A Structural Macro-Econometric Model of the Maltese Economy

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Version 2.0

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Abstract

This paper presents an update of the structural macro-econometric model of the Maltese economy developed by the Central Bank of Malta in 2012-2013 and published in Grech et al. (2013). Since then, there have been five key advancements. Although the updated model remains similar in spirit to the previous version, it now contains a detailed fiscal block, a richer financial block, enhanced macro-financial linkages and a price block that is more responsive to domestic economic activity. In addition, it has been re-estimated using more recent data. Simulation results for five standard shocks illustrate the properties of the updated model and suggest that its mechanics are plausible from both a theoretical and empirical standpoint.

JEL classification: C3, C5, E1, E2.

Keywords: Macro-econometric modelling, Malta.

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1. Introduction

This paper presents an update of the structural macro-econometric model of the Maltese economy developed by the Central Bank of Malta in 2012-2013 and published in Grech et al. (2013). The updated model remains similar in spirit to the previous version. It is still a traditional structural model built around the neo-classical synthesis, which asserts that output is driven by supply in the long run (classical) but, as a result of the sluggish adjustment of quantities and prices, there are deviations from this long-run equilibrium in the short term and output is determined by the components of aggregate demand (Keynesian). It remains a relatively small-scale model with behavioural equations estimated in error-correction form on the basis of quarterly data. Economic agents are still assumed to have adaptive expectations. There have, however, been five key advancements.

First, a detailed fiscal block has been added, making a distinction between various public expenditure and revenue components. The incorporation of a fully-fledged macro-fiscal block allows for the full characterisation of the fiscal multipliers. Second, the financial block is now being modelled in more detail. An equation for bank credit to non-financial corporation, as well as two additional equations for non-performing loans that distinguish between households and non-financial corporations, have been added. Third, the links between the financial sector and the real economy – macro-financial linkages – have been strengthened, with a number of equations being revised to better incorporate self-reinforcing co-movements between economic activity, credit and asset prices. All these features are intended to embed sectoral financial accelerator mechanisms in the model, originating both from households and firms. Fourth, the price block has been revamped, in line with similar models in the literature, to make it more responsive to changes in domestic economic activity. Finally, the model's database has been updated until 2013Q4 and all equations have been re-estimated until 2012. To illustrate the properties of the updated model, the simulation results for five standard shocks are presented. They suggest that the mechanics of the updated model are plausible from both a theoretical and empirical standpoint.

These refinements have been made with three key uses in mind. First, they enhance our capacity to conduct simulations, and thus assess the impact of various shocks on the domestic economy, on two fronts; by capturing the impact of a broader range of variables (e.g. fiscal, financial, etc.), and by opening up channels (e.g. tax rates, interest rates, etc.) that allow for a wider range of shocks. Second, it can complement the Bank's current forecasting framework even further, particularly with regard to medium to long-term forecasts. The final motivation behind this research is that it deepens our understanding of how the domestic economy functions.

The rest of this paper is structured as follows. Section 2 gives an overview of the five key updates. In section three, a description of the model's separate blocks is provided, together with a more detailed account of the five main refinements. Section 4 explains the monetary policy transmission mechanisms in the model, while the simulation results are presented in section 5. Section 6 concludes.

2. Changes compared to CBM MacroModel v1.0

The main changes compared to Version 1 of the Central Bank of Malta's macro-econometric model (Grech et al, 2012) are the following:

Data and estimation: The model's database has been updated until 2013Q4 and all equations have been re-estimated until 2012.

Fiscal block: In the previous version, the fiscal block was largely exogenous and the impact of shocks on the main fiscal variables was calculated via a satellite model. In this version, a detailed fiscal block has been added, making a distinction between various public expenditure and revenue components. The incorporation of a fully-fledged macro-fiscal block allows for the full characterisation of the fiscal multipliers. A fiscal rule was introduced to stabilize the debt-to-GDP ratio in the long run.

Nominal block: The price block has been revamped to make it more responsive to changes in domestic economic activity. Similar to other MCM models (Fagan et al, 2001), a new equation has been added to model the GDP deflator directly, with the other deflators being computed as a weighted average of the GDP deflator and import prices, representing domestic and foreign price pressures, respectively. The inventory deflator is computed as an identity.

Financial block: In the previous version of the model, the financial block was very rudimentary. In this version, we have added a new equation for bank credit to non-financial corporations and two equations for banks' non-performing loans, making a distinction between the household sector and non-financial corporations. Other equations, like bank loans for consumers & other credit, have been substantially revised.

Enhanced macro-financial linkages: A number of equations have been revised to better incorporate self-reinforcing co-movements between economic activity, credit and asset prices. In this version, changes in interest rates exhibit a long-term impact on private consumption. Credit is included as an explanatory variable in the equations for private consumption, dwelling investment and non-dwelling private investment. The credit equations have been revised to better capture the impact of changes in economic activity and asset prices on the demand for bank loans. The inclusion of two equations focusing on bank asset quality – non-performing loans – and its interactions with bank credit ensures that loan developments reflect both demand and supply side influences. All these features are intended to embed sectoral financial accelerator mechanisms in the model, originating both from households and firms.

Overall, these changes have improved the fit of the model and, more importantly, its dynamic simulation properties.

3. An overview of the model

This section provides an overview of the model. The main objective is to highlight, in a non-technical way, the main features and channels of the model.

The updated model remains similar in spirit to the previous version.[2] It is still a traditional structural model built around the neoclassical synthesis. It consists of 179 equations, of which 25 are behavioural equations (see annex C). There are 230 variables; 179 of them are determined endogenously, while the remaining 51 are exogenous. Therefore, although the model has grown in size, it can still be classified as a relatively small-scale model. As in the previous version, most of the behavioural equations are estimated, rather than calibrated, in error-correction form, on the basis of seasonally-unadjusted quarterly data. Economic agents are assumed to have adaptive expectations, and thus the model remains a backward looking one. The model is now composed of five key blocks: (i) an aggregate supply block, (ii) an aggregate demand block, (iii) a price block, (iv) a fiscal block, and (v) a financial block.

3.1 Supply side

In the long run, 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. Trend employment is decomposed in three components; the working age population, the trend participation rate and the structural unemployment rate. The working age population and the structural unemployment rate are exogenously given, while the trend participation rate is computed as a four-quarter moving average of the participation rate. The other factor of production, capital, is unobservable and is assumed to equal

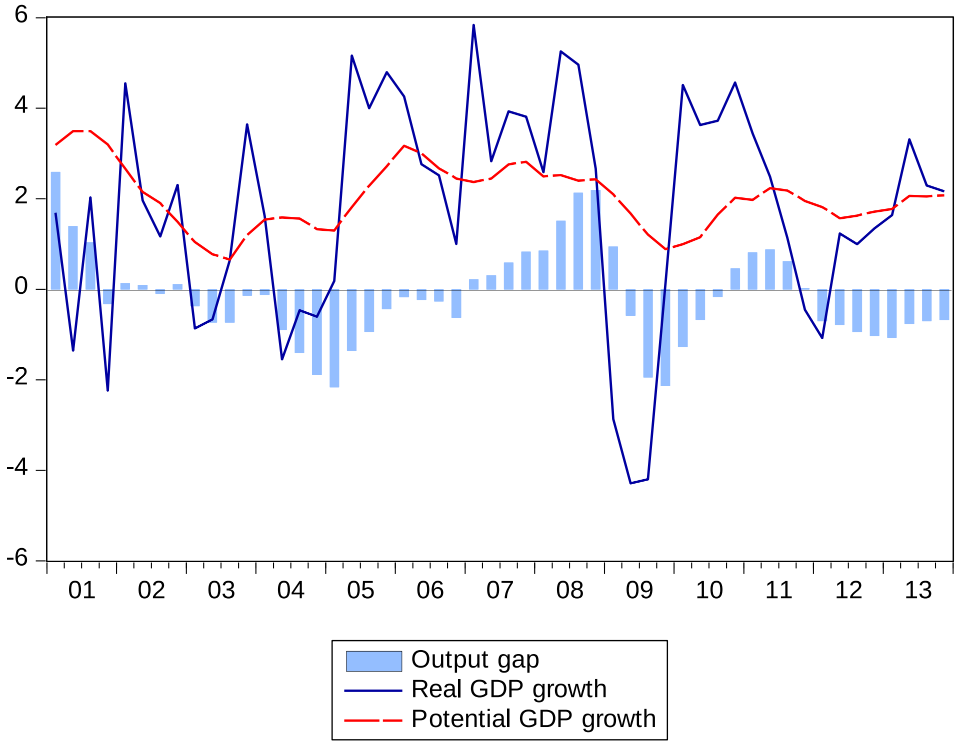
[2] For details, see Grech, O., Micallef, B., Rapa, N., Grech, A. G. and Gatt, W. (2013), "A Structural Macro-Econometric Model of the Maltese Economy", Working Paper No. 02/2013, Central Bank of Malta.

accumulated non-dwelling (public and private) investment after accounting for depreciation.[3] Total factor productivity (TFP) is derived as a smoothed (Solow) residual resulting from the imposition of constant returns to scale parameters on the production function. The share of labour in the production function is calibrated at 0.58, in line with the historical share of labour income (including the self-employed) in Gross Value Added.

In the short run, output is demand driven and may deviate from its potential level. These deviations are measured by then output gap, which serves to gradually bring output in line with its long-run equilibrium through adjustments in wages and prices. Chart 1 shows the development of potential output and actual GDP during the period 2000 – 2013 and the resulting output gap. Deviations from potential have been limited in duration and the economy has fluctuated around its time-varying potential during this decade.

Chart 1: Aggregate Demand and Supply

(percent, percent of potential output)



[3] Following Hall and Jones (1999), the initial capital stock is calculated as follows: $K_0 = I_0/(g+d)$ where I_0 = initial value of real non-dwelling investment, g = long-run average growth rate of non-dwelling investment and d = depreciation rate. The depreciation rate is exogenous and assumed to be 6% per annum.

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. Employment in the short run is determined by developments in real economic activity, whereas in the long run it grows in line with real GDP, while the elasticity with respect to the real wage and to trend TFP is negative, as expected a priori. Profit maximisation and constant-returns-to-scale imply a long-run relationship between the capital-output ratio and the user cost of capital. The latter is made up of the bank lending rate to non-financial corporations less the long-term rate of inflation, also allowing for depreciation. In the long run, labour supply moves with employment, with a unitary restriction, therefore ensuring a stable unemployment rate. In the short run, however, labour supply also depends on developments in real economic activity and real wages. The latter enter the labour supply specification with a positive sign, which implies that, according to Maltese data, the substitution effect – a positive effect on the labour supply from higher real wages due to the increase in the cost of leisure – dominates the income effect, which postulates that higher wages make leisure more affordable, eventually leading to a decline in the labour supply. The discouraged worker effect, that is, the adverse impact of unemployment on households' labour supply decisions, is not supported by Maltese data. For the accumulation of the capital stock, non-dwelling private investment depends on real GDP and the user cost of capital in the long run, each with unitary elasticity, in line with the Cobb-Douglas production function. Details on the short-run specification will be provided in the aggregate demand section.

3.2 Aggregate demand

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, tourism exports, exports of goods & non-tourism services and imports of goods & services. Real inventories are assumed to be a constant share of real GDP. Government consumption and investment are modelled in detail from the fiscal block.

The consumption function 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, real credit to households and the unemployment rate. The latter captures the influence of uncertainty on precautionary saving and, hence, consumption. The short-run coefficient of real disposable income, which in the literature is sometimes associated with liquidity constrained households, stands at 0.52. In the long run, real consumption is determined by real disposable income and real net wealth, with the sum of these two coefficients set to be equal to one, and by the real interest rate to households. Interest rates therefore affect private consumption both directly and indirectly through their effect on other variables, mainly credit and disposable income.

Since not all components of disposable income are published by the National Statistics Office, the Central Bank of Malta's Modelling and Research Office estimated self-employed income and investment income. 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 (HBS) and the EU Survey of Income and Living Conditions (SILC), were used to derive the required series.[4]

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

Real private non-dwelling investment depends on 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. 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. Another short-run determinant is bank credit to non-financial corporations, which is intended to capture credit market conditions for the corporate sector. Together with the equation for private consumption, this equation, through the user 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,

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[4] Further details on the Bank's measure of disposable income can be found in Grech, O. (2014), "A New Measure of Household Disposable Income for Malta", *Annual Report 2013*, Central Bank of Malta.

and real house prices. Government investment is assumed to remain a fixed share of total investment.

Public expenditure is the sum of public sector wages, public sector intermediate consumption, social benefits in kind and consumption of fixed capital (of the public sector), less sales.

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 are principally driven by world demand, though (relative) price competitiveness and bed capacity play 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 are less price-inelastic than tourism exports in the short run. Again, unitary elasticity was imposed in the long run. Compared with tourism exports, the short-term responsiveness to world demand is also less pronounced, possibly reflecting relatively more important supply constraints.

Real imports of goods and services depend on an import demand indicator in both the long run and the short run. The import demand indicator reflects the different import contents of the final demand components and is constructed using information from input-output tables.[5] 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.

[5] The import content of the individual demand components are the following: private consumption (55%), investment (65%), public consumption (20%) and exports (35%).

3.3 Price block

The price block comprises behavioural equations for the GDP deflator, the private consumption deflator, the investment deflator and two deflators for exports and imports of goods and services, respectively. We also include three technical equations for the Harmonized Index of Consumer Prices (HICP), which is linked to the deflator for private consumption equation, HICP Food and HICP Energy. In addition, a number of identities define various transformations of price variables, for instance, HICP excluding energy.

The long-run behaviour of the GDP deflator is similar to a theoretically-derived one from neoclassical behaviour in which monopolistically competitive firms maximize profits with respect to prices given technology and demand (Angelini et al, 2006). In this framework, optimal prices are equal to a constant mark-up over marginal costs, with the latter being proxied by unit labour costs. We also include an economy-wide indirect tax rate in the long run to capture the effect of indirect taxes, like VAT, on domestic prices. In the short run, the GDP deflator depends on its lagged values, representing inertia in the price setting process, foreign prices, changes in wages and the output gap. The latter variable captures the impact of demand pressures on prices, thereby augmenting the link between the real and the nominal side.

Import prices are modelled in accordance with a pricing-to-market model, which implies that in setting their prices, importers also take into consideration prevailing domestic factors, such as the degree of competition in domestic markets. In the long run, import prices set by Maltese importers are linked to foreign producer prices denoted in euros.

The other three deflators – consumption, export and investment prices – are modelled as a weighted average of the GDP deflator and the import price deflator in the long run. In the case of consumption prices, in the short run they also depend on changes in oil prices in euro terms, the unemployment gap and the effective exchange rate. The government deflator is assumed to grow in line with the GDP deflator, while the inventory deflator is computed as an identity so that the weighted sum of the individual price components add up to the GDP deflator.

3.4 Fiscal block

In constructing the fiscal block, the standard approach in the literature was followed.[6] Tables D1 and D2 in the appendices outline, respectively, how the revenue and expenditure sides of the fiscal block are modelled. The tables show that, at the highest level of disaggregation, there are 16 components on the revenue side and 11 categories on the expenditure side, which make the fiscal block one of medium scale.[7]

Most of these fiscal variables are modelled by multiplying an exogenous effective revenue or expenditure rate by a suitable macroeconomic base – a macroeconomic variable to which the fiscal variable is closely tied – where the effective rate is the ratio of the fiscal variable to the chosen base. Since the macroeconomic base is determined endogenously, the same applies to the fiscal variable. For example, VAT receipts are modelled using this approach, where an exogenous effective VAT rate is multiplied by a suitable base, namely nominal consumption, with the effective rate being the ratio of VAT receipts to the base.[8,9,10] Since nominal consumption is determined endogenously, the response of VAT receipts is also endogenous. Suitable bases were chosen by relying on both theory and empirics. In other words, the macroeconomic bases that were ultimately selected bear a strong relationship to the fiscal variable being modelled not only from a theoretical standpoint, but also from a statistical one borne out in the data.[11]

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6 For examples and descriptions of fiscal blocks within traditional structural macro-econometric models, see Fagan, G. and Morgan, J. (eds.), *Econometric Models of the Euro-Area Central Banks*, Edward Elgar, 2005 and Bank of England, *Economic Models at the Bank of England*, London: Bank of England, 2000.

7 In this context, a component at the highest level of disaggregation is not one that cannot be subdivided further, but rather one which is not decomposed to a greater degree in the model.

8 See ECB, *Government Finance Statistics Guide*, Frankfurt: ECB, August 2014, for definitions of fiscal variables.

9 In the absence of additional information, the effective rate is generally based on trends in the actual data.

10 Mathematically:
$VAT\ receipts = effective\ VAT\ rate * nominal\ consumption,$ i.e.
$VAT\ receipts = \frac{VAT\ receipts}{nominal\ consumption} * nominal\ consumption.$

11 Arguably, the only contentious base is that for direct taxes on corporations. From a theoretical point of view, this variable should move in line with gross operating surplus. However, this is not supported empirically, largely as a result of noise in the data. Consequently, nominal GDP was chosen as the base since the data suggest that this variable bears a stronger link with direct taxes on corporations and the choice can also be justified on theoretical grounds.

In cases when the "effective rate times base" approach was not deemed to be a suitable one, a different modelling strategy was employed. The fiscal variable was assumed to maintain its share in a broader fiscal aggregate, or was constructed via decomposition. For instance, a substantial portion of property income consists of profits earned by the Central Bank of Malta that were passed on to the Government. These profits are not closely tied to some macroeconomic variable and hence the "effective rate times base" approach would not be appropriate. Instead, this variable is assumed to maintain its share in government revenue. Alternatively, some variables were constructed through decomposition. Public sector compensation of employees, for example, is calculated by multiplying the number of government employees by the average wage in the public sector, and adding employers' national insurance contributions paid by the government and imputed national insurance contributions. At the highest level of disaggregation, the most significant revenue categories are VAT receipts, direct taxes on households and corporations, which together account for more than half of total revenue, whereas compensation of employees, pension benefits and intermediate consumption are the largest expenditure components, with a combined weight in total expenditure of more than 70%.

