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The Macroeconomic Effects of Closing the Public Sector Capital Gap in Malta

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Policy Note

July 2019

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The authors would like to thank Dr. Aaron G. Grech, Rita Schembri and Brian Micallef for valuable comments and discussions. They are also grateful to John Farrugia for providing internal estimates for the government capital stock and for projections of the estimated sizes of the European Structural and Investment Funds apportioned to Malta and the National Development and Social Fund. The views expressed in this note are those of the authors and do not necessarily reflect those of the Central Bank of Malta. Any errors are the authors' own.

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Abstract

Pressures on Malta's public infrastructure have increased significantly in recent years. Indeed, public capital stock-to-GDP ratio is estimated to stand below that in the EU. This note studies the impact of government investment using a New Keynesian general equilibrium model. Such models are especially useful in capturing both direct and indirect effects of government investment under different financing alternatives. Results indicate that in the short-to-medium run, debt-financed investment shocks are consistent with the highest effects on output. Financing public investment using taxes on returns to factors of production is consistent with the largest output loss. On the other hand, financing through consumption tax increases or cuts in government recurrent expenditure is the least distortionary. Results indicate that a sustained increase in government investment that bridges Malta's public sector capital gap with the rest of the EU could increase long run output by between 6% and 11%. Results depend significantly on the financing option utilised to stabilise public debt-to-GDP, with the smallest output gains achieved under a strategy that seeks to fund outlays by increasing the tax rate on the return to capital or labour. Financing through EU structural or sovereign wealth funds can significantly minimise tax-induced output losses.

JEL Classification: E37, E62, H54.
Keywords: fiscal policy, public investment, general equilibrium modelling

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Executive Summary

Malta's public infrastructure has come under strain as it has struggled to keep up with the recent rapid expansion of economic activity and population. This is shown by relatively low public capital stock per capita and capital stock-to-GDP ratio. Estimates indicate that these measures are well below those of other EU countries. This is likely to be weighing negatively on Malta's potential output. Indeed literature suggests that there are significant economic gains to be reaped from increasing government investment. The extent of these gains does not only depend on the efficiency of the investment projects, but also on the financing strategy employed by the Government.

- **How does Malta's public capital stock compare to the rest of the EU?**

The share of public sector capital spending in total government expenditure has changed over time, reflecting the transformation of the government's role in the economy and demographic trends related to an ageing population. These developments have led to a gradual fall in public investment as a proportion of total government expenditure. These results are also confirmed when government investment is normalised by GDP. The average investment-to-GDP ratio is comparable with that of the EU. However Malta compares less favourably when investment ratio dynamics are taken in consideration, ranking third from last within the EU in terms of the change in the average investment ratio registered between the periods 2017-2006 and 2005-1995. Consequently Malta has been registering considerable public capital-to-GDP and public capital per capita gaps with the EU average. Moreover, in line with the trend decline in government investment observed from the mid-2000s onwards, both metrics indicate a widening of Malta's public capital ratio gap vis-à-vis the EU from 2005 onwards. These conclusions are confirmed by qualitative measures of public capital stock published by the World Bank, in which Malta ranks relatively poorly in terms of the transport and utility infrastructure sub-indicators.

- **Why is public capital stock an important driver of economic growth?**

Theoretical models indicate that an increase in public investment affects the economy by boosting aggregate demand for investment goods as well as increasing the productive capacity of the economy through an increase in the productivity of private factors of production. Partial equilibrium analyses indicate that there is considerable heterogeneity in country-level results for the output elasticity of public capital. Estimates also indicate that as a country's infrastructure matures, there is a fall in the marginal output gain derived out of additional public capital spending. Some studies also show that core infrastructure spending can be as much as three times more productive than other non-infrastructure spending.

These results are also confirmed by VAR analysis. Literature also suggests that public sector infrastructure projects are especially effective in boosting demand in periods of low growth. Apart from the state of the economy, the effectiveness of public investment also depends on the efficiency of the capital projects and on the implementation strategy employed. Indeed structural models indicate that while public investment has unequivocally positive effects on output in the long-run, the extent of these effects depend significantly on the financing method utilised by the government. Debt neutral financing strategies could be mildly contractionary in the short run depending on the fiscal instruments used to stabilise government finances.

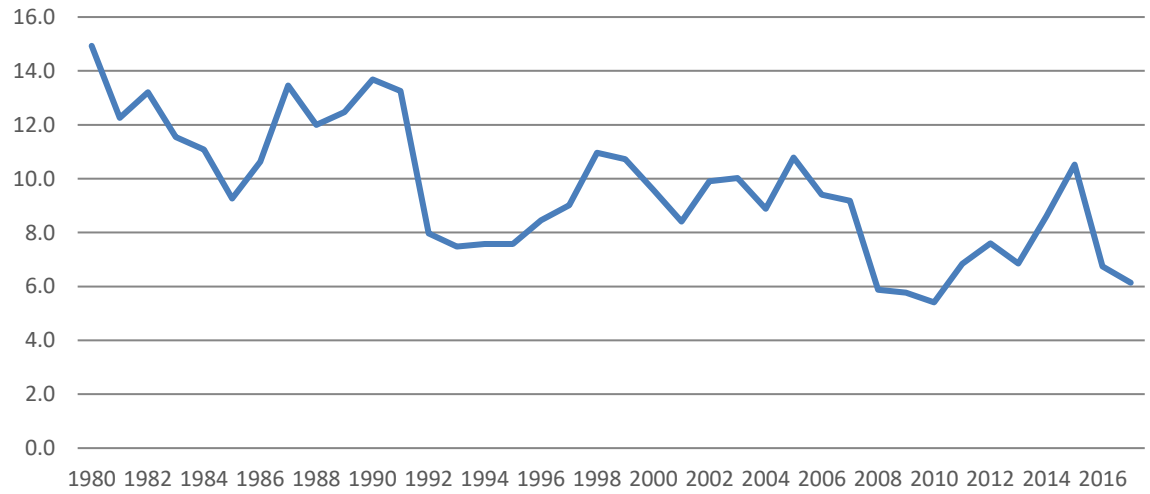
- **What could be the macroeconomic benefits of closing Malta's public capital stock gap?**

In the short run, the expansionary effects of government investment are limited to demand-side effects related to the production of investment goods. As government capital stock accumulates, factor productivity increases, bringing down marginal costs of production which help to crowd-in other private factors of production. The reduction in economy-wide marginal costs transmits itself to lower overall prices which boost Malta's competitiveness. Long-run results indicate that there are considerable output gains associated with bridging Malta's public sector capital gap. Both short and long-run results however are significantly affected by the financing strategy employed by the government. In the short run, government investment is highly expansionary when financed through debt increases. In the case of a debt neutral strategy, there are considerable output losses both in the short and long term, especially when necessary finances are raised through higher taxation on returns to factors of production. These costs could be considerably reduced in case of a strategy that seeks to complement internal financing options with external ones, mainly through an efficient use of EU structural funds and finances available within the National Development and Social Fund. Furthermore, more fiscal space should be created to keep the distortionary effects of internal funding to a minimum.

How does Malta's public capital stock compare to the rest of the EU?

The share of public sector capital spending in total government expenditure has changed over time, reflecting the transformation of the government's role in the economy as well as to the demographic trends that affected the Maltese economy. The re-dimensioning of the State's role in the production of goods and services in the late 1980s and 1990s have led to a significant reduction in the share of capital spending in total government expenditure. Moreover, a maturing pension system and an ageing population have led to an upward trend in the share of current expenditure (driven by expenditure on contributory benefits) further contributing to the fall in the share of government's capital outlays in overall expenditure. Indeed as shown by Figure 1, capital expenditure, which made up almost 13% of total government spending in the early 1980s, fell down significantly to around 10% in the late 1980s and early 1990s. The share of capital expenditure fell further in later years to around 7% of total expenditure before increasing again in the mid-2000s driven by the construction of a new state-owned hospital. After the completion of this project in 2005, general government capital outlays fell significantly. This period was characterised by Malta's inclusion in the Excessive Deficit Procedure due to fiscal deficits that exceeded the 3% limits set by the Maastricht Treaty. Government investment increased again between 2012 and 2015 partly reflecting an improvement in the absorption of EU funds.[3]

