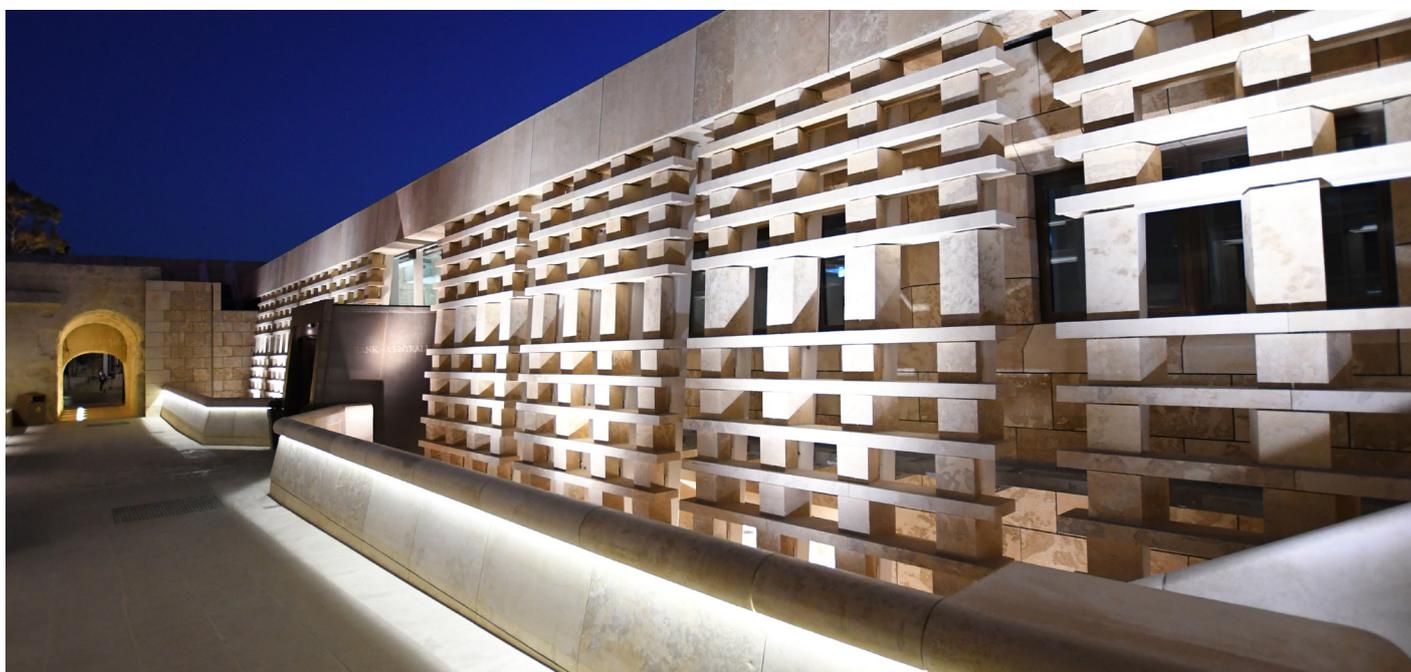




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FOREWORD



This year marks the Central Bank of Malta's fiftieth anniversary. The Bank's journey has been one of impressive progress – from modest beginnings in 1968 to being a fully-fledged member of the Eurosystem. Throughout this time, the Bank managed to transform successfully and supported Malta's economic development.

A key ingredient underlying the Bank's success has been the presence of a strong research function. When the Central Bank of Malta was established in 1968, the Research Department was, in fact, one of its two departments. The decision to promote research so strongly fifty years ago recognised the fact that, by enhancing the understanding of a range of economic issues, research allows policymakers, both within the Bank and beyond, to take better informed decisions. Just as the Bank has made big strides forward over the years, so too has its research output. Both the breadth and depth of the Bank's research have improved markedly over time. This was largely the result of two key developments. First, over the years, the Bank has devoted an increasing portion of its resources towards this crucial function. Second, as a result of Malta's euro area membership, the Bank's staff are now part of a larger research community. Our researchers regularly attend working groups, task forces and research networks that promote beneficial synergies, allow for an exchange of knowledge and experience, and serve to instil new research ideas.

Research is of little use if it does not reach the people who need it. For this reason, the Bank strives to disseminate its research extensively. One avenue of dissemination is through the delivery of presentations. The Bank's staff regularly present their research in a variety of fora that range from internal seminars and presentations at other policy institutions, to specialised conferences abroad. Another method of dissemination is through publications. Some of our research is published in the Bank's Quarterly Reviews and Annual Reports, which have been issued consistently over the last fifty years. More recently, since 2013 the Bank has started to publish on its website a peer-reviewed Working Paper series (to date comprising 32 papers), followed in 2015 by a Policy Note series (to date comprising 14 notes). Moreover, the Bank's staff also publish their work in international peer-reviewed journals.

This year, the Bank is launching a new publication: the Research Bulletin. The scope of this new publication is to showcase, in a concise and more approachable manner, some of the Bank's research output, and therefore serve as another means of disseminating our work. This first edition consists of four articles that explore diverse economic issues, all of which are highly policy relevant.

The first article studies the macroeconomic impact of the recent energy-related reforms in Malta, namely the installation of an undersea interconnector between Sicily and Malta and the changeover of Enemalta's power stations from operating on heavy fuel oil and gasoil to natural gas. This study takes into consideration both demand-side effects related to the conversion and construction of upgraded power plants, as well as supply-side effects, which manifest themselves as reductions in the marginal cost of electricity production of Enemalta. Using the fiscal version of MEDSEA, the Central Bank of Malta's DSGE model, Noel Rapa shows that the decommissioning of the Marsa power plant and the installation of an undersea interconnector, resulted in a fall in marginal costs, and therefore an increase in long-run output of 2.1 per cent. The eventual conversion of Enemalta's power plants to natural gas leads to more pronounced gains in activity of 2.5 per cent. The estimates are sensitive to two key factors – the prevailing oil price levels and the degree of pass-through from Enemalta to its customers.

The next article presents a small macro-econometric model to explain house price developments in Malta, which incorporates both demand and supply-side factors. The core model consists of a stock-flow framework that models the relationship between house prices, residential investment and housing stock. The housing block is augmented with a stylised real economy block that determines potential and actual gross domestic product (GDP), employment and wages, thus allowing the assessment of macro-financial linkages. Using an error-correction modelling framework, the model is used to quantify the degree of misalignment in Maltese house prices and to test the stability of key parameters. The authors, William Gatt, Brian Micallef and Noel Rapa, argue that the recent rise in house prices seems to differ significantly from that observed in the mid-2000s, as house prices are more closely aligned to fundamentals. Moreover, parameter estimates suggest that the responsiveness of house prices to changes in

housing supply has changed significantly in recent years, compared to the pre-crisis boom. In particular, the recent increase in housing supply should attenuate house price inflation, in contrast to what happened in the mid-2000s, when higher supply fuelled a rise in prices in the short term.

The third article, authored by Jude Darmanin, Ilias Georgakopoulos and Clemens Knoppe, explores whether the strong and job-rich expansion that Malta has witnessed over the past years has been accompanied by rising inequality and increased poverty. In particular, this study provides a general overview of the current state of income distribution, inequality and wage mobility in Malta, bringing together material from survey and micro-level datasets. In recent years, income inequality in Malta has returned to the levels observed during the 2008-2010 period, mostly owing to the rapid growth in incomes of those in the middle part of the income ladder. While the proportion of those at risk of poverty or social exclusion has fallen significantly, the unemployed and the less educated remain at risk, while the relative position of the older population has slipped. The wage mobility of those aged 35 to 49 appears to have improved since the mid-2000s, while that of those over 50 has been eroded. This suggests that while boosting employment plays an important role in improving income prospects, there is an important role for government in redistributing the wealth generated by the economy.

The final article assesses the reliability of Maltese GDP data. In particular, Owen Grech presents stylised facts of revisions to overall GDP and its main expenditure components, in both real and nominal terms, which occurred between 2002 and 2018. Towards this end, a number of revision indicators are employed that shed light on the magnitude, bias and volatility of these revisions. This article also presents a useful by-product of this research: Malta's first real-time macroeconomic database. The database covers 14 variables: real and nominal GDP and their main expenditure components. It includes all GDP vintages published between 2002Q1 and 2018Q1 and consists of over 30,000 data points. The results reveal that revisions to initial National Accounts data are sizeable, biased upwards, volatile and increase with the horizon. The size, bias and volatility of revisions to the components of GDP are generally larger than those to their aggregate counterparts. Moreover, revisions to private consumption and government consumption tend to be smaller in terms of size, bias and volatility than revisions to investment, exports and imports.

These four research articles are testament to the development of the Bank's research function over the last fifty years. The Central Bank of Malta has created advanced models of the Maltese economy, regularly assessed official statistics and developed its own surveys in cases when data was found lacking. It has done this to study standard macroeconomic issues, such as the development of potential output or the housing market, but also increasingly topics that are not the traditional areas of central banks, such as the study of inequality. As the Maltese economy continues to evolve and become increasingly complex, so too will the research questions the Bank has to grapple with. However, the human capital the Bank has garnered over the years, coupled with its continued commitment towards economic research, make it well-equipped to rise to this challenge and continue conducting high quality research that points policymakers in the right direction, as it has done in the past fifty years. I hope that the launch of this new annual research publication proves to be a fitting legacy for this important milestone in the Bank's history.



Dr Aaron G. Grech
Chief Officer, Economics

THE MACROECONOMIC EFFECTS OF ENERGY REFORMS IN MALTA

Noel Rapa



This article studies the macroeconomic effects of energy market reforms in Malta using a DSGE model augmented with a rich fiscal block. Contrary to previous studies, this article takes into consideration both demand-side effects related to the conversion and construction of upgraded power plants, as well as supply-side effects, which manifest themselves as reductions in the marginal cost of electricity production of Enemalta. It considers two energy setups – an interconnector and gasoil setup and an interconnector and natural gas setup – and three different oil price levels. Under the baseline oil price scenario, the decommissioning of the Marsa power plant and the installation of an undersea interconnector results in a fall in marginal costs, leading to an increase in long-run output of 2.1%. The eventual shift to natural gas-fired turbines leads to more pronounced gains in activity. The estimates are sensitive to two key factors – the prevailing oil price levels and the degree of pass-through from Enemalta to the final customers.

Introduction

The European Union's (EU) energy policy requires all member states to reform existing power systems and decrease their reliance on single, vertically integrated power suppliers. Malta's small size and geographic isolation implies that it does not have to comply with all EC directives; most notably those regarding the unbundling of distribution system operators, third-party access and market opening. However, in line with the EU Energy Roadmap 2050, Malta is required to reduce the vulnerability of its electricity generation to fossil fuel prices and potential import disruptions.

To this end, Maltese authorities have enacted a number of reforms aimed at diversifying the island's exclusive fossil fuel based energy mix and increase the efficiency of its electricity production. First, authorities opted to install a high voltage alternating current undersea cable that connects Malta's energy grid with that of Europe. This, together with an increase in the nominal capacity of the Delimara power plants, have resulted in the possible decommissioning of the Marsa power station. Second, in a bid to reduce the carbon footprint of domestic energy generation, authorities opted to enter into an agreement with Shanghai Electric Power Co. Ltd to convert Delimara 3 power station from one operating on heavy fuel oil to gas and to build a new combined cycle gas-fired power plant, Delimara 4. The macroeconomic effects of these energy reforms have been analysed in a number of studies, such as Grech (2014), the Ministry for Finance (2016), and in Rapa (2017a).¹ While the latter study captures the supply-side effects of these energy reforms owing to a reduction in economy-wide marginal costs, it does not include the demand-side effects of the short-term increase in government investment required to enact these reforms. Moreover, Rapa (2017a) does not take into consideration neither the increase in the long-run government investment ratio to GDP required to maintain the new capital equipment installed, nor the increase in government investment driven by the expansion in long-run output of the economy.

Efficiency gains in electricity production

The energy reforms undertaken by the Maltese government are expected to affect the Maltese economy in two broad ways. First, the installation of the interconnector across the Sicilian channel and the conversion of Enemalta's powerplants to operate on natural gas are expected to boost government investment, leading to significant demand-side effects. Second, and more importantly, since the new energy setup is more efficient than the one it is replacing, marginal costs faced by Malta's energy provider are expected to fall significantly, leading to substantial positive supply-side effects.

In a recently published study, Ries et al. (2016) estimate how these reforms will likely impact Enemalta's marginal cost of electricity production. Enemalta's power plants contain a number of generators with different efficiency rates.

¹ Grech (2014) uses the Central Bank of Malta's macro-econometric model to estimate the macroeconomic effect of the 25% reduction in utility tariffs enacted in 2014, while Ministry for Finance (2016) also takes into consideration the higher government investment carried out to undertake the reforms.

As demand for electricity increases, Enemalta is required to fire the least efficient generator so as to meet energy demand. To arrive at a figure for marginal cost, the authors use a merit order curve that ranks each generator by its marginal cost of production (in ascending order). The marginal cost of producing an extra MWh of electricity is ultimately given by the marginal cost of the last generation unit used to satisfy any level of electricity consumption. To get at an average clearing price, the authors propose an algorithm that runs through the hourly electricity consumption in Malta between 2007 and 2010 and optimally chooses which energy sources are to be used. This experiment is then repeated over a number of energy setups.