From these 16 components of government revenue and 11 categories of government expenditure, aggregates are produced through identities. For example, on the revenue side, direct taxes on households and corporations are added to generate direct taxes, while, on the expenditure side, the summation of pension benefits, unemployment benefits and other social benefits in cash produces social benefits in cash.

Charts 2 and 3 below provide a schematic representation of the revenue and expenditure sides, respectively. They display the fiscal block's structure, linkages within the fiscal block itself, and linkages which the block shares with the rest of the model. Variables enclosed in blue are endogenous, while those in red are exogenous. Identities are surrounded by black. Arrows indicate the direction of influence which, in some cases, runs in both directions. Starting from the revenue side, a decline in the exogenous direct tax rate on households, for instance, lowers direct taxes on households. This gives rise to a drop in direct taxes but also influences the rest of the model through an increase in disposable income, which largely affects private consumption. The decline in direct taxes leads to lower current revenue, in turn causing a decrease in total revenue. Turning to the expenditure side, an increase in the exogenous policy rate, for example, raises the government ten-year bond yield. This results in an increase in the interest rate on government debt which, in turn, brings about higher interest payments. The change in the latter raises current expenditure and thus total expenditure.

Besides government revenue and expenditure, and their main components, model users are likely to be interested in key fiscal variables, such as government consumption, the government balance, the government primary balance and government debt. These key fiscal variables can easily be computed since they are composed almost entirely of variables that emerge from the revenue side and the expenditure side.[12] Moreover, since the variables needed to compute these key fiscal variables are determined endogenously, the response of the latter is also endogenous. For example, since government consumption is equal to the summation of public sector compensation of employees, intermediate consumption, social benefits in kind and consumption of fixed capital, less sales, and, except for consumption of fixed capital, these components have an endogenous response, government consumption will also be determined in an endogenous manner.

In practice, governments are restricted by the inter-temporal government budget constraint, which implies that, for debt to be sustainable, the initial government debt and the interest accumulated over time have to eventually be paid through sufficiently large primary balances.[13] For this reason, the fiscal block includes a fiscal rule that is activated in long-run simulations to ensure some level of fiscal solvency. This is achieved by adjusting the direct tax rate on households to reach a target debt ratio with a threshold value of 60%.[14,15]

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[12] The only two variables that do not emerge from the revenue side or from the expenditure side are consumption of fixed capital and the deficit-debt adjustment. In this context, consumption of fixed capital refers to depreciation of public sector capital, while the deficit-debt adjustment, commonly referred to as the stock-flow adjustment, captures those transactions or factors that influence the outstanding debt but are not reflected in the primary balance. For further details on the deficit-debt adjustment, see Farrugia, J. and Grech, O., "Assessing the Sustainability of Maltese Government Debt", *Working Paper* No. 04/2013, Central Bank of Malta. In the model, both consumption of fixed capital and the deficit-debt adjustment are given an exogenous path.

[13] For further details on fiscal sustainability, see Farrugia, J. and Grech, O., "Assessing the Sustainability of Maltese Government Debt", *Working Paper* No. 04/2013, Central Bank of Malta, and references therein.

[14] See Mitchell, P., Sault, J. and Wallis, K., "Fiscal Policy Rules in Macroeconomic Models: Principles and Practice", *Economic Modelling*, 17(2), 2000, pp. 171-193, for a comparison of fiscal rules.

[15] For further details on the fiscal block, particularly the data used, see Grech, O. (2014), "A Fiscal Block for the Bank's Structural Macro-Econometric Model of the Maltese Economy", *Quarterly Review*, 47(2), Central Bank of Malta.

3.5 Financial block

The financial block models asset prices, interest rates, credit and non-performing loans. As in Hammersland and Traee (2012), this block is designed to generate the pro-cyclical and self-reinforcing co-movements between interest rates, credit, asset prices and the real economy. The interaction of these variables reinforces financial accelerator mechanisms in a macroeconomic model framework.

The model distinguishes between the policy interest rate, which is exogenously set by the European Central Bank, and four different long-term interest rates: the lending rate to non-financial corporations, the interest rate on housing credit, the interest rate on consumer & other credit and the interest rate on the 10-year government bond yield. There is imperfect pass-through from the policy rate to these retail and long-term interest rates. Estimates of long run pass-through for the four interest rates present in the model range between 50% and 70%.

We make a distinction between three types of credit – consumer & other credit, housing credit and bank lending to non-financial corporations – each of which is modelled through a behavioural equation. In the short run, real credit to households for consumption purposes depends on positively on real private consumption and house prices and negatively on the real interest rate charged by banks to households for this type of credit. In the long run, consumer credit is a function of real private consumption and the real interest rate. The short-run specification of real bank credit to households for mortgages depends positively on real disposable income and house prices. On the contrary, a deterioration in banks' asset quality, proxied by an increase in sector specific non-performing loans, has an adverse impact on credit growth. Loan developments, therefore, reflect influences from both the demand and supply side. In the long run, housing credit depends positively on house prices and negatively on the real interest rate. In the model, the presence of a financial accelerator from the household side is reinforced by the interaction between household credit, private consumption and house prices.

Developments in loans to non-financial corporations are in the short run affected positively by growth in real activity and negatively by sector specific interest rates and non-performing loans. In the long run, real bank credit to non-financial corporations moves proportionately with developments in real economic activity. Since growth in credit to non-financial corporations spurs output, due to its effect on non-dwelling private investment, the model incorporates a financial accelerator mechanism originating from the firm side. This mechanism comes in addition to the one documented for households.

Nominal house price growth is in the short run affected positively by developments in household credit and per capita disposable income and negatively by changes in the unemployment rate. The latter is intended to capture the impact of domestic demand on the real estate market. In the long run, property prices are determined by per capita disposable income. While the impact of interest rates on house prices was not statistically significant, changes in interest rates still exert an indirect impact on property prices through their effects on labour market variables and bank credit to households for mortgages.

Bank asset quality is captured by two equations for non-performing loans, with separate specifications for households and non-financial corporations.[16] Households' non-performing loans, specified as a share of household bank loans, depend on real disposable income, the unemployment rate, real house prices and the real interest rate for households. As regards firms' non-performing loans, there is no homogeneity between problem loans and debt in the short run, only in the long run. Non-performing loans for the non-financial corporate sector depend on real economic activity, the real interest rate to firms, the unemployment rate, the level of debt and real investment in housing. The latter variable captures the importance of construction and real estate in explaining developments in banks' non-performing loans in recent years.

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[16] Non-performing loans are defined as loans which are doubtful and/or irrecoverable. According to Banking Rule BR/09, doubtful loans are credit facilities whose capital and/or interest are overdue by 90 days and over. Such loans also include facilities which, irrespective of the repayment not being overdue by 90 days, are considered by banks as giving rise to doubts regarding their recoverability.

4. Understanding the transmission mechanism

To gain a deeper understanding of the transmission mechanism of the model, we will trace the entire dynamic response of how a shock to the policy interest rate, set in motion by the central bank, will feed through to economic activity and prices, including the interactions between the real economy, the labour market, credit and asset prices. A schematic representation of the model, emphasizing the role of macro-fiscal-financial linkages, is found in Chart 4.

An increase in the policy interest rate is passed through imperfectly to bank lending rates to households and firms. Higher retail rates have an adverse effect on domestic demand through private consumption and investment. The former is affected through a rise in the propensity to save on part of households, while the latter by the increase in the user cost of capital. The initial drop in economic activity will have an additional adverse impact on investment via the accelerator effect.

The decline in output will be transmitted to the labour market with a lag, with a drop in employment and an increase in the unemployment rate. As employment is relatively inelastic in the short run, the drop in output will have an adverse impact on labour productivity. The rise in the unemployment rate will have a further negative effect on private consumption through an increase in precautionary savings.

The decline in GDP compared to its potential creates a negative output gap, thereby exerting downward pressure on prices. The effect of a monetary policy shock on consumer prices is not instantaneous and is typically felt after around one to two years. The combination of subdued prices and lower productivity exerts downward pressure on wages, in turn leading to a drop in disposable income and, eventually, lower private consumption.

A monetary policy shock will also have an impact on credit and asset prices. The increase in retail interest rates, together with the decline in disposable income and economic activity, will have an adverse effect on bank lending to both households and firms. A reduction in bank credit for mortgages and lower disposable income will exert downward pressure on house prices, which, in turn, leads to a second round drop in bank loans to the private sector. This dynamic interaction between bank credit and house prices generates a transmission mechanism that amplifies and increases the persistence of shocks to the real economy. The reduction in bank lending is transmitted to the real economy through its impact on private consumption and investment, thereby reinforcing the macro-financial linkages in the model. Lower house prices also reduce private consumption via the wealth channel, further reinforcing the link between credit, asset prices and the real economy.

Higher interest rates also lead to a deterioration in the banks' asset quality, due to the increase in non-performing loans, further amplifying the tightening impact on bank credit from the supply side, in addition to the slower demand from the private sector for bank loans.

On the fiscal front, higher interest rates are imperfectly transmitted to long-term government bond yields, leading to higher interest payments on government debt. Sluggish economic activity leads to lower tax revenues while, at the same time, public expenditure increases as automatic stabilizers, for instance, higher spending on unemployment benefits, kick in. Tightening of monetary policy leads to a deterioration in public finances and an increase in the debt-to-GDP ratio.

Chart 2: Schematic Representation of the Fiscal Block (Revenue Side)

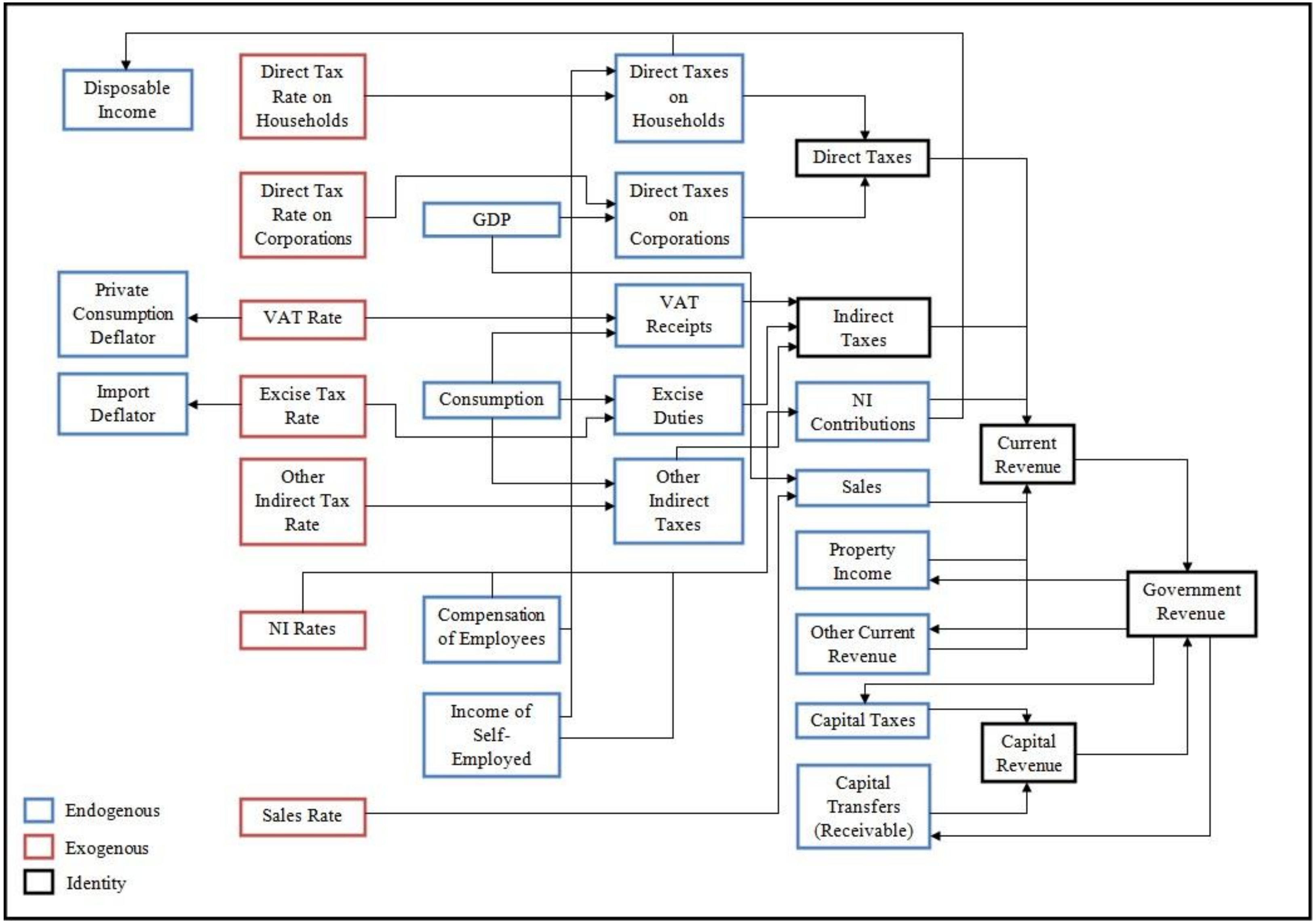


Chart 3: Schematic Representation of the Fiscal Block (Expenditure Side)

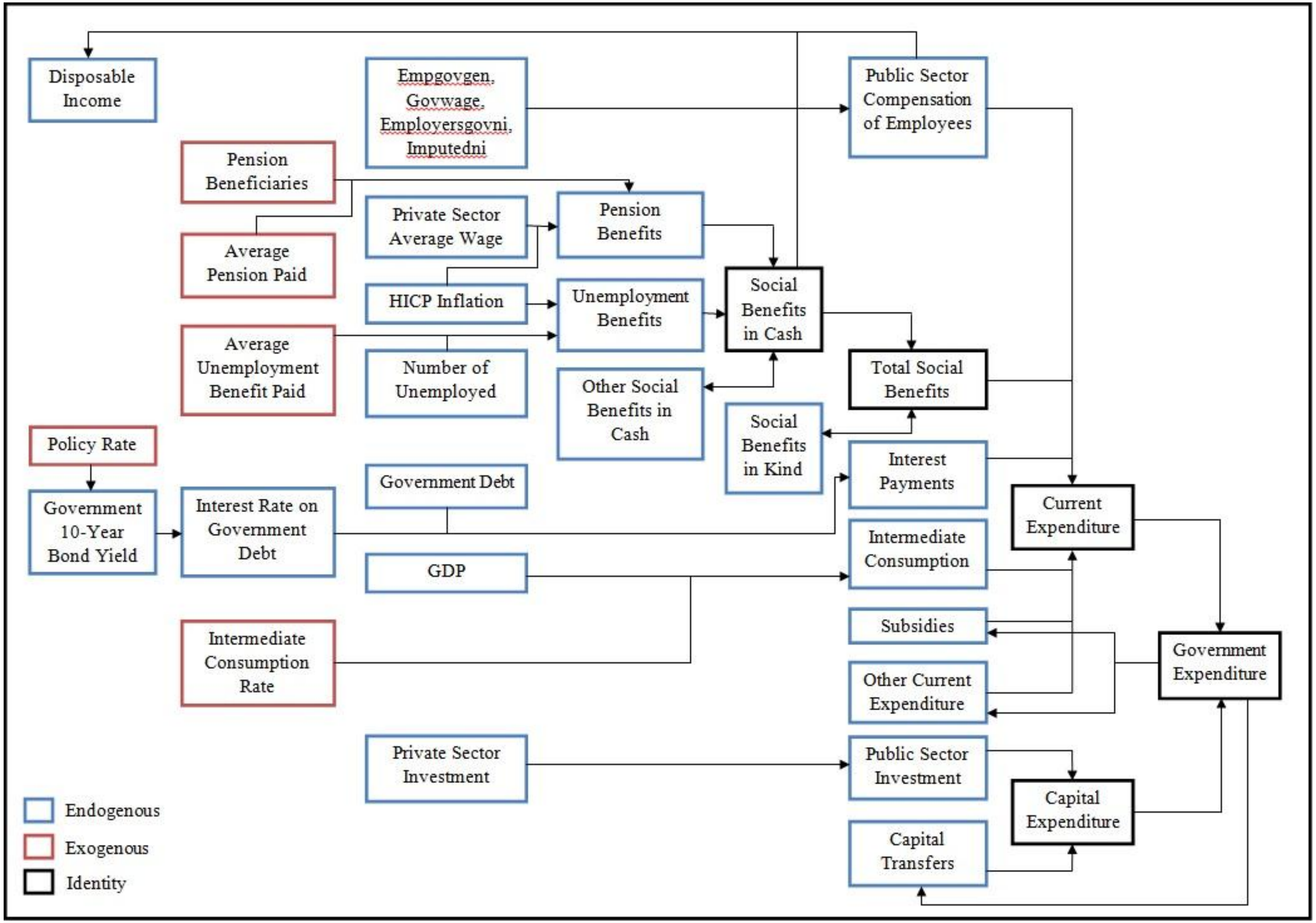
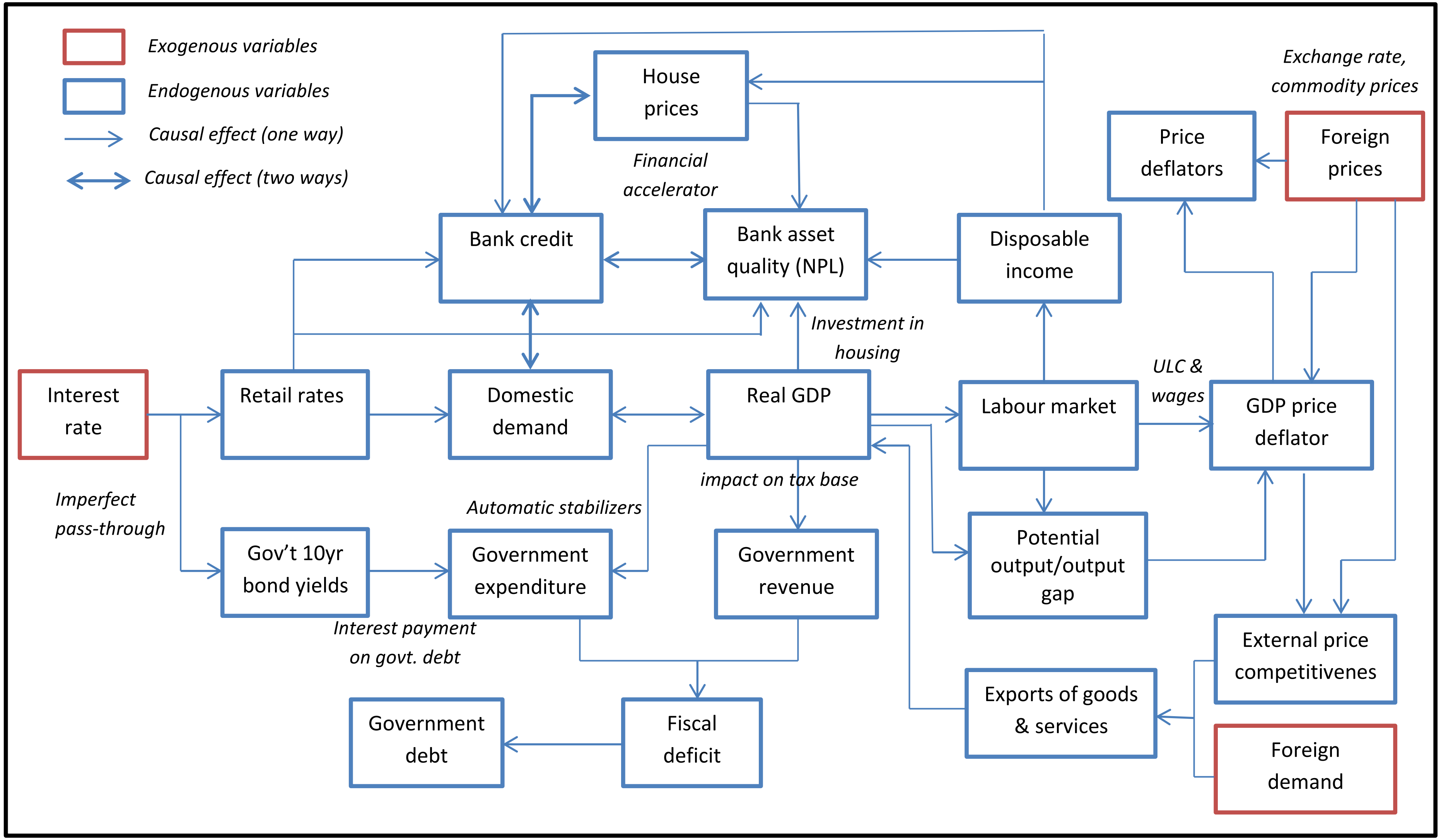


