic product (income)	477.59	467.39	470.51	476.19	485.76	503.51	635.91
Plus:							
Residual error	-0.52	0.00	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	72.85	82.72	82.65	83.31	85.10	87.63	109.13
Equals:							
0 Gross domestic product (exp.mkt.)	549.92	550.12	553.16	559.50	570.86	591.14	745.04
Gross domestic product (expend.)	552.52	550.04	553.04	560.44	571.91	592.97	748.08
0 Difference	2.60	-0.07	-0.12	0.95	1.05	1.83	3.04
Addenda:							
Gross profits, etc. from I-O	187.92	182.19	169.25	184.34	180.47	187.40	237.77
Adj. financial services	26.74	21.58	10.28	14.08	9.71	12.89	20.49
Personal Sector							
Income from Employment	316.41	306.78	311.54	305.93	315.00	329.01	418.64
Income from self-employment	57.66	52.90	55.64	54.94	58.29	63.05	91.94
Imputed rent	20.58	22.64	22.38	23.21	23.59	24.13	30.02
Other rent	4.13	4.53	4.47	4.63	4.70	4.79	5.92
Interest and dividends	71.82	59.86	60.67	60.15	61.80	63.76	78.12
Credit for corporate tax	6.14	6.12	6.20	6.18	6.36	6.62	8.41
Social security benefits	49.50	65.23	64.87	68.05	69.16	69.66	82.02
Other government grants	13.54	14.81	14.81	15.28	15.62	16.02	19.81
Other current transfers	2.90	2.90	2.91	2.95	3.00	3.11	3.89
Capital consumption by NPMB's	0.61	0.64	0.61	0.62	0.61	0.60	0.64
Minus:							
Interest payments	51.68	46.76	47.73	46.91	48.53	50.97	66.38
Equals:							
Total personal income	491.62	489.66	496.37	495.03	509.60	529.77	673.04
Minus:							
Personal income taxes	60.26	60.02	60.85	60.68	62.47	64.94	82.50
Social security contributions	34.79	33.45	34.15	33.56	34.72	36.46	47.48
Other current transfers	12.08	12.65	12.22	12.29	12.20	12.22	13.58
Equals:							
Personal disposable income	384.49	383.53	389.16	388.50	400.22	416.15	529.47
Of which:							
Personal consumption expenditures	354.24	365.08	370.37	370.62	380.86	396.39	504.05
Saving	35.37	19.61	17.89	17.86	18.40	19.14	24.35
Real personal disposable income	281.37	263.35	274.42	272.38	281.42	292.59	337.51
Personal savings rate	9.20	5.11	4.60	4.60	4.60	4.60	4.60

Table V.7: BRIM Forecast With Spending Cut (Continued)

	1990	1991	1992	1993	1994	1995	2000
Corporate Sector							
Gross profits, etc.	71.75	74.27	56.52	73.67	67.91	67.10	75.73
Interest and dividends	55.25	46.05	46.67	46.27	47.54	49.05	60.10
Rent	5.98	6.52	6.45	6.60	6.72	6.89	9.05
Income from abroad	28.45	30.24	28.89	28.97	28.52	28.28	30.06
Minus:							
Interest and dividends	84.88	49.81	57.35	52.16	57.13	60.37	77.61
Transfers to charities	0.14	0.15	0.14	0.14	0.14	0.14	0.15
Profits due abroad	7.28	7.26	3.61	7.53	6.36	6.25	7.65
Corporate income taxes	24.37	23.71	20.91	23.48	22.75	22.84	26.41
Royalties etc. on oil and gas	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Equals:							
Undistributed profits	43.33	74.63	54.97	70.65	62.77	60.16	61.64
Corp.gr.pr. share of IO Gross Pr.	38.18	40.76	33.40	39.97	37.63	35.81	31.85
Government Sector							
Personal income taxes	60.26	60.02	60.85	60.68	62.47	64.94	82.50
Corporate income taxes	24.37	23.71	20.91	23.48	22.75	22.84	26.41
Minus:							
Credit for corporate tax	6.14	6.12	6.20	6.18	6.36	6.62	8.41
Plus:							
Net taxes on expenditure	72.85	82.72	82.65	83.31	85.10	87.63	109.13
Social security contributions	34.79	33.45	34.15	33.56	34.72	36.46	47.48
Gross trading surplus							
Rent	3.37	3.47	3.22	3.13	2.99	2.88	2.63
Royalties and fees from oil	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Interest and dividends	16.66	-3.84	0.89	-0.01	3.37	6.60	20.52
Misc. current transfers(personal)	9.31	9.90	9.46	9.49	9.34	9.26	9.84
Cap. consump., non-trading cap.	3.50	3.78	3.67	3.74	3.73	3.75	4.25
Minus:							
Final consumption	107.85	104.01	105.76	104.73	104.89	109.54	132.51
Social security benefits	49.50	65.23	64.87	68.05	69.16	69.66	82.02
Other government grants to pers.	13.54	14.81	14.81	15.28	15.62	16.02	19.81
Net external transfers	-2.76	-2.75	-2.77	-2.80	-2.86	-2.96	-3.74
Debt interest	24.31	24.20	24.33	24.66	25.16	26.09	32.92
Equals:							
Current surplus	22.42	-2.38	-1.39	-2.79	1.93	5.03	24.84
External Sector							
Exports	141.90	155.62	162.77	179.62	187.20	197.43	288.69
Property income net of taxes	81.29	86.41	82.53	82.77	81.48	80.79	85.90
Transfers to persons	2.76	2.75	2.77	2.80	2.86	2.96	3.74
Transfers to government	3.32	3.30	3.32	3.36	3.43	3.56	4.49
Minus:							
Imports	158.21	151.78	173.45	183.99	197.84	220.30	329.91
Property income net of taxes	77.26	82.13	78.44	78.67	77.44	76.78	81.64
Transfers from persons	2.76	2.75	2.77	2.80	2.86	2.96	3.74
Transfers from government	6.08	6.05	6.08	6.16	6.29	6.52	8.23
Equals:							
Net investment abroad	-15.04	5.37	-9.35	-3.07	-9.46	-21.83	-40.71
Addenda:							
Home population	57.41	57.53	57.72	57.90	58.09	58.28	59.05
Total working population	28.44	28.64	28.74	28.89	29.04	29.19	29.87
0 Total employed	26.88	24.23	24.41	24.18	24.39	24.77	26.09
Her Majesty's Forces	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Government training programs	0.42	0.40	0.40	0.40	0.40	0.40	0.40
Employees in employment	22.86	20.47	20.52	20.23	20.30	20.53	21.10
Self-employed	3.30	3.05	3.19	3.26	3.39	3.55	4.28
Unemployed	1.56	4.41	4.33	4.71	4.65	4.42	3.78
Unemployment rate	5.47	15.40	15.07	16.31	16.02	15.15	12.66
Aggregate labor productivity	14.76	15.31	16.06	16.35	16.83	17.32	19.52
Real income from employment	9.94	10.11	10.75	10.67	11.13	11.59	13.50
Real income from self-employment	12.69	11.69	12.36	11.90	12.35	12.86	14.61
Average wage	13.84	14.96	15.20	15.13	15.53	16.04	19.86
Price index, PCE	1.37	1.46	1.42	1.43	1.42	1.42	1.57
Price index, GDP	1.39	1.48	1.41	1.42	1.40	1.38	1.47