Figure 1: Share of GFCF government expenditure
% of Total government expenditure

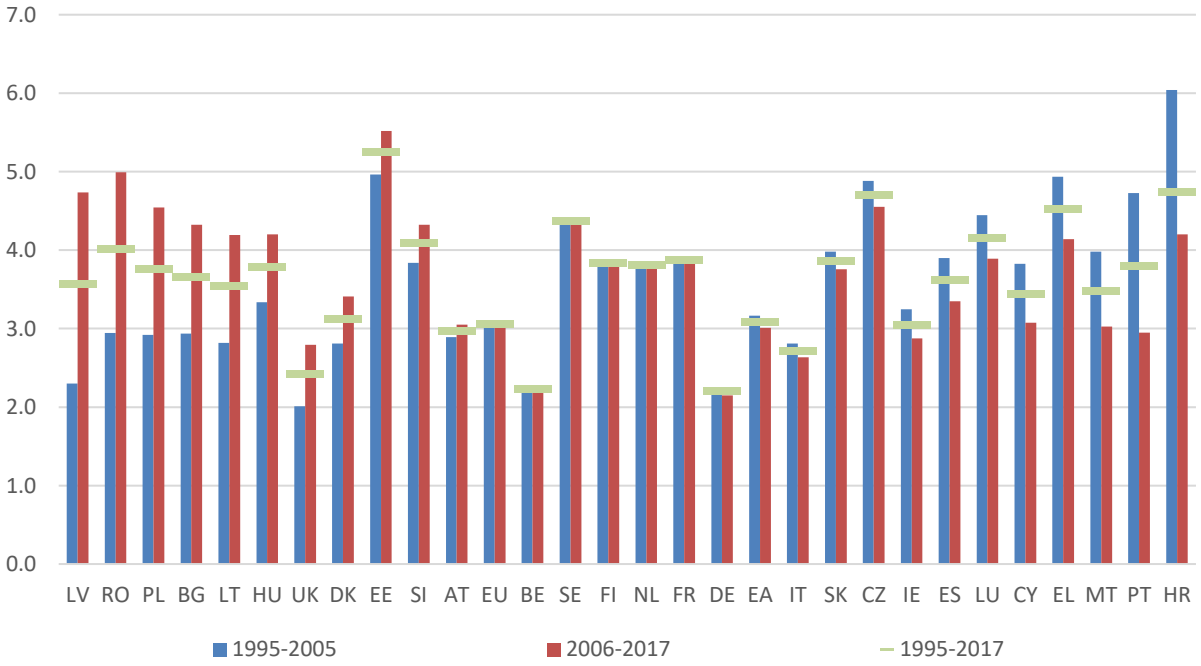


Source: Grech (2015)

[3] These trends are also observed if government's expenditure on capital is expressed in terms of GDP instead of total government expenditure.

Figures 2a and 2b compare dynamics of general government gross fixed capital formation (GFCF) expenditure normalized with total government expenditure and GDP across time and countries. The countries in these charts are ordered by the change in shares of GFCF registered between the 2006-2017 and the 1995-2005 periods, starting with countries that experienced the largest increases. These figures show that when expressed as either a share of GDP or total expenditure, Malta's government spending on GFCF is comparable to the EU and euro area averages. However, Malta compares less favourably to its EU and euro area peers when government investment dynamics are taken in consideration.

Figure 2a: Share of Government Investment in GDP
% of GDP, ranked by magnitude of change in ppts between 2006-2015 and 1995-2005



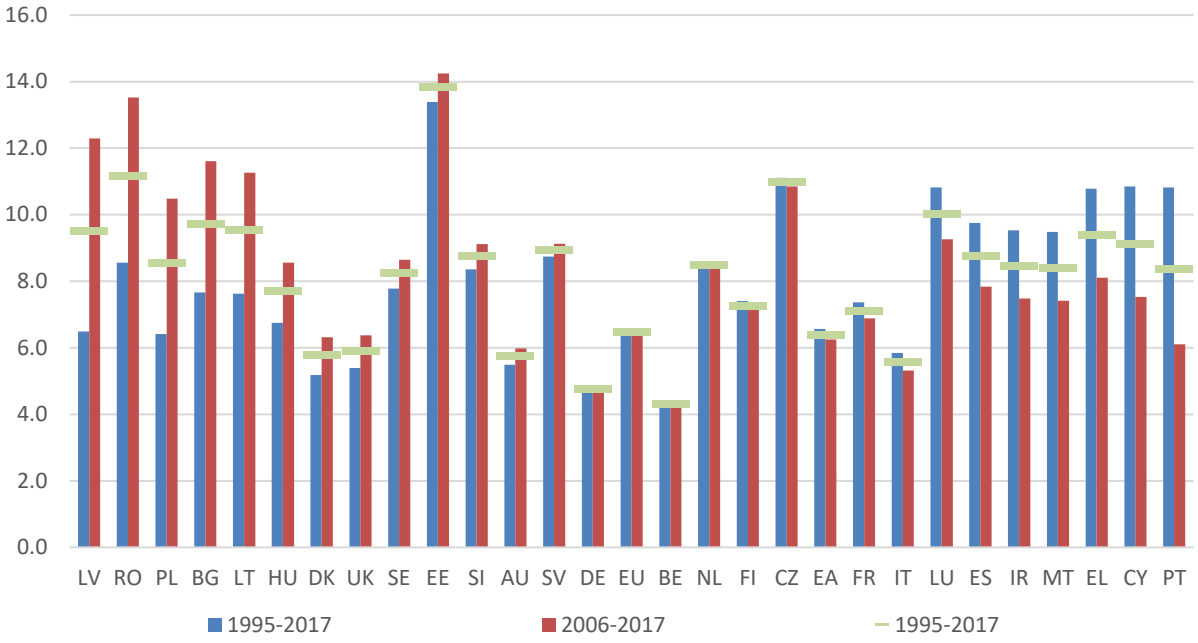
Source: Eurostat, authors' calculations.

Between 2005 and 2017, Malta has registered falls in its government investment ratio vis-à-vis GDP and total government expenditure when compared to the 1995-2005 period, of 1 and 2 percentage points respectively. According to these two metrics, Malta's contraction in its government investment ratios is of a similar magnitude to that registered in Portugal, Cyprus, Ireland and Greece, economies whose investment shares have been affected by the fiscal consolidation strategies employed during the euro area sovereign debt crisis.

The trends identified in both the level and dynamics of government GFCF expenditure are reflected in the figures for capital stock. Before turning to the analysis of capital stock figures, it is important to note that cross-sectional comparisons of capital stock across countries are

Figure 2b: Share of Government Investment in total expenditure

% of total expenditure, ranked by magnitude of change in ppts between 2006-2015 and 1995-2005



Source: Eurostat, authors' calculations.

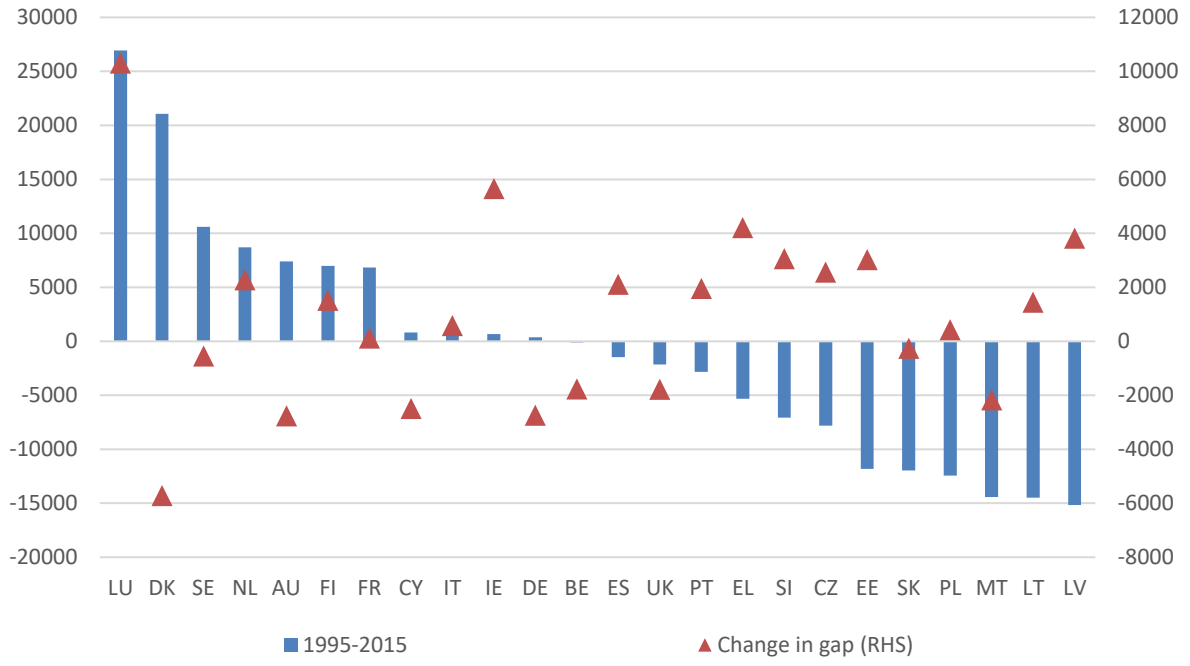
not straight forward. The wide scope of government investment, difficulties in valuation and subjective perceptions make it very difficult to compare government capital stock across economies. There are two broad methods that allow for the quantification of public capital stock; quantitative measures based on attaching a monetary value to the stock of public capital, and qualitative measures based on survey-based indicators aimed at adding a quality dimension to the analysis of public capital stock.

