PREFACE

In September 2007 the national team members of the International Inforum (Interindustry Forecasting Project at the University of Maryland) group held the XV annual World Conference in Truijllo, Spain. Such Conferences offer the participants to report their achievements in the different fields concerning the macroeconomic multisectoral modeling approach and data development.

The national partners build their country model based on a common input-output accounting structure and a similar econometric modeling approach for sectoral and macroeconomic variables. In each Conference, the contributions refer to the wide spectrum of research activities carried on within the Inforum system of models. Modeling methodology, improvements of the common software, data management and development, policy analyses supported by model tools based on a bottom-up approach which properly portrays the economic details used by policy makers are all topics of the conferences.

Inforum was founded 40 years ago by Dr. Clopper Almon, now Professor Emeritus of the University of Maryland. The modeling approach, once named 'modern input-output' model and now with the more descriptive 'Macroeconomic Multisectoral Model', is described in a number of papers available on the web site www.inforum.umd.edu.

This book is a collection of selected papers presented at the XV Inforum World Conference. The opening paper is a remarkable example of the complex approach and innovative solutions created within Inforum. **Clopper Almon** and **San Sampattavanija** propose a method to solve a problem that has great practical importance in applied forecasting: the «ragged-end» phenomenon of statistics that must be used from a model builder to obtain results that are both reliable and up-to-date. The paper presents the first systematic attack on this problem for economy-wide, industry-level models: the approach is to use high-frequency – monthly or quarterly – data to produce estimates of current and near-term future values of the annual series used in the long-term model and thus eliminate, from the point of view of its builder, the ragged-end phenomenon. Results show that annual

Rossella Bardazzi, Maurizio Grassini (edited by), *Structural changes, international trade and multisectoral modelling*, ISBN (on line) 978-88-8453-740-9, ISBN (print) 978-88-8453-739-3, © 2008 Firenze University Press

series forecasted with this method are certainly more accurate than using the long-term model to forecast the current year, although they are sensitive to the accuracy of the forecasts of the exogenous variables.

The first section is devoted to multisectoral modeling. **Maurizio Grassini** describes some issue arisen in building the updated version of INTIMO (Interindustry Italian MOdel): the problem of chain indexes, the analysis of labour productivity and the replacement ratio of capital stock. The adoption of chain indexes does not preserve the accounting identities in the models whereas the variables are measured in constant values thus a rescaling procedure is proposed. The analysis of different measures of the employed work force emphasizes that labour market structural reforms in Italy have produced some effects during the last decade, hence the labour productivity time series have to be carefully used in forecasting because past behavior is unlikely to continue in the near future. **Astra Auziņa** and **Remigijs Počs** present a detailed description of the basic structure of an INFORUM-type model for Latvia. The paper shows the most important steps and gives an insight of the difficulties of multisectoral model building for a recent new EU member state and Inforum new partner as well. The design of scenarios in a fast-growing economy with structural changes makes economic forecasting a challenging task. The final paper of this section is by **Alexander Baranov** and **Victor Pavlov**. The authors present forecasts for the Russian economy with a deterministic Dynamic Input-Output Model for the period 2008-2012. The analysis shows that a double level of fixed assets is necessary for the Russian economy to achieve a considerable growth of GDP up to 2017 with a remarkable increase of labour productivity.

Two contributions about the Chinese economy are collected in the second section on data issues. **Mingshuo Fei** and **Shengchu Pan** describe the new features of a databank for the MUDAN multisectoral model of China. In this country, official statistics frequently change their structure to keep up with the fast-growing economy. Therefore it is of outmost importance to understand and use the most recently released data to make the model more accurately reflect the Chinese economy. On the same topic **Li Shantong**, **Ge Xinquan** and **Shao Huiyanx** analyse the input-output data of China at the regional level to compare the similarity between the local industrial structure and the national one through the similarity coefficient. Then the authors investigate how an industry affects its forwards industry and discussed the relationship between the change in trend of an industry's technological density and its capital structure. Finally, the paper analyzes the importance of each sector in the national economy by using an index of backwards linkage and an index of forwards linkage.

The section on domestic demand is devoted to personal consumption. Indeed while the contribution by **Rossella Bardazzi** estimates and compares the behavior of household expenditure in Italy and France, **Jonela Lula**, **Gabrielle Antille Gaillard** and **Jean-Paul Chaze** estimate private consumption in Switzerland with alternative demand systems. In the first paper household consumption is estimated on a similar classification of expenditure functions for the two EU economies with the system of demand equations PADS developed by Almon and widely used within Inforum models. In the second paper this approach is compared with the linear expenditure system and the almost ideal demand system on a set of 12 functions over the period 1980-2005.

International trade modeling is one of the outstanding features of the Inforum system of models. The related section opens with a contribution by **Josef Richter** and **Reelika Parve** on a linkage between a newly built multisectoral model for Austria and a Bilateral Trade Tool for EU27. This is a partial linking since the model is included as a satellite in the trade system, thus this approach is a first step to a full linkage with feedbacks from other countries included in the system. **Douglas Nyhus** uses the MUDAN multisectoral model of China to examine the effects of possible policies that China could do to narrow and/or close its merchandise trade gap over the next ten years. In recent years Chinese growth has been led by exports and this has created a trade surplus and a 'twin' surplus of domestic savings over investment that must be managed with domestic policies. The currency appreciation associated with domestic demand side measures to reduce savings are simulated in the model to investigate the macroeconomic and the industry-level effects. Finally, the paper of **Reelika Parve** presents a theoretical and empirical analysis of the development of a widely used approach to international trade modelling, namely the gravity approach. An extensive review of both theoretical and empirical literature is presented and the gravity model is applied on Italian multisectoral trade flows. Results confirm serious doubts on the applicability of this approach on sectoral data.

The final section concerns energy issues which are ranked very high on the agenda of all model builders. **Michal Przybylinski** presents a new block of foreign trade equations for IMPEC – the multisectoral model of the Polish economy to enable analysis of how changes in world prices of basic energy carriers can influence the domestic economy, especially households. The contribution by **Mariusz Plich** is related to the construction and preliminary use of a very important set of data to join economic and environmental information: the National Accounting Matrix including Environmental Accounts (NAMEA) implemented at the European level. The author develops this accounting framework for Poland from several sources and presents a time-series of NAMEA (1995-2002). Then a decomposition analysis is performed with this data. Finally, **Velga Ozoliņa** and **Remigijs Počs** develop an analysis of electricity consumption building an energy block within the multisectoral model of Latvia. Sectoral equations for electricity consumption are estimated and used in the model to forecast consumption up to 2020: results show that national production of electricity will be insufficient to cover the estimated absorption then this deficit should be covered with net imports or new production facilities.

