BANK ĊENTRALI TA' MALTA
EUROSISTEMA
CENTRAL BANK OF MALTA

CENTRAL BANK OF MALTA
RESEARCH BULLETIN

2022

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ISSN 2617-5657 (print)
ISSN 2617-5665 (online)

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FOREWORD

In recent years, the world economy has been hit by severe shocks. The COVID-19 pandemic in 2020 led to significant and widespread disruptions in economic activity that required large-scale interventions by fiscal and monetary authorities to prevent very high unemployment, support demand and access to credit for firms and households. The strong rebound in global demand, coupled with shortages in some sectors and disruptions in the logistics industry, resulted in supply chain bottlenecks that led to inflationary pressures. Rising energy and commodity prices, fuelled further by the war in Ukraine, exacerbated such inflationary pressures. As a result, central banks in several economies, including the ECB, embarked on monetary policy normalisation or outright tightening, bringing to an end a period of expansionary monetary policy that was in place since the Great Recession of 2009. These developments have an inevitable impact on the Maltese economy, given its small size and very high degree of openness. Some of the articles in this year's edition of the Research Bulletin deal with some of these topics, while others shed light on recently available datasets.

The first article summarizes the main findings from the fourth wave of the Household Finance and Consumption Survey (HFCS) for Malta. The results presented in this article, based on a sample of 1,018 households, were obtained from fieldwork carried out between November 2020 and February 2021, which are compared with those obtained from the previous waves carried out in 2010, 2013 and 2017. This survey provides an invaluable source of information on Maltese households' balance sheet, with detailed information on their assets, liabilities, wealth, and income. Since this is the fourth wave of the survey, it presents medium-term trends in key indicators, such as Gini coefficients for income and wealth. Furthermore, the granularity of these data facilitates an in-depth assessment that moves away from aggregate statistics and focuses on distributional analysis, with results presented by income and wealth quintiles. Finally, the results provide a glimpse of the impact of the COVID-19 pandemic on household balance sheets and finances. According to this survey, around 72% of households stated that their income in 2020 remained unchanged from a year earlier and was not impacted by the pandemic. This was possible due to government support schemes, such as the wage supplement, which were intended to safeguard household income for those whose jobs were most impacted by the pandemic-related containment measures. For those respondents who reported a lower income, the reduction was between 5% and 25%.

The second article compares the differences between two datasets on private sector rents that have become available for research and policy analysis. The first dataset contains advertised listings collected by the Central Bank of Malta since 2017, while the second refers to rental contracts registered with the Housing Authority after the introduction of the Private Residential Leases Act of 2020. These two datasets differ in important characteristics, most notably on the monthly rent, with advertised rents being much higher than those in the registered database. For instance, in 2021, the share of registered properties with a rent of less than €700 amounted to 51% in the registered database, compared to less than 9% in the advertised one. Since late 2021, the increase in the growth rate of advertised rents, based on hedonic methods, has been significantly more pronounced compared to registered rents. One of the reasons for this discrepancy is the inclusion of renewed contracts in the registered dataset. More than 95% of renewed active contracts in 2021 remained with the same rent as in the original contract. This can be explained by the existing landlord-tenant relationship in renewed contracts, which lowers the information asymmetries that is prevalent in new contracts that in turn helps to reduce risks and keep prices relatively stable. Additionally, the discrepancy reflects other factors such as selection effects on the way advertised data are collected.

The third article looks at the direct impact of the Recovery and Resilience Facility (RRF) fund on the Maltese economy. The RRF is part of the flagship EU programme that was launched soon after the onset of the COVID-19 pandemic to help EU governments to stimulate demand and restructure their economies by improving their infrastructure and facilitate the transition to a green and digitalised economy. Malta has been allocated almost €260 million in the RRF fund that will be disbursed over a 6-year period. This article uses MEDSEA, the Bank's DSGE model, which has a detailed fiscal block to estimate the macroeconomic effects of the agreed RRF funds on the Maltese economy. The baseline results show that the effects of RRF-funded government investment projects are expected to lie between 0.3% and 0.6% of steady-state output with peak gains materialising between 2025 and 2027, depending on the assumed productivity of public capital and the length of the capital gestation period. Overall, these projects are expected to translate to a reduction in government debt of between 0.2 percentage point and 0.5 percentage point of GDP.

The fourth article documents the estimation of MEDSEA-FIN, a medium-scale DSGE model of the Maltese economy with household heterogeneity, housing and borrowing constraints. The model is estimated using Bayesian methods on 11 macroeconomic variables, eight for Malta and three for the euro area, over the period 2000Q1-2019Q4. The estimated model is used to trace the dynamic responses of several macroeconomic variables to a monetary policy shock as well as to decompose observed house price movements into the underlying structural drivers. Overall, the estimated model delivers results that are in line with expectations and other findings in the literature.

As in previous years, these articles provide only a snapshot of the research conducted by staff in the Economics Division of the Bank. In 2021, the Bank published a total of 40 different research outputs, ranging from research boxes or articles in its regular publications, policy notes, working papers and studies in international peer-reviewed journals. These publications were produced with contribution of 20 economists within the Economics Division, a larger number compared to previous years, as more of the Bank's economists are involving themselves in research in addition to their regular contributions for economic and conjunctural analysis.

The increasing complex research questions facing policy makers necessitate a broad suite of models. In response, the Bank's research output has been based on a more diversified toolkit, which include, among others, structural and semi-structural models of the Maltese economy, empirical models, input-output models, surveys, and granular micro-datasets. Ongoing modelling efforts are focused on the development of a Computable General Equilibrium model for the Maltese economy, a more detailed modelling of the euro area economy with energy and environmental considerations and, finally, an extension of the Bank's structural model with a detailed energy block. This is possible thanks to the Bank's human capital, which remains its most valuable resource, as well as past and current collaboration efforts with academia and other institutions, both locally and abroad, to assist in the development of alternative models to complement its existing toolkit. The Bank's economists also participate and collaborate with various local institutions and networks, including the Malta Council for Economic and Social Development, the Rent Observatory of the Housing Authority and the Building Industry Consultative Council. Furthermore, the Bank is regularly holding meetings with senior management of firms and other institutions to collect up-to-date information on current economic conditions, and supplement official statistics. All of this is intended to cement the Bank's position as the leading institution for economic research in Malta, which allows it to actively participate and contribute to the policy debate at a local and European level.

