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ECONOMETRIC MODELLING AT THE BANK OF GREECE

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ABSTRACT

At the Bank of Greece econometric modelling started in 1975 when the Bank's first model of the Greek economy was developed under the leadership of the now Governor of the Bank Nicholas C. Garganas. The model was extensively used for many years in forecasting as well as in policy analysis and proved to be an indispensable tool for the policy decisions of the Bank over a broad spectrum of issues. Model development at the Bank of Greece is an ongoing activity fuelled by the changes in the economy as well as by modelling theoretical advances. This paper describes and documents the use as well as the properties (through a set of standard simulation results) of the current version of the Bank of Greece model.

Keywords: Econometric Modelling; Cointegration Techniques; Simulation Results.
JEL classification: C50; E17

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1. Introduction (a brief historical overview)

Econometric modelling at the Bank of Greece started in 1975 when the first model of the Greek economy was developed in the Econometric Forecasting Unit then headed by the now Governor of the Bank, Nicholas Garganas. In its initial version, the model was relatively small and limited in many respects, but it has been substantially extended and elaborated over the years. Since the late 1970s, the macro model has been the Bank's primary formal model of the Greek economy. The model is used in a wide variety of activities, but mainly in forecasting and to a lesser extent for policy analysis.

A comprehensive presentation of the model, at it stood in 1991, is included in a book written by Governor Garganas, entitled The Bank of Greece Econometric Model of the Greek Economy. At that time, the model contained 507 variables, 84 of which were determined by behavioural equations. Technical equations, accounting as well as reporting identities, completed the model, while 202 variables were exogenous.

This earlier version of the model was deeply rooted in the Keynesian tradition; output was determined by aggregate demand, while the supply side was rather passive. Aggregate demand was built-up by a series of equations describing the spending behaviour of different agents in a detailed disaggregated manner. The particular focus of the specification on aggregate demand reflected the main use of the model, i.e short-term forecasting.

The accounts of the public sector were modelled in substantial detail reflecting the interest of the Bank for a judicious monitoring of public sector aggregates as well as the possibility of examining the quantitative influence on the economy of different discretionary measures (as for example changes in a wide spectrum of tax rates). The monetary sector of the economy was also modelled in considerable detail and the empirical specification focused especially on the modelling of the availability of credit. The underlying theoretical structure of the monetary sector was the "high-powered money multiplier" model developed by Brunner and Meltzer (1972, 1974) where the monetary base was endogenously determined through a set of identities by the net position of the foreign and public sector of the model. A salient feature of the model was that monetary influences were transmitted to the real sector and prices mainly through the availability of credit for investment via a rationing scheme, while the direct

interest rate effect on demand was modest and limited only to some specific components of aggregate demand.

The earlier formulation was dictated by the particular institutional framework operating in Greece until the mid-80s, when financial liberalisation started gradually taking place[1]. Until that time, monetary policy was conducted in a rather direct manner by controlling the monetary aggregates, particularly through the availability of credit via a complex set of regulations. Interest rates were maintained relatively fixed for long periods of time and well below the rate of inflation. Moreover, the large public sector deficit was financed at preferential rates by commercial banks, which held a large part of the outstanding debt. At the same time, secondary markets for securities were practically non existent. Under these circumstances, an excess demand for credit was the prevailing situation in a wide range of sectors of the Greek economy.

It is worth noting that this model has been the only large-scale operational econometric model in Greece for many years, providing assistance to the members of the Monetary Policy Committee of the Bank of Greece over a broad spectrum of issues related to their economic policy objectives. However, given the extensive structural and institutional changes that the Greek economy has undergone in recent years, especially in the financial sector, it was decided to rebuild the model by revising its structure in a number of directions. Of course, one of our main motivations in rebuilding the model was to embed in its structure features that reflect the new regulatory and institutional setting prevailing in Greece. Moreover, given that economic forecasts are usually carried out under strict and rather restricted time constraints, it was judged more appropriate to develop a medium sized model (requiring a less time-consuming data-updating process), better able to support forecasting and, more generally, the economic policy-making process within the Bank. Last but not least, our ambition was to update the theoretical structure of the model using some recent modelling advances. The whole project of model re-specification was undertaken at the econometric forecasting section of the Bank of Greece. The new model, specified to include equilibrium conditions, is more aligned with the "neoclassical synthesis" and takes explicitly into account the long-run supply side of the economy. By its very aggregative nature the revised model

[1] Although financial deregulation began in the mid-1980s, the process was not completed until the mid-1990s.

omits useful information provided in forecasting by the previous large-scale Bank of Greece econometric model. On the other hand, the new structure has the advantage over the previous one of being a more flexible and manageable tool. In addition, its medium size together with the theoretical restrictions imposed on the long-run relations allows a more sensible interpretation of its properties and the possibility of communicating the forecast and simulation results in fully understandable economic terms. In the ensuing paragraphs, the revised model and its uses are described as they stood in its late 2001 version.

2. Uses of the model (an outline of the role the model in forecasting and policy analysis)

The main use of the model is in forecasting and scenario analysis and it is used at the Bank in its regular forecasting rounds and also in the European System of Central Banks (ESCB) forecasting exercise. Moreover, the new model is designed to simulate the economy in terms of the main aggregates and to produce quantitative information for a variety of purposes (e.g. the evaluation of the effects of inflows from EU structural funds). Without describing the forecasting process itself, we now turn to a more detailed exposition of the use of the model in the Bank of Greece.

