

**Computing a time series of  
Input-Output-Tables  
consistent with  
SNA 1993 / NACE Rev. 1**

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Martin Distelkamp

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Gesellschaft für Wirtschaftliche Strukturforschung (GWS) mbH

Weissenburgerstraße 4, D-49076 Osnabrück

Tel.: 0049/541/40933-0

Fax: 0049/541/40933-11

e-mail: [distelkamp@gws-os.de](mailto:distelkamp@gws-os.de)

Internet: <http://www.gws-os.de>

**GWS**



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## 1 THE PROBLEM

In consequence of the Implementation of the new System of National Accounts (SNA 1993) and the new statistical classification of economic activities in the European Community (NACE Rev. 1) in all European countries at the end of the 90`s, input-output model builders are faced by the problem, that there is no longer a time series of Input Output Data available in one conceptual framework.

Normally only one up to two input-output tables according to the new conceptual framework exist for all European countries. Additionally time series of SNA data in the new conceptual framework are available. In Germany this holds for the period back to the year 1991.<sup>1</sup> But unfortunately even this SNA data is not all the data needed for the second and third quadrant of input-output tables.

At first glance appear two possible solutions for this very urgent database problem.

- Either the old conceptual framework will be maintained. This solution implies the necessity to convert data at the current fringe, which is provided by the national statistical offices only according to the SNA1993/NACE Rev. 1, into the old conceptual framework. A decision for this way leads into a dead-end street.
- Or the new conceptual framework will be fully adopted. This solution should include the conversion of old input-output data, that is only available in the old statistical classification, into the new conceptual framework. Furthermore all updating activities with regard to the input-output data have to be done under consideration of the SNA1993/NACE Rev. 1 concepts.

In Germany the calculation of a time series of input-output tables for the years 1991 to 2000 according to the above mentioned second solution is part of a cooperation between the Statistical Office of the Federal Republic of Germany and the GWS.<sup>2</sup>

The advantages of this institutional arrangement are to be seen in two senses:

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<sup>1</sup> The Statistical Office of the Federal Republic of Germany published in July 2002 a long time series of some SNA data in the new classification for the years 1970 to 1991 for West-Germany.

<sup>2</sup> Another part of the project, which should not be subject to this paper, deals with physical data and the updating of the PANTA-RHEI model. A final report of the project is forthcoming. See Meyer, B. et al. (2002).

- The combination of the specific statistical knowledge of the Statistical Office and the technical expertise is enabled.
- In times of shortage of labour forces at the Statistical Office in Germany the outsourcing of some very complex tasks, like the calculation of input-output tables, seems to be the only way for the office to meet their high demands.

But every cooperation between an external institution and the Statistical Office has to bear in mind, that the same high standards in regard to consistency and plausibility that hold for data published by the Statistical Office also apply to the cooperation partner.

This paper deals with some major topics of the input-output time series project. At first there should be given some short hints at the major conceptual changes in SNA and input-output data, that made this project necessary. In this context there is also a brief overview about the database that was available at the beginning of the project to be given. Subsequently the main steps to compute an input-output table in basic prices will be described. For some of these steps this description will be made very detailed to give an insight not only into the complexity of the matter, but also some hints to the technical surrounding used to compute the input-output tables. Some concluding remarks should top this paper off.

## 2 SUBSTANTIAL CONCEPTUAL CHANGES

The first substantial conceptual change regards the classification of economic sectors/commodities due to the implementation of the NACE Rev. 1.<sup>3</sup> In the following table 1 the old classification of economic sectors, that was in charge for national account and input-output data in Germany until the end of the 90's, and the new classification are compared.

**Table 1: Comparison of old and new classification of economic sectors/commodities**

Old classification		New classification	
1	Agricultural products	1	Agriculture, hunting & related serv. act.
2	Forestry and fishery prod.	2	Forestry, logging & related serv. act.
3	Electric power	3	Fishing, fish farming & rel. serv. act.
4	Gas	4	Coal, lignite, peat
5	Water	5	Crude petroleum & nat. gas; rel. serv. act.
6	Coal, prod. of coal mining	6	Uranium & thorium ores
7	Other prod. of mining	7	Metal ores

<sup>3</sup> NACE = Nomenclature générale des activités économiques dans les Communautés européennes.

