Preliminary draft

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Accumulation and Competitiveness

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1. **Introduction**

Capital stock is used to the define an explanatory variable in the Bilateral Trade Model (BTM) import share equations (Ma, 1996). BTM and country models make up the INFORUM system of models. A run of this system implies the simultaneous solution of country models and BTM. From each country model, BTM receives investments data and use them to compute capital stocks. Capital stock data (whereas available) are not used; country Statistical Offices may adopt different approaches in computing capital stock from investments so that capital stock turns out to be incomparable among countries.
In BTM, capital stock is computed applying the perpetual inventory criterion adjusted by 'Almon's unit buckets' (Almon, 2009). Besides investment data, the perpetual inventory criterion requires the definition of a replacement rate. Even if country Statistical Offices adopt such a criterion to 'generate' capital stock data, different investment goods average life and different investment goods mix for similar capital goods concur to their incomparability among countries. At present, a common replacement rate characterizes capital stock data in BTM.
In BTM import share equations consider three explanatory variables: a price factor, a capital stock factor and a trend. The price factor explains price competitiveness. The capital stock gives evidence of non-price factors; the trend is introduced to interpret similar non-price determinants. The reason why these two explanatory variables are both present in the equation is due to the assumption that capital stock may be used as a specific proxy for quality change of product, whereas the quality change of product is positively obtained by the accumulation process and negatively by the decaying of the capital stock. That is to say, a remarkable investment process is expected to improve the quality of the product while a quick decaying decreases the non-price competitiveness with a contraction of the import share in the destination markets.
In order to make capital stock data comparable among countries and to emphasize the above role of index of quality change of product, a common replacement rate has been used in BTM and posed equal to 8 per cent. This replacement rate was considered, on the average, much more weighty than that adopted by country Statistical Offices.

2. **Investments, Capital Stocks and Replacement Rates**

Following the Methodological Guide issued by EUROSTAT, few years ago European Member States began to publish new national account time series. From investment and capital stock data for Italy, replacement rate time series have been computed and presented at the XV INFORUM World Conference (Grassini, 2008). These time series turned out to be non constant over time showing in some cases clear trends; in particular, the replacement rate magnitude were in general greater than

the ‘weighty’ 8 per cent assumed in BTM. Within the framework of the INFORUM system of models, two issues were underlined. First, the replacement rate trends could help to design the scenarios of these ‘exogenous’ parameters. Second, the magnitude as well as the spread of each capital stock replacement rate poses a twofold choice: a) in estimating the import share equations; b) in forecasting import shares in the Bilateral Trade Model.
Here, the impact of different replacement rates on the import share equation estimate is presented.

3 **Experimental design**

The experimental design is very simple. In BTM, the replacement rate is constant equal to 8 per cent. Here, the estimation of import share equations is done with replacement rates values varies from 7 to 14 per cent with a step of 1 per cent.
The objective is to evaluate the impact of the capital stock time series obtained with different replacement rates on the import share equation parameter estimates. The investigation is limited to the Italian shares in the import structure of the INFORUM country system.

3.1 **The Italian Capital Stock time series**

The impact on the Italian capital stock time series is shown in Fig. 1.
The capital stock shown in the graphs is for the replacement rates 7, 9, 11 and 14 per cent. Fig 1A represents the capital stock in the Agriculture; this is the case where capital stock gains a negative trend as the replacement rate goes from 7 to 14 per cent. In Fig. 1B for Fish and other fishing products, the capital stock has a negative trend for low replacement rates which increases as the decaying of capital becomes much more severe.