Table V.8: BRIM Forecast With Income Tax Cut

	1990	1991	1992	1993	1994	1995	2000
Constant 1984 Prices							
Consumers' expenditure	259.24	265.76	281.97	282.08	295.21	304.97	347.38
General government final consump.	75.07	75.74	76.44	77.14	77.86	78.60	82.50
Central government	45.69	45.99	46.29	46.61	46.93	47.27	49.08
Local government	29.37	29.76	30.14	30.54	30.93	31.33	33.42
Gross domestic fixed capital for.	78.03	66.67	73.27	67.48	69.98	72.60	81.65
Value of physical increase in stocks and work in progress	-0.84	-1.33	0.09	-1.29	-2.10	-1.89	-2.79
Exports of goods and services	119.04	119.37	128.81	134.35	135.17	139.19	170.15
0 Total Final Expenditure	530.53	526.22	560.58	559.76	576.12	593.47	678.90
less Imports of goods & services	133.65	126.00	136.72	137.31	141.75	146.90	170.00
Gross domestic product (mkt.prices)	396.88	400.23	423.86	422.45	434.38	446.57	508.89
Net property income from abroad	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Gross national product (mkt.prices)	399.78	403.22	425.87	425.42	436.87	449.64	511.12
Current Prices							
Consumers' expenditure	354.24	382.54	417.62	443.93	479.26	511.77	700.05
General government final consump.	107.85	118.17	126.53	131.15	137.47	147.44	195.64
Central government	64.87	70.77	75.40	78.08	81.61	87.04	113.76
Local government	42.98	47.40	51.13	53.07	55.85	60.39	81.88
Gross domestic fixed capital for.	107.88	94.91	105.09	104.13	108.55	116.52	153.26
Value of physical increase in stocks and work in progress	-1.34	-2.07	-0.28	-2.34	-3.72	-3.52	-6.31
Exports of goods and services	141.90	153.22	169.18	188.39	195.07	205.81	298.12
0 Total Final Expenditure	710.54	746.76	818.13	865.25	916.63	978.02	1340.76
less Imports of goods & services	158.21	163.56	186.16	193.73	205.53	224.48	324.04
Gross domestic product (mkt.prices)	552.52	584.27	634.52	673.13	713.07	757.48	1028.33
Net property income from abroad	4.03	4.22	4.34	4.61	4.76	4.91	5.86
Gross national product (mkt.prices)	556.55	588.49	638.86	677.74	717.82	762.38	1034.18
less Net taxes on expenditure	72.85	86.77	94.08	100.47	107.35	113.90	154.40
0Gross national product (fact. cost)	483.70	501.72	544.78	577.27	610.47	648.48	879.78
less Capital consumption	54.74	57.65	59.29	64.89	66.50	69.73	89.75
0National income	428.96	444.08	485.49	512.38	543.98	578.75	790.03
Factor incomes							
Income from employment	316.41	333.39	362.42	374.44	404.91	430.82	581.71
Income from self-employment	57.66	60.71	68.57	71.17	79.18	86.41	130.39
Corporate gross profits, etc.	71.75	68.60	70.12	89.17	76.93	78.63	97.08
Gross trading surplus of pub.							
Rent	34.06	36.86	39.17	42.87	45.57	48.44	67.19
Capital consump., non-trading	4.10	4.36	4.55	4.89	5.11	5.34	6.73
Equals:							
Total domestic income	483.98	503.92	544.83	582.54	611.69	649.64	883.08
Minus:							
Stock appreciation	6.39	6.62	4.10	9.81	5.20	5.61	8.18
Equals:							
Gross domestic product (income)	477.59	497.29	540.73	572.73	606.49	644.03	874.90
Plus:							
Residual error	-0.52	0.00	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	72.85	86.77	94.08	100.47	107.35	113.90	154.40
Equals:							
0 Gross domestic product (exp.mkt.)	549.92	584.06	634.81	673.20	713.84	757.93	1029.30
Gross domestic product (expend.)	552.52	584.27	634.52	673.13	713.07	757.48	1028.33
0 Difference	2.60	0.21	-0.29	-0.07	-0.78	-0.45	-0.98
Addenda:							
Gross profits, etc. from I-O	187.92	184.47	197.35	223.60	223.80	238.63	326.21
Adj. financial services	26.74	20.57	19.04	25.31	22.21	25.43	33.01
Personal Sector							
Income from Employment	316.41	333.39	362.42	374.44	404.91	430.82	581.71
Income from self-employment	57.66	60.71	68.57	71.17	79.18	86.41	130.39
Imputed rent	20.58	22.33	23.78	26.17	27.94	29.83	42.18
Other rent	4.13	4.47	4.75	5.22	5.56	5.93	8.32
Interest and dividends	71.82	64.06	68.93	71.54	77.00	81.32	107.23
Credit for corporate tax	6.14	5.81	6.28	6.59	7.12	7.58	10.37
Social security benefits	49.50	58.20	60.18	66.99	71.39	75.59	102.53
Other government grants	13.54	14.63	15.51	16.85	17.86	18.89	25.49
Other current transfers	2.90	3.07	3.33	3.53	3.73	3.96	5.35
Capital consumption by NPMB's	0.61	0.63	0.65	0.69	0.71	0.74	0.88
Minus:							
Interest payments	51.68	51.23	56.03	57.93	62.93	67.24	92.57
Equals:							
Total personal income	491.62	516.06	558.38	585.25	632.47	673.83	921.88
Minus:							
Personal income taxes	60.26	57.00	61.68	64.65	69.86	74.43	101.83
Social security contributions	34.79	36.65	40.08	41.44	45.02	48.10	66.22
Other current transfers	12.08	12.69	13.21	14.03	14.56	15.13	18.68
Equals:							
Personal disposable income	384.49	409.72	443.41	465.13	503.03	536.16	735.14
Of which:							
Personal consumption expenditures	354.24	382.54	417.62	443.93	479.26	511.77	700.05
Saving	35.37	27.28	24.52	21.39	23.13	24.65	33.80
Real personal disposable income	281.37	284.72	298.48	295.68	309.44	319.67	364.13
Personal savings rate	9.20	6.66	5.53	4.60	4.60	4.60	4.60

Table V.8: BRIM Forecast With Income Tax Cut (Continued)