Old classification		New classification	
8	Crude petroleum, nat.gas	8	Other mining and quarrying
9	Chemical prod.	9	Food prod. & beverages
10	Refined petroleum prod.	10	Tobacco products
11	Plastic products	11	Textiles
12	Rubber products	12	Wearing apparel
13	Stone and clay	13	Leather prod.
14	Ceramic products	14	Wood; wood & cork prod. except furniture
15	Glass and glass products	15	Pulp, paper and paper products
16	Iron and steel	16	Publishing, printing
17	Non-ferrous metals	17	Coke, refined petroleum prod.
18	Foundry products	18	Chemicals and chemical products
19	Prod. of drawing plants	19	Rubber and plastic products
20	Structural metal prod.	20	Other non-metallic mineral products
21	Machinery and equip.	21	Basic metals
22	Office machinery	22	Metal products, except machinery/equipm.
23	Road vehicles	23	Machinery and equipment n.e.c.
24	Ships, boats	24	Office machinery & computers
25	Aircraft and spacecraft	25	Electrical machinery
26	Electrical machinery	26	Radio, TV & communication equipm.
27	Precision and optical instr.	27	Medical, precision & optical instruments
28	Tools and finished metal prod.	28	Moter vehicles, trailers
29	Musical instr., games, sports goods	29	Other transport equipment
30	Wood	30	Furniture; Manufacturing n.e.c.
31	Wood products	31	Recycling
32	Pulp, paper and -board	32	Electricity, gas, steam and hot water
33	Products of paper and -board	33	Water
34	Prod. of printing and duplication	34	Construction
35	Leather and leather prod., footwear	35	Sale, repair of motor veh., fuel
36	Textiles	36	Wholesale trade; except motor veh.
37	Wearing apparel	37	Retail trade; except motor veh.
38	Food prod. excluding beverages	38	Hotels and restaurants
39	Beverages	39	Land transport; transports via pipelines
40	Tobacco products	40	Water transport
41	Building and civil engineering works	41	Air transport
42	Installation and building completion	42	Supporting transp. act.; Travel agencies
43	Services of wholesale trade, recovery	43	Post and telecommunications
44	Services of retail trade	44	Financial intermediation; except insurance
45	Railway services	45	Insurance; except social security
46	Water transport services	46	Auxiliary activities to financial intermed.
47	Communication services	47	Real estate activities
48	Other transport services, n.e.c.	48	Renting of machinery & equipment
49	Banking services	49	Computer and related activities
50	Insurance services, excl. social sec.	50	Research and development
51	Real estate renting services	51	Other business activities
52	Market services: hotels, restaurants	52	Public administration; defense; social sec.
53	Market services: educ., research, cult.	53	Education
54	Health and veterinary market services	54	Health and social work
55	Other market services, n.e.c.	55	Sewage and refuse disposal
56	Serv. of central and local government	56	Activities of membership org. n.e.c.
57	Services of social security funds	57	Recreational, cultural & sporting act.
58	Priv. non-profit inst., dom. serv.	58	Other service activities
		59	Activities of households as employers

At first glance, looking at the denotation of the sectors in the different classifications, there seems to be a sizable analogy, although the order has changed. But a deeper look at the demarcations shows that this holds only for a very few sectors/commodities.