Chart 4: Schematic Representation of the Macro-Fiscal-Financial Linkages



The propagation mechanisms of a monetary policy shock are illustrated in Table 1. 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 policy tightening leads to an appreciation of the domestic currency. This assumption follows from the uncovered interest rate parity condition. In the simulation, the euro exchange rate is assumed to appreciate by 0.5% against the other currencies. A similar set-up for a monetary policy shock is proposed in Fenz & Spitzer (2005).

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. Similar dynamics are also observed for employment. Private sector credit is very sensitive to interest rate developments, whereas the impact of the exchange rate channel is very muted.

On the contrary, the interest rate channel has a minor 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). The impact of the interest rate channel on prices is only felt with a lag of around two years.

Table 1: Monetary Policy Shock

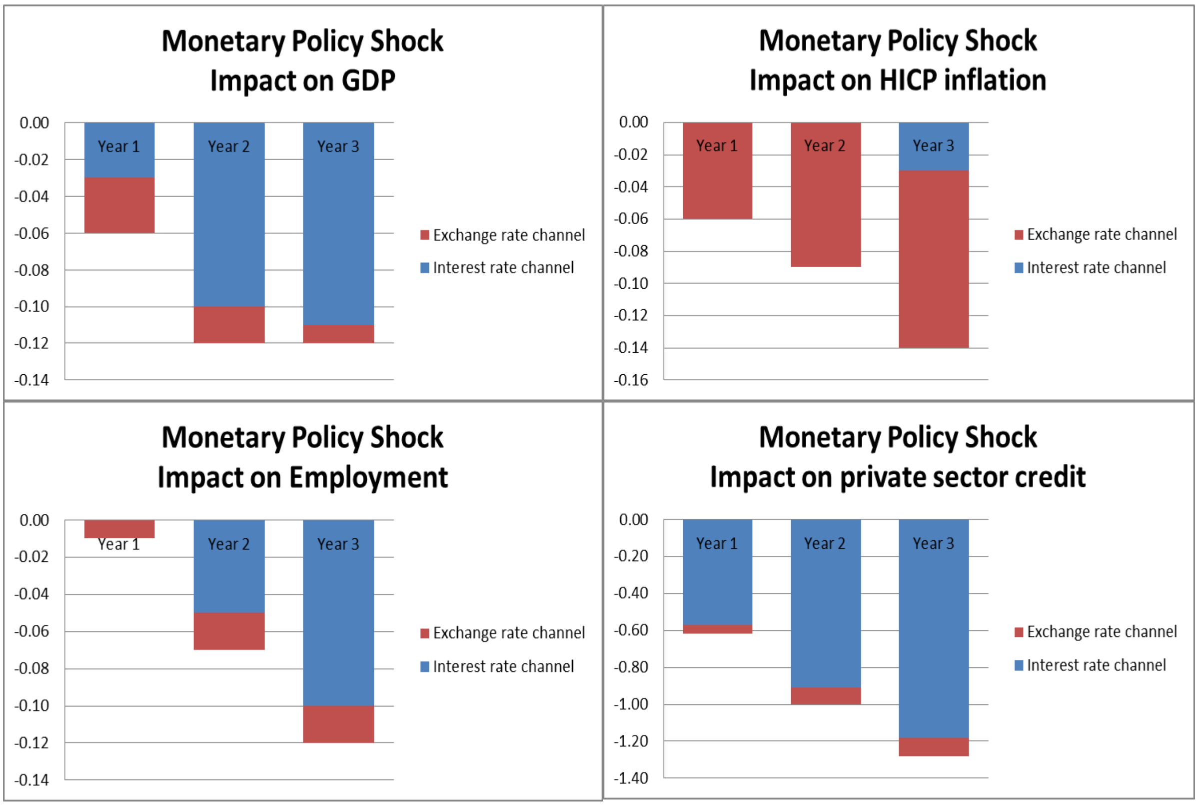
(percent deviation from baseline unless otherwise stated)

	Year 1	Year 2	Year 3
Economic Activity			
(constant prices)			
Real GDP	-0.06	-0.12	-0.12
Private consumption	-0.22	-0.46	-0.49
Government consumption	-0.02	-0.07	-0.06
Gross fixed capital formation	-0.09	-0.76	-0.64
Exports	-0.06	-0.02	0.03
Imports	-0.15	-0.30	-0.25
Prices and cost developments			
HICP	-0.06	-0.09	-0.14
GDP deflator	-0.03	-0.10	-0.18
ULC whole economy	0.02	-0.07	-0.15
Compensation per employee	-0.03	-0.12	-0.15
Productivity whole economy	-0.05	-0.05	0.00
Fiscal Developments			
(as % of GDP)			
Balance	-0.10	-0.18	-0.24
Gross Debt	0.17	0.45	0.72
Labour market			
Unemployment rate[a]	0.00	0.01	0.02
Total employment	-0.01	-0.07	-0.12
Asset prices and credit			
Loans to the private sector	-0.62	-1.00	-1.28
House prices	-0.12	-0.61	-1.03
Non-performing loans ratio[a]	0.16	0.21	0.23

[a] *percentage point deviation*

Chart 5 – Decomposition of Monetary Policy Shock

(percent deviation from baseline)



It is important to note that there are other channels through which monetary policy can have an impact on economic activity and prices but which are not present in the model. 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. Forward looking expectations are also not present in the model. However, the incorporation of macro-financial linkages and the overhaul of the nominal price block have resulted in a more pronounced impact of monetary policy impulses to domestic economic activity and prices compared to the previous version of the model.

5. 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 government consumption shock is defined as a permanent increase in real public intermediate consumption that leads to an *ex-ante* change in the share of real government consumption in real GDP by 1 percentage point. 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%. Following common practice, the fiscal rule was switched off in all simulations. A detailed analysis of the channels which result in these changes is presented below. The full simulation results are available in Appendix B.

5.1 Government consumption shock

The rise in government consumption results in an immediate increase in GDP. This leads to higher employment and wages, and hence disposable income, which, in turn, raises private consumption. Moreover, investment also increases owing to the accelerator principle. These developments bring about a further rise in GDP, offset to some degree by higher imports. This raises the output gap which, in turn, leads to an increase in prices. Higher export prices give rise to a loss in competitiveness and thus a decline in exports. The net effect, however, results in a rise in GDP, which translates into lower unemployment. On the fiscal side, as a result of the increase in government consumption, government expenditure rises. Due to higher macroeconomic bases, government revenue also rises, but the net effect is for government balance ratio to fall – which implies a deterioration of the deficit ratio – and consequently the government debt ratio increases.

5.2 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 0.45% relative to the baseline in the first year. By the third year, the impact on the index rises to 0.7%. The increase in domestic prices leads to a fall in purchasing power and price competitiveness, adversely affecting private consumption and exports. The drop in economic activity leads to a decline in private investment via the accelerator principle and a deterioration in the labour market. In addition, an oil price shock leads to a persistent deterioration in the terms of trade and worsens the trade balance.

On the fiscal front, the decline in economy activity leads to a small fiscal deficit driven mainly by lower revenue receipts.

5.3 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 the Maltese economy, combined with the fact that around 65% of total exports are directed to countries outside the euro area. On the other hand, the US dollar is the currency in which oil is priced and an appreciation of the domestic currency 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 60-65% from import to consumer prices. As a result, the latter decline gradually by 0.5% relative to the baseline in the first year, and by 0.8% by the third year.

Concerning economic activity, the deterioration in external price competitiveness has an immediate and adverse impact on export volumes and consequently, on the trade balance. In contrast, the increase in purchasing power has a positive effect on private consumption, which more than offsets the slight decline in employment. The deterioration in GDP has an adverse effect on investment, the effect of which is also amplified by the decline in bank credit to NFCs.

5.4 Foreign demand

As with the exchange rate shock, the impact of higher foreign demand on economic activity is quite pronounced, with real GDP increasing by around 0.55%-0.65% compared to baseline in the second and third year of the shock. A favourable external demand shock directly leads to higher export volumes and an improvement in the trade balance. The resulting rise in employment and wages boosts disposable income. In turn, the latter exerts a positive impact on house prices and bank credit to the private sector. Together, these elements lead to higher private consumption. Investment rises with buoyant economic activity.

Improved economic activity leads to a positive output gap and increases in compensation per employee. The combination of these two effects leads to a gradual increase in domestic price pressures, though with a lag.

6. Conclusion

This paper presented an update of the structural macro-econometric model of the Maltese economy developed by the Central Bank of Malta in 2012-2013 and published in Grech et al. (2013). Since then, there have been five key advancements.

Although the updated model remains similar in spirit to the previous version, it now contains a detailed fiscal block, a richer financial block, enhanced macro-financial linkages and a price block that is more responsive to domestic economic activity. In addition, it has been re-estimated using more recent data. Simulation results for five standard shocks illustrated the properties of the updated model and suggest that its mechanics are plausible from both a theoretical and empirical standpoint. These refinements and additions to the core model make it a valuable tool in the Central Bank's toolkit in view of recent and upcoming changes in the financial and fiscal areas, both domestically and at European level, such as the creation of an independent fiscal council and the establishment of the Joint Financial Stability Board (JFSB).[17]

Once again, however, this does represent the final stage in the model's development. Other refinements are envisaged, including re-estimating the model using ESA 2010 data and an enhanced integration of supply constraints. The latter is especially relevant in the context of the domestic labour market, with a relatively low (albeit increasing) participation rate and labour shortages in specific sectors which, in turn, could play an important role in price and wage formation. Additionally, further sectoral disaggregation is also envisaged, although this depends, to a large extent, on data availability. Moreover, the model will be evaluated on a regular basis to ensure that it remains a faithful representation of how the Maltese economy functions.

[17] The objective of the JFSB is to establish enhanced cooperation between the Bank and the Malta Financial Services Authority (MFSA) to formulate macro-prudential policy and to safeguard the stability of the domestic financial system.

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Annex A: The model's long run properties

This section presents the long run properties of the model. The long run solution cannot be interpreted as a forecast of the Maltese economy but just as a technical exercise to check the convergence to the stable path in the long run and the plausibility of the ratios obtained.

These simulations are based on assumptions regarding the exogenous variables. The exchange rate and oil prices are fixed at the level of the last observation (oil prices are assumed to remain unchanged beyond the forecasting horizon, which ends in 2016). NAIRU is also set at the level of the last observation, at 6.5%. The policy interest rate is assumed to increase gradually to around 2.50% by 2022, after which it will remain unchanged at this level. The growth rates of all real variables (e.g. foreign demand) are set equal to 2.0%; the growth of price indices, like foreign prices, is 2.0%, whereas the growth rate of nominal variables, like the exogenous component of disposable income, is set equal to 4.0%. The fiscal rule is switched on from 2026 onwards to ensure the stability of the public debt-to-GDP ratio. The model is simulated over a long-term horizon (until 2100) to check the time it takes to reach a stable, balanced growth path.

The long run solution of the model is plausible and realistic (see charts below). The great ratios converge gradually to more or less their historical averages. The output gap and the unemployment gap are closed in the steady state. The annual growth rate of prices, both overall and consumption prices, as well as unit labour costs, converge to 2.0%.

Chart A1: Great Ratios

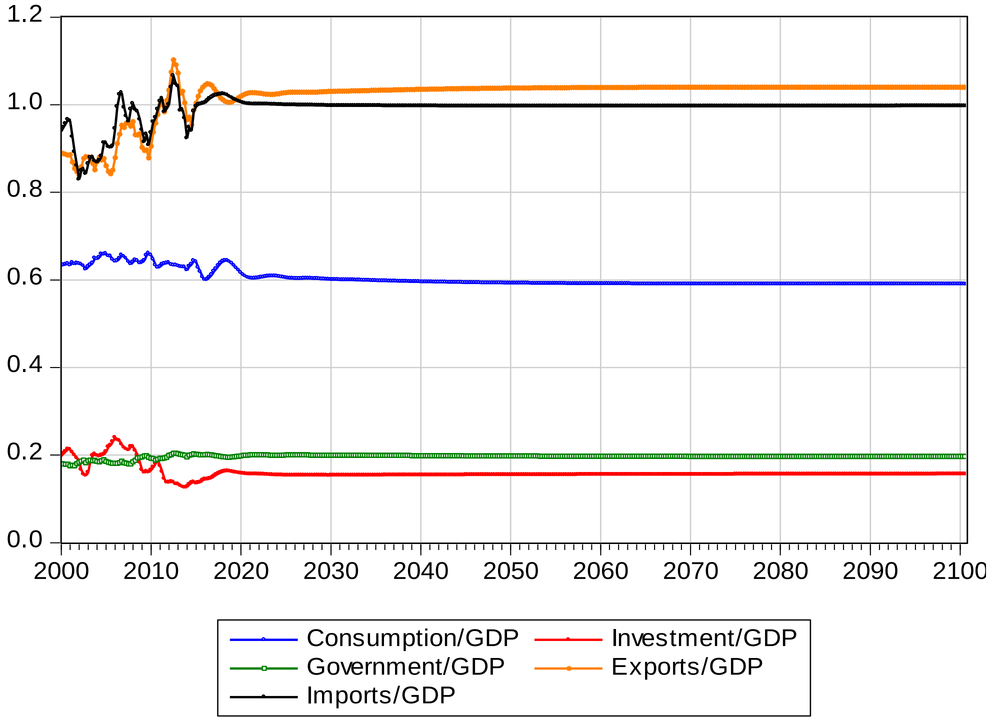
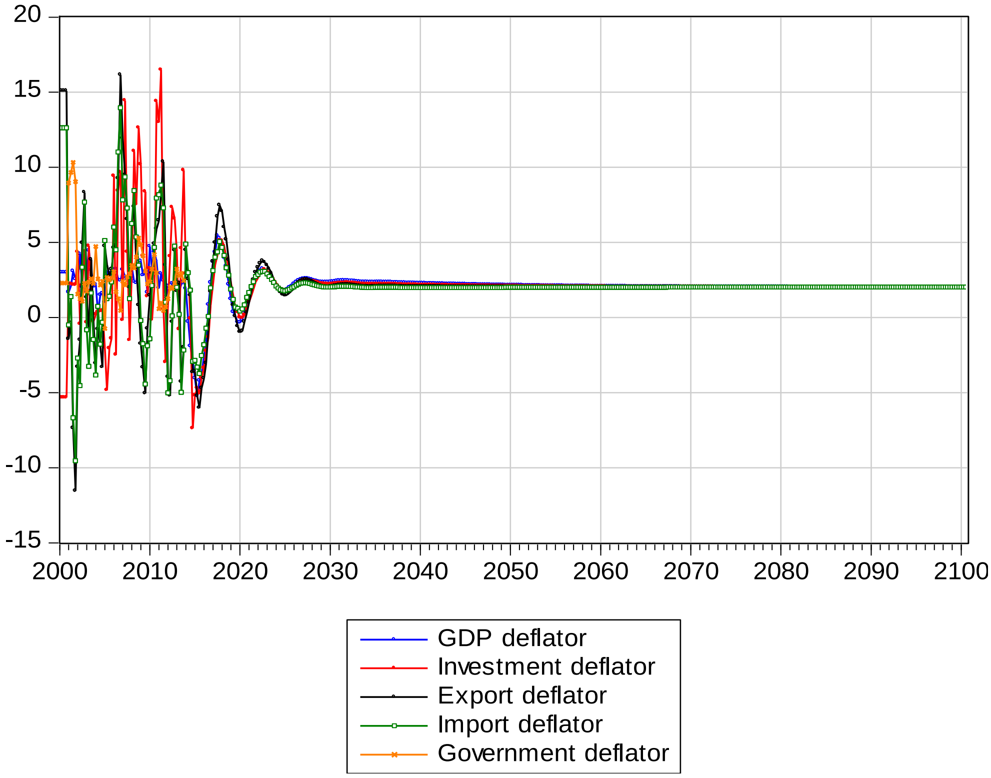