	1990	1991	1992	1993	1994	1995	2000
Corporate Sector							
Gross profits, etc.	71.75	68.60	70.12	89.17	76.93	78.63	97.08
Interest and dividends	55.25	49.27	53.02	55.03	59.23	62.55	82.49
Rent	5.98	6.63	7.22	7.97	8.55	9.16	13.07
Income from abroad	28.45	29.83	30.66	32.56	33.58	34.65	41.35
Minus:							
Interest and dividends	84.88	58.67	65.04	62.19	73.47	78.46	106.43
Transfers to charities	0.14	0.15	0.15	0.16	0.17	0.17	0.21
Profits due abroad	7.28	6.10	6.17	9.94	6.79	6.83	8.90
Corporate income taxes	24.37	20.97	21.88	25.10	24.22	25.14	31.79
Royalties etc. on oil and gas	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Equals:							
Undistributed profits	43.33	66.94	66.24	85.80	72.10	72.84	85.18
Corp.gr.pr. share of IO Gross Pr.	38.18	37.19	35.53	39.88	34.37	32.95	29.76
Government Sector							
Personal income taxes	60.26	57.00	61.68	64.65	69.86	74.43	101.83
Corporate income taxes	24.37	20.97	21.88	25.10	24.22	25.14	31.79
Minus:							
Credit for corporate tax	6.14	5.81	6.28	6.59	7.12	7.58	10.37
Plus:							
Net taxes on expenditure	72.85	86.77	94.08	100.47	107.35	113.90	154.40
Social security contributions	34.79	36.65	40.08	41.44	45.02	48.10	66.22
Gross trading surplus							
Rent	3.37	3.43	3.42	3.52	3.52	3.52	3.61
Royalties and fees from oil	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Interest and dividends	16.66	2.77	6.89	5.15	9.51	12.24	27.94
Misc. current transfers(personal)	9.31	9.77	10.04	10.66	10.99	11.35	13.54
Cap. consump., non-trading cap.	3.50	3.73	3.90	4.20	4.40	4.60	5.85
Minus:							
Final consumption	107.85	118.17	126.53	131.15	137.47	147.44	195.64
Social security benefits	49.50	58.20	60.18	66.99	71.39	75.59	102.53
Other government grants to pers.	13.54	14.63	15.51	16.85	17.86	18.89	25.49
Net external transfers	-2.76	-2.92	-3.17	-3.37	-3.57	-3.79	-5.14
Debt interest	24.31	25.71	27.92	29.62	31.37	33.33	45.25
Equals:							
Current surplus	22.42	-2.85	3.90	2.17	7.63	8.23	22.24
External Sector							
Exports	141.90	153.22	169.18	188.39	195.07	205.81	298.12
Property income net of taxes	81.29	85.22	87.59	93.02	95.94	99.00	118.14
Transfers to persons	2.76	2.92	3.17	3.37	3.57	3.79	5.14
Transfers to government	3.32	3.51	3.81	4.04	4.28	4.54	6.17
Minus:							
Imports	158.21	163.56	186.16	193.73	205.53	224.48	324.04
Property income net of taxes	77.26	80.99	83.25	88.41	91.19	94.09	112.29
Transfers from persons	2.76	2.92	3.17	3.37	3.57	3.79	5.14
Transfers from government	6.08	6.43	6.98	7.40	7.84	8.33	11.31
Equals:							
Net investment abroad	-15.04	-9.04	-15.81	-4.09	-9.27	-17.54	-25.20
Addenda:							
Home population	57.41	57.53	57.72	57.90	58.09	58.28	59.05
Total working population	28.44	28.64	28.74	28.89	29.04	29.19	29.87
Total employed	26.88	25.83	26.30	26.03	26.08	26.16	26.63
Her Majesty's Forces	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Government training programs	0.42	0.40	0.40	0.40	0.40	0.40	0.40
Employees in employment	22.86	21.86	22.14	21.79	21.71	21.65	21.45
Self-employed	3.30	3.27	3.46	3.53	3.67	3.81	4.48
Unemployed	1.56	2.81	2.44	2.87	2.96	3.03	3.24
Unemployment rate	5.47	9.81	8.49	9.92	10.20	10.39	10.84
Aggregate labor productivity	14.76	15.50	16.11	16.23	16.65	17.07	19.11
Real income from employment	9.94	10.45	10.93	10.78	11.36	11.73	13.42
Real income from self-employment	12.69	12.72	13.22	12.64	13.13	13.36	14.39
Average wage	13.84	15.25	16.39	17.18	18.66	19.90	27.14
Price index, PCE	1.37	1.44	1.49	1.57	1.63	1.68	2.02
Price index, GDP	1.39	1.46	1.50	1.59	1.64	1.70	2.02