“Marginal costs faced by Malta’s energy provider are expected to fall significantly, leading to substantial positive supply-side effects”

For the purpose of this article, we will take in consideration three setups: an isolated setup prior to the installation of the interconnector and in which both Delimara and Marsa power stations are operative (EPS 2010), a system in which the Marsa power plant has been decommissioned and where the interconnector gives access to Sicilian energy production (EPS 2015) and a system identical to EPS 2015 but in which Enemalta’s powerplants are converted to natural gas (EPS 2015NG). The interconnector grants Enemalta the possibility to either import or export electricity from or to the Italian grid. Since the Italian energy system is “mature” the European spot price is lower than the marginal cost of most of Enemalta’s existent generators. Moreover, given the higher efficiency of the gas-fired turbines, the cost per MWh of Enemalta’s plants is projected to be lower after the planned conversion. To take in consideration that effects on marginal costs are non-linear in the prevailing oil price level, the authors repeat these experiments with three different oil price levels: a baseline (BOPS), a low price (LOPS) and a high price (HOPS) scenario.²

Table 1
RESULTS FOR MARGINAL COST OF ELECTRICITY PRODUCTION FOR DIFFERENT SCENARIOS

	Baseline Oil Prices (BOPS)			Low Oil Prices (LOPS)			High Oil Prices (HOPS)		
	EPS 2010	EPS 2015	EPS 2015 NG	EPS 2010	EPS 2015	EPS 2015 NG	EPS 2010	EPS 2015	EPS 2015 NG
Marginal cost of electricity (€MWh ⁻¹)	140	105	95	80	85	70	205	125	110
% change in marginal cost vs baseline		-25	-32.1		6.3	-12.5		-39	-46.3

Source: Ries et al. (2016).

Results in Table 1 show that the change in the marginal cost of electricity generation depends on both the generation setup and oil prices. While in both BOPS and HOPS scenarios the EPS 2015 setup is consistent with a reduction in marginal cost, under LOPS, a reduction in marginal costs will only be achievable with the gas-fired setup. In general, the setup of natural gas-fired turbines helps reduce marginal costs across all oil price scenarios. Apart from reducing marginal costs, the setup of the interconnector and the conversion of the existent turbines to natural gas helps reduce Malta’s sensitivity to international oil prices.³ Indeed, prior to these reforms, marginal costs under HOPS are 156% higher than under LOPS. Under EPS 2015 and EPS 2015NG, the difference in marginal costs between HOPS and LOPS falls to 47% and 57%, respectively.

Model and simulation design

Simulations are performed using the fiscal version of MEDSEA (Rapa 2017b). This small open economy New Keynesian general equilibrium model contains a fairly rich fiscal sector. On the government revenue side, the model distinguishes between three types of distortionary taxes – a tax on consumption, labour income and capital/dividend income – and a non-distortionary lump-sum tax. On the government expenditure side, the model allows for three types of government expenditure – government expenditure on goods and services, government employment and public investment. Public investment is modelled in a time-to-build setup, designed to capture the fact that most public capital projects are subject to gestation periods dictated by planning, bidding, contracting and constructing

² Further details on the assumptions used are available in Rapa (2017a).

³ The sensitivity of Maltese economic activity to international oil prices is confirmed by simulation results using STREAM (Grech and Rapa, 2016). Under baseline oil prices, a 20% increase in international oil prices results in a fall of 0.74% in economic activity.

stages. Moreover, in line with Baxter and King (1993), public capital stock enters the production function of private firms with increasing returns to scale:

$$Y_t^i = A_t^i K_t^i{}^{1-\gamma_i} N_t^i{}^{\gamma_i} K_t^G{}^{\gamma_g}$$

Where Y_t^i is output of industry i , A_t^i is total factor productivity, K_t^i is private capital stock of industry i , N_t^i is private labour used by industry i and K_t^G is government capital stock. Parameters γ_i and $1 - \gamma_i$ represent the private labour and capital shares in output respectively, while γ_g is a parameter controlling the efficiency of public sector investment.

This implies that an increase in government investment does not only increase output from the demand side (as more public investment goods are demanded), but also from the supply side through an increase in the marginal productivity of private factors of production and a subsequent fall in economy-wide marginal costs. This setup is particularly appropriate to study the effects of large public sector projects, such as the energy sector reforms, which are expected to have a lasting effect on private sector productivity.

“Simulations are performed using the fiscal version of MEDSEA”

The simulations were conducted as follows. First, we estimate how changes in the marginal costs of electricity generation translate into changes in economy-wide average marginal costs. This is done by estimating the share of the value of electricity inputs arising directly and indirectly in total intermediate domestic production.⁴ In 2010, this share stood at around 5.8%. Second, we shock government investment by the cost of the capital project which depends on the scenario under analysis. EPS2015 corresponds to a government investment shock equal to the cost of the purchase and installation of the interconnector. Under EPS2015NG government investment is additionally augmented by the cost of the installation of the new gas power station and the conversion of Delimara 3 power plant to natural gas. Since the effectiveness of these capital projects at reducing energy production marginal costs depends on technology installed at the power plants and the prevailing oil price level, the parameter governing the efficiency of government investment (γ_g) is calibrated so that each energy setup scenario reduces economy-wide marginal costs by the amounts corresponding to the study conducted by Ries et al. (2016). To allow for a gestation period, it was assumed that under each energy setup Enemalta would benefit from a reduction in marginal costs only after the capital project was fully commissioned. Moreover, it is assumed that economic agents are aware of the future falls in marginal costs, assuming that there is no uncertainty with regards to the pass-through of these efficiency gains to the rest of the economy.

Results

We report two sets of results, the new long-run values, as well as the transition of a number of variables of interest from the initial to the new steady state.

An increase in government investment produces two opposite effects. Depending on the degree of investment efficiency (γ_g), an increase in government capital stock increases the marginal productivity of the other factors of production, crowding in private investment and private employment and reducing marginal costs faced by firms. This produces positive income effects that push up private consumption of both Ricardian and credit-constrained households, while lower marginal costs positively affect external competitiveness and thus Maltese exports. However, due to the distortionary nature of public expenditure, an increase in government investment also creates a negative wealth effect as Ricardian households expect some degree of increase in taxes in the future.⁵ This negative wealth effects could potentially outweigh the positive income effects during the gestation period of the new capital stock. During this period, the interconnector (in case of EPS 2015) and the gas power plants (in case of EPS

⁴ Since the simulation exercise features a shock to domestic technology that changes marginal costs faced by local intermediate firms excluding directly imported costs, the share of electricity on overall production costs needs to be computed vis-à-vis total intermediate production excluding direct imports (as opposed to total output). This share is computed on the basis of the 2010 input output tables for Malta published by NSO in 2016.

⁵ The scenario analyses undertaken in this study are calibrated so as to reflect the fact that only part of the energy reforms had a direct impact on government debt. This reduces the negative wealth effects of government investment, especially at the start of the simulations when the new government investment is still under construction and is therefore unable to positively contribute to the supply side of the economy.

Table 2**LONG-RUN MACROECONOMIC EFFECTS OF ELECTRICITY GENERATION REFORMS***% deviation from baseline*

	Baseline Oil Prices		Low Oil Prices		High Oil Prices	
	EPS 2015	EPS 2015 NG	EPS 2015	EPS 2015 NG	EPS 2015	EPS 2015 NG
Real activity						
GDP	2.1	2.5	-0.3	1.0	3.4	3.7
Consumption	1.5	1.2	-0.7	-0.2	2.6	2.2
Private investment	0.6	0.7	-0.1	0.2	1.0	1.1
Exports	2.0	2.4	-0.2	1.1	3.1	3.5
Imports	1.5	1.8	-0.2	0.8	2.3	2.7
Labour market						
Real wages	1.7	1.8	-0.4	0.5	2.7	2.8
Employment	0.1	0.2	0.1	0.2	0	0.2

Source: Author's calculations.

2015NG) were still being installed, implying that the efficiency gains of these reforms were yet not being passed on to the economic agents in the economy.⁶

Results in Table 2 show that in the baseline oil price scenario (BOPS), an energy setup with an interconnector and the decommissioning of Marsa power station (EPS 2015), raises long-run output by 2.1%.⁷ In the long term, an increase in the government capital stock raises overall productivity of both private capital and labour, raising long-run real wages and leading to a positive income effect that raises long-run consumption. Improvements in long-run productivity outstrip those in real wages, implying a reduction in unit labour costs. Moreover, efficiency gains in both domestic and foreign oriented sectors, lead to lower price pressures that give rise to a depreciation of the real effective exchange rate (REER) and an improvement in long-run price competitiveness. Finally, higher capital productivity reduces the implicit price of capital, thus leading to higher investment in the long run.

“In the baseline oil price scenario, an energy setup with an interconnector and the decommissioning of Marsa power station, raises long-run output by 2.1%”

Mirroring the results shown in Table 1, the long-term gains in output following the installation of the interconnector are very sensitive to the prevailing oil price level. The estimates range from an output loss of around 0.3% in the case of LOPS, to a gain of around 3.4% in the case of HOPS. On the other hand, the plans to fire a number of generators through natural gas have positive macroeconomic effects in all three oil price scenarios considered. This proposed energy setup is expected to raise economic activity by 1.0% in the case of LOPS, 2.5% in the case of BOPS and by a maximum of 3.7% under HOPS.

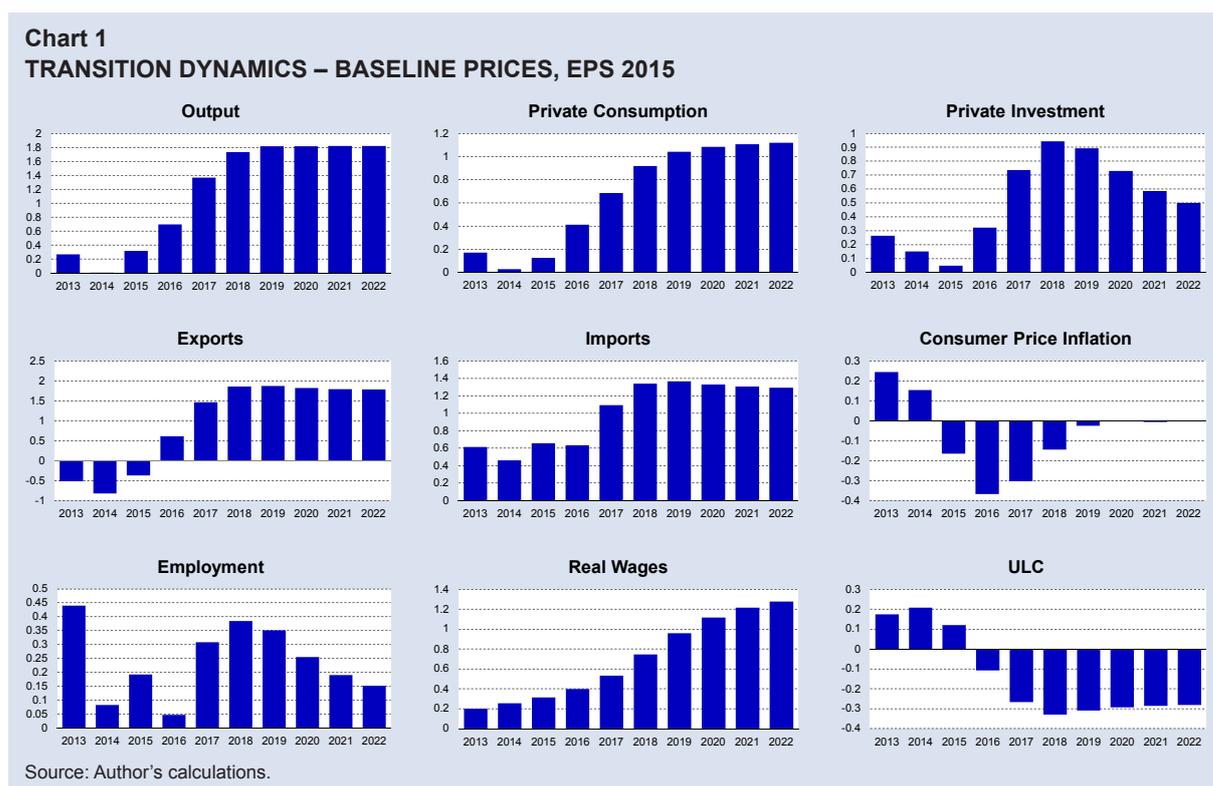
Transition dynamics help us track the transmission mechanism of this shock throughout the economy. Chart 1 illustrates short-term transition dynamics of some key variables under baseline oil prices and under EPS 2015. The impulse responses show that during the first two years after the start of the installation phase of the undersea interconnector, real output increased only marginally, driven solely by demand-side effects which, due to the significant import content of such a capital project, are estimated to be quite small. Despite the significant import intensity of this project, the installation of the interconnector still caused a rather subdued increase in the demand for domestically produced investment goods, mainly related to the construction of the terminal station in Maghtab

⁶ During the capital gestation period, the positive income effects are limited to those arising from the forward-looking expectations of households and firms in the economy who expect marginal costs to fall in the near future.

⁷ Note that these results differ from the ones published in Rapa (2017a). Unlike the latter study, this article takes in consideration both demand and supply-side effects of an increase in government investment, as well as the long-run increase in public investment driven by the long-run increase in output and that required to maintain the new capital installed by the energy provider. This explains the differences in the results of the two studies, especially those relevant to the short-run transition dynamics.

and its connection with in-land distribution centres. This caused a short-lived increase in demand for employment, driving up wages and causing a short-lived increase in overall prices.

As soon as the interconnector became fully operational in the second quarter of 2015, Enemalta, and consequently the economy as a whole, started to benefit from positive supply-side effects stemming from a reduction in marginal costs of electricity production. This was eventually transmitted to lower overall price pressures, leading to an immediate improvement in Malta's cost competitiveness. Improved economic prospects led consumers to increase consumption, while the increase in productive government capital stock was directly responsible for crowding-in private investment. Moreover, lower local production costs led to somewhat higher demand for domestically produced goods at the expense of imported production. The increase in real wages was driven by higher labour productivity and lower inflation, further reinforcing the positive effects on private consumption. It is interesting to note that both nominal and real rigidities embedded in the model lead to a sluggish transmission mechanism implying that after 10 years from the start of the energy reform, real output is projected to still be below its new steady state shown in Table 2. The slow adjustment of the variables of interest to their new steady state is also attributable to two additional factors. First, part of the long-run improvements in real output are related to an increase in long-run government investment meant to cover the maintenance costs of the new capital equipment. Secondly, there is an endogenous and a two-way positive relation between long-run government investment and real output. These two factors, together with the fact that output in the economy enjoys positive returns to scale vis-à-vis public investment, lead to a very slow correction of government investment, and consequently of public capital stock to their new steady-state level, implying a slow, but gradual adjustment in macro-variables.



