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Introducing the Portuguese Macro-Fiscal (PMF) model: A framework for projecting the Portuguese economy*

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Abstract

This paper gives an overview of the current version of the Portuguese Macro-Fiscal (PMF) model, an estimated quarterly macroeconometric model of the Portuguese economy that is the central tool used by the Portuguese Public Finance Council (CFP) for producing its medium-term macroeconomic projections. The specification of the macro side of the model broadly follows those developed by several Eurosystem central banks, in the tradition of the neoclassical synthesis, appropriately adapted to the Portuguese case. The key extension to this framework – one that reflects CFP's mission – has been the inclusion of a rich, disaggregated fiscal block. The structure and specification of the model are briefly discussed, and its properties are illustrated through shock simulation exercises.

JEL classifications: C3, C5, E1, E2.
Keywords: Macroeconometric model; Forecast; Simulation; Portugal.

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1 Introduction

The mission of the Portuguese Public Finance Council (CFP – Conselho das Finanças Públicas) is "to conduct an independent assessment of the consistency, compliance with the stated objectives and the sustainability of public finances, while promoting fiscal transparency" (CFP, 2014). The ability to form its own views regarding both the current state and the likely evolution of the Portuguese economy is a crucial requirement for CFP to fulfil its mission. Towards that end, CFP has developed a suite of models, including a range of tools tailored to its different needs and covering the relevant projection horizons.

This paper introduces the current version of the Portuguese Macro-Fiscal (PMF) model, an estimated quarterly macroeconometric model of the Portuguese economy. This tool has been developed to be used: (*i*) in the assessment of economic and fiscal developments in the Portuguese economy; (*ii*) in producing medium-term macroeconomic projections; and (*iii*) in counterfactual policy simulation exercises. The PMF model is the central tool used by CFP in producing the 5-year macroeconomic projections for the Portuguese economy it publishes twice a year – although those are also informed by a range of supporting models, including vector-autoregressive (VAR) models of quarterly real gross domestic product (GDP) and inflation, and a collection of bridge and mixed-data sampling (MIDAS) models which provide short-term forecasts of GDP and its components.

The modelling strategy broadly follows the European Central Bank's (ECB) Area-Wide Model, summarized in Fagan et al. (2005), and the country blocks of the ECSB's Multi-Country Model.[1] However, it is important to note that the PMF framework is under constant review and development, to better capture the Portuguese economy. For example, for a small open economy a proper modelling of the external sector is crucial; this has prompted several refinements compared to the initial setup. In the near future, further refinements are planned, to introduce rational expectations and to model housing investment and the financial sector. The current version of the model is estimated on ESA 2010 quarterly national accounts data over 1995Q1 : 2016Q4.

The construction of such a rich macroeconometric model entails several challenges, as there is no universally accepted benchmark framework that can be used as a guide. This lack of consensus results from several causes. First, there are multiple macroeconomic modelling approaches available from the literature, upon which each institution might base their own models. Second, there is a wide diversity of institutions with very different economic, historic, demographic, institutional and structural contexts. For example, they may have an international scope (*e.g.* International Monetary Fund, European Central Bank, World Bank) or remain nation-based (such as Bank of Portugal or CFP), implying very different objectives from institution to institution, which in turn may require the adoption of different assumptions and methods in building a suitable model for each case. Third, there are variables for which satisfactory historical time series are not available. Fourth, those time series that are used in estimating or calibrating model parameters can suffer from structural breaks that can lead to biased estimation results, if not properly taken into account.

Despite those challenges and – as with any model – its limitations, in practice the PMF framework has proven to be extremely useful in forecasting and simulation exercises, as it gener-

[1] See, for example, Fenz and Spitzer (2005), Vetlov and Warmedinger (2006), Angelini et al. (2006b), Angelini et al. (2006a), and Fagan and Morgan (2006).

ates credible dynamics and tends to produce sensible predictions. That notwithstanding, expert judgement can be overlaid in order to address any specific factors that the model might not accurately capture. In that event, PMF also provides a coherent framework for assessing the impact and consistency of those judgements.

The remainder of this paper is structured as follows. Section 2 provides a brief overview of the structure of the model, detailing the specification of the theoretical side and describing the base for some behavioural equations of prominent variables. Section 3 presents simulation results for five macroeconomic shocks, and Section 4 concludes.