Chart A2: Price Deflators

(year-on-year growth rates)



Annex B: Model simulations

Government expenditure shock

Table B1: Government Expenditure Shock

(percent deviation from baseline unless otherwise stated)

	Year 1	Year 2	Year 3
Economic Activity			
(constant prices)			
Real GDP	0.77	0.83	0.64
Private consumption	0.12	0.82	0.46
Government consumption	5.23	5.34	5.07
Gross fixed capital formation	0.57	1.11	1.06
Exports	-0.05	-0.28	-0.51
Imports	0.41	0.61	0.28
Prices and cost developments			
HICP	0.02	0.10	0.47
GDP deflator	0.16	0.60	0.87
ULC whole economy	-0.34	0.35	0.56
Compensation per employee	0.20	0.45	0.33
Productivity whole economy	0.54	0.10	-0.22
Fiscal Developments			
(as % of GDP)			
Balance	-0.98	-0.84	-0.88
Gross Debt	0.29	0.75	1.52
Labour market			
Unemployment rate[a]	0.00	-0.11	-0.11
Total employment	0.22	0.73	0.87
Asset prices and credit			
Loans to the private sector	0.33	1.10	1.30
House prices	0.01	0.67	1.10
Non-performing loans ratio[a]	-0.13	-0.21	-0.14

[a] percentage point deviation

Oil price shock

Table B2: Oil Price Shock

(percent deviation from baseline unless otherwise stated)

	Year 1	Year 2	Year 3
Economic Activity			
(constant prices)			
Real GDP	-0.29	-0.52	-0.65
Private consumption	-0.33	-0.65	-0.84
Government consumption	-0.18	-0.23	-0.28
Gross fixed capital formation	-0.17	-0.60	-0.89
Exports	-0.42	-0.59	-0.70
Imports	-0.41	-0.63	-0.78
Prices and cost developments			
HICP	0.45	0.68	0.74
GDP deflator	0.16	0.11	0.07
ULC whole economy	0.30	0.47	0.51
Compensation per employee	0.06	0.28	0.48
Productivity whole economy	-0.24	-0.19	-0.03
Fiscal Developments			
(as % of GDP)			
Balance	0.00	-0.07	-0.10
Gross Debt	0.09	0.37	0.57
Labour market			
Unemployment rate[(a)]	0.00	0.03	0.08
Total employment	-0.05	-0.33	-0.61
Asset prices and credit			
Loans to the private sector	0.24	-0.01	-0.21
House prices	0.21	0.25	-0.03
Non-performing loans ratio[(a)]	0.05	0.12	0.17

[(a)] *percentage point deviation*

Exchange rate shock

Table B3: Appreciation of Euro against US dollar exchange rate

(percent deviation from baseline unless otherwise stated)

	Year 1	Year 2	Year 3
Economic Activity			
(constant prices)			
Real GDP	-0.17	-0.13	0.00
Private consumption	0.31	0.11	0.27
Government consumption	-0.09	-0.13	0.06
Gross fixed capital formation	-0.13	-0.15	-0.04
Exports	-0.37	-0.23	-0.05
Imports	-0.04	-0.09	0.12
Prices and cost developments			
HICP	-0.52	-0.67	-0.84
GDP deflator	-0.14	-0.44	-0.72
ULC whole economy	-0.09	-0.58	-0.79
Compensation per employee	-0.19	-0.60	-0.73
Productivity whole economy	-0.11	-0.03	0.06
Fiscal Developments			
(as % of GDP)			
Balance	-0.05	-0.09	-0.10
Gross Debt	0.28	0.57	0.74
Labour market			
Unemployment rate[(a)]	0.01	0.03	0.00
Total employment	-0.06	-0.10	-0.06
Asset prices and credit			
Loans to the private sector	-0.39	-0.64	-0.73
House prices	-0.23	-0.58	-0.64
Non-performing loans ratio[(a)]	0.03	0.04	-0.03

[(a)] percentage point deviation

Foreign demand

Table B4: Foreign Demand Shock

(percent deviation from baseline unless otherwise stated)

	Year 1	Year 2	Year 3
Economic Activity			
(constant prices)			
Real GDP	0.52	0.65	0.55
Private consumption	0.08	0.57	0.42
Government consumption	0.19	0.36	0.20
Gross fixed capital formation	0.34	0.83	0.88
Exports	0.93	0.79	0.61
Imports	0.54	0.71	0.51
Prices and cost developments			
HICP	0.01	0.06	0.33
GDP deflator	0.10	0.42	0.67
ULC whole economy	-0.26	0.22	0.41
Compensation per employee	0.12	0.35	0.28
Productivity whole economy	0.38	0.12	-0.13
Fiscal Developments			
(as % of GDP)			
Balance	0.05	0.17	0.18
Gross Debt	-0.51	-1.02	-1.23
Labour market			
Unemployment rate[a]	0.00	-0.08	-0.08
Total employment	0.14	0.53	0.68
Asset prices and credit			
Loans to the private sector	0.21	0.78	1.02
House prices	0.00	0.45	0.82
Non-performing loans ratio[a]	-0.09	-0.17	-0.12

[a] *percentage point deviation*

Annex C: Model 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

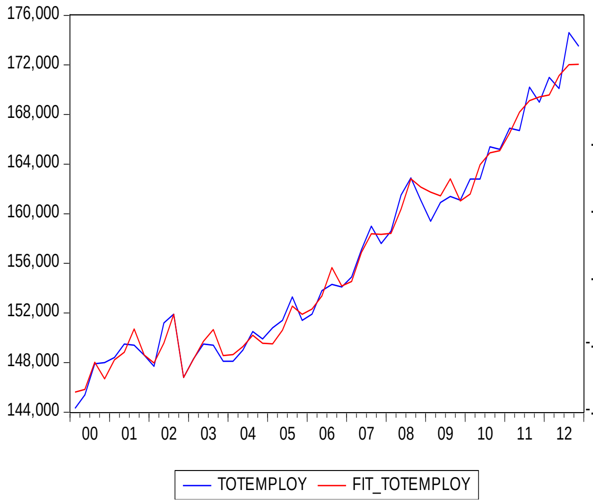
C1. Employment

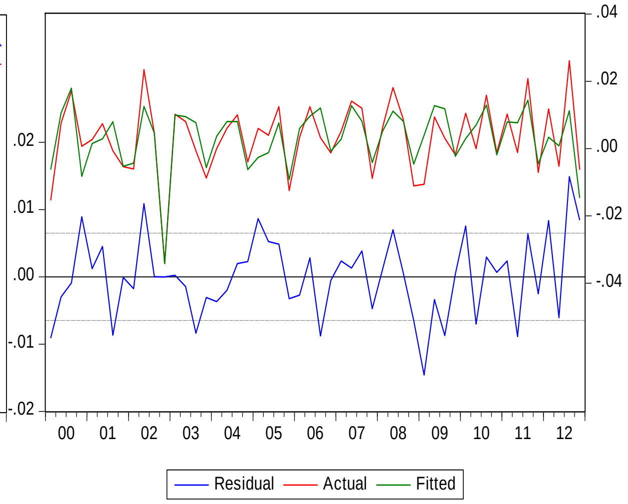
In the long run, demand for labour is negatively affected by the relative price of labour (measured by the ratio of wages to the GDP deflator) and positively by real GDP. The equilibrium level of labour demand is also influenced by trend total factor productivity. In the short run, labour demand is affected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

Dependent Variable: DLOG(TOTEMPLOY)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(TOTEMPLOY) = C_EMP(1) + C_EMP(2)*DLOG(GDPF(-1)) +
C_EMP(4)*(LOG(TOTEMPLOY(-1))-LOG(@MOVAV(GDPF(-1),4))) +
C_EMP(5)*LOG(@MOVAV(CPE(-1)/PGDP(-1),4)) + C_EMP(6)
@SEAS(2)/100 + C_EMP(7)@SEAS(3)/100 + C_EMP(8)*@SEAS(4)
/100 + C_EMP(9)*D02Q4/100 + C_EMP(10)*LOG(@MOVAV(TFPF(
-1),4))

	Coefficient	Std. Error	t-Statistic	Prob.
C_EMP(1)	-1.690908	0.451019	-3.749080	0.0005
C_EMP(2)	0.084241	0.047979	1.755776	0.0862
C_EMP(4)	-0.578261	0.144982	-3.988500	0.0003
C_EMP(5)	-0.194127	0.066896	-2.901926	0.0058
C_EMP(6)	0.892048	0.337685	2.641660	0.0115
C_EMP(7)	0.323561	0.464772	0.696171	0.4901
C_EMP(8)	-1.121865	0.589049	-1.904536	0.0635
C_EMP(9)	-2.382275	0.690878	-3.448185	0.0013
C_EMP(10)	-0.319755	0.105352	-3.035117	0.0041

R-squared	0.693364	Durbin-Watson stat	1.850874
Adjusted R-squared	0.636316	F-statistic	12.15395
S.E. of regression	0.006490	Prob(F-statistic)	0.000000





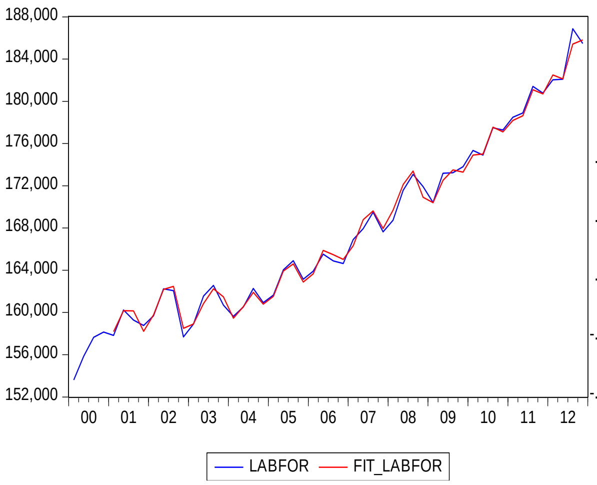
C2. Labour Force

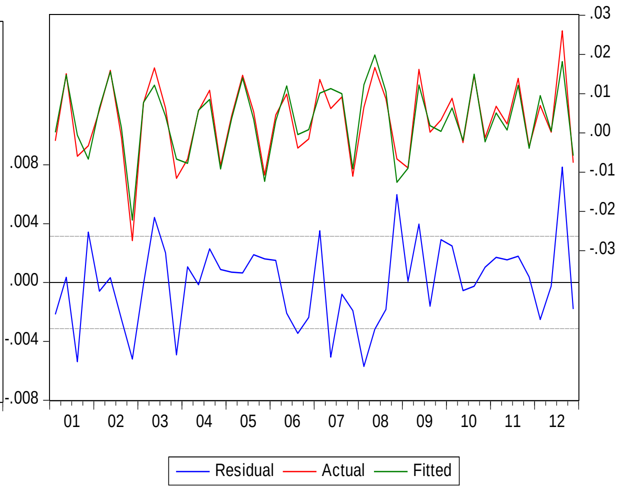
To allow for an endogenous labour force response, the model includes an equation for the labour supply. In the long run, the labour supply is linked with employment, thereby leading to a stable unemployment rate in the steady state. In the short run, it is affected by the growth rate in employment, real GDP and real wages. The impact of real wage on labour supply can be separated in the substitution and income effects, which go in opposite directions; the net effect is left for data to answer. The positive coefficient of real wages suggests that the substitution effect prevails. On the contrary, the discouraged worker effect (i.e. unemployment rate as explanatory variable in labour supply equation) is not supported by Maltese data.

Dependent Variable: DLOG(LABFOR)
Sample (adjusted): 2001Q1 2012Q4
Included observations: 48 after adjustments
DLOG(LABFOR) = C_LF(1) + 0.5*DLOG(TOTEMPLOY) + C_LF(3)
*DLOG(GDPF) + C_LF(4)*DLOG(TOTWAGE(-3)/PCN(-3)) + C_LF(5)
LOG(LABFOR(-1)/TOTEMPLOY(-1)) + C_LF(6)@SEAS(2)/100 +
C_LF(7)*@SEAS(3)/100 + C_LF(8)*@SEAS(4)/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_LF(1)	0.030883	0.006123	5.044159	0.0000
C_LF(3)	0.171328	0.026815	6.389186	0.0000
C_LF(4)	0.128819	0.024669	5.222011	0.0000
C_LF(5)	-0.262273	0.081605	-3.213923	0.0026
C_LF(6)	-1.367679	0.353229	-3.871928	0.0004
C_LF(7)	-2.655972	0.440493	-6.029543	0.0000
C_LF(8)	-0.772918	0.203018	-3.807144	0.0005

R-squared	0.913076	Durbin-Watson stat	2.007632
Adjusted R-squared	0.900356	F-statistic	71.77972
S.E. of regression	0.003137	Prob(F-statistic)	0.000000





Aggregate demand

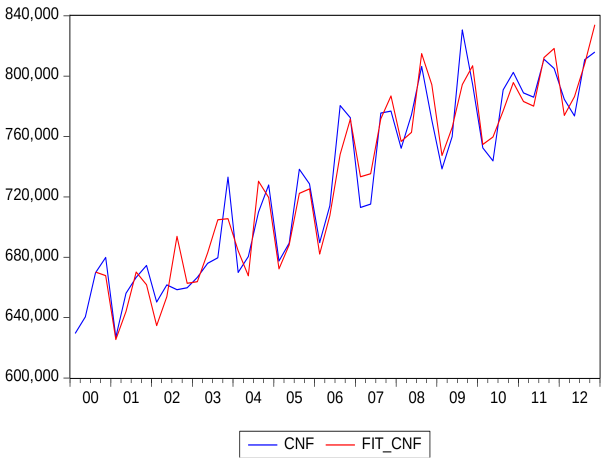
C3. Private consumption

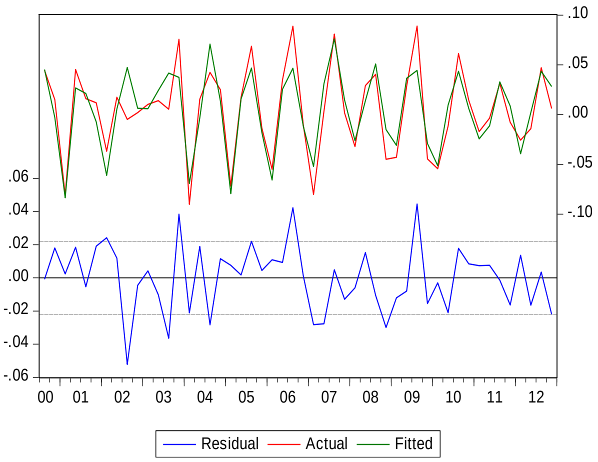
In the short run, private consumption is assumed to depend positively on disposable income and bank lending to households and negatively on the unemployment rate. The latter is assumed to proxy precautionary savings and links developments in the labour market to the real economy. In the long run, private consumption depends on disposable income, real wealth and the real interest rate. The real interest rate is calculated as the nominal bank lending rate to households less inflation expectations, which are proxied by an 8-quarter moving average of the consumption price deflator.

Dependent Variable: DLOG(CNF)
Sample (adjusted): 2000Q3 2012Q4
Included observations: 50 after adjustments
DLOG(CNF) = C_CNF(1) + C_CNF(2)*DLOG(YPDF) + C_CNF(3)*D(URB(-3))/100 + C_CNF(4)*DLOG(TCHHF(-1)) + C_CNF(5)*(LOG(CNF(-1)) - C_CNF(6)*LOG(YPDF(-1)) - (1-C_CNF(6))*LOG(WEALTHNET(-1)/PCN(-1))) + C_CNF(7)*HHRATF(-1) + C_CNF(8)*@SEAS(2)/100 + C_CNF(9)*@SEAS(3)/100 + C_CNF(10)*@SEAS(4)/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_CNF(1)	-0.021510	0.016675	-1.289943	0.2045
C_CNF(2)	0.515864	0.159945	3.225262	0.0025
C_CNF(3)	-1.384741	0.683357	-2.026380	0.0494
C_CNF(4)	0.424498	0.219577	1.933250	0.0603
C_CNF(5)	-0.714341	0.143483	-4.978589	0.0000
C_CNF(6)	0.914198	0.041508	22.02447	0.0000
C_CNF(7)	-0.674410	0.371211	-1.816783	0.0767
C_CNF(8)	0.838697	1.310330	0.640065	0.5258
C_CNF(9)	7.492837	1.190167	6.295616	0.0000
C_CNF(10)	4.979080	0.905908	5.496229	0.0000

R-squared	0.793368	Durbin-Watson stat	2.238680
Adjusted R-squared	0.746876	F-statistic	17.06453
S.E. of regression	0.022013	Prob(F-statistic)	0.000000





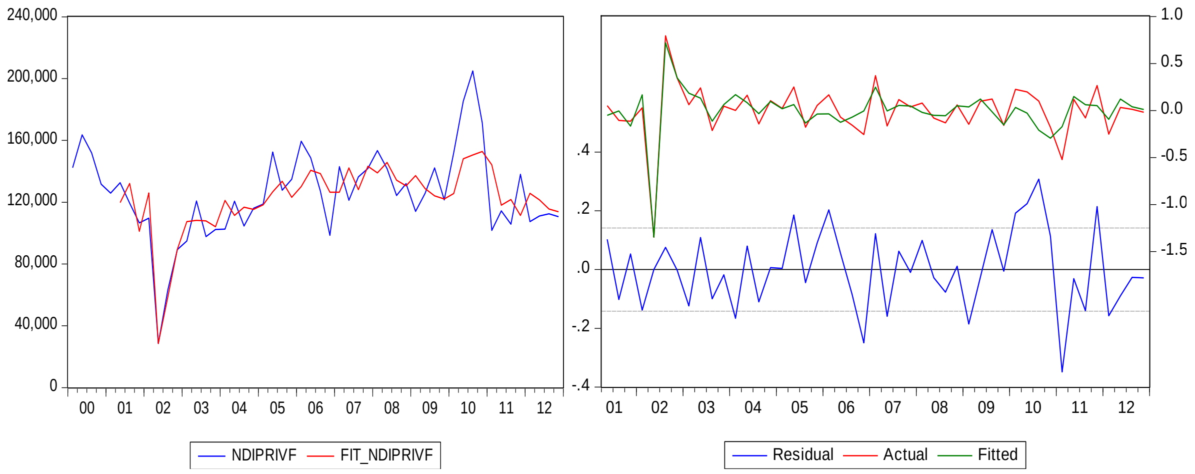
C4. Private non-dwelling investment

Private investment depends on economic activity, with a lagged accelerator principle and bank lending to NFCs in the short-run. In the long run, investment is linked to GDP and the user cost of capital, with the main determinant of the latter being the retail interest rate charged by banks to NFCs. Such a long run specification can be derived from the first order condition of a profit maximising firm, assuming a Cobb-Douglas type production function and taking into consideration the stock-flow relationship between the capital stock and investment (see Danielson et al (2011) for additional detail). We also include a trend that starts from 2007 to help explain the subdued investment outlook since the recession of 2008-09. In addition, an impulse dummy is added to correct for the sharp drop in investment in 2002Q2 following the sale of aircrafts.

