BANK ĊENTRALI TA' MALTA
EUROSISTEMA
CENTRAL BANK OF MALTA

Measuring the Effects of Structural Reforms in Malta: an analysis using the EAGLE model

Brian Micallef[1]

WP/01/2013

[1] *The author is a Senior Research Officer in the Modelling & Research Office of the Central Bank of Malta. The paper was written during the author's visit to the European Central Bank's Monetary Policy Research Division under the ESCB-IO expert programme between October and December 2011. I would like to thank Pascal Jacquinot for helpful discussions and assistance with the EAGLE code. This paper has benefitted from the comments and suggestions of A Gerali, J Bonnici, B Gauci, J Caruana, A Markowski, A Grech and J Gravier-Rymaszewska. The usual disclaimer applies. The views expressed in this paper are the author's and do not necessarily reflect the views of the Central Bank of Malta. All remaining errors are the sole responsibility of the author.*

Author's Email Address: micallefb@centralbankmalta.org

Table of Contents

Abstract

It is widely recognised that structural reforms are needed to boost long-term growth potential and increase an economy's flexibility to adjust in the face of shocks. This paper quantifies the macroeconomic effects of structural reforms in services and labour markets using the EAGLE model calibrated for the Maltese economy. EAGLE is a large scale, multi-country dynamic general equilibrium model. The results show that a 10 percentage point reduction in services and labour mark-ups raises GDP by more than 5% in the long-run. The impact of labour market reforms is more pronounced than that of services reform. If implemented in isolation, however, both reforms are associated with adjustment costs. On the contrary, the joint implementation of reforms can soften, to a large extent, the transition costs associated with pursuing the reforms in isolation. An important driver behind these results is the adjustment in the labour market. This calls for policies to reduce mismatches between the demand and supply of skills that are required in today's industries and to provide incentives so that more people are attracted and retained in the labour market.

JEL Classification: C53, E27, F41, F47

Keywords: structural reforms; competition; DSGE models; Malta.

1. Introduction

This study presents a calibrated version of EAGLE, a multi-country dynamic general equilibrium model. This model is used to assess the macroeconomic impact of structural reforms aimed at increasing competition in Malta's product and labour markets.[2]

There is a broad consensus among economists and policymakers that structural reforms are needed to boost long-term growth potential and increase an economy's flexibility to adjust in the face of shocks. The implementation of these reforms, especially in services and labour markets, has become more urgent in the aftermath of the global recession that began in 2008, which had a persistent adverse effect on potential output in a number of industrialized economies and prospects of an ageing population that will reduce the labour force.

Structural reforms have long been identified as key ingredients to unlock Malta's growth potential.[3] Over the past decade, the Maltese economy's potential growth rate has averaged around 2%, down from around 4% in the late 1990s. A testament of the importance of boosting the supply potential is the performance of the Maltese economy in the latter half of the last decade with the introduction of low cost airlines that increased the connectivity of the island to other European destinations and the emergence of a number of high value-added niche industries.[4] This diversification of the economic base has increased the resilience of the Maltese economy, as evident by the milder economic contraction in 2009 compared to other European countries, and a stronger rebound in 2010. However, in some market segments, such as the energy, retail and wholesale markets, monopolistic practices and low competition are still widespread. In fact, estimates of product market mark-ups in Malta are relatively high compared with other European countries, with mark-ups being on average higher in the services industries than the manufacturing industries, which are more export oriented.[5]

At the same time, both labour productivity and labour utilisation have been lagging behind Malta's European peers. Productivity growth has been very low over the past decade, averaging just 0.5% per annum between 2001 and 2008, and fell even further in the aftermath of the recession. And at 56% in

[2] EAGLE stands for Euro Area and Global Economy model. It was developed by the Eurosystem under the aegis of the Working Group on Econometric Modelling (WGEM). Additional details on EAGLE, including technical derivations, are available in Gomes et al (2010).

[3] See, for instance, Central Bank of Malta (2010), Allard and Everaert (2010), IMF (2010)

[4] Examples include financial services, ICT, remote gaming and the pharmaceutical industry.

[5] See, for instance, Borg (2009) and ECB (2011)

2010, Malta has also one of the lowest employment rates in the EU, driven by low female and older workers' participation rates in the labour market. As a result, Malta's convergence with the EU's income levels has stalled over the past decade and despite some catching-up observed in recent years, Malta's GDP per capita in Purchasing Power Standards (PPS) against the EU average was still lower in 2010 than it was a decade earlier.[6]

The contribution of this paper is twofold. First, it calibrates EAGLE, a dynamic general equilibrium model, for Malta, which, to my knowledge, is the first of its kind. Econometric models of the Maltese economy are limited and, in general, are confined to traditional Keynesian-style models. Dynamic stochastic general equilibrium (DSGE) models are currently the state-of-the-art models used for simulations and policy analysis, not only in academia but also in policy institutions like the IMF, ECB, Bank of England and the Federal Reserve. As result, this model constitutes an important addition to the Central Bank of Malta's toolkit of econometric models.

Second, it uses this calibrated version of EAGLE to analyse the effects of structural reforms in Malta. The key setting is the monopolistic competitive framework in product and labour markets, through which the effectiveness of structural reforms is assessed on the basis of the reduction in mark-ups on prices and wages brought about by the increased competition in these markets.

EAGLE is a large scale, multi-country dynamic general equilibrium model. The main differences of the calibrated version for Malta from the original version of the model, which was calibrated for Germany and documented in Gomes et al (2010), are in terms of economic size, openness, the geographical structure of trade, taxation and the share of tradable and non-tradable sectors.[7] One advantage of using EAGLE is that it allows for a direct comparison with other studies in the literature and, in particular, to better understand the sources of heterogeneity arising from the structural characteristics of the economy, for instance, its trade openness. An additional advantage is the multi-country setting, thereby allowing for an important role to the nominal exchange rate and extra-euro area trade considerations. This is important for a small and open economy like Malta, where around two thirds of its exports are directed to countries outside the euro area. In addition, EAGLE is also widely used within the European System of Central Banks (ESCB).

This study is related to the extensive and growing literature on the effects of structural reforms. On the basis of existing OECD empirical studies, Bouis and Duval (2012) find that structural reforms –

[6] Data source: Eurostat

[7] WGEM (2012) presents a stock-taking exercise of the EAGLE related academic and policy research. In particular, it compares four standard simulations to trace the main sources of heterogeneity across the various calibrations of EAGLE.

ranging from product market regulation, employment protection legislation, unemployment benefits system to labour taxes – bring about long-run improvements in GDP, productivity and employment. Blanchard and Giavazzi (2003) study the effects of product and labour market deregulation using a DSGE model with rents and bargaining, and propose an 'optimal timing' of reforms. Bayoumi et al (2004) analyse the effects of increasing competition in the euro area using a 2-country version of the IMF's Global Economy Model (GEM). However, they do not focus on country-specific reforms and do not make a distinction between reforms in the tradable and non-tradable sectors of the economy. Everaert and Schule (2007) use a similar version of GEM but focus on various sectors and international spillovers. Using a DSGE model for a small and open economy in a monetary union, Almeida et al (2008) find that a reduction in non-tradable goods prices and wage mark-ups has non-negligible positive impact on economic activity, households' consumption and hours worked, reflecting an improvement in the country's international competitiveness. Similar studies for larger euro area countries, such as Forni et al (2009) for Italy, reach similar conclusions. This study is mostly related to Gomes et al (2011), who use EAGLE to study the impact of structural reforms in product and labour markets. Given its multi-country setting, Gomes et al (2011) find that cross-country coordination of reforms produces larger and more evenly distributed positive effects for a monetary union than if pursued by a single country. This study does not address which specific reforms will achieve the desired level of competition. The impact of structural reforms on mark-ups is not easily measurable and requires a detailed assessment of the specific reform in question. International comparisons are not very helpful either, since the effects of a particular reform depend on country-specific characteristics, such as the design and enforcement of the reform, existing institutions and legal framework and the size and openness of the economy. Such a detailed assessment is beyond the scope of this paper.

The main conclusions are the following. First, structural reforms lead to sizeable positive effects in terms of output and employment in the long-run. A 10 percentage point (p.p.) reduction in services and labour markets mark-ups raises Malta's GDP by 5.5% in the long-term compared to a scenario of no reforms. The reforms have positive effects on all components of aggregate demand while increasing the competitiveness of the Maltese economy through the depreciation of the real effective exchange rate. The impact of labour market reforms is more pronounced than that of services reform. In terms of their effect on GDP, the long-term impact of labour and services reforms stands at 3.3% and 2.1%, respectively. Given the small size of the Maltese economy, spillovers to the rest of the euro area are negligible. If implemented in isolation, both reforms are associated with adjustment costs, the effect of which, however, can be softened, to a large extent, if the reforms are implemented jointly. I also find positive spillovers on Malta's GDP and the main components of aggregate demand if reforms are also pursued by the euro area. The results are robust to varying levels of mark-ups and to changes in key parameters that govern the transmission mechanism. Sensitivity analysis suggests that

one important driver behind these results is the adjustment in the labour market. This calls for policies to reduce mismatches between the demand and supply of skills that are required in today's industries and to provide incentives so that more people are attracted in the labour force, for instance, through more flexible work arrangements, tax credit schemes and more affordable childcare facilities.

The rest of the report is organised as follows. Section 2 provides a non-technical overview of the EAGLE model, referring the interested reader to the original report by Gomes et al (2010) for technical details. Section 3 documents the calibration of EAGLE for the Maltese economy while Section 4 simulates the model to assess the effects of structural reforms in the non-tradable and labour markets. Section 5 concludes and provides avenues for future research. Additional details on the EAGLE model are available in the Appendix. Appendix A describes the calibration of the model's parameters; Appendix B evaluates the performance of the model with three illustrative shocks that are commonly examined in policy simulations to assess the main transmission mechanisms of the model; Appendix C describes the Dynare files.

2. The EAGLE Model[8]

In recent years, EAGLE has been used extensively for policy work and research projects. Gomes et al (2011) exploit the sectoral dimension of the model to study the impact of structural reforms. ECB (2012) focuses on the international dimension of EAGLE to analyse imbalances and competitiveness issues. Taking advantage of its fiscal rich environment, Gomes et al (2010) apply the model to analyse the use of temporary fiscal policy stimulus to overcome the zero lower bound, while Senaj and Vyskrabka (2011) studies the implications of tax harmonisation in the euro area. Kolasa (2010) and Brzoza-Brzezina et al (2010) use EAGLE to analyse convergence problems within the euro area and in accessing countries. In Alves et al (2009), EAGLE is used to analyse the mechanics of adjustment inside the euro area by simulating both common and country-specific shocks hitting the monetary union.