2.1 The use of the model as a forecasting devise

A. The use of the model in the internal forecasting rounds of the Bank of Greece

At least twice a year the staff of the econometric forecasting section of the Research Department of the Bank prepare for internal purposes annual projections for the main macroeconomic aggregates and inflation up to one or two years ahead. These forecasts are generated in order to facilitate the discussion as well as to shape the views of the members of the MPC about the prospects of the Greek economy before the regular (mandatory) submission of the Monetary Policy Report of the Bank to the Parliament. While the econometric model of the Bank has always been the main vehicle in the forecasting process, the nature of the forecasts can be qualified as judgmental. Indeed the forecasts combine pure model based information with off-model information and judgements provided by the MPC members as well as by the experts monitoring

particular sectors of the Greek economy. The combination of model and off-model information is done by an iterative procedure allowing a full interaction between the views of the econometric forecasting section staff and the views and suggestions of the members of the MPC as well as of the experts monitoring particular sectors of the Greek economy. For example, conditioning assumptions about the future path of exogenous variables are the results of a consensus view of the members of the MPC. Moreover, information about future policies that also play a central role in shaping the forecast are also a valuable input from the MPC members. The confrontation of model-based information with the experts' judgements about developments in particular sectors of the economy is another key element of the forecasting process. The revelation of discrepancies between the two approaches (in technical terms known as implied residuals) constitutes the fundamental ingredient for a non-trivial, judgmental intervention in the forecast based on past errors adjustments and expected futures shocks. Furthermore, by providing a fully articulated national accounting framework, the model is a useful platform for an evaluation of the overall coherency of views, projections and judgements emanating from a broad spectrum of different sources. In this way, the model is used as a cross-checking device of the heterogeneous assessments about the economy made by specific sector experts, possibly sharing a common set of initial assumptions but processing information using different analytical tools and having different feelings and perceptions about the future.

B. The use of the model in the ESCB, Broad Macroeconomic Projections Exercise (BMPE)

As already mentioned, the model is also used in the ESCB Broad Macroeconomic Projection Exercise (BMPE). The way in which the Bank's model is used in the context of the BMPE is practically identical to its internal use described above. As in our internal forecast exercise, the model has an important role as a tool for checking the internal consistency of the forecast. It is worth noting that, in the BMPE, the forecast for the outlook of the economy is yet again carried out in a decentralised manner blending together model information with expert's knowledge from specific sectors of the economy. In addition, the model helps in the communication of the forecast results as well as in the formulation of the underlying economic analysis

supporting the projections and the accompanying reports. At this point it should be stressed that the BMPE projection differs in at least two important respects from our internal forecast. The BMPE forecast covers three years ahead instead of one or two years as covered by the Bank of Greece's internal forecast and, more importantly, the BMPE projection is strictly considered as a staff forecast and not as forecast necessary reflecting the Bank of Greece views. This has important implications for the way in which the BMPE forecasting process is carried out within the Bank but does not alter the role and the use of the model in the forecasting process itself[2].

2.2 The use of the model in other activities of the Bank.

Aside from forecasting, the model is also used to run simulations and policy scenarios under a variety of policy interventions. In this context the model can provide useful insights into how the effects of policy interventions are transmitted to the economy and how these interventions affect the baseline forecast. Moreover, given that at the Bank of Greece we have not yet developed a formal probabilistic framework to analyse the risks surrounding the projections, the formulation of model based alternative scenarios is a useful guide to evaluate the quantitative impact of different shocks and assumption on the central projection.

Furthermore, it is worth noting that a previous version of this model was used for an ex-ante evaluation of the impact on the Greek economy of the third Community Support Framework.

3. An outline of the theoretical underpinnings of the model

The new Bank of Greece model is a standard aggregate demand and supply structural econometric model developed by the Econometric Forecasting Section. The model shares many features with the ECB Area Wide Model (Fagan et al. (2001)) and the Multi Country Model (MCM) project.

At present, the model contains over 90 equations, 17 of which are behavioural, the remaining being technical relations, identities and reporting identities. The model is

[2] In the sense that the BMPE involves a close interaction between the Bank of Greece and the ECB staff, while in our internal forecasting rounds the role of members of the MPC is prominent.

dynamic and uses the error correction formulation and co-integration techniques in the specification and estimation of the behavioural equations. The model is built around national income and product accounts and has been fitted to annual observations covering the period 1964 to 2000, using the ESA-95 system. Shorter periods were used, mainly in investment equations, in order to preserve financial-regime homogeneity. The structural equations were estimated by the two-step Granger-Engle procedure. The computer implementation of the model is given in portable TROLL. The estimation and the simulation exercises are all carried out in the TROLL system.

Current work on this model focuses mainly on a further development of its theoretical foundation and the re-specification of the main behavioural equations. The model is continuously simulated and tested in order to examine its properties. In this respect, the model should be viewed more as work in progress and a platform for empirical research within the Bank, rather than as a finished product.

In the new version of the Bank of Greece model, real interest rates are endogenous and directly affect domestic demand. However, the main policy variable i.e. the short-term nominal interest rate is left exogenous while the exchange rate follows an agreed predetermined path. This is in accordance with the ECB forecasting practice. Hence there are no equations for the short-term interest rate and the exchange rate.

In what follows, a more complete description of the equations of the model is presented.

3.1 Aggregate Demand

Aggregate demand is determined by individual equations for each expenditure component of demand including consumption, fixed investment, inventory investment, exports, imports and government expenditure. Inventories, public consumption and public investment are exogenous in real terms.