As expected, the effects on economic activity under baseline oil prices and under EPS 2015 are stronger than those reported in Grech (2014), which excludes both the demand-side effects of the government investment needed to undertake the energy reforms and does not capture to a full extent the supply-side effects of lower marginal costs accruing to Malta's energy provider.⁸ The results pertaining to overall GDP under the same scenario are, however, in line with Ministry for Finance (2016), both in terms of their magnitude and transition dynamics.

⁸ Both Grech (2014) and Ministry for Finance (2016) assume a fall in energy tariffs of 25%. Under a perfect pass-through assumption, this is consistent with the results under baseline oil prices with EPS 2015, which predicts a fall in marginal costs of around 25% (see Table 1).

It is important to note that the results in Table 2 are based on the assumption of a full long-run pass-through of Enemalta's efficiency gains to the rest of the economy under all electric power systems (EPS 2015 and EPS 2015NG) and under all oil price scenarios (BOPS, LOPS and HOPS). A lower pass-through assumption would result in higher economic rents accruing to Malta's sole energy provider in lieu of lower economy-wide marginal costs of production, thereby reducing the long-run improvements in Malta's GDP. Moreover, model predictions indicate that the estimated effects of the energy reforms are non-linear in the pass-through assumptions, with the degree of non-linearity depending on the scenario under consideration.⁹ Under an imperfect pass-through of around 50%, long-run effects on output seem to fall the most relative to baseline results under a high oil price scenario, while results seem to be almost linear under a low oil price scenario.

Conclusion

This article estimates the impact of an increase in the efficiency of electricity generation in Malta due to the installation of an undersea interconnector between Sicily and Malta and the changeover of Enemalta's powerstations from operating on heavy fuel oil and gasoil to natural gas. These simulations were undertaken with the fiscal version of MEDSEA, the Central Bank of Malta's DSGE model. Since the magnitude of the pass-through of Enemalta's efficiency gains to its customers is still unknown, this note aims to gauge the reaction of Malta's economy should efficiency gains in electricity production be passed on to the rest of the economy. Results show that under baseline oil prices and assuming full pass-through of the efficiency improvements gained through Enemalta's investment in the interconnector, economic activity in Malta is projected to increase by around 2.1% under baseline oil prices. This is estimated to increase to around 2.5% following the conversion of Enemalta's powerplants to natural gas. These estimates depend on two factors – the prevailing oil price level and the extent to which Enemalta will pass on changes in its marginal costs to its final consumers. The long-run results presented in this article are higher than those published in Rapa (2017a). This is due to the fact that unlike the previous study, this article takes in consideration the increase in government investment required to install and maintain the new capital equipment as well as the long-run increase in public investment driven by the long-run increase in output.

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⁹ This non-linearity stems from the interplay of the negative wealth effects related to higher government intervention in the economy and positive wealth effects driven by the positive externalities associated with productive government investment. Any degree of imperfection in the pass-through of Enemalta's efficiency gains to the rest of the economy can be interpreted as a reduction in the efficiency and productivity of the new government capital stock, reducing the positive wealth effect associated with government investment. Since the negative effects associated with increased government intervention remain unchanged for each pass-through assumption, the net positive effect of the government investment needed to enact the energy reforms is reduced for lower pass-through assumptions.



A MACRO-ECONOMETRIC MODEL OF THE HOUSING MARKET IN MALTA

William Gatt, Brian Micallef and Noel Rapa



This article presents a small macro-econometric model to explain house price developments in Malta. The core model consists of a stock-flow framework that models the relationship between house prices, residential investment and housing stock. The housing block is augmented with a stylised real economy block determining potential and actual gross domestic product (GDP), employment and wages, thus allowing the assessment of macro-financial linkages. Using an error-correction modelling (ECM) framework, the model is used to quantify the degree of misalignment in Maltese house prices over the period 1980-2017. Parameter estimates suggest that the price responsiveness to changes in housing supply has changed significantly in recent years, compared to the pre-crisis boom. The recent rise in house prices seems to differ significantly from that observed in the mid-2000s, with house prices more closely aligned to fundamentals, while the recent increase in housing supply should attenuate house price inflation, in contrast to what happened in the mid-2000s when higher supply fuelled higher prices in the short term.



Introduction

An important factor in determining the appropriate functioning of the property market is the responsiveness of house prices to changes in the supply of housing. A better understanding of the supply side is of key importance since it determines the extent to which the housing market responds to demand shocks – with either more construction or higher prices – which has broad implications, including on housing affordability. The responsiveness of housing supply also has implications on the functioning of labour markets and their adjustment to shocks. For instance, the increase in demand for labour by firms, following a demand shock, may result in upward pressure on wages in areas where building new housing units to accommodate the inflow of workers is more difficult.

“A better understanding of the supply side is of key importance since it determines the extent to which the housing market responds to demand shocks”

The Model

The housing block models the dynamics of house prices and residential investment in a stock-flow framework. This approach makes a distinction between the housing stock, which is rigid in the short run, and the flow of residential investment that reacts faster to macroeconomic conditions. This modelling approach is based on the seminal paper by DiPasquale and Wheaton (1994), which was later implemented in an error-correction framework by McCarthy and Peach (2002). The error correction process, both on the demand and supply sides, is intended to take into account the slow adjustment of the housing market.

Real house prices in the long run depend on the following specification (lower case letters denote variables in logarithms):

$$p_t = \alpha_1 + \alpha_2 ypd_t + \alpha_3 cr_t + \alpha_4 s_t + \alpha_5 r_t + \varepsilon_t^p \quad (1)$$

In the long run, real house prices (p_t) depend on demand shifters (including real disposable income (ypd_t), real credit for mortgages (cr_t) and the real interest rate (r_t)) and the housing stock per capita (s_t). The real interest rate is a simple measure of the user cost, which measures the opportunity cost of capital tied to housing or taken on

credit. The coefficient of interest in this equation is α_4 , which measures the price elasticity to a change in housing supply. A priori, the coefficients on income and credit are expected to be positive, while the coefficients on the housing stock per capita and the interest rates are expected to be negative.

Short-run dynamics of house prices, in turn, depend on demand variables, as well as on the level of disequilibrium between actual and equilibrium house prices in the previous period.

The long-run housing investment equation can be expressed as:

$$i_t = \beta_1 + \beta_2 p_t + \beta_3 cost_t + \beta_4 r_t + \varepsilon_t^i \quad (2)$$

Housing investment (i_t) in the long run depends on real house prices and cost-shifting variables, such as construction costs ($cost_t$) and interest rates (r_t). The coefficient on house prices is expected to be positive, while the coefficients on construction costs and interest rates are expected to be negative. The error term, ε_t^i , tracks the level of over or under-investment in housing investment that cannot be explained by the explanatory variables in equation (2). The short-run dynamics of residential investment depend on the past disequilibrium in residential investment, ε_t^i , which is slowly corrected in each period, as well as on various factors that can influence short-run dynamics in housing investment. Another error-correction form equation links investment to building permits, which are then used to construct a housing stock measure via the following equation:

$$S_t = (1 - \delta)S_{t-1} + PR_{t-1} \quad (3)$$

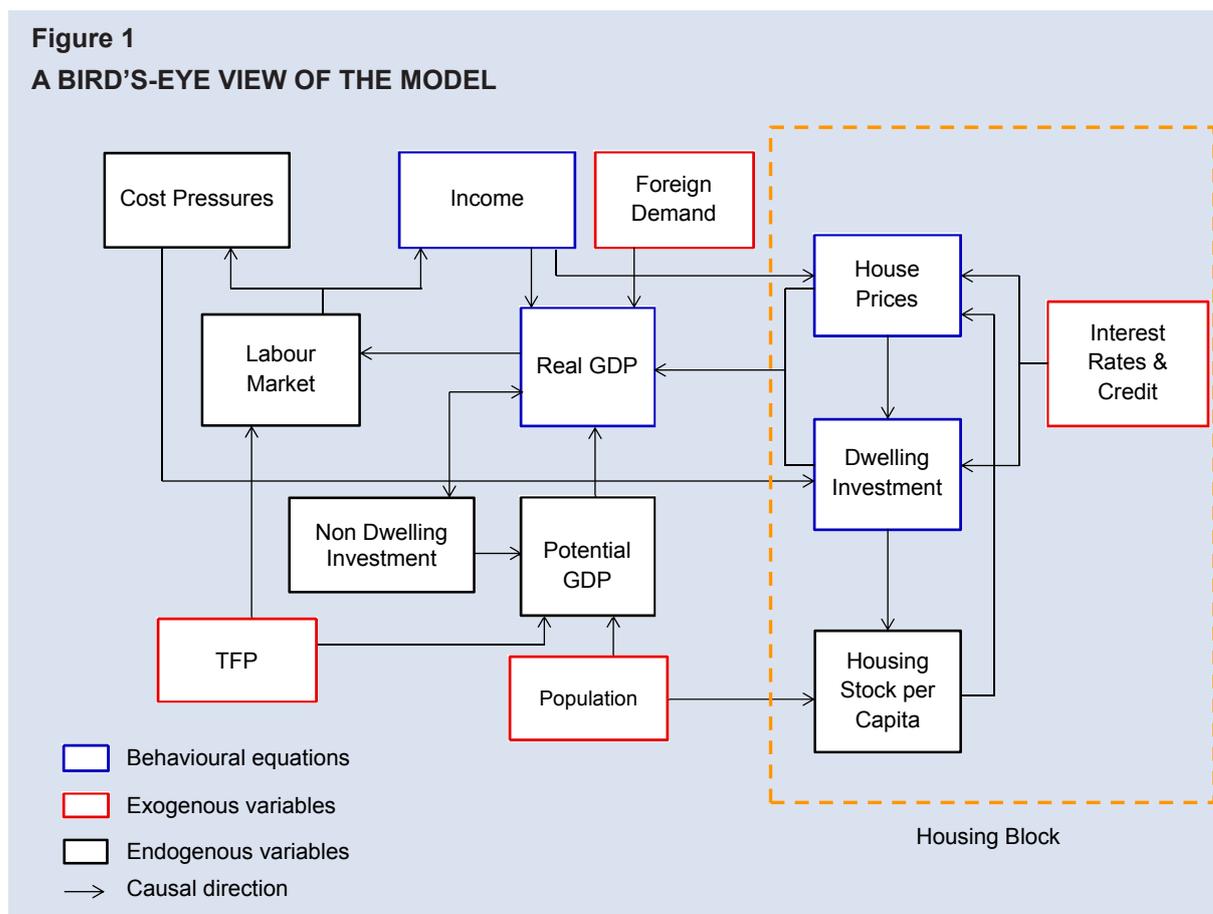
The accumulation identity states that the housing capital stock in period t , S_t , consists of the housing stock in the previous period net of depreciation, augmented by new permits granted, PR_{t-1} . We assume that a permit approved in year t takes a year to be developed into a housing unit. To capture the interlinkages between the housing market and the real economy, the ‘housing’ block described above is augmented with a stylised ‘real’ economy block determining potential and actual output, employment and wages.

Figure 1 provides a stylised representation of the econometric model and the linkages between the ‘housing’ and the ‘real’ blocks of the model. In the long run, the economy’s output is determined by its supply-side potential GDP, which is characterised by a Cobb-Douglas production function, with two factors of production – capital and labour – as well as total factor productivity (TFP). In the short run, real GDP is demand-driven and determined by real house prices (capturing wealth effects associated with home ownership), overall investment, real disposable income and foreign demand. In the long run, employment depends positively on real GDP and negatively on TFP and real wages. Activity and wages also exert short-term effects on employment growth. Real wages are a function of labour productivity, both in the short and long term.

“Despite its stylised nature, the model is able to capture the key macro linkages between activity and the labour market, which, in turn, feed back into the housing market”

Despite its stylised nature, the model is able to capture the key macro linkages between activity and the labour market, which, in turn, feed back into the housing market. Take, for instance, an increase in population. Taking the housing block in isolation, an increase in population lowers the housing stock per capita, thus putting upward pressure on house prices. Taking in consideration the real block, however, higher population will also affect the economy’s supply potential, raising economic activity and income, which will, in turn, feed back into higher house prices and, with a lag, dwelling investment. Increases in activity could also exert cost pressures, which will eventually lower investment in housing.

Figure 1
A BIRD'S-EYE VIEW OF THE MODEL



Data

Most of the variables used for estimation purposes are derived from the annual historical macroeconomic database described in Grech (2015). Property prices refer to the Central Bank of Malta house price index, which is based on advertised prices.¹ A key missing variable from this database refers to the housing stock series. To the best of our knowledge, official data for the housing stock exist only as snapshots across different censuses carried out for Malta. There are five observations for the housing stock since the 1960s (1967, 1985, 1995, 2005 and 2011). As described in equation (1) above, the model-consistent variable refers to housing units rather than the value of the housing investment, with development permits linking residential investment to the housing stock.² Chart 1 plots the model estimates of the housing stock, together with the official data points from the census. According to our estimates, by 2017 the housing stock had increased by around 8%, compared to the 223,850 units reported in the

¹ Another house price index available in Malta is that published by the National Statistics Office (NSO), which is based on contract prices. The main limitation of the NSO house price index is that this series is only available from 2005. On the contrary, the advertised price series goes back to 1980. In recent years, the advertised house price index has been increasing at a much faster pace compared to the index based on contract prices. See Micallef (2018) for a discussion on the differences between the two indices.