2 Model Overview and Structure

The PMF model describes Portugal as a small open economy and a member state of the European Economic and Monetary Union (EMU, informally designated as Euro Area), which implies that the direct influence of Portuguese economic activity on the rest of the world is negligible, and so the set of variables related to external economic conditions and monetary policy can be treated as exogenous.

The model specification combines a microfounded neoclassical long-run equilibrium with short-run estimated Keynesian dynamics, captured through an error-correction (ECM) framework. Where relationships are specified in ECM form, estimations are carried out using the Engle and Granger (1987) two-step procedure. The long-run equilibrium is determined by the supply-side of the model, whereas in the short-run output is determined by the demand side, as prices and wages adjust sluggishly towards equilibrium.

The current version of the model is estimated on ESA 2010 quarterly national accounts data over 19951 : 2016Q4. The model comprises a total of 137 equations, 40 of which are estimated behavioural equations. Data is taken from Statistics Portugal (INE), Bank of Portugal, IMF and Eurostat sources. The model is coded and simulations are performed in EViews.

2.1 The Supply Block

As in most traditional macroeconometric models, only the supply block is rigorously derived from optimizing neoclassical behaviour. The supply block is especially important in the long run because at that horizon the supply curve is necessarily vertical, with actual and potential output determined by technology, the labour force and the natural rate of unemployment given by the NAIRU (Non-Accelerating Inflation Rate of Unemployment). In the long run prices and nominal wages are fully flexible.

Aggregate supply is represented by a labour-augmenting Cobb-Douglas production function with constant returns to scale:

$$Y = \alpha K^{\beta} \left(e^{\gamma t} L \right)^{1-\beta}$$

where Y is real output, K is the real capital stock, L is total employment and t is a deterministic time trend associated with labour-augmenting technical progress, assumed to grow at a constant rate γ. The production function parameters α and β are, respectively, the technology scale factor and the elasticity of output to capital.

Firms, operating under a monopolistic competitive market for output and with no capital

adjustment costs, maximize their profits given technology and demand for their products. The equilibrium factor demand, investment and employment, and the output price are derived from the firms' optimization first-order conditions:

$$\begin{cases} L = & e^{-\gamma t}\left[\dfrac{Y}{\alpha K^{\beta}}\right]^{\frac{1}{1-\beta}} \\ K = & \dfrac{Y}{\alpha e^{(1-\beta)\gamma t}}\left[\dfrac{\beta w}{(1-\beta)P(r+\delta)}\right]^{1-\beta} \\ \dfrac{w}{P} = & \dfrac{(1-\beta)(\epsilon-1)}{\epsilon}\dfrac{Y}{L} \end{cases}$$

where P is the price of output as measured by the GDP at factor cost deflator, w is the nominal wage rate, $\epsilon > 1$ is the price elasticity of demand for goods and services, r is the real interest rate, δ is the capital depreciation rate and $(r+\delta)$ is the real cost of capital.

In order to determine the long-run levels of output, employment and capital, an additional condition has to be met on the labour-market side: the equilibrium rate of unemployment is to be given by a constant NAIRU. In an economy where firms and unions bargain on nominal wages, real wages are driven by labour productivity and by the rate of unemployment. Real wages depend, in the short run, on observed labour productivity and on the unemployment gap dynamics – a Phillips curve. In the long run real wages converge to their equilibrium, determined by the marginal productivity of labour and the equilibrium condition for prices. Dynamic homogeneity is assumed, implying a long-run vertical Phillips curve.

The marginal productivity conditions for capital and for labour show up as error correction terms in the dynamic equations for private investment and private sector employment, ensuring consistency with the underlying supply-side theoretical framework. Similarly, the equilibrium condition for prices shows up as an error correction term in the dynamic equation for the GDP deflator. NAIRU assumptions along with (exogenous) labour force growth (n) determine the long-run employment level. In the short run employment depends on real wages.

Parameters are determined by inverting the model and solving it with respect to each of them. They are then calibrated on the basis of observed data over 1996Q1:2016Q4:

$$\widehat{\beta} = \overline{\left(\frac{(r+\delta)K}{\frac{w}{P}L + (r+\delta)K}\right)},\ \widehat{\epsilon} = \overline{\left(\frac{PY}{PY - wL - P(r+\delta)K}\right)}$$

$$\widehat{\gamma} = \overline{\left(\Delta \log\left(\frac{Y}{L}\right)\right)},\ \widehat{\alpha} = \overline{\left(\frac{Y}{K^{\widehat{\beta}}\left(e^{\widehat{\gamma}t}L\right)^{1-\widehat{\beta}}}\right)},\ \widehat{n} = \overline{\left(\Delta \log\left(\bar{L}\right)\right)}$$

where $\overline{(.)}$ denotes the sample mean operator. In the current model the quarterly values for those parameters and the NAIRU[2] are the following:

[2]The NAIRU is obtained as follows: consider the Phillips curve

$$\Delta \log w = \Delta \log \widetilde{P} + \phi\left(\Delta \log Y - \Delta \log L\right) + \rho - \eta \log u\,,$$

where ρ is a constant, η the sensitivity of nominal wage increases to the unemployment rate (u) and $\widetilde{P}$ is the price anticipations. Taking the equilibrium condition for prices and considering a constant mark-up rate one has,

$$\Delta \log P = \Delta \log w - \Delta \log Y + \Delta \log L\,,$$

Table 1: Calibrated parameters and NAIRU

$\widehat{\beta}$	$\widehat{\gamma}$	$\widehat{\epsilon}$	$\widehat{\alpha}$	$\widehat{n}$	$\widehat{\delta}$	$NAIRU$
0.349	0.002	2.839	1.562	0.0004	0.013	7.38%

The value for labour augmenting technological progress (γ) corresponds to 0.8% growth per year. The estimated ϵ implies a mark-up of $\epsilon/(\epsilon-1) = 1.54$. The labour force growth rate (n) is approximately 0.2% per year. In the used sample, the steady-state potential growth for the Portuguese economy is estimated as $(1+\widehat{\gamma}) \cdot (1+\widehat{n}) \simeq 1.01\%$ per year. The constant NAIRU obtained is 7.38%. The capital depreciation rate considered out-of-sample is about 5.2% per year.

2.2 Aggregate Demand

Real GDP is broken down into the standard six expenditure components. For all demand equations long-run homogeneity has been imposed in order to ensure compatibility with a long-run steady-state.[3]

Private consumption is a function of real disposable income, real financial wealth, the real long-term interest rate and the unemployment rate. Disposable income is the sum of compensation of employees, public sector transfers to households and other household income (*e.g.*, property income, interest income), minus direct taxes paid by households and social security contributions. Real financial wealth in the model is defined as the sum of accumulated savings, the stock of public debt, net foreign assets and private capital stock, although this is best thought of as a proxy, given that Portugal is an open economy and domestic households are far from owning all assets. The inclusion of the long-run real interest rate controls for intertemporal substitution effects. Finally, changes in the unemployment rate are included in an attempt to capture the effects of uncertainty associated with the future stream of income.

Public consumption is exogenous in nominal terms; however as its deflator is endogenous, modelled as a function of harmonised index of consumer prices (HICP) dynamics and of developments in public wages per civil servant, real public consumption is also endogenous.

Gross fixed capital formation (GFCF) is divided into general government GFCF and private GFCF. The former is modelled as a complementary function of private investment which converges to a constant share of GDP in the long run. The latter is determined by a standard accelerator effect from aggregate output in the short run, and incorporates the gap between actual and desired capital stock in the long run, as described in the previous section. Changes in inventories are determined by a separate estimated equation, which tends to restore a constant ratio of accumulated inventories to real GDP in the long run.

Exports of goods and services are a function of real foreign demand and of a measure of Portuguese-exports price competitiveness. Foreign demand is captured by a trade-weighted average of the real import demand of Portugal's 61 main trading partners, covering both the Euro Area (60% of Portugal's total exports in 2016) and non-euro countries. The long-run

which, once substituted into the Phillips curve gives the relationship between inflation and unemployment:

$$\Delta \log P = \Delta \log \widetilde{P} + (\phi - 1)(\Delta \log Y - \Delta \log L) + \rho - \eta \log u \,.$$

By definition the NAIRU is the unemployment rate which solves for $\Delta \log P = \Delta \log \widetilde{P}$. Given the steady-state growth rates $\Delta \log L = n$ and $\Delta \log Y = \gamma + n$, one obtains: $NAIRU = e^{\frac{-(1-\phi)\gamma+\rho}{\eta}}$.

[3] See on this regard, Angelini et al. (2006a, section 2.3) and Botas and Marques (2002)

elasticity of exports to this foreign demand indicator is constrained to unity in the model. Competitiveness is captured by the ratio of the Portuguese export deflator to foreign import prices (a weighted average of the import deflators for an available sample of 33 out of the previous 61 trading partners). In the short run, exports are also assumed to depend on the nominal effective exchange rate.