Dr Aaron G. Grech
Chief Officer, Economics

HOUSEHOLD FINANCE AND CONSUMPTION SURVEY: MAIN FINDINGS FROM THE 2020 WAVE

VALENTINA ANTONAROLI, WARREN DEGUARA AND ALEANDRA MUSCAT[1]

This article summarizes the main findings from the fourth wave of the Household Finance and Consumption Survey (HFCS) for Malta. The HFCS is part of a co-ordinated research project led by the European Central Bank and involves national central banks of all euro area countries and selected non-euro area EU member states. The results presented are obtained from micro-data collected during 2020 from households residing in Malta and compared with the previous three waves. The HFCS provides household-level data on assets, liabilities, wealth and income. As such, it plays an important role in analysing the economic behaviour of Maltese households and contributes to a better understanding of the developments underlying macro statistics. The results provide a glimpse of the impact of the COVID-19 pandemic on household balance sheets and finances.

Introduction

This article provides a summary of the main findings of the fourth wave of the Household Finance Consumption Survey (HFCS) for Malta.[2] The HFCS is co-ordinated by the European Central Bank (ECB)[3] and it involves national central banks (NCBs) of all euro area countries and selected non-euro area EU member states.[4] The Survey provides detailed information on households' real and financial assets, their liabilities, net wealth, income, and consumption. The reference year for the last vintage of the HFCS is 2020, while the three previous waves were carried out in 2010, 2014 and in 2017 respectively.[5]

Following the methodological guidelines of the Household Finance and Consumption Network (HFCN), a systematic sample selection was implemented, in line with the sampling criteria of the previous waves. The Survey is designed such that the probabilistic sample is representative of the entire population. Only private households are considered for the Survey and persons living in institutions are excluded from the sample.[6] Due to the COVID-19 pandemic, data collection for this wave could not be carried out through face-to-face personal interviews unlike the previous waves. Instead, data was collected by means of Computer Assisted Telephone Interviews (CATI). The fieldwork took place between November 2020 and February 2021. The total net sample for the HFCS 2020 wave consisted of 1,018 households, of which 342 represented the panel component, i.e., households that had also participated in the third wave. The overall response rate amounted to 54.1%.

The remainder of this article presents a summary of the main findings for Malta and focuses on households' demographic characteristics, assets, liabilities, net wealth, and income. It also reports on households' consumption patterns and their ability to save during the COVID-19 pandemic. The concluding section summarises the key results of this study and delineates a few limitations of the Survey.

[1] The authors would like to acknowledge the assistance provided by various officials at the National Statistics Office who were responsible for carrying out this survey and who assisted in the compilation of the data.

[2] Data for the 2020 HFCS wave is provisional.

[3] More detailed information on the HFCS can be retrieved from the ECB's website: https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html

[4] The participating countries include Belgium (BE), Germany (DE), Estonia (EE), Ireland (IE), Greece (GR), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Slovenia (SI), Slovakia (SK) and Finland (FI).

[5] More information on the main findings of the first three waves of the HFCS conducted in Malta, including previous research, are available on the CBM's website: https://www.centralbankmalta.org/en/household-finance-and-consumption-survey.

[6] Population in institutions include persons living in homes for elderly people, military compounds, prisons and boarding schools, amongst others.

Household characteristics

In 2020, around 60% of households in Malta consisted of one or two members (see Table 1). The latter increased when compared to the 2017 wave, which confirms the trends observed in previous waves whereby the size of households is getting progressively smaller. In terms of housing status, 60% of households are outright owners. This share has been declining slightly over time, as more households are either renting their main residence (21% in 2020) or still paying a mortgage on their property (18.6% in 2020).

Around 28% of reference persons who participated in the 2020 wave are older than 65 years of age. Another 12.8% of reference persons are aged between 16 and 34, while the remaining 59.2% of respondents are aged between 35 and 64 years.

"The share of population with a tertiary level of education has been increasing"

Around half of the reference persons are in employment while an additional 8% are self-employed. The proportion of people in employment has increased in comparison to the previous wave, while the number of reference persons who are either unemployed, students, permanently disabled, doing compulsory military service, fulfilling domestic tasks or not working for pay in other ways has decreased from 22.5% in 2017 to 17.4% in 2020.

Table 1
HOUSEHOLD STRUCTURE[1]
(Percentage of households)

	2010	2014	2017	2020[2]
Household size				
1 and 2 persons	44.4	52.3	53.6	59.8
3 and more persons	55.6	47.7	46.4	40.2
Housing status				
Owners outright	64.9	64.5	63.5	60.4
Owners – with mortgage	12.9	15.6	17.8	18.6
Renters/other	22.3	19.9	18.6	21.0
Age (in years) of reference person				
16-34	8.8	12.8	12.7	12.8
35-44	22.3	16.8	18.2	22.1
45-54	21	20.1	18	18.3
55-64	23.1	20.4	20.5	18.8
65-74	13.7	17.7	18.9	17.7
75+	11.1	12.2	11.7	10.3
Work status of reference person[3]				
Employee	36.2	39.4	42.9	51.0
Self-employed	7.6	8.0	6.4	8.1
Retired	27.3	28.9	28.2	23.5
Other	28.9	23.7	22.5	17.4
Education level of reference person[4]				
Non-tertiary	84.8	83.6	81.3	78.9
Tertiary	15.2	16.4	18.7	21.1

Source: Own calculations based on MT-HFCS data.

[1] The table shows weighted household structure of the HFCS samples.

[2] Provisional data.

[3] The 'Other' category includes reference persons who are: unemployed, students, permanently disabled, doing compulsory military service, fulfilling domestic tasks, or not working for pay in other ways.

[4] Educational attainment is measured on the basis of the ISCED-2011 scale, ranging from 0 to 8. The 'Non-tertiary' category is composed of reference persons with ISCED scale 0 to ISCED scale 4, while the 'Tertiary' category refers to ISCED scale 5 to ISCED scale 8.

The share of population with a tertiary level of education has been increasing across waves. Around 21% of persons interviewed in 2020 said to be in possession of a tertiary level of education, against the 18.7% figure reported in 2017.

Household assets

One of the main contributions of the HFCS is the collection of information on households' assets, with a distinction between real and financial assets.[7] In 2020, the median value of households' total assets was estimated at €314,300 (see Chart 1). This value has been constantly increasing across waves with the most significant increase happening between 2017 and 2020 where the median value increased by €61,500.

"In 2020, the median value of households' total assets was estimated at €314,300"

Similar to previous waves, the composition of households' assets in 2020 is mainly in the form of real assets. The share of real assets rose compared to the previous wave (89.4% versus 86.4%). As a result, the proportion of financial assets declined from 13.6% in 2017 to 10.6% in 2020.