Fig.1A

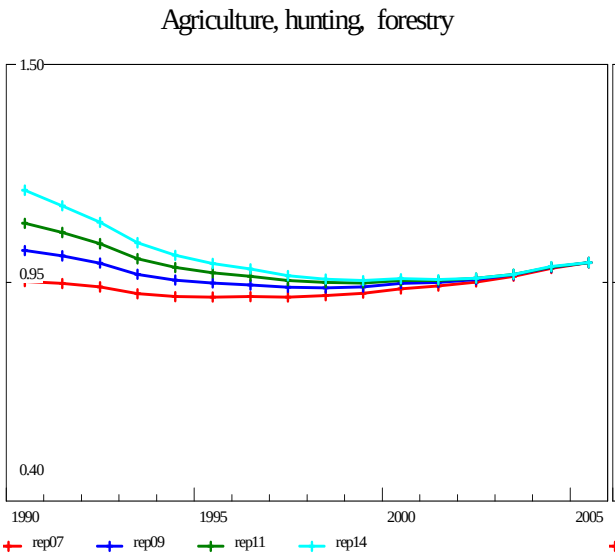


Fig. 1B

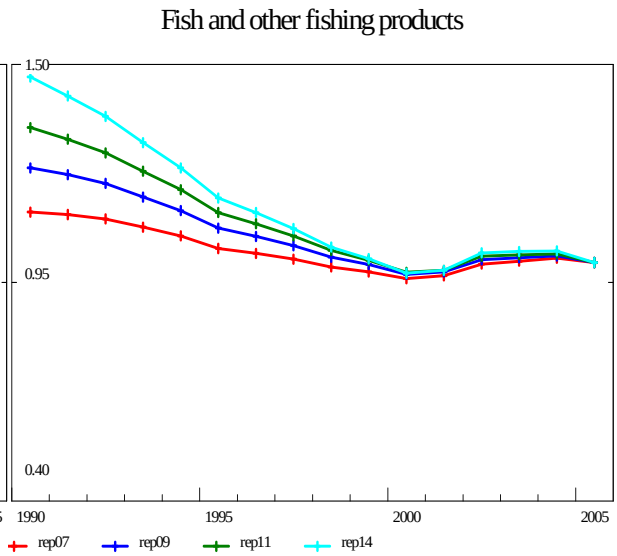


Fig. 1C shows, for Rubber and plastic products, the case of a loss of a trend for higher replacement rates; while, in Fig. 1D Machinery and equipment n.e.c., capital stock spans from positive to negative trend.

3.2 **Italian, French, German and Spanish capital stock time series for different replacement rates**

Figures 2 show capital stock time series graphs for Italy, France, Germany e Spain obtained with the lowest replacement rate considered in this study (7 per cent) and those computed with the highest one (14 per cent).
Fig. 2A shows the case where the capital stock trend for Germany is emphasized and that for Italy, for the highest replacement rate, appears similar to the Germany one for the lowest replacement rate.
Fig. 2B shows the case of trends that disappear and appear passing from 7 to 14 per cent: France and Germany capital stock accentuate the trend and Italy and Spain ones become flat.