Dependent Variable: DLOG(NDIPRIVF)
Sample (adjusted): 2001Q2 2012Q4
Included observations: 47 after adjustments
DLOG(NDIPRIVF) = C_NDIPRIVF(1) + C_NDIPRIVF(2)*DLOG(GDPF(-3)) +
C_NDIPRIVF(3)*DLOG(CNFCF(-4)) + C_NDIPRIVF(4)
*(LOG(NDIPRIVF(-1))-LOG(GDPF(-1))+LOG(PCAP(-1))) +
C_NDIPRIVF(5)*D02Q2/100 + C_NDIPRIVF(6)*TREND07/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_NDIPRIVF(1)	1.399277	0.186003	7.522894	0.0000
C_NDIPRIVF(2)	1.295052	0.437628	2.959250	0.0051
C_NDIPRIVF(3)	1.499857	0.796997	1.881886	0.0670
C_NDIPRIVF(4)	-0.563696	0.076932	-7.327224	0.0000
C_NDIPRIVF(5)	-146.6800	14.79166	-9.916395	0.0000
C_NDIPRIVF(6)	-0.429723	0.261404	-1.643907	0.1078

R-squared	0.785047	Durbin-Watson stat	2.034892
Adjusted R-squared	0.758834	F-statistic	29.94793
S.E. of regression	0.141607	Prob(F-statistic)	0.000000



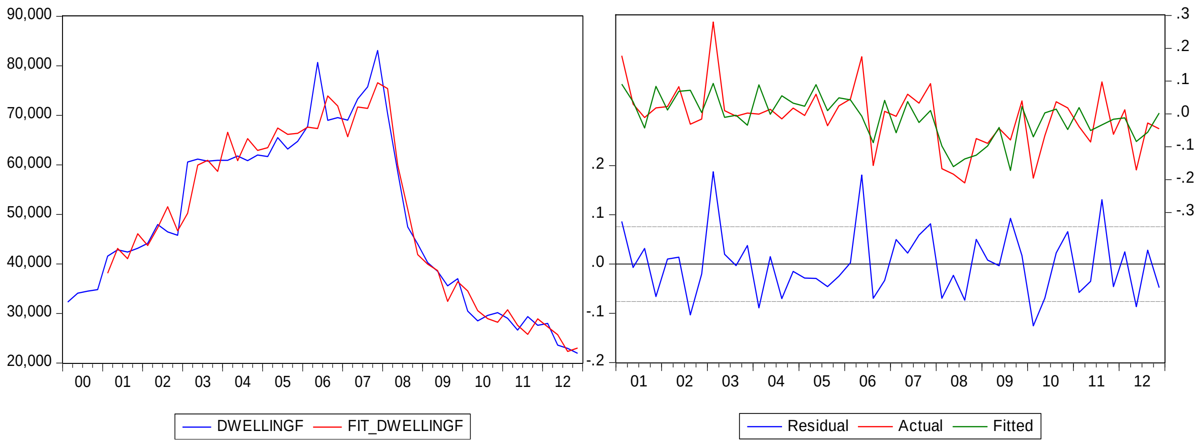
C5. Dwelling investment

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, real mortgage credit and real house prices.

Dependent Variable: DLOG(DWELLINGF)
Sample (adjusted): 2001Q1 2012Q4
Included observations: 48 after adjustments
DLOG(DWELLINGF) = C_DWEL(1) + C_DWEL(2)*DLOG(PERMITS) + C_DWEL(3)*DLOG(PERMITS(-1)) + C_DWEL(4)*DLOG(PERMITS(-2)) + C_DWEL(5)*DLOG(PERMITS(-3)) + C_DWEL(6)*DLOG(TCHHF(-3)) + C_DWEL(7)*DLOG(PIHF(-2)) + C_DWEL(8)*LOG(DWELLINGF(-1) /PRIVGDPF(-1)) + C_DWEL(9)*@SEAS(2) + C_DWEL(10)*@SEAS(3) + C_DWEL(11)*@SEAS(4)

	Coefficient	Std. Error	t-Statistic	Prob.
C_DWEL(1)	-0.226348	0.109293	-2.071021	0.0454
C_DWEL(2)	0.160464	0.058156	2.759185	0.0090
C_DWEL(3)	0.190850	0.071136	2.682873	0.0108
C_DWEL(4)	0.186106	0.073196	2.542575	0.0153
C_DWEL(5)	0.176366	0.064538	2.732762	0.0096
C_DWEL(6)	1.591611	0.799965	1.989602	0.0541
C_DWEL(7)	0.413434	0.269683	1.533036	0.1338
C_DWEL(8)	-0.063698	0.033590	-1.896336	0.0657
C_DWEL(9)	-0.015874	0.041935	-0.378543	0.7072
C_DWEL(10)	-0.049794	0.042814	-1.163043	0.2523
C_DWEL(11)	-0.019254	0.042181	-0.456467	0.6507

R-squared	0.492328	Durbin-Watson stat	2.193765
Adjusted R-squared	0.355120	F-statistic	3.588176
S.E. of regression	0.075880	Prob(F-statistic)	0.002110



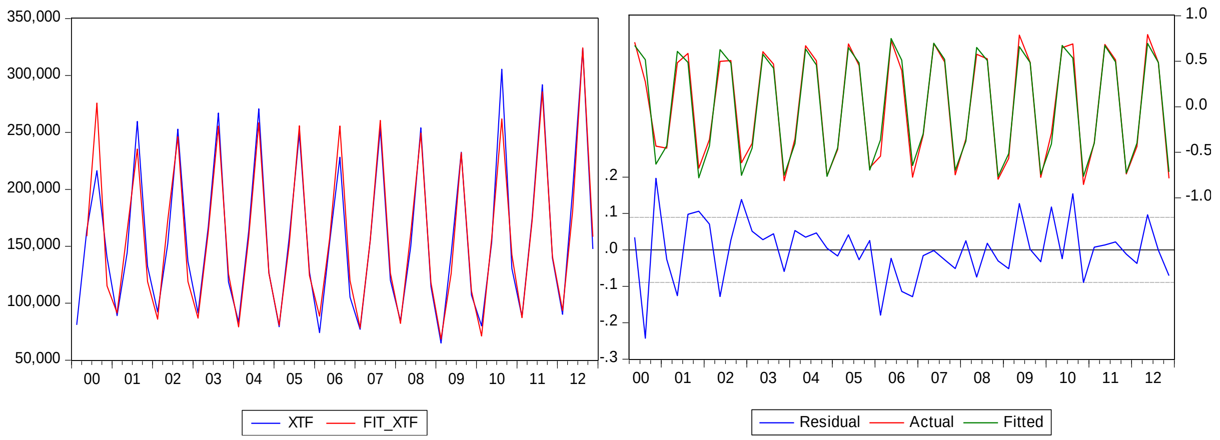
C6. Tourism exports

In the long run, tourism exports depend on foreign demand, the hotel industry's bed capacity (as a measure of supply) and the real effective exchange rate deflated by the consumption price deflator (as a measure of price competitiveness). The elasticity of real tourism exports with respect to world demand and bed capacity is restricted to one, whereas the elasticity of price competitiveness is higher than unity. In the short run, only foreign demand was found to be statistically significant.

Dependent Variable: DLOG(XTF)
Sample (adjusted): 2000Q2 2012Q4
Included observations: 51 after adjustments
DLOG(XTF) = C_XT(1) + C_XT(2)*DLOG(WDR) + C_XT(3)*(LOG(XTF(-1)) -LOG(WDR(-1))-LOG(BEDCAPACITYNSO(-1))) + C_XT(4)*LOG(PCN(-1)/CXD1(-1)) + C_XT(5)*@SEAS(2) + C_XT(6)*@SEAS(3) + C_XT(7) *@SEAS(4)

	Coefficient	Std. Error	t-Statistic	Prob.
C_XT(1)	-1.463639	0.341839	-4.281658	0.0001
C_XT(2)	1.314962	0.593520	2.215532	0.0319
C_XT(3)	-0.331340	0.107747	-3.075151	0.0036
C_XT(4)	-0.752799	0.310692	-2.422974	0.0196
C_XT(5)	0.921227	0.059436	15.49960	0.0000
C_XT(6)	0.972146	0.042858	22.68291	0.0000
C_XT(7)	-0.094086	0.081106	-1.160049	0.2523

R-squared	0.980596	Durbin-Watson stat	2.400243
Adjusted R-squared	0.977950	F-statistic	370.5972
S.E. of regression	0.089310	Prob(F-statistic)	0.000000



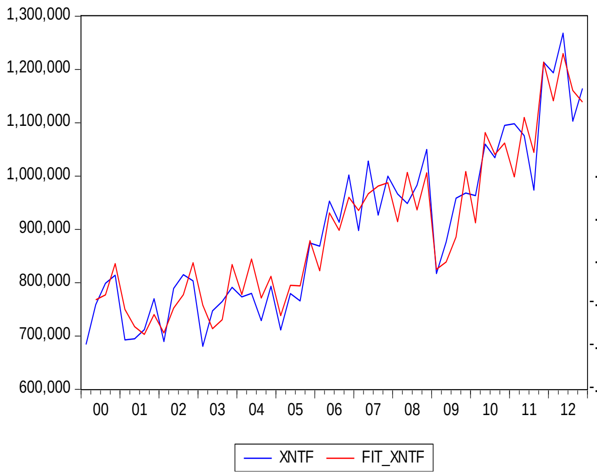
C7. Non-tourism exports

The long-run equilibrium of non-tourism exports depends on world demand and price competitiveness deflated by the export price deflator. The elasticity of real non-tourism exports with respect to these two variables is restricted to one. In the short run, non-tourism exports are driven by world demand and price competitiveness. The estimated elasticities of both variables are less than those for tourism.

Dependent Variable: DLOG(XNTF)
Sample (adjusted): 2000Q2 2012Q4
Included observations: 51 after adjustments
DLOG(XNTF) = C_XNT(1) + C_XNT(2)*DLOG(WDR) + C_XNT(3)*DLOG(PX/CXD1) + C_XNT(4)*(LOG(XNTF(-1))-LOG(WDR(-1)) +LOG(@MOVAV(PX(-1)/CXD1(-1),4))) + C_XNT(5)*@SEAS(2) + C_XNT(6)*@SEAS(3) + C_XNT(7)*@SEAS(4) + C_XNT(8)*D11Q4

	Coefficient	Std. Error	t-Statistic	Prob.
C_XNT(1)	1.309150	0.692090	1.891589	0.0653
C_XNT(2)	1.102730	0.330026	3.341342	0.0017
C_XNT(3)	-0.703623	0.240881	-2.921033	0.0055
C_XNT(4)	-0.153141	0.077164	-1.984608	0.0536
C_XNT(5)	0.107355	0.022671	4.735317	0.0000
C_XNT(6)	0.030184	0.022051	1.368804	0.1782
C_XNT(7)	0.071536	0.027861	2.567616	0.0138
C_XNT(8)	0.129894	0.055005	2.361499	0.0228

R-squared	0.731465	Durbin-Watson stat	2.044061
Adjusted R-squared	0.687750	F-statistic	16.73260
S.E. of regression	0.050526	Prob(F-statistic)	0.000000



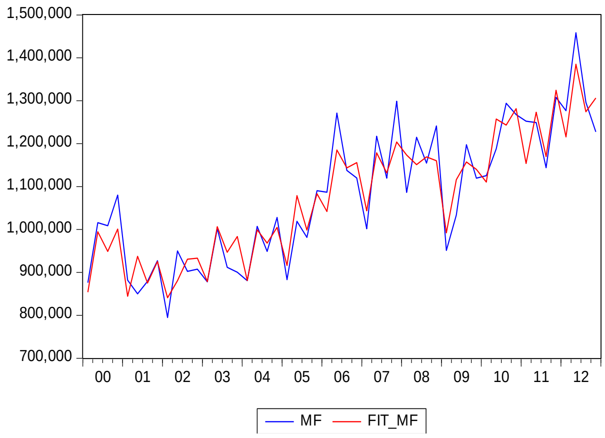
C8. Imports

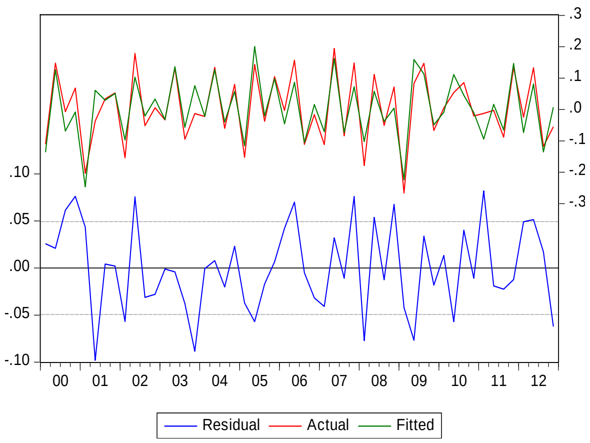
Imports of goods and services depend on an import demand indicator, which is made up of the individual import content of the domestic demand components and exports. The import contents are the following: 55% for private consumption, 20% for public consumption, 65% for investment and 35% for exports of goods and services. These have been calculated separately using input-output tables.

Dependent Variable: DLOG(MF)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(MF) = C_MF(1) + C_MF(2)*DLOG(MFDEM6) + C_MF(3)*LOG(MF(-1)
/MFDEM6(-1)) + C_MF(4)*@SEAS(2)/100 + C_MF(5)*@SEAS(3)/100 +
C_MF(6)*@SEAS(4)/100 + C_MF(7)*TREND00Q1/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_MF(1)	0.049284	0.024908	1.978626	0.0540
C_MF(2)	1.383997	0.251724	5.498082	0.0000
C_MF(3)	-0.619237	0.143997	-4.300354	0.0001
C_MF(4)	0.850057	3.723262	0.228310	0.8204
C_MF(5)	-8.449516	3.593050	-2.351628	0.0231
C_MF(6)	1.809791	2.402238	0.753377	0.4551
C_MF(7)	0.138838	0.054246	2.559423	0.0139

R-squared	0.817702	Durbin-Watson stat	2.176675
Adjusted R-squared	0.793396	F-statistic	33.64141
S.E. of regression	0.049269	Prob(F-statistic)	0.000000





Wage-price block

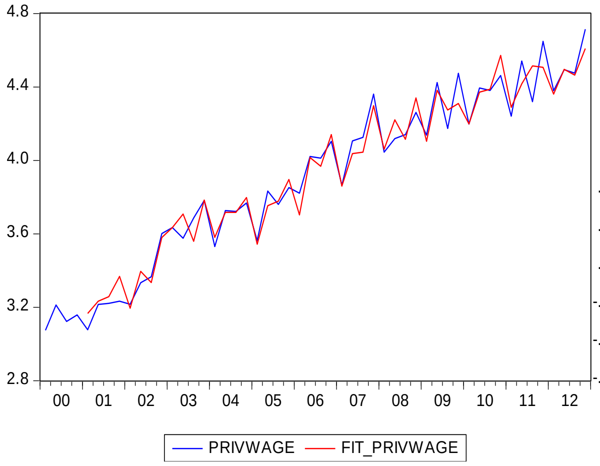
C9. Private wages

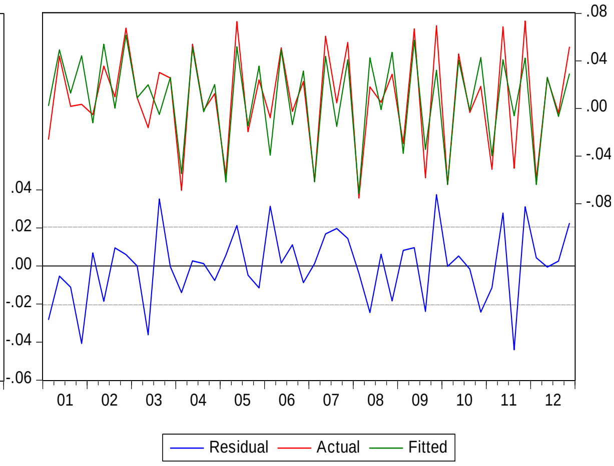
The long run condition for private wages is derived from the first order condition of a profit maximising firm. Thus, the long-run elasticity of nominal private wages with respect to both private labour productivity and prices is set to one. The unemployment rate is also assumed to have an adverse pressure on private wage developments in the long run. The short run dynamics are driven by private productivity and consumer prices. The impact of price developments in the short-run is intended to capture the partial indexation of wages to prices (COLA), which is a specific feature of the domestic labour market.