Table V.9: BRIM Forecast With High Money Supply Growth

	1990	1991	1992	1993	1994	1995	2000
Constant 1984 Prices							
Consumers' expenditure	259.24	260.24	275.42	275.71	288.73	300.63	349.12
General government final consump.	75.07	75.74	76.44	77.14	77.86	78.60	82.50
Central government	45.69	45.99	46.29	46.61	46.93	47.27	49.08
Local government	29.37	29.76	30.14	30.54	30.93	31.33	33.42
Gross domestic fixed capital for.	78.03	64.83	71.12	65.28	67.75	71.14	79.73
Value of physical increase in stocks and work in progress	-0.84	-1.60	-0.43	-1.78	-2.51	-2.23	-3.59
Exports of goods and services	119.04	119.37	127.06	130.89	130.32	132.44	150.98
0 Total Final Expenditure	530.53	518.58	549.61	547.24	562.15	580.58	658.74
less Imports of goods & services	133.65	124.17	134.15	134.41	138.49	143.98	165.34
Gross domestic product (mkt.prices)	396.88	394.41	415.47	412.83	423.66	436.59	493.40
Net property income from abroad	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Gross national product (mkt.prices)	399.78	397.67	417.65	416.08	426.46	439.89	495.93
Current Prices							
Consumers' expenditure	354.24	381.32	421.98	456.13	501.84	549.63	846.24
General government final consump.	107.85	120.15	131.74	138.99	148.21	162.37	238.72
Central government	64.87	71.92	78.39	82.57	87.78	95.55	138.03
Local government	42.98	48.22	53.35	56.42	60.42	66.82	100.69
Gross domestic fixed capital for.	107.88	94.02	105.20	105.70	112.04	123.30	175.78
Value of physical increase in stocks and work in progress	-1.34	-2.46	-1.07	-3.27	-4.76	-4.59	-10.22
Exports of goods and services	141.90	155.44	171.87	191.54	199.54	211.02	311.17
0 Total Final Expenditure	710.54	748.46	829.71	889.08	956.88	1041.74	1561.69
less Imports of goods & services	158.21	161.24	182.75	189.74	200.95	220.14	315.20
Gross domestic product (mkt.prices)	552.52	587.95	648.12	699.13	755.08	821.56	1245.45
Net property income from abroad	4.03	4.31	4.52	4.90	5.16	5.44	7.31
Gross national product (mkt.prices)	556.55	592.26	652.65	704.03	760.24	827.00	1252.77
less Net taxes on expenditure	72.85	87.04	95.85	104.25	113.75	123.83	189.79
0Gross national product (fact. cost)	483.70	505.21	556.80	599.77	646.48	703.18	1062.98
less Capital consumption	54.74	58.55	60.95	67.44	70.01	74.23	103.48
0National income	428.96	446.66	495.84	532.33	576.47	628.95	959.50
Factor incomes							
Income from employment	316.41	336.86	374.94	394.58	433.48	472.03	711.94
Income from self-employment	57.66	60.83	70.23	74.23	83.86	93.91	159.07
Corporate gross profits, etc.	71.75	70.82	69.98	89.96	80.49	84.71	115.00
Gross trading surplus of pub.							
Rent	34.06	37.58	40.75	45.43	49.30	53.53	83.64
Capital consump., non-trading	4.10	4.45	4.74	5.20	5.54	5.92	8.40
Equals:							
Total domestic income	483.98	510.56	560.65	609.39	652.67	710.09	1078.05
Minus:							
Stock appreciation	6.39	9.67	7.51	13.67	9.50	10.54	17.75
Equals:							
Gross domestic product (income)	477.59	500.88	553.14	595.72	643.17	699.55	1060.30
Plus:							
Residual error	-0.52	0.00	0.00	0.00	0.00	0.00	0.00
Net taxes on expenditure	72.85	87.04	95.85	104.25	113.75	123.83	189.79
Equals:							
0 Gross domestic product (exp.mkt.)	549.92	587.93	648.99	699.98	756.92	823.38	1250.09
Gross domestic product (expend.)	552.52	587.95	648.12	699.13	755.08	821.56	1245.45
0 Difference	2.60	0.02	-0.86	-0.85	-1.84	-1.81	-4.63
Addenda:							
Gross profits, etc. from I-O	187.92	186.92	200.29	231.33	237.59	260.03	397.55
Adj. financial services	26.74	22.89	22.09	30.19	27.90	32.50	49.19
Personal Sector							
Income from Employment	316.41	336.86	374.94	394.58	433.48	472.03	711.94
Income from self-employment	57.66	60.83	70.23	74.23	83.86	93.91	159.07
Imputed rent	20.58	22.78	24.77	27.77	30.28	33.03	52.59
Other rent	4.13	4.56	4.95	5.54	6.03	6.56	10.38
Interest and dividends	71.82	64.61	70.91	75.30	82.15	88.80	130.70
Credit for corporate tax	6.14	6.54	7.23	7.73	8.49	9.25	14.13
Social security benefits	49.50	60.23	63.98	72.65	78.99	84.87	127.28
Other government grants	13.54	14.88	16.03	17.70	19.10	20.56	30.65
Other current transfers	2.90	3.09	3.40	3.67	3.96	4.30	6.48
Capital consumption by NPMB's	0.61	0.65	0.68	0.74	0.78	0.82	1.10
Minus:							
Interest payments	51.68	51.70	57.87	60.95	67.25	73.57	113.23
Equals:							
Total personal income	491.62	523.34	579.26	618.96	679.87	740.55	1131.09
Minus:							
Personal income taxes	60.26	64.15	71.01	75.87	83.34	90.78	138.65
Social security contributions	34.79	36.99	41.40	43.60	48.11	52.63	81.00
Other current transfers	12.08	12.90	13.70	14.82	15.70	16.69	23.13
Equals:							
Personal disposable income	384.49	409.30	453.15	484.67	532.71	580.46	888.31
Of which:							
Personal consumption expenditures	354.24	381.32	421.98	456.13	501.84	549.63	846.24
Saving	35.37	28.46	30.15	29.10	30.64	31.49	40.85
Real personal disposable income	281.37	279.69	295.05	293.32	306.35	317.87	365.95
Personal savings rate	9.20	6.95	6.65	6.00	5.75	5.42	4.60

Table V.9: BRIM Forecast With High Money Supply Growth (Continued)

	1990	1991	1992	1993	1994	1995	2000
Corporate Sector							
Gross profits, etc.	71.75	70.82	69.98	89.96	80.49	84.71	115.00
Interest and dividends	55.25	49.70	54.55	57.93	63.19	68.30	100.54
Rent	5.98	6.74	7.47	8.38	9.17	10.03	16.17
Income from abroad	28.45	30.44	31.94	34.58	36.43	38.42	51.62
Minus:							
Interest and dividends	84.88	58.31	66.77	66.32	77.96	85.14	128.57
Transfers to charities	0.14	0.15	0.16	0.17	0.18	0.19	0.26
Profits due abroad	7.28	6.41	5.72	9.46	6.68	7.00	9.68
Corporate income taxes	24.37	23.81	24.75	28.81	28.58	30.41	42.77
Royalties etc. on oil and gas	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Equals:							
Undistributed profits	43.33	67.52	65.00	84.54	74.35	77.15	100.57
Corp.gr.pr. share of IO Gross Pr.	38.18	37.89	34.94	38.89	33.88	32.58	28.93
Government Sector							
Personal income taxes	60.26	64.15	71.01	75.87	83.34	90.78	138.65
Corporate income taxes	24.37	23.81	24.75	28.81	28.58	30.41	42.77
Minus:							
Credit for corporate tax	6.14	6.54	7.23	7.73	8.49	9.25	14.13
Plus:							
Net taxes on expenditure	72.85	87.04	95.85	104.25	113.75	123.83	189.79
Social security contributions	34.79	36.99	41.40	43.60	48.11	52.63	81.00
Gross trading surplus							
Rent	3.37	3.50	3.56	3.74	3.82	3.91	4.51
Royalties and fees from oil	1.42	1.51	1.54	1.54	1.54	1.56	1.48
Interest and dividends	16.66	1.84	6.01	4.57	8.50	11.78	30.73
Misc. current transfers(personal)	9.31	9.97	10.46	11.32	11.93	12.58	16.90
Cap. consump., non-trading cap.	3.50	3.81	4.06	4.46	4.77	5.10	7.30
Minus:							
Final consumption	107.85	120.15	131.74	138.99	148.21	162.37	238.72
Social security benefits	49.50	60.23	63.98	72.65	78.99	84.87	127.28
Other government grants to pers.	13.54	14.88	16.03	17.70	19.10	20.56	30.65
Net external transfers	-2.76	-2.94	-3.24	-3.50	-3.78	-4.11	-6.23
Debt interest	24.31	25.87	28.52	30.76	33.22	36.15	54.80
Equals:							
Current surplus	22.42	2.01	7.89	6.85	12.54	15.26	41.32
External Sector							
Exports	141.90	155.44	171.87	191.54	199.54	211.02	311.17
Property income net of taxes	81.29	86.96	91.24	98.80	104.09	109.77	147.50
Transfers to persons	2.76	2.94	3.24	3.50	3.78	4.11	6.23
Transfers to government	3.32	3.53	3.89	4.19	4.53	4.93	7.47
Minus:							
Imports	158.21	161.24	182.75	189.74	200.95	220.14	315.20
Property income net of taxes	77.26	82.65	86.72	93.90	98.93	104.33	140.19
Transfers from persons	2.76	2.94	3.24	3.50	3.78	4.11	6.23
Transfers from government	6.08	6.47	7.13	7.69	8.31	9.04	13.70
Equals:							
Net investment abroad	-15.04	-4.43	-9.60	3.21	-0.03	-7.79	-2.95
Addenda:							
Home population	57.41	57.53	57.72	57.90	58.09	58.28	59.05
Total working population	28.44	28.64	28.74	28.89	29.04	29.19	29.87
0 Total employed	26.88	25.56	25.88	25.52	25.52	25.64	26.02
Her Majesty's Forces	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Government training programs	0.42	0.40	0.40	0.40	0.40	0.40	0.40
Employees in employment	22.86	21.63	21.78	21.35	21.23	21.20	20.90
Self-employed	3.30	3.23	3.40	3.46	3.60	3.74	4.42
Unemployed	1.56	3.08	2.86	3.38	3.52	3.55	3.85
Unemployment rate	5.47	10.75	9.95	11.69	12.12	12.17	12.89
Aggregate labor productivity	14.76	15.43	16.05	16.18	16.60	17.03	18.96
Real income from employment	9.94	10.45	11.03	10.91	11.46	11.84	13.49
Real income from self-employment	12.69	12.64	13.24	12.66	13.09	13.33	14.26
Average wage	13.84	15.56	17.23	18.47	20.42	22.25	34.09
Price index, PCE	1.37	1.46	1.54	1.65	1.74	1.83	2.43
Price index, GDP	1.39	1.49	1.56	1.69	1.78	1.88	2.53