Imports of goods and services depend on an indicator of demand for real imports and on relative prices. The import demand indicator[4] is calculated as a weighted sum of real final domestic demand components and exports, with weights set to each expenditure component's average import content in the last three publications of Statistics Portugal concerning input-output matrices (INE, 2016). The long-run elasticity of imports to this demand indicator is constrained to unity. Relative prices are captured by the ratio of the import deflator to domestic prices (as measured by the GDP deflator at factor cost).

2.3 Prices and Wages

The GDP at factor cost deflator is the central price index in PMF. As described in Section 2.1, its long-run level is pinned down by supply conditions. Recall that the model assumes a monopolistic competition setting, allowing the representative firm to retain some market power so that prices include a mark-up over marginal cost. Consistent with that, the long-run error-correction component in the GDP deflator specification has it depending on a constant mark-up and on marginal costs. Short-run price dynamics reflect changes in the wage rate, changes in productivity, and also depend on the output gap.

All other deflators in the model are mainly driven by the GDP deflator at factor cost and by foreign prices. Import and exports prices are determined both by the domestic price level (as measured by the GDP deflator) and by the relevant measure of foreign prices: the trade partners' consumer price index (CPI) in the case of imports, and their import prices in the case of exports – reflecting the fact that the small open Portuguese economy is largely a price taker in the international arena. Import prices are also dependent on the euro-dollar exchange rate and on oil prices. The private consumption deflator, the dynamics of HICP and the GFCF deflator are mainly determined by the GDP at factor cost deflator and import prices.

Nominal wages, modelled as a Phillips curve, are indexed to the private consumption deflator in the short run and to the GDP deflator at factor costs in the long run. The ECM term reflects the relevant first-order condition for profit maximization in the long-run equilibrium, incorporating labour productivity and a constant mark-up. short-run dynamics include a lag of real wages, labour productivity, the wedge between the deflators for consumption and GDP at factor costs, and the gap between observed unemployment and its structural level (NAIRU). The Phillips curve has been estimated imposing a few restrictions on the coefficients, to ensure dynamic homogeneity, making steady-state real wages levels independent of inflation – the curve is vertical in the long run.

2.4 Trade Block

The current account is the sum of the trade balance, net income balance and transfers from the rest of the world. The net income balance is estimated separately, as a function of lagged net

[4]Cardoso et al. (2013) compute a similar indicator for Portugal.

foreign assets (*i.e.*, the net international investment position of the Portuguese economy) and of the nominal short-run interest rate. Net transfers from the rest of the world are assumed to converge to a constant ratio of GDP in the long run. The stock of net foreign assets is calculated from the accumulation of the current account.

2.5 The Fiscal Block

The public sector in PMF is disaggregated into the following key components: government consumption, government investment, transfers paid and received by households, direct taxes paid by households and firms, and indirect taxes.[5] The government budget balance is defined as total receipts minus total primary expenditure and interest payments.

Government consumption and investment are described in Section 2.2. In the long run, the ratios of government consumption to GDP and of public to private investment are assumed to be constant. The (evolution of the) number of civil servants is exogenous, and public sector wages (compensation of employees) are a function of real GDP, HICP and the number of civil servants, making intermediate consumption endogenous. Apart from these, the main variables in the government expenditure side are transfers from general government to households, which include unemployment benefits, pension payments and other social transfers; and subsidies. Interest payments are modelled as an identity, depending on the stock of public debt in the previous period and on the long-term interest rate (as measured by the 10-year bond Maastricht criterion interest rate).

Most components of government revenue are modelled endogenously, based on an error-correction mechanism, where long-run elasticities to the respective macroeconomic bases are calibrated to unity. The elasticities in the short-run dynamics are estimated jointly with specific period-dummies/step-dummies which attempt to capture significant tax revenue legislation changes. For long-run simulations, the model incorporates a fiscal policy rule with respect to indirect tax rates, which become a function of public debt and of the Maastricht public debt criterion of 60 per cent.

2.6 Monetary and Financial Block

The monetary channel in PMF is limited to the role of interest rates: monetary policy is exogenous, as previously indicated. The main monetary policy instrument is the short-term interest rate (as measured by the 3-month euribor), which for projection purposes is taken as given from ECB forecasts. In the long run domestic inflation converges to the Euro Area inflation target, which is set consistent with a yearly 2 per cent average. The current version of the model assumes the exchange rates to also be exogenous. The long-term interest rate is determined by a behavioural equation representing the yield to maturity for government bonds (a function of the short-term interest rate). The main financial channels are given by the flows of interest payments. The model does not include the financial sector; however equations determining financial asset prices (*i.e.*, equities, bonds and real estate) may be added in future versions.