Real assets

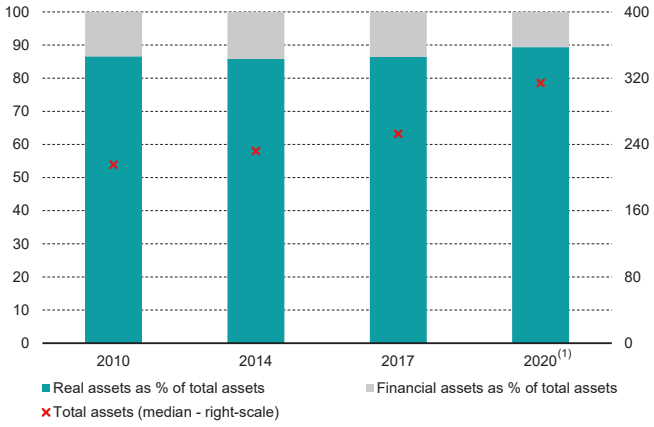
The households' main residence and other properties owned represent 69% and 22%, respectively, of total real assets (see Chart 2). The composition of real assets is consistent across waves, except for the share of self-employment, which dropped from 19% in 2017 to 6% in 2020. The median value of real assets has increased significantly to €300,000 in 2020 from €225,800 in 2017, which was mainly driven by the increase in the median value of main residence. The percentage of households owing properties other than their main residence stood at 26.6% in 2020.

Financial assets

The majority of interviewed households hold some type of financial assets with deposits representing the largest category of financial assets at 57.7% (see Chart 3). Bonds make up 17% of total financial assets, followed by voluntary pensions/ whole life insurance (11.8%) and investment funds and listed shares (8.9%).

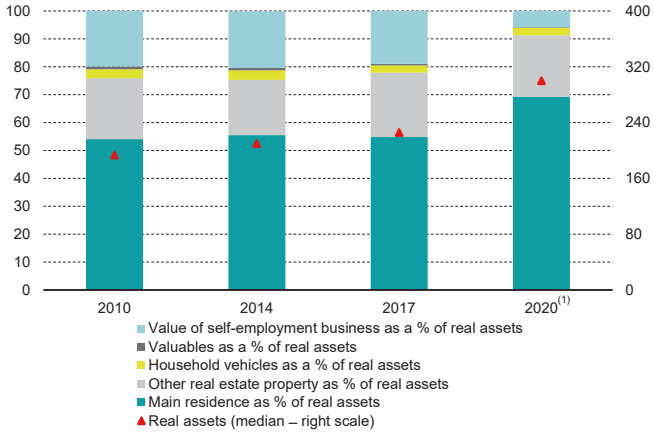
The median value of total financial assets has decreased from €25,000 in 2017 to

Chart 1
TOTAL ASSETS
(percentage; EUR thousands)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data.

Chart 2
TOTAL REAL ASSETS
(percentage; EUR thousands)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data.

[7] Real assets comprise of the household's main residence, other real estate properties, vehicles, valuables and self-employment business. Financial assets refer to bank deposits, mutual funds, bonds, shares, money owed to the household, voluntary pension/whole life insurance and any other types of financial assets.

€20,000 in 2020. With regards to the median value of deposits it stood at €14,820, up from €12,612 in 2017. The biggest drop when compared to 2017 occurred in investment funds and listed shares: its median value declined by 34.1%.

Household liabilities[8]

Around a third of Maltese households hold some form of debt and the percentage of households holding mortgage debt stood at 23.6%. This was mainly in the form of mortgage debt on the household main residence. The household main residence mortgage constituted 71.9% of total household debt. This declined marginally from the 72.8% found in 2017. At the same time, other properties mortgage as a percentage of total debt stood at 16.2% up from 14.7% in 2017.

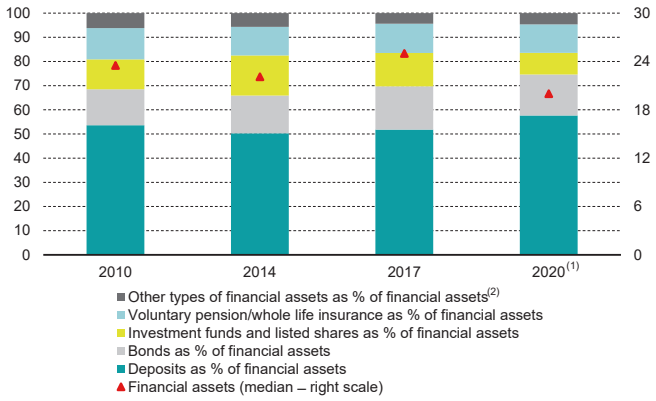
"Around a third of Maltese households hold some form of debt and the percentage of households holding mortgage debt stood at 23.6%"

The median debt level rose from €40,000 in the 2017 to €45,000 in 2020 (see Chart 4). Meanwhile, the median debt on the household main residence and on other properties stood at €65,000 and €130,000 respectively in 2020.

Financial burden indicators

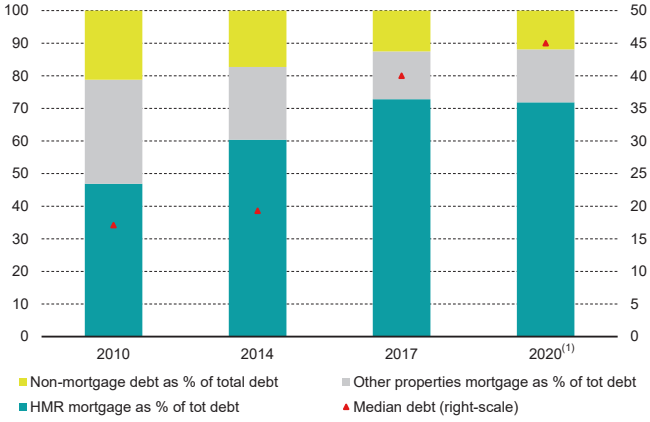
The survey contained a section on financial burden indicators, which are important in assessing the sustainability of households' finances. Debt to gross household wealth, debt payments to gross household income, as well as mortgage debt payment to gross household income have remained broadly unchanged compared to the previous waves (see Chart 5).[9] This implies that the burden on household finances has remained constant over the past decade. Meanwhile, the debt to gross household income ratio rose to 122.3% from 110.6% in the previous wave. This extends the trend increase observed in previous

Chart 3
TOTAL FINANCIAL ASSETS
(percentage; EUR thousands)



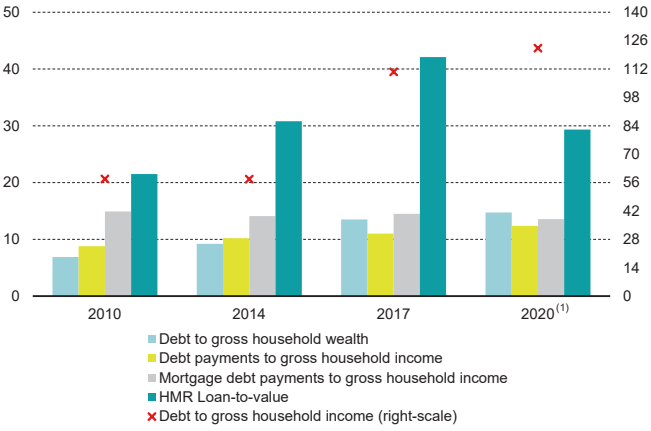
Source: Own calculations based on MT-HFCS data.
(1) Provisional data
(2) Include: Non self-employment private (not traded) businesses, managed accounts and other (options, futures, etc.).