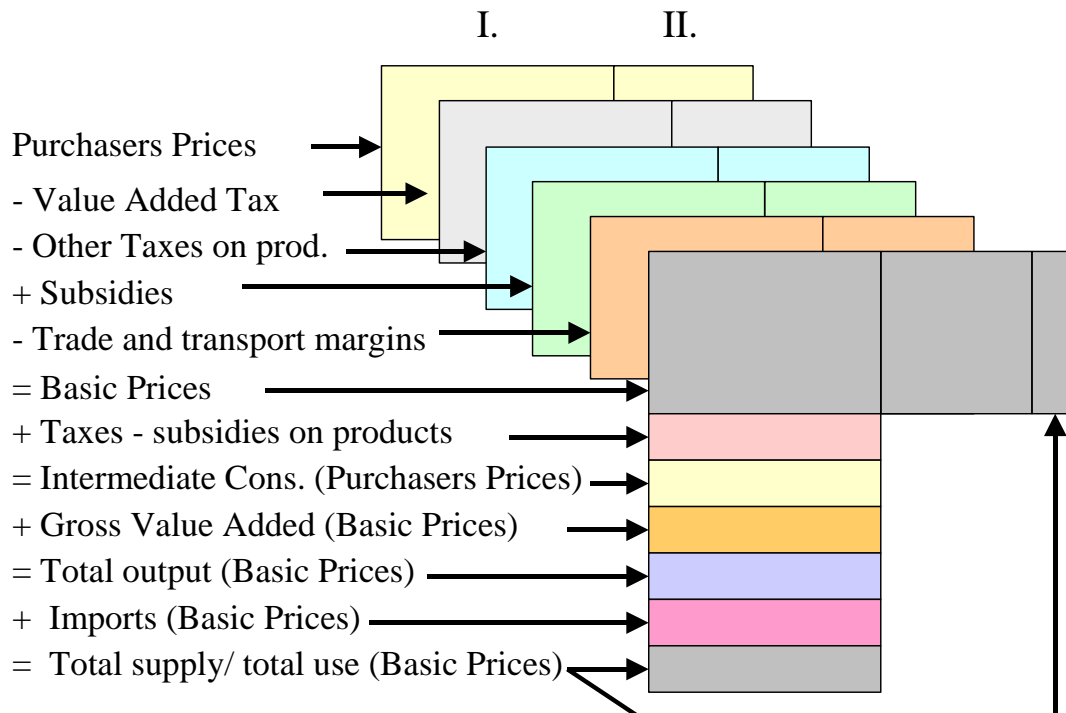
Another very important conceptual change concerns the valuation of national account and input-output data. In the old conceptual framework the total output, the gross value added and the input-output tables were valued by ex-factory-prices. Nowadays all this data is valued by basic prices. These changes in valuation practice, which affect the different treatment of trade and transport margins, of subsidies and of other taxes on products, have to be kept in mind when computing a time series of input-output tables.

### 3 THE DATABASE

At the beginning of the project in spring 2001 the following set of data was provided by the Statistical Office:

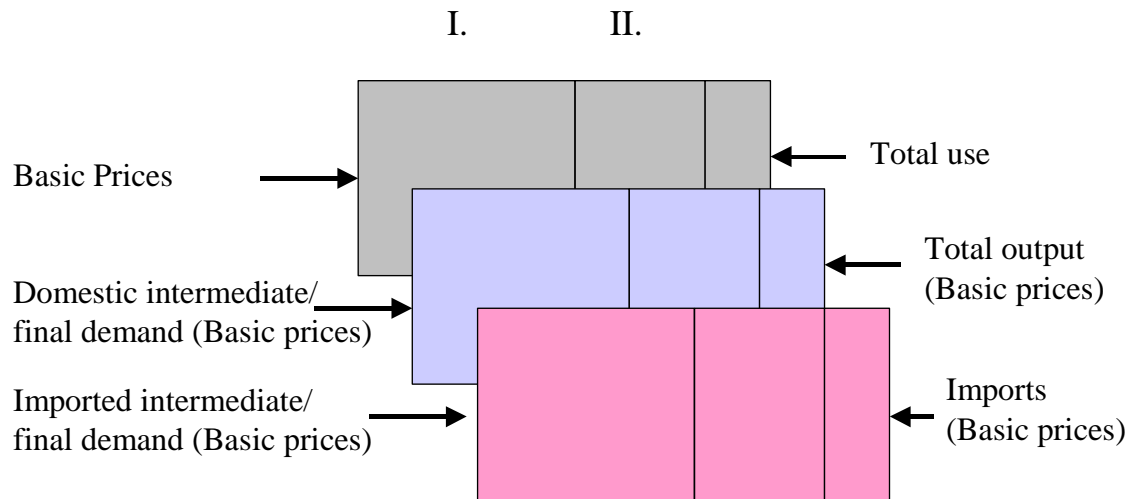
- Complete input-output tables in current prices according to the NACE Rev. 1/SNA 1993 conceptual framework for the years 1995 and 1997 (see figure 1).