Private consumer expenditure constitutes a large part, about 55%, of total final expenditure and it is modelled in an aggregative manner including both durables and non-durables. In the long run, private consumption is determined by real disposable income and the real interest rate. In this version of the model, wealth variables are not introduced explicitly in the long-run consumption function and therefore any type of stock accumulation effects on consumer behaviour is not taken into account. The short

run equation is of the error correction type. The dynamic equation includes also an inflation surprise term measured as a deviation of the private consumption deflator inflation from its Hodrick-Prescott trend. This variable aims to capture the erosion of the real value of nominal assets in the face of an unexpected inflation increase.

The optimal capital stock is determined by the marginal conditions as a function of the user cost of capital. This long-run function is estimated in order to overcome scaling problems and then introduced back in an error-correction formulation for private business investment. The dynamic specification of the investment equation incorporates an acceleration term and some profitability effects measured by the gross operating surplus.

3.2 The Supply side of the model

Output is given by a constant return to scale Cobb-Douglas production technology in labour and capital. The coefficients of the equation are calibrated according to the average sample share of labour income in value added. Potential output is derived by inserting in the calibrated function the actual capital stock, the trend in total factor productivity, and by replacing actual employment with its full employment level (derived from the exogenous labour force and the calculated NAWRU). The output gap is the difference between potential and actual output.

The long-run employment equation is derived by inverting the production function. In the short run, total employment adjusts towards its long-run level by an adjustment equation in which short-run influences from changes in final demand and real product wages are taken into account. Self-employment is treated as exogenous and demand for dependent employment is determined residually.

3.3 Prices and Wages

With respect to the determination of prices, the GDP deflator at factor cost is considered to be the general inflation indicator. Modelling the GDP deflator reflects our interest in the domestic origins of inflation. All other prices, except import prices, are related to this indicator with specific additional context-dependent adjustments. Import prices are linked to foreign prices via the exchange rate.

The formulation of the price equation is given by monopolistic price setting. As already mentioned, firms operate under a Cobb-Douglas constant-return-to-scale production technology. Assuming a degree of monopoly power, the representative firm sets prices in the market for its diversified product with a constant mark-up on marginal cost. In this set-up, the profit-maximising price level is determined by the unit labour cost and the mark-up subject to the demand function faced by firms and the production function.

This price equation can also be viewed as a short-run supply curve of the economy, which has the usual positive slope. However, the mark-up is not constant and varies with the elasticity of demand. The mark-up can be affected by economic activity and also, given the openness of the Greek economy, by the real exchange rate. Moreover given the considerable structural changes that have taken place in Greece in the last few years, the ratio of value added in the services sector to total value added is included in the long-run supply function. These variables also help the cointegration properties of the respective equations. With this consideration in mind, the long-run price equation is a function of unit labour cost (based on a measure of average productivity), import prices and the services-to-GDP ratio. Long-run homogeneity is imposed on the equation.

The residuals of the long-run equation are incorporated in a dynamic ECM price equation. Some short-run influences from the unit labour cost and import prices have also been introduced. Dynamic homogeneity is accepted by the data and imposed in this equation.

The consumption deflator and the CPI are modelled as a function of the GDP deflator, and import prices.

Wages are modelled via a bargaining type equation and the dynamic specification displays dynamic homogeneity. In the long run, real product wages are determined by average productivity and the exogenously determined NAWRU. Moreover, in the short run nominal wages respond to the deviation of actual unemployment from the NAWRU level and to the changes of productivity.

3.4 Foreign Trade

Exports of goods and services are determined in the long-run by world demand, which, enters the equation with a unit elasticity, and relative prices. The unit elasticity restriction is accepted by the data. In the short run, real exports' growth is affected by the growth in relative prices, the growth in foreign demand and the lagged long-run relationship, which, enters as an error correction term and thus, ensures adjustment to equilibrium.

Imports of goods and services are determined in the long run by total final expenditure and relative prices. A unit elasticity is imposed on the demand variable and a logistic trend is also included in the long-run specification. The dynamic adjustment of real imports of goods and services towards long-run equilibrium is given by a standard ECM in which the growth of domestic demand and relative prices influence imports' growth.

Import prices as measured by the deflator of imports of goods and services are mainly determined by foreign prices and the exchange rate. However, a pricing-to-market effect is also captured by the GDP deflator in the long run equation. The dynamic adjustment equation takes the traditional ECM form.

The export deflator of goods and services is determined by the GDP deflator and competitors' prices. In the long-run equation the coefficient of domestic prices is rather small. The adjustment of export prices to their long-run equilibrium is described by a standard ECM.

The fiscal block has no behavioural equations, but is modelled by accounting identities. Direct and indirect taxes are the product of exogenous tax rates and the corresponding nominal aggregates. Interest payments by the government to the private sector are not yet linked to the debt stock but estimated by off-model calculations. In some simulations a fiscal reaction function for direct taxation is in operation.

Long-term interest rates are linked to short-term rates by a backward-looking term-structure scheme.

The nominal exchange rate is exogenous and expectations are static.

4. An Outline of the Key Characteristics of the Model

In this section the characteristics and the functioning of the model are described through a set of standard simulation results.

4.1 A monetary policy shock (Shift in euro–area policy rates by 100 b.p. for two years)

This is a standardised monetary policy simulation carried out in the context of the monetary transmission exercise undertaken by the WGEM. Results (intra euro-area spillover effects are included) refer to a temporary (two years) shock of 100 b.p. in short-term nominal interest rates and a return immediately back to base for the rest of the simulation period. Long rates are adjusted according to a term structure scheme and the exchange rate appreciates according to area-wide UIP condition. The simulation was originally designed to be conducted over a ten-year period and therefore numerical results are available for this horizon. A graphical exposition of the main results for the first five years of the simulation is given in Chart 1.