APPENDIX: DATA SOURCES AND METHODS

The primary data source for BRIM is the British government's Central Statistical Office. The CSO publishes National Accounts (traditionally called the "Blue Book") comparable for the most part to the U.S. National Income and Product Accounts; these accounts provide macroeconomic aggregates, gross and net output (value added, or what is referred to here as gross product originating) for about 30 industries, some data on constant price industry output, final demand expenditures by category (consumption, investment, etc.) and sector (e.g. personal, corporate, financial, or public), and some disaggregated inventory, capital stock and capital consumption data.

The CSO makes the National Accounts available, rather expensively, on magnetic media. I obtained a tape in June 1988, with the most recent data being for 1987. Most of the National Accounts data used in constructing the model came from this tape, with some additions coming from later editions of the printed National Accounts. The data were converted to G databanks using a C program called UKNIPTOG.C. The references herein to particular data series NA uses Table numbers and series names from the 1987 edition of the Accounts, which have since been revised.

Input-output tables. The CSO also publishes quinquennial input-output tables compatible, for the most part, with the National Accounts. In general, input-output tables are derived from data on industries and commodities, where a given industry — defined as those establishments which produce a given commodity as their primary product — often produces more than one commodity. The primary data is used to develop two commodity-industry matrices. One, the use or "absorption" matrix, gives the commodity composition of the intermediate purchases of industries; the other, the "make" matrix, gives the commodity composition of industries' output. The absorption and make matrices are then used to derive symmetric industry-industry and commodity-commodity accounts, using assumptions about the technology used by industries to produce commodities.

The available IO tables for Britain include "make" matrices which detail the commodity output of industries; "use" matrices which detail commodity purchases by industry; commodity-by-commodity and industry-by-industry domestic and import matrices; and final demand "bridge" matrices that translate final demand by functional category or industry to demands by IO commodity. The symmetric matrices are derived using a combination of technology assumptions: the commodity-technology approach assumes that every industry producing a particular commodity uses the same technology to do so; while the industry-technology approach assumes that each industry uses its own specific technology to produce all the commodities that it produces. The makers of the British tables use a hybrid system of these assumptions to derive the symmetric matrices. In general, they assume that the intermediate use commodity mix of a particular industry reflects the technology required to produce its principal commodity. They use this commodity mix to net out the intermediate commodities used to produce this particular commodity in other industries. Thus the commodity-commodity matrix reflects a best effort to isolate the specific technologies used to produce specific commodities, though given the nature of the data the process is necessarily imperfect.

I aggregated the 1984 make matrix, the commodity domestic and import matrices, and the consumption, investment and government bridges to 53 sectors, using a C program named

OTMINPUT.C. The data are stored in a "card" file named OTM.CRD (for "one table maker"). There are comparable tables available for 1985, derived from the 1984 tables and 1985 data using RAS techniques, but as their compiler said to me in a wonderful Scottish accent, "you wouldn't want to know what we did to that data to get it to fit." It seemed best to stick to the more reliable 1984 tables.

In addition, the CSO publishes an Annual Abstract of Statistics, which provides population, employment and price data; most of the price data comes from this source, although I obtained some more detailed price data from the Business Statistics Office. The CSO also makes available detailed import and export data in what is referred to as the "Pink Book". The detailed commodity trade data come from Inforum's international trade database, which itself is mainly drawn from the United Nations detailed trade series.

The Business Statistics Office conducts and publishes results of an Annual Census of Production, conducted annually since 1970 (prior to 1968, the COP was conducted once every five years). For the energy, manufacturing and construction sectors, the ACOP provides very detailed industry data on sales, output, intermediate inputs, inventories, value added, and investment, among other things. I aggregated these data to the 53-sector level; they are stored in a G databank named UKCP.

The Department of Trade and Industry produces 40-sector Commodity Flow Accounts, which provide a detailed picture of intermediate and final demand by commodity, based on the most recent input-output tables and tied to gross domestic product data from the National Accounts. Finally, the Department of Employment provides detailed labor data, including employment by industry and labor productivity. Data on hours is available but is prohibitively expensive at this point.

Taken together, these sources provide practically all of the information needed to construct a model of the intended form. However, much of the data have required extensive manipulation to develop useful series at the desired level of aggregation. The biggest difficulty was reconciling data from different classifications. Most of the production numbers available are classified by the Standard Industrial Classification devised and maintained by the CSO. The SIC was substantially revised in 1968 and 1980; the only data available in both classifications is for 1979. I reconciled SIC68 and SIC80 Census of Production and other information by apportioning 1968-79 data to SIC80 classifications in the same proportions as the gross output data for 1979, referring to the Indexes to the Standard Industrial Classification Revised 1980 to make as accurate an apportioning as possible. For this reason, much of the pre-1979 data may be substantially less accurate than later data, especially for series other than gross output. See Tables A.1 and A.2 at the end of this Appendix for a correspondence between the SIC, National Accounts and Input-Output classifications.

All of the data described above is found in a series of archived G databanks whose names — UKNIPA.ARC, UKCP.ARC, etc. — describe their contents.

Gross Output and Deflators: an input-output approach to modeling requires one to develop current- and constant-price industry gross output series that are compatible with the gross output series in the Input-Output Tables. Such series proved to be very difficult to gather or construct. The British government provides a wide variety of price and output data but much of it is inconsistent and/or spotty. Although there is extensive data available on current-price industry gross output and on prices, there are no officially produced series which properly measure commodity gross output at constant prices. There are several alternative approaches to choose from, and each has its limitations.

The most popular approach — used by the builders of the Cambridge and the Department of Trade and Industry models — uses the Commodity Flow Accounts. These accounts are derived from a variety of sources, including the National Accounts and the most recent I-O tables, and provide 39 series on constant price commodity gross outputs, final demand components, and trade, generally mutually consistent and compatible with the National Accounts data. However, for the manufacturing industries, these series are largely incompatible with current price gross output deflated by the available deflators. Another, related approach would use the National Accounts estimates of constant price gross domestic product, which are derived by weighting together quantity measures of net output or value added. As a rule, these output indices are based on gross output or sales, and so are available as proxies for constant price gross output. Again, however, these series are largely incompatible with the ACOP data deflated by the available price indices.