Fig. 1C

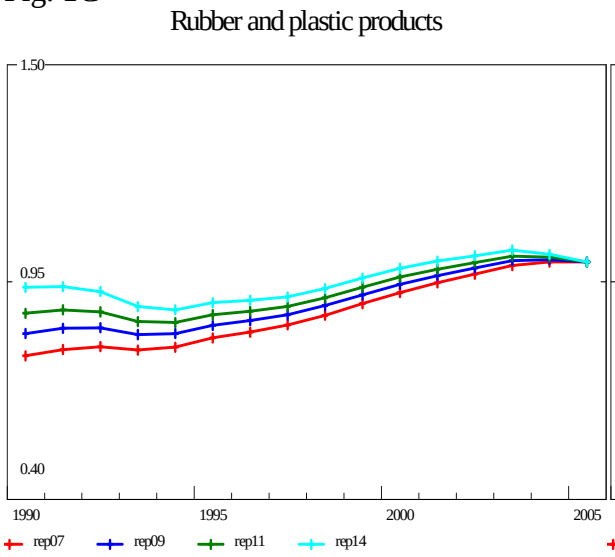


Fig. 1D

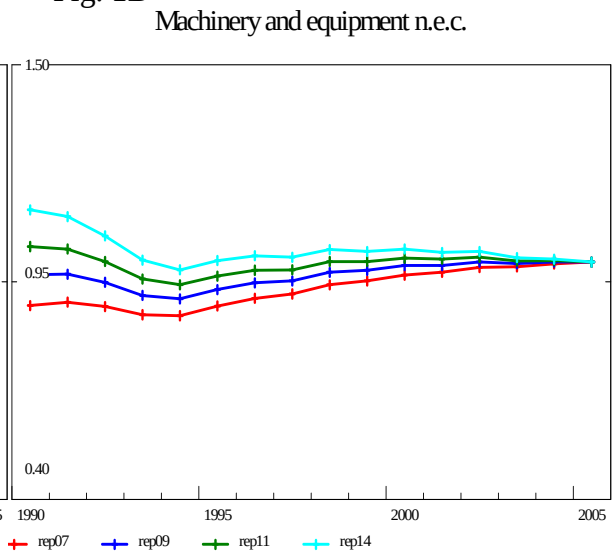
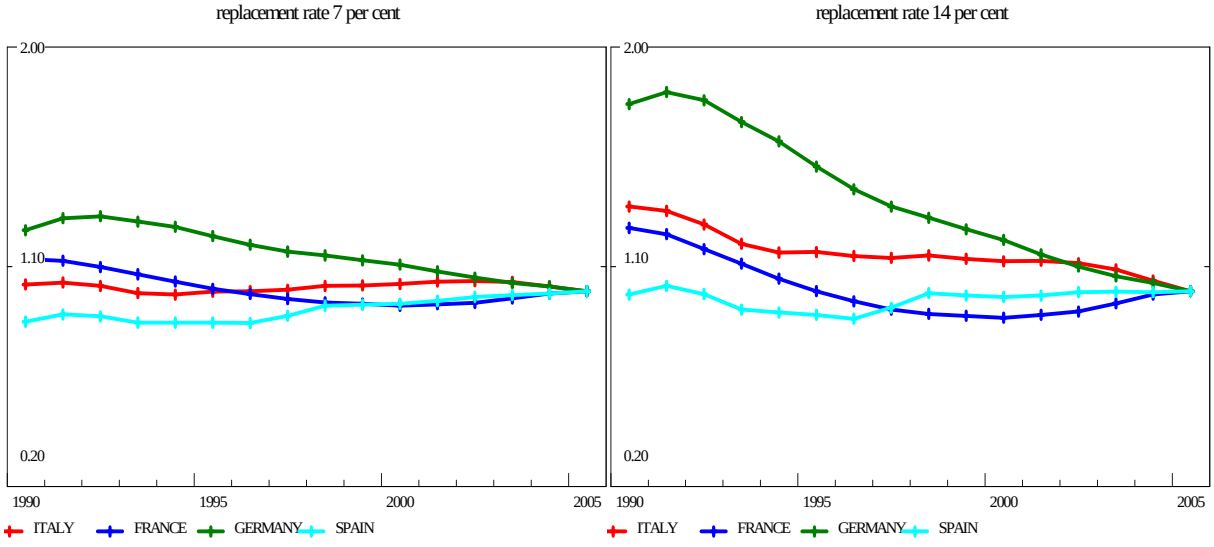


Fig. 2A



In Fig. 2C passing from 7 per cent to 14 per cent replacement rate, Germany and Italy capital stock overlook the trend while France and Spain time series do not visibly change.
Figures 2 show that the replacement rate mattes in computing capital stock time series; however, the effect may be significant or negligible. Furthermore, an higher replacement rate have a tendency to

slow down positive trend and to increase the negative ones. If this effect, by chance, homogeneously influences all the capital stock time series used to define the explanatory variable in an import share equation, that explanatory variable turn out to be not altered by different replacement rates.