The temporary monetary policy shock sets off a cyclical response from all the endogenous variables of the model. Output and prices remain below base throughout the simulation horizon. The maximum effect on output is reached in the second year while the maximum for prices is reached in period five. By the end of the simulation period (ten years) the effect on output and prices is reduced considerably and practically eliminated.

The fast inflationary impact of the shock comes more from the exchange rate channel (the exchange rate follows the predetermined UIP path) than from the change in demand. Prices respond with a lag to lower demand and higher unemployment. There are two real channels that affect prices and operate through the effect of unemployment on wage bargaining and through the effect of the capital stock on average productivity. The weak responsiveness of employment to output reflects the prevailing rigidities in the Greek labour market.

The domestic demand components move in line with GDP and are below base throughout the ten years simulation period. Investment starts to recover slowly after 2006 reflecting the long-lasting effect of the monetary policy shock. The accelerator term dominates investment, which is much stronger than the cost of capital effect. The

recovery of investment has a stabilising impact on the capital stock, improves the supply conditions and undermines the return of prices to base. Compensation per employee drops throughout the reported five-year simulation period, however from 2007 (see Table 1) starts recovering under the influence of consumer prices and the reduction in the unemployment rate. Private consumption reacts vigorously to the fall in real interest rates and disposable income. The maximum effect is attained in the second year when consumption falls by around 0.65%. As there is no monetary policy rule in operation, short-term rates return to base immediately boosting consumption. The direct interest rate effect on consumption is reinforced by the gradual return to baseline of real disposable income.

Table 1 depicts the numerical results for some main macroeconomic aggregates over the whole ten-year simulation horizon.

Table 1[3]

Monetary Policy shock (Levels, percentage deviations from baseline)

	1	2	3	4	5	6	7	8	9	10
Prices and Wages										
Consumption Deflator	-0.17	-0.24	-0.32	-0.40	-0.45	-0.45	-0.42	-0.34	-0.24	-0.12
Compensation per	-0.01	-0.29	-0.55	-0.74	-0.89	-0.97	-0.95	-0.84	-0.66	-0.43
GDP	-0.33	-0.62	-0.52	-0.52	-0.52	-0.50	-0.47	-0.41	-0.29	-0.12
Consumption	-0.33	-0.64	-0.48	-0.39	-0.31	-0.25	-0.20	-0.15	-0.12	-0.08
Investment	-0.19	-1.21	-1.45	-1.70	-1.94	-1.96	-1.80	-1.44	-0.87	-0.09
Exports	-0.50	-0.50	-0.23	-0.03	0.16	0.23	0.19	0.11	0.03	-0.05
Imports	-0.23	-0.82	-0.83	-0.77	-0.74	-0.71	-0.63	-0.49	-0.26	0.04
Labour Market										
Total employment	-0.10	-0.18	-0.20	-0.23	-0.25	-0.26	-0.26	-0.26	-0.23	-0.19
Budget deficit *(% of GDP) absolute deviations from base.*	-0.08	-0.15	-0.15	-0.16	-0.15	-0.14	-0.12	-0.10	-0.07	-0.05

Imports follow a path similar to GDP and are below base throughout the simulation period; they start to recover by 2006. The behaviour of exports is determined by the euro appreciation and the stronger effect is attained at the beginning of the simulation period. The effect on exports turns positive by year 2004 two years after the

[3] In order to save space detailed numerical results will be presented only for this simulation. Needless to say, that the complete simulation results are available on request.

exchange rate returns to base. The pass-through of domestic cost on export prices is generally low.

The budget balance deteriorates in the first two years of the simulation, returning slowly to base by the end of the 10-year period of simulation.

4.2 A fiscal policy shock (Permanent increase in government consumption)

The fiscal policy shock is a sustained increase in public consumption equivalent to 1 per cent of GDP (Chart 2). It is assumed that this increase corresponds only to an increase in procurement expenditure while wage expenditure remains constant.

The increase in public consumption raises output, employment and the components of domestic demand. The implied multiplier is around 0.8 for the first year and then rises throughout the simulation period. Prices respond sluggishly to the demand shock through the usual channels, but the effect on prices in the year 2005 is rather low. The demand expansion raises the level of imports while the stabilising impact of exports through erosion of the real exchange rate is limited. This is mainly due to a weak pass-through of domestic prices to export prices in the present model.

Without the operation of a fiscal rule, the path for the public debt is explosive. In our regular medium run simulations a fiscal rule allowing taxes to react to deviations of the debt ratio from its baseline value is normally in operation. The implementation of this rule stabilises the model in the long run in the case of a fiscal shock. Moreover, in this simulation the assumed exogeneity of interest rates and the absence of a monetary policy rule exclude the appearance of crowding out effects that normally should be present in a more realist depiction of the working of the economy.

4.3 An exchange rate shock

In this simulation (results are depicted in Chart 3) we investigate the effect of a 1 per cent appreciation of the euro for five years against all other currencies. This entails an appreciation of the national effective exchange rate by 0.30 per cent while the dollar rate adjusts by a full jump. The immediate effect of the currency appreciation is that import and export prices fall. The loss in competitiveness is translated directly to a trade balance deterioration and a reduction in output. However, net export losses are reversed gradually as domestic prices start to decline in response to lower import prices and

through the reinforcing effect of the decline in activity. At the end of the simulation period output is 0.15 per cent lower relative to base, affected mainly by the decline in domestic demand (especially in investment). Private consumption returns to base by the end of the simulation period sustained by the increase in real disposable income.