2.1. Theoretical framework

The theoretical framework of EAGLE builds on the ECB's New Area Wide Model (NAWM) and the IMF's GEM.[9] This structure, based on the open economy version of the new Keynesian paradigm, is

[8] This section draws on Gomes et al (2010, 2011) and WGEM (2012).

designed to analyse the interdependencies arising from trade in goods and financial assets, including the transmission of both domestic and external shocks, including spillovers arising from national policy measures. This is a relevant topic in a monetary union, where monetary policy is conducted taking into consideration euro area-wide performance while other policies, such as fiscal and structural, are mainly conducted at a national level.

EAGLE is designed to cover four regions of the world economy, two of which constitute a monetary union and thus share a common monetary policy and exchange rate. The model is thus well-suited to assess the implications of the common monetary policy and country-specific characteristics for the transmission of country-specific or common shocks in the euro area. The two non-monetary union blocks – the US and the rest of the world – allow for the analysis of the role of the euro exchange rate and extra-euro area trade in the transmission of shocks outside the euro area. With the exception of some parameter values, each region is modelled in a symmetric fashion. The regions are linked with each other by bilateral trade relations and international financial markets, which are assumed to be incomplete, thus allowing only for imperfect risk sharing across countries. In addition to fiscal and monetary policy, the model also incorporates a rich set of nominal and real rigidities. The micro foundations of the model, together with its detailed structure, allow for quantitative analysis in a theoretically coherent and fully consistent model setup, clearly spelling out all the policy implications.

2.2. Firms

On the supply side, there are two types of firms, intermediate-goods producing firms and final-good producers. Intermediate-goods firms produce tradable and non-tradable goods. Final-goods producing firms operate in a perfectly competitive market, take the prices of intermediate goods as given and produce three different goods: a private consumption good, a private investment good and a public consumption good. Final-goods are bundled using intermediate domestic goods (tradable and non-tradable) and imports (that are subject to adjustment costs) as inputs using a Constant Elasticity of Substitution (CES) production function. The bundles differ in terms of their composition, depending upon the weights assigned to the different types of intermediate goods.

Firms producing intermediate goods – both tradable and non-tradable – operate in a monopolistically competitive environment. Each good is produced according to a sector-specific Cobb-Douglas technology with domestic capital and labour as inputs. Since the intermediate goods are differentiated, firms have market power and restrict their output to produce excess profits. The degree of market

[9] See Christoffel et al (2008) for details of the NAWM and Laxton and Pesenti (2003) for GEM.

power depends on the price elasticity of demand, which determines the degree of competition in the intermediate goods market. Mark-ups are inversely related to the degree of substitutability between the different varieties and therefore, to the degree of competition in the respective sectors.

Price contracts are staggered a la Calvo to introduce sluggish price adjustment. Those firms that are able to re-optimize their price contracts set prices to equate the discounted sum of expected revenues to the discounted sum of expected marginal costs. On the contrary, those that are not allowed to re-optimize index their prices to past sector-specific inflation and the central bank's inflation objective.

In pricing their products, firms make a distinction between the domestic and the foreign markets. In particular, export prices are set in the currency of the destination market, better known as local currency pricing. Together with sticky prices, this setup limits the degree of nominal exchange rate pass-through to import prices in the short-to-medium run.

The model features a number of adjustment costs to capture the degree of persistence observed in aggregate data and to generate realistic dynamics. The role of these adjustment costs is to ensure that, in response to shocks, nominal and real variables feature smooth adjustment dynamics, as is widely documented in empirical research. More specifically, such costs prolong the adjustment of investment and imports, while habit persistence plays a similar role in the adjustment of consumption and labour supply.

2.3. Households

Households consume a final non-tradable good which is a composite of domestic tradable and non-tradable intermediate goods and imported intermediate goods. The model distinguishes between two types of households, optimizing ones (labelled I-type households) and those that are liquidity constrained (labelled J-type households). In both cases, households aim to maximize utility – which depends positively on consumption and negatively on hours worked – subject to their budget constraint.

Optimizing households have access to financial markets and smooth consumption by trading two types of riskless nominal bonds. One type of bond is denominated in euro and traded across the euro area while the other one is denominated in foreign currency (US dollar) and traded internationally. The uncovered interest rate parity condition holds and determines the exchange rate between the euro and the worldwide core currency (assumed to be the US dollar) subject to an endogenous risk

premium depending on the net foreign asset position. Optimizing households also accumulate physical capital and rent their services to firms and hold money for transaction purposes.

Liquidity constrained households cannot trade in financial and physical assets. In each period, they consume their disposable income and their only source of income is the labour supplied to domestic firms. To a limited extent, however, they can smooth intertemporal consumption by adjusting their money holdings (subject to a transaction-technology type cost). These households allow for Keynesian effects of public expenditure in EAGLE since Ricardian equivalence does not hold for them.

Both types of households supply differentiated labour to domestic intermediate-good firms in a monopolistic manner, thereby exerting limited bargaining power and charge mark-ups over the marginal rate of substitution between consumption and leisure. Wages are assumed to be sticky a la Calvo with indexation.

2.4. Monetary and fiscal authorities

In each country, there is a monetary and a fiscal authority (in the case of the euro area, there is a common monetary authority). Monetary policy is conducted by a Taylor-type interest rate rule specified in terms of annual CPI inflation and quarterly output growth. In the monetary union, the single central bank targets a weighted (by regional size) average of the regional macroeconomic variables. Regions in the monetary union share both a nominal interest rate and a nominal exchange rate against non-euro area countries.

The fiscal authority purchases a public good, which is fully biased towards non-tradable intermediate goods, and finances its expenditure by issuing bonds and levying taxes. Taxes can be either lump-sum or distortionary (raised on consumption purchases, labour income, capital income and dividends). In addition, the fiscal authority makes transfers to households and earns seigniorage on outstanding money holdings. A fiscal rule guarantees the stability of public debt. In the case of the two countries belonging to the monetary union, fiscal policies are region-specific.

2.5 The role of mark-ups in product and labour markets

The key mechanism to assess the impact of structural reforms in a general equilibrium framework is the monopolistic competitive setup in the intermediate goods and labour market. Let’s start with the

intermediate goods market. In a perfectly competitive environment, the prices charged by producers are equal to the marginal costs. However, this is not the case in a monopolistic competitive environment, where there are a number of firms that offer different products that are imperfect substitutes. In this case, firms are able to introduce a mark-up between prices and marginal costs. In EAGLE (as in other New Keynesian models), the elasticity of substitution between products of different firms determines the degree of market power. The first order condition for price setting in the steady state is the following:

$$P_Y = \frac{\theta_Y}{(\theta_Y - 1)} MC, \;\; \theta_Y > 1$$

where P_Y is the price of the intermediate good Y and MC is the marginal cost of producing Y. The mark-up is $\theta_Y/(\theta_Y\text{-}1)$ and depends negatively on the elasticity of substitution between different products, θ_Y. So for instance, a small elasticity of substitution, say 3, will imply a mark-up of 50%, whereas a higher elasticity of substitution, say 9, will imply a mark-up of 12.5%. In general, therefore, the higher the degree of substitutability, the lower the implied mark-up and the higher the production level for a given price.

Imperfect competition in the labour market is modelled in a similar fashion. Each household offers a specific kind of labour service that is an imperfect substitute with the services offered by the other households and sets wages in order to maximize utility. Lower degree of substitutability can be due to skill differences or anti-competitive labour market regulation. As in the case of the intermediate product market, the elasticity of substitution between the different labour bundles determines the market power of households to set wages. In EAGLE, the first order condition for labour supply L in the flexible-price equilibrium is:

$$\frac{W}{P} = \frac{\theta_L}{(\theta_L - 1)} \lambda^{-1} L_t^{\tau}, \;\; \theta_L > 1$$

where W/P is the real wage expressed in units of domestic consumption, λ is the marginal utility of consumption and τ is the inverse of the Frisch elasticity of labour supply. The latter elasticity refers to the elasticity of hours worked to changes in the real wage, holding the marginal utility of consumption constant. In other words, it measures the sensitivity of the labour supply to changes in the wage rate. The mark-up is $\theta_L/(\theta_L\text{-}1)$ and depends negatively on the elasticity of substitution between the different labour varieties θ_L.

3. Calibration

The calibration of the model for the Maltese economy captures crucial differences with respect to Germany, the monetary union country in the original calibration of EAGLE in Gomes et al (2010). These refer mainly to the size of the economy, its openness, the geographical structure of trade, taxation and the weight of the tradable and non-tradable sectors.

In general, the calibration strategy can be divided in two parts. First, a subset of parameters governing key steady-state ratios is calibrated using their empirical counterparts. Next, I calibrate the remaining parameters of the model drawing heavily on the original version of EAGLE, which in turn can be traced back to the parameterization of NAWM and GEM. Unless otherwise stated, the calibration for the remaining three regions is left unchanged from the original version. Technical details of the parameters are available in Appendix A.

3.1. Steady-state values

The relative size of each economy is calibrated to reflect its GDP share in the world economy. The calibration ensures that Malta is a small fraction of the euro area economy and that domestic developments have no impact on the other economies.[10] For the steady state ratios, data for Malta corresponds to the average of the period 2000-2010 and is derived from the National Accounts statistics in Eurostat. The share of private consumption in Malta is calibrated at 63% of GDP, which is higher than the corresponding ratio for the euro area. On the contrary, the shares of investment and public expenditure are lower than in the euro area, averaging 19.5% and 20%, respectively. Given these values, the trade balance amounts to around -2% of GDP, which is broadly equivalent to the trade deficit recorded over the past decade.

In view of Malta's changing trade patterns, the total import shares of each region were averaged over a shorter period of time. Bilateral imports to Malta were carefully calibrated to match the country's bilateral export structure, which in EAGLE is endogenously calculated. In particular, the calibration closely captures the asymmetry in Malta's trade structure, with more than half of Malta's imports coming from the euro area but only around a third of its exports being directed towards it. The calibration of Malta's trade matrix in EAGLE, together with its empirical counterpart for the period 2007-2009, is summarized in Table 1:

[10] Since the numerical algorithm to compute the steady state equilibrium requires a non-zero entry, the size of Malta in the global economy had to be artificially increased. This feature does not have any impact on the dynamics of the model. More importantly, developments in Malta do not have any impact on the rest of the euro area or the rest of the world.

Table 1: Model and Empirical Bilateral Trade Structure
(percent of total exports and imports)

	Model				Data		
	EA	RW	US		EA	RW	US
Exports	0.35	0.49	0.16	Exports	0.36	0.49	0.15
Imports	0.51	0.41	0.08	Imports	0.52	0.41	0.08

Note: Figures may not add up due to rounding up.