Chart 4
LIABILITIES
(EUR thousands; percentage of households)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data.

Chart 5
FINANCIAL BURDEN INDICATORS, MEDIAN RATIOS
(percentage)

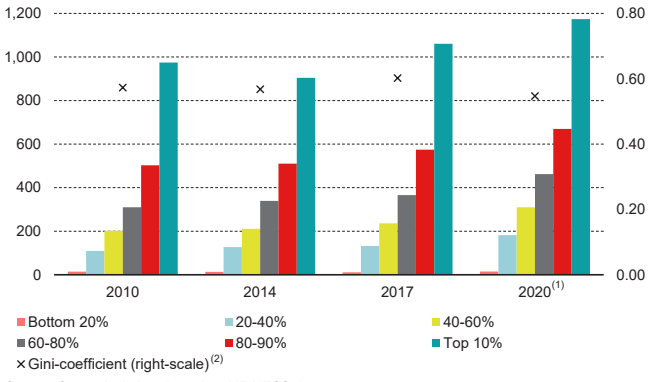


Source: Own calculations based on MT-HFCS data.
(1) Provisional data.

[8] Total liabilities include mortgages collateralised on household's main residence, mortgages collateralised on other real estate property owned by the household, non-mortgage loans, credit lines/bank overdrafts debt and credit card debt.
[9] Debt payment to gross household income and gross debt payments to gross household income are defined for indebted households.

waves. Moreover, the HMR loan to value ratio, defined as the ratio between the outstanding amount of household main residence mortgage and the current value of the residence, has dropped significantly to 29.3% in 2020 from 42.1% in 2017 on the back of a substantial increase in the current value of household's main residence.

Chart 6
MEDIAN NET WEALTH, BY WEALTH QUINTILE
(EUR thousands; ratio)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data.
(2) The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. This coefficient is bound between 0 and 1, where the higher the value, the more unequal a society is.

Household net wealth

The estimated household median net wealth, which is defined as households' total assets net of liabilities, increased from €236,100 in 2017 to €282,500 in 2020 (see Chart 6). To shed light on the distribution of wealth, we split the last quintile in two sub-groups, namely 80-90% and above 90%. While net wealth for the lowest quintile of the population stood at €14,800, the median value for the wealthiest 10% of households stood above €1 million. Moreover, households in the top 10% of the population hold almost twice the wealth of households in the 80-90% bracket and more than four times the median value. This distribution has been rather stable over time.

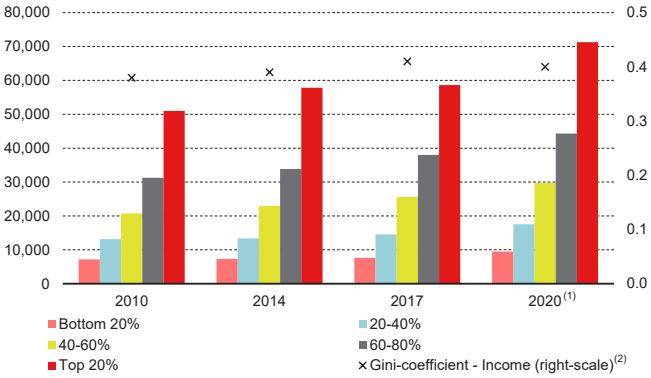
"The estimated household median net wealth, which is defined as households' total assets net of liabilities, increased from €236,100 in 2017 to €282,500 in 2020"

The HFCS-based Gini coefficient[10] for wealth in 2020 stood at 0.55, down from 0.60 in 2017, suggesting that wealth inequality in Malta has decreased in the past three years. In fact, we can observe that the median value of net wealth increased across all quintiles of income, but more so for the lowest brackets of the population. This is also confirmed by the fact that households in the top 10% of the distribution were 95 times wealthier than households in the 20-40% bracket in 2017, but this figure decreased to 80 times in 2020.

Household income and consumption

The annual household gross median income for Malta in 2020 stood at €29,716, up from €25,417 in 2017 (see Chart 7). This increase was broad-based across all income quintiles, but the most significant occurred in the bottom 20% quintile, which went up by 24.4% with a median value of €9,497. Households in the top 20% of the income distribution have a median income of €71,291, implying that they hold on average more than two times the overall median value and almost eight times that of households in the bottom 20%. These ratios are consistent across time.

Chart 7
MEDIAN HOUSEHOLD INCOME, BY INCOME QUINTILE
(EUR thousands; ratio)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data
(2) The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. This coefficient is bound between 0 and 1, where the higher the value, the more unequal a society is.

[10] The Gini coefficient is measure of statistical dispersion for inequality, ranging from 0 (maximum equality) to 1 (maximum inequality).

The HFCS-Gini coefficient for income in 2020 stood at 0.40, only slightly decreasing from 0.41 in 2017, suggesting that inequality in Malta has decreased in the past three years also from the income point of view.

"The annual household gross median income for Malta in 2020 stood at €29,716"

Food expenditure remains the biggest item in the consumption basket of Maltese families, in line with previous vintages of the Survey. Specifically, the median value of annual consumption on food increased by 5% from 2017 to €7,200 in 2020. Even though restaurants were forced to close for dine-in services as part of the containment measures introduced to mitigate the spread of the virus, the median value of expenditure on food from outside home increased in 2020 when compared to the 2017 wave due to the establishment of food delivery service companies, making take-away services more efficient. As expected, since many countries including Malta introduced travel bans, the median value of spending on holidays decreased by half in 2020.

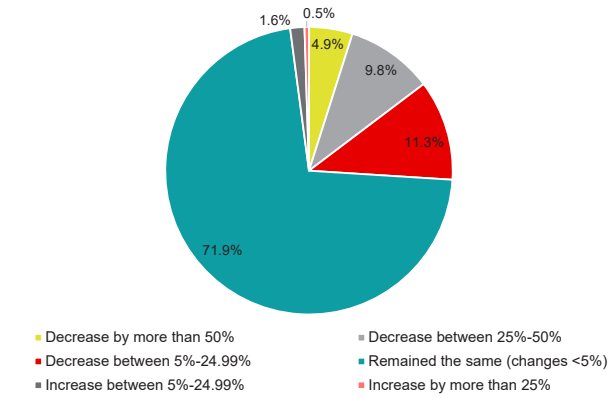
"Food expenditure remains the biggest item in the consumption basket of Maltese families"

Comparing the results from the 2020 wave to that of 2017, the share of households for which expenditure was less than income, and were therefore able to save, increased by around 3 percentage points to 48.3%. The share of dissaving households remained at around 11%.