THREE ISSUES RELATED TO THE CONSTRUCTION OF A MULTISECTORAL MODEL

Maurizio Grassini

1. Introduction

Firstly, this paper deals with the issue of the impact of chain indexing on the database built according to the ESA95 system. Some problems concerning measurement in purchasers prices and basic prices among make and use matrices and available time series related to groups of commodities or to industries are outlined. The size of the loss in the accounting identities due to the introduction of chain indexing is analyzed for Personal Consumption Expenditure by COICOP groups of expenditures and Investments by investors.

Besides the estimation of labour productivity equations, the impact of the European Employment Strategy and reforms in the labour market institutions are analyzed to point out a likely bias in the decline of Italian labour productivity.

Investments and capital stock data are used to investigate the replacement ratios attributed to investors. The replacement ratio time trends and the Istat (the Italian Central Statistical Bureau) Methodological Guide suggest using a non constant replacement ratio while capital stock is computed from investments according to the perpetual inventory principle.

2. Accounting framework

Istat has published a time series of supply, use and import flow matrices for the years 1995-2003. These matrices are built according to the Eurostat format based on ESA95. Details are given for 60 European sectors; the Italian matrices have 59 sectors both for industries and products (the last, which refers to extra-territorial units, is omitted). The supply matrices are built at basic prices; use matrices are available at purchasers' and basic prices.

Istat has made a set of matrices for the year 2000 available. Besides the supply and use matrix at basic prices, a set of other matrices is pro-

Rossella Bardazzi, Maurizio Grassini (edited by), *Structural changes, international trade and multisectoral modelling*, ISBN (on line) 978-88-8453-740-9, ISBN (print) 978-88-8453-739-3,

vided: a matrix of non-deductable VAT, a matrix of excise taxes and a matrix of trade and transport margins. This special windfall of matrices has led to the choice of year 2000 as the base year of the new INTIMO, INTIMO2000.

The supply matrix is moderately sparse. The construction of a product-to-product matrix was obtained by means of Almon's algorithm which applied to domestic and import flow intermediate matrices. The procedure was completed by balancing the value added sector.

The ESA95 framework considers national macroeconomic accounts, institutional accounts and input-output tables as part of a single system of accounts. It makes it easy to construct databases for macroeconomic and, in particular, for multisectoral models which requires aggregate as well as sectoral (industries, commodities and institutions) data.

The maximum detail of Personal Consumption Expenditure, Total Output and Employment time series is available from year 1992; Capital Stock time series begin from 1980; Investments time series show the most detail from 1970. The reconstruction of the time series goes back to the year 1970, but only for a few subtotals. Exports, Imports, Inventory Change (and Total Intermediate Consumption) time series are available for the use matrix in detail (59 sectors) for the time interval of these matrices, precisely years 1995-2003.

Total Output and Employment figures are available for 45 sectors corresponding to industries. Investment and Capital Stock is related to 29 groups of investors. Personal Consumption Expenditure gives details for 56 items. Bridge matrices link the items of Personal Consumption Expenditure and the Investments to the 59 commodities of the corresponding vectors in the final demand of the use matrix.

3. The chain index drawback

Unfortunately, in ESA95 the use of chain indexes does not allow us to preserve the accounting identities whereas the variables are measured in constant values. This is a serious handicap for macroeconomic model builders as far as variables in constant terms are required. Of course, a multisectoral model builder must necessarily tackle the problem concerning the time series used to construct the real side of the model.

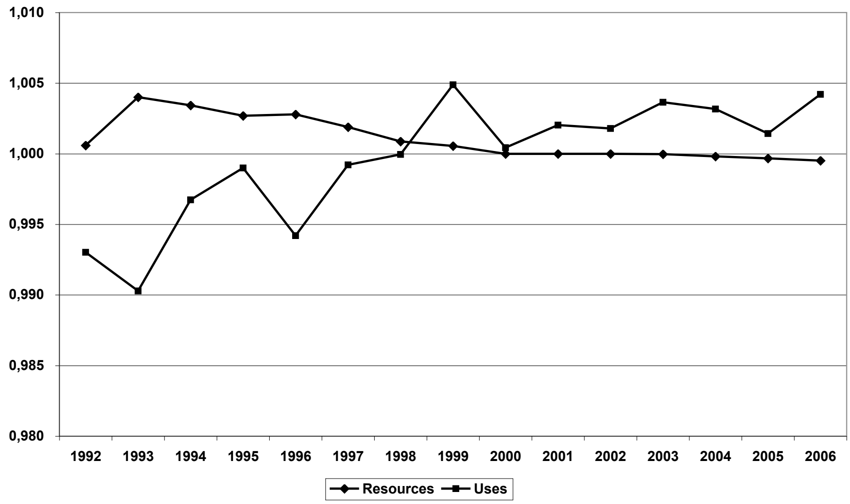
Personal Consumption Expenditure, Investment, Capital Stock , Exports, Imports and Total Output are all used in the real side of the multisectoral model They are required at constant prices. The chain index permits a comparison of the real values of two adjacent years: a variable deflated by means of a price index computed applying weights of the mix of the year before may be compared in real terms only with the variable of the previous year. The idea of the chain index only allows us to compare observations of successive years. However, changes in prices and quantities between nonadjacent periods are obtained by accumulating the «short-term» variations. This procedure leads to the so-called «chain indices». These may be used to deflate the time series in current value obtaining time series in volume within the chain-linking system. Istat has fully adopted the chain-linking system which now replaces the previous fixed-base methodology. Now, the time series in volume are called «chained», no longer «in constant value»; this is to remind us that time series in volume incorporate the pros and contros of the chain index system. Among the disadvantages, the loss of additivity represents a serious drawback for a macroeconomic model builder. Almon (2005) (who already experienced the introduction of the chain index system in the USA National Accounts) showed that there is no elegant analytical method to circumvent the problem. It is up to the model builder to provide a way to overcome the loss of additivity.

First of all, the loss of additivity appears when totals are compared with subtotals. A total may be a subtotal of other aggregated macroeconomic variables. For example, the sum of the 56 «chained» Personal Consumption Expenditure items is not equal to their «chained» total. In turn, total Personal Consumption Expenditure is not equal to the «chained» series in the Resources and Use Account. Furthermore, the «chained» Uses in the Resources and Use Account do not sum up to the corresponding total of the «chained» Uses.

For the purpose of INTIMO2000, in order to recover additivity, a spread procedure is adopted. It is possible to apply a bottom up as well as a top down approach. Here, a top-down procedure is adopted. This choice is suggested by the priority given to the Resources and Uses macroeconomic account as a benchmark of the database. In this account the Total Resource are equal to Total Uses chained values. The total of Resource items, that is to say GDP and Imports, and total of Use items are both different to their common chained total. Moreover, different correction factors are applied to them.