In the absence of input/output tables for Malta, the quasi-shares of non-tradables in final consumption and investment goods were calculated from Lombardo and Ravenna (2010).[11] This study shows that the tradable component of consumption and investment in small open economies is higher than that of larger economies. The calibration ensures that Malta's tradable sector, which comprises not only primary commodities and manufacturing but also tradable industries in the services sector, is higher than the tradable sector of the three other regions in EAGLE and consistent with the calibrated import-to-GDP ratio.

3.2. Mark-ups

Studies on the empirical estimates of mark-ups in Malta are relatively scarce. Borg (2009) estimates and compares mark-ups in products markets among 22 European countries, including Malta, for the period 1995-2005. According to this study, the average markup in Malta's product market is estimated at 1.32 (i.e. 32%), the sixth highest among the countries considered. Mark-ups are found to be heterogenous among sectors, being higher in the services sector compared to the manufacturing industries. Sectors that are characterised by strong network effects, such as retail, wholesale and the electricity, gas and water sectors, tend to display higher markups. For services industries, the mean mark-up is estimated at 1.5 and the median at 1.4, while for the manufacturing sector, the mean and median mark-ups are estimated at 1.3 and 1.2, respectively. In a separate study conducted by the Eurosystem, retail sector regulation in Malta turned out to be relatively high compared to most other European countries, thus confirming the findings by Borg (2009) in this respect.[12]

[11] Lombardo and Ravenna (2010) defines tradability for each industry in the input-output table if the sum of exports and imports relative to its gross output exceeds a threshold of 10%.

[12] The study refers to the 2011 Structural Issues Report on structural features of distributive trades and their impact on prices in the euro area. See ECB (2011) page 42 for further details.

In the baseline calibration, the elasticity of substitution between different product varieties in the non-tradable sector in Malta is set at 3, which implies a mark-up of 50%. For the tradable sector, the elasticity of substitution is set at 6, which implies a mark-up of 20%.

Empirical estimates of labour mark-ups for Malta are not available. In the literature, estimates of wage mark-ups usually rely on inter-industry wage differentials in OECD countries.[13] However, anecdotal evidence suggests that mismatches between the demand and supply for particular skills, especially for jobs in high value added sectors, are present in Malta's labour market. For instance, education attainment statistics, such as the number of people with only a compulsory level of education and early school leavers, rank Malta at the lower end of the tables when compared with other EU countries.[14] Shortages in specific segments of the labour market are also evident by the number of foreigners with a licence to work in Malta, with the number increasing from around 6,000 in 2005 to around 9,000 in 2010. In the baseline calibration, the elasticity of substitution between different labour varieties is set at 4.33 in line with Gomes et al (2011), which implies a mark-up of 30%.

Mark-up values for the other countries were left unchanged from the original version of EAGLE. Mark-ups in the euro area are calibrated at 20% in the tradable sector, 30% in the labour market and 50% in the non-tradable sector. In the US and rest of the world, the corresponding mark-ups are set at 20%, 16% and 30%, respectively[15]. Thus, mark-ups in the non-tradable sector and the labour market in Malta and the euro area are higher than the corresponding values in the US and the rest of the world, implying a lower degree of competition in these markets.

3.3. Other parameters

The tradable sector is assumed to be more capital intensive than the non-tradable sector. In addition, the capital share in Malta's production functions – both in the tradable and non-tradable sectors – is calibrated at a higher value (40% and 35%, respectively) compared to the other regions (35% and 30%, respectively). This is broadly in line with the evidence that Malta's share of compensation per employee to Gross Value Added over the past decade is lower than the equivalent euro area average.

[13] See for instance Jean and Nicoletti (2002).

[14] In 2010, 56% of the Maltese population aged between 25 and 34 years had only a compulsory level of education, compared with 19% in the EU. The percentage for those between 35 and 44 years of age stand at 65% in Malta and 24% in the EU. Early school leavers in Malta, defined as the percentage of the population aged between 18 and 24 with only a compulsory level of education and in no further training is more than double the EU average (MT: 37%; EU: 14%)

[15] These values are in line with other existing similar studies in the literature, such as Gomes et al (2011), Bayoumi et al (2004), Farquee et al (2007) and Everaert and Schule (2008).

It also ensures that the share of labour in GDP is around 54%, which is broadly equivalent to the share of compensation of employees in gross value added over the past decade.[16]

A number of parameters are assumed to be the same across the four regions and broadly consistent with the original version of EAGLE. Calvo probabilities on the labour and domestic product markets are set at 0.75 for all regions, implying an average time between wage and price re-optimization of four quarters. For Malta, this is broadly consistent with the findings of the Wage Dynamics Network.[17] For the euro area, this value is consistent with the findings of the Inflation Persistence Network but on the low side of estimates of price stickiness from estimated DSGE models, such as Smets and Wouters (2003) and Christoffel et al (2008).[18] Price and wage indexation were set at 0.5 and 0.75, respectively, unchanged from the original version of EAGLE. The degree of substitutability between domestic and imported tradables is higher than that between tradables and non-tradables, consistent with existing literature. In particular, the elasticity of substitution between tradables and non-tradables is set at 0.5, while the elasticity between domestic and imported tradables in Malta is calibrated at 1.5. The latter elasticity is lower than the calibrated value of 2.5 set for the other three regions to account for the fact that as a small and open economy, the choices of Maltese households and firms between consuming/investing domestic and imported goods are rather limited.
In the absence of data, the calibrated parameters related to households were largely left unchanged from the original version of EAGLE. The share of non-Ricardian households is calibrated at 25% and habit formation is set at 0.6. The discount factor, the intertemporal elasticity of substitution and the Frisch elasticity were set respectively for all regions at 0.9926 (implying a steady-state annualized real interest rate of about 3%), 1 and 0.5. The quarterly depreciation rate of capital is set at 0.025 for all regions, consistent with an annual depreciation rate of 10%.

The adjustment cost parameters are taken directly from the original version of EAGLE. The only difference is the lower import adjustment parameter of consumption goods in Malta, which reflects the country's higher import content and reliance on imported goods.

[16] After accounting for the share of self-employed, which is recorded under ''Gross Operating Surplus and Mixed Income" in the National Accounts statistics, the average share of compensation of employees in Gross Value Added between 2000 and 2010 stood at around 58%.

[17] See Central Bank of Malta (2011) for the wage dynamics report.

[18] Gomes et al (2010, 2011) calibrate the Calvo price parameter at 0.92, which implies that prices are changed on average every 2.5 years. This calibration is derived from Smets and Wouters (2003) and Christoffel et al (2008) but is in contrast with micro evidence. Christoffel et al (2008) explain that such a high estimate is reflective of a flat Phillips Curve rather than an extremely high degree of nominal rigidity.

Turning to monetary policy, the response to inflation and output growth is calibrated at 1.7 and 0.1, respectively, while the interest rate smoothing parameter is set to 0.87. Long-run inflation targets are set equal across all regions at 2% per annum.

Regarding the fiscal parameters, the response of the share of lump-sum taxes in nominal output to deviation of the public debt-to-output ratio (60% on an annual basis) is set at 0.1, in line with the original version of EAGLE. I also maintain the original version of EAGLE assumption on asymmetric distribution of lump sum transfers and taxes across the two types of households, favouring those with limited access to capital markets in the proportion of 3 to 1. VAT and income tax are broadly similar between Malta and the euro area but social security contributions are substantially lower in Malta. In line with the evidence from *'Taxation Trends in the European Union'* (2010 Edition), the contribution of Maltese employees and employers to SSC is set at around two thirds and one third of the euro area average, respectively.[19]

Appendix B documents three standard simulations - a monetary policy shock, a productivity shock and a government expenditure shock – using the calibrated version of EAGLE for Malta to illustrate the main properties of the model and the transmission channels operating in EAGLE. Overall, the reaction of the main macroeconomic variables to the three shocks produces plausible and realistic responses that are in line with the literature.

4. Results

I use the re-calibrated version of EAGLE to assess the macroeconomic impact of reforms aimed at increasing competition in the Maltese non-tradable goods and labour markets. The setup of the simulation builds heavily on Gomes et al (2011). In the baseline version of the model, the respective elasticities of substitution are set as exogenous parameters but are endogenized for the purposes of the simulation. The impact of the structural reforms is assessed by permanently increasing the parameters governing the elasticity of substitution between product and labour varieties, thereby increasing competition in these markets. The shocks are modelled as AR(1) processes and the persistence parameter determines the time it takes for the elasticities of substitution to converge to the new equilibrium value. In all the simulations considered below, the persistence parameter is set at 0.7, which implies that the reforms are implemented gradually over a period of around four years. It is

[19] The steady-state tax rates refer to the tax wedges published by the OECD. The figures for the euro area are taken from Coenen, McAdam and Straub (2008).

assumed from the outset that households and firms have perfect foresight, thereby eliminating any uncertainty concerning the credibility of the reforms.[20]

For each simulation, I report the long-run (steady state) values of the main macroeconomic variables and the transition dynamics from the initial steady state to the new one following a 10 percentage point reduction in mark-ups. I report on the results when the reforms are implemented in isolation, jointly and in conjunction with the rest of the euro area. Finally, I assess the robustness of the results by performing a sensitivity analysis by changing the values of some key parameters. The main results are summarized in Table 2.

Table 2: Long Run Effects of Reforms: 10 p.p. reduction in mark-ups

(percent deviations from baseline)

	NT	W	NT+W	Spillovers
Real activity				
GDP	2.1	3.3	5.5	6.0
Consumption	1.1	3.1	4.2	5.7
Investment	3.2	1.5	4.8	6.1
Exports	0.8	4.0	4.7	5.4
Imports	0.5	2.3	2.7	4.4
Labour market				
Hours	0.9	3.4	4.3	4.2
Real wage	3.5	-1.6	1.9	3.0
International relative prices				
REER	2.8	0.7	3.6	1.7
Terms of trade	0.3	1.6	1.9	1.8
Spillovers to EA				
GDP	0.0	0.0	0.0	-

Note: NT refers to Non-Tradable Sector, W to the Labour reform, NT+W to the simultaneous non-tradable and labour market reforms. Spillovers refer to the additional gains if reforms are implemented simultaneously in the rest of the euro area as well.