With regards to the former type of methods, literature typically approximates government capital stock as a sum of general government fixed capital formation after allowing for depreciation using a perpetual inventory method. While these data are generally widely available, the measurement of public capital stock in monetary terms is affected by a number of shortcomings that limit the comparability of public capital stock values across countries (see Kamps, 2004 for more details). In this light, this study makes use of government capital stock data found in the IMF Investment and Capital Stock Dataset, ensuring a greater comparability across countries.[4]

[4] The database is available for download at: https://www.imf.org/external/np/fad/publicinvestment/#5. Capital stock is computed using the perpetual inventory method using data found in the OECD Analytical Database, the Penn World Tables, the IMF World Economic Outlook and European Investment Bank. The data are then converted into real terms and adjusted for variations in purchasing power across countries. Moreover, the depreciation rates used are time-varying and depend on the country income-grouping. Since this approach is based on a standardized framework, it allows consistent comparisons of capital stock levels across countries.

Figures 3a and 3b show measures of public capital stock gaps for Malta and for the rest of the EU countries vis-à-vis the EU average. Capital stock measures are normalized by the size of the countries' respective populations and real GDP. These figures show that Malta has struggled to expand its public capital stock in line with economic and population growth. Both capital estimates show that (when expressed as ratios of population and national income) Malta has one of the lowest levels of public capital stock in the EU with an average negative public capital output gap between 1995 and 2015 of around US$ 15,000 per capita. In line with the trend decline in government investment ratios observed from the mid-2000s onwards, both gap metrics indicate a widening of Malta's public capital stock gap vis-à-vis the EU, especially from 2005 onwards.

Figure 3a: Public Capital Stock Gap - Per Capita US$ PPP terms
Difference vs EU, Change in gap between 2006-2015 and 1995-2005 (RHS)



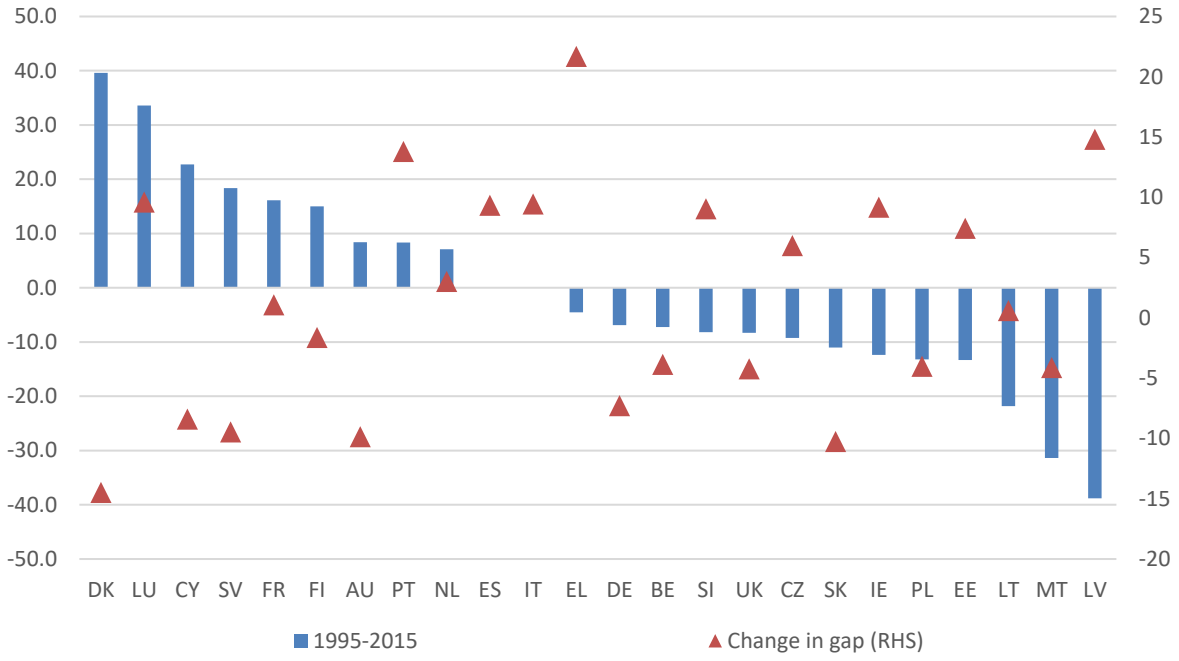
Source: IMF Investment and Capital Stock Dataset, Eurostat, authors' calculations.

The fall in the Maltese government's investment needs to be interpreted within the context of a general trend which sees most euro area (and advanced OECD economies) reduce their government investment outlays. This long-term trend can be attributed to three major factors: a consistent shift towards services-driven economies that are less capital-intensive, an ageing population in the developed world that has led governments to cut capital outlays

More information on the method and definitions of data series used for the computation of capital stock can be found in: http://www.imf.org/external/pp/longres.aspx?id=4959.

to finance recurrent expenditure on health and pensions and a cut in investment expenditure during the great recession of 2009 and the subsequent euro area sovereign debt crisis.

Figure 3b: Public Capital Stock Gap - % of GDP terms
Difference vs EU ppts, Change in gap between 2006-2015 and 1995-2005 (RHS)



Source: IMF Investment and Capital Stock Dataset, authors' calculations.

Indeed, as noted by Bedogni and Scott (2017), given the timing inconsistency that exists between returns to investment and the length of a government's legislature, during periods of fiscal consolidation, governments prefer cutting down on investment spending while retaining current expenditure. Since the benefits of government investment expenditure materialise in the long-term, political economy considerations may create a bias in favour of current expenditure (Alesina and Perotti, 1994). Also, as noted by Hemming and Ter-Minassian (2004), it is operationally easier to achieve fiscal consolidation either by reducing capital expenditure meant to maintain existent public infrastructure (thus leaving public capital to slowly depreciate) or by suspending a relatively small number of large capital projects. On the other hand, recurrent expenditure meant to sustain public employment, pensions and entitlement programmes, is politically harder to reduce. These findings are confirmed by other empirical studies conducted by the World Bank (1988, 1994), Roubini and Sachs (1989), de Haan et al (1996) and Lane (2003), all of which find that government investment is significantly pro-cyclical.[5]

[5] Toigo and Woods (2006) offer a literature review and a comprehensive discussion of the main factors affecting government investment policies.

Aggregate euro area and EU figures for public capital gaps hide considerable heterogeneity across countries. Generally speaking, government investment and relative capital stock figures have declined the most in countries with relatively high investment and capital ratios and in countries that were hit hardest by the sovereign debt crisis. On the other hand, capital ratios have increased the most in countries that have benefitted from increasing support of EU funds, such as Latvia, Lithuania and Poland. Against this backdrop, Malta's public sector investment and capital stock appear to be significantly lagging behind those of its peers.

It is important to note that the monetary measure of public capital stock is affected by a number of issues which complicates considerably comparisons across countries. First, it is not always possible to distinguish between public investment and other government expenditure in terms of its effects on long-run economic growth. At face value, one might regard government investment as being supportive to long-run economic growth, while government consumption might be regarded as creating negative wealth effects that weigh negatively on long-run productivity of factors of production (Forni et al, 2010 and Rapa, 2017). However, this distinction is not always clear-cut. For instance, government expenditure on education and health-care contribute to the build-up of private human capital stock and thus are also conducive to long-run productivity growth. Second, the distinction between public and private investment – and therefore that between public and private capital stock – is not always straight forward. Private corporations, often participate in the provision of public infrastructure through public-private partnerships. For instance, the energy sector reforms that have led to a changeover of Malta's power plants from gasoil to gas, while induced by government, have been undertaken by private corporations. Thus despite improving Malta's infrastructure, these investment outlays do not contribute to the public sector capital stock.[6]

Qualitative measures of public capital stock (such as those provided by the World Economic Forum's Global Competitiveness Indicators - GCI) try to overcome some of these shortcomings and add a qualitative dimension to measures of public infrastructure.[7] As shown in Figure 4, these indicators broadly confirm the main trends identified by monetary measures of public capital stock for Malta, pointing at significant weaknesses in the quality of infrastructure. Both Malta's transport and utility infrastructure sub-indicators are worse than