Figure 1 shows the spread factor applied to the aggregates of Resources and Uses account in the years 1992-2006. The Resources correction factor is more constant than the Uses one; while the Resources correction factor ranges between 1.004 and .99995, the Uses correction factor is a bit more erratic and reaches a deviation of about 1 per cent in year 1993, revealing the impact of the heavy currency devaluation which took place the year before. Table 1 contains the percentage values (equal to 100*(correction factor -1)) of the difference between the aggregate values for Resources and Uses (as shown in figure 1), for Personal Consumption Expenditure and Investments.

Fig. 1. Spread Factors



Source: Istat, *Conti economici nazionali 1970-2006*

Tab. 1. Percentage discrepancies between Totals and Sub-totals

Years	Resources	Uses	PCE	CAP
1992	0.059	-0.697	0.010	-0.046
1993	0.401	-0.971	0.013	-0.104
1994	0.344	-0.326	0.008	-0.059
1995	0.269	-0.100	0.005	0.005
1996	0.280	-0.580	0.009	-0.008
1997	0.189	-0.079	0.002	-0.004
1998	0.087	-0.005	0.001	0.003
1999	0.055	0.488	-0.004	-0.005
2000	0.000	0.044	0.000	0.000
2001	0.000	0.202	-0.002	0.000
2002	-0.001	0.179	-0.001	0.006
2003	-0.004	0.364	-0.003	0.000
2004	-0.018	0.318	-0.002	-0.005
2005	-0.032	0.142	0.001	
2006	-0.048	0.420	0.000	

4. Employment, Labour productivity and Labour market structural changes

The sectoral Labour productivity equations largely follow «Verdoorn's Law» which states that empirical evidence supports a «fairly constant relation over a long period between the growth of labour productivity and the volume of industrial production».

This statement may be supported by a number of arguments: a) in a rapidly growing sector, investments may embody technical progress which improves labour productivity; b) an increase of industrial production may make room for economies of scale; c) a sudden important technological innovation can seriously raise competitiveness which in turn leads to an increase in output.

At present, sectoral labour productivity equations are determined by sectoral output dynamics and a time trend. These equations have a very simple analytical structure. Other structures designed to explain total factor productivity indexes (which consider capital stock and labour, at least, as production factors) have been estimated in the past. A good fit and reliable estimated parameter structures at the level of single equation performance put untrustworthy model behaviour out of sight. Gratifying sectoral total factor productivity equation estimates were abandoned and a simple labour productivity equation was maintained where, as mentioned above, the reciprocal of labour productivity (employment over output) was explained by the output rate of growth and a time trend.

In the multisectoral model, labour productivity equations play a double role. On the one hand, they determine the cost of labour (together with capital in the case of total factor productivity) per unit of output; on the other, employment is the by-product of these equations. Two labour statistics are available[1]: labour force and labour employed; the latter has a dual measure: employment and Unit of Labour (UL).

The amount of labour in a unit of time (for example, hours worked per employee per year) is the appropriate input to measure labour productivity. UL, which defines the «number of full time equivalent persons employed by industry», is the closest estimate of the amount of labour in a unit of time available using Italian statistics. The full time equivalent employed person is computed considering the «amount of labour in hours per week» from the prevailing contract in the national labour market. The ratio between «full time equivalent employed person» and «man-hour per unit of time» is not constant over time. It may vary but constantly so that UL can be a good proxy of the labour input related to «employees per industry».

[1] Recently, Istat has published «Total hours worked» for about 30 industries. The labour productivity equations are estimated by using employment statistics available for 45 industries

Employment statistics include overtime, full-time, part-time and a variety of workers who over time may statistically pop up or disappear on account of changing rules in the labour market. Table 2 shows the employment/UL ratio (%) in the market sectors. A ratio above 100 is evidence of a number of employed people greater than their measure in terms of UL. The first row shows the ratio relative to total employment; the second row refers to employees and the third to self-employed workers. From the series relative to the period 1990-2006, employees turn out to be very close to their UL measure. Self-employed workers work about 15-20 per cent more than an employed worker. While self-employed workers show a constant employment/UL ratio over time, this ratio has a constant positive trend for employees.

Tab. 2. Employment to UL in the market sector, (%)
First row: Total; Second row: employees; Third row: self-employed

1990	1991	1992	1993	1994	1995	1996	1997	1998
94.35	94.94	94.91	95.40	94.58	94.30	94.26	94.07	94.01
99.88	100.54	100.88	101.63	100.70	100.42	100.54	100.16	100.10
85.09	85.66	85.04	84.91	84.24	84.04	83.88	83.89	83.74

1999	2000	2001	2002	2003	2004	2005	2006
94.68	94.82	95.31	95.29	95.59	95.73	96.37	96.61
101.02	101.10	101.80	101.64	102.17	102.29	102.84	103.14
83.81	83.99	83.86	83.82	83.87	84.11	84.18	84.13

Source: Istat, Conti economici nazionali 1970-2006

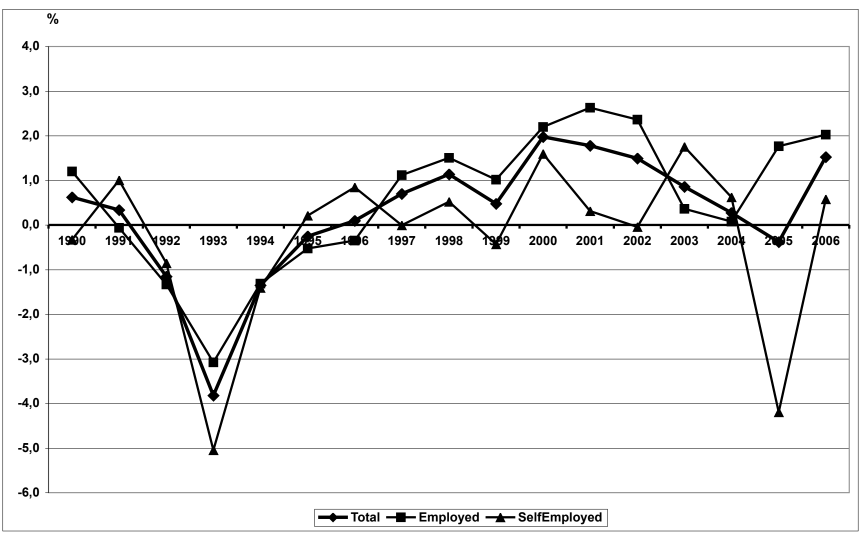
During the early 1990's, as the pace of European integration accelerated in various fields, the European Union realized that it did not have adequate tools to prevent and tackle the persistent high unemployment levels present in many European countries. The real beginning of the examination of employment at a European Union level came about in 1993 with the «White Paper» on Growth, Competitiveness and Employment prepared by the President of the European Commission, Jacques Delors. Inspired by this book in December 1994 in Essen the European Council agreed to five key objectives to be pursued by the Member States to fight unemployment. Two of them concerned the promotion of moderate wage policies and the improvement of efficiency of the labour market institutions.