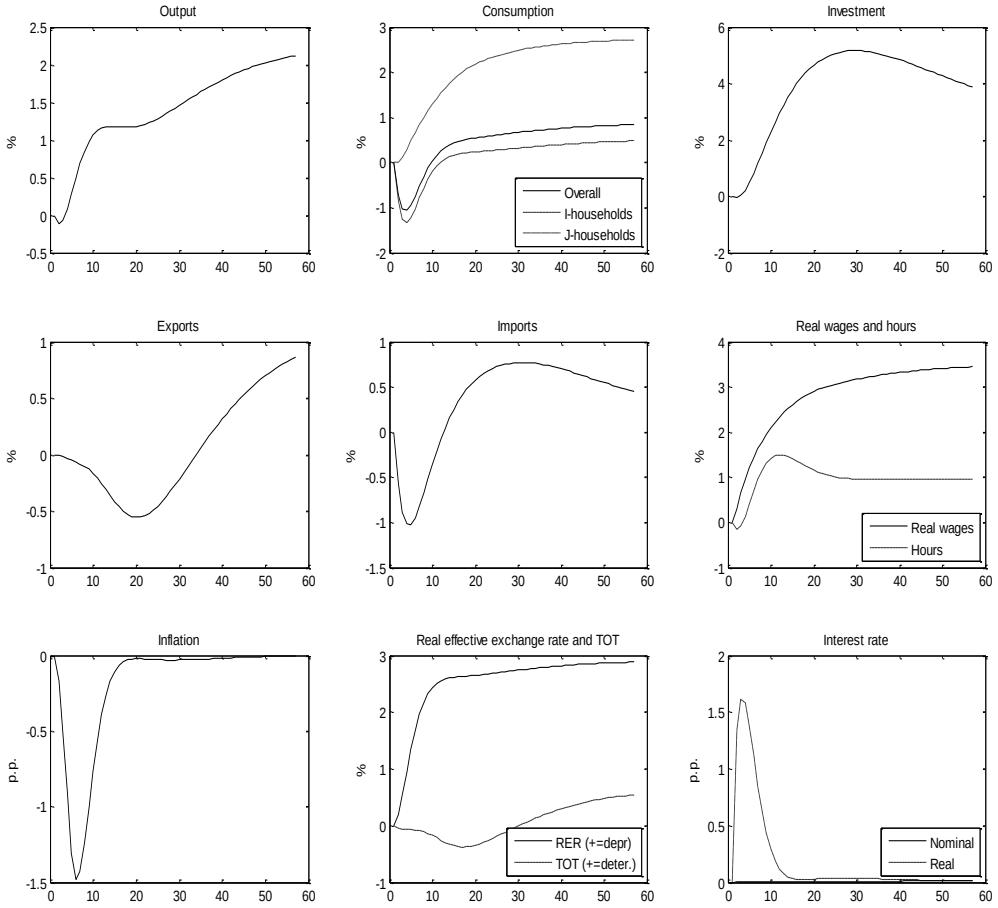
[20] Similar assumptions are common in the literature, especially when the simulations involve large scale models, since they simplify the computation. See for instance Gomes et al (2011) and Almeida et al (2008)

4.1. Non-tradable sector reforms

The first column of Table 2 shows the long-run results of reducing the mark-up in the Maltese non-tradable sector (a proxy for the services sector) by 10 p.p i.e. from 50% to 40%. Similar to other studies in the literature, the overall macroeconomic impact of the reforms is sizeable. In the long-run, GDP increases by 2.1% compared to the baseline case of no reforms. The increase is driven mainly by investment and to a lesser extent, consumption and exports. Anticipating higher future demand, firms increase the demand for capital and labour, triggering an increase in hours worked and wages as labour becomes relatively scarce. Real wages and hours worked increase by 3.5% and 0.9%, respectively. As for international trade, the excess supply of Maltese services leads to a depreciation of the real effective exchange rate. The deterioration in the terms of trade is however less pronounced due to the increase in the prices of domestic tradable goods. The two channels that lead to higher prices of domestic tradable goods are the following. First, the increased demand for factor inputs raises marginal costs in the tradable sector which is not subject to lower mark-ups. Second, since tradable and non-tradable goods and services are complements, higher demand for non-tradables will also exert an upward pressure on the demand for tradable goods and therefore, higher prices. Higher aggregate demand drives up imports, which increase by 0.5% in the long run. In light of the small size of the Maltese economy, spillovers to the rest of the euro area and the world are negligible.

Figure 6 illustrates the transition dynamics from the initial to the new steady state. Compared to the long-run results, there are short-term costs associated with the reforms. In particular, the non-constrained households anticipate that services will be cheaper in the future and thereby postpone consumption to future periods. On the other hand, consumption by the liquidity constrained households increases immediately. Given the larger share of the non-constrained households, I observe a temporary decline in overall consumption which lasts for around two to three years. Firms gradually start to increase demand for capital in order to raise their stock of capital in anticipation of higher future production. The increased demand for labour leads to a gradual increase in the real wage and hours worked, although the latter reacts sluggishly in the first few quarters after the start of the reforms. Higher competition in the non-tradable sector leads to lower price pressures, driving inflation below equilibrium in the short to medium term. With unchanged nominal interest rates, this leads to temporary higher real interest rates, further encouraging the non-constrained households to postpone consumption.

Figure 6: Product Market Reform: Transition Dynamics



The gradual increase in output towards its new long-run level is mainly driven by higher production of non-tradables. Higher real wages in both the tradable and non-tradable sector exert upward pressures on export prices, while at the same time, exports do not benefit from an increase in foreign demand as spillovers to the rest of the world are negligible. As a result, I observe a slight appreciation of the terms of trade, which explains the sluggish performance of exports. Imports also decline temporarily given the initial decline in consumption. The trade balance initially improves as domestic demand declines in the first few quarters after the reform but subsequently deteriorates over the medium term as domestic demand picks up while exports remain sluggish for a longer period of time.

4.2. Labour market reforms

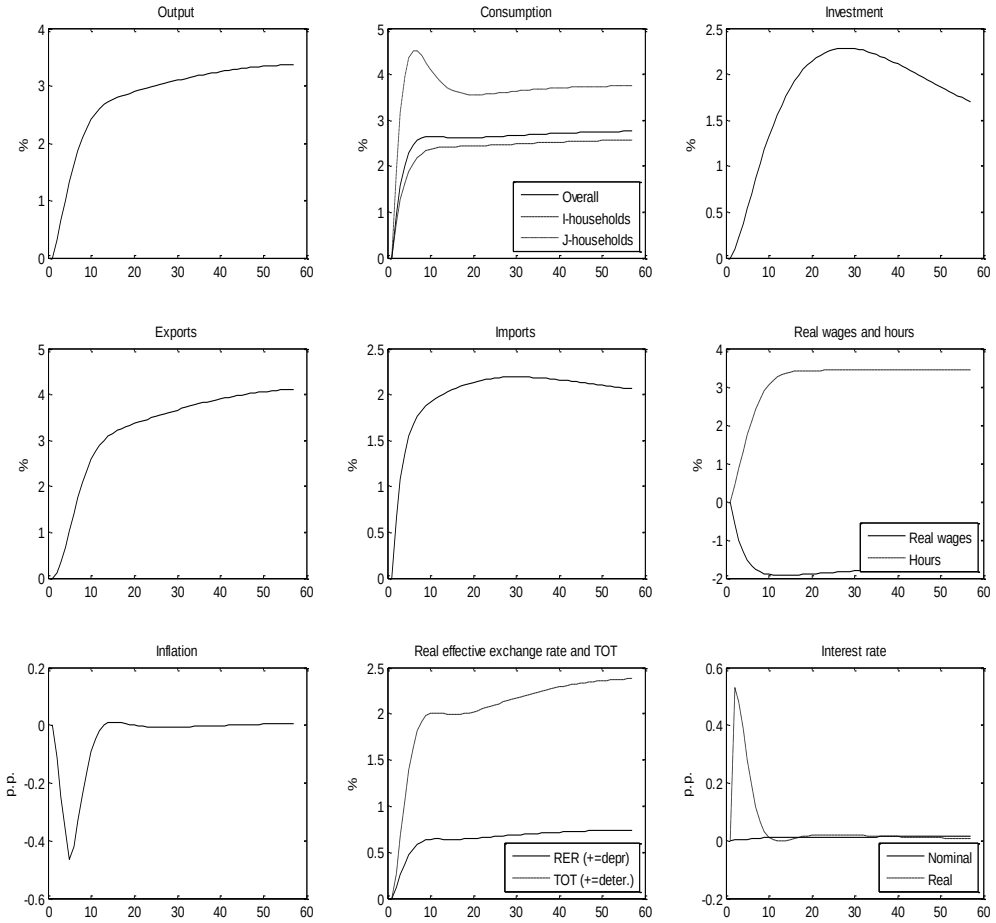
The second column of Table 2 shows the long-run results of reducing mark-ups in the Maltese labour market from 30% to 20%. There are noticeable differences in terms of the effects of this reform from the previous one on the main macroeconomic variables.

Focusing first on the long-run results, the increase in GDP is more pronounced with labour market reforms as compared to the services reform. GDP increases by 3.3% compared to the baseline scenario of no-reform, driven mainly by exports and consumption, which increase by 4.0% and 3.1%, respectively. The main differences are found in the labour market. In particular, labour market reforms lead to an increase in hours worked and a reduction in real wages, due to the increased supply of labour. This contrasts with the reform in the non-tradable sector but is in line with similar studies in the literature.[21] I also observe a more pronounced increase in hours worked since firms have a stronger incentive to use labour input given the decline in the real wage. The deterioration in the terms of trade is stronger than the real effective exchange rate since the decline in the prices of non-tradables is less pronounced. Lower real wages also translate in lower marginal costs for firms, thereby pushing down export prices. The higher price competitiveness stimulates exports, which become the main driver of growth. Imports increase more as well, given the increase in aggregate demand and lower real exchange rate depreciation. As in the other simulation, spillovers to the rest of the euro area are negligible.

Figure 7 illustrates the effects of reforms in Malta's labour market along the transition path to the new steady state. As firms anticipate that labour costs will be lower in the future and that the labour supply will increase, they start to adjust the capital stock, inducing an increase in investment and labour demand. Real wages decline for around two years, after which they settle to the new, albeit lower, equilibrium. The decline in wages lowers firms' marginal costs, pushing inflation below its equilibrium level in the short to medium run. Consistently, Malta's terms of trade deteriorate to a greater extent. Nominal interest rates remain unchanged as the euro area variables are not affected by the Maltese reforms. Higher labour income in response to the increase in hours worked boosts consumption by both types of households, though it is partially offset by lower wages and an increase in the real interest rate. Exports benefit from the depreciation of the real effective exchange rate, as the increase in the supply of labour translates into excess supply in the goods market. Imports also increase given the higher aggregate demand.

[21] See, for instance, Gomes et al (2011) and Blanchard and Giavazzi (2003)

Figure 7: Labour Market Reform: Transition Dynamics



4.3. Non-tradable and labour market reform

The previous simulations focused on the two reforms being carried out separately. The third column of Table 2 reports on the long-run effects of the two reforms being implemented simultaneously. The results are more or less additive since the non-tradable mark-up and the wage mark-up are uncorrelated in the model. In general, one would typically also expect that higher competition will also induce productivity gains, for example, through the transfer of resources from inefficient production units to more efficient ones or due to foreign direct investment.[22] If this is indeed the case, the long-run gains reported in Table 2 are likely to be on the low side of what should be expected from the implementation of structural reforms.

