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Abstract

This paper presents a structural macro-econometric model of the Maltese economy developed at the Modelling & Research Office of the Central Bank of Malta during 2012. This model is small-scale, consisting of 19 behavioural equations (estimated on quarterly data from 2000 to 2011) and 130 identities. There are 33 exogenous variables, mostly economic variables for trading partners, commodity prices, demographic developments and fiscal variables. The model is built around the neoclassical synthesis, with sluggish adjustment of wages and prices in the short run and also some inertia of real variables in response to shocks. Economic agents are assumed to have adaptive expectations.

There are four blocks in the model. The supply block is composed of a Cobb-Douglas production function and a demand for labour equation. The aggregate demand block has six behavioural equations explaining the components of real GDP. The wage/price block includes four equations for the aggregate demand components of real GDP, a private wage function and a house price equation. The financial block models consumer credit and mortgage credit, with three other equations determining the pass-through of the policy rate to lending rates.

This paper also presents the economic impact of four simulated shocks: an increase in the policy rate, a rise in oil prices, an appreciation of the euro against the US dollar and higher world demand. The simulations confirm that the impact of monetary policy is weak in Malta while that of a change in foreign demand is quite strong. The exposure of the Maltese economy to shocks in oil prices and in the value of the US dollar also appears to be relatively significant.

This paper is meant to constitute an intermediate stage in the structural model's development. In future there will be further refinements, such as an enhanced integration of the supply side, the inclusion of an endogenous fiscal block, a more detailed financial block and further sectorial disaggregation.

JEL classification: C3, C5, E1, E2.

Keywords: Macro-econometric modelling, Malta.

TABLE OF CONTENTS

1. INTRODUCTION

This paper gives an overview of a structural model developed by the Modelling and Research Office of the Central Bank of Malta (CBM) during 2012. The objective of this model is to help analyse economic developments in Malta, prepare macroeconomic forecasts and evaluate the potential impact of different economic shocks. This model is just one of the tools adopted by the CBM to analyse and forecast economic developments. For instance, the Bank has two satellite models to forecast in a disaggregated way changes in the Harmonised Index of Consumer Prices (HICP) and to make fiscal projections. This paper is meant to present an intermediate stage in the structural model's development. In the future, the supply side will be integrated more fully in the model, an endogenous fiscal block and a more detailed financial block will be developed, and the sectorial disaggregation of the model will be enriched.

This structural model is similar to the CBM's previous macro-econometric model, but includes a number of modifications to reflect, among other things, the structural changes the Maltese economy has witnessed since EU accession and the adoption of the euro. For instance, the growing importance of the services sector compared to the more capital-intensive manufacturing and construction sectors necessitated a revisiting of the labour demand and investment functions of the model. Recent financial developments also required a more disaggregated financial sector block and a more realistic monetary policy transmission mechanism.

The model is partly inspired by the European System of Central Banks Multi-Country Model,[3] and uses exogenous variables, supplied by the ECB, that relate to foreign demand, international competitiveness and foreign prices affecting the Maltese economy. Due to the relatively small size of the model, it is easy to interpret simulation results and the model provides a simple and effective operational tool for economic analysis.

The rest of this paper is structured as follows. Section 2 provides an overview of the model and its key features, and discusses the modelling strategy. In section 3, a more rigorous description of the model's separate blocks and the main behavioural equations is provided,

[3] See Angelini et al. (2006a, 2006b), Boissay & Villetelle (2005), Fagan et al. (2001), Fagan et al. (2005), Fenz & Spitzer (2005), Livermore (2004), Sideris & Zonzilos (2005), Willman & Estrada (2002), Vetlov (2004), Vetlov & Warmedinger (2006). The model is also similar to Bank of England (2000) and Daníelsson et al. (2009).

while section 4 assesses the dynamic properties of the model by considering four standard simulations. Section 5 concludes. There are three appendices: Appendix A documents the behavioural equations in the model and presents estimation results, Appendix B presents in detail some simulation results, while Appendix C lists the exogenous variables.

2. AN OVERVIEW OF THE MODEL AND THE MODELLING STRATEGY

In line with many structural macro-econometric models, this new model is built around the neoclassical synthesis which asserts that the economy is classical in the long run, but Keynesian in the short run. In other words, while in the longer term output is driven by the supply of labour, capital stock and by total factor productivity,[4] in the short run it is determined by the components of aggregate demand, as a result of the sluggish adjustment of quantities and prices.

The model exhibits two kinds of inertia that allow for short-run deviations from the long-run equilibrium. The first is real inertia, with real variables (quantities) responding sluggishly to shocks and moving only gradually towards their long-run values. This could reflect the costs of adjusting employment or the capital stock. The model also displays nominal inertia since prices do not respond immediately either. This form of inertia could, for example, represent the costs associated with changing prices (menu costs) or wage stickiness brought about by negotiated wages or indexation. In the model, the deviation from long-run equilibrium is captured by the output gap – the deviation of actual output (aggregate demand) from its potential level (aggregate supply) – and the unemployment gap – the deviation of the unemployment rate from the non-accelerating inflation rate of unemployment (NAIRU)[5] – which trigger price and wage adjustments that gradually restore long-run equilibrium.

There are 149 equations in the model, 19 estimated behavioural equations and 130 identities. There are 33 exogenous variables (see Appendix C). It is therefore a relatively small-scale model which strikes a reasonable balance between containing sufficient detail to capture the key economic relationships underpinning the domestic economy, and being tractable and manageable. This is in line with the current modelling practice among many central banks which generally rely on small or medium-sized models, even when modelling large and complex economies.

The model deals with the determination of private sector outcomes, with government variables being treated as exogenous. The private sector is fairly aggregated with

[4] Total factor productivity reflects added production due to the combination of labour and capital, e.g. the use of new technologies, better organisation of production, etc.

[5] The NAIRU is that level of unemployment which is consistent with an economy operating at its capacity. In any economy, there is a 'normal' level of unemployment related to the structure of its labour market. The NAIRU is estimated exogenously by means of a multivariate filter approach, inspired by established economic relationships, such as the Phillips Curve and Okun's Law. See Benes et al. (2010).

disaggregation only present in few cases. More specifically, exports are divided into exports of tourism and those of goods and non-tourism services. Private investment is broken down into dwelling and non-dwelling investment and credit to households is decomposed into consumer credit and mortgage lending. This model may be extended to capture sectoral differences and more inter-linkages within the economy, particularly as the required data become available.[6]

The behavioural equations are estimated – rather than calibrated[7] – and specified in error-correction form. Hence, changes in a variable are modelled as being dependent not only on the short-run dynamics of other variables, but also on the deviation of its actual value from its long-run value, allowing this deviation to be gradually corrected via the error-correction term. This error-correction approach reflects the underlying inertia in the economy since long-run relationships assert themselves only gradually in the face of shocks.

The supply side of the model has elements derived from the profit maximisation problem of firms, and long run parameter restrictions to ensure the model's stability. The demand side equations are postulated and do not originate from an optimisation framework. This allows the estimation of the demand side to be more faithful to the data.

The model is estimated using seasonally-unadjusted quarterly data spanning from 2000Q1 to 2011Q4.[8] No restrictions are placed on the equations' short-run coefficients. As a result, the economy's short-run dynamics are captured more closely and this, in turn, enhances the model's usefulness with regard to forecasting. The model is backward-looking, with expectation formation entering implicitly through the inclusion of lagged values in the dynamic equations, as is the case with many models embodying adaptive expectations.

The model was built with four key uses in mind. Firstly, it can be used to conduct simulations and thus assess the impact of various shocks on the domestic economy.

[6] For example, a richer treatment of some of the components of aggregate demand requires data on deflators at a level of disaggregation which is not publicly available.

[7] In contrast to estimation, which allows the modeller to estimate parameter values from historical data, calibration involves setting these values on the basis of prior information, such as that obtained from micro studies, generally with the intention of being more faithful to economic theory or with the intention of producing a model with properties which are in line with some stylised facts about the underlying economy.

[8] The vintage used was NSO News Release 049/2012. Seasonality was treated through the use of seasonal dummy variables as in Daníelsson et al. (2009). Note also that data for the period before the adoption of the euro are transformed to reflect the actual exchange rate during that period rather than the constant conversion factor adopted by Eurostat.

Secondly, the model can contribute towards the projection exercises carried out by the Bank, including those incorporated in the bi-annual Broad Macroeconomic Projection Exercise of the Eurosystem.[9] Since short-term forecasting tools augmented by expert judgement are likely to outperform any pure model forecast over shorter horizons, the model's main usefulness lies in providing a framework that helps ensure internal consistency in the judgment-based forecast, serving as a tool for rapidly updating projections, and acting as an aid when studying the different inter-linkages within the economy.

Another potential use of the model is that of examining the impact of policy actions on the economy.[10] Finally, the model is meant to deepen understanding of how the Maltese economy functions and ignite further debate.

[9] See ECB (2001) for further details regarding the Eurosystem's staff macroeconomic projection exercises. These projections are based on a set of common assumptions which cover variables such as world trade developments, the international price of oil and other commodities, nominal exchange rates and the policy rate.

[10] The model is, however, subject to the Lucas (1976) critique. If agents are rational and forward looking, they would change their behaviour to counteract preannounced changes in policy.

3. A CLOSER LOOK AT THE MODEL

The model is composed of four blocks: a supply block, a demand block, a wage-price block, and a financial block. Charts 1 and 2 portray the model's structure and the inter-linkages it captures. The first chart brings together the supply, demand and financial blocks, together with elements of the wage-price block. The second chart highlights the links within the aggregate demand component deflators. Variables within a red frame are exogenous, while those in blue are endogenous. Identities are surrounded by black. Variables in green in Chart 1 emerge from the price block, whereas in Chart 2 they are determined endogenously. Arrows indicate the direction of influence, which in some cases runs in both directions.

For instance, any change in the exogenously set policy interest rates impacts retail interest rates. The latter then influence private non-dwelling investment, in turn affecting GDP, which then leads to a second-round impact on investment.

Similarly in Chart 2, an increase in foreign prices affects the price of imports, which then causes a rise in consumer prices. Then, as shown in Chart 1, inflation raises private wages, which results in increased unit labour costs, bringing about a second-round impact on consumer prices and export prices, as captured by the private consumption deflator and export deflator, respectively.

Chart 1: Schematic Representation of the Model (Excluding the Aggregate Demand Component Deflators)

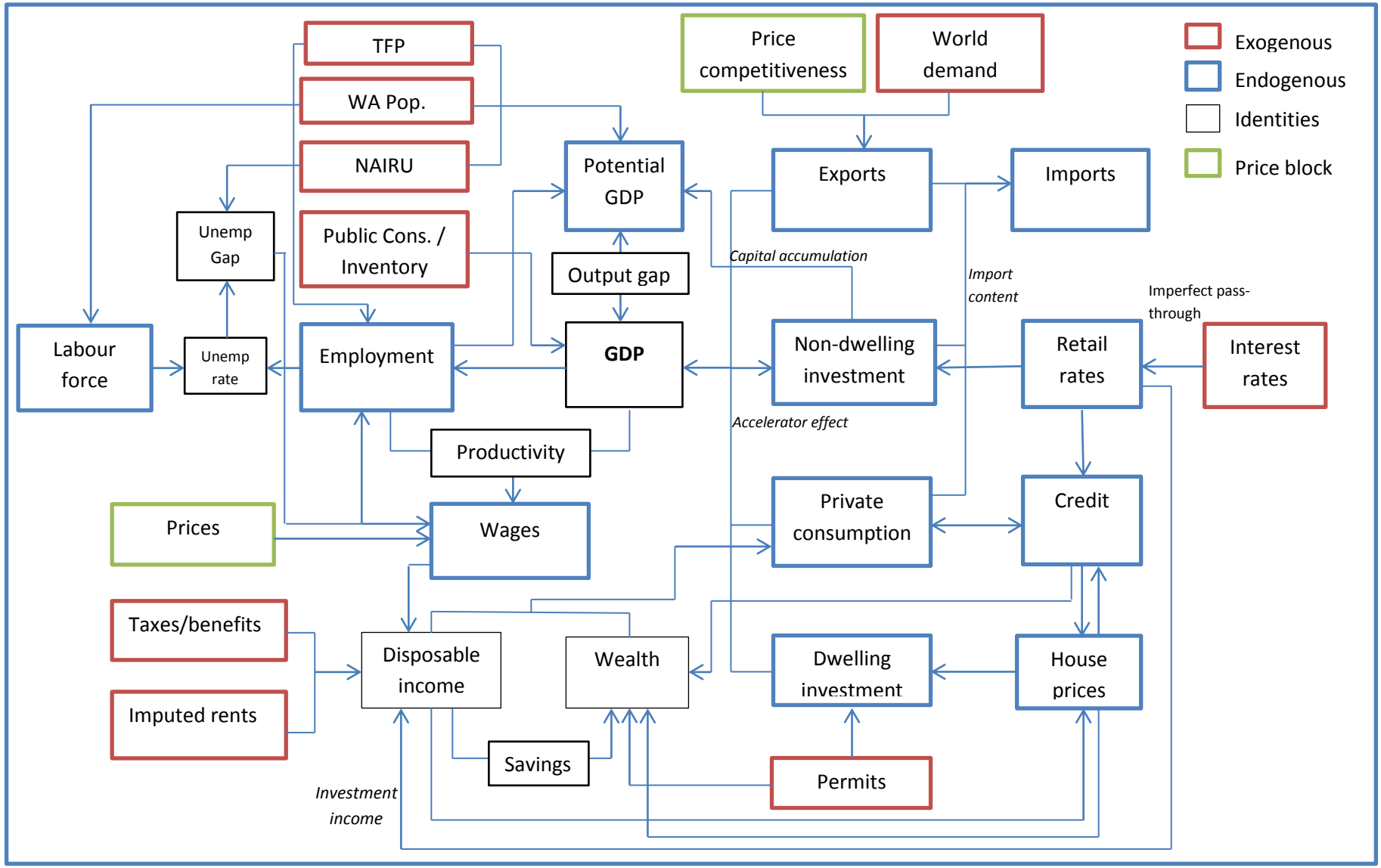
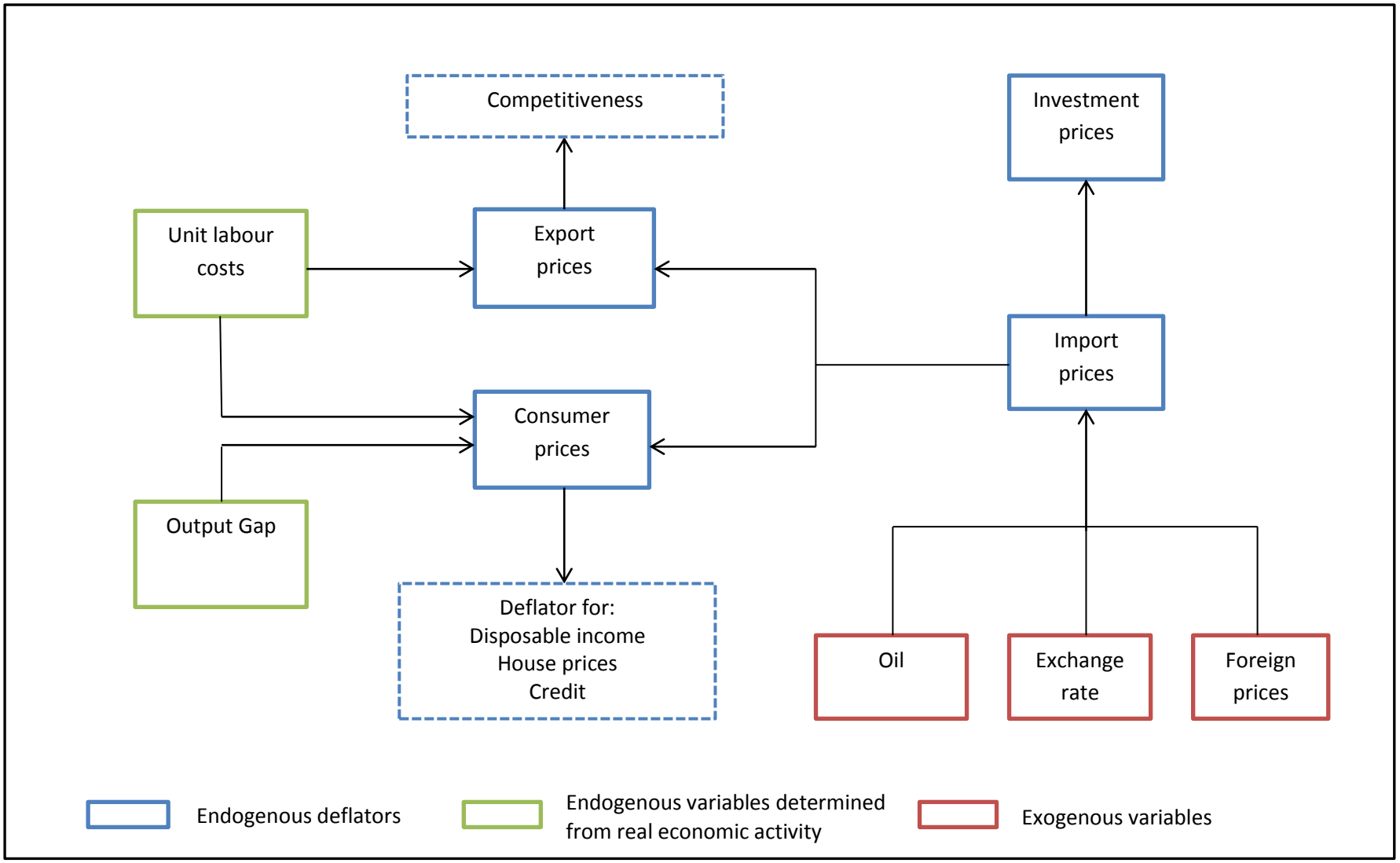