Dependent Variable: DLOG(PRIVWAGE)
Sample (adjusted): 2001Q1 2012Q4
Included observations: 48 after adjustments
DLOG(PRIVWAGE) = C_PW(1) + C_PW(2)*DLOG(PRIVPRODF(-3)) +
C_PW(3)*DLOG(PCN(-2)) + C_PW(4)*LOG(((PRIVWAGE(-1)
/(@MOVAV(PCN(-1),4)))/(@MOVAV(PRIVPRODF(-1),4)))) - 0.05*URB(
-1)/100 + C_PW(5)*@SEAS(2) + C_PW(6)*@SEAS(3) + C_PW(7)
*@SEAS(4) + C_PW(8)*D03Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C_PW(1)	-1.960275	0.554394	-3.535891	0.0010
C_PW(2)	0.274430	0.127580	2.151037	0.0376
C_PW(3)	0.519120	0.319227	1.626179	0.1118
C_PW(4)	-0.349195	0.101898	-3.426913	0.0014
C_PW(5)	0.063478	0.010170	6.241928	0.0000
C_PW(6)	0.057846	0.013040	4.436106	0.0001
C_PW(7)	0.107201	0.020767	5.162008	0.0000
C_PW(8)	0.059256	0.021545	2.750313	0.0089

R-squared	0.808189	Durbin-Watson stat	2.491378
Adjusted R-squared	0.774622	F-statistic	24.07694
S.E. of regression	0.020445	Prob(F-statistic)	0.000000





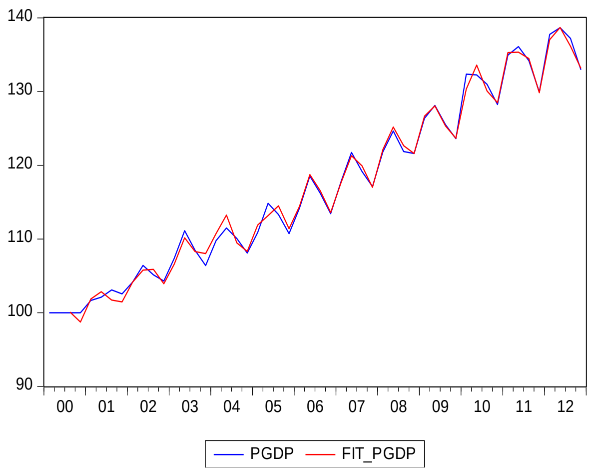
C10. GDP deflator

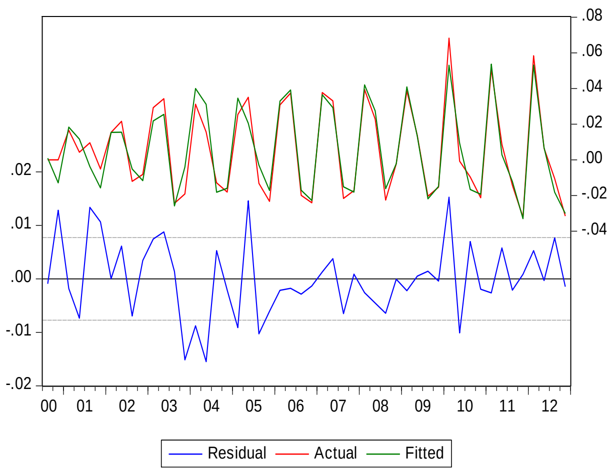
In the short run, the GDP deflator depends on its own lags (inertia in the price formation process), foreign prices in euro terms (thereby capturing both foreign price developments and exchange rate movements), wage developments and the output gap. The last two variables provide a link between developments in the labour market and the real economy, respectively, to prices. In the long run, the GDP deflator depends on domestic cost pressures, proxied by the unit labour costs, the growth of which is determined by the excess of wage growth over labour productivity. We also include an additional variable, TSR, to capture the effects of indirect taxes on prices.

Dependent Variable: DLOG(PGDP)
Sample (adjusted): 2000Q3 2012Q4
Included observations: 50 after adjustments
DLOG(PGDP) = C_PGDP(1) + C_PGDP(2)*DLOG(PGDP(-4)) + C_PGDP(3)
*DLOG(CMD1(-1)) + C_PGDP(4)*DLOG(TOTWAGE(-1)) + C_PGDP(5)
GDPFGAP/100 + C_PGDP(6)(LOG(PGDP(-1))-LOG(@MOVAV(ULC(
-1),4))) + C_PGDP(8)*@SEAS(2)/100 + C_PGDP(9)*@SEAS(3)/100 +
C_PGDP(10)*@SEAS(4)/100 + 0.12*LOG(TSR(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C_PGDP(1)	2.021272	0.487505	4.146154	0.0002
C_PGDP(2)	0.557385	0.099456	5.604349	0.0000
C_PGDP(3)	0.153907	0.099253	1.550654	0.1287
C_PGDP(4)	0.231057	0.064278	3.594641	0.0009
C_PGDP(5)	0.409197	0.139976	2.923343	0.0056
C_PGDP(6)	-0.386304	0.092475	-4.177373	0.0002
C_PGDP(8)	1.678801	0.550719	3.048383	0.0040
C_PGDP(9)	-0.707834	0.595013	-1.189610	0.2410
C_PGDP(10)	-1.052045	0.616260	-1.707144	0.0954

R-squared	0.924268	Durbin-Watson stat	2.187184
Adjusted R-squared	0.909491	F-statistic	62.54751
S.E. of regression	0.007710	Prob(F-statistic)	0.000000





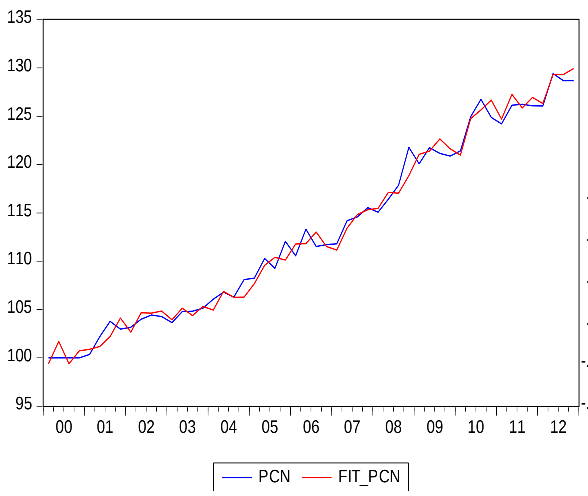
C11. Consumption deflator

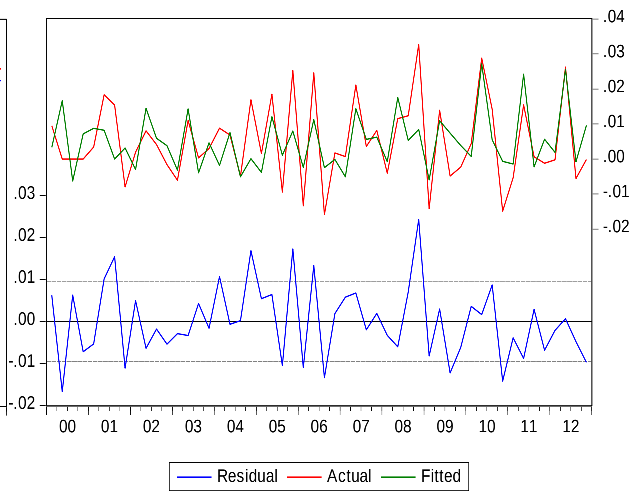
In the short run, consumer prices depend on lagged oil prices in euro terms and the unemployment gap; in the long run, consumer prices are a weighted average of domestic and foreign prices. This means that all those domestic factors that have an impact on price setting developments – developments in wages, unit labour costs and the cyclical position of the economy – will have an impact on consumer prices via the inclusion of the GDP deflator.

Dependent Variable: DLOG(PCN)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(PCN)=C_PCN(1) + C_PCN(2)*DLOG(BRENT_EUR(-1)) +
C_PCN(3)*URBGAP(-4)/100 + C_PCN(5)*DLOG(EENM1(-1)) +
C_PCN(6)*(LOG(PCN(-1))-0.45*LOG(PM(-1))-0.55*LOG(PGDP(-1))) +
C_PCN(8)*@SEAS(2)/100 + C_PCN(9)*@SEAS(3)/100 + C_PCN(10)
*@SEAS(4)/100 + 0.15*DLOG(PGDP(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C_PCN(1)	0.003822	0.002946	1.297088	0.2014
C_PCN(2)	0.025225	0.010735	2.349872	0.0233
C_PCN(3)	-0.524001	0.298148	-1.757522	0.0858
C_PCN(5)	0.310130	0.182949	1.695171	0.0971
C_PCN(6)	-0.069254	0.045898	-1.508858	0.1385
C_PCN(8)	0.515750	0.406374	1.269150	0.2111
C_PCN(9)	-0.879755	0.419500	-2.097151	0.0418
C_PCN(10)	0.018780	0.413084	0.045463	0.9639

R-squared	0.413012	Durbin-Watson stat	2.498978
Adjusted R-squared	0.319627	F-statistic	4.422698
S.E. of regression	0.009530	Prob(F-statistic)	0.000860





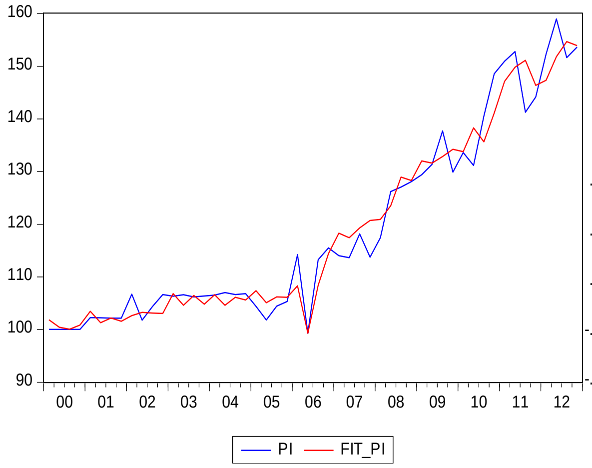
C12. Investment deflator

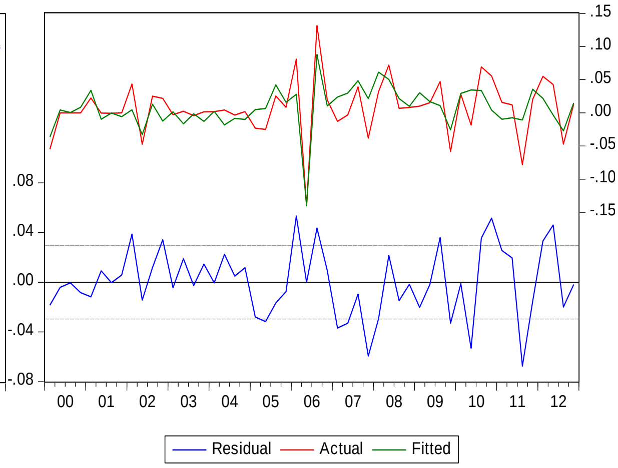
In the long run, the investment deflator is a weighted average of the GDP deflator and import deflator. The short-run relation allows for a linear time trend which starts from the first quarter of 2006 and captures the statistical break evident in the investment deflator series from 2006 onwards. Otherwise,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

Dependent Variable: DLOG(PI)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(PI) = C_PI(1) + C_PI(2)*DLOG(PGDP(-1)) + C_PI(4)*(LOG(PI(-1)) -0.6*LOG(PGDP(-1))-0.4*LOG(PM(-1))) + C_PI(5)*TREND06 + C_PI(6) *@SEAS(2) + C_PI(7)*@SEAS(3) + C_PI(8)*@SEAS(4) + C_PI(9) *D06Q2

	Coefficient	Std. Error	t-Statistic	Prob.
C_PI(1)	0.034064	0.010308	3.304720	0.0019
C_PI(2)	0.409671	0.343977	1.190985	0.2400
C_PI(4)	-0.587256	0.109317	-5.372066	0.0000
C_PI(5)	0.002837	0.000652	4.351189	0.0001
C_PI(6)	-0.041936	0.021096	-1.987887	0.0531
C_PI(7)	-0.033653	0.016240	-2.072196	0.0441
C_PI(8)	-0.025641	0.011902	-2.154346	0.0367
C_PI(9)	-0.125766	0.031068	-4.048077	0.0002

R-squared	0.574651	Durbin-Watson stat	1.777029
Adjusted R-squared	0.506982	F-statistic	8.492084
S.E. of regression	0.029576	Prob(F-statistic)	0.000002





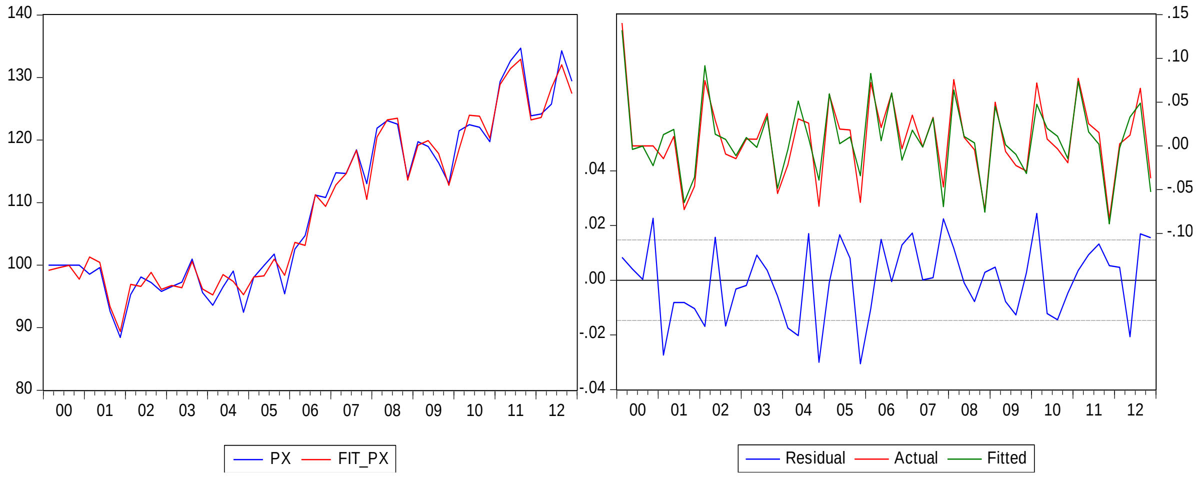
C13. Export deflator

Similar to the other deflators, the export deflator is determined in the long run by import prices – measured by the import deflator – and domestic price pressures – measured by the GDP deflator. In the short run, the export deflator is driven contemporaneously by imported inflation and by domestic price pressures with a lag.

Dependent Variable: DLOG(PX)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(PX)=C_PX(1) + C_PX(2)*DLOG(PM) + C_PX(3)*DLOG(PGDP(-4)) + C_PX(4)*(LOG(PX(-1)) - 0.75*LOG(PM(-1)) - 0.25*LOG(PGDP(-1))) + C_PX(5)*@SEAS(2)/100 + C_PX(6)*@SEAS(3)/100 + C_PX(7) *@SEAS(4)/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_PX(1)	-0.002869	0.008313	-0.345179	0.7316
C_PX(2)	0.877844	0.066720	13.15707	0.0000
C_PX(3)	0.682263	0.183165	3.724853	0.0005
C_PX(4)	-0.437509	0.121471	-3.601763	0.0008
C_PX(5)	-0.122388	0.725078	-0.168793	0.8667
C_PX(6)	0.257732	1.040813	0.247626	0.8056
C_PX(7)	-1.979255	1.136769	-1.741123	0.0885

R-squared	0.907079	Durbin-Watson stat	2.022534
Adjusted R-squared	0.894690	F-statistic	73.21398
S.E. of regression	0.014713	Prob(F-statistic)	0.000000



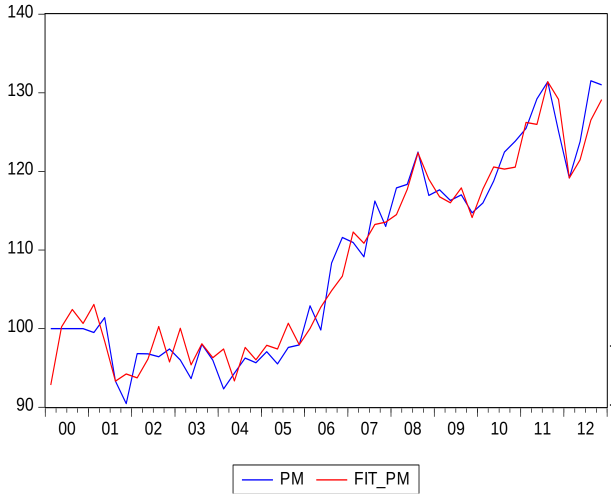
C14. Import deflator

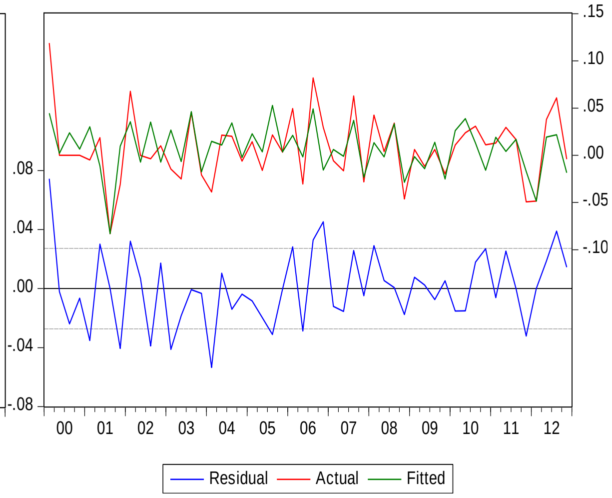
Both the equilibrium level and the dynamics of the import deflator depend on Malta's trading partners' export prices. This variable is a weighted average of the export prices of trading partners, with weights reflecting each country's relative share in Maltese imports of goods.