[22] A similar argument was made by Jean and Nicoletti (2002)

The simultaneous implementation of the two reforms will raise real GDP by 5.5% in the long-run compared to the no-reform baseline scenario. All components of aggregate demand increase, with consumption, investment and exports increasing by 4% to 5% in the long run. Real wages rise as well, as the increase in demand for labour, associated with the reforms in the non-tradables sector, offsets the increase in the supply of labour associated with the labour market reform. Again, spillovers to the rest of the euro area are negligible.

Figure 8: Non-Tradable and Labour Market Reforms: Transitional Dynamics

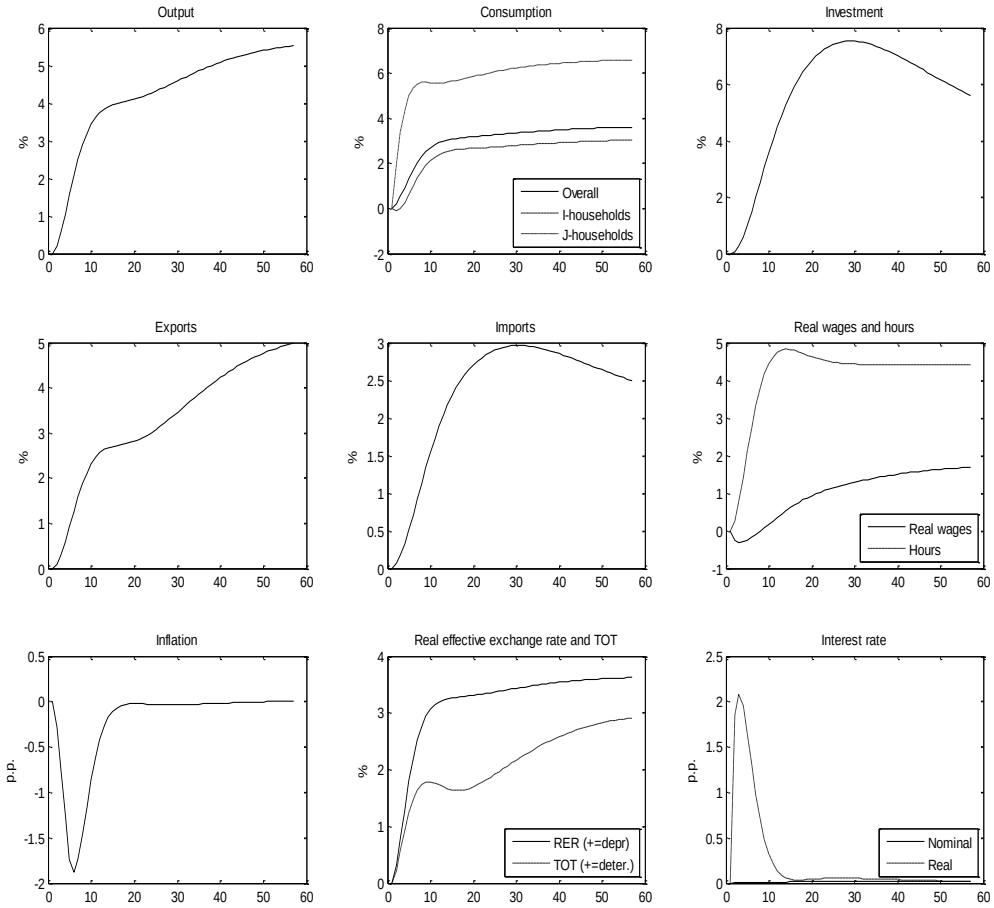


Figure 8 describes the transition dynamics to the new equilibrium. In general, the dynamics are similar to the average of the two reforms implemented separately. The simultaneous implementation of both reforms can soften, to a large extent, the transition costs associated primarily with the decline in consumption and exports (in the non-tradable sector reform) and the real wage (in the labour market reform). This time, the decline in the real wage is less pronounced and temporary, and wages start to increase after around two years, even though the labour market reforms are still being implemented. The short to medium term drops in consumption and exports associated with the reform

in the non-tradable sector are outweighed by the effects of the labour market reform, pushing up these variables on impact.

Overall, the main conclusion is that the joint implementation of services and labour market reforms, though potentially challenging for policy makers, could limit the transition costs associated with pursuing one reform in isolation, in particular, by softening the decline in the real wages following labour market reforms. This conclusion is somewhat related to the 'optimal' timing policy prescription put forward by Blanchard and Giavazzi (2003), who suggested that reforms in the services sector should precede those in the labour market since the increase in the real wage associated with the former will help to generate support for the labour market reform (which is associated with a decline in real wages).

4.4. Spillovers from euro area reforms

The previous section showed that Malta stands to benefit from domestic structural reforms but spillovers to the rest of the euro area are insignificant, given the small size of the Maltese economy. However, reforms implemented in the euro area are likely to have positive spillovers on the Maltese economy, given the size of the euro area and trade linkages between the two economies. The fourth column of Table 2 illustrates the results when both reforms are implemented simultaneously in Malta and in the euro area.[23]

As expected, there are positive spillovers on GDP and all components of aggregate demand. A 10 p.p. reduction in product and labour market mark-ups in both regions of the monetary union raises Malta's GDP by 6% in the long run, 0.5 p.p. higher than if the reforms are implemented only in Malta. Spillovers are greater when labour market reforms are implemented, since the increase in production in the services reform is primarily concentrated in the non-tradable sector. Consumption and investment in Malta increase by more than 1 p.p., respectively, compared to the benchmark scenario. Hours worked remain broadly unchanged as Maltese households substitute domestic for imported goods, whose supply increases strongly. Exports benefits from a buoyant foreign demand but are weighed down by a less pronounced depreciation of the real effective exchange rate since the increase in aggregate supply also pushes down prices in the euro area. In addition, imports are strongly boosted by the increase in the import-intensive domestic demand components.

[23] For the purpose of this exercise, product and labour market reforms in the euro area were simulated and the spillovers were added to the Malta's steady state results. The results are similar to those presented in Gomes et al (2011).

4.5. Comparison with other studies

In this section, I discuss and compare the results reported in this study for Malta with those for other EU countries. Appendix D provides a concise overview of the main studies reviewed, including the type of model used, the initial mark-up and the overall reduction in the mark-up. These studies have similar features: they are all multi-country DSGE models and the impact of structural reforms is estimated by permanently reducing the elasticity of substitution between different bundles. Qualitatively, therefore, the results are quite robust.

A direct quantitative comparison, however, should be treated with caution since the results could differ due to different model structures, calibration and on the size of the shock. For instance, Forni et al (2009) compare the effects of structural reforms if mark-ups in Italy's services sector are reduced to the euro area level, which imply a reduction in mark-ups of more than 25 p.p., whereas Everaert (2007) considers a scenario with structural reforms implemented in three different markets – labour, traded and non-traded sectors.

A more straightforward comparison is with Gomes et al (2011), the results of which are based on the same structural model used in this paper.[24] The main differences lie in the calibration of the EAGLE for Malta as a very small and open economy. As a result, I will mainly compare the results for Malta with those of Gomes et al (2011) and try to identify the sources of heterogeneity in terms of the different structure of the economies.

Compared to the case of a larger economy, the effects of structural reforms implemented unilaterally on domestic output are slightly lower, reflecting the higher degree of openness and the higher import content of domestic demand. In a small and open economy, the depreciation of the real exchange rate has a more pronounced impact on export volumes, which is, however, partly offset by higher imports. This effect, which is especially pronounced for the labour market reform, is further accentuated by Malta's trade structure, in which around two thirds of total exports are directed to non-euro area countries. The simulated increase in investment could be lower for a number of reasons. Since Malta is a very small economy, monetary policy at the euro area level does not react to domestic developments, therefore leading to somewhat higher real interest rate compared to a larger economy. In addition, the exchange rate depreciation can exert a more pronounced adverse impact on investment since the latter is more biased towards imported goods.

[24] Gomes et al (2011) is also a good benchmark because they compare the effects of structural reforms in two euro area countries, a large economy (Germany) and a smaller one (Portugal).

On the contrary, reforms implemented simultaneously with the rest of the euro area produce relatively larger positive effects for the domestic economy as the country benefits from the increase in aggregate demand in the rest of the euro area.

4.6. Sensitivity analysis

Given the uncertainty surrounding the different parameter estimates, this section provides a sensitivity analysis to assess the robustness of the results to (i) changes in the level of mark-ups and (ii) changes in key parameters governing the transmission mechanism.

Table 3 presents a sensitivity analysis of the long-run estimates to varying mark-up levels. The baseline product market mark-up of 50% is at the upper bound of the range of values commonly found in the literature. In addition, the empirical estimates of Borg (2009) for the period 1995-2005 may overestimate the actual level of product market mark-ups in Malta for two reasons. First, the output of the different sectors is measured at base prices i.e. including subsidies, which may lead to higher mark-up values. Second, the estimates refer mainly to the pre-EU accession period and the dismantling of levies following Malta's EU membership in 2004 may have exerted downward pressure on mark-ups. Similarly, I also test the sensitivity of the results to different labour market mark-ups since no direct estimates are available for Malta.

The sensitivity of the baseline results is assessed both through variations in the level of the mark-up and to the size of the shocks. The first two columns of Table 3 present the results of a 10 p.p. reduction in product market mark-up, with the initial mark-ups standing at 40% ($\theta_Y = 3.5$) and 30% ($\theta_Y = 4.33$) respectively instead of 50% as in the baseline calibration. The last two columns present the result of a 5 p.p. reduction in labour mark-ups, again starting from lower levels (25% and 20% instead of 30%). The smaller size of the shock in the case of labour market reforms is intended to assess the effects of possible non-linearities on the results to shocks of different magnitudes.

Table 3: Sensitivity Analysis to Level Varying Mark-Ups

(percent deviations from baseline)

	Product market		Labour market	
	10 p.p. reduction		5 p.p. reduction	
	40%	30%	25%	20%
Real activity				
GDP	2.3	2.5	1.7	1.8
Consumption	1.1	1.1	1.6	1.7
Investment	3.5	3.7	0.8	0.8
Exports	0.8	0.8	2.0	2.1
Imports	0.5	0.5	1.2	1.2
Labour Market				
Hours	1.0	1.1	1.7	1.8
Real wage	3.8	4.0	-0.8	-0.9
International relative prices				
REER	3.0	3.2	0.4	0.4
TOT	0.3	0.3	0.8	0.9

Two findings are noteworthy. First, the results are broadly robust to varying levels of mark-ups, though lower levels of mark-ups lead to slightly higher increases in GDP.[25] This feature stems mainly from the fact that the same percentage point reduction in the mark-up represents a larger percentage decline in prices and wages as the level of the mark-up decreases. Second, despite the non-linear properties of the model, the impact on the main economic variables stemming from shocks of different magnitudes can broadly be approximated linearly. For instance, the 1.7% increase in GDP from a 5 p.p. reduction in labour market mark-up is approximately half the baseline estimate of 3.3% following a 10 p.p. reduction in wage mark-ups.