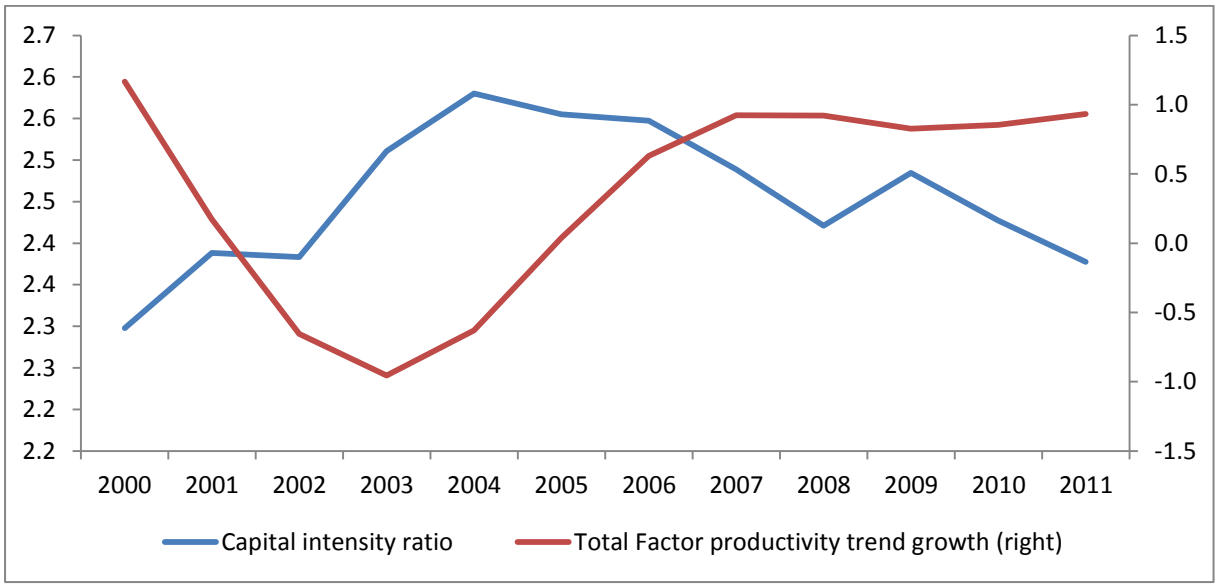
Chart 2: Schematic Representation of the Aggregate Demand Component Deflators



3.1 The Supply Block

In the longer term, output is driven by supply-side developments. This long-run equilibrium level of output – or potential output – is provided by an economy-wide Cobb-Douglas production function with constant returns to scale.[11] Trend employment is derived by applying the four-quarter moving average of the participation rate (defined as the labour force over the working-age population) to the working age population, and then subtracting the unemployment level consistent with the NAIRU from it. The other factor of production, capital, is unobservable and is assumed to equal accumulated non-dwelling investment after accounting for depreciation.

Chart 3: Annual Percentage Change in Trend Total Factor Productivity and Development of Capital Intensity Ratio



[11] The Cobb-Douglas production function is given by:

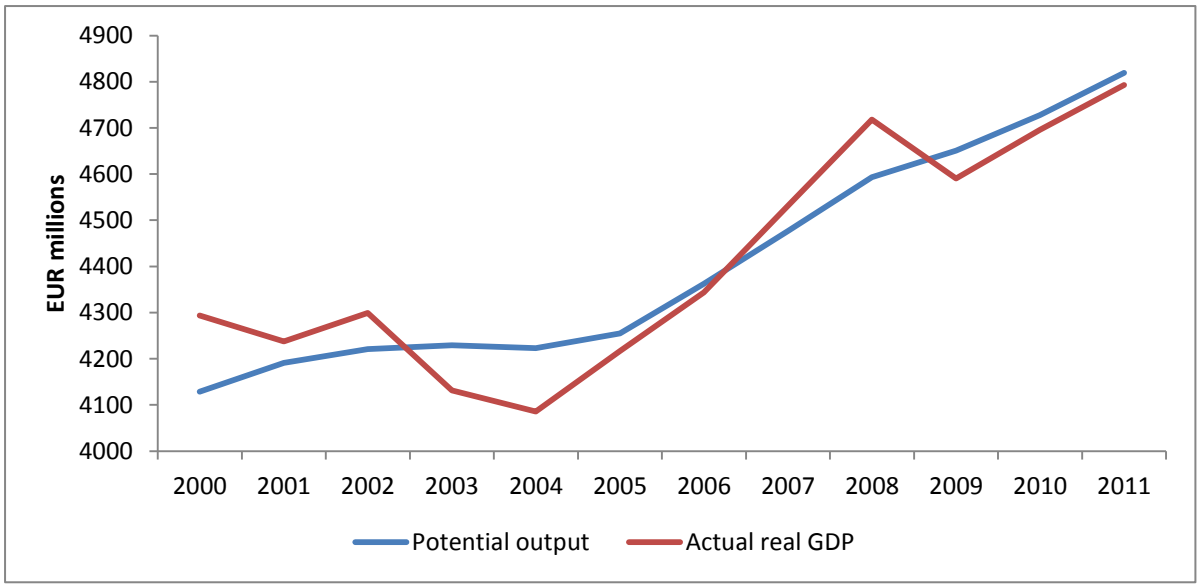
GDPFPO = TFPFT*(CAPSTOCKTOTF^0.42)*((WAP*(1-NAIRU/100)*(@MOVAV(PARTICRAT,4)))^0.58)

where:

GDPFPO = Real potential output
TFPFT = Trend real total factor productivity
CAPSTOCKTOTF = Real total capital stock, excluding dwellings
WAP = Working age population
NAIRU = Non-accelerating inflation rate of unemployment
PARTICRAT = Participation rate

As is customary, total factor productivity is derived as a smoothed (Solow) residual resulting from the imposition of constant returns to scale parameters on the production function.[12] Chart 3 shows that growth in total factor productivity was inversely related to the capital intensity ratio, which is computed as the ratio between the capital stock and GDP. Total factor productivity picked up as from 2003, reflecting faster growth of less capital-intensive service industries, such as financial and professional services and remote gaming. Labour productivity also accelerated during this period.

Chart 4: Trends in Level of Potential Output and Actual GDP



Over the short term, output is demand driven and may deviate from its potential level, which is determined by the Cobb-Douglas production function referred to above. These deviations are measured by an output gap variable which serves to gradually bring output in line with its long-run equilibrium through adjustments in wages and prices. Chart 4 shows the development of potential output and actual GDP during the period covered by the model. Deviations from potential have been limited in duration and the economy has fluctuated around its time-varying potential during this decade.

[12] The income share was set at 0.58 in line with the historical income share of total gross value added.

In the short run, real wages (the payment for the labour input) grow in line with productivity – resulting in a stable share of labour income (see Appendix A9). Private employment[13] in the short run is determined by real private GDP and the real wage (see Appendix A1). In the long run, it grows in line with private sector real GDP, while the elasticity with respect to the real wage and to trend total factor productivity is negative, as expected a priori. Investment is carried out until the marginal product of capital is equal to the user cost of capital.[14]

3.2 THE AGGREGATE DEMAND BLOCK

In the model, real aggregate demand is split into nine (real) expenditure components, with each modelled separately; private consumption, private non-dwelling investment, private dwelling investment, government investment, inventories, government consumption, exports of tourism, exports of goods & non-tourism services and imports of goods & services. Real government investment and real government consumption are exogenous, while real inventories are assumed to be a constant share of real GDP.

The consumption function (see Appendix A3) is based on two approaches: Keynesian theory, which asserts that consumption is a function of current income, and the life-cycle or permanent income hypotheses, which postulate that economic agents base their consumption decisions on expected lifetime resources, rather than current income. Over the short run, consumption is driven by real disposable income,[15] real credit and a measure of volatility.[16] The latter captures the influence of uncertainty on precautionary saving and, hence, consumption. In the literature, the unemployment rate is often included as a variable that

[13] All employment variables in the model are converted to full-time equivalent. A constant conversion factor of 2.145 was used to convert part-time employees into full-time employment terms. This estimate is similar to that found in Grech (2003).

[14] The user cost of capital consists of three components: the bank lending rate to non-financial corporations, the depreciation rate and a long term interest rate.

[15] Disposable income is defined as the sum of compensation of employees (less national insurance contributions paid by employers and imputed government national insurance contributions in respect of its own employees), income earned by the self-employed, investment income received by households, cash social payments (i.e. total social payments less those in kind), and imputed rents, less taxes paid on employment income (which consist of income taxes, and national insurance contributions paid by employees and the self-employed).

[16] The Chicago Board Options Market Volatility Index (VIX Index). The consumer confidence indicator for Malta published by the European Commission was considered as an alternative measure of uncertainty and yielded similar results. The key advantage of the VIX index lies in the availability of a transparent exogenous path from futures data, and its longer historical time series.

influences precautionary saving. However, in the case of Malta, it was found to be statistically insignificant. Interest rates were also found to have no direct effect on consumption, though they have an indirect influence through credit.[17] The short-run coefficient of real disposable income stands at 0.76. In the long run, real consumption is determined by real disposable income and real net wealth.[18] The sum of these two coefficients was set to be equal to one.

Since not all components of disposable income are published by the National Statistics Office or Eurostat, the Central Bank of Malta's Modelling and Research Office estimated self-employed income and investment income.[19] Where possible, for instance in the case of interest earned by households on deposits or income on government bonds, available time series were used. In other cases, particular point-in-time estimates, from surveys like the Household Budgetary Survey, the EU Survey of Income and Living Conditions and the Eurosystem's Household Finance and Consumption Survey, were used to derive the required series.[20]

Gross fixed capital formation is broken down into three components: government investment, which is exogenous, private non-dwelling investment and private dwelling investment.

Real private non-dwelling investment depends on private real GDP and the user cost of capital in the long run, with both elasticities restricted to one, consistently with the Cobb-Douglas production function (see Appendix A4). In the short term, this investment component is influenced by real economic activity, with the results showing a coefficient higher than one, capturing the accelerator principle. Note that this equation, through the user

[17] This effect is diluted to some extent by the interest rate's influence on disposable income via investment income. An increase in interest rates, for example, gives rise to a decline in credit, in turn causing consumption to fall. At the same time, however, higher interest rates boost investment income, and hence disposable income, causing consumption to rise, albeit to a lesser degree.

[18] Net wealth consists of housing wealth and net financial wealth owned by households. The latter is the difference between households' financial assets and financial liabilities as calculated by the Bank's Statistics Department. Over the forecast or simulation horizon, housing wealth is calculated by multiplying the stock of each housing category – terraced houses, maisonettes, and apartments – by the unit price of the respective category and adding up the resulting three amounts. The housing stocks are determined exogenously, in line with housing permits, while the unit house price of the separate categories grows in line with the year-on-year growth rate of overall house prices, which is estimated through a behavioural equation. Financial assets grow by the amount of savings. Financial liabilities consist of credit to households and credit to non-profit institutions serving households. The former is composed of consumer and other credit as well as housing credit, which are determined via behavioural equations.

[19] Note that over the forecast or simulation horizon, investment income is calculated in line with the changes in net financial wealth and interest rates. Self-employed income grows in line with employment income.

[20] For example, a time series for self-employed income was derived using a margin over per capita employment income. Income surveys provide particular point-in-time readings of this margin.

cost of capital term, serves as the direct channel through which interest rates affect the broader economy.

Private dwelling investment is modelled as a constant share of real private sector GDP in the long run. Its short-term dynamics are driven by the housing permits issued, real housing credit, and real house prices (see Appendix A5).