The approach I chose for the energy and manufacturing sectors makes use of the detailed Annual Census of Production (ACOP) data. The approach is apparently unique; and while British government officials with whom I discussed the problem did not enthusiastically endorse it, neither did they object that it would be less accurate than the approaches outlined above. The approach did, however, involve a great deal of work. The gross output data that is available is often not entirely consistent with the industry data available in the input-output tables, even if one makes the adjustments suggested by the producers of the input-output tables. The problem stems mainly from RAS adjustments required to balance the rows and columns of the input-output matrices. Moreover, the approach required deflating industry time series by commodity deflators. Despite its limitations, however, I believe also that this approach turns out to be less problematic than any other, except for the paucity of reliable price data.

Price indices, which for the most part are found in the Annual Abstract of Statistics, proved to be very difficult to work with for several reasons. First, producing industries report prices largely on a voluntary basis, and much of the data are withheld to avoid disclosure. In addition, the 1980 revision of the Standard Industrial Classification leaves only about 85% of the data strictly comparable between classifications. To make matters worse, the price data is generally available at the two-digit and four-digit SIC levels, while I had production data at the three-digit level. Since I could not spare the expense of gathering the data at a greater level of detail, I often simply averaged together four-digit indices to come up with three-digit ones. Finally, the price data refers to commodities, while the output data refers to industries.

The upshot of these problems is that the price data on which the price side of the model is based is neither comprehensive nor entirely reliable. However, given the need to derive gross output and deflator series, all compatible with the input-output tables at the 53-sector level of disaggregation, I believe that for the energy and manufacturing sectors, this approach is at least as reliable than the Commodity Flow approach; and I am comforted by the fact that the CFA are built on price data that cannot be a great deal more reliable that the data I had to work with. The resulting deflators are generally based on actual price data, rather than being implied as they would have been had I chosen to use the Commodity Flows.

For a few sectors, no prices were available at all. For some of the energy sectors — mineral oil, electricity and natural gas — I derived constant-price series from measures of physical output from the Annual Abstract of Statistics (AAS). For the ordnance sector, I used an American price index converted to British pounds. For some sectors for earlier years, I simply used the GDP deflator. I used AAS data also to derive current price construction output.

For the agriculture, forestry and fishing industries, I used detailed agricultural output data from the Annual Abstract of Statistics because it yielded the most reasonable-looking price index, even though it only applies strictly to agricultural activity and captures only 75% to 90% of total agricultural output. The official output series yielded an implied deflator completely incompatible with the AAS data, and I had no useful data for either forestry or fishing.

For the service industries, I constructed current-price gross output series from the gross output data from the input-output tables and the value added data from the National Accounts. The constant price data came from the National Accounts output indices, and the price indices were derived from the current- and constant-price series. (This is similar to the Commodity Flow approach.)

The source price series were based in various years, and I had to link them together as best I could. The final series were all rebased to 1984, the year of the base I-O tables. Since official British series are rebased in years ending in 0's and 5's, my constant price series are not consistent with the official ones, and it is likely that distortions crop up due to index number problems. Since the bases are only one year off, however, I take the liberty of hoping the distortions are not serious.

The main work for the manufacturing and energy industries deflators is stored in two LOTUS files named GOUT7079.WK1 and GOUT7985.WK1; the work on non-manufacturing industries is stored in a LOTUS file named NMFGGOUT.WK1. All of the work is saved in two archive files called GOUTWK.ARC and PRICES.ARC; the resulting series are in a G databank called UKGOUT.

Personal Consumption Expenditures: PCE data broken down to 68 functional categories are found in tables 4.7 and 4.8 of the National Accounts. A PCE bridge of 32 functional categories by 102 commodities is found in the 1984 Input-Output Tables, reconciled to the 1987 edition of the National Accounts. I aggregated these to 39 categories compatible with both the Accounts and the Input-Output Tables. The aggregation can be found in Table A.4.

Constant price data were based in 1980; I rebased them to 1984 by dividing constant-price data by current-price data to derive implicit consumer price deflators and then multiplying the constant 1980 price data by the 1984 deflators. The G "ADD" file that developed the 39-category current-, constant-price, and deflator series is named ADDCONS.ADD. The information is stored in a G databank named UKCONS, and all the work on the data and regressions is stored in UKCONS.ARC.

The PCE bridge required manipulation because net taxes, distributional margins and freight on imports are given as separate columns rather than being distributed across functional categories. I adjusted the PCE bridge, using a FORTRAN program named OTMADJ.FOR, to allocate these expenditures proportionately across rows. This proportional allocation is somewhat arbitrary but the only available recourse.

The cross-section data used to derive estimates of income elasticities come from the Department of Employment's Family Expenditure Survey for 1986, which gives average expenditure on about 100 commodities by 16 income groups.

Gross Fixed Capital Formation: current-price investment series for 43 industries (plus total leased assets) and 3 types of assets is available in Table 12.8 of the National Accounts, classified by **industry of ownership**, mainly dating from 1965. Constant-price data are available by asset in Table 12.5 and by industry in Table 12.7, permitting the development of investment deflators. Furthermore, highly detailed current-price investment data for the manufacturing and energy sectors are available in the Annual Census of Production; these are generally closely compatible with the National Accounts data. I used both sources to develop current- and constant-price investment series at the 53-sector level of aggregation. The G "ADD" file that developed the 53-category current- and constant-price series is named ADDCAP.ADD.

Unfortunately, for the purposes of modeling industrial activity and investment demand it is more appropriate to use data classified by **user industry** rather than industry of ownership, especially when, as in the U.K., leased assets currently account for some 7% of total investment, if a smaller portion of total capital stock. The only information available on asset leasing by user industry is highly aggregated data on page 125 of the 1987 edition of the National Accounts. I used these and a FORTRAN program (BALCAP.FOR and BALCOM.INC) employing a RAS technique to apportion leased assets to user industries. The data are stored in a G databank named CAP, and all of the work on the data and regressions in stored in UKGDFCF.ARC. However, I did not alter the capital stock and depreciation data to take into account the redistribution of leased assets. Although the distribution would have a relatively minor effect on the data in general, it should be implemented in the future.

An investment bridge of 46 industries by 102 commodities is found in the 1984 Input-Output Tables, reconciled to the 1987 edition of the National Accounts. I aggregated this data to 28 categories compatible with both the Accounts and the Input-Output Tables, and then reapportioned these 28 columns to derive a 55-by-55 investment bridge covering each industry separately. I also adjusted the bridge to apportion leased assets, for which a separate column exists in the I-O table, to user industries.