Fig. 2B Leather and leather products

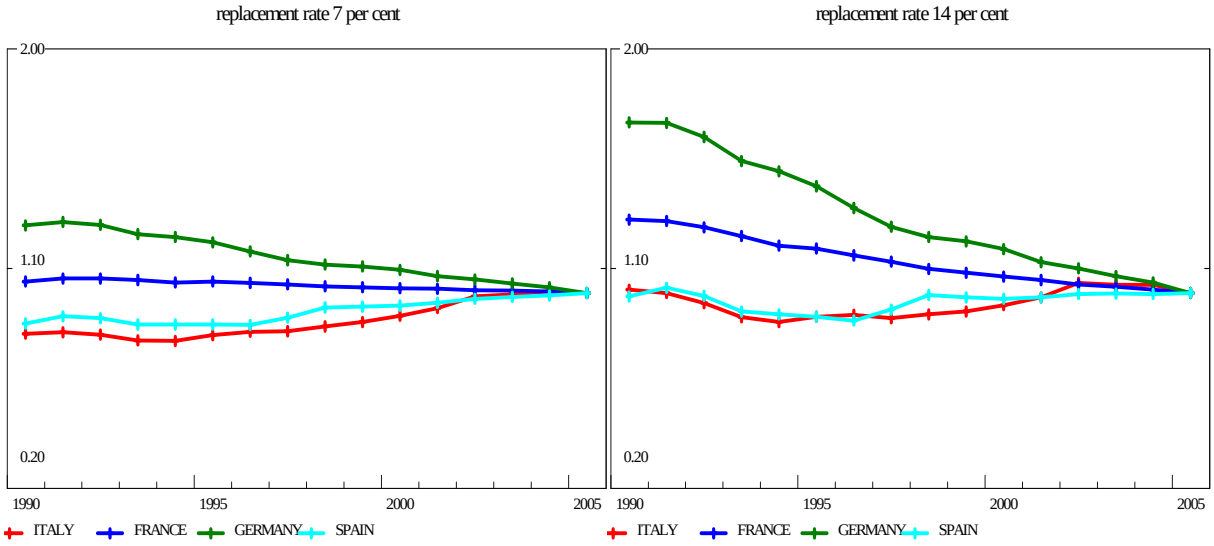
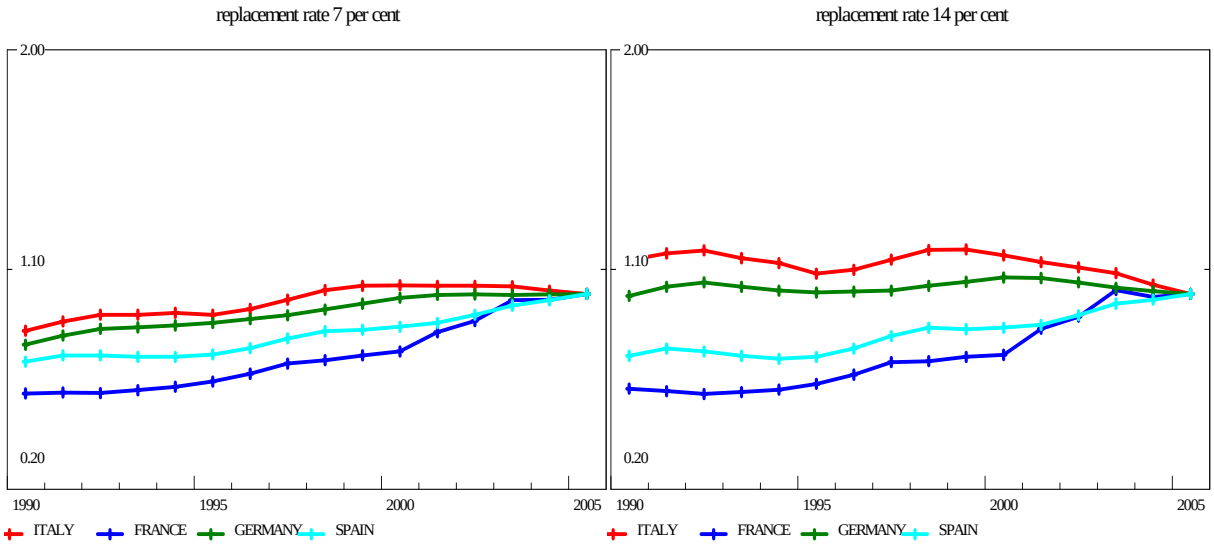


Fig.2C Chemicals. chemical products and fibres



3.3 **The replacement rate effect on the capital stock explanatory variable**

4. **The import share equation re-estimated**

The import share equations have been re-estimated using set of independent explanatory variables generated with different replacement rates applied to compute capital stock time series. Each set of independent explanatory variables contains identical data for prices and for Nyhus's trends.
The procedure to select the explanatory variables follows the criterion adopted by Ma (Ma, 1996).