Turning to the external sector, real exports are modelled in a standard fashion, with the long-run elasticity with respect to world demand restricted to one. The export equation can therefore be interpreted as a market share equation, whereby a gain (loss) in market share, in the long run, is driven by an improvement (deterioration) in price competitiveness. Exports of tourism are modelled separately from other exports.

Tourism exports (see Appendix A6) are principally driven by world demand,[21] though (relative) price competitiveness[22] plays an important role. While in the short run, demand for tourism is price-inelastic, the results support the imposition of unitary elasticity in the long run. Non-tourism exports were more price-inelastic[23] than tourism exports in the short run. Again, unitary elasticity was imposed in the long run. Compared with tourism exports, short term responsiveness to world demand is also less pronounced (see Appendix A7), possibly reflecting relatively more important supply constraints.

As shown in Appendix A8, real imports depend on an import demand indicator[24] in both the long run and the short run. The elasticity of imports with respect to import demand was, by

[21] The variable for world demand is an index constructed by the ECB that specifically measures the demand for Maltese exports. It is a weighted average of the import volumes of trading partners, with weights derived on the basis of the direction of Maltese exports. See Hubrich & Karlsson (2010) for further details.

[22] The real effective exchange rate for the tourism sector is constructed using a chain linked geometric weighted average index of bilateral exchange rates deflated by relative export prices. The weighting scheme adopted is a double weighting system which allows for the capturing of third market effects (Turner & Van't dack (1993)). Weights are derived from overnight stays of non-resident tourists in all types of accommodation as reported by the Yearbook of Tourism Statistics published by the World Tourism Organisation. Time varying weights in the form of three year moving average shares are used.

[23] This index, constructed by the ECB, is computed as a double-weighted average of export prices of Malta's competitors. In the first stage of the weighting scheme, the competitor's price faced by Malta in its individual export markets is calculated as a weighted average of competitors' export prices, with the weights reflecting the importance of each competitor with regards to the imports of that individual country. In the second stage, the competitors' prices faced by Malta in each of its export markets are weighted according to the share of each market in Malta's total exports, and aggregated. Further details can be found in Hubrich & Karlsson (2010).

[24] The import demand indicator is a measure of the import content of the components of final demand. In the absence of recent Input-Output tables for Malta that would provide the import content of these components, the first step in constructing the indicator was to estimate a regression with the log of real imports as the dependent variable, and the logs of real consumption, real non-dwelling private investment, and real exports as dependent variables. This revealed that a one per cent increase in real consumption, real non-dwelling private investment, and real exports lead to a 0.53, 0.09, and 0.63 per cent rise in real imports, respectively (Note that these

definition, set to one in the long run, and estimated to be around 0.99 in the short run. Therefore, the unitary elasticity imposed in the long run also broadly holds in the short run. In many of the import equations found in other studies, real imports are also a function of import price competitiveness, defined as the ratio of import prices (often measured by the import deflator) to domestic prices (frequently measured by the overall GDP deflator). However, in the case of Malta, relative prices were not included given that a substantial proportion of them cannot be substituted by domestic products.

3.3 THE WAGE-PRICE BLOCK

The private wage equation has been outlined in the supply block. Price formation is modelled in a relatively rich manner, with separate behavioural equations for the personal consumption deflator, the investment deflator,[25] the export deflator,[26] and the import deflator. The inventories deflator is assumed to grow at the same rate as the overall GDP deflator, while the government consumption deflator is exogenous.

The import deflator is determined in both the short run and the long run by export prices in Malta's main import source markets.[27] In the short run, import prices tend to move less than competitor's export prices, possibly reflecting delays in pass-through (see Appendix A13). However, in the long run these price changes are passed on completely to import prices. The import deflator is the main determinant of investment prices, reflecting the fact that most investment goods are imported. The pass-through in the short run is 0.69 (see Appendix A11).

Import prices also play an important role in determining consumer prices. In the long run, the personal consumption deflator is determined by import prices – measured by the import deflator – and unit labour costs (see Appendix A10). Over the short term, the consumption

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elasticities cannot be interpreted as import contents). By excluding dwelling investment, government investment (mostly construction), inventories (which includes a substantial statistical discrepancy), and government consumption (a substantial portion of which is wages) from the regression, it is implicitly assumed that the import content of these components is negligible. The elasticities were then used to translate changes in the components of final demand into changes in imports.

[25] Note that although real non-dwelling private investment, real dwelling private investment, and real government investment are modelled separately, they are all subject to the same aggregate investment deflator.

[26] While real tourism exports and real non-tourism exports are modelled separately, they are both subject to the same aggregate export deflator.

[27] This variable is a weighted average of the export prices of our main trading partners, with weights reflecting each country's relative share in total Maltese imports of goods. This series is provided by the ECB.

deflator is influenced by its own lagged values, the output gap, competitors' prices on the import side (excluding exchange rate effects),[28] and the nominal effective exchange rate on the import side.[29] The long-run elasticity of the private consumption deflator with respect to import prices and unit labour costs is 0.49 and 0.51, respectively. This is broadly in line with the shares in the household consumption basket of goods and services, respectively. In turn, this would be consistent with the view that goods are more likely to be tradable and, hence, influenced by foreign prices, than services.

The export deflator is determined in the long run by imported prices and domestic costs – measured by the unit labour costs (see Appendix A12). These elasticities add up to one, thereby ensuring a stable profit margin of Maltese exporters. Domestic costs play only a limited role, accounting for less than 15% of export price changes in the long run, possibly reflecting the high import content of export production. In the short run, the export deflator is solely driven by imported inflation.

House prices are also modelled separately via a behavioural equation (see Appendix A14), given their importance within the local context. In the long run, to ensure the affordability of housing, the elasticity of house prices with respect to disposable income per capita is restricted to one. In the short run, the provision of mortgage loans plays a very important role in driving house price inflation, while the elasticity in respect of changes in disposable income per capita is lower than one.

3.4 THE FINANCIAL BLOCK

The financial block models credit and interest rates, albeit in a rudimentary fashion. The model distinguishes between two types of credit – consumer & other credit, and housing credit – each of which is modelled through a behavioural equation[30] (see Appendix A15 and A16). It should be noted that, within the model, credit is entirely demand driven, and is influenced by disposable income, private consumption, house prices and real lending rates. In other words, any demands for credit are met; there are no supply constraints such as

[28] This can be extracted by dividing the series for competitors' prices on the import side in euro by the nominal effective exchange on the import side, and multiplying by hundred. Both series are provided by the ECB.
[29] This series is provided by the ECB.
[30] A behavioural equation modelling credit to non-financial corporations is also available. However, since this variable was found to have no influence on investment, the equation is not generally part of the model and is only used for forecasting total credit.

influences from banks' balance sheet positions. The financial block contains three other behavioural equations that determine a range of interest rates that feature in the model: the lending rate to non-financial corporations, the interest rate on consumer & other credit, and the interest rate on housing credit (see Appendix A17, A18 and A19). There is imperfect pass-through from the policy rate to the retail interest rates. Estimates of interest rate pass-through for the three interest rates present in the model range between 55% and 70%.

4. THE SIMULATION PROPERTIES OF THE MODEL

To illustrate the simulation properties of the model, this section outlines the response of the main macroeconomic variables to the following four standard shocks. The shocks are defined as follows: the monetary policy shock consists of a permanent increase of 50 basis points in the policy interest rate, which is exogenously given. In addition, we also assume that the monetary tightening leads to an appreciation of the domestic currency.[31] The oil price shock is defined as a 20% permanent increase in oil prices in US dollar terms. The exchange rate shock consists of a 10% permanent currency appreciation against the US dollar. Finally, the world demand shock is defined as a permanent increase in foreign demand by 1%.

Table 1 summarises the response of three macroeconomic variables – GDP, HICP inflation[32] and employment – to the four shocks over three years. More detailed tables are available in Appendix B. A detailed analysis of the channels which result in these changes is presented below.

Table 1: Impact of Shocks on Main Macroeconomic Variables
(Size of shock as indicated in the text; deviations from baseline in p.p.)

	Impact on GDP			Impact on HICP			Impact on Employment		
	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3
Monetary policy shock	-0.01	-0.03	-0.06	-0.02	-0.02	-0.03	0.00	-0.02	-0.05
Oil price shock	-0.10	-0.29	-0.52	0.62	0.95	1.40	-0.02	-0.02	-0.12
Exchange rate shock	-0.13	-0.20	-0.20	-0.33	-0.44	-0.63	-0.04	-0.14	-0.21
World demand shock	0.46	0.55	0.54	0.04	0.04	0.10	0.12	0.34	0.43

4.1 MONETARY POLICY SHOCK

Monetary policy affects non-residential investment adversely through the increase in the user cost of capital, while private consumption and housing investment are affected indirectly by a drop in credit demand that follows the rise in interest rates. Private consumption is also negatively affected by a drop in households' wealth, arising mainly from lower house prices,

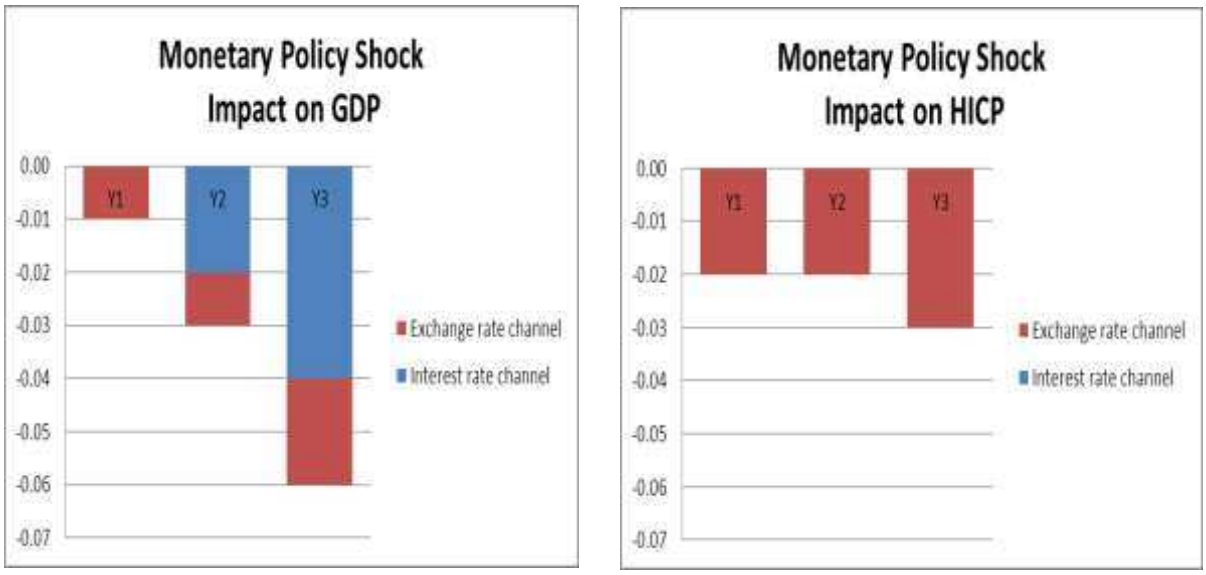
[31] This assumption follows from the uncovered interest rate parity condition. In the simulation, the domestic currency is assumed to appreciate by 0.5% against the US dollar. A similar set-up for a monetary policy shock is proposed in Fenz & Spitzer (2005).
[32] In this model, HICP inflation is not directly modelled by a behavioural equation but is linked to movements in the private consumption deflator, which is the main consumer price index in the model.

and a slight fall in disposable income due to lower employment and wages. The appreciation of the exchange rate leads to lower exports.

The impact of the monetary shock on GDP and HICP inflation can be decomposed into the interest rate and the exchange rate channels, respectively (see Chart 5). The impact of the interest rate channel on GDP operates with a lag, while the exchange rate channel, which affects the tradable sector's price competitiveness, has an immediate impact. From the second year onwards, however, the fall in GDP is mainly attributable to the interest rate channel.

On the contrary, the interest rate channel has a negligible impact on prices, with the drop in inflation being entirely driven by the exchange rate channel. This pattern can be traced back to the determinants of price inflation in the model – primarily fluctuations in foreign prices and the exchange rate, and a domestic cost component (unit labour costs) – whereas the output gap plays only a minor role in the short term.

Chart 5: Decomposition of Impact of Monetary Policy Shock – Interest Rate and Exchange Rate Channels (p.p. deviations from baseline)



These results suggest that a monetary policy shock has a relatively weak effect on domestic output and prices, compared with the effect observed in other countries. There are three main explanations for this. The first relates to model specification, while the rest are related to certain characteristics of the domestic financial system.

First, the model does not include some channels that would otherwise affect this simulation. For instance, a monetary tightening would lead to lower prices and economic activity in the euro area, leading to an indirect effect on domestic prices and activity. The incorporation of this channel would require a multi-country setting or ad hoc adjustments.

Moreover, the policy rate may be less than fully transmitted to the retail interest rates, which, ultimately, affect the saving and investment decisions of economic agents.

Furthermore dependence on credit to finance consumption and investment may be more limited in Malta. Maltese households, for instance, are currently less dependent on mortgage lending than households in many other European countries.

4.2 Oil Price Shock

The impact of a permanent oil shock on economic activity and inflation is relatively strong, reflecting Malta's high degree of dependence on oil to generate energy. The growing importance of the services sector – which is less energy-intensive – may be partly counteracting this.

The effects of an oil price shock are similar to an adverse supply shock, with a negative impact on economic activity and an increase in prices. Higher oil prices significantly influence all domestic prices both directly, through higher import prices, and indirectly, via second-round effects. The latter feed into domestic prices through the increase in unit labour costs, in turn driven by a combination of higher nominal compensation per employee and a deterioration in labour productivity. The pass-through from a 20% oil price shock to consumer price inflation increases gradually, with the HICP increasing by 0.6% relative to the baseline in the first year. By the third year, the impact on the index rises to 1.4%. The increase in domestic prices leads to a fall in purchasing power and price competitiveness, adversely affecting private consumption and exports, while private investment declines with a lag via the accelerator principle. In addition, an oil price shock leads to a persistent deterioration in the terms of trade and worsens the trade balance.

4.3 EXCHANGE RATE SHOCK

An appreciation of the euro against the US dollar has a pronounced impact on domestic economic activity and employment. This reflects the very open nature of Malta's economy, combined with the fact that around 65% of total exports are directed to countries outside the euro area.[33] On the other hand, the US dollar is the currency in which oil is priced, and an appreciation of the domestic currency hence results in lower oil prices in euro terms and some improvement in activity, as suggested in the previously described shock in oil prices.

The appreciation has an immediate impact on all deflators, although the impact on consumer prices is gradual, reflecting a pass-through of 55-60% from import to consumer prices. As a result, the latter decline gradually by 0.3% relative to the baseline in the first year and by 0.6% by year 3.