**Figure 1: Input-output tables for the years 1995 and 1997**



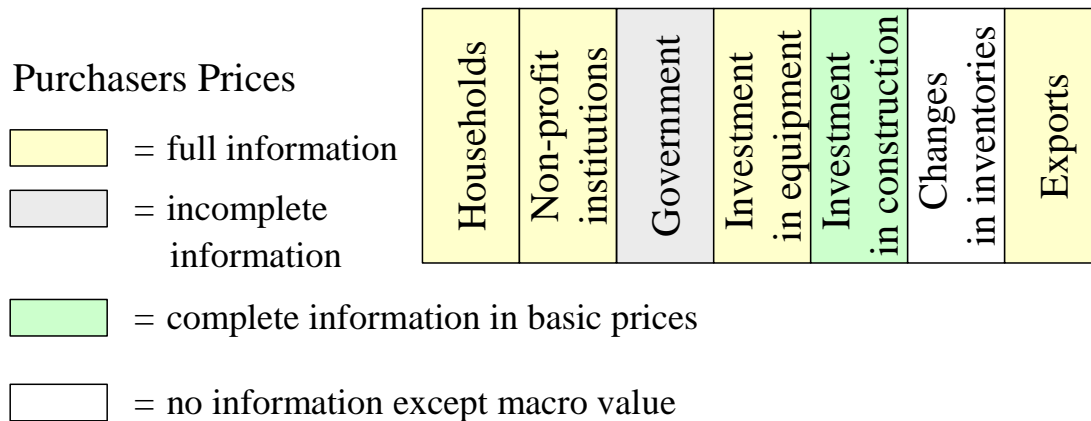
- The input-output tables in basic prices for these years are also separated into domestic input-output tables and imported input-output tables (see figure 2).

**Figure 2: Domestic and imported input-output tables for the years 1995 and 1997**



- Data out of the regular SNA publications of the Statistical Office:
  - Full set of macro data needed to compute a time series of input-output tables
  - Vectors of final demand in current and constant prices according to the NACE Rev. 1/SNA 1993 conceptual framework for the years 1991 to 2000. In addition to the information out of the regular SNA publication (households, exports) the Statistical Office provided full information about the demand vectors „non-profit institutions“ and „investment in equipment“ in purchaseres prices. There was also full information available about the vector of investment in construction, but in this case valued by basic prices. About the vectors of government demand there was also some, but not complete information available. (see figure 1).
  - Vectors of gross value added, total output and imports according to the NACE Rev. 1/SNA 1993 conceptual framework in basic prices (current and constant prices) for the years 1991 to 2000.

**Figure 3: Vectors of final demand**



- Input-output tables (old classification of economic activities) for 1991 and 1993 in purchasers prices
- A key-matrix that shows the connection between the sectors in old classification and the sectors in new classification for the year 1995
- Incomplete information about the tax-, subsidies- and the trade and transport margins-vectors

All this data, that was provided by the Statistical Office at the beginning of the project, built the raw database and was treated in following process as exogenous data and put into vam- and bnk-files.

In a first step this database was supplemented by some data, that was calculated with simple conversions. For example some vectors had to be filled only in a few sectors/commodities. These elements are calculated under the assumption of structural constancy. These simple conversions were computed by using visual-basic macros. Again this data was treated in the following process as exogenous data and put into vam- and bnk-files.

These bnk- and vam-files in the following were used in model.cpp (interdyme) and the rest of data was computed. The main steps of this process and some examples are described in the following chapter.

In a next step the calculated data was checked and revised by the Statistical Office and in a next round these revisions and confirmations were again treated as original data. On basis of this data there was again made a historical database (bnk- and vam-files) and in the following the computing procedure only varied those values that had to be readapted as a consequence of the revisions.

As a consequence of this procedure computing historical input-output data is a kind of modelling with lots of exogenous variables.



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#### 4 COMPUTING INPUT-OUTPUT TABLES IN BASIC PRICES

Below the main steps in computing a time series of input-output tables in basic prices are shown. They are a direct consequence of the conceptual framework and the available, respective particularly the missing, data. The first five steps serve the calculation of the boundaries of the input-output tables in basic prices, the last three steps the calculation of the intermediate demand matrix itself and the segmentation of the matrix into the domestic production- and the import-matrix.

1. *Completion of missing information about vectors of final demand in purchasers prices:*

As mentioned with regard to the available data there was full information about the majority of final demand vectors given. Only the vectors of government expenditures had to be completed and the vectors of changes in inventories had to be calculated. Especially the second point, where only the macro values were known, appeared to be a very difficult one and needed the tight cooperation between the GWS and the Statistical Office.