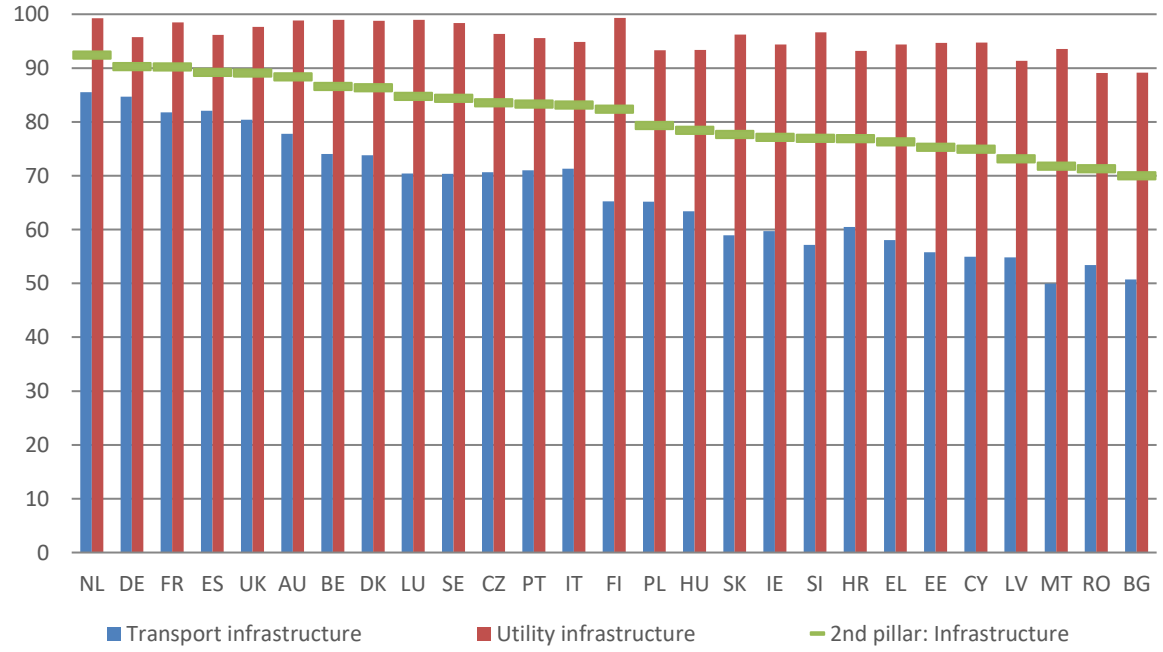
[6] Due to data limitations, estimates of the public sector capital stock gap presented in this study do not take in consideration the recently announced infrastructure projects (including the Marsa junction project), together with the government's commitment to re-surface and in some cases re-build regional roads within the next seven years. Once completed, these projects are expected to help reduce the capital stock gap and in the process ease the burden on Malta's current infrastructure.

[7] While public capital can contain assets other than those typically associated with public infrastructure, they typically make up a very small share of the total public capital stock. To this end, this note uses public infrastructure quality measures as a proxy for the overall quality of total public capital stock.

the EU average, with particularly low scores for the former. Within the utility infrastructure sub-index, Malta ranks relatively poorly in terms of water related infrastructure. While ranking relatively better, electricity infrastructure scores are still below EU average. However, one needs to keep in consideration that GCI indicators for 2018 might still not fully take in consideration the effects of the recent overhaul of the energy sector which are expected to lead to significant long-run macroeconomic gains (Rapa, 2018).

With regards to the transport infrastructure sub-indicator, Malta ranks last within the EU and 66th out of 140 countries. These results are mainly driven by a significantly low score in relation to the quality of roads, where Malta currently ranks 105th out of 140 countries included in the GCI report. Significantly better results are achieved in the Efficiency of Air and Sea transport categories, where Malta ranks 31st and 35th respectively. The GCI infrastructure results are corroborated by data on road density per capita in which Malta ranks quite poorly when compared to its EU peers.[8] Again, similar to the electricity infrastructure scores, one needs to interpret these results with caution. It is important to keep in consideration that these results (especially the ones for the Road Transport category) do not take into consideration the Maltese government's plans to substantially upgrade Malta's road network, with an estimated €700 million investment over seven years.

Figure 4: Infarastructure Pillar and Transport and Utility sub-pillars
Score normalised to 100, ranked by quality of overall infrastructure

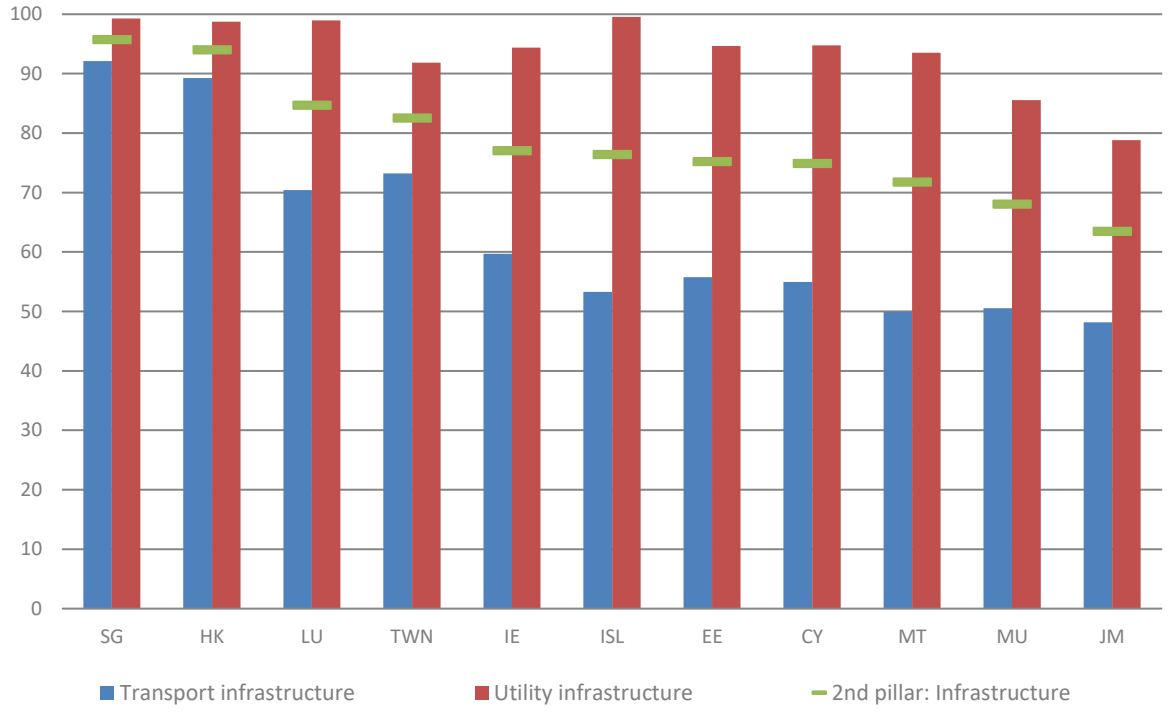


Source: The Global Competitiveness Report 2018.

[8] Data on road density per capita was computed using data on length of regional roads and motorways in kilometres, normalised by total population. All data were extracted from the EUROSTAT database. Results refer to average road length per capita computed between 2000 and 2017.

Focusing exclusively on a comparison with other small states, we note that Malta still ranks quite poorly in terms of the quality of its infrastructure. Figure 5 shows that small island states such as Singapore, Ireland, Iceland and Cyprus rank above Malta in terms of both Utility and Transport sub-pillars. The only small countries in the sample under consideration ranking behind Malta in this regard are Mauritius and Jamaica. The need for further investment in transport infrastructure is confirmed by results published in the annual European Investment Bank Investment Survey. In 2018, 66% of Maltese private sector firms interviewed in the survey cited the lack of adequate transport infrastructure as being a long-term barrier to private investment and growth. This is considerably higher than the corresponding proportion reported in the EU as a whole, which stood at around 45% in 2018.

Figure 5: Infrastructure Pillar and Transport and Utility sub-pillars
Score normalised to 100, ranked by quality of overall infrastructure



Source: The Global Competitiveness Report 2018.
SG: Singapore, HK: Hong Kong; LU: Luxembourg; TWN: Taiwan; IE: Ireland; ISL: Iceland; EE: Estonia; CY: Cyprus; MT: Malta; MU: Mauritius; JM: Jamaica

Why is public capital stock an important driver of economic growth?