Concerning economic activity, the deterioration in external price competitiveness has an immediate and adverse impact on export volumes. In contrast, the increase in purchasing power boosts consumption in the short run but this effect gradually dies out as the decline in disposable income from the deterioration in the labour market, together with an adverse wealth effect from lower house prices, eventually start to take their toll on private consumption.

4.4 FOREIGN DEMAND SHOCK

As with the exchange rate shock, the impact of higher foreign demand on GDP is quite pronounced. A favourable external demand shock directly leads to higher export volumes. The resulting rise in employment and wages boosts disposable income. In turn, the latter exerts a positive impact on house prices and bank credit. Together, these elements lead to higher private consumption. Investment rises with buoyant economic activity. Due to the high import content of domestic demand and exports, however, higher foreign demand leads only to a small improvement in the trade balance.

There is only a very slight increase in domestic consumer prices following a foreign demand shock. As explained elsewhere, this reflects the fact that developments in the output gap play

[33] Among the non-euro area trading partners, the largest shares are attributable to Asia excluding Japan (22%), the US (17%), and the UK (12%). Further details are available in Hubrich & Karlsson (2010).

only a minor role in determining prices. The supply of labour and of capital, moreover, tends to rise quickly to accommodate increased demand.

5. CONCLUSION

Economic modelling is a continuous process. Models can be constantly improved to capture more of the intricacies within the economy. For this reason, this paper is meant to present an intermediate stage in the structural model's development. For example, in future, the supply side of the model could be integrated to a greater degree, and the model could be expanded to include an endogenous fiscal block as well as a more detailed and richer financial block, where credit also depends on bank balance sheets. Further disaggregation could also become possible, if sector specific deflator statistics become available. Similarly if currently unobservable variables – such as certain components of disposable income – are officially published, these would replace estimates presently used in the model. Moreover, given the very dynamic nature of Malta's economy and the need to increase statistical robustness due to the short time series currently available, the model needs to be assessed regularly and revised to ensure that it still faithfully represents developments in the Maltese economy.

At this stage, the model presents some interesting results, contrasting with those observed in larger economies in some respects. For instance, the lag structure of the equations is shorter, suggesting a relatively fast response adjustment to shocks. This could reflect the volatile nature of the time series used, with a number of structural shocks occurring during the period. However, the relatively high degree of openness to trade and labour market flexibility, such as the growing use of part-time employment and firm-level wage negotiations, could also be contributory factors to the speed of adjustment. Simulation results suggest that the impact of monetary policy is weak while that of changes in foreign demand is quite strong. The exposure of the Maltese economy to oil prices and the value of the US dollar also appears to be relatively significant.

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APPENDICES

APPENDIX A: BEHAVIOURAL EQUATIONS

This Appendix describes the behavioural equations of the model (which is estimated in EViews). Several conventions and functions are used in the presentation of the empirical results. Data are quarterly; LOG denotes the natural logarithm of a variable; D refers to the first-difference of the variable; @MOVAV(*variable_name*,4) denotes a four quarter moving-average of a variable; @PCY refers to the annual percentage change in a variable; @SEAS/100 refer to seasonal dummies. Dummy variables are denoted by D, followed by the year and the quarter. For example, D02Q3/100 refers to a dummy variable centred in 2002Q3. Finally, @TREND/100 denotes a linear time trend, which, unless stated otherwise, starts from the beginning of the sample. Lagged values are shown in brackets.

The regression output is divided into three panels. The top panel summarises the input to the regression (the dependent variable, the estimation method, the sample period, and the number of observations). The middle panel gives information about each regression coefficient (estimated coefficient, standard errors, T-statistics and the associated p-values). The bottom panel provides summary statistics about the whole regression equation. The R^2, the adjusted R^2, the standard error of the regression, the Durbin-Watson test and the F-Test are also reported. Definitions of the model variables are provided beneath each equation. The empirical fit of the modelled variable and the residuals from the equation are presented graphically.

Supply Block

A1. Private Employment

In the long run, demand for labour is negatively affected by the relative price of labour (measured by the ratio of private wages to the GDP deflator) and is positively dependent on real private sector GDP. These also affect private labour demand in the short run. The equilibrium level of labour demand is also influenced by trend total factor productivity.

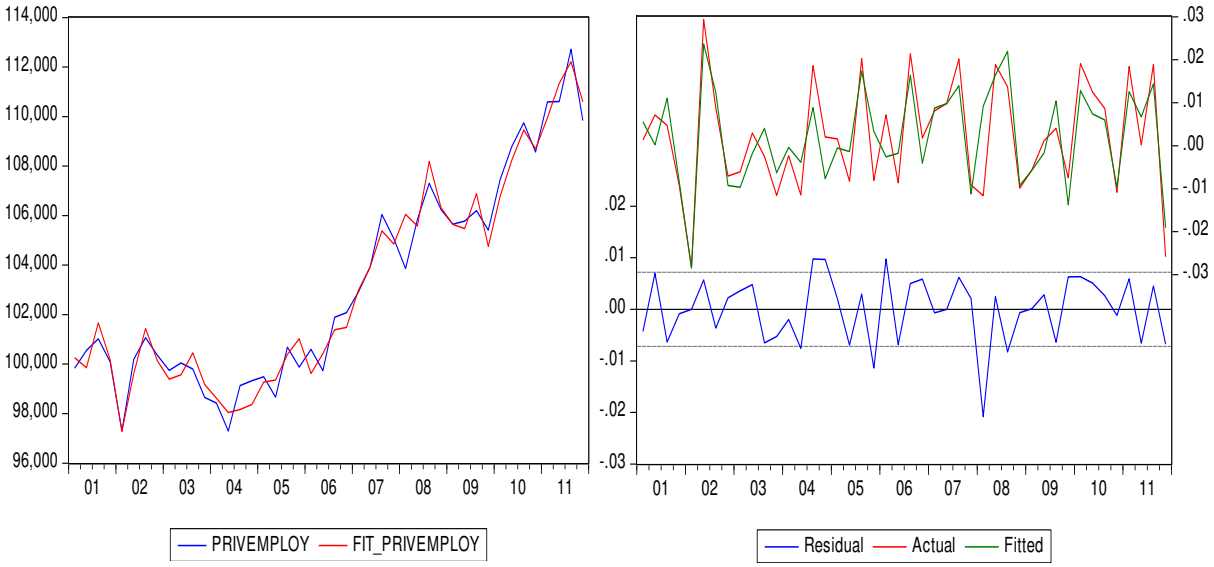
Dependent Variable: DLOG(PRIVEMPLOY)
Sample (adjusted): 2001Q1 2011Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.740062	0.258800	-2.859587	0.0072
DLOG(PRIVGDPF)	0.141894	0.062528	2.269299	0.0297
DLOG(PRIVWAGE/@MOVAV(PGDP,4))	-0.206333	0.049802	-4.143059	0.0002
LOG(PRIVEMPLOY(-1)/PRIVGDPF(-1))	-0.223275	0.059457	-3.755224	0.0006
LOG(PRIVWAGE(-1)/PGDP(-1))	-0.089271	0.051293	-1.740411	0.0908
LOG(TFPFT(-1))	-0.154231	0.082151	-1.877405	0.0691
@SEAS(2)/100	0.389030	0.928499	0.418987	0.6779
@SEAS(3)/100	-0.797190	1.052635	-0.757328	0.4541
@SEAS(4)/100	-2.318463	0.725299	-3.196563	0.0030
D02Q1/100	-2.444418	0.953990	-2.562309	0.0150

R-squared	0.753574	Durbin-Watson stat	2.456999
Adjusted R-squared	0.688343	F-statistic	11.55249
S.E. of regression	0.007207	Prob(F-statistic)	0.000000

where:

PGDP	GDP price deflator
PRIVEMPLOY	Private sector employment
PRIVWAGE	Private sector wages
PRIVGDPF	Real GDP (private sector)
TFPFT	Total Factor Productivity (HP Filter)
D02Q1	Dummy variable: 1 in 2002Q1, 0 otherwise



A2. Labour Force

To allow for an endogenous labour force response, the model includes an equation for the labour supply. The long-run value of the labour force is affected by an increasing participation rate captured by a linear trend, and by the encouraged worker effect caused by higher employment. The dynamics of the labour supply in the short run are solely affected by total employment.

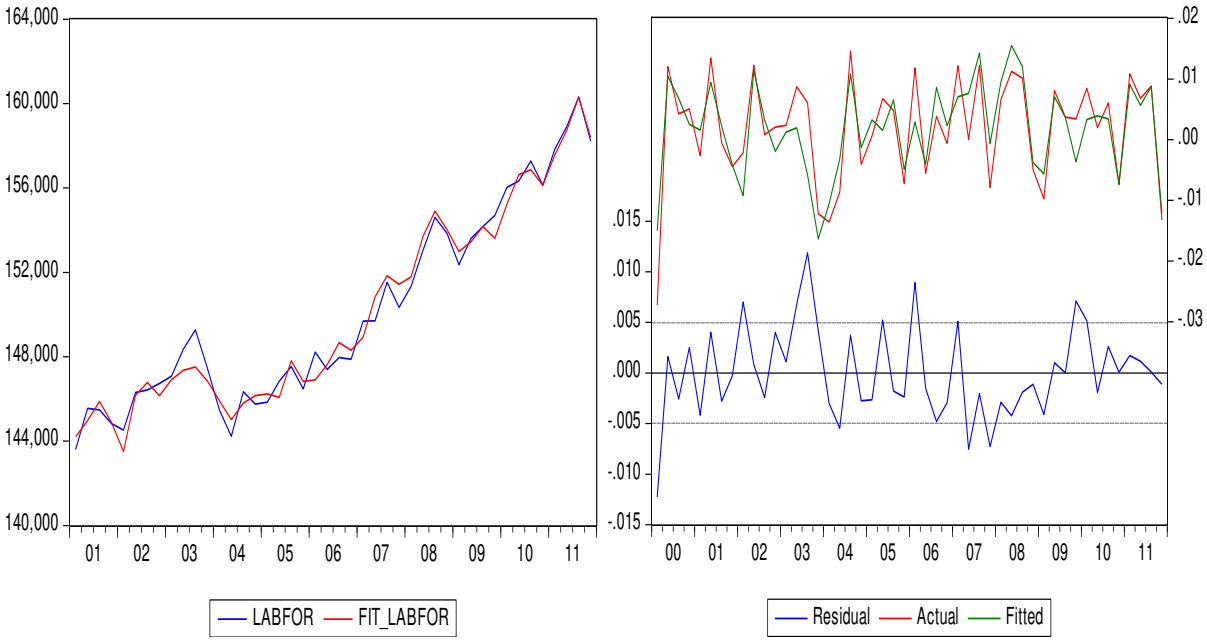
Dependent Variable: DLOG(LABFOR)
Sample: 2000Q1 2011Q4
Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.005590	0.821920	2.440128	0.0192
DLOG(TOTEMPLOY)	0.623792	0.104698	5.957992	0.0000
LOG(LABFOR(-1))	-0.609781	0.137774	-4.425959	0.0001
LOG(TOTEMPLOY(-1))	0.442551	0.110875	3.991435	0.0003
@TREND/100	0.040617	0.015883	2.557251	0.0144
@SEAS(2)/100	0.333225	0.204951	1.625880	0.1118
@SEAS(3)/100	0.128749	0.229735	0.560424	0.5783
@SEAS(4)/100	-0.055572	0.212424	-0.261610	0.7950

R-squared	0.728242	Durbin-Watson stat	1.727264
Adjusted R-squared	0.680685	F-statistic	15.31286
S.E. of regression	0.004963	Prob(F-statistic)	0.000000

where:

LABFOR	Labour Force
TOTEMPLOY	Total employment



Aggregate Demand Block

A3. Private Consumption

In the long run, private consumption is dependent on real disposable income and real net wealth. The combined elasticity of these variables is set to one, as statistical tests support the assumption of a stable household savings rate. In the short run, real private consumption depends on real disposable income, real credit and a proxy for economic uncertainty.

Dependent Variable: DLOG(CNF)
Sample (adjusted): 2001Q1 2011Q4
Included observations: 44 after adjustments

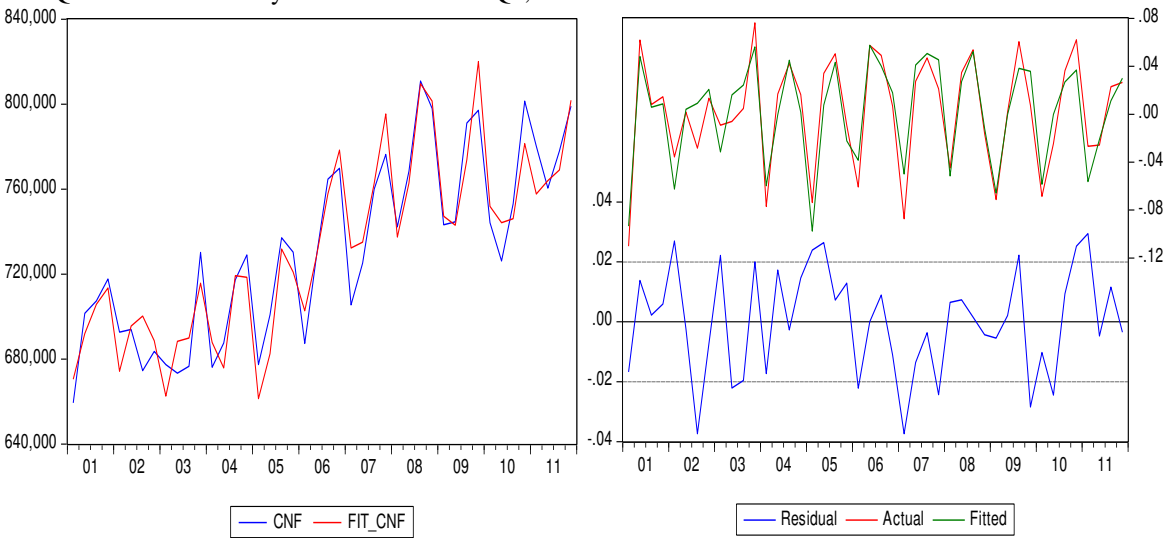
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.253795	0.554934	4.061372	0.0003
DLOG(YPD/PCN)	0.762637	0.134676	5.662769	0.0000
DLOG(TC(-1)/PCN(-1))	0.287968	0.159355	1.807082	0.0796
DLOG(@MOVAV(VIX,4))	-0.069937	0.031287	-2.235365	0.0321
LOG(CNF(-1))	-0.581932	0.134680	-4.320858	0.0001
LOG(YPD(-1)/PCN(-1))	0.854501	0.038456	22.22046	0.0000
LOG(WEALTHNET(-1)/PCN(-1))*	0.145499			
@SEAS(2)/100	2.776082	1.252769	2.215957	0.0335
@SEAS(3)/100	8.153910	1.151670	7.080077	0.0000
@SEAS(4)/100	6.836654	0.892995	7.655872	0.0000
D06Q2/100	4.350980	2.241164	1.941393	0.0605

R-squared	0.850256	Durbin-Watson stat	1.794445
Adjusted R-squared	0.810618	F-statistic	21.45052
S.E. of regression	0.019969	Prob(F-statistic)	0.000000

*Implied by long run restriction

where:

CNF	Real private consumption
PCN	Consumption deflator
TC	Total credit to households
VIX	VIX index, proxy for economic uncertainty
YPD	Nominal disposable income
WEALTHNET	Households' Net Wealth
D06Q2	Dummy variable: 1 in 2006Q2, 0 otherwise



A4. Private Non-Dwelling Investment

In the long run, private non-dwelling investment is positively dependent on private sector real GDP and negatively related to the user cost of capital, with both elasticities restricted to one. These unitary elasticities are predicted by theory and supported by the data. In the short run, real private investment is driven by lagged output, which captures the accelerator effect. The dummy variable was introduced to cater for the sale of aircraft in 2002, which pushed investment down sharply.