2. *Transition from purchasers prices to basic prices for the final demand columns:*

This step consists of four parts:

- a) *Calculation of the value added tax columns (see example 1)*
- b) *Calculation of the other taxes on products columns*
- c) *Calculation of the subsidies columns*
- d) *Calculation of the trade and transport margins columns (see example 2)*

In the annex two of these steps will be described more detailed to give an insight not only into the complexity of the matter but also into the technical surrounding.

3. *Calculation of the intermediate demand column in basic prices by definition*

Intermediate demand column in basic prices

$$= \text{total output} + \text{imports} - \text{total final demand}$$

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4. *Transition from basic prices to purchasers prices for the intermediate demand column*

This step again consists of four parts:

- a) *Calculation of the value added tax column*
- b) *Calculation of the other taxes on products column*
- c) *Calculation of the subsidies column*
- d) *Calculation of the trade and transport margins column*

The intermediate demand column in purchasers prices is not implicitly needed to compute the input-output tables in basic prices. Although this step is useful. On the one hand the tax and subsidies vectors are needed as boundary vectors to compute the tax and subsidies matrices. On the other hand the intermediate demand column in purchasers prices serve as a consistency check. An exception is the period from 1991 to 1994. In these years the input-output tables according to the old conceptual framework are available only in purchasers prices and not in basic prices. For this reason the computing of a full set of input-output tables (including purchasers prices and trade and transport margins matrices) was inevitable.

5. *Transition from purchasers prices to basic prices for the intermediate supply row*

This step consists only of three parts, because the trade and transport margins row for intermediate supply is by definition in all elements zero:

- a) *Calculation of the value added tax row*
- b) *Calculation of the other taxes on products row*
- c) *Calculation of the subsidies row*

In the end the boundaries of the input-output tables in basic prices are known, and if the fourth step is carried out completely even those of the input-output tables in purchasers prices.

The next step is to calculate the intermediate demand matrix itself. In the following there should be described only the procedure for the years 1991 to 1994. The goal was to find a way that enables the consideration of information of the input-output tables according to the old classification of sectors/commodities. The computing procedure for the updating period (1998 to 2000) can directly put up on the basic prices columns and rows.

- 
6. *Calculation of the intermediate demand matrix in purchasers prices by using an modified RAS-Algorithm, that allows the consideration of information from the input-output tables in the old classification of economic activities.*

Within this step first those sectors/commodities had to be identified, where the sector/commodity in new classification shows a sufficient congruence with a sector/commodity in old classification. The assumption is, that this holds when there is a congruence of more than 75 % in the key-matrix for 1995 and the discrepancy between the corresponding input coefficients is not too big. The predeterminations of these limits (congruence and discrepancy of input coefficients) were the result of an intensive exchange of informations between the Statistical Office and the GWS.

Next a reference matrix in new classification of sectors/commodities was calculated. In this matrix each element for which it is possible to consider information from the input-output tables in old classification is one, all other elements are zero. This reference matrix was basis for the compilation of a modified RAS-algorithm. This RAS-algorithm has the following characteristics: All elements with a value of one in the reference matrix are excluded from the RAS procedure. These array elements are calculated first by using the input-coefficients known from the input-output table in old classification of sectors/commodities. The values of these elements are allowed to differ from the calculations only in a very short range. For all other array elements the start values for the RAS-procedure are calculated on basis of the input-coefficients known from the 1995 input-output table in new classification.

The result of this computing effort was, that it was possible to consider for about 9 % of all elements the input coefficients of the input-output matrix in old classification. These 9 % of elements represent about 17 % of the volume of the input-output matrix.

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7. *Transition from purchasers prices to basic prices for the intermediate demand matrix*

This step with the following subareas is only necessary for the years 1991 to 1994.

- a) Calculation of the value added tax matrix
- b) Calculation of the other taxes on products matrix
- c) Calculation of the subsidies matrix
- d) Calculation of the trade and transport margins matrix

8. *Calculation of the import matrix and the domestic production matrix (including the intermediate demand matrices and the final demand vectors)*

## 5 CONCLUSION

The cooperation between the Statistical Office of the Federal Republic of Germany and the GWS has proved to be a successful combination between statistical expertise and technical know how. Although the project meant more than 1 ½ year of work on both sides. There had to be programmed a few tens of visual-basic macros with up to 300 lines and over 10000 lines of cpp-code.