COVID-19 impact on household finances

Given the exceptional circumstances of the COVID-19 pandemic faced by countries in 2020, the HFCS network decided to include a section in the questionnaire to capture the impact of the pandemic on households' finances. When comparing their income in 2020 with that in 2019, the majority of households (71.9%) stated that their income remained the same and was not impacted by the pandemic (see Chart 8). This was possible due to state aid schemes, such as the wage supplement implemented that was intended to safeguard household income for those whose jobs were most impacted by the pandemic-related lockdowns and containment measures. Despite these measures, around 26% reported a lower income, with most households replying that the reduction was between 5%-25%. The majority of respondents that reported a decrease in income stated that they have lowered their expenditure on food, clothes, travelling and other consumer goods and services to cope with the reduction in earnings. Only 2.1% of households reported a higher income in 2020 compared to a year earlier.

Chart 8
COVID-19 IMPACT – CHANGE IN INCOME (2020 vs 2019)[1]
(percentage)



Source: Own calculations based on MT-HFCS data.
(1) Provisional data.

Conclusion

The HFCS provides valuable information on households' consumption and finances, including information on their assets and liabilities, which in turn allows for a deeper understanding of household behaviour. This information helps to shed light on the transmission mechanism of monetary policy, as well as issues related to financial stability in the euro area.

Results from surveys need to be interpreted with caution due to a few caveats. The main limitation of the HFCS relies on the subjective self-assessed valuation of

assets. Whilst perceptions and preferences are crucial for understanding individual economic behaviour, such self-assessments are normally imprecise. Due to a relatively small sample size in Malta, another limitation of the survey relates to a possible lack of representation of population sub-groups. The latter is a concern, particularly with regards to households of foreign nationals living in Malta, rich households, and other sub-categories, such as self-employed that make it difficult to extract meaningful results from a small number of observations. Despite these limitations, however, the availability of this granular survey data opens interesting avenues for research, both on Malta and, at a later stage, cross-country studies utilizing the EU-wide HFCS dataset.

Currently, the Central Bank of Malta is preparing a detailed report on the main findings from the fourth wave which will be published later this year. Preparations for the collection of data for the fifth wave of the HFCS, which should be published in 2025, have already began (Borg & Caruana, 2017).

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A COMPARISON BETWEEN REGISTERED RENTS AND ADVERTISED RENTS IN MALTA

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This article compares the differences between two datasets on rents – a dataset with advertised listings maintained by the Central Bank of Malta and the registered dataset of the Housing Authority – that in recent years have become available for research and policy analysis. Advertised rents are much higher than those in the registered dataset: in 2021, the share of registered properties with a monthly rent of less than €700 amounted to 51%, compared to less than 9% in the advertised dataset. Furthermore, since late 2021, the increase in the growth rate of advertised rents has been significantly more pronounced compared to registered rents. The inclusion of renewed contracts in the registered dataset provides one potential explanation for this divergence. The existing landlord-tenant relationship in renewed contracts lowers the information asymmetries that is prevalent in new contracts, which in turn helps to reduce risks and keep prices relatively stable. However, this only explains part of the gap between the two indices and other potential explanations are left for future research.

Introduction

The Maltese private rental market has been characterised by rapid development over the last decade, on the back of strong economic and population growth. While homeownership remains the predominant tenure in Malta, it is estimated that around 14% of the resident population were living in private residential leases in 2021 (Housing Authority, 2022).[2]

Until a few years ago, the available information on the private rental market fell short of what is required for a holistic assessment of this sector (Micallef, 2021). To address this gap, in 2017, the Central Bank of Malta started to collect advertised rents to complement its regular assessment of the local housing market. Data are collected on a quarterly basis using big data techniques from adverts by real estate agencies (Micallef et al., 2021).

The introduction of the Private Residential Leases Act on 1 January 2020 provided a new source of data on the private rental market. The obligation of mandatory registration of rental contracts with the Housing Authority led to the creation of a rent register. In contrast to the advertised database, registered rents cover all segments of the rental market. As at the beginning of September 2022, a total of 82,897 leases have been registered with the Housing Authority with the number of active contracts standing at 42,988. This represents an increase of 13.2% compared to the situation prevailing at the end of 2021, when active contracts stood at 37,976 (Gauci et al., 2022).

The objective of this article is to compare the characteristics and the associated growth rates in rents from these two datasets. The datasets include comparable characteristics such as property type, size, and location, but differs in other important contract and amenity dimensions.

The rest of the article is organised as follows. Section 2 provides a concise review of the literature about potential differences between registered and advertised datasets. Section 3 describes the characteristics of the two datasets, while Section 4 briefly outlines the methodology used. Section 5 describes the empirical results. Section 6 explores the role of renewed contracts in the registered dataset to explain the differences between the two indices. Section 7 concludes and points to some avenues for future research.

[1] Both authors are members of the Rent Observatory. The authors wish to thank Mr Leonid McKay and Ms Romina Fenech for their helpful assistance with the Housing Authority dataset. The views expressed in this article are those of the authors and should not be interpreted to represent those of the Central Bank of Malta or the Housing Authority. Any remaining errors are the authors' own.

[2] Fiott (2021) estimates that a further 3.8% of the population reside in around 10,545 dwellings covered by a protected lease.

Literature review

This article is related to two broad strands in the literature. The first refers to sample selection bias, which occurs from the use of non-randomly selected samples. The second refers to the role played by asymmetric information between the landlords and tenants.

The reliance on adverts by real estate agents can lead to a sample selection bias. This bias arises when a rule other than simple random sampling is used to sample the underlying population of interest (Heckman, 1979). A random sample, meaning that all units in the population – rental properties in this case – are equally likely to be sampled, produces a population distribution that approximates the true population distribution as the sample size grows. While being publicly accessible, data from real estate agents provide only a partial picture of the rental market, since this information excludes those properties that are not advertised with these agents, such as through word of mouth or listed by landlords on social media. Furthermore, the publicly available website that is used as the main source for data collection does not capture all the adverts by real estate agents, possibly creating a secondary layer of selection bias.

"The reliance on adverts by real estate agents can lead to a sample selection bias"

Asymmetric information refers to a situation when one party in a transaction has more information than the other. Such information asymmetries are common in housing markets, which are characterised by high search costs, infrequent trading and where information is difficult to obtain, especially for non-locals (Zhou et al., 2015). In the rental market, this asymmetry manifests itself in various areas, including on tenant quality (Ambrose and Diop, 2021). These asymmetries can be exacerbated by regulations that restrict the ability of landlords to evict bad tenants (Miron, 1990). Such regulations will result in higher screening by landlords of prospective tenants and such costs can be priced into rents to the extent permitted by the elasticity of rental demand (Hirsch et al., 1975; Ambrose and Diop, 2021).