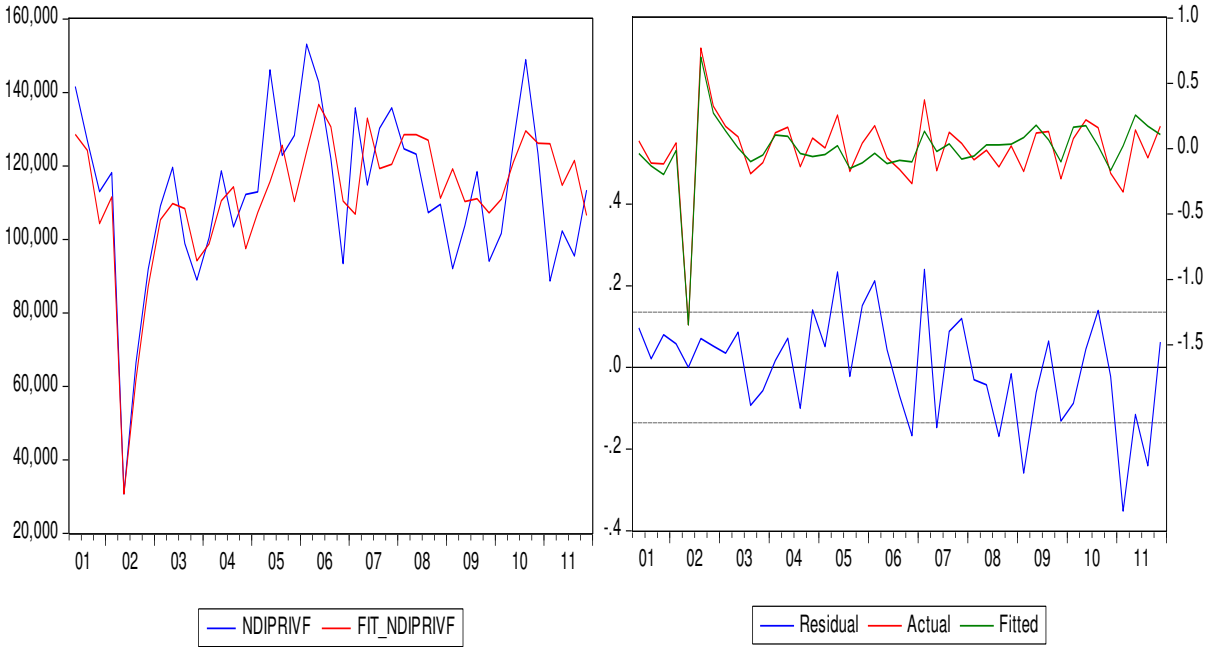
Dependent Variable: DLOG(NDIPRIVF)
Sample (adjusted): 2001Q1 2011Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.456167	0.201475	7.227517	0.0000
DLOG(PRIVGDPF(-3))	0.928379	0.328001	2.830417	0.0074
DLOG(PRIVGDPF(-4))	0.569596	0.336779	1.691305	0.0990
LOG(NDIPRIVF(-1))-LOG(PRIVGDPF(-1))+LOG(PCAP(-1))	-0.573470	0.080485	-7.125195	0.0000
D02Q2/100	-137.3585	14.06645	-9.764970	0.0000

R-squared	0.803283	Durbin-Watson stat	1.802438
Adjusted R-squared	0.782576	F-statistic	38.79279
S.E. of regression	0.135421	Prob(F-statistic)	0.000000

where:

PRIVGDPF	Real GDP (private sector)
NDIPRIVF	Real private non-residential investment
PCAP	User cost of capital
D02Q2	Dummy variable: 1 in 2002Q2, 0 otherwise



A5. Dwelling Investment

In the long run, real dwelling investment is modelled as a constant share of real private GDP. In the short run real dwelling investment is driven by both contemporaneous and lagged number of permits issued, mortgage credit and real house prices.

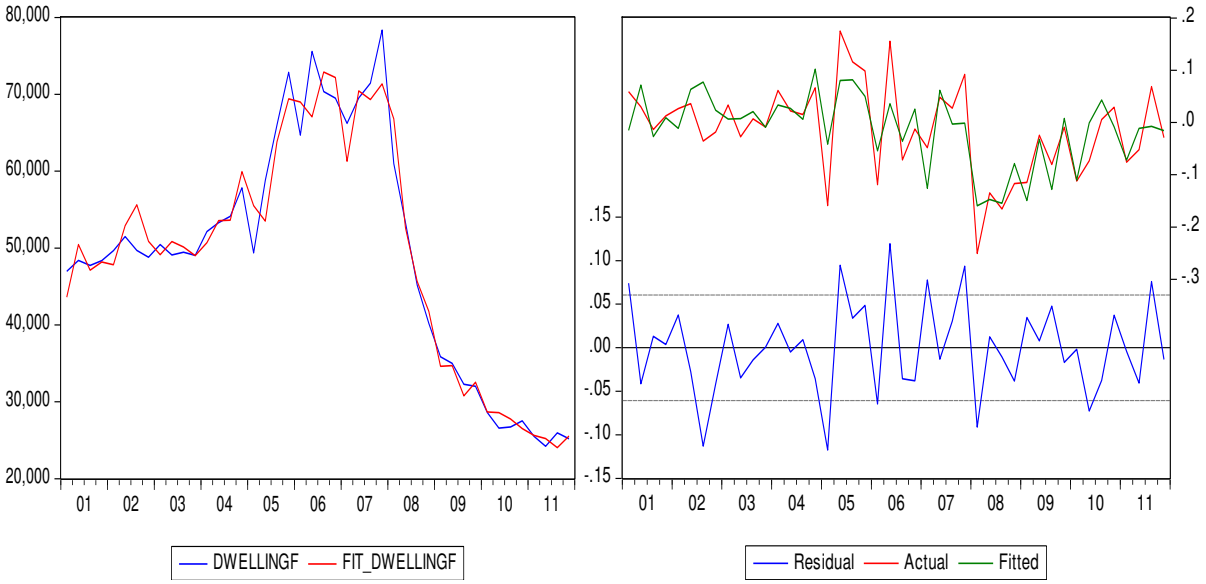
Dependent Variable: DLOG(DWELLINGF)
Sample (adjusted): 2001Q1 2011Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.170464	0.100701	-1.692781	0.0999
DLOG(PERMITS)	0.153335	0.050990	3.007145	0.0050
DLOG(PERMITS(-1))	0.263981	0.059273	4.453673	0.0001
DLOG(PERMITS(-2))	0.182267	0.062013	2.939190	0.0060
DLOG(PERMITS(-3))	0.099239	0.053185	1.865946	0.0710
DLOG(HCF(-3))	0.958627	0.512751	1.869575	0.0704
DLOG(PIH(-2)/PCN(-2))	0.579063	0.216145	2.679054	0.0114
LOG(DWELLINGF(-1)/PRIVGDPF(-1))	-0.053044	0.029512	-1.797367	0.0814
@SEAS(1)/100	-0.065893	0.033267	-1.980769	0.0560
@SEAS(2)/100	-0.016777	0.040192	-0.417409	0.6791
@SEAS(3)/100	-0.059964	0.034502	-1.738001	0.0915

R-squared	0.625477	Durbin-Watson stat	2.441699
Adjusted R-squared	0.511985	F-statistic	5.511203
S.E. of regression	0.060603	Prob(F-statistic)	0.000087

where:

DWELLINGF	Real private dwelling investment
HCF	Real mortgage credit
PERMITS	Building Permits Issued
PIH	House price index
PRIVGDPF	Real private sector GDP



A6. Tourism Exports

The long-run equilibrium condition for real tourism exports depends on world demand and price competitiveness on the (tourism) export side. The elasticity of real tourism exports with respect to world demand and to price competitiveness is restricted to one. This restriction is supported by statistical tests. In the short run, real tourism exports are driven by world demand and to a lesser extent by price competitiveness.

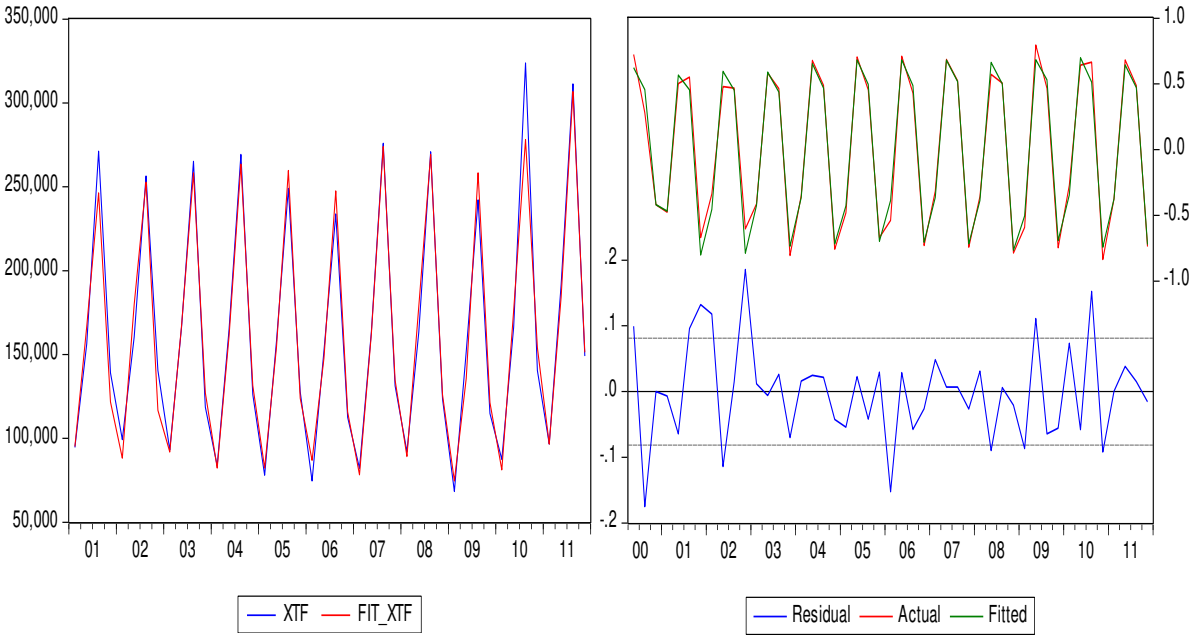
Dependent Variable: DLOG(XTF)
Sample: 2000Q2 2011Q4
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.734449	0.443559	1.655810	0.1058
DLOG(WDR)	1.013514	0.543716	1.864051	0.0699
DLOG(PX/CXD_T)	-0.592516	0.502592	-1.178920	0.2456
LOG(XTF(-1))-LOG(WDR(-1))+LOG(@MOVAV(PX(-1)/CXD_T(-1),4))	-0.164421	0.063984	-2.569743	0.0141
@SEAS(2)/100	97.28758	4.575396	21.26320	0.0000
@SEAS(3)/100	91.89048	3.990045	23.02994	0.0000
@SEAS(4)/100	-27.21487	7.688894	-3.539505	0.0011
D00Q4/100	35.72641	8.965960	3.984672	0.0003

R-squared	0.983962	Durbin-Watson stat	2.472257
Adjusted R-squared	0.981084	F-statistic	341.8252
S.E. of regression	0.081348	Prob(F-statistic)	0.000000

where:

CXD_T	Competitors' export prices (tourism sector)
PX	Export price deflator
WDR	World demand indicator
XTF	Real exports of tourism
D00Q4	Dummy variable: 1 in 2000Q4, 0 otherwise



A7. Non-Tourism Exports

The long-run equilibrium condition for non-tourism exports depends on world demand and price competitiveness on the export side. The elasticity of real non-tourism exports with respect to world demand and to price competitiveness is restricted to one, on the basis of statistical tests. In the short run non-tourism exports are driven by world demand and to a lesser extent by price competitiveness. Note that responsiveness is less than that for tourism.