² The computation of the historical series of the housing stock differs slightly from equation (3) and is specified as follows: $S_t = (1 - \delta_t) S_{t-1} + \gamma_t PR_{t-1}$ whereby γ is the utilization rate. The depreciation rate accounts for both the natural destruction of housing units due to low maintenance or due to the dwellings becoming uninhabited, as well as for the destruction of dwellings for re-development purposes. The depreciation and utilisation rates are both time varying, which allow us to control the rate at which the housing stock accumulates, such that our estimates pass as close to the official census data points as possible. Official data on development permits start in 1993. For pre-1993, we use an estimated relationship between permits, dwelling investment and the lending interest rate for the period 1993-2015, and assume that the same relationship held in the earlier period. After 2011, there are no official housing stock figures that would help the calibration of the depreciation and utilisation rates. In this regard, from 2012 onwards, we use information on permits for net new units after controlling for any dwelling units that are destroyed in conversion or re-development projects. This information can be found on the Planning Authority website: <https://www.pa.org.mt/file.aspx?f=12616>.

census in 2011. The key housing supply variable in the model (s_t in equation 1) is computed as the housing stock per population head.

In the absence of a long time series of construction costs in Malta, unit labour costs are used as an imperfect proxy of cost pressures.

Estimation

Table 1 reports the parameter estimates of the two key equations in the housing block – real house prices and real dwelling investment – making a distinction between the short and long-run elasticities. All equations in the model are estimated using ordinary least squares (OLS) on annual data from 1980 to 2017. The coefficients have the expected sign and are statistically significant.

House prices tend to increase with households' disposable income, mortgage credit and population, with these variables being related to higher demand for housing. The sum of the coefficients of disposable income and credit are restricted to unity in the long run. On the contrary, the effects of the housing stock and real interest rates have



**Table 1
ESTIMATION RESULTS**

Real house prices			Real dwelling investment		
Long-run elasticities			Long-run elasticities		
Real disposable income	0.83	***	Real house prices	0.56	*
Real mortgage credit	0.17	***	Real unit labour costs	-2.62	**
Housing stock per capita	-1.3	***	Real lending rate	-5.44	***
Real lending rate	-2.17	***			
Short-run elasticities			Short-run elasticities		
Δ Lagged real house prices	0.29	***	Δ Lagged real dwelling investment	0.4	***
Δ Real mortgage credit	0.17	**	Δ Real construction lending	0.22	***
			Δ Real GDP growth between Y1 and Y2	0.66	
Error correction term	-0.4	***	Error correction term	-0.32	***
Adj R2	0.71		Adj R2	0.79	
DW	1.76		DW	2.25	

Note: (*), (**) and (***) denote statistical significance at the 10%, 5% and 1% level, respectively.

Estimation period: 1980-2017.

Source: Authors' calculations.

a dampening effect on house prices. *Ceteris paribus*, a 1% increase in the housing stock per capita, lowers real house prices by 1.30% in the long run. Similarly, a 1 percentage point increase in the real interest rate, lowers house prices by 2.2% in the long run.³ In the short run, real house prices are affected by past developments in house prices and real mortgage credit. The adjustment of house prices to their long-run equilibrium is moderate, with 40% of the adjustment occurring after the first year.

In the supply equation, real house prices have a positive effect on investment, while cost pressures and interest rates have a negative effect. The price elasticity of housing supply, that is, the responsiveness of new supply to changes in house prices, is below unity. *Ceteris paribus*, a 1% increase in real house prices, raises housing investment by 0.56% in the long run. This means that in response to a demand shock, housing output will increase proportionally less than prices. The below unitary price elasticity of supply could be due to limitations on land for development, given the small size of the Maltese islands. Indeed, Caldera and Johansson (2011) find a negative cross-country correlation between estimates of housing supply elasticity and population densities. The Maltese labour market also tends to be quite tight and many large projects would require the importation of expensive capital equipment, which tends to delay the response. Other explanations in the literature, which include local land-use and planning regulations, the provision of infrastructure and other public services complimentary to housing, such as road junctions or water drainage, are also likely to influence supply, although the magnitudes of these effects are uncertain.

In the short run, real housing investment is affected by real lending to the construction sector, the change in real GDP growth compared to a year earlier (capturing accelerator effects), as well as by lagged housing investment. The adjustment of investment to its long-run equilibrium is more sluggish than house prices, with only around 32% of past misalignment corrected after the first year.

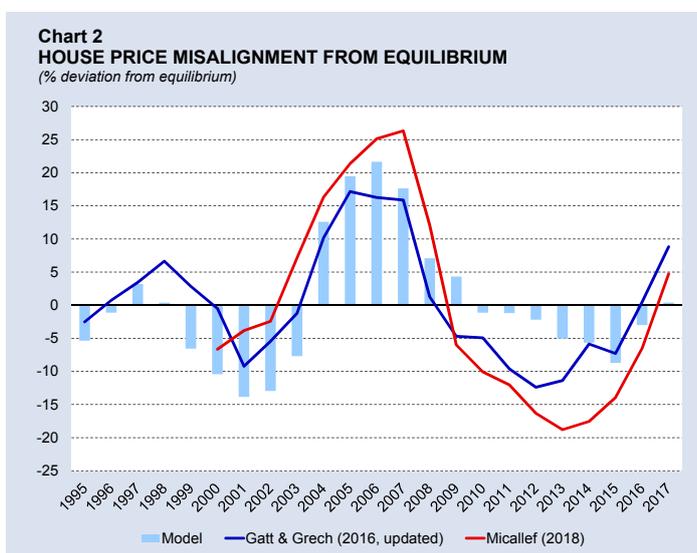
Model applications

The empirical properties of the model are validated by comparing the degree of over or under-valuation of house prices in Malta with other studies in the literature. In addition, we also test the stability of the supply elasticity in the house price equation over the past twenty years to gauge whether the current house price cycle bears any similarity with the pre-crisis housing boom period.

House price misalignment

In addition to examining the impact of shocks to a number of variables on house prices, the model permits an assessment of the misalignment of house prices from their equilibrium value. The equilibrium value of house prices can be determined from the residuals of the long-run house price equation.

Chart 2 compares the deviation of actual house prices from their equilibrium values derived from the model, with two recent studies that also looked at the degree of house price misalignment in Malta (Micallef, 2018; Gatt and Grech, 2016). In all cases, the gaps are based



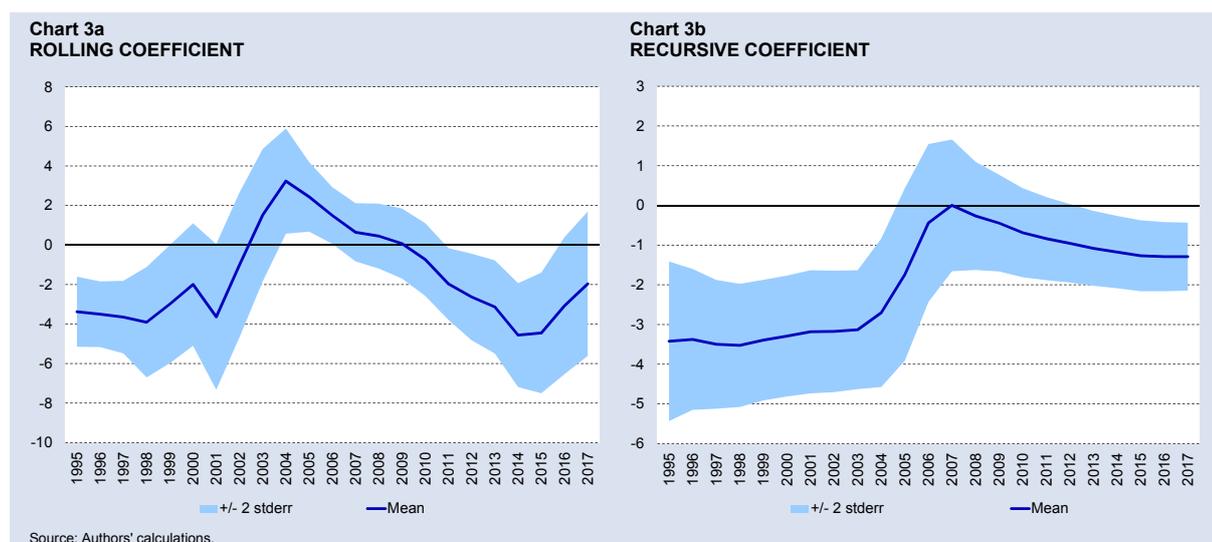
³ In line with literature, we have estimated the house price equation using a number of different supply measures, namely using the number of housing units per household and the vacancy rate of dwellings, thereby controlling for changes in the typical size of households. In both cases, the estimated price elasticity with regards to housing supply is lower than in the baseline version but is not statistically significant at conventional levels. However, the magnitude is well in line with results published in Caldera and Johansson (2011), especially for countries with high population density. Results for the elasticity of house prices with respect to real interest rates are broadly in line with empirical evidence from other countries in which mortgage rates are linked with market rates. For more information, see Tsatsaronis and Zhu (2004).

on advertised house prices to ensure comparability, given that the increases in contract prices were much less pronounced in recent years. The model-implied house price misalignment is broadly in line with these studies. According to the model, real house prices in Malta were overvalued by around 20% in the pre-crisis housing boom. All three measures indicate that this overvaluation started to be corrected during and after the financial crisis. The inclusion of housing supply per capita could explain the difference in misalignment compared to the other two measures during 2010-2013. In particular, the sharp decline in development permits, coupled with population growth, led to a slowdown in per capita housing which, in turn, limits the drop in equilibrium prices that would otherwise prevail. However, this was only a temporary factor and a negative misalignment started to emerge from 2013 onwards. Similar to the other two indicators, the undervaluation in house prices started to be corrected such that, by 2017, house prices were either broadly in line with, or slightly above, fundamentals, depending on the house valuation method. The difference in misalignment between the model-implied figures and those of the other methods can also be explained by the supply-side factors that are captured by the model. In recent years, population, and consequently household numbers in Malta, have climbed rapidly on the back of strong inward migration. This has resulted in a reduction in available housing stock, creating upward pressures in the model-implied fundamental house prices.⁴

“The difference in misalignment between the model-implied figures and those of the other methods can also be explained by the supply-side factors that are captured by the model”

Testing the stability of the supply elasticity: is this time different?

One of the key questions that can be answered with this model is whether the current buoyant activity in property prices is different from the pre-crisis housing boom. The deviation of house prices from their long-run equilibrium levels has already indicated that the current period is different from before, at least in terms of house price overvaluation measures. Another approach is to test the stability of some coefficients, in this case, the supply elasticity in the house price equation. This stability is tested using a rolling regression, in which the equation is estimated using a sequence of sample periods, thereby estimating a set of estimated coefficients. Chart 3a applies this technique on the house price equation using a fixed window of 15 years, which broadly constitutes the length of the financial cycle (Runstler and Vlekke, 2016). More specifically, the first equation is estimated over the period 1980-1995, the second one for 1981-1996 and so on, until the final regression includes the last observation from the sample. Alternatively, Chart 3b plots the recursive coefficient, with the first regression estimated over the period 1980-1995



⁴ The discrepancy in the 2017 equilibrium valuation of house prices between the different methods is also present under alternative house price specifications, which include the number of households and the house vacancy rate as housing supply proxies.

and each subsequent regression adding one additional observation until the final regression is estimated over the entire sample.

Both specifications indicate significant time variation in the supply elasticity over the sample period. In particular, during the pre-crisis period, this elasticity even changed the sign, implying that, everything else held constant, an increase in the housing supply per capita would have led to even higher increases in real house prices. This could be indicative of a 'bubble' episode in which the increase in the housing stock, rather than reducing the degree of overheating in the housing market, leads to further house price appreciation, possibly due to speculation and exuberance which, in turn, stimulates additional demand for housing. This trend in the pre-crisis period is clearly visible in both charts and is in line with the conclusion from Chart 3, which indicated a substantial over-valuation of house prices during this period. Perhaps more importantly, especially for financial stability purposes, the current period is different from the pre-crisis housing boom. Increases in housing supply should result in house price growth moderating and reduce overvaluation. However, differences in land use and planning regulations, imply that the supply elasticity estimated on the entire sample is unlikely to return to the levels prevailing when the equation was estimated on the sample covering only the 1980s and early 1990s.

Conclusion

The parsimonious housing model documented in this article is designed to integrate both demand and supply-side factors affecting house prices in Malta. Its main contribution lies in the explicit treatment of housing supply and the linkages of the housing market with the real economy, and can be used to conduct simulation and policy analysis. The model is used to quantify the degree of misalignment in Maltese house prices and test the stability of key parameters. The results presented here suggest that the recent rise in house prices differs significantly from the boom period of the mid-2000s, with house prices more closely aligned to fundamentals, while the recent increase in housing supply should attenuate house price inflation, in contrast to what happened in the mid-2000s, when higher supply drove prices higher in the short term.

Some caveats are in order. The parameters of the model are estimated on past data and assumed to remain fixed in the future. The coefficients of some parameters are likely to have changed over time, due to policy changes, and may continue to do so in the future. The model abstracts from a more explicit treatment of the private rental market, in no small part due to the absence of adequate information on the rental sector. Going forward, however, the rental market is likely to play an increasingly important role, especially with the strong inflow of foreign workers, as well as socio-demographic changes. The current version of the model does not allow any feedback between housing and the banking sector, with credit and interest rates being exogenous. Similarly, demographics are exogenous but one can envisage extensions that model household tenure, making use of micro data from household surveys. All of these are important areas for further research.