4.4 A permanent foreign demand shock

In this simulation the effects on the model of a permanent increase in foreign demand is examined through a 1 per cent increase in foreign demand outside the euro-area (Chart 4). In the Greek case exports of goods and services outside the euro area constitute more than 50 per cent of total exports. Hence, the increase in our world market variable is 0.55. The increase in foreign demand leads to an increase in exports, which in the medium run reaches a level of around 0.6 above base consistent with the long-run unit elasticity of exports with respect to world demand. The increase in exports sets up an upward reaction of all the expenditure components. However the positive effect of rising demand and the consequent fall in unemployment has a sluggish and modest impact on wages and prices. Thus a rise in exports are maintained throughout the simulation period, as some minor competitiveness losses caused by the rise in domestic prices cannot erode the impact of the increase in foreign demand. The gradual increase in the components of aggregate demand boost imports which in turn counterbalance the impact of exports on the contribution of the external sector on output growth. By the end of the simulation period, output is 0.27 per cent above base and the foreign sector contributes only 0.02 percentage points to this deviation.

4.5 A permanent oil price shock

This simulation shows the effect of a permanent 10 per cent increase in oil prices expressed in dollar terms. The results presented graphically in Chart 5 are purely model based but conditional on a constant real interest rates assumption in order to avoid a demand boosting effect due to higher inflation.

The initial effect of the oil price rise is an increase in the level of import prices by 0.8 per cent, which builds up over time and levels off to around 1.1 per cent by the year 2005. The impact of the oil price shock by the end of the simulation period on the GDP deflator and on the private consumption deflator is respectively an increase of 0.36

and of 0.46 per cent above base. Higher prices reduce real disposable income, which in turn dampens consumer expenditure at first and then investment through the reinforcing effect of the accelerator. By the end of the simulation period GDP is around 0.2 percentage points below base. Nominal wages react positively to higher prices and real wages after 2004 exceed slightly the values of the base run.

This scenario does not represent the most realistic quantitative effect on the Greek economy of an increase in the world price of oil. Since in practice there is an institutional framework for setting fuel prices to market, the behaviour of the mark–ups and the terms-of-trade losses should be taken into account by additional exogenous adjustments and considerations. However, the results are useful for tracing the main channels through which an oil price increase affects the economy.

5. Conclusions

Econometric models play an important role in the forecasting and the macroeconomic policy making process of the Bank of Greece. In this paper we have presented the structure and documented the use as well as the key properties of the current version of the Bank of Greece model. The model gives a rather accurate depiction of the dynamic behaviour of the main macroeconomic aggregates of the Greek economy. Moreover the model proved to be a useful tool in forecasting as well as in providing answers to questions related to the economic policy process. In this respect the message that emerges from our experience using the model at the Bank of Greece is that the model can shed light on a wide spectrum of macroeconomic issues, especially in forecasting and in the support of the macroeconomic policy decisions of the members of the MPC.

The development of the model is an ongoing activity at the Bank of Greece. Therefore, the presented model should be considered more as a work in progress rather than a finished product. In this conviction, possible extensions of the model could include a different and more sophisticated treatment of the expectations formation mechanism, which at present, are modeled in a backward-looking manner, in order to be able to analyze and answer policy questions more accurately. In addition, the desegregation of some equations, especially in the foreign and the public sectors are

among our priorities in an aim to enhance the usability of the model in the policy process and to improve the information content of the forecast.

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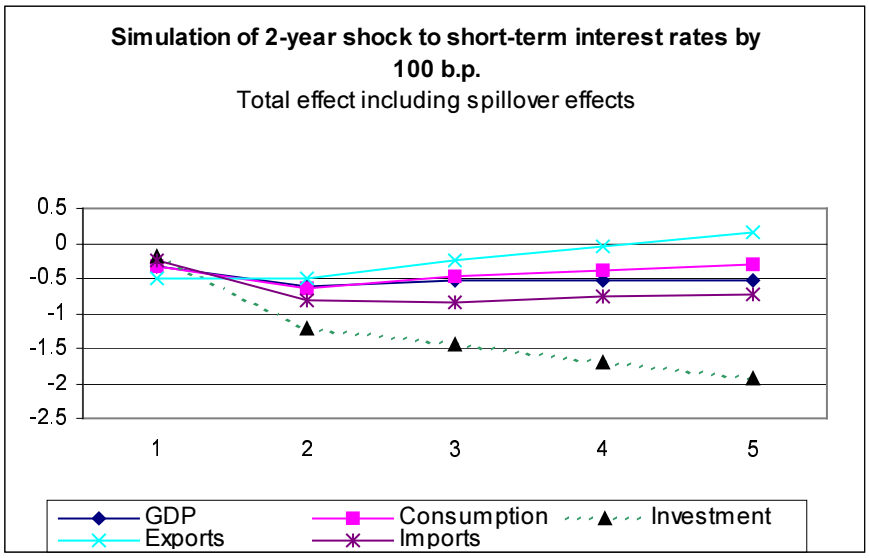
Chart 1


Simulation of 2-year shock to short-term interest rates by 100 b.p.
Total effect including spillover effects
0.5
0
-0.5
-1
-1.5
-2
-2.5
1
2
3
4
5
GDP
Consumption
Investment
Exports
Imports