In Italy, the effect of moderate wage policies is shown in Figure 5. In 1990 and 1991 wages per worker grew much faster than the PCE deflator. In 1992 the Italian currency was hit by a serious financial crisis which led to its devaluation by about 25 per cent. The economy went

Fig. 2. Growth rates of Employment

Source: Istat, *Conti economici nazionali 1970-2006*

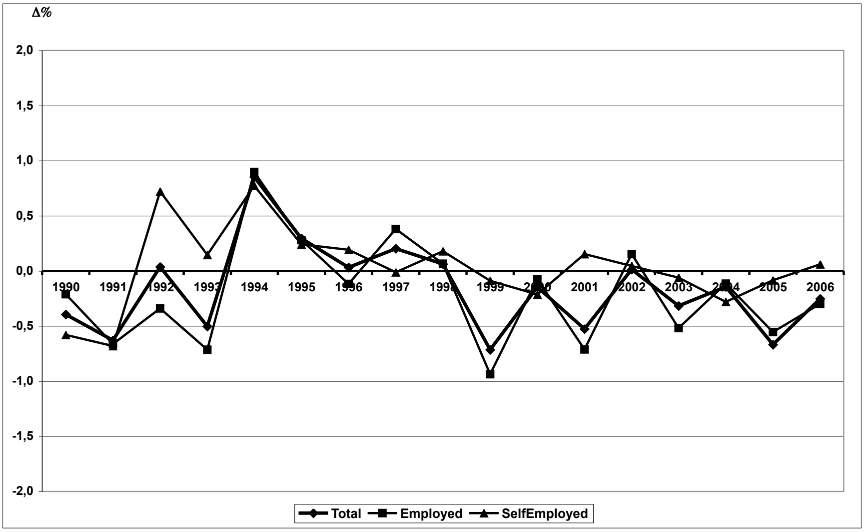
Fig. 3. Growth rates of UL



Source: Istat, *Conti economici nazionali 1970-2006*

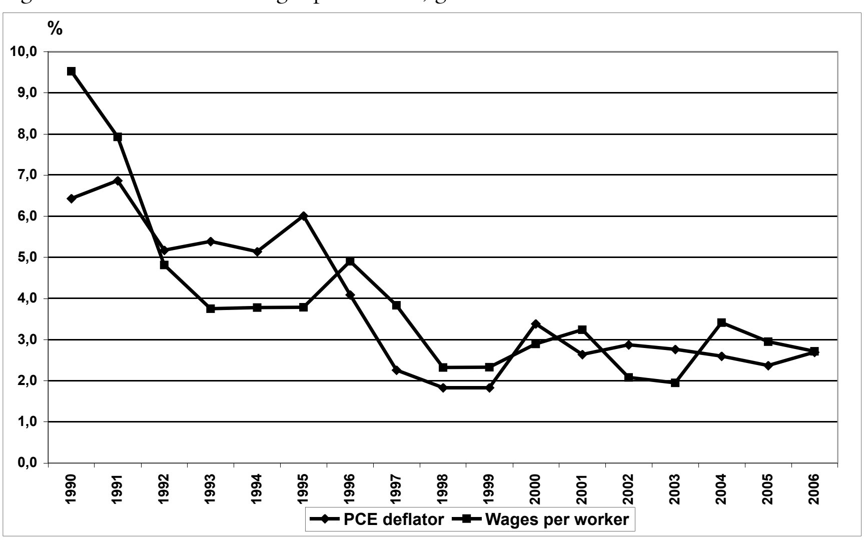
into a recession with a negative GDP rate of growth in 1993. For three years wages grew at a rate of 4 per cent; the PCE deflator grew at 5-6 per cent so that real wages decreased.

Fig. 4. Differences in rates of growth. UL versus Employment



Source: Istat, *Conti economici nazionali 1970-2006*

Fig. 5. PCE deflator and wages per worker, growth rates



Source: Istat, *Conti economici nazionali 1970-2006*

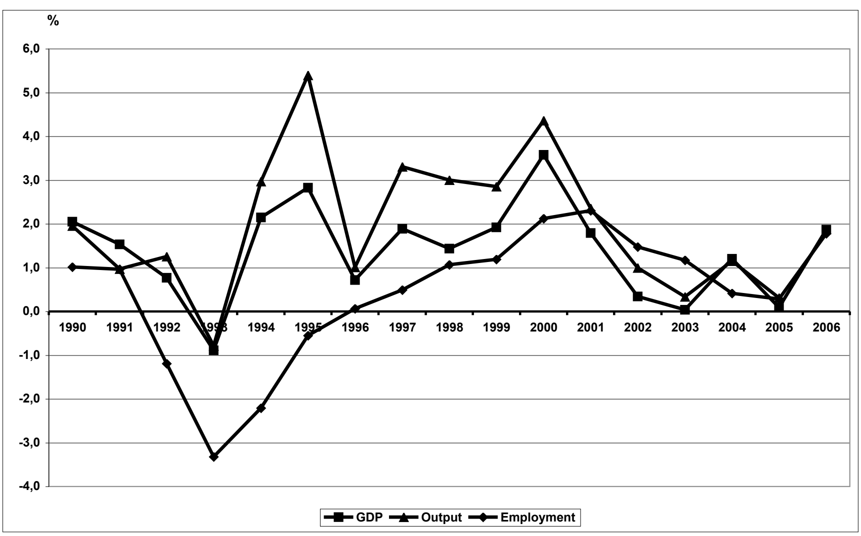
From 1992, the European Member States' economic policies were submitted to multilateral surveillance as defined in the Maastricht treaty. The introduction of a common currency was the objective; a set of indicators were used to monitor the Member States' performance for eligibility to the currency area. The rate of inflation was among these indicators. Surprisingly, Italy, with a history of high inflation, performed very well. Inflation fell rapidly to a rate of 2 per cent. Workers shared the cost of matching the so-called Maastricht criteria. Figure 5 shows that wage dynamics followed the path of inflation over the last decade with no perceivable improvement in real terms.

The path towards a common currency forced European Member States to look for better co-ordination of their social-economic policies. The Treaty of Amsterdam (1995) gives evidence of this concern. It contains a new Title dedicated to actions aimed at fostering employment. In 1996 a permanent Employment and Labour Market Committee was created and in 1997 a European Employment Strategy was launched. The Treaty of Amsterdam emphasized that employment was an issue of common concern and the Member States committed themselves to co-ordinating their employment policies.