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INCOME DISTRIBUTION, INEQUALITY AND MOBILITY IN MALTA

Jude Darmanin, Ilias Georgakopoulos and Clemens Knoppe

The Maltese economy has undergone a strong and job-rich expansion in recent years. In many countries, economic expansion has, however, been accompanied by rising inequality and increased poverty among certain categories of households. This article provides a general overview of the current state of income distribution, inequality and wage mobility in Malta, bringing together material from survey and micro-level datasets. Income inequality in Malta has, in recent years, returned to the levels observed during the 2008-2010 period, mostly owing to rapid growth of incomes of those in the middle part of the income ladder. While the proportion of those at risk of poverty or social exclusion has fallen from 24.0% in 2013 to 19.2% in 2017, the unemployed and the less educated remain at risk, while the relative position of the older population has slipped. The wage mobility of those aged 35 to 49 appears to have improved since the mid-2000s, while that of those over 50 has eroded. This suggests that while boosting employment improves income prospects, there is an important role for government in redistributing the wealth generated by the economy.

Introduction

The Maltese economy has undergone a strong and job-rich expansion in recent years, leading to higher household incomes, historically low unemployment rates and a booming property market. In many countries, such episodes have frequently been characterised by rising inequality and increased poverty among categories of households not in a position to benefit from such an expansion, and hence lose out in relative or, in some cases, even absolute terms.

This article provides a general overview of the current state of income distribution, inequality and wage mobility in Malta, bringing together material from a number of different sources. The first section describes the distribution of household income in Malta using data obtained from the Household Finance and Consumption Survey (HFCS). The second section analyses official estimates of income inequality and of poverty and social exclusion using data from the European Statistics on Income and Living Conditions (EU-SILC). The third section discusses wage mobility in Malta, utilising micro-data on wages obtained from the Inland Revenue Department.

Income distribution and inequality

Income distribution and inequality measures allow policymakers to assess the extent to which economic growth is benefitting members of society. Such measures have a long tradition in developed countries, but have only been recently available in Malta. In this Section, we focus initially on data on household income in Malta obtained from the HFCS, a survey carried out by the Central Bank of Malta as part of a euro area project coordinated by the European Central Bank.¹ The HFCS, first held in 2010 and subsequently in 2013 and 2016, collects micro-data on household assets and liabilities, wealth, income, consumption and savings.

The distribution of gross household income in Malta in 2016, adjusted for inflation, is depicted in Chart 1.² Compared with 2010, households in the mid-to-higher part of the distribution have seen an increase in their overall incomes, particularly those in the top 20% of the distribution. At the same time, households in the bottom 30% experienced no change in real income.

¹ More information on the survey is available on the Central Bank of Malta's website at: <https://www.centralbankmalta.org/household-finance-and-consumption-survey>.

² Gross household income is defined as income received from market sources on labour and capital, as well as from direct government payments. The adjustment for inflation was done using the Retail Price Index.

The increase in incomes along the higher part of the income distribution has led to an overall increase in the mean household income between 2010 and 2016, depicted in Table 1. At the same time, the mean income has stood consistently higher than the median income over the years, an indication of a skewed distribution of income.

Table 2 shows how the median gross household income in Malta has varied across the five income quintiles between 2010 and 2016. During the period, income for households in the bottom quintile stagnated, while increases were observed in all other quintiles. It is interesting to note that those in the middle part of the income

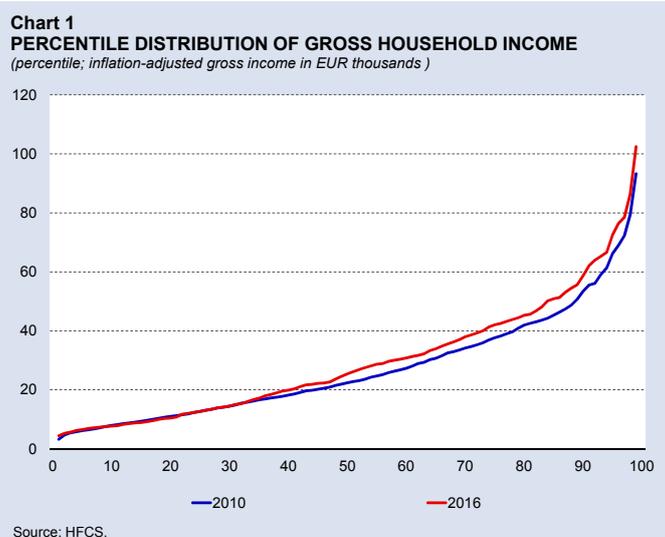


Table 1
OVERVIEW OF GROSS HOUSEHOLD INCOME

EUR

	2010	2016
Mean	27,823	31,203
Median	21,905	25,417
Mean-Median Ratio	1.27	1.23

Source: HFCS.

Table 2
MEDIAN GROSS HOUSEHOLD INCOME BY QUINTILE

EUR

	2010	2016	% change
1 st Quintile	7,708	7,637	-0.9
2 nd Quintile	13,767	14,551	5.7
3 rd Quintile	22,040	25,568	16.0
4 th Quintile	33,681	38,015	12.9
5 th Quintile	54,495	58,642	7.6

Source: HFCS.

distribution have experienced double the percentage increase of those at the top of the distribution. While someone in the top household income quintile had an income 2.5 times that of someone in the third quintile in 2010, by 2016 this ratio had dropped to 2.3 times. In contrast, while someone in the bottom quintile in 2010 had an income equal to 35% of that of someone in the third quintile, by 2016 this ratio had fallen to 30%.

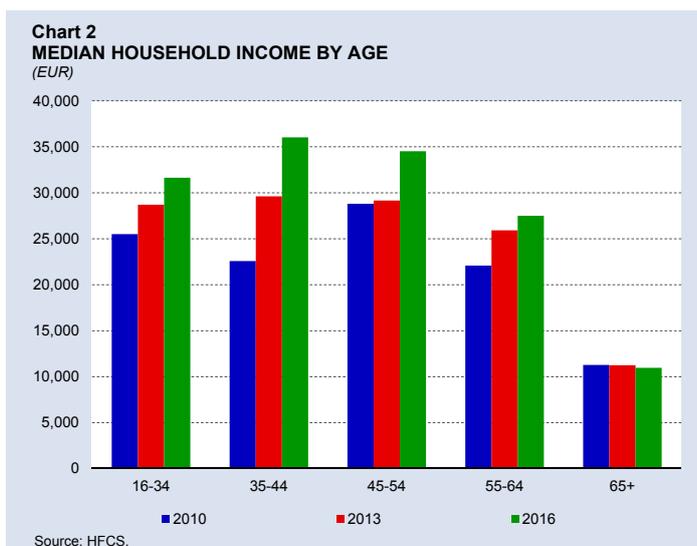
“Income for households in the bottom quintile stagnated, while increases were observed in all other quintiles”

Further disaggregation of the household income distribution gives a clearer picture of income inequality in Malta. Chart 2, which depicts the distribution of median income by age of the reference person in the household, shows a large gap between elder households (65+) and the younger cohorts. Over the three waves of the survey, this gap has increased, with the 65+ category being the only category not to experience an increase in income across surveys. This suggests that old age pensions have lost their relativity with median income. This life-cycle

profile of household income exhibits the hump-shaped pattern found in the literature (Azpitarte, 2010; Kolasa, 2017).

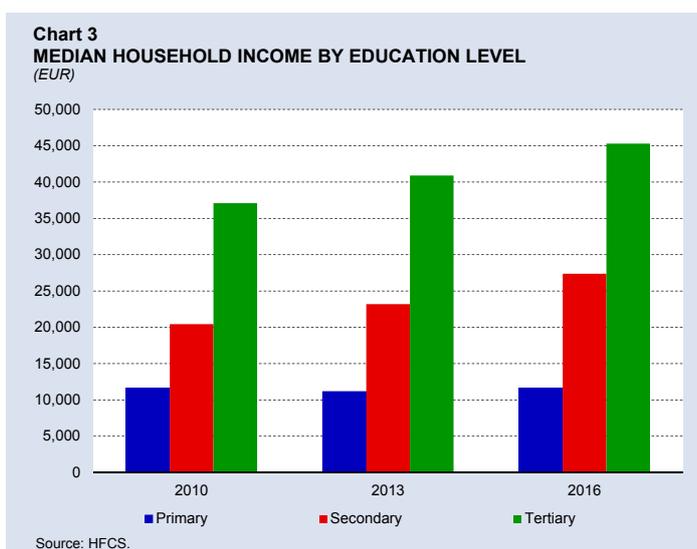
“Old age pensions have lost their relativity with median income”

Typically, when looking at individual incomes, one would expect the peak of the income life-cycle to occur just before retirement age, as persons reaching the end of their careers typically earn more than their younger peers. However, when looking at household incomes, as in Chart 2, the picture changes due to the increase in the number of households with multiple incomes, particularly as more women enter the labour force. Since this development has mainly occurred among younger cohorts, the household income of this generation is higher than that of the single-income older generation. This development partly explains the rapid rise in incomes for households aged 35-44 between 2010 and 2016. At the same time, this increase has not been observed in the 65+ category, the majority of which rely on one pension income. Moreover, old age pensions have only increased in line with the cost of living during the period under review, while they are also subject to a cap on pensionable income.



Another cause of rising discrepancy in income is evident in Chart 3, which plots median household income by education of the reference person. As expected, households with higher education levels tend to earn higher incomes than their less educated counterparts. At the same time, the income gap between more and less educated households has widened over the years. Indeed, for households with a primary level of education, income levels have generally stagnated since 2010. It is important to note that this ties in with the data on household income by age, as older households tend to be less educated than younger ones.

One way of defining the level of inequality in numerical terms, thereby allowing for comparisons across time and space, is through the Gini coefficient. The Gini coefficient is an inequality statistic that establishes the gap between the income distribution of an economy and the income distribution under conditions of perfect equality. Hence, a large Gini coefficient would indicate a more unequal distribution of income. In the European Union (EU), the official measure of the Gini coefficient is obtained from EU-SILC, an annual EU-wide survey collecting micro-data on households, such as income, housing and welfare.³



³ Further information is available from: https://nso.gov.mt/en/nso/Sources_and_Methods/Unit_C1/Living_Conditions_and_Culture_Statistics/Pages/Statistics-on-Income-and-Living-Conditions.aspx. The sample for the EU-SILC survey is obtained from the latest census, published in 2011, and hence may under-represent foreign workers who have immigrated to Malta in the intervening period.

The Gini coefficient for Malta, based on equivalised disposable income after social transfers, is depicted in Chart 4.⁴ Over the years, the coefficient has been lower than that in the euro area, suggesting a more equal distribution of income. Income inequality in Malta rose between 2008 and 2010, which could reflect the impact of the Great Recession. Inequality eased in the post-2010 years, before experiencing a gradual increase from 2012 onward. By 2016, the Gini coefficient had reached 28.5, close to the high registered in 2010, before falling marginally to 28.3 in 2017. Overall, this suggests that inequality in Malta has returned close to 2008-2010 levels in spite of the faster rate of economic growth, which could indicate that some segments of the population have not benefited from the expansion in economic activity.

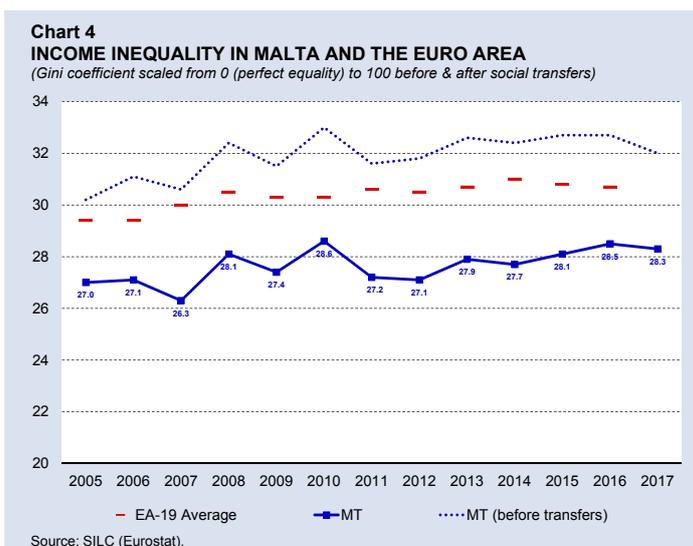
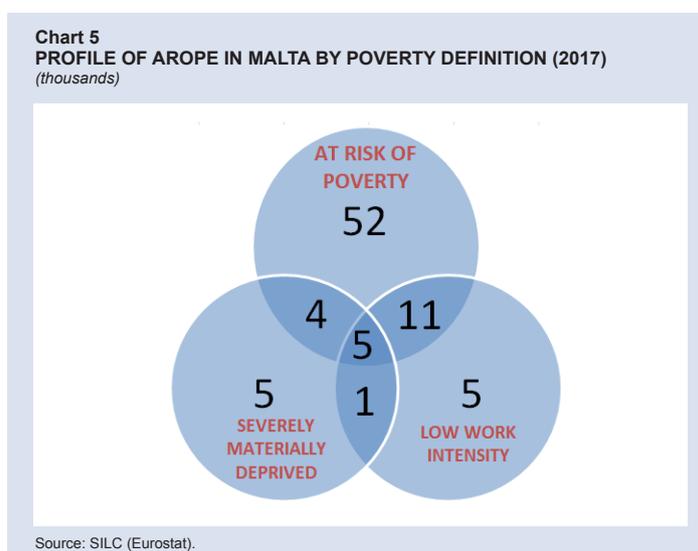


Chart 4 also depicts the Gini coefficient before social transfers, from which one can deduce the impact of social policy on reducing income inequality. As expected, social transfers have a strong redistributing effect on the income distribution of Malta, leading to a drop in the coefficient.

The EU-SILC database also contains statistics on poverty and social exclusion. This is measured through the “at-risk-of-poverty or social exclusion” rate (AROPE), based on three definitions of poverty, namely (i) those households with an equivalised disposable income below 60% of the national median, referred to as “at-risk-of-poverty”; (ii) those unable to afford several items considered to be desirable or necessary to lead an adequate life, referred to as “severely materially deprived”; and (iii) those living in households where the members of working age work less than 20% of their total potential, referred to as “low work intensity”.