Whereas the import shares are not zero, the equation estimate may have all the three explanatory variable (a Price term, a Capital stock term and the trend) or a subset of them. In particular, there are cases with a) Price term elasticity, Capital term elasticity and trend, b) Price term elasticity and Capital term elasticity, c) Capital term elasticity and trend, d) Price term elasticity and trend, e) only Price termelasticity, f) only Capital term elasticity and g) only trend. Of course, the impact of the replacement rate is observable for the cases which include the capital stock factor, that is to say a), b), c) and f).
In the import share equations relative to Italy in the importing countries, cases with a single explanatory variable (cases e), f) and g)) are relatively infrequent. Cases a), b), c) and d) prevails. The investigation of the impact of different replacement rates on import share equation estimates has been done taking into account the size of the Italian import share; that is to say, the relative magnitude of Italian exports in a foreign market deserves a detailed attention because of the import share forecast treatment in the BTM model. Germany, France, Spain and UK are the countries where Italy – for some of the 120 commodities in BTM – marks large import shares. Tab. 1 shows three import share equation estimates for different replacement rates. These results are representative of those obtained in a number of estimations. First, different replacement rates produce irrelevant changes in goodness of fit. Regression coefficient change. Price term regression coefficients change steadily in Home Apparel in German Market and Other Textile Spanish Market; in Construction Equipment Spanish Market, the Price term regression coefficient is unaffected by the replacement rate changes. From the Mexval, in these cases Price term has the highest explanatory power, while Capital term and the Trend give a very light contribution to the description of the import share. Capital term and Trend, which have a relative good correlation, tend to exchange each other the duty to explain the dependent variable. The case of Home apparel in German imports from Italy clearly show this trade-off with the trend regression coefficient passing steadily from positive to negative values. But, behind regression coefficient changes, the fitting is not influenced; it is clear from the RSQ values. In Fig 3A and 3B is even more striking: predictions estimate obtained with different replacement rates are not discernible.
Tab. 2 contains two cases b): price and capital terms. Both concern Italian exports of fruits. The destination markets are UK and France. In both markets, Price term coefficient decreases as replacement rate increases. Capital term increases in French market while halves in UK market. R-square is very stable in UK and for the French market some improvement is gained with higher replacement rates. Even in these cases, Mexval indices declare the Price term as the explanatory variable that produces the strongest reduction of the Standard Error of Estimate (SEE). In these cases, Capital term does not share its explanatory power with a Trend; so that, the predictions obtained with different replacement rates may not overlap each other as in the case described above. Furthermore, the intercepts shown in Tab. 1 and 2 do not vary very much. Since the sample spans from year 1990 up to 2005, and given the value of the explanatory variables (Capital and Price terms equal to 1 and NyhusTrend equal to zero in year 2005), the intercept is the share predicted by the estimated equation at year 2005. It represents the import share that will be towed in the forecasting horizon with the help of three (case a)) or two(case b)) multiplicative factors.

Tab. 1

Home Apparel - German Imports from Italy

	Regression Coefficients				Mexval			RSQ
REP%	intercept	price	capital	NyhTrend	price	capital	NyhTrend	
7	-1.72	-2.15	1.82	0.024	48.7	4.6	0.9	0.92
8	-1.72	-2.09	1.75	0.018	49.6	4.0	0.6	0.91
9	-1.70	-2.05	1.26	0.009	45.7	3.0	0.1	0.91
10	-1.69	-2.01	1.05	0.003	44.7	2.5	0.0	0.91
11	-1.68	-1.96	1.00	-0.001	45.3	2.1	0.0	0.91
12	-1.67	-1.94	0.75	-0.006	43.4	1.7	0.0	0.91
13	-1.66	-1.91	0.62	-0.010	43.0	1.4	0.3	0.91
14	-1.66	-1.88	0.53	-0.013	42.8	1.1	0.6	0.91

Other Textile - Spanish Imports from Italy

	Regression Coefficients				Mexval			RSQ
REP%	intercept	price	capital	NyhTrend	price	capital	NyhTrend	
7	-1.71	-1.88	0.99	-0.0021	23.6	0.8	0.1	0.77
8	-1.71	-1.85	0.83	-0.0027	25.0	0.6	3.9	0.77
9	-1.70	-1.82	0.70	-0.0032	23.8	0.5	0.4	0.77
10	-1.70	-1.79	0.58	-0.0036	24.0	0.4	0.5	0.77
11	-1.69	-1.77	0.49	-0.0040	26.0	0.3	2.7	0.77
12	-1.69	-1.75	0.41	-0.0044	24.4	0.3	0.8	0.76
13	-1.68	-1.72	0.33	-0.0047	24.7	0.2	1.0	0.76
14	-1.68	-1.70	0.27	-0.0050	25.0	0.2	1.2	0.76

Construction Equipment - Spanish Import from Italy

	Regression Coefficients				Mexval			RSQ
REP%	intercept	price	capital	NyhTrend	price	capital	NyhTrend	
7	-1.74	-3.55	0.80	0.0049	82.4	0.7	0.2	0.72
8	-1.74	-3.54	0.72	0.0048	81.6	0.7	0.1	0.72
9	-1.74	-3.54	0.65	0.0046	82.2	0.6	0.2	0.72
10	-1.74	-3.54	0.59	0.0043	82.1	0.6	0.2	0.72
11	-1.73	-3.54	0.53	0.0040	81.4	0.5	0.1	0.72
12	-1.73	-3.54	0.48	0.0036	81.9	0.4	0.1	0.72
13	-1.73	-3.54	0.42	0.0031	81.8	0.4	0.1	0.72
14	-1.73	-3.54	0.37	0.0027	81.7	0.3	0.1	0.72