[5]It is worth mention that although the PMF model provides a fiscal outlook, for projections purposes it is adapted to exogenous projections made for the public sector by means of different instruments in the CFP. Nonetheless, the macroeconomic outlook is adapted to and is fully compatible with the fiscal outlook.

3 Simulation Results

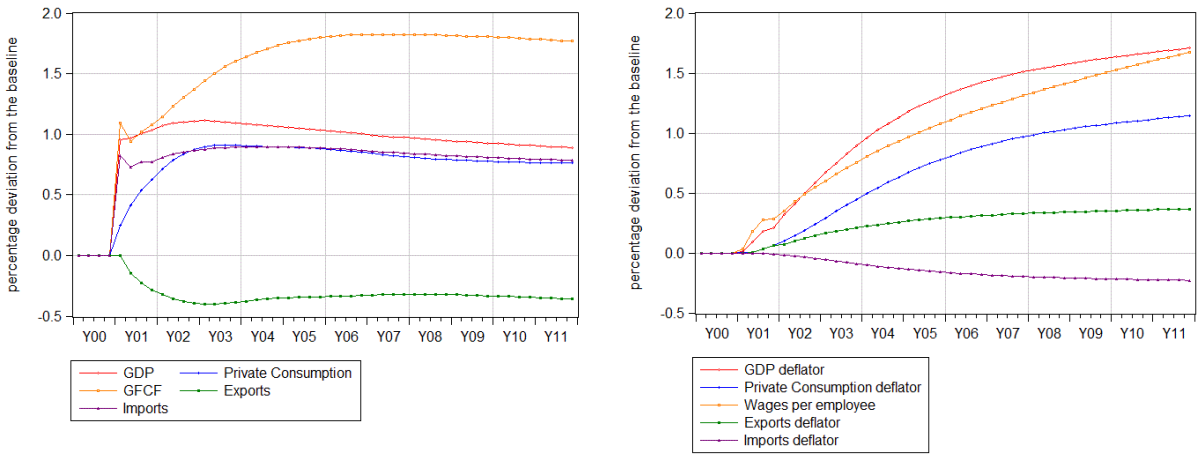
This section presents the results of a few standard simulations demonstrating the properties of the model. For simulation purposes (unlike for projection exercises), policy rules are included in order to close the model, ensuring stability over a long-run horizon. The fiscal rule in indirect taxes described in the previous section ensures government debt converges to its 60 per cent target. The monetary policy rule is a standard Taylor rule linking the short-term interest rate to deviations of inflation from the 2 per cent target and to the output gap. A simple uncovered interest parity assumption is made for the euro-U.S. dollar exchange rate.

The sub-sections below report the results from five standard shock simulations: a government demand shock, a monetary policy shock, a foreign demand shock, an exchange rate shock and an oil price shock. Note that the out-of-sample simulations are entirely model based, under the assumption of unchanged policies and international environment, and so results cannot be interpreted as meaningful macroeconomic forecasts.

3.1 Government Demand Shock

The first simulation analyses a permanent increase in real government consumption worth 1 per cent of the initial value of real GDP.

Figure 1: Effects of a permanent increase in real government consumption worth 1% of real GDP



The immediate impact on output is amplified by increases in investment and consumption (Figure 1). Investment is boosted directly due to the accelerator effect, reinforced by a drop in real user costs of capital. Private consumption rises as higher employment and wages increase households' disposable income, and is also boosted by lower real interest rates. Demand-side pressures lead to a continuous rise in prices which deteriorates international competitiveness, dampening export activity. Overall, the effect of the fiscal policy shock on GDP is 0.95 per cent on impact, reaching a peak of 1.11 per cent in year 3, after which output slowly returns to baseline as higher prices erode the fiscal stimulus.