The complexity of the task also can be made clear just by stating the mere quantity of data that had to be computed, always under the constraint that every single value has to fulfil the high standards with regard to consistency and plausibility that are valid for the Statistical Office:

- Over 200 matrices with over 1 million elements
- Over 3000 vectors with over 200000 elements

Concluding it has to be emphasized that the results of the project (input-output tables in current and in constant prices for the years 1991 to 2000) will be published by the Statistical Office as official data in autumn 2002.

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## 6 ANNEX

### Example 1: Calculation of the value added tax column of household consumption expenditures for the years 1998 to 2000

Intention: Computing the tax column in consideration of the increase in value added tax rate in Germany in 1998. Until the end of march 1998 the normal value added tax rate was 15% and the reduced value added tax rate (i.e. for food, books) was 7%. Since then the normal tax rate changed to 16 while the reduced tax rate remained unchanged.

```
If (t == 1997)
{
  for (i=1;i<60;i++)
    if ((cpn[i] - vatcpn[i]) != 0)
      qvatcp[i] = 100*vatcpn[i]/(cpn[i]-vatcpn[i]);
    else qvatcp[i] = 0;
}

double REMCPN =0;
If (t==1998)
{
  for (i=1;i<60;i++)
  {
    if (qvatcp[i] > 6 && qvatcp[i] < 8)
    {
      vatcpn[i] = (cpn[i]*qvatcp[i]/100)/(1+qvatcp[i]/100);
      RECPN += vatcpn[i];
    }
    else if (qvatcp[i] > 14)
    {
      vatcpn[i] =
      cpn[i]*(qvatcp[i]+0.75)/100)/(1+(qvatcp[i]+0.75)/100);
      RECPN += vatcpn[i]; }
    else
      vatcpn[i] = (cpn[i]*qvatcp[i]/100)/(1+qvatcp[i]/100);
  }
}
```

Variables:

qvatcp = value added tax quota

vatcpn = value added tax on household consumption expenditure

cpn = household consumption expenditures in purchasers prices

RECPN = sum of value added tax on household consumption expenditures for those goods and services with clearly identifiable value added tax rate (normal or reduced)

```

if (t= 1998)
{
double ZSUM = vatcpn.sum();
for (i=1;i<60;i++)
    if (qvatcp[i] < 6 || (qvatcp[i] > 8 && qvatcp[i] < 14))
        vatcpn[i]=vatcpn[i]*(VATCPN[t]-RECPN)/(ZSUM-RECPN);
for (i=1;i<60;i++)
    if ((cpn[i]-vatcpn[i]) != 0)
        qvatcp[i] = vatcpn[i]/(cpn[i]-vatcpn[i])*100;
    else
        qvatcp[i] = 0;
}

```

Variables:

ZSUM	=	sum of value added tax on household consumption expenditure before scaling
VATCPN	=	sum of value added tax on household consumption expenditure

In 1999 same procedure as in 1998, only with different changes of the parameters (if  $qvatcp[i] > 14,75$  then  $qvatcp[i] = qvatcp[i] + 0.25$ ).

In 2000 same procedure as in 1999, but with no changes in the value added tax quota.

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**Example 2: Calculation of the trade and transport margin columns of household consumption expenditures for the years 1998 to 2000**

Intention: Computing the column in consideration of the restriction that the column sum has to be zero. Trade and transport margins are only transfer postings between the producing sectors (1 to 31) and the trade and transport sectors (32 to 40).

```
if (t == 1997)
{
  for (i=1;i<32;i++)
  {
    TTCPN[t] += ttcpn[i];
    if (cpn[i]!=0) qttcp[i] = 100*ttcpn[i]/cpn[i];
  }
  for (i=32;i<60;i++)
  {
    ASSERT(TTCPN[t] != 0);
    qttcp[i] = 100*ttcpn[i]/TTCPN[t];
  }
}
```

Variables:

qttcp	= trade and transport margin quota
ttcpn	= trade and transport margin on household consumption expenditure
TTCPN	= sum of trade and transport margins on household consumption expenditure for the producing sectors 1 to 31

```
if (t>1997)
{
  for (i=1;i<60;i++)
  {
    if (i<32)
    {
      ttcpn[i] = qttcp[i]*cpn[i]/100;
      TTCPN[t] +=ttcpn[i];
    }
    if (i>31)
      ttcpn[i] = qttcp[i] * TTCPN[t]/100;
  }
}
```

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## 7 LITERATURE

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