Fig. 3A

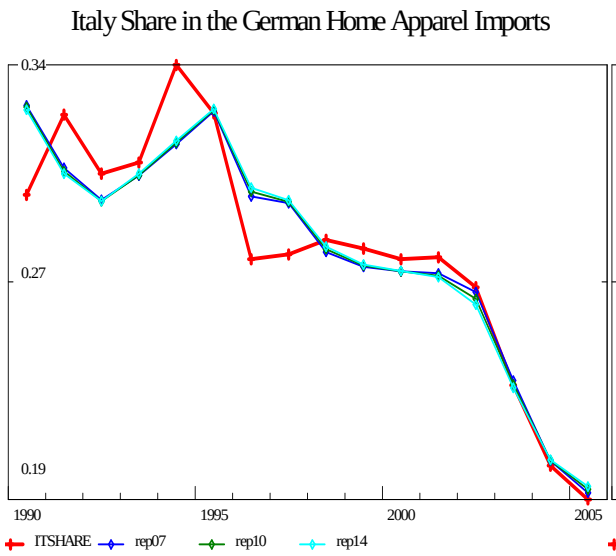
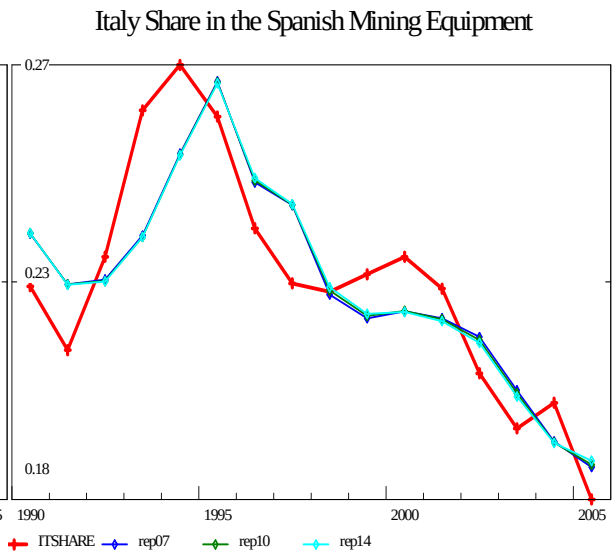


Fig. 3B



Tab. 2

Fruits - Italian Import Share in the UK Market

	Regression coefficients			Mexval		RSQ
REP%	intercept	price	capital	price	capital	
7	-3,17	-1,38	3,20	109,4	21,8	0,82
8	-3,17	-1,35	2,90	105,5	23,3	0,83
9	-3,18	-1,32	2,62	101,8	24,5	0,83
10	-3,18	-1,30	2,37	98,6	21,6	0,83
11	-3,19	-1,28	2,15	96,6	26,5	0,83
12	-3,19	-1,27	1,98	94,1	27,2	0,84
13	-3,19	-1,25	1,80	92,4	27,9	0,84
14	-3,20	-1,24	1,66	91,5	28,4	0,84

Fruits - Italian Import Share in the French Market

	Regression coefficients			Mexval		RSQ
REP%	intercept	price	capital	price	capital	
7	-2,58	-1,81	0,55	62,9	0,1	0,74
8	-2,56	-1,88	1,49	78,9	1,3	0,75
9	-2,54	-1,90	2,12	94,0	3,4	0,76
10	-2,54	-1,89	2,45	105,9	6,1	0,77
11	-2,54	-1,85	2,58	113,4	9,1	0,78
12	-2,54	-1,82	2,58	116,8	11,8	0,79
13	-2,54	-1,77	2,49	118,1	14,9	0,80
14	-2,55	-1,73	2,37	117,7	17,4	0,81