[25] Similar results were also reported in Bayoumi et al (2004).

Table 4: Sensitivity Analysis: Long-Run Effects of Reducing Mark-ups by 10 p.p.

(percent deviations from baseline)

	Baseline	Inverse Frisch elasticity	Intertemp. Elasticity of substitution	Elasticity of substitution btw tradables	Liquidity constrained households
		$\tau = 3$	$\sigma = 1.5$	$\mu_{TC}=\mu_{TI}=2.5$	J = 0.4
Real activity					
GDP	5.5	4.7	4.9	5.5	4.6
Consumption	4.2	3.5	3.7	4.2	3.4
Investment	4.8	4.4	4.5	4.8	4.4
Exports	4.7	3.8	4.0	4.7	3.7
Imports	2.7	2.2	2.3	2.7	2.1
Labour Market					
Hours	4.3	3.5	3.7	4.3	3.4
Real wage	1.9	2.2	2.1	1.9	2.3
International relative prices					
REER	3.6	3.4	3.4	3.5	3.4
TOT	1.9	1.5	1.6	1.8	1.5

Table 4 presents a sensitivity analysis of the results to changes in key parameters. Four different scenarios are reported, which are benchmarked against the baseline results as reported in Table 2 (when both reforms are implemented simultaneously). The second column in Table 4 reports the case of a higher inverse Frisch elasticity, which governs the sensitivity of hours worked to a change in the real wage (while keeping the marginal utility of consumption constant). In the sensitivity exercise, the inverse of the Frisch elasticity is increased from 2 to 3, thereby reducing the sensitivity of hours worked to changes in the real wage.[26] The third column reports the results when the intertemporal elasticity of substitution is increased from 1 to 1.5. A higher (lower) intertemporal elasticity of substitution raises (lowers) the sensitivity of consumption to the real interest rate. Column 4 increases the elasticity of substitution between domestic tradables and imported goods from 1.5 to 2.5, moving it closer to the values typically found in microeconomic studies.[27] Finally, the fifth column reports the result if the share of liquidity constrained households is increased from 25% to 40%, in line with the estimates of Castro (2006) and the calibration in Almeida et al (2009) for the Portuguese economy.

[26] This means that, given a 1% increase in the real wage, hours worked will increase by 0.33% compared to 0.5% in the baseline scenario.

[27] See, for instance, ECB (2012) for a discussion and alternate estimates of trade elasticities.

The main conclusion is that the results are robust to changes in the considered parameters. In particular, the economic expansion in Malta continues to be sizeable, with the long-run impact on GDP ranging between 4.6% to 5.5% for a 10 p.p. reduction in the non-tradable and labour market mark-ups. Similar conclusions hold for the components of aggregate demand. In three out of the four cases considered, an important channel driving the result is a smaller increase in hours worked, which in turn affects consumption through lower disposable income in the long run. The only exception is the case of higher elasticity of substitution between domestic tradables and imports, the results of which are very similar to the baseline figures, with the exception of some slight changes in international relative prices. Overall, this calls for policies to make the labour more inclusive in order to attract more people in the labour force, for instance, through more flexible work arrangements, tax credit schemes and more affordable childcare facilities.

5. Conclusion

This paper has quantitatively analysed the macroeconomic implications of structural reforms in product and labour markets by simulating a calibrated version of EAGLE for Malta. Better functioning of these markets is widely recognised as a precondition for unlocking the country's growth potential, especially in the face of an ageing population and a slowdown in external demand due to the austerity measures adopted by Malta's trading partners.

The analysis shows that there are sizeable long-run positive effects associated with the implementation of structural reforms. Within a monetary union framework, these reforms will boost Malta's external competitiveness through the depreciation of the real effective exchange rate, thereby addressing some of the imbalances accumulated in this area over the past decade. Moreover, if these reforms stimulate productivity gains, for instance, by attracting foreign direct investment or shifting resources towards more productive enterprises, the long-run benefits could be even more pronounced than those reported in this paper. Boosting the country's supply capacity will in turn facilitate convergence with the EU's income level, a process that came to a halt over the ten years up to 2010. Malta also stands to benefit from positive spillover effects if structural reforms are pursued by the rest of the monetary union, given the resultant economic expansion and Malta's trade linkages with the rest of the euro area.

The simulations point to qualitative differences in the impact on the main macroeconomic variables if the reforms are implemented in isolation or jointly. In particular, both reforms are associated with short to medium term adjustment costs if implemented in isolation. This result suggests that

coordination of the reforms is beneficial since it will soften, to a large extent, the adjustment costs associated with the implementation of the reforms in isolation, especially the decline in real wages.

In the absence of similar studies for Malta, it is important to stress that the results are still preliminary. However, it is encouraging that the sensitivity analysis showed that the findings are robust to varying levels of mark-ups and different parameterization of the model. In general, rather than focusing on point estimates, the results should be interpreted to suggest that there are non-trivial long-run positive effects associated with the implementation of structural reforms. One caveat is that the model does not include labour market frictions (e.g. search and matching frictions). As the long-run effects seem to be more pronounced as more people are attracted to the labour market, this calls for policies to reduce skills mismatches to facilitate the matching between prospective employees and firms and to make labour more inclusive so that more people are attracted in the labour force. With Malta having one of the lowest employment rates in the EU, there is ample room for improvement in this area.

Further research in this area is warranted. The calibration of dynamic general equilibrium models typically depends on empirical analysis at the micro level, which is almost non-existent for Malta. In this regard, one promising area of research relates to a more in depth analysis of product market and labour market mark-ups, especially after the removal of levies following EU membership in 2004, which could help to refine the results by tailoring the calibration of EAGLE to the estimated mark-ups. These estimates will also serve as inputs in other related topics, for instance, to understand Malta's persistent inflation differentials with the euro area, which can lead to the accumulation of domestic imbalances and erosion in the country's external competitiveness. In terms of the EAGLE model, one interesting area of research relates to how improvements in the country's external competitiveness, for instance, through policies aimed at wage moderation or productivity gains, can help to reduce the trade deficit. These avenues will be left for future research.

References

Allard, C. and Everaert, L. (2010) Lifting Euro Area Growth: Priorities for Structural Reforms and Governance, IMF Staff Position Note SPN/10/19.

Almeida, V., Castro, G. and Felix, R. (2008), Improving Competition in the Non-Tradable Goods and Labour Markets: the Portuguese case, Banco de Portugal Working Paper 16.

Alves, N., Correia, I., Gomes, S. and Sousa, J. (2009), An Insider's View on the Euro Area: Dynamics, Heterogeneity and Policy, in *The Portuguese Economy in the Context of Economic, Financial and Monetary Integration*, Economics and Research Department, Banco de Portugal, 1-64.

Bayoumi, T., Laxton, D. and Pesenti, P. (2004), Benefits and Spillovers of Greater Competition in Europe: A Macroeconomic Assessment, ECB Working Paper 341.

Blanchard, O. and Giavazzi, F. (2003), The Macroeconomic Effects of Regulation and Deregulation in Goods and Labour Markets, The Quarterly Journal of Economics 118(3), 879-909.

Borg, M. (2009), Measuring Market Competition in the EU: the Mark-Up Approach, Bank of Valletta Review, No.39, Spring 2009.

Bouis, R., and Duval, R. (2011), Raining Potential Growth After the Crisis: A Quantitative Assessment of the Potential Gains from Various Structural Reforms in the OECD Area and Beyond, OECD Economics Department Working Papers, No. 835.

Brzoza-Brzezina, M., Jacquinot, P. and Kolasa, M. (2010), Can we Prevent Boom-Bust Cycles during Euro Area Accession?, ECB Working Paper 1280.

Castro, G. (2006), Consumption, Disposable Income and Liquidity Constraints, Economic Bulletin, Banco de Portugal.

Central Bank of Malta (2010), Annual Report, available on CBM website.

Central Bank of Malta (2011), Wage Dynamics Report, available on CBM website.

Christoffel, K., Coenen, G. and Warne, A. (2008), The New Area Wide Model of the Euro Area: a micro founded open economy model for forecasting and policy analysis, ECB Working Paper 599.

Coenen, G., McAdam, P. and Straub, R. (2007), Tax Reform and Labour Market Performance in the Euro Area: a Simulation-Based Analysis using the New Area-Wide Model, ECB Working Paper 747.

ECB (2011), Structural Features of Distributive Trades and Their Impact on Price in the Euro Area, ECB Structural Issues Report.

ECB (2012), Competitiveness and External Imbalances Within the Euro Area, ECB Occasional Paper No 139.

Everaert, L. and Schule, W. (2008), Why It Pays to Synchronize Structural Reforms in the Euro Area Across Markets and Countries, IMF Staff Papers (55)2.

Forni, L., Gerali, A. and Pisani, M. (2010), Macroeconomic Effects of Greater Competition in the Services: The Case of Italy, Macroeconomics Dynamics, forthcoming.

Gali, J. (1999), Technology, Employment and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?, American Economic Review, 89(1), 249-271.

Gali, J. (2008), Monetary Policy, Inflation and the Business Cycle: an Introduction to the New Keynesian Framework, Princeton University Press.

Gomes, S., Jacquinot, P., Mestre, R. and Sousa, J. (2010), Global Policy at the Zero Lower Bound in a Large-Scale DSGE Model, ECB Working Paper 1254.

Gomes, S., Jacquinot, P. and Pisani, M. (2010), The EAGLE: A Model for Policy Analysis of Macroeconomic Interdependence in the Euro Area, ECB Working Paper 1195.

Gomes, S., Jacquinot, P., Mohr, M. and Pisani, M. (2011), Structural Reforms and Macroeconomic Performance in the Euro Area Countries: A Model-Based Assessment, ECB Working Paper 1323.

Griffoli, T. M. (2013), DYNARE User Guide: An Introduction to the Solution and Estimation of DSGE Models, available on Dynare website.

Jean, S. and Nicoletti, G. (2002), Product Market Regulation and Wage Premia in Europe and North America: An Empirical Investigation, OECD Working Paper 318.

Kolasa, M. (2010), Real Convergence and its Illusions, ECB Working Paper 1231.

Lombardo, G. and Ravenna, F. (2010), Openess and Optimal Monetary Policy, ECB Working Paper 1279.

Senaj, M. and Vyskrabka, M. (2011), European Taxes in a Laboratory, National Bank of Slovakia Working Paper 2/2011.

Smets, F. and Wouters, R. (2003), An Estimated Dynamic Stochastic General Equilibrium Model for the Euro Area, Journal of European Economic Association (5), 1123-1175.