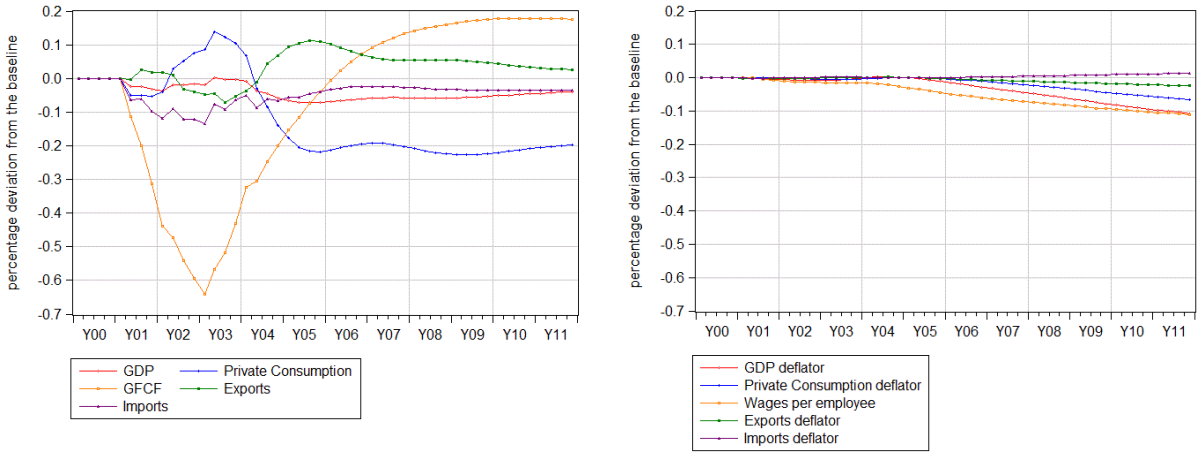
It is important to note, however, that the backward-looking nature of the model limits its appropriateness for analysing fiscal shocks, given the role played by expectations; and further-

more, the current setup does not allow for other potentially important non-linear effects (for example in government funding costs) so results should be interpreted with caution.

3.2 Monetary Policy Shock

This simulation involves a two-year increase in the nominal short-term interest rate by 100 basis points. Long-term interest rates respond according to the expectations hypothesis and the euro exchange rate appreciates in line with a simplified uncovered interest parity condition. The short-term interest rate and the exchange rate return to baseline in the first quarter of the third year of the simulation. No international spillover effects between Euro Area countries are considered.

Figure 2: Effects of a 100 basis points increase in the short-term interest rate lasting two years



As illustrated in Figure 2, the rise in nominal interest rates reduces demand through lower private consumption and investment. The fall in consumption follows from lower household disposable income, largely on account of lower employment, although that is somewhat mitigated by an increase in revenue from deposits and assets. The latter effect drives the 0.14 per cent increase in consumption in year 3, after which it moves back towards baseline. Investment reaches a low of -0.64 per cent at the beginning of year 3, mainly driven by rising real user costs of capital. The drag from domestic demand is sightly offset by exports, reflecting improvements in competitiveness due to lower prices. Overall the impact of this shock on GDP is fairly small, with a maximum deviation from baseline of -0.07 per cent in the fifth year of the simulation.

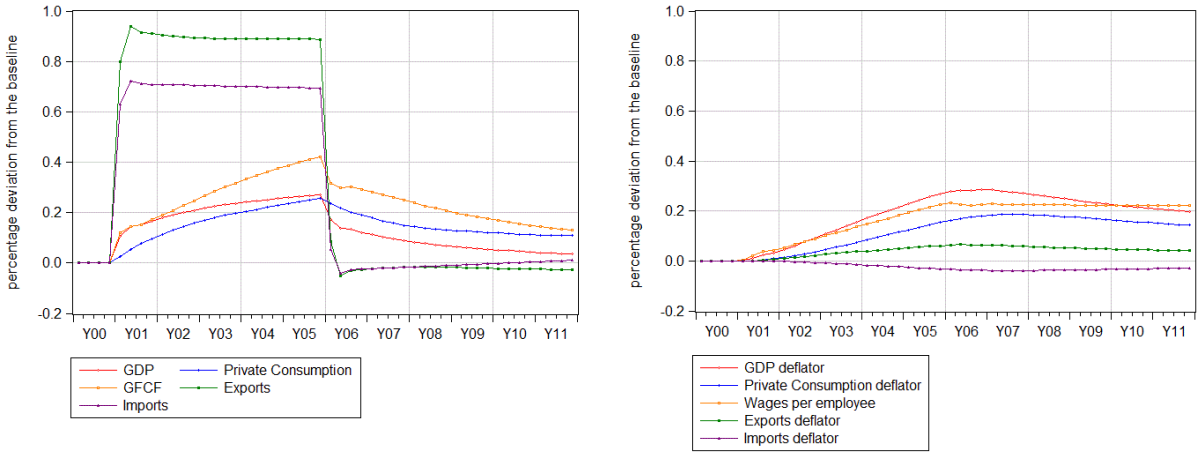
The impact of the monetary policy shock on prices is moderate (Figure 2) but persistent, with the GDP deflator gradually falling until year 11, bottoming out at 0.11 per cent below baseline. The drop in consumer prices is only 0.07 per cent (also in year 11). The fall in wages per employee reaches 0.11 per cent in the same year.