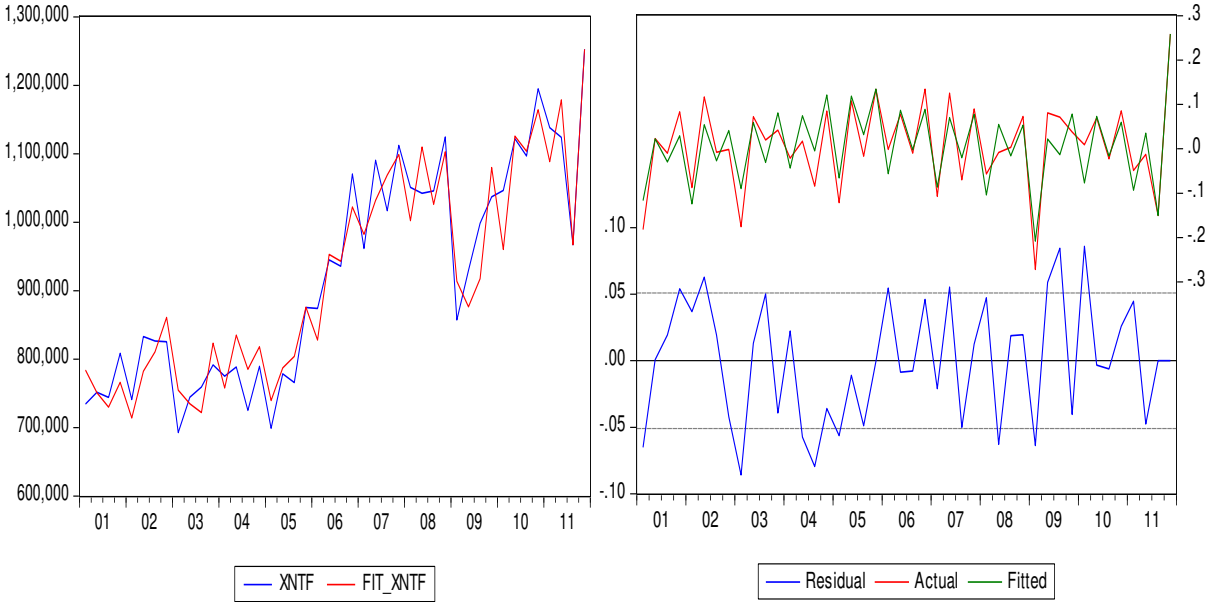
Dependent Variable: DLOG(XNTF)
Sample: 2001Q1 2011Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.120957	0.910350	2.329826	0.0257
DLOG(@MOVAV(WDR,2))	0.866028	0.399376	2.168454	0.0370
DLOG(PX/CXD)	-0.421320	0.310597	-1.356485	0.1836
LOG(XNTF(-1))-LOG(WDR(-1))+LOG(@MOVAV(PX(-1)/CXD(-1),4))	-0.243987	0.100274	-2.433207	0.0202
@SEAS(2)/100	11.31628	2.740989	4.128538	0.0002
@SEAS(3)/100	6.358251	2.444243	2.601317	0.0135
@SEAS(4)/100	14.54343	3.710470	3.919565	0.0004
D11Q3/100	-11.49686	5.392227	-2.132117	0.0401
D11Q4/100	14.68613	5.584962	2.629586	0.0126

R-squared	0.785247	Durbin-Watson stat	2.006782
Adjusted R-squared	0.736161	F-statistic	15.99726
S.E. of regression	0.050899	Prob(F-statistic)	0.000000

where:

CXD	Competitors' export prices
PX	Export price deflator
WDR	World demand indicator
XNTF	Real exports of non-tourism services and of goods
D11Q3	Dummy variable: 1 in 2011Q3, 0 otherwise
D11Q4	Dummy variable: 1 in 2011Q4, 0 otherwise



A8. Imports

In the absence of import content estimates provided by updated Input-Output tables, an import demand indicator based on a regression linking imports to exports, consumption and private non-dwelling investment was constructed. Real imports are affected both in the short run and long run by this demand indicator. By definition, the long-run elasticity of the import demand indicator is set to unity.

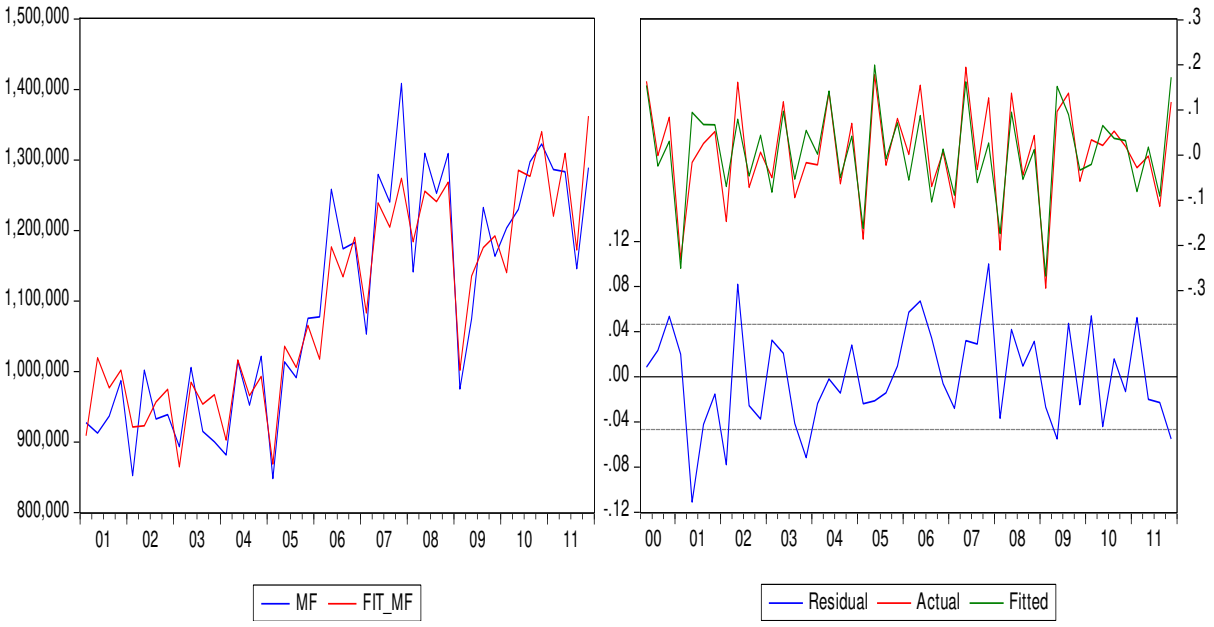
Dependent Variable: DLOG(MF)
Sample (adjusted): 2000Q2 2011Q4
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.660369	0.482057	-5.518782	0.0000
DLOG(MFDEM)	0.994618	0.151187	6.578734	0.0000
LOG(MF(-1)/MFDEM(-1))	-0.876027	0.158285	-5.534476	0.0000
@SEAS(2)	0.024068	0.036332	0.662442	0.5114
@SEAS(3)	-0.069918	0.033584	-2.081853	0.0436
@SEAS(4)	0.005944	0.025814	0.230269	0.8190

R-squared	0.848156	Durbin-Watson stat	1.976843
Adjusted R-squared	0.829639	F-statistic	45.80285
S.E. of regression	0.046541	Prob(F-statistic)	0.000000

where:

MF	Real imports of goods and services
MFDEM	Import demand indicator



Wage-Price Block

A9. Private Wage

The long-run condition for private wages is derived from the first order condition of a profit maximising firm. Thus, nominal private wages are set to increase proportionally with both private labour productivity and prices. The short-run dynamics are driven by the unemployment gap, private productivity and consumer prices.

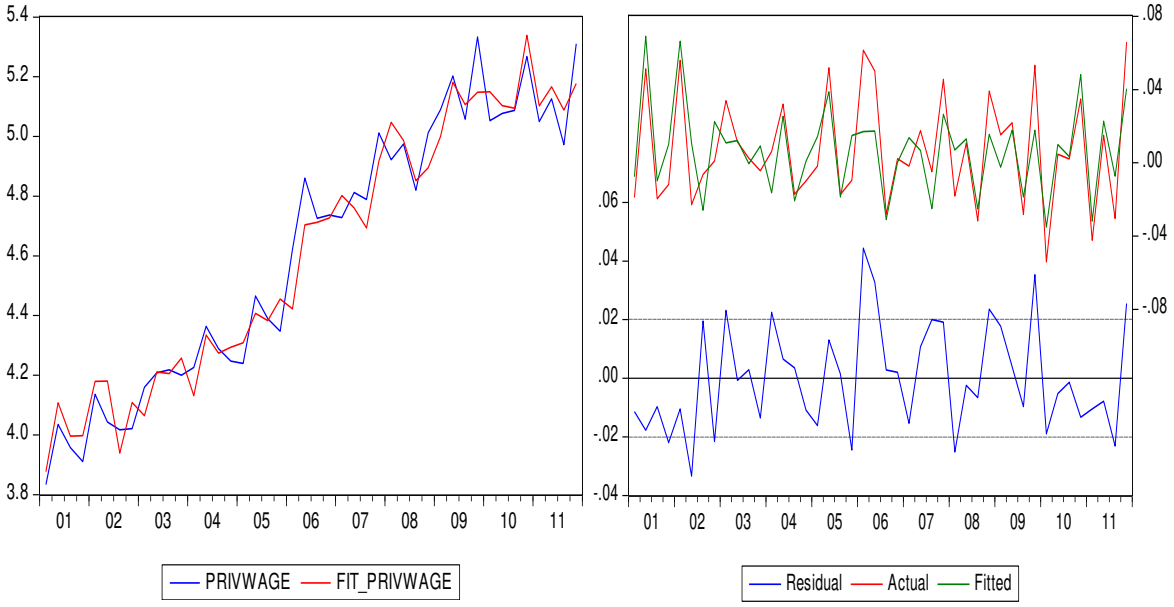
Dependent Variable: DLOG(PRIVWAGE)
Sample (adjusted): 2001Q1 2011Q4
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.423698	0.493091	-2.887293	0.0065
D(URBGAP(-2))/100	-0.586393	0.629540	-0.931463	0.3578
DLOG(PRIVPRODF)	0.537878	0.113740	4.729017	0.0000
DLOG(PCN(-1))	0.549218	0.313376	1.752586	0.0882
LOG(PRIVWAGE(-1))+LOG(@MOVAV(PCN(-1),4))-LOG(@MOVAV(PRIVPRODF(-1),4))	-0.270817	0.091045	-2.974533	0.0052
@SEAS(2)/100	-4.804323	1.784799	-2.691800	0.0107
@SEAS(3)/100	-9.138111	1.905754	-4.795012	0.0000
@SEAS(4)/100	-2.672412	1.364943	-1.957893	0.0580

R-squared	0.628655	Durbin-Watson stat	2.085191
Adjusted R-squared	0.556449	F-statistic	8.706398
S.E. of regression	0.020109	Prob(F-statistic)	0.000003

where:

PCN	Consumption price deflator
PRIVPRODF	Private sector productivity
PRIVWAGE	Private sector wages
URBGAP	Unemployment Gap



A10. Consumption Deflator

In the long run, the consumption deflator is determined by import prices and domestic costs (unit labour costs). The long-run elasticities are restricted to add up to one, thereby ensuring a stable profit margin. The short-run dynamics of the consumption deflator are driven by its lag, the output gap, foreign prices and the nominal effective exchange rate.

Dependent Variable: DLOG(PCN)
Sample: 2001Q1 2011Q4
Included observations: 44

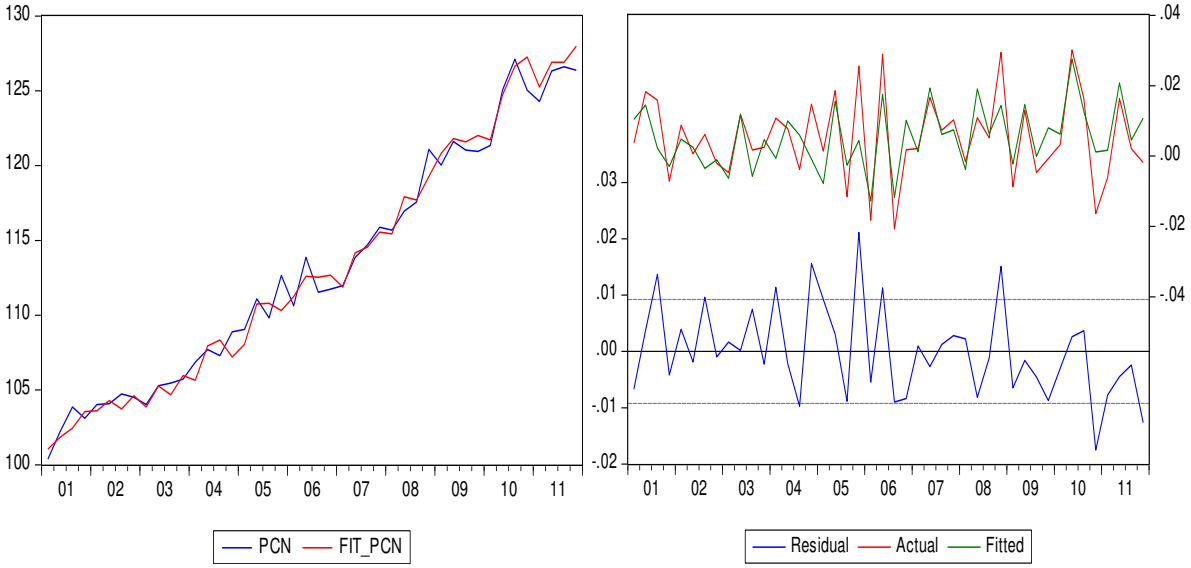
	Coefficient	Std. Error	t-Statistic	Prob.
C	0.965207	0.344377	2.802763	0.0083
DLOG(PCN(-2))	0.264546	0.142493	1.856556	0.0721
DLOG(GDPF(-3)/GDPFPO(-3))	0.096463	0.063505	1.518989	0.1380
DLOG(CMDFOR(-1))	0.318780	0.184697	1.725963	0.0934
DLOG(EENM(-1)	0.395118	0.214802	1.839453	0.0746
LOG(PCN(-1))	-0.359048	0.105449	-3.404953	0.0017
LOG(@MOVAV(PM(-1),4))	0.490027	0.082395	5.947286	0.0000
LOG(@MOVAV(ULC(-1),4))*	0.509973			
@SEAS(2)/100	1.291121	0.405443	3.184469	0.0031
@SEAS(3)/100	0.843287	0.561543	1.501732	0.1424
@SEAS(4)/100	1.189573	0.942629	1.261973	0.2155

R-squared	0.544365	Durbin-Watson stat	2.222416
Adjusted R-squared	0.423756	F-statistic	4.513462
S.E. of regression	0.009210	Prob(F-statistic)	0.000592

*Implied by long run restriction

where:

CMDFOR	Index of price inflation in competitor countries
EENM	Effective exchange rate
GDPF	Real GDP
GDPFPO	Potential GDP
PCN	Consumption price deflator
PM	Import price deflator



A11. Investment Deflator

In the long run, the investment deflator depends proportionally on import prices. The short-run relation also allows for a linear time trend which starts from the first quarter of 2006 and captures the statistical break evident in the investment deflator series from 2006 onwards. Otherwise, in the short run the investment deflator is driven by the import deflator.