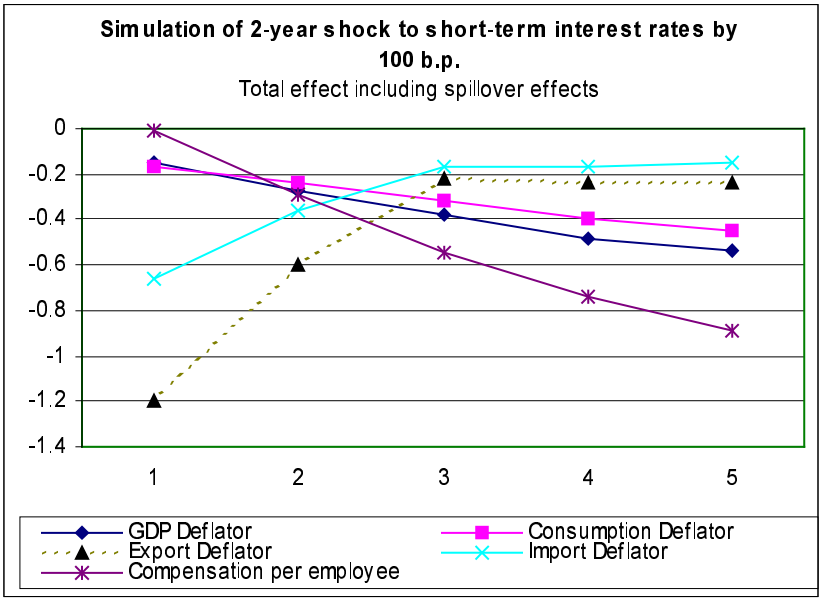
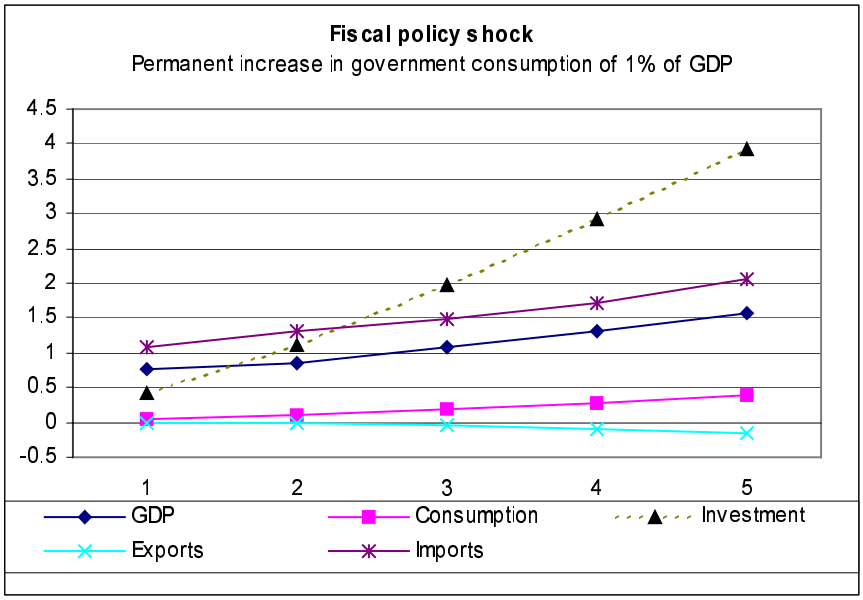

Simulation of 2-year shock to short-term interest rates by 100 b.p.
Total effect including spillover effects
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
1
2
3
4
5
GDP Deflator
Consumption Deflator
Export Deflator
Import Deflator
Compensation per employee

Chart 2


Fiscal policy shock
Permanent increase in government consumption of 1% of GDP
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
1
2
3
4
5
GDP
Consumption
Investment
Exports
Imports

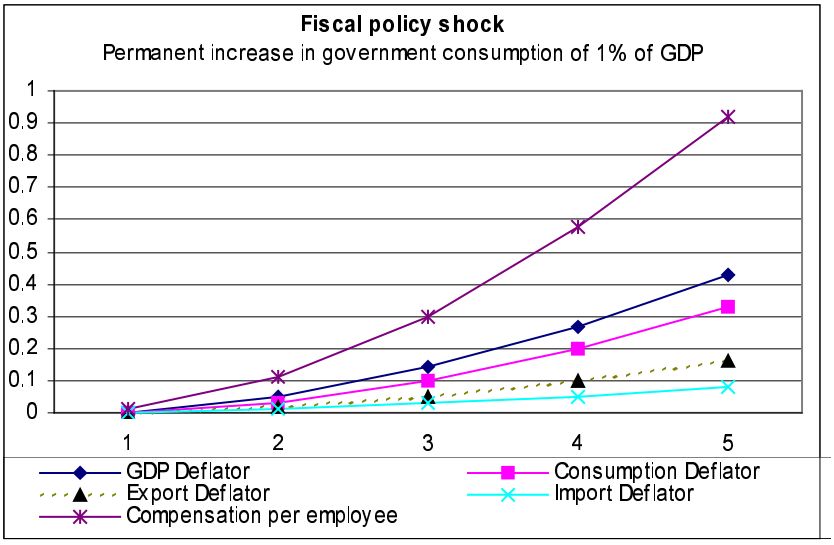
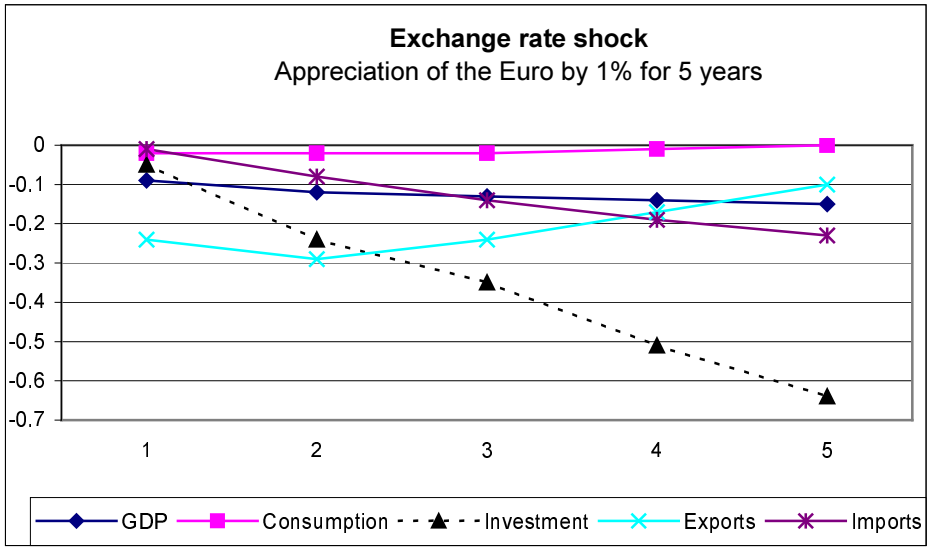