Dependent Variable: DLOG(PM)
Sample: 2000Q1 2012Q4
Included observations: 52
DLOG(PM) = C_PM(1) + C_PM(2)*DLOG(CMD1) + C_PM(3)*DLOG(PGDP(
-1)) + C_PM(4)*LOG(PM(-1)/CMD1(-1)) + C_PM(5)*@SEAS(2) +
C_PM(6)*@SEAS(3) + C_PM(7)*@SEAS(4) + C_PM(8)*D01Q3 +
C_PM(9)*D12Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C_PM(1)	0.031556	0.008974	3.516170	0.0010
C_PM(2)	0.568718	0.349742	1.626107	0.1112
C_PM(3)	0.703254	0.330163	2.130018	0.0389
C_PM(4)	-0.090882	0.053264	-1.706240	0.0952
C_PM(5)	-0.053073	0.019645	-2.701537	0.0098
C_PM(6)	-0.013494	0.015438	-0.874058	0.3869
C_PM(7)	-0.028214	0.011128	-2.535475	0.0149
C_PM(8)	-0.101088	0.029022	-3.483153	0.0012
C_PM(9)	-0.060029	0.029890	-2.008346	0.0509

R-squared	0.512764	Durbin-Watson stat	1.970476
Adjusted R-squared	0.422116	F-statistic	5.656623
S.E. of regression	0.027263	Prob(F-statistic)	0.000064





House prices, credit and banks' asset quality

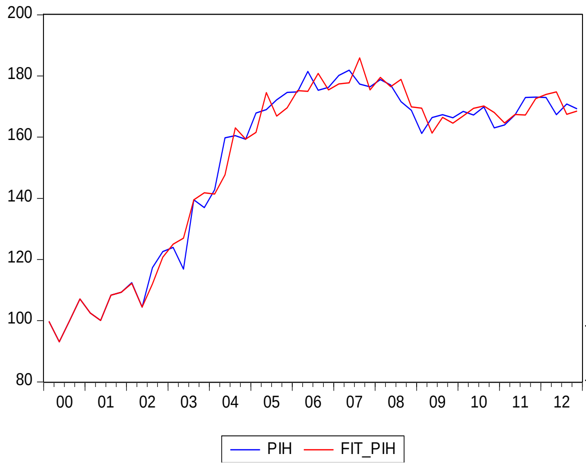
C15. House prices

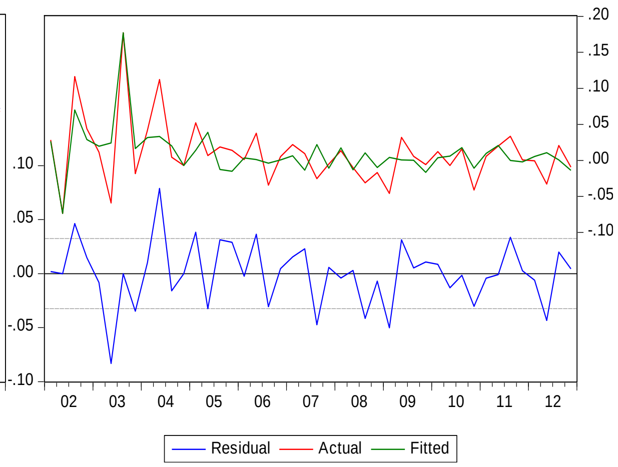
In the long run, house prices are driven by disposable income per capita. So as to ensure the affordability of house prices, their long-run elasticity with respect to disposable income per capita is restricted to one. The short-run dynamics are affected by bank credit for mortgages, disposable income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

Dependent Variable: DLOG(PIH)
Sample: 2002Q1 2012Q4
Included observations: 44
DLOG(PIH) = C_PIH(1) + C_PIH(2)*DLOG(HC(-1)) + 0.2*DLOG(YPD(-1)
/POP(-1)) + C_PIH(3)*D(URB(-1))/100 + C_PIH(4)*(LOG(PIH(-1))
-LOG(YPD(-1)/POP(-1))) + C_PIH(5)*D02Q2/100 + C_PIH(6)*D03Q3
/100 + C_PIH(7)*@SEAS(2)/100 + C_PIH(8)*@SEAS(3)/100 +
C_PIH(9)*@SEAS(4)/100

	Coefficient	Std. Error	t-Statistic	Prob.
C_PIH(1)	0.403447	0.192167	2.099466	0.0431
C_PIH(2)	0.808643	0.322683	2.506002	0.0170
C_PIH(3)	-1.908240	1.233600	-1.546888	0.1309
C_PIH(4)	-0.097911	0.045663	-2.144228	0.0390
C_PIH(5)	-8.322764	3.823568	-2.176701	0.0363
C_PIH(6)	15.58024	3.675854	4.238535	0.0002
C_PIH(7)	-0.063043	1.447261	-0.043560	0.9655
C_PIH(8)	-0.446519	1.423431	-0.313692	0.7556
C_PIH(9)	-1.405778	1.455319	-0.965959	0.3407

R-squared	0.562100	Durbin-Watson stat	2.237801
Adjusted R-squared	0.462008	F-statistic	5.615862
S.E. of regression	0.032479	Prob(F-statistic)	0.000132





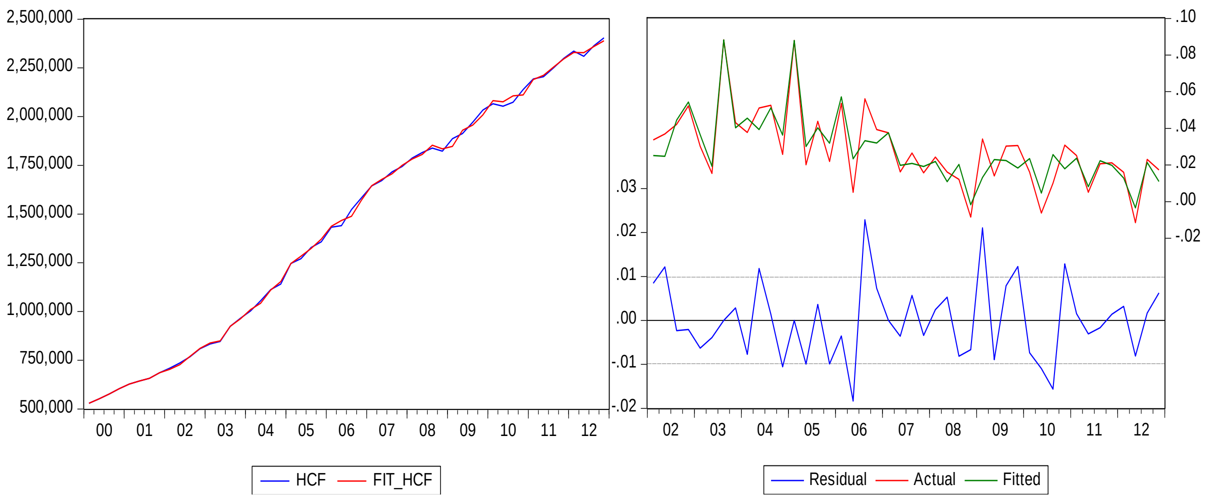
C16. Bank loans for mortgages

Real housing credit in the long run depends on real house prices with an elasticity of one and on the real interest rate on mortgages. Its short-run dynamics are driven by lagged values of mortgage credit, real disposable income and real house prices. In the short run, developments in bank asset quality for the household sector, proxied by the non-performing loan ratio for households, have an adverse effect on mortgage credit.

Dependent Variable: DLOG(HCF)
Sample: 2002Q1 2012Q4
Included observations: 44
DLOG(HCF) = C_HC(1) + C_HC(2)*DLOG(HCF(-4)) + C_HC(3)
*DLOG(PIHF) + C_HC(4)*DLOG(YPDF(-3)) + C_HC(5)*D(NPLHHRAT)
/100 + C_HC(6)*LOG(HCF(-1)/PIHF(-1)) + C_HC(7)*HCRATF(-1) +
C_HC(8)*D03Q3 + C_HC(9)*D05Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C_HC(1)	0.262228	0.082303	3.186137	0.0030
C_HC(2)	0.194685	0.096557	2.016262	0.0515
C_HC(3)	0.165334	0.043007	3.844338	0.0005
C_HC(4)	0.141296	0.063189	2.236070	0.0318
C_HC(5)	-1.769514	0.620153	-2.853350	0.0072
C_HC(6)	-0.025274	0.008361	-3.022897	0.0047
C_HC(7)	-0.398640	0.207250	-1.923473	0.0626
C_HC(8)	0.024905	0.012827	1.941563	0.0603
C_HC(9)	0.031654	0.011226	2.819720	0.0079

R-squared	0.818329	Durbin-Watson stat	2.315635
Adjusted R-squared	0.776804	F-statistic	19.70702
S.E. of regression	0.009849	Prob(F-statistic)	0.000000



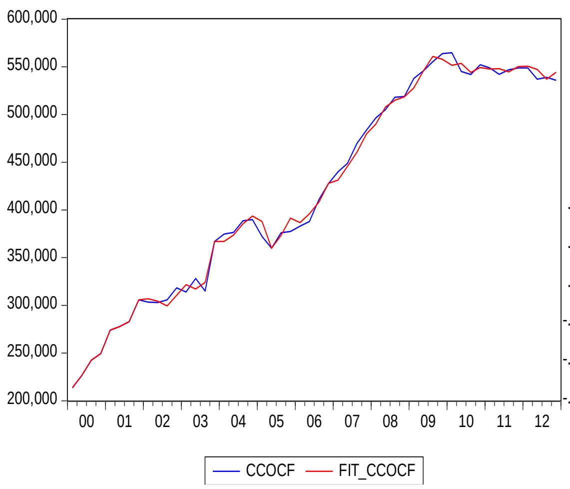
C17. Bank loans for consumer credit

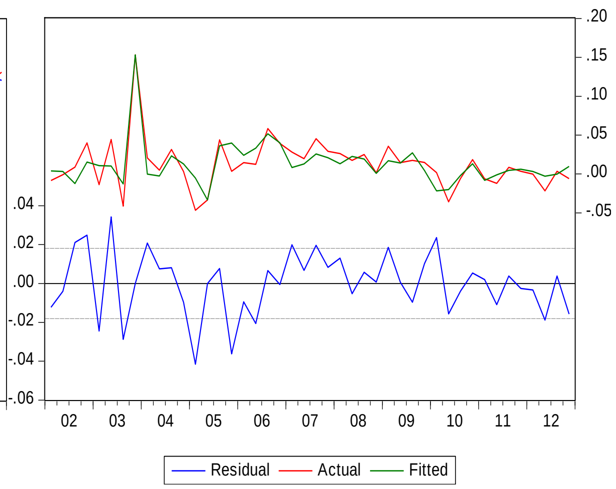
In the long run, real consumer and other credit is positively affected by real private consumption and adversely by bank asset quality for the household sector, proxied by the non-performing loan ratio for households. Over the short run it is influenced by developments in private consumption growth, real interest rates on consumer credit and real house prices.

Dependent Variable: DLOG(CCOCF)
Sample: 2002Q1 2012Q4
Included observations: 44
DLOG(CCOCF) = C_CC(1) + C_CC(2)*DLOG(CNF) + C_CC(3)
*D(CCOCRATF(-1)) + C_CC(4)*DLOG(PIHF(-1)) + C_CC(5)
*LOG(CCOCF(-1)) + C_CC(6)*LOG(CNF(-1)) + C_CC(7)*NPLHHRAT(
-1)/100 + C_CC(8)*D03Q4 + C_CC(9)*D05Q2

	Coefficient	Std. Error	t-Statistic	Prob.
C_CC(1)	-1.647361	1.298542	-1.268623	0.2129
C_CC(2)	0.254953	0.087113	2.926710	0.0060
C_CC(3)	-1.635970	0.692752	-2.361553	0.0239
C_CC(4)	0.160540	0.080074	2.004908	0.0528
C_CC(5)	-0.138884	0.036072	-3.850152	0.0005
C_CC(6)	0.259056	0.121509	2.131999	0.0401
C_CC(7)	-1.053939	0.315220	-3.343506	0.0020
C_CC(8)	0.104735	0.023678	4.423292	0.0001
C_CC(9)	-0.058905	0.019650	-2.997758	0.0050

R-squared	0.741692	Durbin-Watson stat	2.165754
Adjusted R-squared	0.682650	F-statistic	12.56211
S.E. of regression	0.018050	Prob(F-statistic)	0.000000





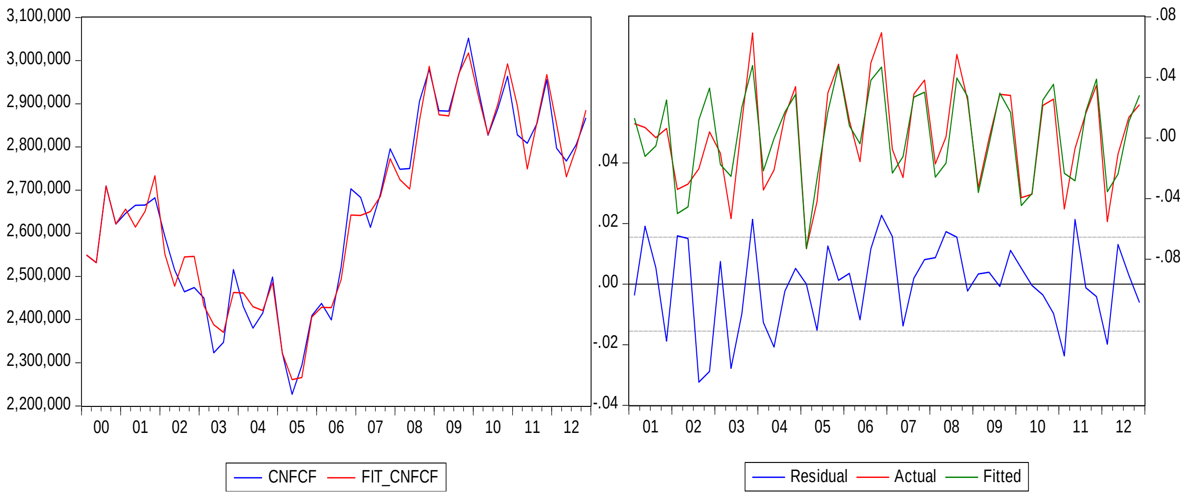
C18. Bank loans to non-financial corporations

In the long run, bank credit to NFCs is assumed to remain as a fixed share of GDP. In the short run, it is affected positively by developments in real GDP growth and negatively by the real interest rate to NFCs and by non-performing loans in the NFC sector.

Dependent Variable: DLOG(CNFCF)
Sample: 2001Q1 2012Q4
Included observations: 48
DLOG(CNFCF) = C_CNFC(1) + C_CNFC(2)*DLOG(GDPF(-4)) + C_CNFC(3)*D(NFCRATF(-2)) + C_CNFC(4)*D(NPLNFCRAT(-2))/100 + C_CNFC(5)*LOG(CNFCF(-1)/GDPF(-1)) + C_CNFC(6)*@SEAS(1)/100 + C_CNFC(7)*@SEAS(2)/100 + C_CNFC(8)*@SEAS(3)/100 + C_CNFC(9)*D05Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C_CNFC(1)	0.137206	0.037707	3.638794	0.0008
C_CNFC(2)	0.283430	0.114577	2.473721	0.0178
C_CNFC(3)	-2.620298	0.955876	-2.741252	0.0092
C_CNFC(4)	-0.592121	0.148379	-3.990596	0.0003
C_CNFC(5)	-0.123430	0.047392	-2.604421	0.0130
C_CNFC(6)	-4.130039	0.902310	-4.577186	0.0000
C_CNFC(7)	-6.160156	1.232999	-4.996074	0.0000
C_CNFC(8)	-3.516931	1.393381	-2.524027	0.0158
C_CNFC(9)	-0.053757	0.016525	-3.253022	0.0024

R-squared	0.822212	Durbin-Watson stat	1.970326
Adjusted R-squared	0.785743	F-statistic	22.54537
S.E. of regression	0.015498	Prob(F-statistic)	0.000000



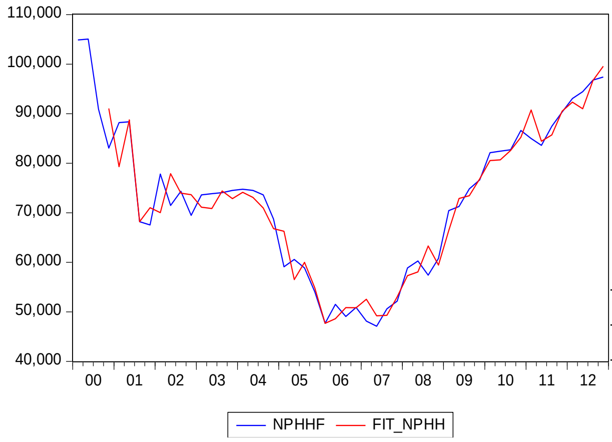
C19. Bank non-performing loans of households

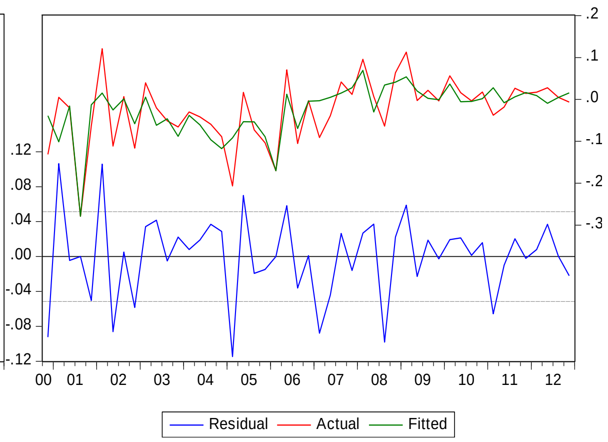
Households' non-performing loans is specified as a share of household credit both in the short and long run. Apart from sector specific credit, in the long run non-performing loans are influenced by real house prices and the real interest rate to households. In the short run, the non-performing loans are adversely affected by developments in real disposable income and positively by the unemployment rate.