Inventories: highly aggregated current- and constant-price inventory data by holding industry is available in Tables 14.1, 14.2 and 14.3 of the National Accounts. In addition, the Annual Census of Production provides highly disaggregated current-price data, which I aggregated to 53 sectors and reconciled with the National Accounts data. This data is data of inventories by industry, however, while the inventories column in the I-O tables is by commodity held, regardless of industry. One could assume that an industry's inventory change is split between commodities in the same proportion as is its output, and run the industry inventory data through the 'make' matrix to derive commodity inventory data. However, since even aggregate inventory change is notoriously difficult to forecast, and these changes mainly play a stabilizing role in the model, I have made the simplifying assumption that commodity inventories adjust slowly to a rather arbitrarily chosen ideal level, regardless of holding industry; and have dispensed with the need to forecast detailed commodity inventory change by industry, despite the relative wealth of data. The work and data are stored in UKDINV.ARC

Imports, exports and trade deflators: all of the trade data comes from Inforum's data base. Country shares of each country's total trade by commodity are calculated from the United Nation's international trade data. The British trade data comes from the U.N., too, but the commodity trade time series have been adjusted to be consistent with the detail in the 1984 I-O tables. (However, they are not necessarily consistent with the detail in previous tables.) Foreign price data comes mainly from the other national models in the system. Export deflators are simply the domestic commodity price deflators. It is quite likely that these deflators are not necessarily very accurate — it is certainly the case that U.S. export deflators differ considerably from domestic ones. However, the development of detailed export deflators is beyond my current capabilities. Data on trade in services comes mainly from the CSO's "Pink Book"; but the data were adjusted to the extent possible to be consistent with the I-O data. These figures are therefore of questionable reliability. The work and data are stored in UKEXP.ARC and UKIMP.arc; the work on the attempted nonlinear estimations is stored in UKNLEXP.ARC and UKNLIMP.ARC.

Government expenditures: detailed government final demand and other expenditures is available in the National Accounts. The 1984 Input-Output Tables provide a government bridge matrix for 4 government sectors: defense, National Health Service, other central government, and local authorities. No further detail is available, so distortions are certain to crop up over time. As with personal consumption expenditures, adjustments were required to apportion net taxes, distributional margins and freight on imports across columns. The adjustments were made in the OTMADJ.FOR program.

Capital stock and capital consumption: the National Accounts distinguish between gross capital stock, which includes the constant-price value of all capital that has not yet been completely depreciated and retired; and net capital stock, which is the value of undepreciated capital, given only in current prices in the published National Accounts. The net capital stock is based on the assumption of constant proportional (not exponential), or straight line depreciation, with different depreciation rates applying to different types of assets; and the assumed asset lives are rather long by U.S. standards. I suspect that this restrictive set of assumptions introduces rather serious biases in the investment and depreciation equations.

Highly aggregated estimates are available in the National Accounts for capital consumption at current and constant prices, current-price net capital stock and constant-price gross capital stock. I used these to develop industry series by allocating capital stock data from the NIPA to 53 industries and 3 assets, using as weights the average of the first available three years of investment data by industry and asset. For vehicles and plant and equipment, I added the resulting capital stock data to the beginning of the investment time series, and cumulated and depleted the resulting series using "bucket lags" to derive capital consumption series. However, the resulting series tended to be large relative to the published aggregate consumption series, no matter how reasonable the spill rates on the buckets. I therefore readjusted the initial capital stock data, reducing the vehicles stock to 60% of original stock and plant and equipment stock to 65% of original stock, resulting in series more compatible with the National Accounts aggregates. For buildings, the depreciation series were derived more simply because the bucket technique results in unreasonable wear if the depreciation rate is very long. For these assets, I allocated the stock data from the Blue Book as above, and then took depreciation as a small fixed percentage of stock.

Despite the effort applied to develop these stock and depreciation series, I got terrible results when I applied them to the investment equations. I did not know whether the poor results were a consequence of the inapplicability of the model to the data or a consequence of the data construction process; so I finally decided to acquire more detailed stock and depreciation data, for three assets and approximately forty industries, from the CSO at further expense. I used these series to develop more disaggregated series, using the results of my previous efforts to apportion the CSO data to the 55-sector level. (For dwellings, depreciation is simply capital consumption from the National Accounts.) The work and data are split between UKVADEP.ARC and various UKGDFCF.ARC files.

Net output (value added): income from employment, depreciation, profits, etc.: total value added, income from employment, and other income are available for 30 industries in tables 2.1, 2.2 and 2.3 of the National Accounts. The information is based on tax records, and are generally compatible with the data from the Input-Output Tables. The ACOP provide highly disaggregated value added and income from employment data, but they are not reconciled with the National Accounts data. I developed detailed industry data by distributing the National Accounts aggregates to individual industries in proportion to industry shares in the ACOP measures. I am reasonably but not entirely confident of the reliability of the income from employment series. I am confident in the depreciation data and the gross profit data, which is constructed from the NA profit data, disaggregated using the detailed ACOP data. For indirect business taxes, which are a component of value added in the I-O tables, I have no disaggregated time series; for these series I simply apply the taxes' fractions of gross output in the 1984 I-O tables as a first cut. The work is stored in UKVAIE.ARC, UKVADEP.ARC and UKVAGP.ARC.

Employment: the Department of Employment provides detailed employment data for mid-June of each year, though not annual averages. Annual averages are available for the energy and manufacturing sectors in the ACOP, but they are not entirely compatible with the mid-June annual data. I therefore chose to start with the mid-June data, and disaggregated it using proportions developed from the ACOP annual average data. Data on self-employment was apportioned in a similar fashion. The resulting series, consistent with the DOE data, do not seem unreasonable.

I hoped to develop industry productivity series using gross output, annual employment and average weekly hours. Unfortunately, average monthly hours by industry are available only at prohibitive cost. I therefore chose to use only the output and annual employment data to develop productivity series; so that my productivity equations do not take into account changes in hours, and their reliability suffers correspondingly. All of the employment and productivity work is found in an archive file called UKEMP.ARC.

Table A.1: Correspondence Between Classifications in BRIM

53-SECTOR INDUSTRY	SIC '80	SIC '68
1 Agriculture, forestry & fishing	010,020,030	001,002,003
2 Coal, coke, & solid fuels	111,120	101,261
3 Oil & natural gas extraction	130	104
4 Mineral oil processing	140	262,263
5 Electricity prod. & distrib.	152,161,163	602,20.41% of 2713
6 Public gas supply	162	601
7 Water supply	170	603
8 Metal ores & minerals n.e.s.	210,233,239	15.00% of 103,92.00% of 109
9 Stone, clay, sand & gravel	231	3.13% of 102,85.00% of 103, 8.00% of 109
10 Iron & steel & steel products	221,222,223	311,312,10.87% of 313, 60.00% of 394
11 Other metals	224	71.50% of [321,322,and323], 40.00% of 394,50.00% of 396
12 Products of stone, clay, etc.	241-248	96.87% of 102,4291,461-469
13 Basic chemicals	251-256,259	2711,2712,79.59% of 2713,274, 12.13% of 275,69.47% of 276,277, 278,279 except 2796, 3.62% of 491
14 Pharmaceuticals	257	272,2796
15 Soap & toilet preparations	258	273,87.87% of 275
16 Man-made fibers	260	411
17 Other metal products n.e.s.	311-316	89.13% of 313,28.50% of [321, 322, and 323],95.00% of 391, 85.00% of 392,393,395,3991,3995, 3996-7,and 99.22% of 3992-12
18 Industrial plant & steelwork	320	73.75% of 341
19 Agricultural machinery	321	331,380
20 Machine tools & eng.s' tools	322	332,69.09% of 390
21 Textile, mining, construct. & mechan. hand. equipment	323,325	335,336,337,3391,3392, 43.19% of 3399
22 Other machinery n.e.s.	324,326-328	333,334,3393-3397,56.81% of 3399, 26.25% of 341,3491,96.60% of 3492, 20.00% of 370, 2.50% of 384-5
23 Ordnance	329	342
24 Office machinery & computers	330	338,366
25 Basic electrical equipment	341-343	361,362,23.00% of 367,3691, 3692-3, 25.00% of 3694-5
26 Electronic equipment	344,345	59.50% of 354,363,364,3651,3652, 77.00% of 367
27 Domestic electrical appliances	346	368
28 Electric lighting equipment	347,348	75.00% of 3694-5
29 Motor vehicles & parts	351-353	381