Finally, it is worth mentioning that adverts only provide asking prices. A negotiation process usually follows between prospective tenants and landlords with actual contracted price often differing from those advertised (Han and Strange, 2016). Hence, while the advertised listings take place prior to this negotiation process, the registered dataset contains information on the rents after the negotiation takes place.

Characteristics of the data sets

The advertised database of the Central Bank of Malta comprises data about residential properties starting from 2017Q4. Until 2018Q4, the database consisted of only two types of properties – apartments and maisonettes – along with information about the location of the property and the number of bedrooms. In 2019Q1, this information was supplemented by the collection of data about penthouses and additional localities that previously were not incorporated. In addition, information started being collected on several other characteristics including the availability of a garage, garden or pool facilities, proximity to a seafront or the availability of a view (Micallef et al., 2022).

The registered dataset of the Housing Authority includes information on commencement and termination dates, property types, localities, number of bedrooms, lease type and prices (Debono et al., 2021). This dataset also contains information on multi-year contracts and renewed contracts. Around 96% of the contracts in this register were for long leases with a duration of one year or more (Gauci et al., 2022).

"The share of registered properties with a rent of less than €700 amounts to 51%, compared to less than 9% in the advertised dataset"

Chart 1 plots the distribution of the monthly rent in euro for the properties in both datasets. The rent distribution of the advertised dataset is skewed to the right, indicating the prevalence of listings with a medium-to-high price range (Micallef and Gauci, 2022). More than half of the adverts had a rent exceeding €1,000 per month in 2021, with almost 25% of properties listed with a monthly rent of more than €1,500. More than 90% of all properties in the advertised dataset in 2021 requested a monthly rent of €700 or more. On the contrary, around two-thirds of active contracts registered with the Housing Authority in 2021 had a monthly rent between €400 and €899. The most

common bracket refers to the €600-€699 range, which comprises 17% of all active contracts in 2021. The share of registered contracts exceeding €1,000 per month stood at 18%, with only 5% of active contracts in 2021 having a monthly rent exceeding €1,500. The share of registered properties with a rent of less than €700 amounts to 51%, compared to less than 9% in the advertised dataset.

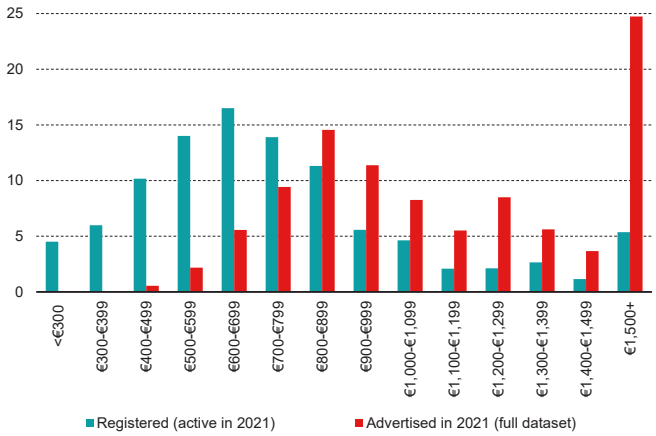
Chart 2 compares the spatial distribution by region.[3] Rents are highly concentrated in the Northern Harbour region, followed by the Northern region – both regions with a large share of non-Maltese residents. Almost 60% of advertised listings in 2021 were for properties in the Northern Harbour. Given that the Northern Harbour region commands amongst the highest rents (Micallef and Gauci, 2022), this partly explains the skewness of the advertised rents database. This contrasts with the registered dataset, where the share of active contracts in the Northern Harbour stood at 45% in 2021. With the exception of the Western region, the share of properties in the remaining four regions is slightly lower in the advertised dataset compared to the registered contracts with the Housing Authority.

Chart 3 shows that the most prevalent property sizes in both datasets refer to 2-bedroom and 3-bedroom dwellings. The share of the latter is however more pronounced in the advertised dataset. Contrarily, the advertised dataset contains relatively fewer 1-bedroom units. The proportion of large properties consisting of four bedrooms or more stood at less than 4% in both datasets.

Methodology

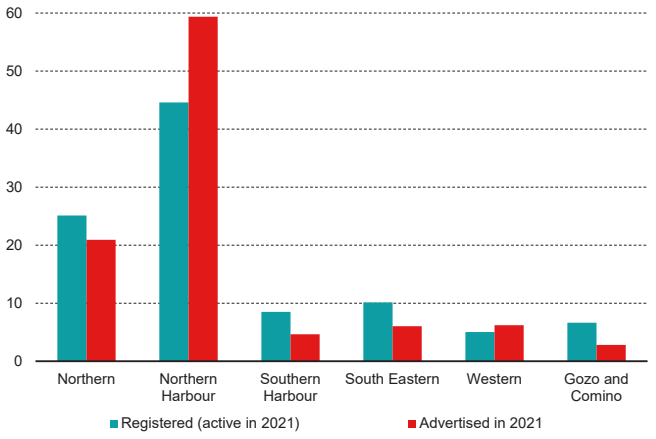
The methodology used to construct hedonic rent indices is described in Micallef et al. (2022) for advertised listings, and Micallef (2022) for registered rents.[4] Three changes were made to facilitate the comparability of the two datasets. First, the time dimension was set at a quarterly frequency. This meant that the observations

Chart 1
RENT DISTRIBUTION
(percentage)



Sources: Central Bank of Malta; Housing Authority.

Chart 2
DISTRIBUTION BY REGION
(percentage)



Sources: Central Bank of Malta; Housing Authority.

Chart 3
DISTRIBUTION BY PROPERTY SIZE
(percentage)

Sources: Central Bank of Malta; Housing Authority.

[3] For the list of localities within each region see NSO (2022). Regional Statistics Malta: 2022 Edition.
[4] One minor technical change has been made from Micallef (2022). This concerns renewed contracts that were subsequently terminated by the Housing Authority within 45 days from the renewed commencement date. These contracts, which mostly refer to auto-renewals, were excluded from the dataset.

in the registered dataset were aggregated from monthly to quarterly frequency. Second, the reference quarter was set at 2020Q1. This mainly impacted the advertised dataset since earlier studies had set the reference quarters to 2017Q4 and 2019Q1, respectively (Micallef et al., 2022; Micallef and Gauci, 2022). Finally, the locality variable in the advertised dataset was changed from ten clusters as documented in Micallef and Gauci (2022) to six regions.

The registered dataset has 104,794 observations and covers the period 2020Q1–2022Q2. The advertised dataset is split in two groups. The entire dataset has 55,438 listings, spanning the period 2017Q4-2022Q2, while the dataset with the full characteristics starts from 2019Q1 and contains only 47,174 observations.