Within this European policy strategy, two reforms of labour market institutions were introduced in Italy: respectively in 1997 and 2003. These reforms basically introduced a variety of new types of labour contract aimed at removing the demand-supply mismatch which was considered the main cause of the high level of unemployment. The effect of these reforms can be seen in Figure 6.

The recession provoked by the 1992 Italian financial crisis was anticipated by negative growth of employment rates. Despite a remark-

Fig. 6. Growth rates of GDP, output and employment



Source: Istat, *Conti economici nazionali 1970-2006* able increase in total output, the recovery in 1994 and 1995 took place with declining employment. In 1997, with the introduction of the first reform, employment began to grow and the rates of growth remained positive for a decade. In this period, GDP (and total output) and employment dynamics do not show any production function approach in their background. In other words, the reduction of the unemployment rate worsened labour productivity. Figure 4 shows that the UL rates of growth were largely greater than employment growth rates and Figure 6 shows employment growth rates generally greater than output growth rates from 2001 onwards.

However, the sectoral employment over sectoral output ratio shows in general the expected negative trend and the Verdoon's law-inspired model still performs quite well as regards fit. The impact of the labour market reforms certainly contributed to lower labour productivity which will be able to follow a better trend when the «new» structural unemployment rate is achieved

5. *Capital stock and capital investment*

Within the ESA95 system, Istat has recently published a new time series of investments, capital stock and amortization. These time series cover the time interval 1970-2003 for investments and 1980-2003 for capital stock (gross and net) and amortization. The time series are available for 29 investors. A bridge matrix to link these investors to producers is available for the year 2000. The row sum and column sum of this matrix match the investments in the time series and in the use matrix in the year 2000.

Capital stock and investments time series for 29 investors enabled a simple investigation of the replacement rates which relate them.

By using the formula $K_t = I_t + (1 - \alpha) * K_{t-1}$, the replacement rate applied to the perpetual inventory system turns out to be rather variable among the investors and over time as shown in Table 3. Figure 7 shows some investors who faced a replacement rate with a positive trend (Agriculture, Fishery, Mining non energetic materials, Food and Beverages industry and Textile and clothes industry); Figure 8 shows replacement rates which are more or less constant over time for Chemicals, Construction, Health services, Real Estate and Government; in Figure 9 two sectors (Mining of energetic raw materials and Coke and oil products) present a declining replacement rate but well over the average value of the aggregate.

Table 4 shows the composition of capital stock at the beginning and at the end of the time interval and, in the third column, the differences between them. Real estate, Financial services and Government declined from over 46 per cent of total investment in 1980 to 37 per cent in 2003.

Tab. 3. Replacement Rates

INVESTORS	YEARS																						
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1 Agriculture	4.9	5.0	5.1	5.2	5.2	5.3	5.4	5.4	5.4	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9	6.0	6.0	6.1	6.1
2 Fishery	9.0	9.1	9.2	9.4	9.6	9.7	9.9	10.2	10.2	10.3	10.4	10.5	10.6	10.7	10.7	10.9	10.8	10.8	10.8	10.8	11.0	11.0	10.6
3 Energetic mineral	11.3	11.1	10.8	10.5	10.7	10.9	10.5	10.3	10.1	10.0	10.4	10.5	10.4	9.9	10.0	9.7	9.8	9.7	9.7	10.0	10.1	10.1	10.6
4 Non energetic mineral	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.2	8.5	8.7	8.8	8.8	8.7	8.8	9.0	9.3	9.2	9.2	9.4	9.3	9.3	9.5	9.5
5 Food beverage industry	7.8	7.8	7.9	8.1	8.2	8.3	8.5	8.7	8.8	8.9	9.0	9.1	9.0	9.0	9.2	9.0	9.1	9.1	9.2	9.0	9.0	8.9	8.9
6 Textiles & Clothes	7.2	7.3	7.4	7.7	7.8	8.0	8.2	8.4	8.5	8.7	8.7	8.5	8.5	8.8	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.1	9.1
7 Leather and products	7.4	7.5	7.7	7.8	8.0	8.2	8.4	8.6	8.8	8.9	9.1	9.2	9.2	9.5	9.7	9.7	9.6	9.8	9.7	9.8	9.7	9.7	9.3
8 Wood and furniture	6.7	6.9	7.0	7.2	7.4	7.6	7.8	7.9	8.0	8.1	8.2	8.3	8.3	8.4	8.6	8.6	8.7	8.7	8.8	8.7	8.6	8.7	8.6
9 Paper, paper products	7.3	7.4	7.6	8.0	8.2	8.5	8.7	8.8	8.9	9.0	9.2	9.2	9.2	9.4	9.7	9.5	9.5	9.6	9.4	9.6	9.4	9.3	9.3
10 Coke, oil products	10.3	10.1	9.9	9.6	9.8	9.9	9.5	9.3	9.3	9.1	9.4	9.5	9.2	9.0	9.0	9.3	9.3	9.6	9.3	9.5	9.3	9.2	9.4
11 Chemicals	8.2	8.5	8.8	9.1	9.4	9.6	9.9	10.1	10.2	10.2	10.2	10.2	10.1	10.1	10.1	10.3	10.2	10.1	9.9	9.8	9.8	9.8	9.8
12 Rubber & Plastic	7.4	7.6	7.7	8.0	8.1	8.5	8.7	8.9	9.0	9.0	9.1	9.1	9.1	9.3	9.5	9.4	9.4	9.5	9.5	9.5	9.4	9.4	9.4
13 Non metallic minerals	7.3	7.4	7.6	7.8	7.9	8.1	8.4	8.6	8.8	8.8	8.8	8.9	8.8	8.9	9.2	9.1	9.2	9.1	9.2	9.1	9.1	9.2	9.1
14 Metal products	7.4	7.6	7.8	8.0	8.2	8.4	8.7	9.0	9.1	9.1	9.2	9.2	9.1	9.4	9.6	9.7	9.5	9.6	9.7	9.6	9.5	9.3	9.1
15 Mechanical machinery	7.1	7.3	7.4	7.7	7.9	8.1	8.3	8.6	8.8	8.8	8.8	8.7	8.7	9.0	9.2	9.1	9.0	9.1	9.0	9.1	9.1	9.2	9.1
16 Electrical machinery	8.3	8.4	8.6	8.9	9.0	9.3	9.5	9.7	9.9	10.0	10.0	9.8	9.8	10.0	10.3	10.2	10.2	10.1	10.2	10.8	10.6	10.2	10.2
17 Motor vehicles	8.3	8.6	8.6	8.7	8.7	9.0	9.5	9.6	9.5	9.7	9.8	9.9	9.7	9.5	9.6	9.5	9.6	9.7	9.8	10.0	10.0	10.1	10.1
18 Other industries	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.9	8.1	8.2	8.4	8.6	8.7	9.0	9.0	9.1	9.1	9.2	9.3	9.2	9.2	9.0
19 Electricity, gas, water	5.5	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.9	6.2	6.2	6.3	6.4	6.5	6.6	6.8	6.9	7.0	7.2	7.3	7.5
20 Construction	8.9	8.9	8.9	9.1	9.4	9.5	9.7	9.9	10.0	10.1	10.2	10.2	10.0	10.0	10.2	10.2	10.1	10.0	9.8	9.8	9.8	9.5	9.2
21 Trade	5.9	6.0	6.1	6.2	6.2	6.3	6.3	6.5	6.6	6.6	6.7	6.6	6.6	6.6	6.7	6.8	6.8	6.9	6.9	7.0	7.1	7.2	7.0
22 Hotels & Restaurants	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.8	4.8	5.0	5.0	5.1	5.2	5.2	5.3	5.5	5.6	5.7	5.7	5.7	5.8
23 Transport, Communic.	8.0	8.1	8.2	8.4	8.4	8.5	8.7	8.8	8.9	9.1	9.2	9.3	9.3	9.4	9.5	9.7	9.9	9.9	10.0	10.0	9.9	9.8	9.7
24 Financial services	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.5	4.7	4.8	4.8	4.8	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.7	4.8	4.9	5.0
25 Real Estate	2.0	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6
26 Government	2.7	2.7	2.8	2.8	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.2	3.2	3.2	3.3	3.3	3.4	3.4	3.4
27 Education	4.3	4.3	4.3	4.3	4.3	4.4	4.4	4.4	4.4	4.3	4.3	4.3	4.2	4.2	4.2	4.3	4.3	4.4	4.4	4.5	4.4	4.6	4.6
28 Health services	8.8	8.9	9.0	9.2	9.4	9.4	9.5	9.5	9.5	9.4	9.2	9.0	8.8	8.7	8.9	9.0	9.1	9.2	9.1	9.1	9.0	8.9	8.8
29 Other personal services	6.0	5.9	5.8	5.8	5.8	5.8	5.9	5.9	5.9	6.0	6.0	6.0	6.0	6.1	6.2	6.3	6.4	6.4	6.5	6.5	6.6	6.6	6.6