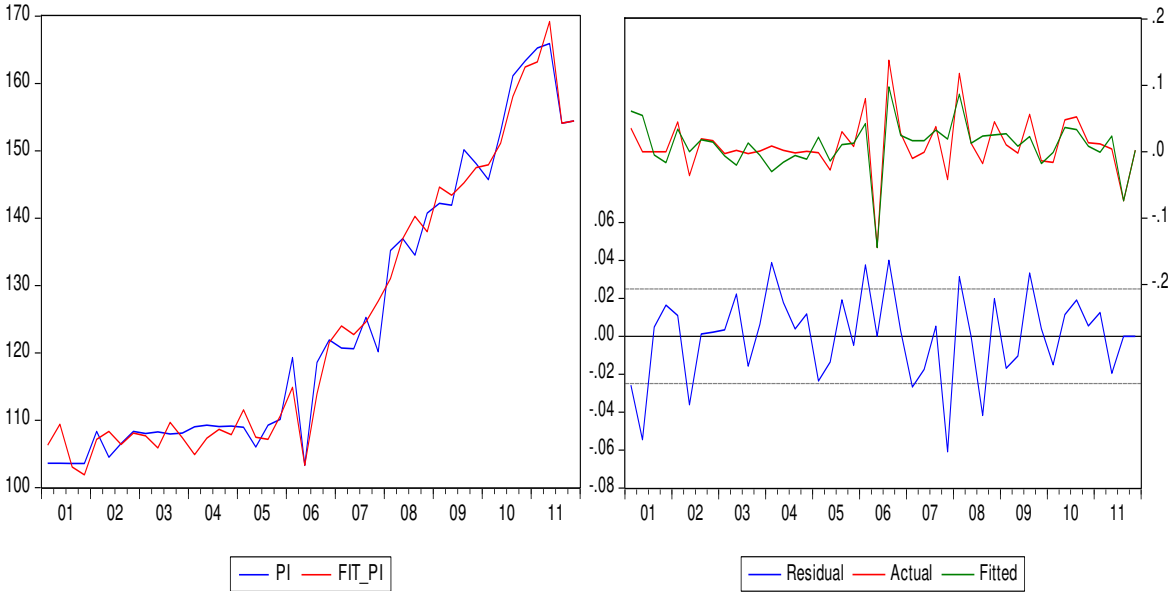
Dependent Variable: DLOG(PI)
Sample: 2001Q1 2011Q4
Included observations: 44

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.064592	0.011092	5.823120	0.0000
DLOG(PM(-1))	0.689645	0.135016	5.107885	0.0000
LOG(PI(-1)/PM(-1))	-0.571370	0.106745	-5.352664	0.0000
@TREND06Q1/100	0.639215	0.126805	5.040910	0.0000
D06Q2/100	-12.19276	2.591659	-4.704617	0.0000
D11Q3/100	-12.04803	2.698213	-4.465190	0.0001
D11Q4/100	-5.010257	3.010967	-1.664002	0.1046

R-squared	0.726828	Durbin-Watson stat	2.140545
Adjusted R-squared	0.682530	F-statistic	16.40764
S.E. of regression	0.024928	Prob(F-statistic)	0.000000

where:

PI	Investment deflator
PM	Import deflator
TREND06Q1	Time trend starting from 2006Q1
D06Q2	Dummy: 1 in 2006Q2, 0 otherwise
D11Q3	Dummy: 1 in 2011Q3, 0 otherwise
D11Q4	Dummy: 1 in 2011Q4, 0 otherwise



A12. Export Deflator

Similar to the personal consumption deflator, the export deflator is determined in the long run by import prices – measured by the import deflator – and domestic costs – measured by the unit labour costs. The long-run elasticities are restricted to add up to one, ensuring a stable profit margin. In the short run, the export deflator is solely driven by imported inflation.

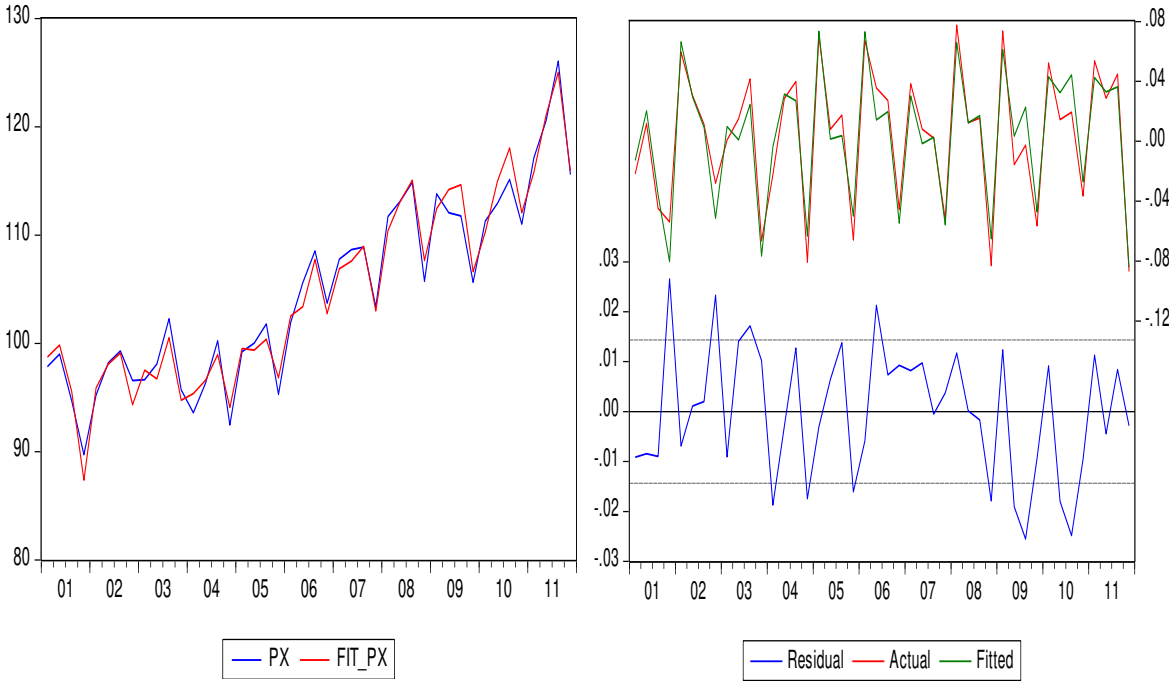
Dependent Variable: DLOG(PX)
Sample: 2001Q1 2011Q4
Included observations: 44

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.411654	0.318959	1.290618	0.2051
DLOG(PM)	0.626740	0.085310	7.346597	0.0000
LOG(PX(-1))	-0.676109	0.133582	-5.061389	0.0000
LOG(PM(-1))	0.885951	0.091692	9.662282	0.0000
LOG(@MOVAV(ULC(-1),4))	0.114049	0.091692	1.243828	0.2216
@SEAS(2)/100	0.527009	0.736045	0.716002	0.4786
@SEAS(3)/100	0.809256	0.862972	0.937755	0.3546
@SEAS(4)/100	-5.154949	0.957092	-5.386051	0.0000
D01/100	-0.013631	0.010498	-1.298425	0.2024

R-squared	0.916707	Durbin-Watson stat	1.919002
Adjusted R-squared	0.900511	F-statistic	56.60130
S.E. of regression	0.014346	Prob(F-statistic)	0.000000

where:

PM	Import deflator
PX	Export deflator
ULC	Unit labour costs
D01	Dummy: 1 in 2001Q1-2001Q4, 0 otherwise



A13. Import Deflator

Both the equilibrium level and the dynamics of the import deflator depend on Malta's trading partners' export prices. This variable is a weighted average of the export prices of trading partners, with weights reflecting each country's relative share in total Maltese imports.

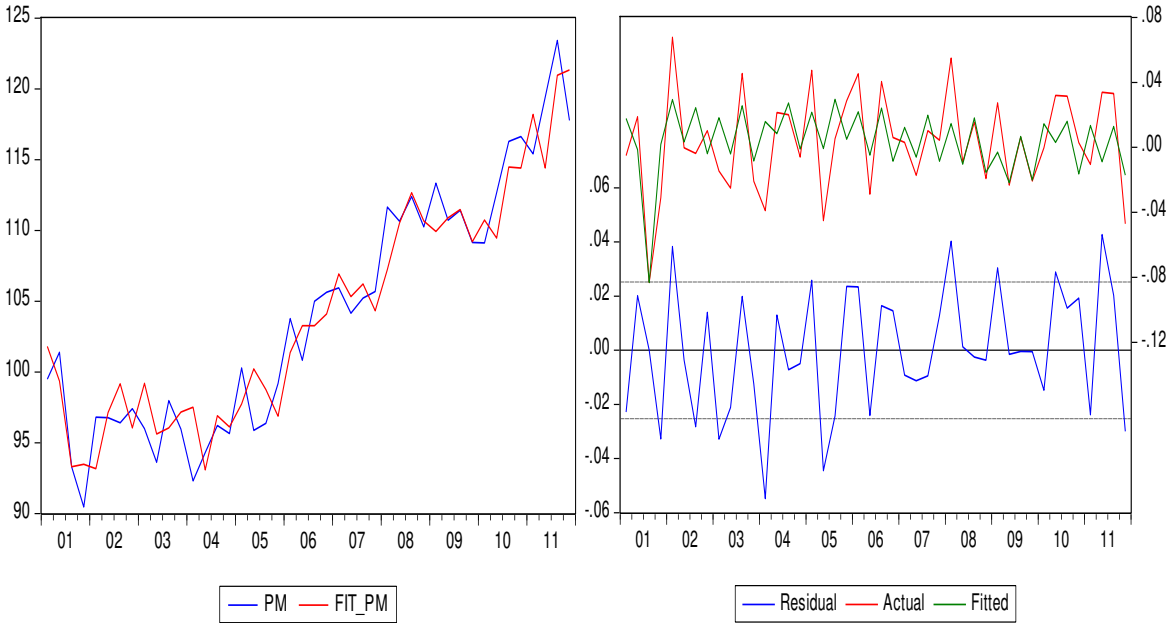
Dependent Variable: DLOG(PM)
Sample: 2001Q1 2011Q4
Included observations: 44

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016768	0.007639	2.195144	0.0345
DLOG(CMD)	0.375134	0.365379	1.026698	0.3112
LOG(PM(-1)/CMD(-1))	-0.143067	0.077674	-1.841891	0.0735
@SEAS(2)/100	-1.874029	1.085258	-1.726805	0.0925
@SEAS(3)/100	0.367558	1.119239	0.328400	0.7445
@SEAS(4)/100	-2.197805	1.084392	-2.026763	0.0499
D01Q3/100	-10.21972	2.660668	-3.841035	0.0005

R-squared	0.414680	Durbin-Watson stat	2.289518
Adjusted R-squared	0.319763	F-statistic	4.368882
S.E. of regression	0.025257	Prob(F-statistic)	0.001974

where:

CMD	Competitors' import prices
PM	Import deflator
D01Q3	Dummy: 1 in 2001Q3, 0 otherwise



A14. House Prices

In the long run, house prices are driven by disposable income per capita. So as to ensure the affordability of house prices, their long-run elasticity with respect to disposable income per capita is restricted to one. The short-run dynamics are affected by mortgages, and disposable income per capita.

Dependent Variable: DLOG(PIH)
Sample: 2002Q1 2011Q4
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.546186	0.206967	2.639003	0.0129
DLOG(HC(-1))	0.921738	0.425665	2.165407	0.0382
DLOG(YPD(-1)/POP(-1))	0.540132	0.346512	1.558768	0.1292
LOG(PIH(-1))-LOG(YPD(-1)/POP(-1))	-0.134150	0.050464	-2.658338	0.0123
@SEAS(2)/100	1.599824	1.666641	0.959909	0.3445
@SEAS(3)/100	-0.059360	1.554577	-0.038184	0.9698
@SEAS(4)/100	0.350187	1.925901	0.181830	0.8569
D02Q2/100	-13.42569	3.902674	-3.440126	0.0017
D03Q3/100	13.42773	3.930330	3.416439	0.0018

R-squared	0.568703	Durbin-Watson stat	1.754599
Adjusted R-squared	0.457401	F-statistic	5.109536
S.E. of regression	0.033745	Prob(F-statistic)	0.000411

where:

HC	Bank lending for mortgages
PIH	House price index
POP	Population
YPD	Disposable income
D02Q2	Dummy: 1 in 2002Q2, 0 otherwise
D03Q3	Dummy: 1 in 2003Q3, 0 otherwise

Financial Block

A15. Consumer and Other Credit

In the long run real consumer and other credit is linearly dependent on real consumption. Over the short run it is influenced by its own lag, real consumption and real interest rates on consumer credit.

Dependent Variable: DLOG(CCOCF)
Sample: 2002Q1 2011Q4
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.256010	0.077494	-3.303633	0.0023
DLOG(CNF)	0.370671	0.101359	3.657015	0.0009
DLOG(CCOCF(-2))	0.291752	0.132720	2.198255	0.0348
D(CCOCFRAT/100-@MOVAV(@PCY(PCN)/100,4))	-1.418808	0.662965	-2.140095	0.0396
LOG(CCOCF(-1)/CNF(-1))	-0.325442	0.093403	-3.484285	0.0014
@TREND/100	0.430814	0.132318	3.255898	0.0026

R-squared	0.427651	Durbin-Watson stat	1.740043
Adjusted R-squared	0.343482	F-statistic	5.080865
S.E. of regression	0.026904	Prob(F-statistic)	0.001388

where:

CCOCF	Bank lending for consumer credit and other credit (deflated by consumption deflator)
CCOCFRAT	Bank lending rate for consumer credit and other credit
CNF	Real private consumption

A16. Housing Credit

Real housing credit in the long run depends linearly on real house prices and the real interest rate on mortgages. Its short-run dynamics are driven by real disposable income and real house prices.