Results

Table 1 presents the results for three regressions using the time dummy variable method. The first column presents the estimates for registered rents, while the second and third columns show the results from the advertised model based on the full dataset (starting from 2017Q4), and the one with the full characteristics (starting from 2019Q1), respectively.

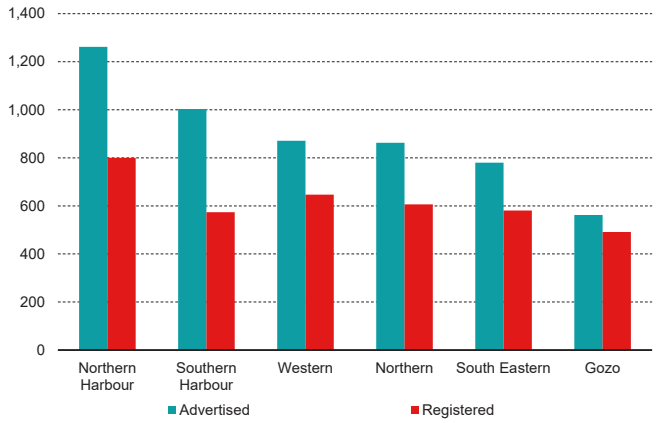
The regression results are qualitatively similar although quantitative differences are noticeable. In both datasets, rents in the Northern Harbour region are the most expensive, while prices in Gozo are the least expensive. Quantitatively, registered rents in Gozo stood 39% lower than those prevailing in the Northern Harbour, while the difference in the advertised dataset stood at 55%. There is also a positive association between rents and size in the two datasets although, even in this case, the differences of larger units compared to the benchmark 1-bedroom unit tend to be larger in the advertised dataset. The third column shows that property amenities are all statistically significant, with the impact being especially pronounced for properties with a pool, with a view or close to the seafront. As expected, the inclusion of these attributes results in an increase in the adjusted-R2 compared to a model without these characteristics.

"For all regions, the implied monthly rent from the advertised dataset is higher than for registered rents"

In terms of the time dimension, two differences stand out. First, the decline in the time coefficients was more pronounced in the early stages of the COVID-19 pandemic in registered rents, compared to the advertised dataset. On the contrary, both datasets show similar declining magnitudes in rents towards the end of 2020, and the first half of 2021. The second difference starts towards the end of 2021 and became more magnified in 2022. During this period, the time coefficients for registered rents remained negative (compared to the reference quarter of 2020Q1), whereas the advertised dataset indicates strong increases.

These differences between the two datasets are best illustrated graphically. Chart 4 shows the implied rent in euro per month from the hedonic models for a 2-bedroom apartment by region in 2021Q4. No additional property features are assumed to facilitate the comparison between the two datasets. Hence, for the advertised dataset, the coefficients of the second column of Table 1 are used. For all regions, the implied monthly rent from the advertised dataset is higher than for registered rents. According to these estimates, the implied advertised rent for a 2-bedroom flat in 2021Q4 in the Southern Harbour and the Northern Harbour stood 75%, and 58% respectively, higher

Chart 4
IMPUTED MONTHLY RENT FOR A 2-BEDROOM APARTMENT BY REGION IN 2021Q4
(euro per month)



Source: Authors' calculations.

Table 1
COMPARISON OF REGISTERED AND ADVERTISED RENT COEFFICIENTS

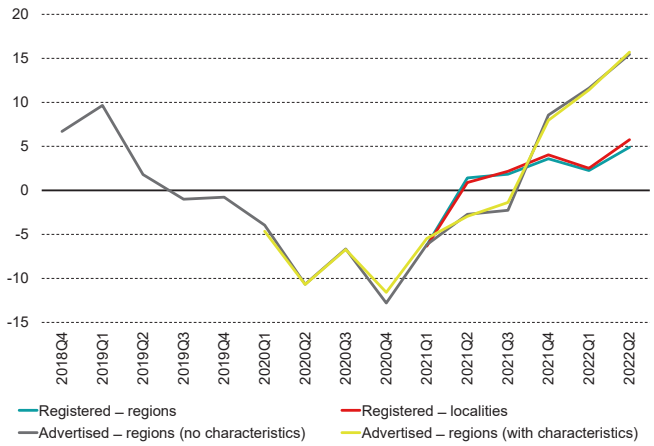
	Registered dataset	Advertised – no characteristics	Advertised – including characteristics
Location			
Northern Harbour	(b)	(b)	(b)
Northern	-0.278 ***	-0.381 ***	-0.383 ***
South Eastern	-0.320 ***	-0.481 ***	-0.463 ***
Southern Harbour	-0.333 ***	-0.230 ***	-0.204 ***
Western	-0.213 ***	-0.371 ***	-0.317 ***
Gozo	-0.487 ***	-0.809 ***	-0.799 ***
Size			
1-bed	(b)	(b)	(b)
2-bed	0.265 ***	0.299 ***	0.291 ***
3-bed	0.453 ***	0.527 ***	0.504 ***
4-bed+	0.528 ***	0.786 ***	0.743 ***
Contract			
Long-let	(b)		
Short-let	-0.01		
Shared space	-1.30 ***		
Multi-year contracts (5 yrs+)	-1.01 ***		
Characteristics			
Garage			0.067 ***
Garden			0.034 **
Pool			0.423 ***
Seafront			0.183 ***
Has view			0.204 ***
Time			
Q4_17		-0.005	
Q1_18		-0.052 ***	
Q2_18		0.074 ***	
Q3_18		0.073 ***	
Q4_18		0.060 ***	
Q1_19		0.040 ***	0.048 ***
Q2_19		0.092 ***	0.098 ***
Q3_19		0.063 ***	0.067 ***
Q4_19		0.052 ***	0.050 ***
Q1_20	(b)	(b)	(b)
Q2_20	-0.075 ***	-0.021 **	-0.015 *
Q3_20	-0.049 ***	-0.006	-0.002
Q4_20	-0.078 ***	-0.085 ***	-0.073 ***
Q1_21	-0.064 ***	-0.064 ***	-0.056 ***
Q2_21	-0.061 ***	-0.048 ***	-0.045 ***
Q3_21	-0.031 ***	-0.029 ***	-0.016 **
Q4_21	-0.043 ***	-0.003	0.003
Q1_22	-0.042 ***	0.046 ***	0.052 ***
Q2_22	-0.013 *	0.096 ***	0.101 ***
Controls			
Constant	Yes	Yes	Yes
Property type	Yes	Yes	Yes
Observations	104,794	55,438	47,174
Adjusted R^2	0.3859	0.3912	0.4672

Source: Authors' calculations.

than those in the registered dataset. The least pronounced differences were found in Gozo, with the gap between the two standing at 14%.