Theoretical models indicate that an increase in public investment affects the economy in two ways (de Jong et al, 2017). First, similar to other types of government expenditure, government investment boosts aggregate demand through an increase in the demand for the factors of production needed to produce investment goods. In the short-run, this could also result in some crowding-out effects on private factors of production leading to some price pressures. In the long run, however, the new capital stock is expected to increase the productive capacity of the economy leading to a permanent increase in overall output. Public capital stock, especially in the form of public infrastructure, is expected to increase the productivity of private capital stock and private employment, leading to the crowding-in of private factors of production. In the long-run therefore, the effects of an increase in public infrastructure is similar in nature to a positive supply-side shock which expands potential output, leading to lower marginal costs, lower price pressures and improved international competitiveness (Rapa 2017).

There are two broad strands of literature that aim to shed light on the effects public investment is expected to have on other macroeconomic variables, one based on partial equilibrium analysis and another based on general equilibrium effects. Partial equilibrium analysis is mainly conducted by augmenting a Cobb Douglas function with a public capital measure and estimating the output elasticity of public capital (γ_g).

$$Y_t = A_t K_t^{\gamma_K} N_t^{\gamma_N} K_t^{G\gamma_g} \qquad \text{Eq 1.}$$

Overall, empirical evidence provides mixed results with respect to the elasticity of output to changes in public capital. A literature survey conducted by Bom and Ligthart (2014), show estimates running from -1.7 to 2.0, with an average elasticity of 0.1. This implies that ceteris paribus (that is under partial equilibrium) a 1% increase in public capital stock is expected to increase long run output by 0.1% excluding two-way feedback effects stemming from a reduction in marginal costs in the overall economy. These estimates vary considerably over time and across aggregation level as well as type of public capital. Estimates reported in de Jong et al (2017) show that capital stock making up core infrastructure at national level, such as railway systems, roads, telecommunications and utilities, can be as much as three times more productive than regional non-infrastructure spending consisting of other urban

structures such as hospital and education buildings.[9] Moreover, estimates indicate that the cross-country elasticity of output to public capital stock has been decreasing over time. This could be an indication that as a country's infrastructure network matures, there is a fall in the marginal gain in terms of output of additional public spending on capital. Using panel data techniques, Kamps (2004) concludes that the productivity of capital in OECD countries is positive and statistically significant. He also reports considerable heterogeneity in country-level results, with the output elasticity of public capital ranging from -0.6 for Portugal to 1.3 for Denmark. Estimating equation 1 for Malta using a variety of specifications leads to estimates for γ_G ranging from 0.1 to 0.5, thus in line with estimates of other EU economies[10].

The inability of partial equilibrium analysis to explicitly take in consideration the two-way feedback that exists between public sector capital and output could lead to two issues. First, the long run output effects of exogenous public capital stock shocks are not limited to those predicted by parameter γ_G. Indeed, an exogenous shock to government capital stock is expected to raise output which is then expected to increase demand for all factors of production including public capital, which is then again expected to raise long run output. Moreover, the endogenous nature of public capital stock leads to an endogeneity bias in the OLS estimator, potentially leading to an overestimation of the OLS estimate of γ_G. In this regard the analysis that is provided with VAR and structural macroeconomic models such as new Keynesian models is better suited at estimating the effects of public capital on the economy.

VAR-based analysis put forward by Kamps (2004) reveals that the effects on output of an increase in public sector capital stock is positive and statistically different from zero but is lower than estimates derived from production function approaches. This points at significant endogeneity bias in the partial equilibrium estimates of γ_G. Indeed VAR estimates overwhelmingly show a positive covariation between private factors of production (especially private capital) and public capital. VAR estimates however confirm the results put forward by partial equilibrium studies, that indicate stronger positive effects of infrastructure spending when compare to other types of public capital (de Jong et al 2017). IMF studies (Abiad et al, 2015 and Kamps 2004) show that the effects of public capital stock are significantly positive

[9] The definitions of core and non-core public capital stock vary considerably and in some cases are also country dependent. Malta's small size makes it quite difficult to differentiate between infrastructure projects at national and regional levels. In this light this study adopts a general definition of public capital stock without differentiating between regional and national projects.

[10] Equation 1 was estimated both in log level and difference specifications. Log level specifications were estimated both with and without deterministic trends and residuals were checked for stationary. Both level and difference specifications were also estimated using unrestricted and restricted specifications where the sum of γ_K and γ_N are restricted to sum up to one. Data for output and labour are extracted from the annual historical macroeconomic database described in Grech (2015). Data for public capital stock are derived from IMF Investment and Capital Stock Dataset and from internal estimates. See Appendix 1 for more information.

especially during periods of low growth. The authors also show that apart from the state of the economy, the effects of public investment depend on the method of financing chosen by the government, with debt financing having significantly larger effects on economic activity than tax or expenditure financing.

Structural models within a general equilibrium framework are especially useful to analyse the trade-off that exists between the positive effects of government investment and the negative effects brought about by the financing options chosen by the government. Moreover, structural models are also able to internalise general equilibrium effects stemming from the two-way relation that exists between public capital stock and other factors of production. Using a structural model assessment, Bom and Ligthart (2014) argue that despite being significantly expansionary in the long run, positive public investment shocks can be mildly contractionary in the short run especially if investment outlays are financed by raising highly distortionary taxes such as labour taxes. A qualitatively similar conclusion is reached by Hickey et al (2018) who show that debt financed investment shocks are significantly more expansionary in the short run when compared to debt-neutral shocks financed by labour tax hikes.

The contained short-run effects of public investment shocks are also confirmed by another strand of literature that models public investment in a time-to-build setup in line with Kydland and Prescott (1982), Leeper et al. (2009) and Elekdag and Muir (2014). These authors argue that in the short run, implementation delays associated with public investment projects may lead to negative wealth effects. The latter are associated with the initial deterioration in the fiscal position and may dominate the positive wealth effects that arise only when the new government capital stock becomes productive. Under this scenario, the short-run positive effects of government investment shocks are limited to the increased demand for investment good production in the economy which might be outweighed by the negative wealth effects associated with higher government deficits that are likely to distort consumption of Ricardian households. These effects are likely to contribute towards significantly low output multipliers in the short run after a public investment shock even if the project is completely debt-financed[11].

[11] See Rapa (2017) for a discussion on the effects of government investment under time-to-build delays.

What could be the macroeconomic benefits of closing Malta's infrastructure gap?

The model

In order to shed some light on the macroeconomic implications of a sustained increase in government investment meant to bridge Malta's public sector capital gap with the rest of the EU, we perform a number of simulations using the fiscal version of MEDSEA (Rapa 2017). Public capital stock enters the private sector production functions in line with equation (1) above, thus allowing to internalise the positive externalities associated with public investment. Moreover, the general equilibrium properties of this model allow for the fact that an increase in government investment does not only raise output from the demand, 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.

Models such as MEDSEA can also take in consideration the fact that the effects of persistent fiscal stimuli depend significantly on the fiscal instrument used for financing. The published version of MEDSEA assumes that the government can use any one of its fiscal instruments to ensure a stable debt ratio. To this end, the model distinguishes between 3 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 3 types of government expenditure – government expenditure on goods and services, government employment and public investment. The model also allows for the financing of expenditure through debt accumulation. In order to take in consideration the fact that the government can complement tax increases or expenditure cuts with external financing options relating to EU structural funds as well as Malta's sovereign fund which accumulates proceeds from the Individual Investor Programme (IIP), the baseline version of the model was extended in line with Varga and in't Veld (2009).[12] Unlike internal funding options, funds available through either EU structural funds or the IIP, are not financed by levying taxes on Maltese residents. Thus, these two external funding options do not have distortionary effects on Maltese output, effects which are, on the other hand, associated with conventional financing options such as tax and government expenditure instruments and public debt accumulation.

[12] This modification extends the government budget constraint with an externally funded fiscal instrument which complements the existing number of domestic funding instruments available to the government. The external funds received by the Maltese state are significantly small when compared to the aggregate expenditure of donor countries. In this light, and in line with the modelling strategy employed for the rest of foreign variables present in the model, the externally funded fiscal instrument is modelled in reduced form ignoring the (significantly small) second-round effects on foreign demand emanating from the need of the donor states to finance the structural funds transferred to the Maltese state.

Almost all parameters, including those governing both steady-state and dynamic properties of the model, are calibrated in line with Rapa (2017).[13] The only exception in this regards lies with the public sector capital stock depreciation rate. In Rapa (2017), this parameter was set as equal to the private sector capital stock depreciation rate, which was in turn set to pin down the private investment ratio to total output to its long run average observed in the data. Since the purpose of this exercise is to quantify the effects of closing the public sector capital-output gap with that of the EU average, results, especially those pertaining to the long-run, will depend on the level of the public sector capital-to-output ratio. To this end, the depreciation rate of the public sector capital stock was calibrated so as to set the public sector capital-to-output ratio equal to 38%, thus replicating the long-run average observed from internal estimates of public sector government stock[14].