In 2017, 83,000 individuals were classified as being at risk of poverty or social exclusion, the majority of which (72,000) fell under the “at-risk-of-poverty” measure, commonly termed as monetary poverty (see Chart 5). As a proportion of the total population, poverty and social exclusion in Malta stood at 19.2%, compared with the peak of 24.0% observed in 2013.



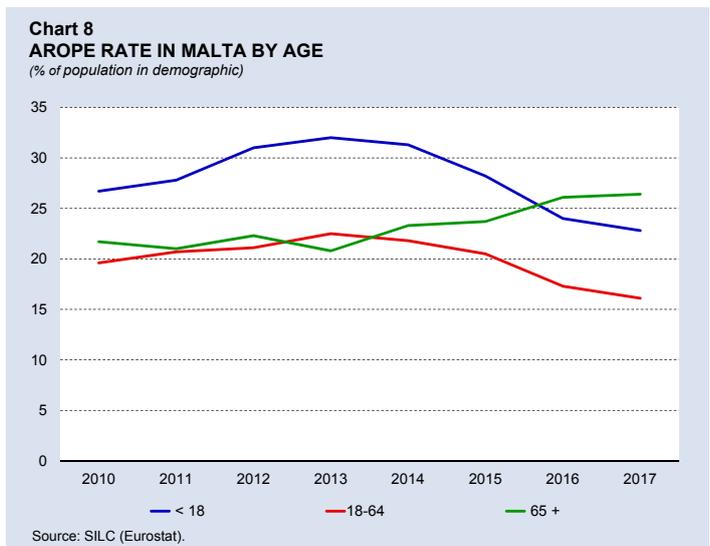
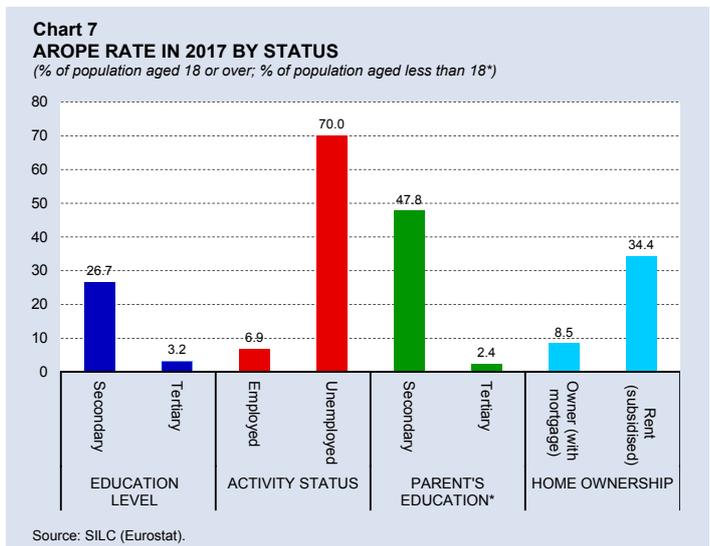
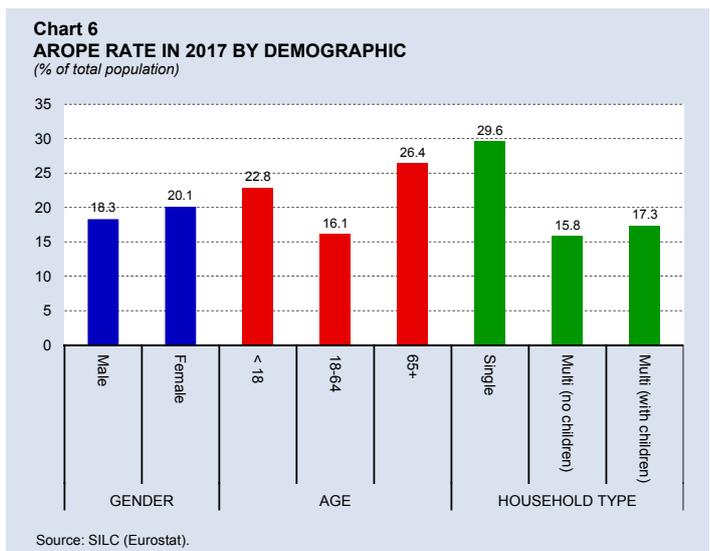
⁴ The equivalised disposable income is the total disposable income of a household, after social transfers, divided by the number of household members converted into equalised adults using a scale defined by the Organisation for Economic Co-operation and Development (OECD). Social transfers are current transfers that are compulsory and based on the principle of social solidarity. Pensions are not included.

Charts 6 and 7 decompose Malta's AROPE in 2017. In general, the risk of poverty or social exclusion is much lower among the educated, employed and home-owners, while the gap between male and female poverty levels is small. On the other hand, the risk of poverty or social exclusion is very high among the unemployed and the less educated. The impact of education is also generational, meaning that persons with less educated parents are more likely to fall below the poverty threshold. This could indicate some form of social poverty trap or inequality of opportunity for children born into less educated households, despite education in Malta being provided for by the state.

“The risk of poverty or social exclusion is much lower among the educated, employed and home-owners”

Also evident in the data is the higher poverty risk among elders (65+). The AROPE rate among elders stood at 26.4% in 2017, compared with 16.1% among their working age counterparts. This is also reflected in the higher AROPE rate for subsidised tenants when compared with home-owners. This category largely consists of elderly people living in pre-1995 rental housing. The presence of elder widows/widowers could also explain the relatively higher AROPE rate for the single household category. The presence of elder widows/widowers could also explain the relatively higher AROPE rate for the single household category.

Chart 8 takes a closer look at the AROPE rate in Malta disaggregated by age. This data points to an increasing trend in poverty levels among older persons (65+), particularly since 2013. At the same time, monetary poverty among the younger cohorts has dropped or stabilised. This complements the narrative obtained from the HFCS that the well-being of older persons has failed to increase in line with that of younger cohorts. It should also be noted that, during this period, income on savings – another mainstay of the income of the older population – was negatively affected by the drop in interest rates.



Wage income mobility

Given the importance placed in recent years on raising employment, a study of income distribution and inequality needs also to look at wage mobility. Differences in lifetime incomes are reduced by mobility, and low wage employment is less problematic if it is transitory in nature. To analyse wage mobility in Malta, we use anonymised information on full-time annual wage incomes obtained from the Inland Revenue Department, covering the period between 2000 and 2015. Mobility is studied at an individual level, looking at gross income rather than disposable income, so as to focus on changes determined by the labour market rather than by government policy. Furthermore, the fact that the data set is longitudinal, allows the incomes of individuals to be tracked over time.

Transition matrices, which indicate the proportion (p_{ij}) of individuals starting the period in quintile i who end the period in the j^{th} quintile, are a useful method of studying wage mobility. Tables 3 and 4 illustrate two examples of these transition matrices, using five and ten year horizons, respectively. For instance, according to Table 3, 60% of individuals in Malta who were in the lower quintile of the wage distribution in 2004 were still in this quintile in 2009, while 24% had moved up to the second quintile and the remaining 16% to higher quintiles. A completely employment income-immobile economy would have values of 1 across the matrix diagonal, with all other values standing at zero.

Table 3
INCOME TRANSITION MATRIX (5-YEAR)

Probability of transitioning between quintiles

Quintile in 2004	Quintile in 2009				
	1	2	3	4	5
1	0.60	0.24	0.09	0.04	0.03
2	0.12	0.53	0.25	0.07	0.03
3	0.04	0.16	0.50	0.24	0.07
4	0.02	0.04	0.17	0.55	0.22
5	0.01	0.01	0.04	0.18	0.77

Source: Inland Revenue Department; CBM estimates.

Table 4
INCOME TRANSITION MATRIX (10-YEAR)

Probability of transitioning between quintiles

Quintile in 2004	Quintile in 2014				
	1	2	3	4	5
1	0.48	0.25	0.15	0.07	0.05
2	0.16	0.42	0.26	0.11	0.05
3	0.06	0.19	0.37	0.27	0.11
4	0.04	0.07	0.19	0.46	0.24
5	0.02	0.03	0.06	0.20	0.69

Source: Inland Revenue Department; CBM estimates.

The probability of remaining within the same income quintile is quite high for the shorter, five-year period. The probability of remaining within the same quintile is largest for the highest and the lowest quintiles, while higher mobility is observed in the middle of the wage income distribution. In part, this could reflect a higher density (and hence a lower income quintile range) in the middle part of the wage distribution.

Wage income mobility is generally higher for the longer, ten-year period, given that movements within the distribution tend to be gradual. For most quintiles, the probability of remaining within the same quintile over ten years is less than 50%. Furthermore, upward movements are more likely than downward movements. This reflects the impact of experience, with individuals starting their careers at relatively low incomes and progressing as experience is gained. It also points to opportunities for individuals to work their way up the income ladder in a dynamic and expanding economy.

Apart from transition matrices, one can also measure the upward mobility of low-wage earners, approximated by the probability of escaping low-wage employment. As discussed above, finding stable, full-time employment is one of the best ways to lower one's risk of poverty. However, sometimes even full-time work does not enable an individual to earn enough to avoid financial difficulties. For the purposes of this analysis, a low wage is defined as a salary below two-thirds of the median (OECD, 1996). The probability of escaping low wage employment is thereby calculated as the proportion of individuals earning below this low wage threshold who, after a set time period of five years, earn above the threshold.

Young individuals (20-34) are the most likely to experience sufficient wage increases over time, with around 45% of those earning low wages in 2010 moving above the threshold by 2015. The corresponding figures for those in the 35-49 and in the 50+ age brackets were 35% and 31%, respectively. This can be explained by a relatively larger value of added experience at the early stages of one's career.

The probability of escaping low wage employment dropped noticeably in the early 2000s, particularly for older workers (see Chart 9). This probably reflected the restructuring of the Maltese economy, which resulted in a number of sectors shrinking, such as manufacturing firms protected by trade restrictions. At the same time, one can observe an improvement in the probability of escaping low wages for those aged between 35 and 49 years of age, particularly since the mid-2000s when a number of new service-based industries set up in Malta.

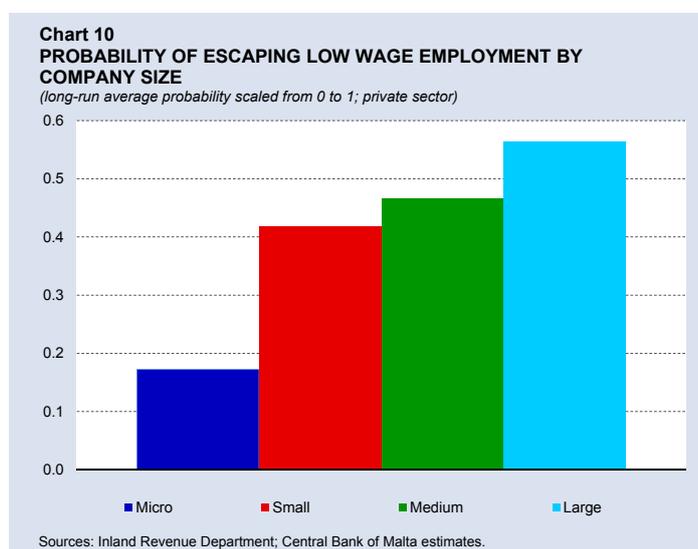
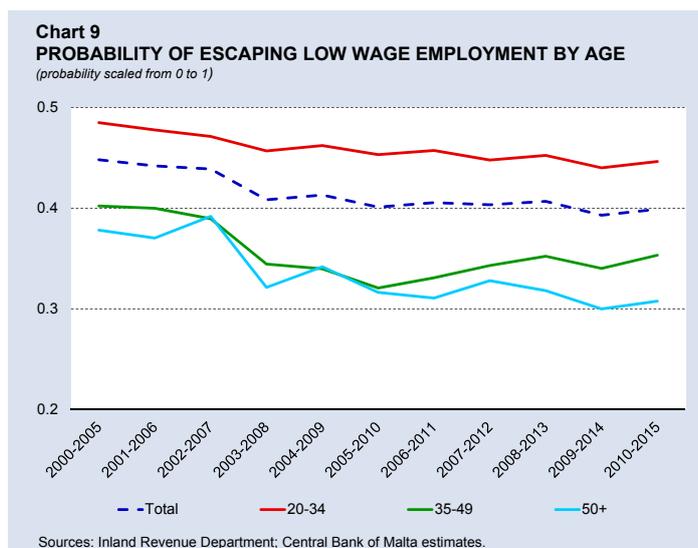
This indicates that this cohort has benefitted strongly from the economic diversification and expansion observed in recent years. On the other hand, opportunities for the older generation seem to have continued to erode. The growth of the services sector has benefitted the more highly educated younger cohorts, while the skill set of the older generation may be more suited to an industry-based economy.

“The growth of the services sector has benefitted the more highly educated younger cohorts”

Chart 10 shows how the probability of escaping low wages varies by company size. The larger the company, the more opportunities tend to arise for employees to move up the career ladder, thereby improving their take-home pay. On the other hand, micro enterprises offer fewer opportunities to move up the internal hierarchy, so that the probability of an increase in pay is relatively smaller. As company size increases and firm hierarchies become larger and more complex, more qualified and hard-working employees tend to move up the income ladder much faster. In light of an increase in the proportion of small and micro enterprises in Malta in recent years (Grech, 2018), this might imply a future risk for wage mobility.

Conclusion

Income inequality in Malta has, in recent years, returned to the levels observed during the 2008-2010 period, mostly owing to rapid growth of incomes of those in the middle part of the income ladder. In particular, older households have seen pension income failing to keep up with the overall increase in national median income. This implies that



with an ageing population, Malta may experience further increases in inequality in the future. The analysis also shows that older generations tend to be less mobile in terms of income, being unable to adapt their skill set to the rapid structural changes in the economy. This indicates a potential for on-the-job training and other measures aimed at improving the employability of older individuals still in the labour force, while also encouraging persons who reached retirement age to remain in the workforce.