3.3 Foreign Demand Shock

In this simulation, foreign demand for Portuguese exports is increased by 1 per cent for five years. Figure 3 shows that this pushes exports 0.94 per cent above baseline in year 1. The impact on GDP is boosted in the short run by the accelerator effect on investment and the income effect

on consumption. Investment and consumption gradually rise, peaking, respectively, at 0.42 and 0.26 above the baseline in year 5.

Figure 3: Effects of a 1% increase in foreign demand lasting five years



Given the high import content of Portuguese exports, however, there is a strong crowding-out effect from imports. As a result, GDP rises by only 0.11 per cent on impact, peaking at 0.27 per cent in year 5.

The fall in the unemployment rate causes wages to rise (Figure 3), peaking at 0.23 per cent in year 6 before declining smoothly. The consumption deflator rises, reaching 0.19 per cent in year 7 and declining thereafter. This largely reflects the GDP deflator's slow return to baseline after peaking at 0.29 per cent in year 6. Once foreign demand returns to baseline, the deterioration in competitiveness pushes exports below baseline in year 6; and the fall in exports drags imports down along a similar path. Consumption and investment are still 0.13 and 0.11 per cent above baseline in year 10, respectively, reflecting lower real interest rates and higher real wealth, boosted by the accumulation of capital stock and net foreign assets.

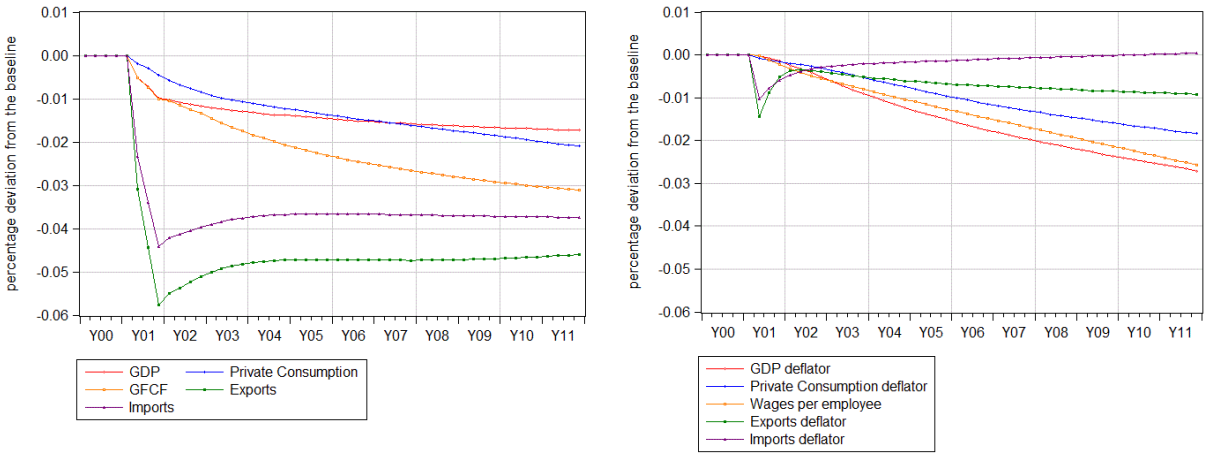
3.4 Exchange Rate Shock

The exchange rate shock illustrated in Figure 4 assumes a permanent 1 per cent appreciation of the euro against all other currencies. This shock directly impacts the nominal side of the model, mainly through the trade deflators. The appreciation is also directly transmitted to the oil price (in euros), depressing import prices, and the consumption deflator at a slower pace. Wages fall until year 11, allowing the export deflator to decline over the same time span.

On the real side, an appreciation of the euro represents a loss of competitiveness, translating into lower exports, and consequently lower GDP, investment and imports. The fall in GDP and the rise in unemployment also cause private consumption to decrease. Private consumption is also affected by the decrease in real wealth due to a fall in the capital stock.

In the long run the decrease in domestic prices tends to offset the nominal exchange rate effects, restoring competitiveness and ensuring the convergence of GDP to its baseline path.