The effects of government investment in Malta

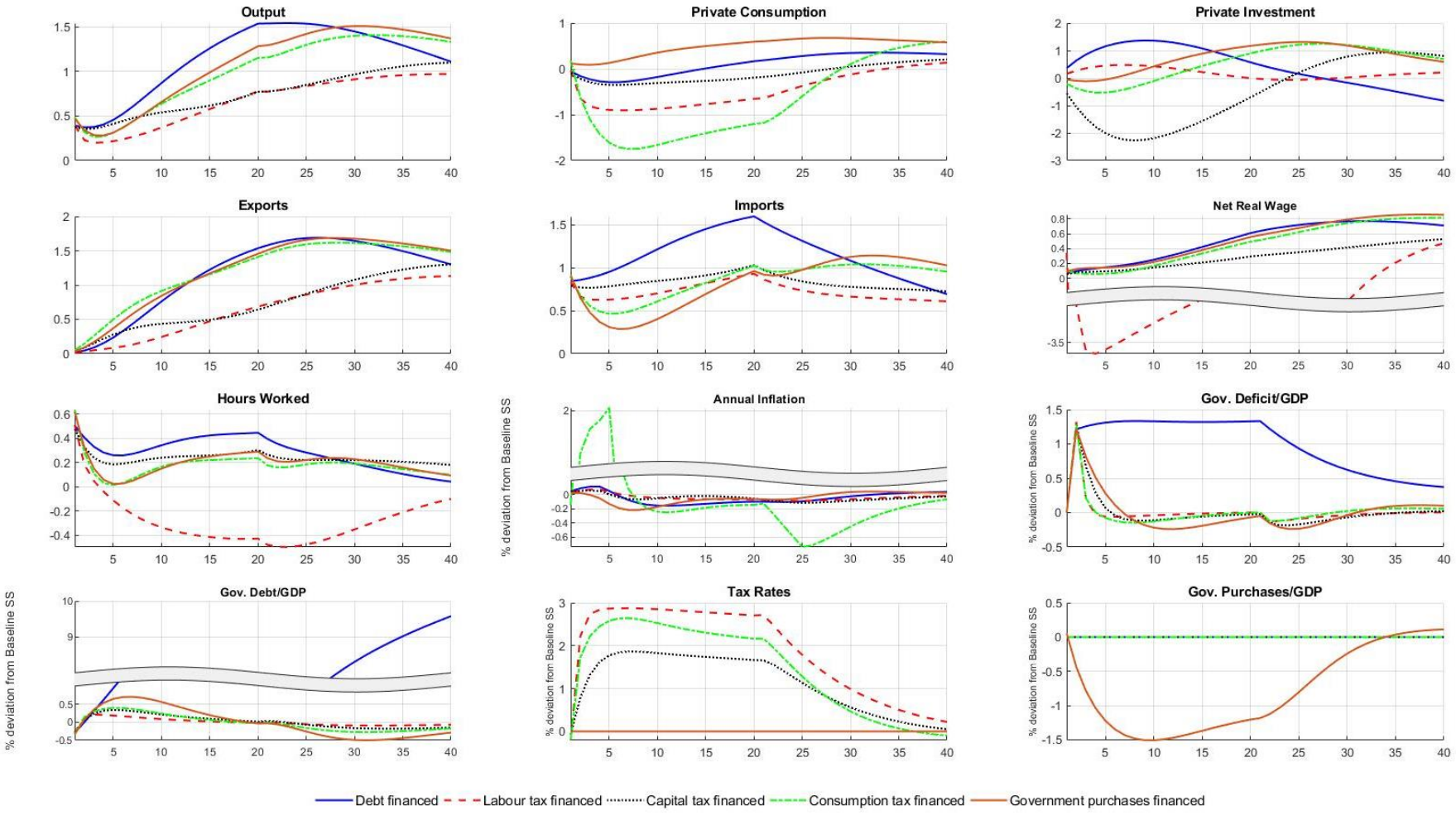
The macroeconomic benefits of a positive shock to Maltese government investment have already been explored by Bower (2018). This study estimates that the net present value of cumulative long run output gains after a 1 percentage point increase in the government investment-to-GDP ratio, range between 12-18%. This is approximately consistent with an increase in the level of output relative to initial steady-state equivalent to 3-4% after 50 years. These results, however, are based on the assumption that the government will be able to finance the investment outlays by levying a non-distortionary lump-sum tax. This financing assumption might result in an overestimation of both short-run and long-run impacts an increase in public sector investment will have on overall output. The potential macroeconomic gains related to an increase in government capital stock need to be balanced out by the output losses associated with the distortionary nature of either tax financing or debt accumulation.

In this light, the impact of public investment shocks is estimated under a number of financing strategies that are more likely to be adopted by the government, thus internalising output costs related to the distortionary nature of fiscal intervention within the market economy.

[13] In view of its importance in this study, it is noteworthy to state that the parameter, governing the elasticity of output with respect to the public capital stock is calibrated to 0.1, in line with Rapa (2017) and with the lower end of the range of estimates for Malta presented in this policy note. For more information on the procedure to estimate γ_G, kindly see Appendix 1.

[14] The public capital output ratio in the model was calibrated in line with internal estimates computed using ESA consistent data ensuring a capital stock figure which is consistent with the rest of the model calibration which is also based on ESA definitions. Using IMF sourced data for the public capital stock output ratio in conjunction with investment great ratios consistent with ESA data would result in unrealistic public capital depreciation rates. On the other hand IMF data as used in the first part of this policy note is especially suited for consistently comparing capital stock estimates across countries To this end, the shock meant to simulate the closing of the public sector capital output gap ratio was calibrated using IMF statistics as described in the first part of this policy note.

Figure 6: Impulse Responses for temporary shock to government investment
% deviation from initial steady-state unless otherwise specified



This section illustrates the dynamic effects of a transitory, but persistent, ex-ante increase in government investment under different assumptions on the source of financing chosen by the government. To this end, we shock government investment by 1% of ex-ante output over 20 quarters. Thereafter, the government investment-to-output ratio is allowed to gradually return to its baseline figure. This exercise assumes that the government can choose to finance its investment outlays using one of the following five options; increasing debt, labour income tax, capital income tax, consumption tax or reducing government purchases.[15]

Figure 6 shows that under all scenarios, an increase in government investment is expansionary throughout the time-period under consideration. In the short run, the expansionary effects of government investment are limited to demand-side effects related to the production of investment goods bringing about a marginal and short-lived period of higher consumer price inflation. As government capital stock starts to accumulate however, these effects start to be outweighed by significant supply-side effects. Indeed, a higher government capital stock helps reduce marginal costs, boosting factor productivity and helping to crowd-in other private factors of production. The reduction in economy-wide marginal costs transmits itself to lower overall-prices, boosting Malta's competitiveness and significantly raising exports.

Results also point at significantly different macro-dynamics depending on the instrument used by the government to finance its capital projects. As expected, debt-financing has the most positive effect in the short-to-medium run (blue line). Under this scenario, both demand and supply-side effects are not affected by additional distortions brought about by a rise in tax rates or a change in government purchases. Indeed, the demand for private factors of production is the highest under a debt-financing scenario. Notwithstanding the largest increase in output and real wages, the effects of a debt-financed expansionary shock to government investment leads to a marginal drop in private consumption in the short-run. This effect is solely due to Ricardian households who foresee a rise in future taxes to finance the debt servicing related to these public investment outlays. Moreover, Ricardian households (who are the sole owners of private capital goods in the economy) are seen to react to the higher productivity of private investment by reducing consumption and boosting savings and consequently investment. Moreover, despite considerable positive effects on output and private factor utilisation, the effects of an expansionary public investment shock on the government debt-to-GDP ratio are substantially positive. This contrasts sharply with results for larger euro area economies, where government investment shocks are expected

[15] Under the debt financing option, it is assumed that no attempt is made to rebalance the debt-to-GDP ratio in the sample under consideration. Under a balanced-budget assumption, it is assumed that the government will either increase one tax rate at a time or reduce government purchases in order to stabilise its debt-to-GDP ratio.

to be largely debt-neutral driven by both denominator and nominator effects as tax revenues increase on the back of higher economic activity (de Jong et al 2017). This prediction might be attributable to the substantial import content of government investment goods in Malta, which translates into subdued positive demand side effects in the short-run following a positive shock to government investment. Indeed, a debt-financed 1pp increase in government investment-to-GDP ratio in Malta is expected to raise output by less than 0.5% in the first 2 years, significantly less than the 1.5% increase in output projected in large euro area economies following the same shock (de Jong et al 2017).