Fig. 3C

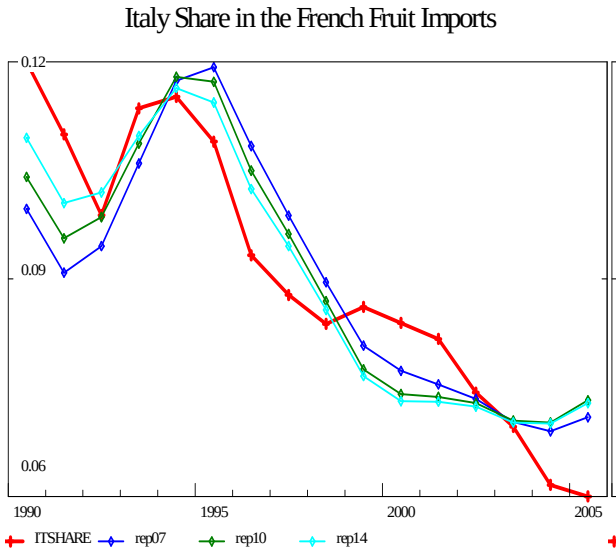
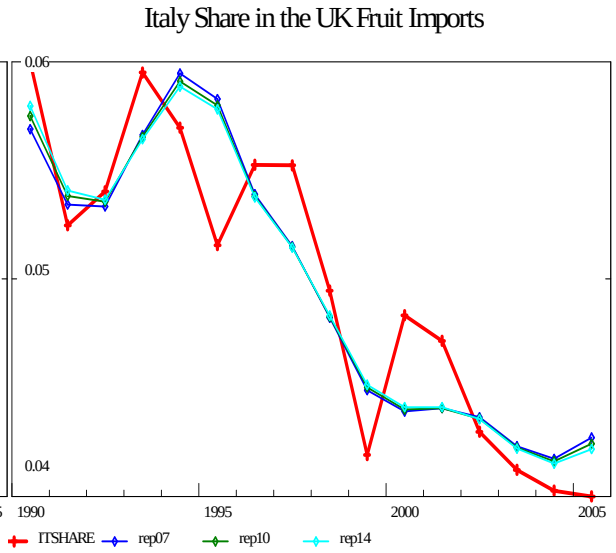


Fig. 3D



5. **Fitting and forecasting**

Goodness of fit indicators are initial guides to evaluate regression estimates. Then, descriptive statistics and statistical hypothesis testing may lead to exhaustive judgements of regression estimates; but, using them for forecasting purposes, the evaluation viewpoint may deeply change. The estimation procedure used in BTM (Ma, 1966) is based on least square method under the constraint to get parameter estimates within given feasible sets. Price term elasticity is limited in the interval (-4.0,0.0); Capital term elasticity in (0.0,+4.0). If Capital term elasticity turns out to be greater than 4.0, it assumes value 4.0; if the elasticity is negative, this explanatory variable is excluded from the model. The Price term elasticity is submitted to the same criterion within its parameter feasible set.

Many Italy import share equation estimates under different replacement rates present Price term and Capital term elasticity stick on their extreme values (respectively -4 and +4; not zero, because in such a case the variable would not be inserted in the model). The cases presented in the previous paragraph have been selected among those which had elasticity estimate changing in their feasible set.

The goodness of fit turned out to be moderately influenced by changing replacement rates while Capita as well as Price elasticities presented relevant and interesting shifts. In addition, Capital term marked a modest explanatory power with respect to that shown by Price term. This scrutiny may induce to consider Capital term a second hand explanatory variable. In forecasting, this judgement is misleading; in fact, once the estimation stage is over, in forecasting each explanatory variable fully works on the basis of its estimated parameter, independently from its measured explanatory power.

The importance of the estimated Capital term elasticity has been scrutinized in the forecasting horizon 2005-2030. The scenario has been designed as follows. The NyhusTrend has been computed on the basis of the December 2008 INFORUM forecast. The price term has been assumed constant over time; that is to say, no price effect has been considered. The Capital term has been moved with a growth of 1 per cent per year. While the fitting in Fig. 3A-D are relative to the import share logarithm, Fig. 4A-B show the time path of the import shares as they work in BTM with respect to replacement rates 7, 10 and 14 per cent.

Fig. 4A shows the forecast of the Italy share in the German Home Apparel market. In Tab 1, the impact of different Capital stock term was seen on the regression coefficient estimates and on the

goodness of fit. Here, the 'out the sample' impact is evaluated. In Tab 1, the impact was irrelevant in term of fitting; the Price term elasticity marked a 10% reduction in absolute value as the replacement rate moved from 7 to 14 per cent; the Capital term elasticity decreased from 1.82 to .53 and the NyhusTrend changed its direction: positive for low replacement rates and negative for the highest ones. These changes are reflected in the import share equation performance 'out of the sample'; these changes are clearly shown in Fig. 4A.
Fig. 4B shows the forecasting performance of an import share equation which does not include the NyhusTrend. In Tab. 2, this equation presents an noticeable increase in fitting, and intercept clearly stable and a modest change in the Price term elasticity; Capital stock regression coefficient goes from 0.55 to 2.37 reaching a peak of 2.58 at the replacement rate equal to 11 per cent. The replacement rates impact on Capital stock term are clearly reflected in Fig 4B: higher Capital stock elasticities emphasize the import share forecast trend.
Fig. 4A and Fig. 4B show that the Capital stock term computed with different replacement rates influences the import share equation forecasting performance, but no hint is given about changes in trend.