WGEM (2012), EAGLE Stock-Taking Exercise and the Way Forward, WGEM mimeo

Appendix A: Steady State Values of the Model

Table A1: Steady-State National Accounts (Ratio to GDP, percent)

	MT	EA	US	RW
Share in world GDP	0.2	22.8	28.0	49.0
Domestic Demand				
Private consumption	63	58	66	64
Public consumption	20	21	15	16
Private investment	19.5	21	19	20
Trade				
Imports (excl. intermediate imports)	50	24	11	15
Imports of consumption goods	36	20	7	9
Imports of investment goods	14	5	4	6
Trade balance	-2	0	0	0
Production				
Tradables	50	40	35	35
Non-tradables	50	60	65	65
Labour	54	54	57	57

Table A2: Implied Trade Linkages

Exports				
% of total	MT	EA	RW	US
MT	-	35	49	16
EA	0	-	87	12
RW	0	45	-	55
US	0	17	89	-
Imports				
% of total				
MT	-	51	41	8
EA	0	-	86	14
RW	0	50	-	50
US	0	6	94	-

Table A3: Price and Wage Mark-ups (Implied Elasticities of Substitution)

	Tradables (θ_T)	Non-Tradables (θ_N)	Wages (η_I=η_J)
MT	1.20 (6.0)	1.50 (3.0)	1.30 (4.3)
EA	1.20 (6.0)	1.50 (3.0)	1.30 (4.3)
US	1.20 (6.0)	1.28 (4.6)	1.16 (7.3)
RW	1.20 (6.0)	1.28 (4.6)	1.16 (7.3)

Table A4: Final Goods

	MT	EA	US	RW
Share of tradables in final consumption good (υ_C)	0.60	0.45	0.35	0.35
Share of tradables in final investment good (υ_I)	0.75	0.75	0.75	0.75
Quasi-share of domestic tradables in tradable consumption bundle (υ_{TC})	0.55	0.55	0.75	0.75
Quasi-share of domestic tradables in tradable investment bundle (υ_{TI})	0.55	0.55	0.70	0.65
Elasticity of substitution between tradable and non-tradable goods (μ_C and μ_I)	0.50	0.50	0.50	0.50
Elasticity of substitution between domestic goods and imports (consumption and investment goods) (μ_{IMC} and μ_{IMI})	1.50	2.50	2.50	2.50
Elasticity of substitution between imported goods (μ_{TC} and μ_{TI})	2.50	2.50	2.50	2.50

Table A5: Intermediate Goods

	MT	EA	US	RW
Capital share in non-tradable production (α_{NT})	0.35	0.30	0.30	0.30
Capital share in tradable production (α_T)	0.40	0.35	0.35	0.35
Fixed costs in tradable production (ψ_T)	0.20	0.20	0.20	0.20
Fixed costs in non-tradable production (ψ_{NT})	0.28	0.28	0.08	0.08
Calvo probability for goods sold domestically (ξ_H and ξ_N)	0.75	0.75	0.75	0.75
Calvo probability for exported goods (ξ_X)	0.75	0.75	0.75	0.75
Price indexation (χ_H, χ_N and χ_X)	0.50	0.50	0.50	0.50

Table A6: Households

	MT	EA	US	RW
Share of J-type households (ω)	0.25	0.25	0.25	0.25
Inverse of the intertemporal elasticity of substitution (σ^{-1})	1.00	1.00	1.00	1.00
Habit formation (κ)	0.60	0.60	0.60	0.60
Inverse elasticity of labour supply (ζ)	2.00	2.00	2.00	2.00
Calvo probability for wages (ξ_I and ξ_J)	0.75	0.75	0.75	0.75
Wage indexation (χ_I and χ_J)	0.75	0.75	0.75	0.75
Depreciation rate (δ)	0.025	0.025	0.025	0.025
Discount factor (β)	0.9926	0.9926	0.9926	0.9926

Table 7: Fiscal authorities

	MT	EA	US	RW
Target government debt-to-output ratio ($\overline{B_Y}$)	2.40	2.40	2.40	2.40
Sensitivity of lump-sum taxes to debt-to-output ratio ($\emptyset_{BY}$)	0.10	0.10	0.10	0.10
Consumption tax rate (τ^C)	0.18	0.183	0.077	0.077
Personal income tax rate (τ^N)	0.122	0.122	0.154	0.154
Social security contribution paid by firms (τ^{Wf})	0.079	0.219	0.071	0.071
Social security contribution paid by employees (τ^{Wh})	0.072	0.119	0.071	0.071

Table A8: Monetary Policy

	EA	US	RW
Inflation target ($\overline{\Pi^4}$)	1.02	1.02	1.02
Interest rate smoothing ($\emptyset_R$)	0.87	0.87	0.87
Interest rate sensitivity to inflation gap ($\emptyset_\pi$)	1.70	1.70	1.70
Interest rate sensitivity to output growth ($\emptyset_Y$)	0.10	0.10	0.10

Table A9: Adjustment costs

	MT	EA	US	RW
Capacity utilisation cost (γ_{u2})	2000	2000	2000	2000
Investment adjustment cost (γ_I)	6.0	6.0	4.0	4.0
Import adjustment cost for consumption good (γ_{IMC})	1.0	2.0	2.0	2.0
Import adjustment cost for investment good (γ_{IMI})	1.0	1.0	1.0	1.0
Transaction cost function (γ_{v1})	0.0267	0.0267	0.0267	0.0267
Transaction cost function (γ_{v2})	0.1284	0.1284	0.1284	0.1284
Intermediation cost function (γ_{B*})	0.01	0.01	-	0.01

Appendix B: Simulations using EAGLE

This Appendix documents three illustrative shocks that are often examined in policy simulations. These refer to (i) a monetary policy shock (ii) a domestic productivity shock in both the tradable and non-tradable sectors, and (iii) a domestic government expenditure shock. These simulations are intended to highlight the main transmission channels operating in EAGLE.

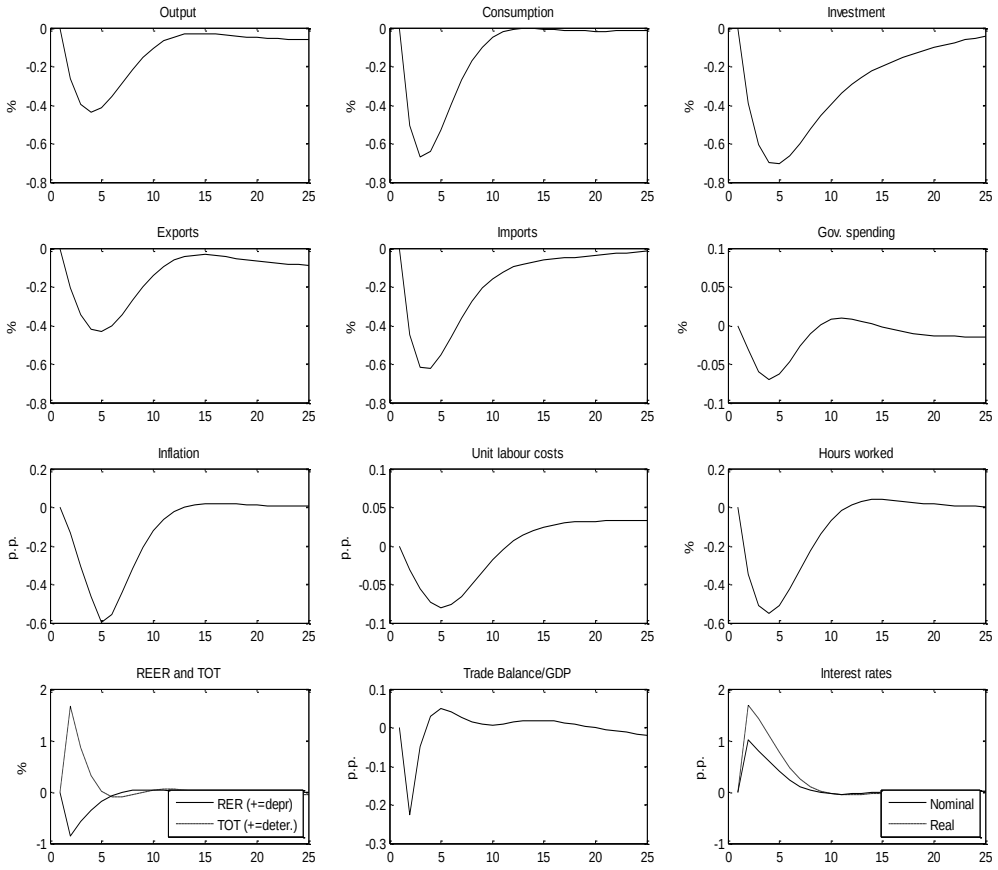
A. Monetary policy shock

Figure B1 plots the reaction of the main macroeconomic variables to a monetary policy shock in the euro area. The shock is calibrated such that there is an initial increase in the (annualized) short-term interest rate of about 100 basis points.

The shape of the reaction functions is standard. The decline in output, consumption and investment is hump-shaped in line with the IRFs obtained from empirical VAR studies.[28] GDP declines by around 0.4% four quarters after the initial shock, driven primarily by consumption and investment, which decline by around 0.6%-0.7%. Exports also fall, albeit by a lesser extent, reflecting lower aggregate demand in the euro area and the appreciation of the real effective exchange rate. The drop in output is, however, mitigated by a decline in imports, given the high import content of domestic demand. The slowdown in economic activity leads to lower demand for labour and hence, lower hours worked. On the nominal side, inflation declines by around 0.6 percentage points five quarters after the shock. The trade balance-to-GDP ratio initially decreases as the real exchange rate appreciation induces a decline in the domestic currency value of exports. Subsequently, it improves somewhat as imports closely track aggregate demand and are rather insensitive to changes in relative prices, given the assumption of low elasticity of substitution between domestic and imported tradable goods.

[28] See, for instance, Gali (2008), chapter 1.