Fiscal policy shock
Permanent increase in government consumption of 1% of GDP
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
GDP Deflator
Consumption Deflator
Export Deflator
Import Deflator
Compensation per employee

Chart 3


Exchange rate shock
Appreciation of the Euro by 1% for 5 years
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
1
2
3
4
5
GDP
Consumption
Investment
Exports
Imports

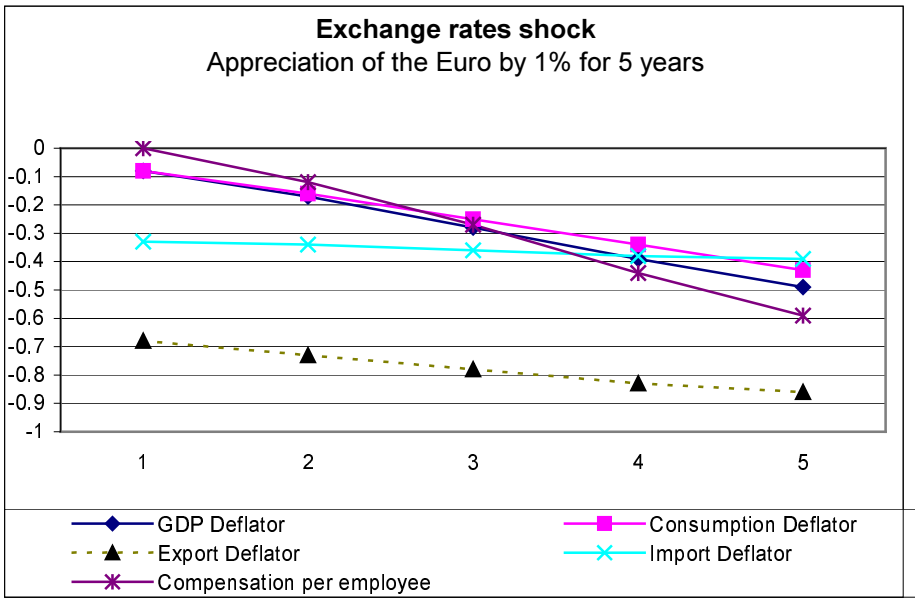
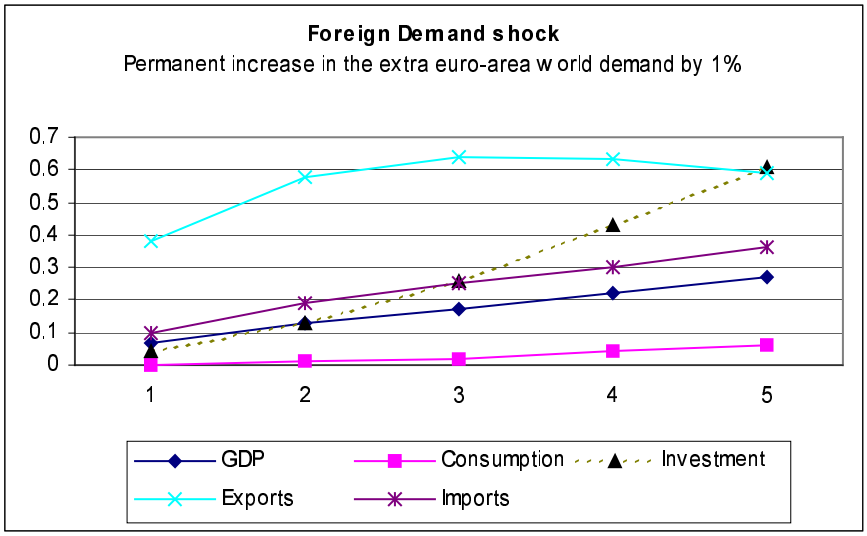

Exchange rates shock
Appreciation of the Euro by 1% for 5 years
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
1
2
3
4
5
GDP Deflator
Consumption Deflator
Export Deflator
Import Deflator
Compensation per employee