Fig. 4A

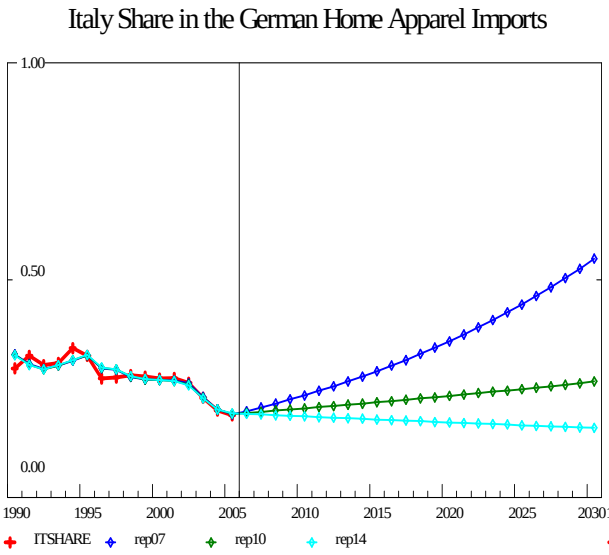
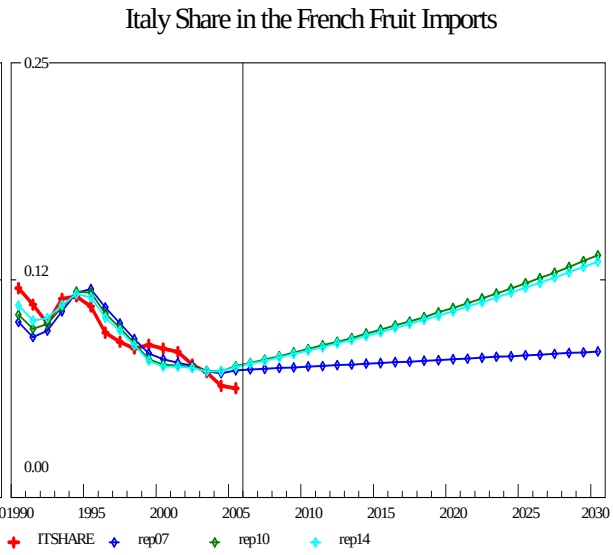


Fig. 4B



6. **A concern on the import share estimation procedure.**

The estimation procedure proposed and followed by Ma (1996) was addressed to test the basic idea behind the import share equation. Once, the 'selected' estimates are going to be put into the BTM as forecasting tool, it may be the case to revise and redefine the basic criterion plan.
As briefly described above, the estimated parameters are searched in two feasible sets: one for the Price term and one for the Capital term elasticity. Both sets have zero as an extreme value. It happens that when the estimated parameter has a wrong sign, it is put equal to zero so that the explanatory variable turn out to be excluded from the equation. When the expected sign is right but out the feasible set, it assumes respectively value -4.0 for the Price term and 4.0 for the Capital term. This criterion is clearly asymmetric because of the chosen extreme value of the feasible sets. In fact, when the estimated parameter assumes zero value, the explanatory variable is eliminated; if the estimated parameter has the right sign but it is greater than the extreme value of the feasible set, the explanatory variable is maintained with an elasticity equal to 4 in absolute value.
This criterion is useful to give evidence about the location of the parameter estimates and keeping away nonsense figures. However, it is risky as a criterion to select equation estimates to be used in

forecasting. In fact, on the basis of the scenario used to measure the impact of the Capital term elasticity in the previous paragraph, it is worthwhile to notice that an elasticity of 4.0 implies an increase of 27 per cent of the import share in the interval 2005-2030. If such an impact hits a dominant import share and no other similar effect acts on other import shares, high Capital term elasticities may generate crowding out effects on other econometrically estimated import share equation forecasts. In fact, import shares are always rescaled to sum up to one and a 'dominant' import share can prevail over the others.

7. **Concluding remark**

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