The lowest effects on overall output in the medium run are registered in the case government chooses to finance its investment outlays by levying taxes on either labour or capital. An increase in labour income tax (dashed red line) gives rise to a negative income effect through a reduction in net real wages. This in turn leads to a substantial fall in private consumption driven by both Ricardian and credit-constrained households. Moreover the increase in labour income taxes also raises the marginal rate of substitution between consumption and leisure, driving households to decrease labour effort for each and every wage level. The inward shift in the labour supply schedule causes a rise in gross real wages which translates into higher marginal costs for firms, hurting competitiveness and partly outweighing the competitiveness gains brought about by the increase in government capital stock.

Financing public investment outlays through an increase in capital income tax (dashed black line) would have similar detrimental effects on Malta's competitiveness as the reduction in after-tax return on capital leads firms to diversify away from capital and choose a more labour intensive capital-labour mix. This reduces private investment, outweighing part of the crowding-in effects brought about by the increase in government investment, thus significantly reducing overall productivity, putting upward pressure on marginal costs and leading to a lower increase in net exports when compared to the debt-financed scenario. The fall in private consumption in the short run is significantly less pronounced than in the case of labour-income tax financed capital projects. This is due to the fact that while under labour income tax financing both Ricardian and non-Ricardian households experience negative income effects due to falls in net real wages, under a capital income tax financed measure, households that do not own private capital, will not be affected by lower capital returns. Indeed, non-Ricardian households are expected to increase their consumption on the back of a positive income effect brought about by an increase in the returns to labour hours.

The distortionary effects on overall output brought about by a non-debt neutral financing strategy, are lowest in the case of either a hike in consumption taxes (dotted green line) or a

reduction in government purchases (solid orange line). An increase in consumption taxes causes a reduction in households' purchasing power leading to a fall in aggregate demand. This in turn reduces demand for factors of production leading to negative pressures on real wages which further restrain per capita private consumption. Lower real wage pressures when compared to the baseline debt-financed scenario transmit into lower marginal costs which boost export demand beyond the levels reached under the benchmark scenario.

Effects on private consumption following a cut in government purchases are on the other hand slightly positive as the reduction in government's recurrent expenditure eliminates the need for future tax hikes in order to finance the increase in capital expenditure. Thus, the negative wealth effect associated with the increase in government investment prevalent under all tax or debt-driven financing scenarios will no longer affect consumption decisions of Ricardian households. Despite the increase in private consumption, the fall in the demand for public consumption goods lowers demand for factors of production leading to lower real wages when compared to the benchmark debt-financing scenario. This in turn translates to lower marginal costs contributing positively to Malta's external competitiveness.

Long-run results of closing the public sector capital stock-to-output ratio gap in Malta

In order to estimate the long-run economic implications of closing Malta's capital-to-output gap with that of the EU average, we simulate the model with a constant and permanent shock to the government investment-to-GDP ratio. We calibrate the shock such that the change in the government capital stock-to-output ratio at the new steady state equals Malta's 2015 capital gap as estimated in the IMF Investment and Capital Stock Dataset.[16] Table 1 shows the long-run results for a number of key economic variables under a number of financing strategies. For the purpose of this exercise, all simulations are performed under the assumption of government debt neutrality in the long-run. The government can choose to finance its investment outlays either by raising one of the three tax rates at its disposal, or by reducing its recurrent expenditure. To this end the table also contains information on the long-run change in the fiscal instrument chosen by the government to stabilise its debt-to-output ratio[17].

[16] The annualised capital stock-to-output ratio at steady state is a function of the steady state investment-to-output ratio and the depreciation rate. Assuming a constant depreciation rate, the change in the investment ratio required to engineer a specific change in the capital-to-output ratio is given by the following expression: $\left(\frac{I_2^G}{Y_2} - \frac{I_1^G}{Y_1}\right) = \left(\frac{K_2^G}{Y_2} - \frac{K_1^G}{Y_1}\right) * 4 * \delta_G$. In this simulation, the investment-to-GDP ratio is shocked such that the capital to output ratio increases by 35% (relative to baseline), in the long-run.

[17] Long-run debt financing is not explored in this note. Debt financing implies a higher debt-to-GDP ratio in the long run which in turn requires a higher primary surplus in the long run to finance interest expenses. When conducting debt-neutral shocks in the long-run one still needs to specify a fiscal instrument that will be used to stabilise the debt ratio by running a primary surplus. Thus even under a debt-financing strategy, long-run results

Table 1: long-run macroeconomic effects of closing public capital gap

% deviation from baseline; fiscal instrument results shown in terms of pp deviations in tax rates and government purchases-to-GDP ratio

	Labour income tax			Capital income tax			Consumption tax			Government purchases		
	No EU	Part-EU	Part-EU_NDSF	No EU	Part-EU	Part-EU_NDSF	No EU	Part-EU	Part-EU_NDSF	No EU	Part-EU	Part-EU_NDSF
Real activity												
GDP	7.2	8.1	10.0	6.1	7.2	9.6	10.2	10.4	11.0	10.9	11.0	11.2
Private Consumption	-2.1	-1.5	-0.4	-1.8	-1.3	-0.3	-0.2	-0.1	0.2	6.6	5.3	2.5
Private Investment	2.9	3.5	4.7	-6.0	-3.7	1.5	4.8	4.9	5.2	6.6	6.4	5.9
Exports	8.8	9.7	11.6	7.2	8.4	11.0	11.8	12.0	12.6	11.6	11.9	12.5
Imports	6.5	7.2	8.6	5.4	6.3	8.2	8.7	8.9	9.3	8.6	8.8	9.3
Labour market												
Real Wages	-11.4	-7.8	0.1	3.0	3.6	5.0	6.5	6.4	6.2	7.1	6.9	6.4
Employment	-2.5	-1.7	0.2	1.2	1.3	1.5	0.4	0.6	1.2	0.5	0.8	1.2
Fiscal Instrument	12.8	10.2	4.4	7.4	5.9	2.5	7.9	6.3	2.7	-4.0	-3.2	-1.4

When looking at the different effects of the alternative financing options, we also take in consideration the government's ability to utilise European Structural and Investment Funds, as well as funds available in the recently established National Development and Social Fund (NDSF). These scenarios are based on internal estimates for the size of the European Structural and Investment Fund which is projected to be allocated to the Maltese economy for the coming years as well as information on the Maltese government's use of EU funding to part-finance capital projects in the recent past. The future size of the NDSF was internally estimated by taking in consideration the number of non-EU citizens that have successfully applied for Maltese citizenship since the inception of the IIP and the current size of the fund[18]. The future size of the NDSF has been extrapolated by assuming a constant relation between the fund size and the number of persons applying and successfully receiving

will still be dependent on the fiscal instrument chosen to pay for interest expenses. In general, while debt-neutral strategies are preferred in the short-run, they consistently deliver lower output results in the long-run.

[18] The mandate of the NDSF is to manage and administer around 70% of the contributions received from the IIP. According to Article 13 of the IIP regulations, "the funds received by the NDSF shall be used in the public interest inter alia for the advancement of education, research, innovation, social purposes, justice and the rule of law, employment initiatives, the environment and public health". It is assumed that all funds accumulated in the NDSF are used for government investment projects.

Maltese citizenship under the IIP, as well as assuming that the maximum number of persons to be accepted under the IIP will be capped at 1,800 applicants.

Results indicate that there are significant long-term GDP benefits to be achieved from increasing the public capital stock-to-output ratio. As expected however, both the extent of the output gain as well as the drivers behind such gains, vary significantly depending on the financing options chosen by the government. As already suggested by the temporary simulations, financing capital projects by increasing taxation on the returns of factors of production is costliest in terms of overall output loss. Indeed, as confirmed by Forni et al (2010) and Rapa (2017), taxes levied on returns to factors of production are highly distortive fiscal instruments. A rise in capital or labour income taxes distorts the optimal capital-to-labour ratio chosen by firms, as well as the optimal consumption/investment and labour supply decisions of households. These distortions are therefore expected to partially outweigh the output gains driven by the positive-supply side effects of a long-run rise in the public capital stock. Under the assumption of full internal financing (therefore assuming that the government chooses not to use either EU structural funds or NDSF funds), overall output gains of closing the public capital stock-to-output ratio lies between 6% and 7% in case of capital and labour income tax financing options respectively. Under both financing options, private consumption will be expected to fall marginally driven by negative permanent income effects in case of labour income tax increases and negative wealth effects (affecting Ricardian households who are sole owners of private capital stock) in case of capital income tax increases. Indeed an increase in labour income tax is expected to force a larger wedge between the net real wage received by households and that paid by firms, implying a fall in net real wages and a fall in labour demand. While effects on real wages are positive in case of capital income taxes, lower returns on private capital causes a significant fall in private investment which hurts Ricardian households' net wealth.