Another implication relates to the ongoing shift away from large companies to smaller enterprises, reflecting the structural changes in the economy, especially the shift towards services. The above analysis shows how individuals employed in smaller enterprises tend to have lower opportunities to escape low wages. This is particularly so within certain sectors of the services industry, such as retail or tourism.

In recent years, the authorities have introduced a number of measures aimed at tackling the issues highlighted in this article. These include increased allowances for the elderly, as well as measures aimed at encouraging participation in the labour force amongst disadvantaged groups. Although the above analysis suggests that these measures and the drive to increase employment have indeed made an impact on the proportion of the population at risk of poverty or social exclusion, structural economic and demographic changes mean that there is still a very important role for government in redistributing the wealth generated by the expanding economy.

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AN ANALYSIS OF REVISIONS TO MALTESE GDP DATA

Owen Grech¹

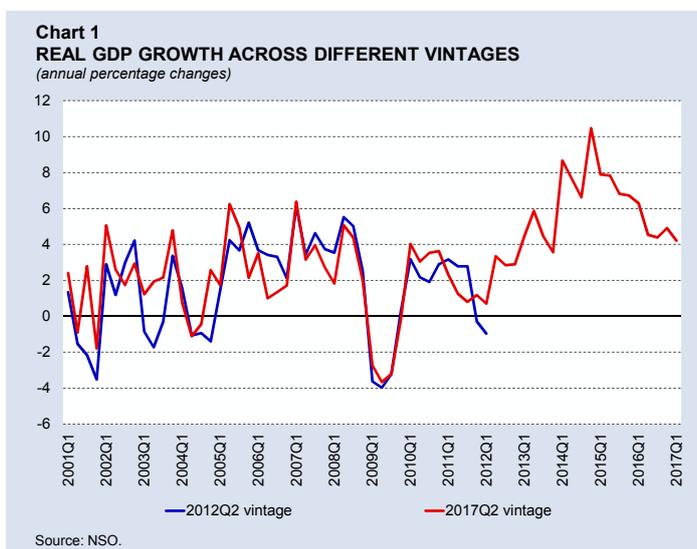


This study assesses the reliability of Maltese GDP data. In particular, it presents stylised facts of revisions to overall gross domestic product (GDP) and its main expenditure components, in both real and nominal terms, that occurred between 2002 and 2018. Towards this end, a number of revision indicators are employed that shed light on the magnitude, bias and volatility of these revisions. This article also presents a useful by-product of this research: Malta's first real-time macroeconomic database. The database covers 14 variables: real and nominal GDP and their main expenditure components. It includes all GDP vintages published by the National Statistics Office (NSO) between 2002Q1 and 2018Q1 and consists of over 30,000 data points. The results reveal that revisions to initial National Accounts data are sizeable, biased upwards, volatile and increase with the horizon. The size, bias and volatility of revisions to the components of GDP are generally larger than those to their aggregate counterparts. Moreover, revisions to private consumption and government consumption tend to be smaller in terms of size, bias and volatility than revisions to investment, exports and imports.

Introduction

GDP is a key macroeconomic variable that often features in the policy making process, including the formulation of monetary policy. As is the case with most data, the publication of GDP data is subject to a trade-off between timeliness and reliability. Data users require timely data that are published with a relatively short lag so they can base their assessment on relatively recent, and hence relevant, developments. However, timeliness comes at the expense of reliability. Data that are published promptly are often based on less complete information, making them subject to revisions as more comprehensive information is gathered. In this context, reliability refers to the closeness of the initial estimated value to subsequent estimated values (Carson and Laliberte, 2002). It should not be confused with the accuracy of these estimates, that is, the extent to which the estimates truly represent the full extent of economic activity in a given time period.

Malta's NSO publishes GDP data slightly more than two months after the end of the reference quarter. For instance, GDP data for the first quarter of the year are usually published in the first week of June.² While the first GDP estimate is arguably the most important for data users since it provides the first reading of national income in that particular quarter, it is based on limited information and is therefore revised in subsequent quarters to give a more complete picture of what the pace of economic activity is likely to have been. Chart 1 shows the vintage of real GDP growth published



¹ The author would like to thank Luisa Tolu and Bernice Amaira for excellent research assistance, Malta's National Statistics Office (NSO) for providing additional data that contributed towards populating the real-time database to the highest degree, as well as participants at an internal research seminar for valuable discussions, comments and suggestions. The views expressed are those of the author and do not necessarily reflect the views of the Central Bank of Malta. Any errors are the author's own. Email address: grecho@centralbankmalta.org.

² Unlike many other national statistical institutes, the NSO does not publish a flash estimate for GDP.

in 2012Q2 together with that published five years later in 2017Q2 and therefore provides an example of how GDP estimates are revised, sometimes substantially, in later quarters.

While revisions occur for a variety of reasons, it is possible to distinguish between two broad categories: informative and uninformative revisions.³ Informative revisions arise as more complete information becomes available over time, whereas uninformative revisions result from changes in the methodology underlying the data, such as definitional changes, a change in the base year and the adoption of a new weighting system.

This study examines the reliability of Maltese GDP data. In particular, it presents stylised facts relating to the revisions to overall GDP from the expenditure side and its main components, in both real and nominal terms, that took place over the 16 year period spanning between 2002 and 2018. Towards this end, a number of revision indicators are employed that shed light on the magnitude, bias and volatility of these revisions. This article also presents a useful by-product of this research: Malta's first real-time macroeconomic database.

“This study examines the reliability of Maltese GDP data. It presents stylised facts relating to the revisions to overall GDP from the expenditure side and its main components, in both real and nominal terms”

Studying data revisions is of interest for at least two reasons. First, revision statistics equip data users with a tool that enhances their interpretation of data releases. For instance, if the first estimate of GDP is usually revised upwards in later releases, data users can reasonably conclude that economic activity in the previous quarter is likely to have been more buoyant than official statistics suggest. This is particularly useful for forecasters.⁴ Second, revision statistics can be used to improve the reliability of the data by the statistical institute compiling it. Building on our earlier example, if the initial GDP estimate is generally revised upwards, the statistical institute can incorporate this information and publish first estimates of GDP that are higher than preliminary data suggest. This should make the data subject to lower revisions than would be the case if past revisions are not taken into account.

The data: a real-time macroeconomic database for Malta

In conducting revision analysis, a useful starting point is to construct a real-time database. A real-time database is a collection of data vintages, where, in this case, a vintage represents a time series that was the latest data at a particular point in time. Such a database therefore provides a snapshot of the data available in real time, that is, the data actually at the disposal of users at any given point in the past.

A real-time database has several applications. It can be used to study data revisions, as in this article, but also to examine whether empirical macroeconomic results are sensitive to the data vintage used, to evaluate policy actions ex-post and to evaluate forecasts.⁵ In fact, several central banks, such as the Federal Reserve, the Bank of England and the European Central Bank have constructed real time databases in recent years.⁶

In light of the above, the Central Bank of Malta has constructed a real-time macroeconomic database for Malta. The database covers 14 variables: GDP, private consumption, government consumption, investment, changes in

³ For example, in its Policy for Revisions of Official Statistics, the NSO (2004) explains that statistical revisions may be effected for at least eight reasons: (i) incorporation of source data that is more complete or superior, (ii) incorporation of source data that bears out concepts more closely, (iii) replacement by source data of judgement values or values derived largely by statistical techniques, (iv) incorporation of updated seasonal factors, (v) updating of base period, (vi) changes in statistical methods, (vii) changes in concepts, definitions and classifications and (viii) correction of errors in source data and computations.

⁴ Revision statistics provide forecasters with information on how the data, on which their forecasts are based, are likely to be revised, which makes them better placed to produce accurate forecasts. Moreover, revision statistics shed light on the probable revisions to future outturns, against which their forecasts will be evaluated. This highlights a dilemma forecasters face: whether to select the first or final vintage as the target to forecast. If they seek to forecast the first vintage, initially they are likely to have a relatively small forecast error, which, however, will probably increase over time as more vintages are published. If, instead, forecasters choose to forecast the final vintage, the forecast error is likely to be relatively large initially, but this error is expected to decline over time. In other words, forecasters must decide whether they would rather have a small forecast error initially, when their forecasts are under the greatest scrutiny but at the expense of a forecast which is probably not the best projection of economic developments, or whether the opposite scenario is more desirable.

⁵ See Croushore and Stark (1999) and Croushore and Stark (2000) for further details on the uses of real time databases and Croushore (2011) for an extensive list of studies that make use of real-time data.

⁶ These databases are documented in Croushore and Stark (2001), Castle and Ellis (2002) and Giannone et al. (2010), respectively.

inventories and acquisitions less disposals of valuables, exports and imports, in both real and nominal terms, all measured from the expenditure side. It includes all GDP releases published by the NSO between 2002Q1 and 2018Q1, thus covering more than 16 years of data spread over 65 vintages. The database consists of over 30,000 data points. A large portion of the data was collected from the original GDP releases issued by the NSO. However, in some cases, the data release does not provide all the historical data for that vintage as required for the purposes of the database. In such instances, where available, additional data was kindly provided by the NSO.⁷

“The Central Bank of Malta has constructed a real-time macroeconomic database for Malta”

For illustrative purposes, Table 1 below shows a section of the database for real GDP. Each column represents a separate vintage, that is, the most updated time series for that variable – real GDP in this case – at a particular point in time. The heading of the column shows when that vintage was released. The last data point in each column is the first estimate for the preceding quarter. For example, the first vintage in the database was published in 2002Q1 and provides data between 2000Q1 and 2001Q4.⁸ The last figure of this vintage – the figure of 835,313 (€ 000s) – is the first estimate for 2001Q4. In subsequent vintages, these data are revised and estimates for more recent quarters are provided. This gives the database its triangular form. Each row records all the readings for one particular quarter. In other words, a row shows how the estimate for an individual quarter changed across vintages. For instance, consider the row that corresponds to 2001Q4. This row shows how the estimate of real GDP for 2001Q4 changed across different data releases. The first estimate for this quarter, published in 2002Q1, amounted to 835,313 (€ 000s). In later vintages, this figure was revised, such that the last vintage in the database, published in 2018Q1, suggests that real GDP in 2001Q4 was actually 1,365,297 (€ 000s).⁹

Table 1
AN EXTRACT OF THE REAL-TIME DATABASE

EUR thousands

	Real GDP								
	2002Q1	2002Q2	2002Q3	2002Q4	...	2017Q2	2017Q3	2017Q4	2018Q1
2000Q1	779175	781039	776613	785465	...	1181627	1181627	1181627	1181627
2000Q2	815980	817377	813650	823899	...	1332755	1332755	1332755	1332755
2000Q3	839739	844864	839506	849522	...	1487128	1487128	1487128	1487128
2000Q4	860005	861402	853017	863732	...	1390128	1390128	1390128	1390128
2001Q1	777312	782437	779874	786629	...	1210044	1210044	1210044	1210044
2001Q2	810389	814116	809923	817610	...	1320719	1320719	1320719	1320719
2001Q3	837643	840438	839506	845563	...	1528369	1528369	1528369	1528369
2001Q4	835313	842534	840205	844631	...	1365297	1365297	1365297	1365297
2002Q1		793618	788959	792453	...	1271165	1271165	1271165	1271165
2002Q2			827741	839739	...	1354979	1354979	1354979	1354979
2002Q3				880037	...	1554838	1554838	1554838	1554838
...				
2017Q1						2091478	2133391	2139124	2192328
2017Q2							2246812	2276517	2333566
2017Q3								2541595	2620963
2017Q4									2453170

Source: NSO.

⁷ To promote research on real-time issues, the database is available from the author upon request and will be updated regularly.

⁸ Some vintages, including that published in 2002Q1, extend further back than 2000Q1. However, since most vintages only provide data as from 2000Q1, we use this as the starting point for all vintages in the database.

⁹ These revisions do not only reflect the arrival of new information but also methodological changes. For instance, the data published between 2002Q1 and 2004Q2 are based on the 1953 System of National Accounts (SNA) and the base year is 1995. Data issued between 2004Q3 and 2014Q3 are in line with the 1995 European System of National Accounts (ESA) with 2000 as the base year, while thereafter the data are consistent with the 2010 ESA and are chain-linked with 2010 as the reference year.

Methodology

A data revision is the difference between the data in a later vintage and that in an earlier vintage. This study considers revisions to the year-on-year growth rates of the data, rather than revisions to their levels, since users are generally interested in the former.¹⁰

We distinguish between eight types of revisions: those that occur between the first release and the release published one quarter, two quarters, three quarters, one year, two years, three years, four years and five years later. In other words, we consider revisions between the first estimate and the second, third, fourth, fifth, ninth, thirteenth, seventeenth and twenty-first estimate, respectively.¹¹

In assessing the nature of revisions, three issues that are of particular interest are the size, sign and volatility of the revisions. Evaluating the size of revisions sheds light on whether there are large differences between the first estimate and subsequent estimates. This information is useful for interpreting data releases. Larger revisions imply that the corresponding first estimates are less reliable and later estimates are likely to be quite different than those in the initial release. The indicator used to gauge the magnitude of revisions is the average absolute revision (AAR), which is computed as the mean of the absolute value of the revisions, as described by the formula below:

$$AAR_{j,j+t} = \frac{1}{n} \sum_{i=1}^n |g_{i,j+t} - g_{i,j}|$$

where $AAR_{j,j+t}$ is the average absolute revision between release j and the later release $j+t$, n is the number of revisions considered, $g_{i,j+t}$ is the estimate of GDP growth in period i as published in release $j+t$ and $g_{i,j}$ is the estimate of GDP growth in the same period i as published in the earlier release j .