(continued)

Table A.1: Correspondence Between Classifications in BRIM (continued)

53-SECTOR INDUSTRY	SIC '80	SIC '68
30 Shipbuilding & repairing	361	80.00% of 370,0.78% of 3992-
31 Aerospace engineering	364	383
32 Other vehicles	362,363,365	3.40% of 3492,382,97.50% of 384-5,0.78% of 3992-12, 10.00% of 4941
33 Instrument engineering	371-374	351,352,353,40.50% of 354,30.01% of 390,5.00% of 391
34 Food	411-423	211-2292
35 Drink	424-428	231-239
36 Tobacco	429	240
37 Yarn	431-434	412,413,93.59% of 414
38 Textiles	435-439,455	6.41% of 414,415-423, 4292, 34.79% of 473
39 Apparel	453,456	433,441-9
40 Leather & footwear	441,442,451	431,432,450
41 Timber & wood products	461-467	471,472,65.21% of 473,474,475, 479,493
42 Pulp & paper	471,472	481,482,483,484
43 Printing & publishing	475	485,486,489
44 Rubber	481,482	96.38% of 491
45 Plastics	483	30.53% of 276,492,496
46 Other manufacturing	491-495	15.00% of 392,50.00% of 396, 90.00% of 4941,4943,495,4991, 4992
47 Construction	5	500
48 Distribution, hotels, catering	6	
49 Transportation	710-770	
50 Postal & telecommunications	7901,7902	
51 Banking, finance, insurance, & business services	814-850	
52 Ownership of dwellings	?	
53 Other services n.e.s.	9	

Table A.2: Correspondence Between Classifications in BRIM

NATIONAL ACCOUNTS SECTOR GROSS DOMESTIC PRODUCT	G.D.F.C.F.	53 SECTORS
1 Agriculture, forestry, & fishing	1 Same	1 Same
2 Coal & coke	2 Same	2 Same
3 Extraction of oil & natural gas	3 Same	3 Same
4 Mineral oil processing	4 Same	4 Same
5 Other energy & water supply	5a Electricity	5 Same
	5b Natrl gas	6 Same
	5c Wtr spply	7 Same
6 Metals	6 Same	8 Metal ores etc.
		10 Iron & steel
		11 Other metals
7 Other minerals & mineral products	7 Same	9 Stone, clay, etc.
		12 Prod. of stone etc.
8 Chemicals & man-made fibers	8 Same	13 Basic chemicals
		14 Pharmaceuticals
		15 Soap & toiletries
		16 Man-made fibres
9 Metal goods n.e.s.	9 Same	17 Same
10 Mechanical engineering	10 Same	18 Industrial plant
		19 Agricultural mach.
		20 Machine tools etc.
		21 Textile, etc. mach.
		22 Other machinery
		23 Ordnance
11 Electrical & instrument engineering	11 Same	24 Office equipment
		25 Basic electrical equipment
		26 Electronic equip.
		27 Dom. electr. appl.
		28 Electrical lighting
		33 Instrument engin.
12 Motor vehicles & parts	12 Same	29 Same
13 Other transport equipment	13 Same	30 Shipbuilding etc.
		31 Aerospace eng.
		32 Other vehicles
14 Food	14 Same	34 Same
15 Drink & tobacco	15 Same	35 Drink
		36 Tobacco
16 Textiles	16 Same	37 Yarn
		38 Textiles
17 Clothing, footwear & leather	17 Same	39 Apparel
		40 Leather, footwear
18 Timber & wooden furniture	18 Same	41 Same
19 Paper, printing & publishing	19 Same	42 Pulp & paper
		43 Printing & publ.

Table A.2: Correspondence Between Classifications in BRIM

NATIONAL ACCOUNTS SECTOR GROSS DOMESTIC PRODUCT	G.D.F.C.F.	53 SECTORS
20 Rubber & plastics	20 Same	44 Rubber
		45 Plastics
21 Other manufacturing	21 Same	46 Same
22 Construction	22 Same	47 Same
23 Distribution, hotels, catering etc.	23 Same	48 Same
24 Transportation	24 Same	49 Same
25 Communication	25 Same	50 Same
26 Banking, finance, insurance, etc.	26 Same	51 Same
27 Ownership of dwellings	27 Same	52 Same
28 Public administration, defense, s.s.	28 Same	53 \
29 Education & health services	29 Same	53 >Other Services
30 Other services	30 Same	53 /

Table A.3: Personal Consumption Functional Categories

CONSUMPTION CATEGORY	NATL. ACCNTS. CODE	1984 IO ID
1. Food	CCDW	1
2. Alcohol	CDCZ	2
3. Tobacco	CCDZ	3
4. Clothing	CDDC+CDDD	4 (part)
5. Footwear	CCEB	4 (part)
6. Owner-Occupied Dwellings: Rent	CDDF	5 (part)
7. Other Housing	CDDG+CDDH+CDDI +CDDJ	5 (part)
8. Energy: Electricity	CDDL	6 (part)
9. Energy: Gas	CDDM	6 (part)
10. Energy: Coal	CDDN	6 (part)
11. Energy: Other	CDDO	6 (part)
12. Furniture	CDDQ	7
13. Floor Coverings	CDDR	8
14. Major Appliances	CDDS	9
15. Textiles & Soft Furnishings	CDDT	10
16. Hardware	CDDU	11
17. Cleaning Materials	CDDV	12
18. Household & Domestic Services	CDDW	13
19. Motor Vehicles	CCDT	14
20. Excise Tax on Motor Vehicles	CDDZ	15
21. Petrol (a.k.a. Gasoline)	CDDY	16
22. Other Vehicle Running Costs	CDEA	17
23. Travel	CDEB+CDEC+CDED +CDEE	18
24. Postal & Telecommunications	CDEF+CDEG	19
25. Other Durables, incl. Rentals	CDEI+CDEJ	20
26. Sporting Goods, Toys, etc.	CDEK	21
27. Other Recreational Goods	CDEL	22
28. Recreational Services	CDEM+CDEN	23
29. Books, Newspapers & Magazines	CDEO+CDEP	24
30. Education	CDEQ	25
31. Medical Goods & Services	CDES+CDET	26
32. Toilet Articles & Perfumery	CDEU	27
33. Hairdressing & Beauty Care	CDEV	28
34. Other Goods	CDEW+CDEX	29
35. Catering	CDEY	30
36. Other Services	CDEZ+CDFA	31
37. Expenditure by Tourists in U.K.	CDFD	32
38. U.K. Tourist Expenditure Abroad	CDFE	33
39. Non-Profit Making Bodies	CDFG	34

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