Fig. 7. Growing Replacement Rates

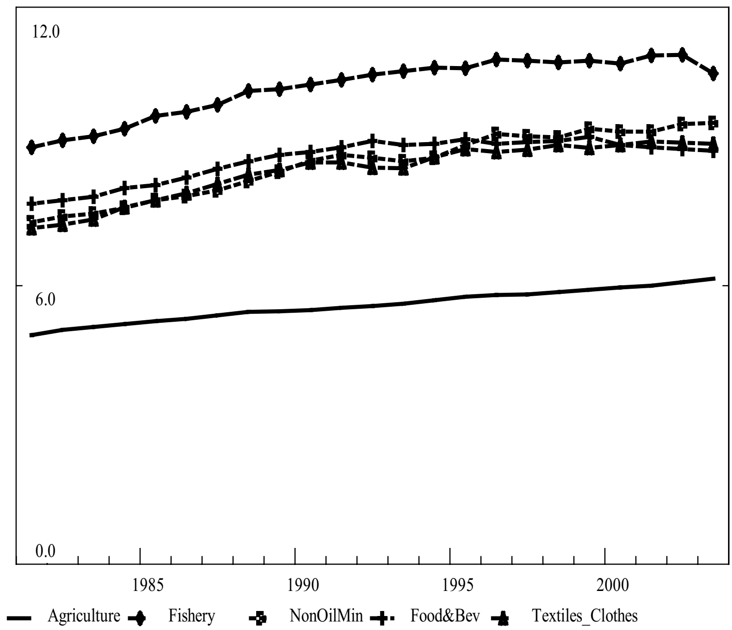


Fig. 8. Relatively Constant Replacement Rates

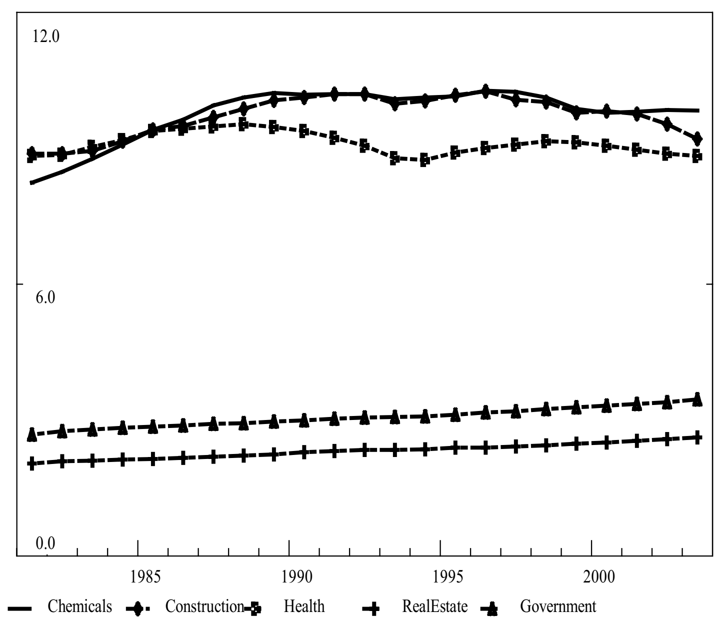


Fig. 9. Declining Replacement Rates

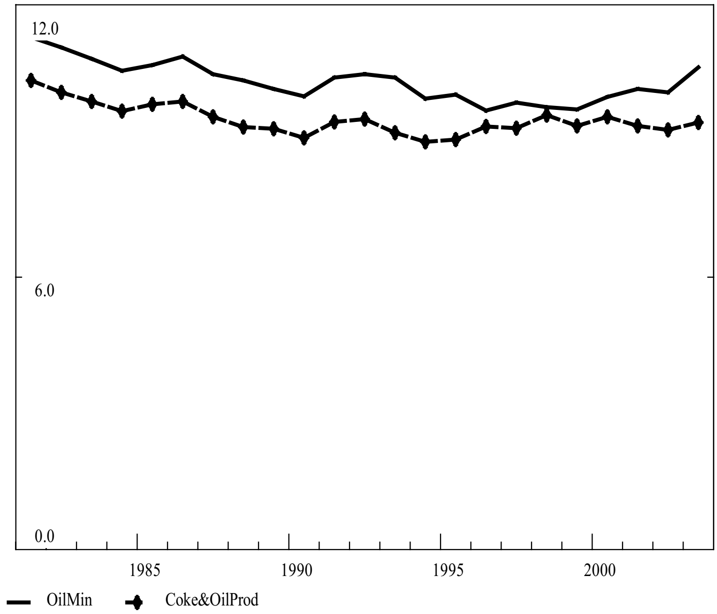
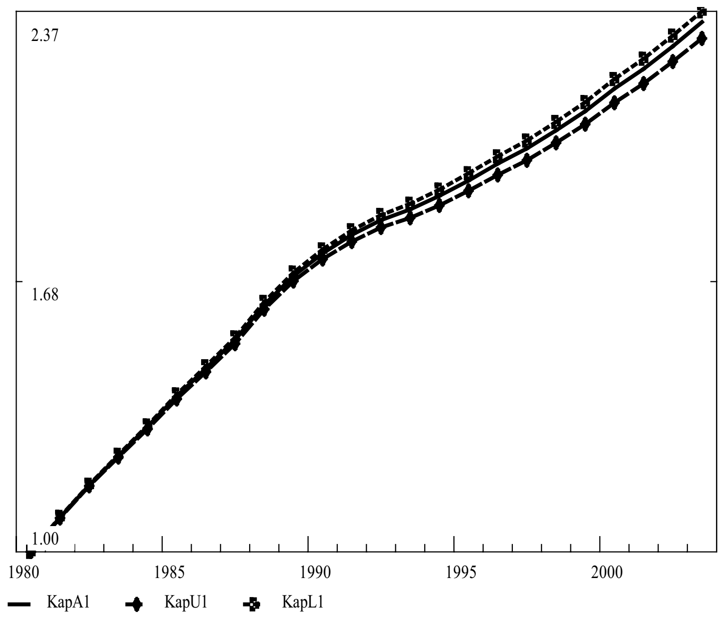


Fig. 10. Education – Replacement Rates: Lower .042, Average .044, Upper .046



Tab. 4. Capital Stock composition and Replacement Rates

Years	Investments 1981	2003	diff	Replacement rates period 1981-2003 average	min	max	diff
Agriculture	4.84	4.00	-0.84	5.57	4.93	6.14	1.21
Fishery	0.21	0.14	-0.07	10.27	8.97	10.97	2.01
Mining of energetic Raw Mat	0.13	0.42	0.29	10.31	9.67	11.28	1.61
Mining non energetic materials	0.32	0.19	-0.13	8.60	7.36	9.50	2.14
Food beverage industry	2.17	2.19	0.01	8.72	7.76	9.20	1.44
Textiles & Clothes	2.29	1.47	-0.82	8.46	7.24	9.10	1.86
Leather and products	0.49	0.34	-0.15	8.92	7.41	9.77	2.36
Wood and furniture	0.90	0.53	-0.37	8.07	6.71	8.79	2.09
Paper, paper products	0.86	1.45	0.59	8.90	7.28	9.66	2.38
Coke, oil products	0.41	0.46	0.05	9.47	8.98	10.33	1.35
Chemicals	2.06	1.79	-0.28	9.76	8.24	10.26	2.02
Rubber & plastic	1.15	1.25	0.11	8.90	7.43	9.51	2.08
Non metallic minerals	1.32	1.69	0.37	8.62	7.31	9.21	1.90
Metal products	4.12	3.71	-0.41	8.95	7.42	9.66	2.24
Mechanical machinery	2.75	2.16	-0.59	8.58	7.13	9.21	2.08
Electrical machinery	1.38	1.66	0.28	9.74	8.26	10.75	2.50
Motor vehicles	1.61	1.61	0.00	9.45	8.30	10.10	1.80
Other industries	0.93	0.73	-0.19	8.13	6.20	9.32	3.12
Electricity, gas, water	4.29	4.42	0.13	6.14	5.37	7.46	2.09
Construction	3.38	4.06	0.67	9.71	8.87	10.25	1.38
Trade	4.75	8.04	3.29	6.60	5.91	7.17	1.26
Hotels & Restaurants	1.65	2.61	0.96	4.96	4.02	5.80	1.77
Transport, comunic.	7.39	12.73	5.34	9.16	8.01	10.01	2.00
Financial services	4.22	1.92	-2.31	4.43	3.26	4.99	1.72
Real Estate	31.39	27.01	-4.38	2.31	2.04	2.61	0.57
Government	10.77	8.11	-2.66	3.05	2.68	3.45	0.77
Education	0.86	0.74	-0.13	4.35	4.20	4.57	0.38
Health services	1.49	1.74	0.25	9.10	8.74	9.53	0.79
Other personal services	1.86	2.84	0.98	6.13	5.79	6.65	0.85
Total	100.00	100.00					

Investment in Transports and Communications reached a share of 12.73 per cent in 2003 starting from 7.39 per cent in 1980.