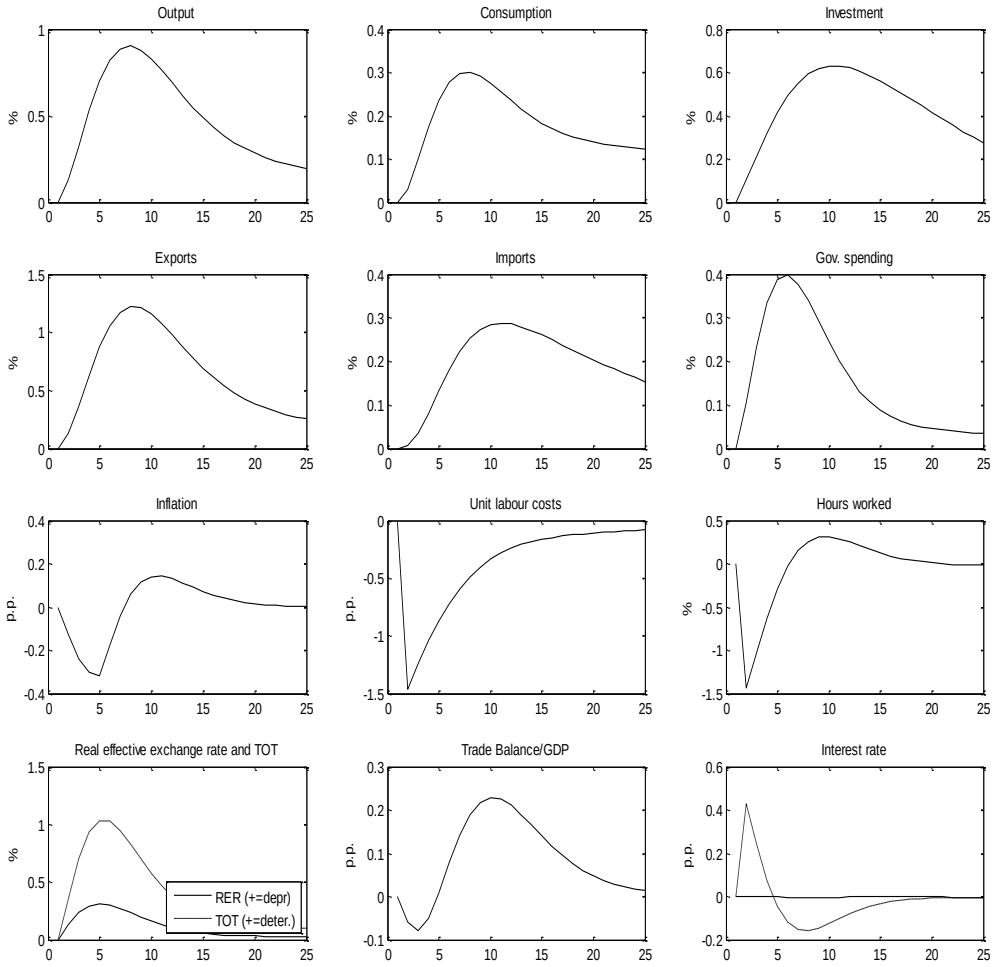
Figure B1: Monetary Policy Shock



B. Productivity shock

Figure B2 shows the reaction to a standard technology shock in Malta, which raises the degree of productivity in the tradable and non-tradable sectors by 1%. The productivity shock is temporary but persistent, with an AR coefficient of 0.9.

Figure B2: Productivity Shock



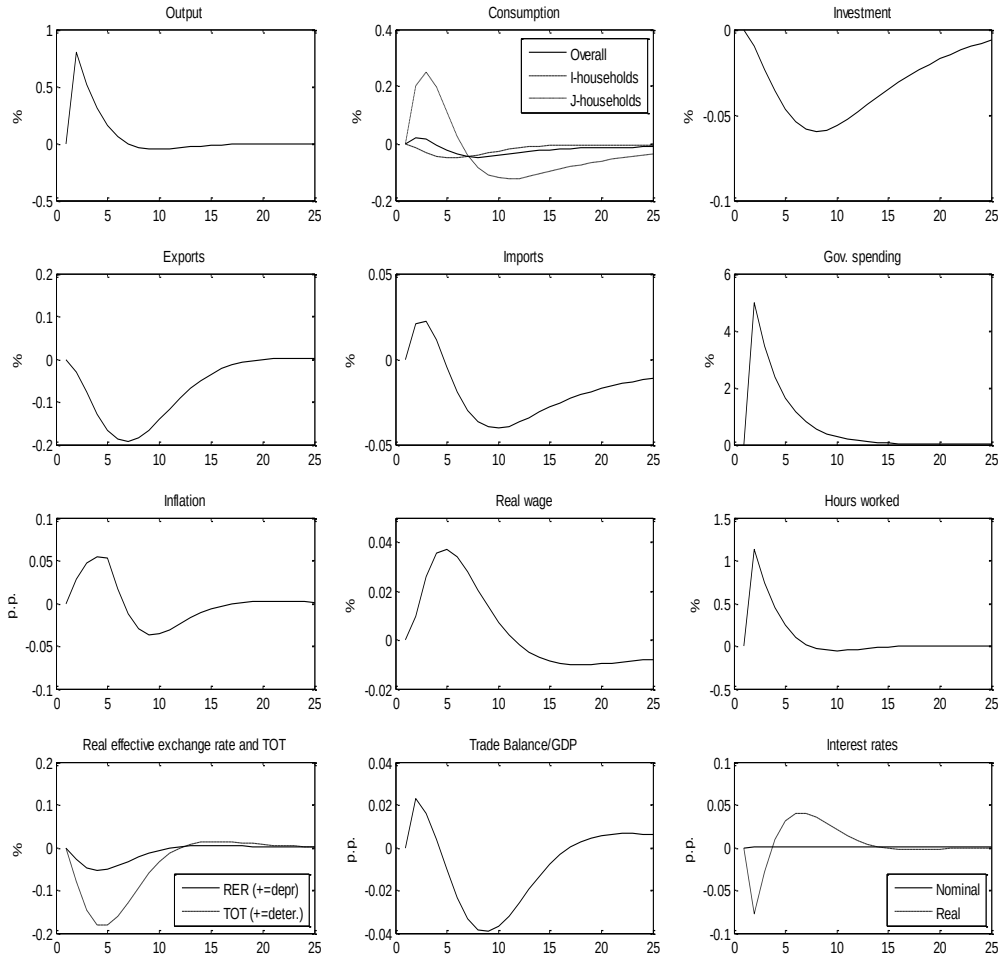
The impulse responses are standard to a favourable supply side shock, with an increase in real variables and a decline in inflation. GDP increases by around 0.9% two years after the initial shock, driven primarily by exports and, to a lesser extent, investment and consumption. The decline in domestic inflationary pressures leads to a depreciation in the real effective exchange rate, which, together with the decline in unit labour costs, improves the country's external competitive position. Buoyant domestic activity, however, leads to higher inflation after around two years. The trade balance deteriorates slightly at first but improves gradually after around one year. Since inputs are more productive, firms reduce their demand for labour, thereby explaining the decline in hours worked.[29] Finally, the small country assumption implies that euro area interest rates are not affected by domestic development.

[29] The response of hours worked to a productivity shocks is in line with the empirical findings of Gali (1999), using a VAR with long run restrictions.

C. Government expenditure shock

Figure B3 shows the reaction to an exogenous and mildly persistent increase in government spending equal to 1% of steady state output. Government spending as a percentage of steady state GDP is modelled as an autoregressive process with an AR coefficient equal to 0.7, taking around 4 years for the shock to die out.

Figure B3: Government Spending Shock



The increase in government expenditure leads to an increase in GDP of around 0.8% that gradually returns to its steady state value. Given its share in GDP, public expenditure increases by around 5%.The higher demand for factor inputs lead to an increase in hours worked and, to a lesser extent, to the real wage. Higher employment and real wages induces a positive income effect that only partially offset the negative wealth effect associated with higher government spending. In general, I observe very small crowding out effects on consumption and investment. Moreover, the response of overall

consumption masks the differences in the behaviour of the two types of households. Higher government expenditure leads to an increase in consumption by the liquidity constrained households (given the increase in the real wage). This is, however, offset by the decline in consumption of non-constrained households due to the negative wealth effect (since households anticipate higher taxes in the future). The effects of government expenditure on inflation are small and given the small country assumption, they have no effect on the monetary policy stance of the monetary union central bank. With unchanged nominal interest rates, there is a small reduction in the real interest rate, which partially compensates for the negative wealth effect of optimizing households.

Overall, the reaction of the main macro variables to the three shocks presented produce plausible and realistic responses that are in line with the literature.

Appendix C: DYNARE Files

The version of EAGLE used in this paper is coded in DYNARE. I would to thank the original authors for making the code available.

DYNARE is a collection of Matlab routines used for the estimation and simulation of DSGE models. Details of DYNARE are available in Griffoli (2013). The EAGLE code consists of the following 7 files:

`init.mod` provides generic initializations, such as the country list.

`symdecls.mod` declares all the endogenous and exogenous variables, together with the parameters of the model.

`modeqs.mod` contains all the equations of the model.

`param.mod` provides the set of parameters for the initial steady state.

`initval.mod` contains the set of endogenous and exogenous for the initial steady state.

`steady1.mod` first-stage computation of the steady state.

`steady2.mod` second-stage computation of the steady state.

The files `steady1.mod` and `steady2.mod` instruct DYANRE to find the steady state of the model. An initial steady state is used as a starting point (calling `params.mod` and `initval.mod` included in `steady1.mod`). The first set of parameters is changed and the corresponding steady state is recomputed using the divide-and-conquer (homotopy) method. The results are stored in '`eagle_steady_stage1.txt`'. A second set of parameters are changed using the same technique but this time some endogenous variables and parameters are flipped (`steady2.mod`). The results are stored in '`eagle_steady.txt`' for use during dynamic simulation exercises.

Changing the calibration of the model involves changing some parameters in either `steady1.mod` or `steady2.mod` and then running DYNARE on the two files. Once the steady state has been calibrated, a deterministic simulation can be performed.

Appendix D: Selected Literature Review

Author	Country	Model	Initial level of Mark-up		New level of Mark-up		Long run effects on GDP		
			Services	Labour	Services	Labour	Services	Labour	Total
Gomes, Jacquinot, Mohr & Pisani (2011)	Germany	Calibrated	1.50	1.30	1.40	1.20	2.87	2.77	5.71
			1.50	1.30	1.35	1.15	4.39	4.27	8.83
Gomes, Jacquinot, Mohr & Pisani (2011)	Portugal	Calibrated	1.50	1.30	1.35	1.15	3.62	4.02	7.77
Forni, Gerali & Pisani (2009)	Italy	Calibrated	1.61	1.61	1.55	1.55	2.10	1.80	3.90
			1.61	1.61	1.45	1.45	6.30	5.50	11.60
			1.61	1.61	1.35	1.35	10.80	9.10	19.90
Everaert (2007)	Belgium	Calibrated	1.39	1.29	1.24	1.13	4.30	5.00	11.50
	France	Calibrated	1.41	1.35	1.24	1.13	6.40	7.50	17.50
Bayoumi, Laxton & Pesenti (2004)	euro area	Calibrated	1.35	1.35	1.25	1.25	4.80	2.10	6.90
			1.35	1.35	1.20	1.20	7.40	3.30	10.70

Note: The results of Everaert (2007) include also a reform in the traded sector.Results are reported for the case of simultaneous reforms with the rest of the euro area.