Chart 4


Foreign Demand shock
Permanent increase in the extra euro-area w orld demand by 1%
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
GDP
Consumption
Investment
Exports
Imports

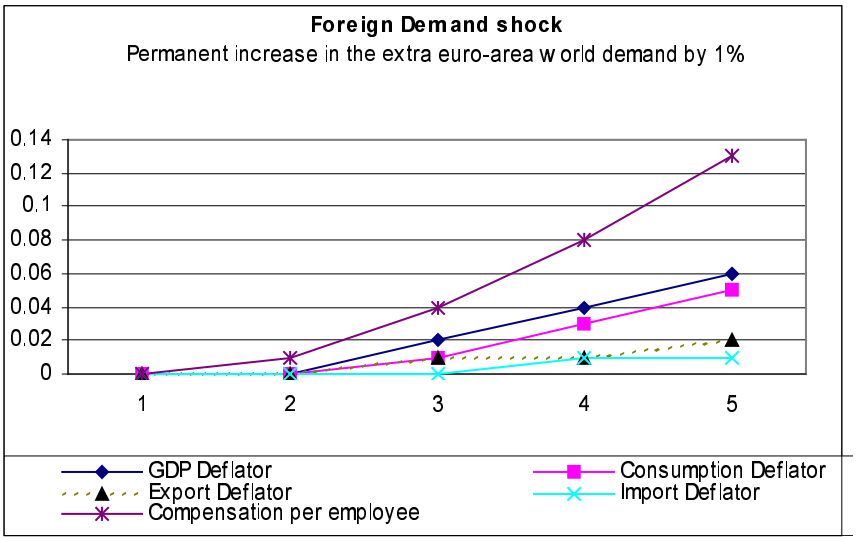
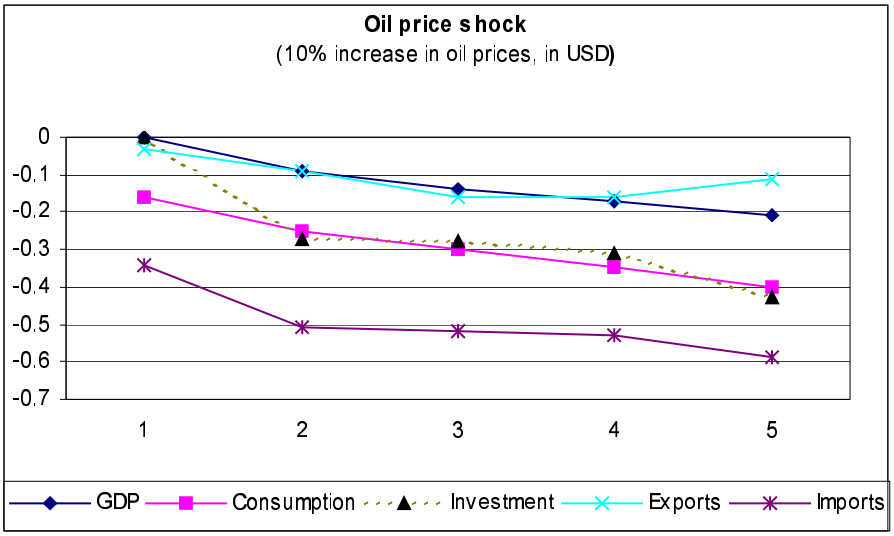
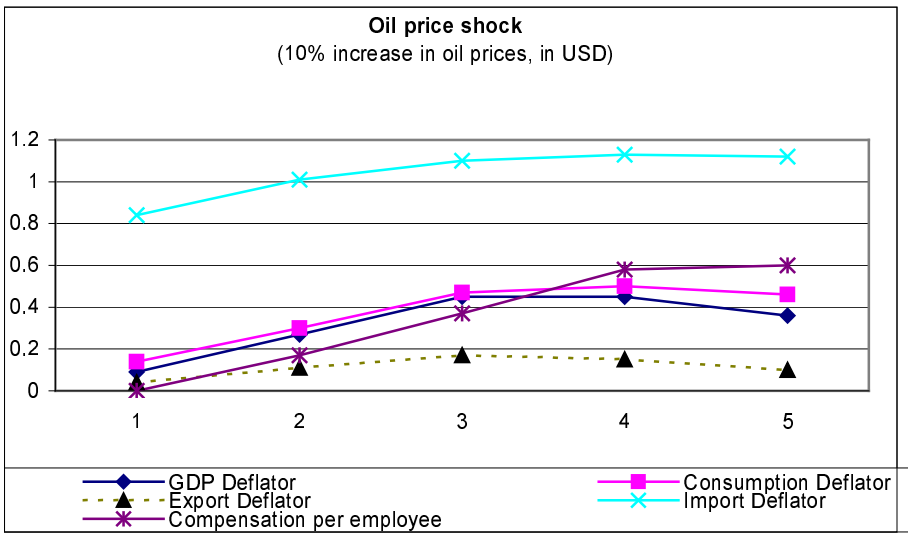

Foreign Demand shock
Permanent increase in the extra euro-area w orld demand by 1%
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
2
3
4
5
GDP Deflator
Consumption Deflator
Export Deflator
Import Deflator
Compensation per employee

Chart 5


Oil price shock
(10% increase in oil prices, in USD)
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
1
2
3
4
5
GDP
Consumption
Investment
Exports
Imports


Oil price shock
(10% increase in oil prices, in USD)
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
GDP Deflator
Consumption Deflator
Export Deflator
Import Deflator
Compensation per employee

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