The far right column in Table 4 shows the average replacement rates. These averages range from 2.31 per cent of Real estate up to 10.27 per cent for Fishery. The replacement rate used to compute capital stock from capital investment (applying the perpetual inventory criterion and using it as an explanatory variable in the shares equations in BTM) is (or was) 8 per cent. This replacement rate was considered to have much more weight than the one «behind» the capital stock time series and it was used to emphasize the influence of the younger capital investment and hence the content of embodied technical progress. Unexpectedly, 20 out of 29 replacement rates in Table 4 are greater than 8.00 per cent. This means that the decay of capital stock is higher than the depreciation used in the BTM share equations. The replacement rate applied to each investor is determined by the capital investment mix and by the capital investment average life used by Istat (see Table 5).

In Table 4, the average value and the maximum and minimum value of the replacement rates are shown. The last column shows the difference between the maximum and the minimum replacement rates per investor. Real Estate, Government, Education, Health services and Other services show a difference of less than 1; since the replacement rates appear to be quite constant over time, we can assume that the variability may be duly considered just a random component. This is not the case for Fishery, Mining of non energetic materials, Leather and leather products, Wood and furniture, Paper and paper products, Chemicals, Rubber and plastic, Metal products, Mechanical machinery, Electrical machinery, Other industries, Electricity, gas, water and Transport and communication, which show differences of not less than 2 percentage points. Large differences together with regular trends may generate significantly different capital stock forecasts. While Education capital stock shows different but common trends according to lower, average and maximum replacement rates, Other manufacturing industries may even have positive or negative trends within the range of the observed sectoral replacement rate.