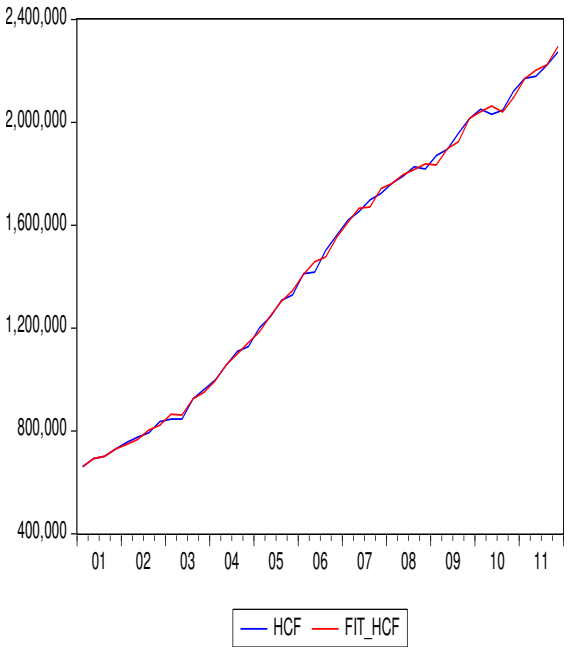
Dependent Variable: DLOG(HCF)
Sample: 2002Q1 2011Q4
Included observations: 40

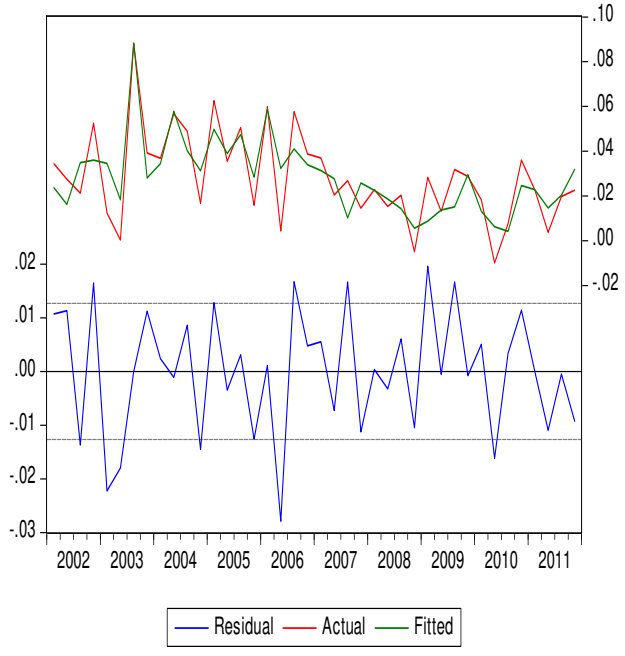
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.301863	0.437046	2.978776	0.0054
DLOG(PIH/PCN)	0.255307	0.061613	4.143732	0.0002
DLOG(YPD/PCN)	0.293013	0.098325	2.980037	0.0054
LOG(HCF(-1))-LOG(PIH(-1)/PCN(-1))	-0.094303	0.032825	-2.872893	0.0071
@MOVAV((HCRAT(-1)-@PCY(PCN(-1)))/100,4)	-0.362570	0.226435	-1.601211	0.1189
@TREND/100	0.175457	0.087640	2.002011	0.0536
D03Q3/100	4.300078	1.712758	2.510616	0.0171

R-squared	0.668715	Durbin-Watson stat	2.636531
Adjusted R-squared	0.608482	F-statistic	11.10203
S.E. of regression	0.012675	Prob(F-statistic)	0.000001

where:

HCF	Bank lending for mortgages (deflated by consumption deflator)
PCN	Consumption deflator
PIH	House price index
HCRAT	Bank lending rate for house mortgages
D03Q3	Dummy: 1 in 2003Q3, 0 otherwise





A17. Lending Rate to Non-Financial Corporations

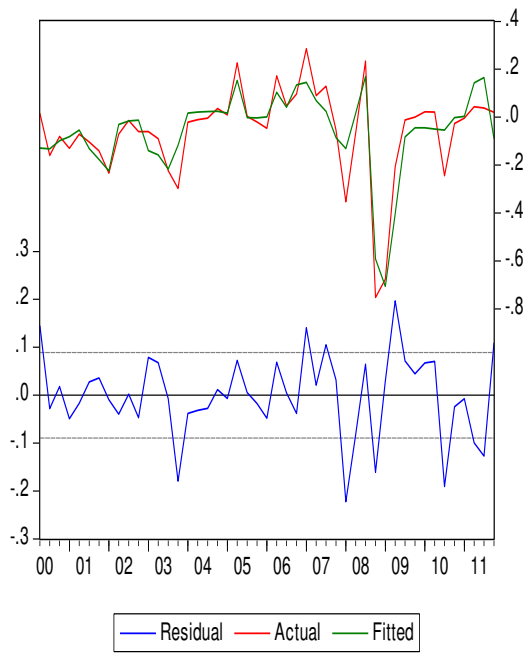
The model contains three different bank lending rates, modelled through a simple interest rate pass-through approach. In all three cases, lending rates are dependent both in the short run and long run on a benchmark rate, in this case the ECB policy rate. The long-run coefficient shows the equilibrium pass-through, while the short-run coefficients show the impact pass-through.

Dependent Variable: D(NFCLENDRAT)
Sample (adjusted): 2000Q2 2011Q4
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.880287	0.311330	2.827506	0.0071
D(POLICYRAT)	0.556765	0.043847	12.69789	0.0000
NFCLENDRAT(-1)	-0.213413	0.076355	-2.795005	0.0077
POLICYRAT(-1)	0.125301	0.049703	2.521002	0.0155

R-squared	0.794653	Durbin-Watson stat	1.788905
Adjusted R-squared	0.780327	F-statistic	55.46729
S.E. of regression	0.089083	Prob(F-statistic)	0.000000

where:
NFCLENDRAT Bank lending rate to non-financial corporations
POLICYRAT Policy rate set by European Central Bank



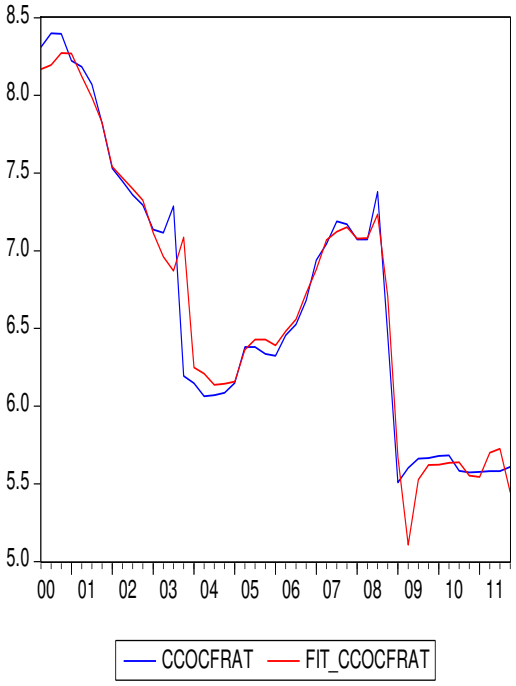
A18. Lending Rate on Consumer and Other Credit

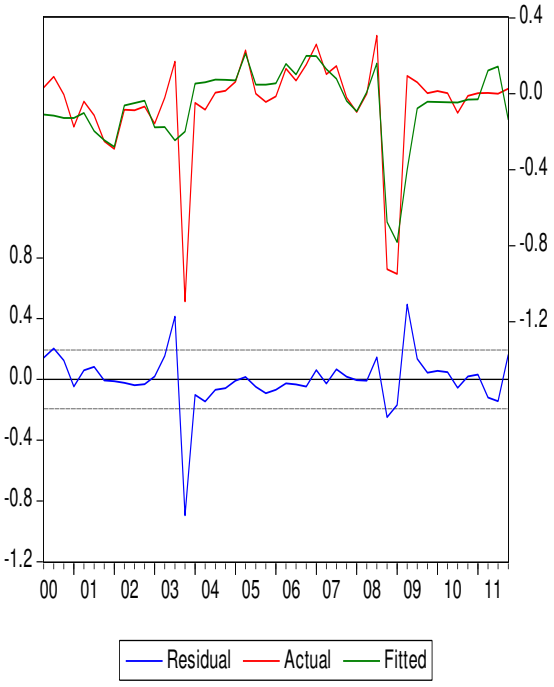
Dependent Variable: D(CCOCFRAT)
Sample (adjusted): 2000Q2 2011Q4
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.736536	0.355882	2.069606	0.0445
D(POLICYRAT)	0.607846	0.093976	6.468067	0.0000
CCOCFRAT(-1)	-0.153216	0.074716	-2.050636	0.0464
POLICYRAT(-1)	0.088984	0.053674	1.657841	0.1046

R-squared	0.529570	Durbin-Watson stat	2.140948
Adjusted R-squared	0.496750	F-statistic	16.13526
S.E. of regression	0.193184	Prob(F-statistic)	0.000000

where:
CCOCFRAT Bank lending rate for consumer credit and other credit
POLICYRAT Policy rate set by European Central Bank





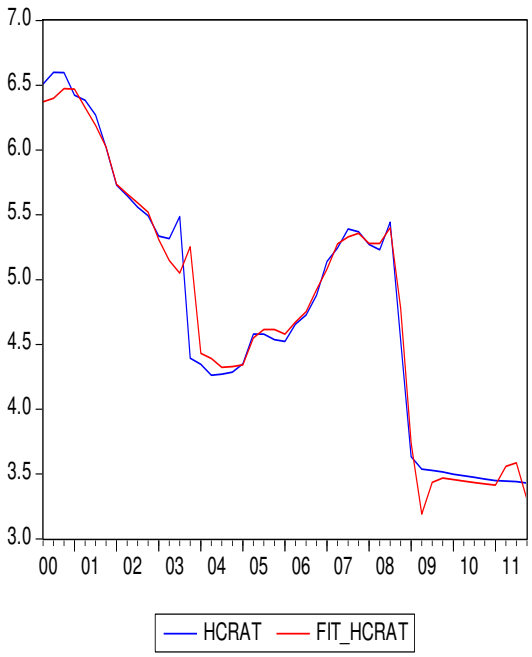
A19. Lending Rate on Housing Credit

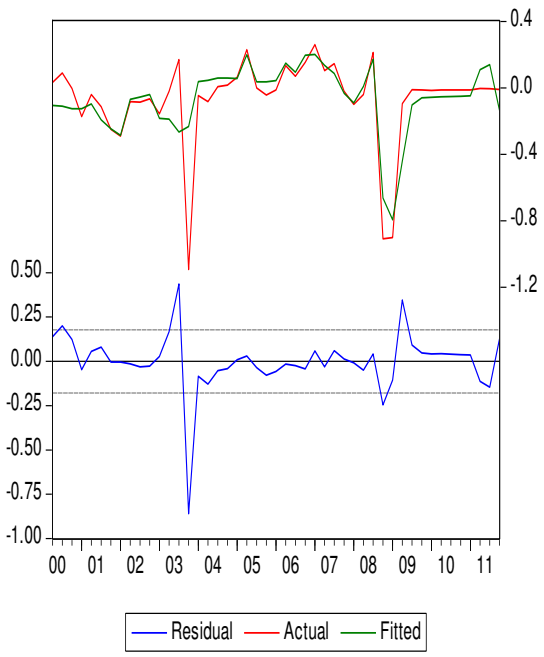
Dependent Variable: D(HCRAT)
Sample (adjusted): 2000Q2 2011Q4
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.421904	0.204017	2.067989	0.0447
D(POLICYRAT)	0.621151	0.086572	7.174984	0.0000
HCRAT(-1)	-0.171088	0.077448	-2.209079	0.0325
POLICYRAT(-1)	0.122296	0.061490	1.988874	0.0531

R-squared	0.572444	Durbin-Watson stat	2.177119
Adjusted R-squared	0.542614	F-statistic	19.19053
S.E. of regression	0.178112	Prob(F-statistic)	0.000000

where:
HCRAT Bank lending rate for mortgages
POLICYRAT Policy rate set by European Central Bank





APPENDIX B: SIMULATIONS

B1. Monetary Policy Shock

Impact of Monetary Policy Shock on Main Macroeconomic Variables (percentage deviation from baseline; deviations in trade balance and unemployment rate in p.p.)

	Year 1	Year 2	Year 3
ECONOMIC ACTIVITY			
GDP	-0.01	-0.03	-0.06
Consumption	-0.01	-0.07	-0.13
GFCF	-0.07	-0.28	-0.44
Exports	-0.01	-0.02	-0.02
Imports	-0.02	-0.08	-0.11
PRICES			
HICP	-0.02	-0.02	-0.03
GDP deflator	-0.02	-0.04	-0.07
LABOUR MARKET			
Unemployment rate	0.00	0.01	0.01
Total employment	0.00	-0.02	-0.05
Unit labour costs	0.00	-0.02	-0.03
Compensation per employee	-0.01	-0.03	-0.04
Labour productivity	-0.01	-0.01	-0.01

B2. Oil Price Shock

Impact of Oil Price Shock on Main Macroeconomic Variables (percentage deviation from baseline; deviations in trade balance and unemployment rate in p.p.)

	Year 1	Year 2	Year 3
ECONOMIC ACTIVITY			
GDP	-0.10	-0.29	-0.52
Consumption	-0.43	-0.46	-0.74
GFCF	-0.05	-0.31	-0.49
Exports	-0.13	-0.46	-0.85
Imports	-0.32	-0.55	-0.97
PRICES			
HICP	0.62	0.95	1.40
GDP deflator	0.39	0.90	1.38
LABOUR MARKET			
Unemployment rate	0.01	0.01	0.03
Total employment	-0.02	-0.02	-0.12
Unit labour costs	0.29	0.80	1.20
Compensation per employee	0.21	0.52	0.79
Labour productivity	-0.08	-0.27	-0.40

B3. Exchange Rate Shock

Impact of Exchange Rate Shock on Main Macroeconomic Variables (percentage deviation from baseline; deviations in trade balance and unemployment rate in p.p.)

	Year 1	Year 2	Year 3
ECONOMIC ACTIVITY			
GDP	-0.13	-0.20	-0.20
Consumption	0.13	-0.07	-0.09
GFCF	-0.16	-0.23	-0.28
Exports	-0.26	-0.36	-0.34
Imports	-0.10	-0.29	-0.29
PRICES			
HICP	-0.33	-0.44	-0.63
GDP deflator	-0.20	-0.41	-0.62
LABOUR MARKET			
Unemployment rate	0.01	0.04	0.06
Total employment	-0.04	-0.14	-0.21
Unit labour costs	-0.10	-0.35	-0.54
Compensation per employee	-0.19	-0.40	-0.53
Labour productivity	-0.09	-0.06	0.01

B4. Foreign Demand Shock

Impact of Foreign Demand Shock on Main Macroeconomic Variables (percentage deviation from baseline; deviations in trade balance and unemployment rate in p.p.)

	Year 1	Year 2	Year 3
ECONOMIC ACTIVITY			
GDP	0.46	0.55	0.54
Consumption	0.23	0.53	0.56
GFCF	0.28	0.78	0.60
Exports	0.84	0.92	0.87
Imports	0.68	0.94	0.89
PRICES			
HICP	0.04	0.04	0.10
GDP deflator	0.00	0.05	0.12
LABOUR MARKET			
Unemployment rate	-0.04	-0.09	-0.11
Total employment	0.12	0.34	0.43
Unit labour costs	-0.15	0.06	0.14
Compensation per employee	0.20	0.28	0.25
Labour productivity	0.35	0.22	0.11

APPENDIX C: LIST OF EXOGENOUS VARIABLES

The model contains the following exogenous variables:

Social security payments

Social security transfers in kind

Income tax paid by households

National insurance contributions paid by employees

Other national insurance contributions

Imputed national insurance contributions

National insurance contributions paid by employers

Permits for terraced houses

Permits for maisonettes

Permits for apartments

VIX index

Nominal government investment

Central bank policy rate

Nominal government consumption

Government consumption deflator

World demand

National insurance contributions paid by the government

Government wage bill

Government employees

Share of full timers in total employment

NAIRU

Average government wage

Nominal effective exchange rate on the import side

Depreciation on private non-dwelling investment

Maltese population

Share of working age population

Nominal effective exchange rate on the export side

Euro-dollar exchange rate

Price of Brent crude oil in dollars

Competitors' prices on the import side (excluding exchange rate effects)

Competitors' prices on the export side (excluding exchange rate effects)

Competitors' prices on the tourism side

International food prices