Dependent Variable: DLOG(NPHHF/TCHHF)
Sample (adjusted): 2000Q4 2012Q4
Included observations: 49 after adjustments
DLOG(NPHHF/TCHHF) = C_NPH(1) + C_NPH(2)*DLOG(YPDF(-2)) +
C_NPH(3)*D(URB(-4))/100 + C_NPH(4)*LOG(NPHH(-1)/TCHH(-1)) +
C_NPH(5)*HHRATF(-1) + C_NPH(6)*LOG(PIHF(-1)) + C_NPH(7)
*D06Q1 + C_NPH(8)*D01Q3

	Coefficient	Std. Error	t-Statistic	Prob.
C_NPH(1)	1.457695	0.405545	3.594413	0.0009
C_NPH(2)	-0.544044	0.283701	-1.917667	0.0621
C_NPH(3)	2.344337	1.509959	1.552583	0.1282
C_NPH(4)	-0.204001	0.039307	-5.189875	0.0000
C_NPH(5)	1.505509	0.795805	1.891807	0.0656
C_NPH(6)	-0.444758	0.103162	-4.311259	0.0001
C_NPH(7)	-0.135249	0.053746	-2.516443	0.0159
C_NPH(8)	-0.237499	0.056012	-4.240102	0.0001

R-squared	0.621202	Durbin-Watson stat	2.694530
Adjusted R-squared	0.556529	F-statistic	9.605290
S.E. of regression	0.051487	Prob(F-statistic)	0.000001





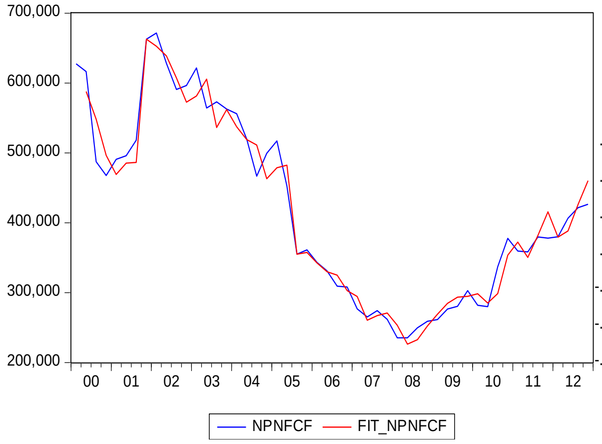
C20. Bank non-performing loans of non-financial corporations

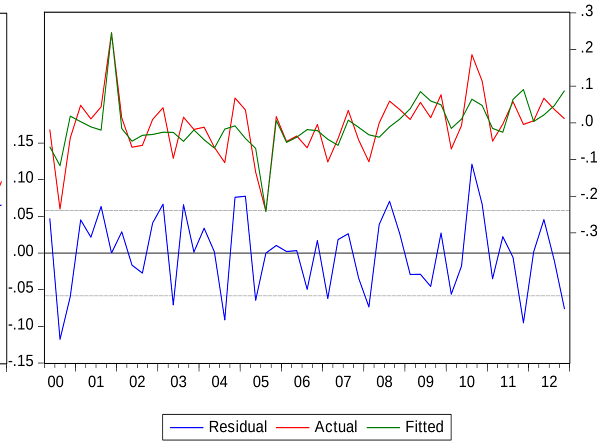
In the long run, NFCs' non-performing loans are assumed to move proportionately with bank credit to NFCs. In addition, they also depend on real investment in dwellings, underling the important role of the property sector in driving developments in non-performing loans. In the short run, non-performing loans depend on developments in real GDP, the unemployment rate and on the real interest rate to NFCs.

Dependent Variable: DLOG(NPNFCF)
Sample (adjusted): 2000Q2 2012Q4
Included observations: 51 after adjustments
DLOG(NPNFCF) = C_NPF(1) + C_NPF(2)*DLOG(@MOVAV(GDPF(-1),2)) +
C_NPF(3)*D(NFCRATF(-3)) + C_NPF(4)*D(URB(-2))/100 + C_NPF(5)
*LOG(NPNFC(-1)/CNFC(-1)) + C_NPF(6)*LOG(DWELLINGF(-1)) +
C_NPF(7)*@SEAS(1) + C_NPF(8)*@SEAS(2) + C_NPF(9)*@SEAS(3)
+ C_NPF(10)*D01Q4 + C_NPF(11)*D05Q3

	Coefficient	Std. Error	t-Statistic	Prob.
C_NPF(1)	0.688845	0.258106	2.668843	0.0109
C_NPF(2)	-1.880330	0.682260	-2.756030	0.0088
C_NPF(3)	2.833589	3.209661	0.882831	0.3826
C_NPF(4)	3.082441	1.796478	1.715825	0.0939
C_NPF(5)	-0.050412	0.022491	-2.241410	0.0306
C_NPF(6)	-0.060949	0.023358	-2.609344	0.0127
C_NPF(7)	-0.097793	0.036987	-2.643974	0.0116
C_NPF(8)	-0.253926	0.082037	-3.095274	0.0036
C_NPF(9)	-0.152682	0.057355	-2.662071	0.0111
C_NPF(10)	0.246839	0.062601	3.943041	0.0003
C_NPF(11)	-0.192570	0.062153	-3.098300	0.0036

R-squared	0.613975	Durbin-Watson stat	2.070758
Adjusted R-squared	0.517469	F-statistic	6.362019
S.E. of regression	0.058381	Prob(F-statistic)	0.000009





Interest rates

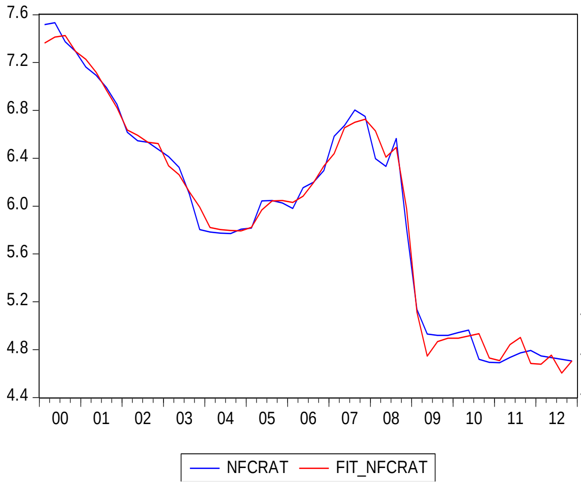
The model contains three different bank lending rates, modelled through a simple interest rate pass-through approach. In all three cases, lending rates are dependent both in the short run and long run on a benchmark rate, in this case the ECB policy rate. The long-run coefficient shows the equilibrium pass-through, while the short-run coefficients show the impact pass-through. In addition, we also model the interest rate pass-through from the policy interest rate to the 10-year government bond yield. In addition to the policy rate, the spread between the domestic and the German 10-year bond yields also feature as an explanatory variable in the latter equation, capturing the tensions in the sovereign bond markets in recent years. Another equation links the 10-year government bond yield to the interest payments by government on its debt.

C21. Lending rate to non-financial corporations

Dependent Variable: D(NFCRAT)
Sample: 2000Q1 2012Q4
Included observations: 52
D(NFCRAT) = C_RF(1) + C_RF(2)*D(POLICYRAT) + C_RF(3)*NFCRAT(-1)
+ C_RF(4)*POLICYRAT(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
C_RF(1)	0.702868	0.296147	2.373374	0.0217
C_RF(2)	0.546622	0.043872	12.45942	0.0000
C_RF(3)	-0.166801	0.072466	-2.301785	0.0257
C_RF(4)	0.094058	0.047052	1.999017	0.0513

R-squared	0.768348	Durbin-Watson stat	1.751072
Adjusted R-squared	0.753869	F-statistic	53.06898
S.E. of regression	0.090051	Prob(F-statistic)	0.000000



C22. Lending rate for mortgages

Dependent Variable: D(HCRAT)
Sample (adjusted): 2000Q2 2012Q4
Included observations: 51 after adjustments
D(HCRAT) = C_RM(1) + C_RM(2)*D(POLICYRAT) + C_RM(3)*HCRAT(-1) +
C_RM(4)*POLICYRAT(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
C_RM(1)	0.437018	0.198005	2.207108	0.0322
C_RM(2)	0.606402	0.083522	7.260427	0.0000
C_RM(3)	-0.162677	0.074276	-2.190164	0.0335
C_RM(4)	0.106564	0.057093	1.866489	0.0682

R-squared	0.557555	Durbin-Watson stat	2.154703
Adjusted R-squared	0.529314	F-statistic	19.74265
S.E. of regression	0.173628	Prob(F-statistic)	0.000000

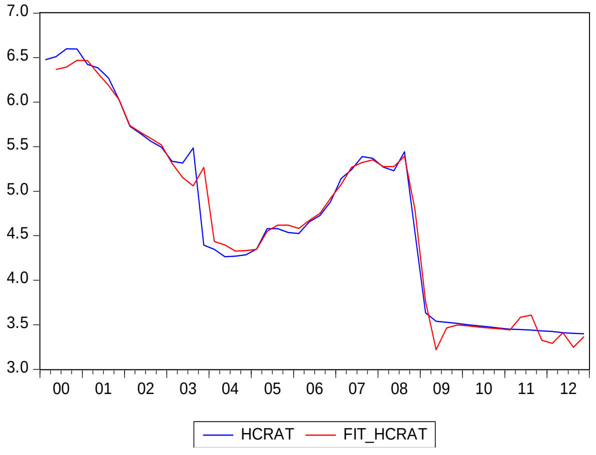
C23. Lending rate for consumer credit

Dependent Variable: D(CCOCRAT)
Sample (adjusted): 2000Q2 2012Q4
Included observations: 51 after adjustments

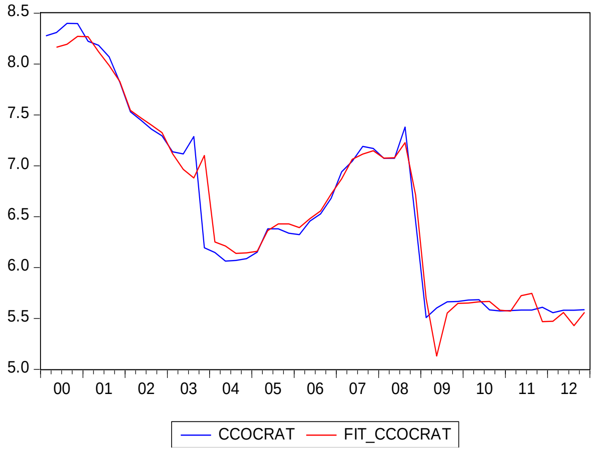
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.721123	0.342859	2.103261	0.0408
D(POLICYRAT)	0.596383	0.090078	6.620731	0.0000
CCOCRAT(-1)	-0.142937	0.070946	-2.014741	0.0497
POLICYRAT(-1)	0.073766	0.048592	1.518087	0.1357

R-squared	0.519776	Durbin-Watson stat	2.135684
Adjusted R-squared	0.489124	F-statistic	16.95702
S.E. of regression	0.187042	Prob(F-statistic)	0.000000

Mortgages



Consumer Credit



C24. 10-year government bond yield

Dependent Variable: D(GOV10)
Sample: 2000Q1 2012Q4
Included observations: 52
D(GOV10) = C_GOV(1) + C_GOV(2)*D(POLICYRAT) + C_GOV(3)
*D(POLICYRAT(-1)) + C_GOV(4)*D(SPREAD) + C_GOV(5)*GOV10(-1)
+ C_GOV(6)*POLICYRAT(-1) + C_GOV(7)*D11Q1

	Coefficient	Std. Error	t-Statistic	Prob.
C_GOV(1)	0.333506	0.178389	1.869544	0.0681
C_GOV(2)	0.380398	0.085744	4.436449	0.0001
C_GOV(3)	-0.348345	0.089733	-3.882028	0.0003
C_GOV(4)	0.268612	0.078383	3.426916	0.0013
C_GOV(5)	-0.134945	0.045358	-2.975132	0.0047
C_GOV(6)	0.089778	0.022744	3.947311	0.0003
C_GOV(7)	0.610913	0.149000	4.100096	0.0002

R-squared	0.521247	Durbin-Watson stat	2.083015
Adjusted R-squared	0.457413	F-statistic	8.165687
S.E. of regression	0.143074	Prob(F-statistic)	0.000005

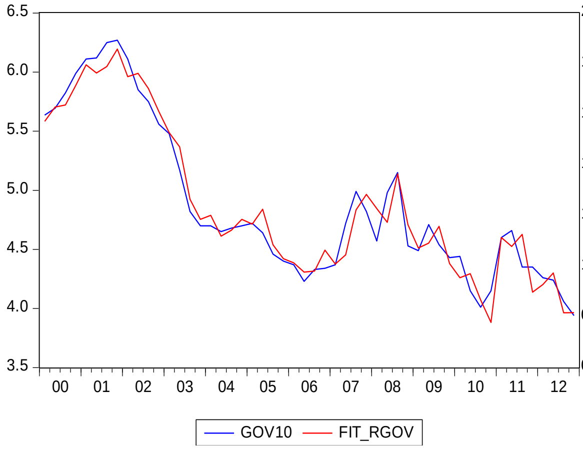
C25. Interest payment on government debt

Dependent Variable: IPD
Sample: 2000Q1 2012Q4
Included observations: 52
IPD = C_IPD(1) + C_IPD(2)*GOV10

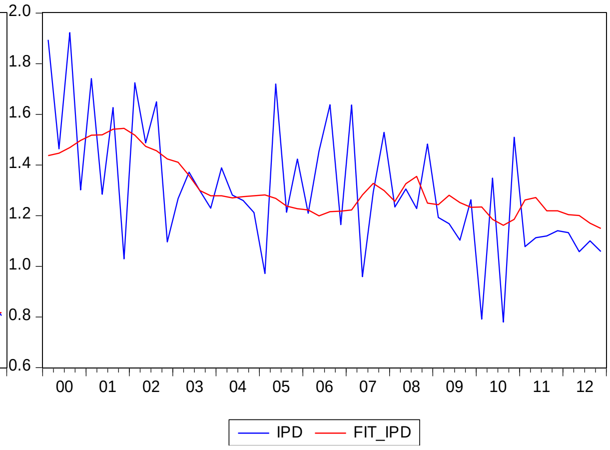
	Coefficient	Std. Error	t-Statistic	Prob.
C_IPD(1)	0.481806	0.239617	2.010732	0.0498
C_IPD(2)	0.169478	0.048795	3.473288	0.0011

R-squared	0.194377	Durbin-Watson stat	2.543512
Adjusted R-squared	0.178264	F-statistic	12.06373
S.E. of regression	0.231148	Prob(F-statistic)	0.001071

10-year government bond yield



Interest payments on debt



Annex D: Fiscal block

Table D1: Revenue Side

		Share in Total Revenue (%)	Modelling Strategy	Details
	Revenue		Identity	
	Current Revenue	95.7	Identity	
	Direct Taxes	33.0	Identity	
1	Direct Taxes on Households	16.3	Endogenous: rate times base	Base: Compensation of Employees + Income of the Self-Employed
2	Direct Taxes on Corporations	16.7	Endogenous: rate times base	Base: GDP
	Indirect Taxes	35.2	Identity	
3	VAT	19.8	Endogenous: rate times base	Base: Private Consumption
4	Excise Duties	7.3	Endogenous: rate times base	Base: Private Consumption
5	Other Indirect Taxes	8.1	Endogenous: rate times base	Base: Private Consumption
	Social Security Contributions	18.9	Identity	
	Actual SSC	15.6	Identity	
	Employers' SSC	7.1	Identity	
6	Private	5.1	Endogenous: rate times base	Base: Compensation of Employees in the Private Sector
7	Government	2.1	Endogenous: rate times base	Base: Compensation of Employees in the Public Sector
	Employees' SSC	7.0	Identity	
8	Private	5.4	Endogenous: rate times base	Base: Compensation of Employees in the Private Sector
9	Government	1.6	Endogenous: rate times base	Base: Compensation of Employees in the Public Sector
10	Self-Employed SSC	1.4	Endogenous: rate times base	Base: Income of the Self-Employed
11	Imputed SSC	3.4	Endogenous: rate times base	Base: Compensation of Employees in the Public Sector
12	Sales	4.8	Endogenous: rate times base	Base: GDP
13	Property Income	3.1	Endogenous: maintains share	Share of: Government Revenue
14	Other	0.7	Endogenous: maintains share	Share of: Government Revenue
	Capital Revenue	4.3	Identity	
15	Capital Taxes	0.6	Endogenous: maintains share	Share of: Government Revenue
16	Capital Transfers	3.7	Endogenous: maintains share	Share of: Government Revenue

Table D2: Expenditure Side

		Share in Total Expenditure (%)	Modelling Strategy	Details
	Expenditure		Identity	
	Current Expenditure	92.6	Identity	
1	Compensation of Employees	31.7	Endogenous	(Public Sector Employees x Average Wage in the Public Sector) + Employers' NI Contributions paid by the Government + Imputed NI Contributions, with public sector employees and the average wage in the public sector moving in line with their private sector counterparts
	Social Benefits	32.1	Identity	
	Social Benefits in Cash	30.4	Identity	
2	Pension Benefits	24.5	Endogenous	Pension Beneficiaries x Average Pension Paid, with the latter adjusted according to growth in wages and prices
3	Unemployment Benefits	1.2	Endogenous	Number of Unemployed x Average Unemployment Benefit Paid, with the latter adjusted according to growth in prices
4	Other Social Benefits in Cash	4.8	Endogenous: maintains share	Share of: Social Benefits in Cash
5	Social Benefits in Kind	1.7	Endogenous: maintains share	Share of: Social Benefits
6	Interest	7.3	Endogenous	Government Debt in previous period x Interest Rate on Government Debt, with latter dependent on Government 10-Year Bond Yield (via behavioural equation), which is, in turn, dependent on the Policy Rate (via behavioural equation)
7	Intermediate Consumption	15.3	Endogenous: rate times base	Base: GDP
8	Subsidies	2.3	Endogenous: maintains share	Share of: Government Expenditure
9	Other	3.9	Endogenous: maintains share	Share of: Government Expenditure
	Capital Expenditure	7.4	Identity	
10	Investment	5.8	Endogenous: maintains share	Share of: Private Investment
11	Capital Transfers	1.6	Endogenous: maintains share	Share of: Government Expenditure