Such distortions are significantly less pronounced in case the government chooses to finance its capital projects through a rise in consumption taxes or a reduction in its government expenditure, with output gains ranging between 10% and 11% under the assumption of full internal financing. Effects on private consumption are practically unchanged under a consumption tax financing option, with positive real wealth effects associated with increases in public capital stock making up for a loss in households' real purchasing power. Financing capital projects through a fall in government purchases will on the other hand lead to an increase in private consumption due to a fall in the distortions

associated with government purchases to be used in public expenditure, which is expected to reinforce the positive wealth effects associated with the increase in public capital stock.[19]

Results also show that the possibility for government to utilise EU-funds as well as funds accumulated within the NDSF would significantly reduce the distortionary effects of all financing options, most notably those consisting of increases in labour and capital income tax finances. Indeed, output gains are expected to rise from 6%-7% to around 10% in the case of a scenario where tax finances are supplemented with EU and NDSF funds, with improvements expected to be registered both in the tradeable and non-tradeable sectors of the economy. The relative output gains expected to be registered when using NDSF and EU funding to complement either a rise in consumption taxes or a fall in government purchases are significantly lower, reflecting the lower distortionary effects of these fiscal instruments.

Policy recommendations

The results presented in this note suggest that Malta's public sector capita-to-GDP gap relative to the EU average is weighing significantly on Malta's potential output. Results also suggest that the benefits of an increase in public investment need to be assessed in the light of its relative costs and financing strategy employed by government. Indeed, while the long-run GDP effects of a permanent increase in public capital stock is unequivocally positive, the magnitude of the output gains as well as their drivers depend significantly on the fiscal tools used by the government to finance the investment outlays needed to increase capital stock as well as those required to pay for its depreciation.

In general, results for Malta indicate that the largest output gains in the short-to-medium run following an increase in public investment are achieved under a debt financing option. Against the backdrop of an improving fiscal position, with the government debt-to-GDP ratio expected to keep falling to a level between 25-35% by 2027[20], this result suggests that in the short-to-medium run, it would be optimal for government to finance an increase in investment outlays by increasing its borrowing requirement. This would reduce the negative effects associated with other distortive fiscal measures, which are expected to negatively affect both domestic demand as well as net export performance. Reducing the negative distortive effects of government financing is especially important in the short run, when most

[19] In line with standard DSGE literature, under the baseline calibration of Rapa (2017), public consumption is assumed to be unable to directly affect private welfare. Despite this conservative assumption, private consumption will still be affected by general equilibrium effects. As government expenditure falls, resources once employed by the government can be freely employed by the private sector, attenuating crowding-out brought about by the increase in the demand of public investment goods.

[20] See Farrugia (2019), Central Bank of Malta, Annual report 2018. The study undertaken by Farrugia (2019) suggests that under the assumption of a stable fiscal stance, the government debt-to-GDP ratio is expected to keep falling to around2 25% under the baseline scenario and to a maximum of 35% under the assumption of an adverse real GDP and interest rate shock.

of the capital projects would still be going through their building phase, implying that their positive impact on the supply-side of the economy would still be moderate.

On the other hand, the positive output effects of an increase in public investment financed through public debt must be weighed against possible fiscal sustainability concerns. In this light, once the positive productivity effects of an increase in public capital stock start to materialise, the government can switch towards a debt-neutral financing strategy. This would ensure that the distortionary effects of an increase in tax rates would be compensated by the positive productivity effects of newly implemented capital projects, limiting the negative effects on economic activity. Under all internal funding options that can be adopted by the government, the change in the fiscal instruments required to finance an increase in government investment which suffices to close the public capital-to-GDP gap is significant, ranging from an increase of almost 13pp in labour income tax to a reduction in the government expenditure to GDP ratio of almost 4pp. The considerable fiscal adjustments required under such a financing strategy could negatively impact the willingness of the policymaker to undertake such a reform.

To this end, it is important for government to supplement internal funding of projects with both funds from the EU structural and cohesion funds and the NDSF. In recent years, Malta has registered important efficiency improvements in the management of EU structural and cohesion funds, with the absorption rate climbing from 10% in 2010 to around 95% registered in recent years. Funds within the NDSF have however still not been used effectively to finance large infrastructural projects. Given the NDSF's wide mandate and the considerable amount of funds that will accumulate within it in the coming years, it is important to bolster the administrative capacity of the Fund with the main aim of using these funds in the most efficient way possible. To keep the distortionary effects of internal funding to a minimum, government should also create more fiscal space by complementing tax increases with cuts in its recurrent expenditure. In this light and against the backdrop of an ageing population, policies aimed at promoting efficient and affordable public health and pension systems could help create the necessary fiscal space to implement the required capital projects.

Appendix 1

This section uses alternative specifications and capital stock measures to estimate the elasticity of output with respect to public capital stock, applying the production function approach. The starting point of this empirical application relies on the aggregate production function of the form $\mathrm{Y_t} = \mathrm{f}(\mathrm{A_t}, \mathrm{N_t}, \mathrm{K_t^P})$, where $\mathrm{A_t}$ represents Total Factor Productivity (TFP), $\mathrm{N_t}$ is labour input, $\mathrm{K_t^P}$ is the private sector capital stock. This standard expression is then extended by including the public sector capital stock (K_t^G). Using the Cobb Douglas form and taking the natural logarithm yields the following estimating regression:

$$\mathrm{y_t} = \mathrm{c_0} + \mathrm{c_1 t} + \gamma_\mathrm{K} \mathrm{k_t^P} + \gamma_\mathrm{N} \mathrm{n_t} + \gamma_\mathrm{G} \mathrm{k_t^G} \quad \text{Eq(2)}$$

where lowercase letters represent logarithmic transformations. In its most general form, equation (2) allows for a constant and a time trend which in line with Aschauer (1989) are introduced as a proxy for TFP. Equation 2 is also estimated by imposing two different restrictions, one assuming that there is no trend in TFP, (that is restricting $\mathrm{c_1}$ to zero) and another one imposing constant returns to scale on private factors of production. In the latter case the estimating equation becomes:

$$y_t = c_0 + c_1 t + (1-\alpha) k_t^P + \alpha n_t + \gamma_G k_t^G$$
$$y_t = c_0 + c_1 t + k_t^P - \alpha k_t^P + \alpha n_t + \gamma_G k_t^G$$
$$y_t - k_t^P = c_0 + c_1 t + \alpha (n_t - k_t^P) + \gamma_G k_t^G \quad \text{Eq(3)}$$

Table A1: Estimates of the elasticity of output with respect to public capital stock

		Level		Differences	
		Unrestricted	Restricted	Unrestricted	Restricted
Internal Estimates of Public Capital Stock	No trend	0.12	0.11	0.29	0.29
		(0.05)	(0.04)	(0.10)	(0.10)
	Trend	0.21	0.20	0.29	0.29
		(0.05)	(0.05)	(0.10)	(0.10)
IMF Estimates of Public Capital Stock	No trend	0.32	0.29	0.26	0.46
		(0.05)	(0.06)	(0.14)	(0.16)
	Trend	0.43	0.40	0.28	0.47
		(0.09)	(0.05)	(0.21)	(0.22)

The most important issue encountered when estimating both equation (2) and (3) by OLS, is the fact that the variables included in the regressions are non-stationary. Level specifications

of both equations could therefore lead to spurious results. To account for this, we perform Augmented Dicky Fuller tests on the residuals of each equation to ensure the existence of a cointegration relation between the variables. In view of the low power of unit root tests in discriminating between a unit root and a near unit root process, we choose to bypass the possibility of spurious relations by inducing stationarity by also estimating equations (2) and (3) in log differences. Moreover, we allow for different estimates of public sector capital stock by estimating all specifications using both internal estimates of public capital stock and those found in the IMF Investment and Capital Stock Dataset. Data for other macroeconomic variables, mainly those relating to output and labour are extracted from the annual historical macroeconomic database described in Grech (2015).

Estimates for γ_G together with their standard errors (shown in parenthesis) are shown in Table A1. Values for γ_G estimated using internal estimates of public sector capital stock range between 0.11 for a restricted level specification without trend, to around 0.3 for a restricted difference specification without trend. Results are higher for specifications estimated using capital stock values extracted from the IMF Investment and Capital Stock Dataset, ranging from 0.26 for an unrestricted differences specification without trend to 0.47 for a restricted differences specification with trend. All results are significant to the 95% confidence interval.

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