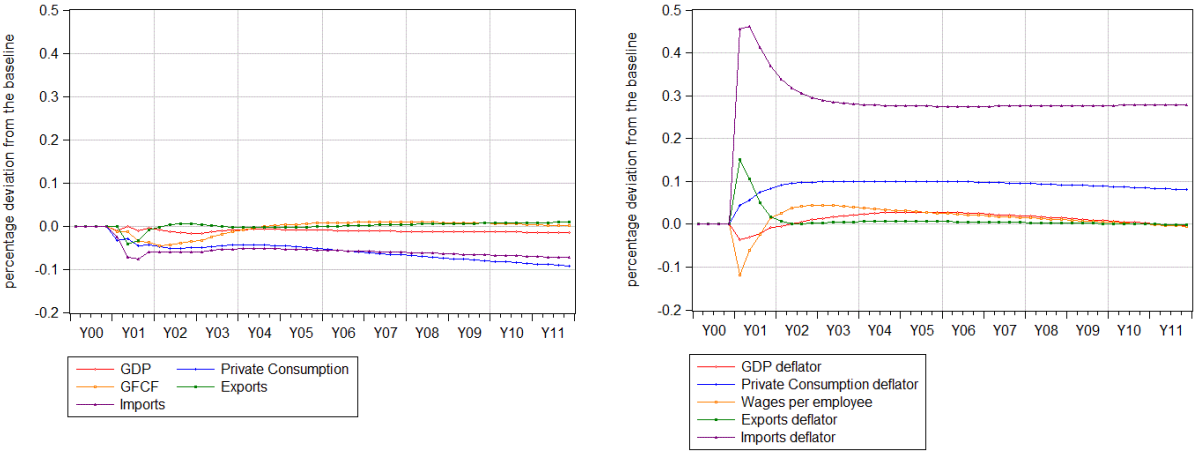
Figure 4: Effects of a permanent 1% appreciation of the Euro



3.5 Oil Price Shock

An oil price shock affects the domestic economy via several channels (Figure 5). It is transmitted immediately to the import deflator, which jumps by 0.46 per cent above baseline on impact, thereby affecting the GDP deflator and all other key deflators. The consumption deflator increases by 0.10 by year 2. The rise in inflation causes real disposable income to fall, dragging on real private consumption. Investment falls, reacting to the fall in output via the accelerator mechanism. This effect is not completely offset by the fall in the real user costs of capital caused by the rise in inflation. Since imports fall more sharply than other components of real GDP (-0.08 per cent in year 1), GDP drops only mildly by 0.02 per cent by year 2.

Figure 5: Effects of a permanent 10% increase in the price of oil



4 Conclusions

This paper presented the current version of the Portuguese Macro-Fiscal (PMF) model. PMF is an estimated quarterly macroeconometric model of the Portuguese economy, described as a small open economy within a monetary union. As in other models of this type, the econometric specification relies on a theoretically-based supply side and on a behavioural-equation based demand side, where the latter pins down output in the short run. In the long run prices adjust fully, but adjustment towards the equilibrium given by the supply-side is sluggish. The model is backward-looking and expectations are only implicitly included when considering contemporaneous and lagged variables in equations. Monetary policy is exogenous, whereas fiscal policy is partially endogenous.

This tool has been developed to be used: (*i*)in the assessment of economic and fiscal developments in the Portuguese economy; (*ii*) in producing medium-term macroeconomic projections; and (*iii*) in counterfactual policy simulation exercises. On the projections side, the PMF model produces the baseline scenarios for CFP's medium-term projections, although it can also adapt to, being fully compatible with: exogenous projections made for the public sector by means of CFP's purpose-specific fiscal forecasting tools; any broader forecast judgments made on the basis of expert knowledge or results of other econometric models. On the simulations side, the response of the model to most macroeconomic shocks is broadly as expected for a small open economy. Note that all simulations shown in the paper are entirely model based, and so must not be interpreted as proper macroeconomic projections. The model shows significant effects from government and foreign demand shocks, but relatively muted responses to changes in the exchange rate and in oil prices.

In order to extend the model and include more realistic features of the Portuguese economy, several issues are on the current research agenda, such as: the disaggregation of total exports into exports of goods and exports of services (given the greater importance that tourism has assumed recently); the specification of housing investment; the incorporation of forward looking expectations in order to capture fiscal foresight behaviour of agents; and the specification of the financial sector.

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