“Three issues that are of particular interest are the size, sign and volatility of the revisions”

Another issue of interest is whether revisions are, on average, positive or negative, that is, whether the first estimate is biased. Such information may also help considerably in interpreting data releases. For example, if past revisions to the first estimate were positive, on average, then it may be reasonable to expect future first releases to eventually be revised upwards as well. Two revision indicators have been employed to evaluate the sign of revisions: the average revision (AR) and the proportion of positive revisions. The average revision is computed as the mean value of the revisions, as described more formally below:

$$AR_{j,j+t} = \frac{1}{n} \sum_{i=1}^n (g_{i,j+t} - g_{i,j})$$

where the notation is identical to that above. The proportion of positive revisions is calculated as the number of upward revisions divided by the total number of revisions.

Another important question is whether revisions are volatile. Once again, insight into this issue will have implications for the interpretation of data releases: if revisions are highly volatile, it is much harder to predict the magnitude of future revisions. The standard deviation and the range of the revisions are used to gauge volatility. The standard deviation (σ) of the revisions is calculated as follows:

$$\sigma_{j,j+t} = \sqrt{\frac{1}{n} \sum_{i=1}^n (g_{i,j+t} - g_{i,j} - AR_{j,j+t})^2}$$

¹⁰ That said, the availability of a real-time database makes it relatively straightforward to conduct a similar analysis in terms of the levels of the data. However, in the case of real variables, such an exercise can only extend until the 2014Q2 vintage since, thereafter, the NSO published chain-linked data which should not be subtracted.

¹¹ Although for conciseness we focus on eight types of revisions, using the real-time database, one can easily compute revision statistics for any two sets of estimates.

where, again, the notation is the same as that used previously. The range of the revisions is the difference between the maximum positive revision and the maximum negative revision but, for convenience, we report both of these figures.

Results

A number of useful stylised facts emerge from the results. A selection of these results – those for overall real GDP – is presented in Table 2 below.¹²

	Mean Absolute Revision	Mean Revision	Proportion of Positive Revisions	Standard Deviation of Revisions	Maximum Negative Revision	Maximum Positive Revision	Sample Size
	<i>Percentage points</i>		<i>Per cent</i>		<i>Percentage points</i>		
1 st vs. 2 nd release	0.51	0.20	57	0.71	-2.24	2.00	63
1 st vs. 3 rd release	0.73	0.21	64	0.98	-3.38	2.29	61
1 st vs. 4 th release	0.87	0.23	61	1.14	-3.69	2.58	59
1 st vs. 5 th release	0.94	0.18	58	1.24	-4.38	2.72	57
1 st vs. 9 th release	1.31	0.84	60	1.71	-1.32	6.51	43
1 st vs. 13 th release	1.71	1.42	73	1.77	-1.38	6.55	40
1 st vs. 17 th release	1.44	1.00	72	1.49	-2.10	4.21	36
1 st vs. 21 st release	1.31	0.75	61	1.43	-1.43	3.91	31

Source: Author's calculations.

Starting with the size of revisions, the results suggest that revisions to initial overall real GDP growth data are relatively large. For instance, the growth rate reported in the second release differs from that published in the first release one quarter earlier by around half a percentage point, on average. Moreover, the size of the revision tends to grow with the horizon. The revision, in absolute terms, between the first release and the fifth release published a year later increases to nearly one percentage point, on average, while the absolute revision between the first release and the twenty-first release published five years later rises to around 1.3 percentage points.

Turning to the sign, or direction, of revisions, initial overall real GDP growth figures tend to be revised upwards in later releases. In other words, revisions have a positive bias. For example, one of the revision indicators employed, the mean revision, shows that the growth rate published in the second release is 0.2 percentage point higher than that in the first release, on average. The other revision indicator used to gauge the direction of revisions, the proportion of positive revisions, also points towards a positive bias: 57 per cent of revisions between the first and second release are upward revisions. Furthermore, the degree of biasedness also tends to increase with the horizon, such that when one compares the first estimate to that published five years later, the mean revision rises to 0.75 percentage point and the proportion of positive revisions climbs to 61 per cent.

With regards to volatility, the results indicate that revisions to initial estimates of overall real GDP growth are considerably volatile. This is evidenced by both the relatively large standard deviations, as well as the wide ranges. For instance, the revision between the first and the second estimate ranges from -2.24 percentage points to 2.00 percentage points.¹³

The stylised facts documented so far, namely, that revisions to initial overall real GDP growth rates are sizeable, biased upwards, volatile and increase with the horizon, also hold for the main expenditure components of GDP: private

¹² Although, for brevity, we only show detailed results for overall real GDP, more comprehensive results for overall nominal GDP and for the main expenditure components of GDP, in both real and nominal terms, are available from the author upon request.

¹³ Despite this volatility, t-tests suggest that, over most horizons, the positive bias in revisions to overall real GDP is statistically significant at conventional levels. This also holds for revisions to overall nominal GDP and their main expenditure components.

consumption, government consumption, investment, exports and imports.¹⁴ However, revisions to these components are generally larger in terms of size, bias and volatility than the revisions to overall real GDP. This generally applies across all horizons. The size, bias and volatility of revisions to private consumption and government consumption tend to be smaller than revisions to investment, exports and imports (see Charts 2 and 3).

“Revisions to initial overall real GDP growth rates are sizeable, biased upwards, volatile and increase with the horizon”

Turning to the nominal side, the stylised facts that emerge for overall nominal GDP growth and its components are identical to those discussed above for the real side. Since the NSO first compiles GDP data in nominal terms, which are then deflated to produce real variables, an important implication of this is that much of the revisions stem from adjustments to the nominal side, rather than to the deflators, since the latter would imply that revisions to nominal and real variables are dissimilar.

A word on a limitation of this analysis is in order. As outlined previously, there are two main types of revisions: informative and uninformative revisions. Our data does not

allow us to disentangle these two different classes of revisions and therefore, the revision statistics reported here, do not only reflect the arrival of more comprehensive information, but also changes in the underlying methodology.

Cross-country comparison

In order to put the results for Malta into perspective, we compare them with those for other countries. Table 3 reports revision statistics for real GDP growth of a sample of OECD countries.¹⁵ Data on the mean absolute revision show that while revisions to initial estimates of overall real GDP growth in other countries tend to be smaller in size than in Malta, these revisions are generally still relatively large. For example, the revision, in absolute terms, between the first estimate and that published a year later reaches 0.63 percentage point in Japan. Turning to the mean revision, the data suggest that initial overall GDP growth rates are biased upwards in most countries. Indeed, in only three of the twelve countries in the sample are these figures revised downwards, on average, in the data release published a year later. However, this positive bias is less pronounced than is the case for Malta. Figures for the standard

¹⁴ In our analysis, we do not include changes in inventories and acquisitions less disposals of valuables. This component is largely composed of the statistical discrepancy, which makes it highly volatile. Consequently, revision statistics for this variable are of little use.

¹⁵ These revision statistics were compiled using the OECD’s Revisions Analysis Dataset, to our knowledge the most comprehensive cross-country database of macroeconomic data revisions. The data we report here are discussed in Zwijnenburg et al. (2014) and Zwijnenburg (2015).

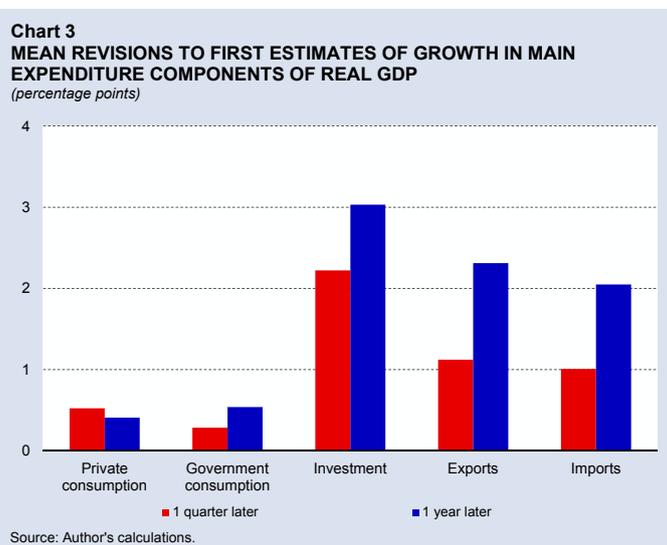
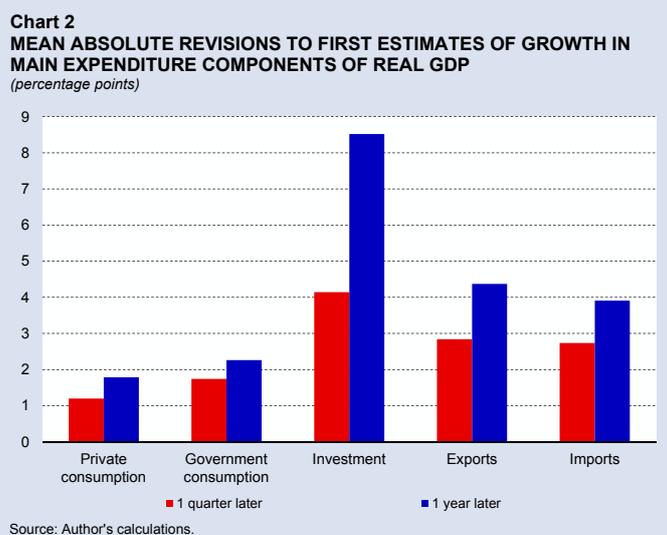


Table 3
REVISION STATISTICS FOR REAL GDP GROWTH DATA OF A SAMPLE OF OECD COUNTRIES

Percentage points

	Mean Absolute Revision		Mean Revision		Standard Deviation of Revisions	
	1 year later	3 years later	1 year later	3 years later	1 year later	3 years later
Australia	0.36	0.57	0.12	0.35	0.46	0.60
Belgium	0.29	0.48	0.03	0.11	0.37	0.59
Canada	0.22	0.44	0.07	0.26	0.28	0.52
France	0.29	0.53	0.03	0.15	0.34	0.61
Germany	0.23	0.47	0.07	-0.03	0.31	0.59
Italy	0.20	0.39	-0.02	0.11	0.26	0.47
Japan	0.63	0.93	-0.07	0.29	0.78	1.12
Netherlands	0.32	0.60	0.12	0.44	0.37	0.57
Portugal	0.27	0.53	0.01	0.34	0.39	0.57
Spain	0.19	0.43	0.03	0.26	0.24	0.50
United Kingdom	0.25	0.58	0.07	0.15	0.32	0.91
United States	0.32	0.68	-0.03	-0.33	0.44	0.79
Average	0.30	0.55	0.04	0.18	0.38	0.65

Sources: OECD; author's calculations.

deviation reveal that first estimates of growth in overall real GDP are relatively volatile in many countries, although less so than in Malta. As is the case for Malta, the size, bias and volatility of revisions in other countries tend to increase with the horizon. In many cases, the revision statistics for the three year horizon are greater than those for the one year horizon.

The OECD's revisions database shows that the main expenditure components of GDP generally witness revisions that are larger in terms of size, bias and volatility than the revisions to their aggregate counterpart, in line with the result for Malta. Similarly, revisions to private consumption and government consumption tend to be smaller in magnitude, less biased and less volatile than revisions to investment, exports and imports.¹⁶

“The stylised facts relating to the revisions to Maltese GDP data are very similar to those reported for other countries. However, in the case of Malta, revisions are generally larger in terms of size, bias, as well as volatility”

In summary, the stylised facts relating to the revisions to Maltese GDP data are very similar to those reported for other countries. There is, however, an important difference: in the case of Malta, revisions are generally larger in terms of size, bias, as well as volatility. Although all effort should be made to improve the reliability of Maltese GDP data since this would enhance their usefulness, relatively large revisions to Maltese GDP data in comparison with those in other countries, can be justified on at least two grounds. First, over the time period considered – 2002Q1 to 2018Q1 – Malta experienced robust economic growth of 3.6 per cent per annum, on average, in real terms, or 6.1 per cent in nominal terms.¹⁷ Higher rates of growth are bound to give rise to larger revisions. To circumvent this issue and improve cross-country comparability, one can consider the revision statistics relative to GDP growth but we leave this to future research. Second, due to the small size of the Maltese economy, the volume of activity is low compared to that in other countries. Consequently, revisions to individual transactions will influence overall revisions in a more potent manner.

¹⁶ The stylised facts we report for Malta are also in line with those for other economies, besides those mentioned here, such as the euro area and Ireland, amongst others, as discussed in Giannone et al. (2010) and Bermingham (2006), respectively.

¹⁷ According to the 2018Q1 vintage.

Conclusion

A number of policy implications can be drawn from the results. Here we will limit ourselves to two of them. First, the stylised facts documented here can significantly enhance users' interpretation of GDP releases. Policymakers, researchers, forecasters and analysts should, for example, bear in mind that initial GDP data are likely to be subject to considerable revisions, which are likely to be on the upside. Taking this information into account will allow them to have a more complete understanding of what the true state of the economy is likely to be. Second, these revision statistics can be used by the NSO to improve the reliability of GDP data. Incorporating this information by, for instance, publishing first GDP estimates that are higher than preliminary data suggest, should make National Accounts data subject to lower revisions.

Going forward, there are several avenues of further research that can be pursued. First, this study can be extended in a number of ways, for instance by splitting the sample to examine whether the properties of revisions have changed over time and by using a more extensive range of revision indicators that shed light on whether revisions are correlated with the business cycle, across quarters and across components. Second, the real-time database can be used in other applications, such as to study whether empirical macroeconomic results for Malta are sensitive to the data vintage used, to evaluate past policy actions and to evaluate forecasts. To promote such research, the real-time database will be updated on a regular basis and possibly extended to include additional variables.

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