6. *Concluding remarks*

Accounting identities play a crucial role in the construction of econometric models. Tackling practical problems, Klein (1983) admitted that «model building took an unfortunate doctrinal turn» when economic theories were formulated side-by-side with mathematical equation systems. This «doctrinal turn» was mostly made at the Cowles Foundation where the first and influential paradigms of the statistical approach to econometrics were dictated. Then Klein realised that a fruitful approach

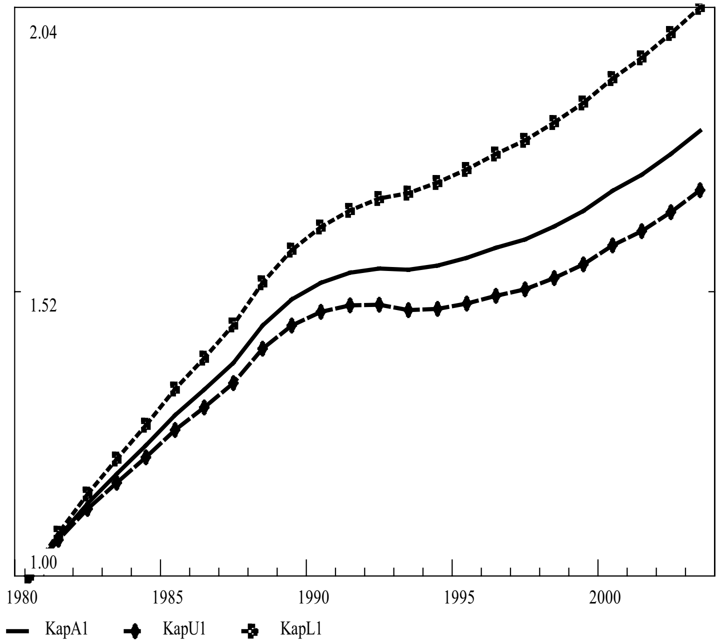
Tab. 5. Average life of Capital stock

INVESTORS	INVESTMENT GOODS								
	Machinery and equip.	Office machinery	Telecomu- nication equip.	Furniture	Land transport	Other transport	Construc- tion	Software	Other goods and services
Agriculture	18	7	7	16	10	18	51	5	34
Fishing	18	7	7	16	10	18	35	5	34
Mining Energetic Raw Material	18	7	7	16	10	18	35	5	34
Mining non Energetic Materials	18	7	7	16	10	18	35	5	34
Food, Beverages and Tobacco Industries	18	7	7	16	10	18	36	5	34
Textiles and Clothes	18	7	7	16	10	18	35	5	34
Leather and Leather products	18	7	7	16	10	18	35	5	34
Wood and wood products	18	7	7	16	10	18	35	5	34
Paper, paper products and printing	18	7	7	16	10	18	35	5	34
Coke and oil products	18	7	7	16	10	18	35	5	34
Chemicals and synthetic fibers	18	7	7	16	10	18	35	5	34
Rubber and Plastic products	18	7	7	16	10	18	35	5	34
Non metallic products	18	7	7	16	10	18	35	5	34
Metal products	18	7	7	16	10	18	35	5	34
Machinery and equipment	18	7	7	16	10	18	35	5	34

INVESTORS	INVESTMENT GOODS								
	Machinery and equip.	Office machinery	Telecomu-nication equip.	Furniture	Land transport	Other transport	Construc-tion	Software	Other goods and services
Electrical machinery and optical instruments	18	7	7	16	10	18	35	5	34
Transport equipment	18	7	7	16	10	18	35	5	34
Other manufactured goods	18	7	7	16	10	18	35	5	34
Electrical energy, gas, steam and hot water	18	7	7	16	10	18	40	5	34
Construction	18	7	7	16	10	18	35	5	34
Trade	18	7	7	12	10	18	65	5	34
Hotels and Restaurant	18	7	7	12	10	18	65	5	34
Transport, storage and communications	18	7	7	16	10	18	50	5	34
Financial intermediation services	18	7	7	16	10	18	65	5	34
Real estate services, renting, computer services, research and development, other business services	18	7	7	16	10	18	79	5	34
Government	18	7	7	16	10	18	60	5	34
Education	18	7	7	16	10	18	57	5	34
Health services	18	7	7	16	10	18	35	5	34
Other services	18	7	7	16	10	18	56	5	34

Source: Istat

Fig. 11. Other Manufacturing – Replacement Rates: Lower .062, Average .081, Upper .093



to the definition of the structure of a model and its estimation might be founded through the accounting structure. Lately, Almon (1996) clearly showed that the Standard National Accounts (the accounting system used in the United States) involves some 150 items connected to 40 identities; since these represent a set of equations, they may be used as the cornerstone for the so called *identity-centred* modelling. Unfortunately, the adoption of the chain indexes does not preserve the accounting identities whereas the variables are measured in constant values. This loss is common to all the European Member States. The discrepancies due to the chain indexes have been evaluated for the Italian «chained» time series. Firstly, these statistics reveal common features of the chain indexes effect: the discrepancies are much more modest after the base year than before it. Secondly, the discrepancies turned out to be very modest; in other words, the «departure» from the exact accounting identity may be considered negligible. Rescaling the partial items over their total does not introduce noticeable changes to the original «chained» time series. The top-down approach has been applied to the Italian statistics: totals drive the rescaling of the subtotals.

According to previous experience, Verdoorn's law will be the cornerstone model for estimating labour productivity equations. The measurement of labour productivity is derived from the ratio of gross output to the work force employed. The latter has a dual measure: the number of people employed and the number of full-time employed persons. The comparison of these two measures gives evidence of the impact of the structural reforms of the labour market occurring over the last decade. A trade-off between labour productivity and job creation has taken place. Structural reforms have constantly spread their effect over time not signalling any instantaneous structural break. Hence, the labour productivity time series have to be carefully used in forecasting because the leeway observed in the last decade is unlikely to continue in the near future.

From investment and capital stock sectoral time series, replacement rates have been computed applying the perpetual inventory formula. These rates are not constant over time. The Istat «Methodological Notes» related to these time series tell us which factors influence the evolution of each sectoral replacement rate. Two issues may be underlined within the framework of the Inforum model system. First, the replacement rate trends must help to design the scenarios of these exogenous variables. Second, 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 (BTM) which links the Inforum country models. Since in BTM capital stock is computed from investment flows, the perpetual inventory principle should be applied using sector specific and time varying replacement rates. Furthermore, although chosen within the observed spread, different replacement rates may generate extremely different trends in capital stock.

References

Almon C. 1996, *Identity-centered Modeling in the Accountant of SNA Based Model*, INFORUM Working Paper, series 95, University of Maryland, <http://inforumweb.umd.edu/Workpapr.html>.

EUROSTAT 1996, *European System of Accounts ESA 1995*, Luxembourg

Klein L.R. 1983, *Lectures in Econometrics*, North-Holland, Amsterdam

Verdoorn P. 1949, *Fattori che regolano lo sviluppo della produttività*, «L'Industria», 1