Chart 5 illustrates the annual growth rate from the different models. In addition to the three models represented in Table 1, the chart includes the results of the time dummy approach for registered rents, with 68 different locations instead of six regions. The growth rate from the advertised dataset produces similar results irrespective of whether one uses the full characteristics or not. The annual growth rate in registered rents followed a broadly similar trajectory to advertised rent during 2021 but, towards the end of 2021, the growth rates started to diverge. In 2022Q2, the annual growth rate in registered rents stood between 4.7% and 5.7% depending on the hedonic method chosen.[5] During the same period, the annual growth rate from five advertised rent indices averaged 13.6%.[6]

Chart 5
COMPARISON OF ADVERTISED AND REGISTERED RENTS
(annual growth rates)



Source: Authors' calculations.

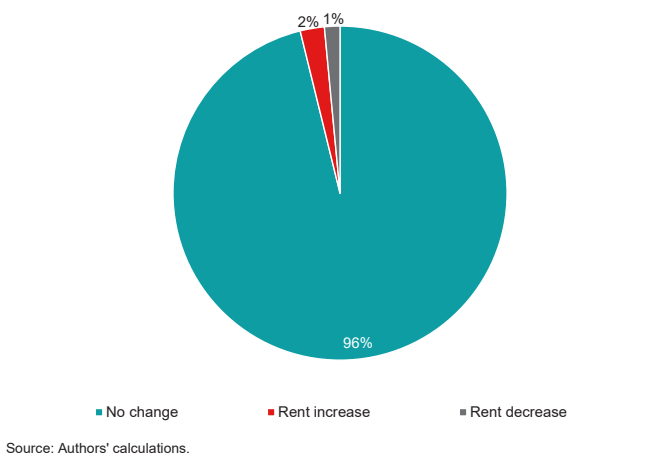
The role of renewed contracts

One major difference between the two datasets is the inclusion of renewable contracts, which are only present in the registered dataset. In 2021, the Housing Authority received 14,310 contract renewals. Excluding the 6,148 renewed contracts that were terminated by the Housing Authority before the expiration of the original date, 8,162 contracts were either active (7,924) or terminated at the end of the stipulated period (238). The latter group of contracts constitute slightly more than 20% of the active contracts in 2021 (Gauci et al., 2022).

"A contract renewal eliminates the information asymmetry prevalent in new contracts"

Chart 6 shows that the rent in 96% of these 8,162 renewed contracts in 2021 remained unchanged compared to the original contract. Only slightly less than 4% were renewed with a different rent, with the share of those with an increase in rent being slightly higher than those contracts renewed with a lower rent than in the original contract. As most of the renewed contracts remain with the same rent, this put downward pressure on the registered hedonic index. A contract renewal eliminates the information asymmetry prevalent in new contracts (Ambrose and Diop, 2021). The prevailing landlord-tenant relationship thus leads to a reduction in risk for the landlord that are generally not prevalent at the start of a

Chart 6
RENT CHANGES FOR RENEWED CONTRACTS COMMENCING IN 2021
(per cent)



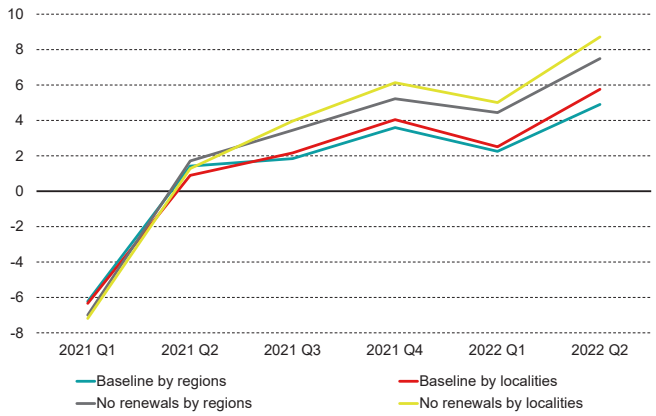
Source: Authors' calculations.

[5] This range includes all the hedonic approaches described in Micallef (2022).
[6] This range includes all the hedonic approaches described in Micallef et al. (2022).

new contract, such as those observed in advertised listings.

The impact of renewed contracts on the growth rates of registered rents is illustrated through a hypothetical scenario. Chart 7 shows the results from an exercise that excludes all the renewals from the registered dataset and compare the results with the baseline model using the time dummy variable approach for regions and localities, respectively. The results indicate that the hypothetical exclusion of renewed contracts raises the annual growth rate of registered rents to 7.5%-8.7% in 2022Q2, compared to 4.9%-5.7% in the baseline. This comes at the expense of a significant loss in observations, which drop from 104,794 in the baseline model to 83,225. The exclusion of renewed contracts also results in a slight increase in the adjusted-R2 of the respective models. This suggests that the independent variables are able to explain a higher proportion of the variance of the dependent variable once renewed contracts are removed from the dataset.

Chart 7
COMPARISON OF REGISTERED RENTS WITH AND WITHOUT RENEWALS
(annual growth rate)



Source: Authors' calculations.

Conclusion

This article documented the differences between the advertised and registered datasets for rents that in recent years have become available for research and policy analysis. Since late 2021, the increase in advertised rents has been significantly more pronounced compared to registered rents. The analysis in this article showed that the inclusion of renewed contracts in the registered dataset provides one potential reason for the gap between the two indices. The existing landlord-tenant relationship in renewed contracts lowers the information asymmetries that is prevalent in new contracts, which helps to reduce risks and keep prices relatively stable.

However, it is important to point out that renewed contracts only explain part of the gap between registered and advertised rents. More research is needed to understand the drivers of this difference, which can also result from selection effects of the way advertised data is collected (Heckman, 1979) or alternatively, the under-declaration of registered rents for taxation purposes. The exploration of these differences is left for future research.

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THE DIRECT IMPACT OF THE RECOVERY AND RESILIENCE FACILITY FUND IN MALTA

NOEL RAPA

Soon after the onset of the COVID-19 pandemic, the European Commission launched a number of measures targeted to help EU governments in preventing mass unemployment, stimulate demand and restructure their economies by improving infrastructure and facilitate the transition to a green and digitalised economy. The flagship EU program in this respect is the NextGenerationEU recovery programme, of which the vast majority of funds were allocated to the Recovery and Resilience Facility (RRF) fund. Under the latter programme, Malta has been allocated almost €260 million which will be disbursed over a 6-year period. These funds will be utilised by Government to finance a number of infrastructural projects which are expected to boost Malta's aggregate demand and productive capacity. In this light, this article uses a New Keynesian model with a detailed fiscal block to estimate the macroeconomic effects of the agreed recovery and resilience plan on the Maltese economy. Baseline results show that the effects of RRF-funded government investment projects are expected to lie between 0.3% and 0.6% of steady-state output with peak gains materialising between 2025 and 2027, depending on the assumed productivity of public capital and the length of the capital gestation period. Moreover, these projects are expected to translate to a fall in government debt-to-GDP ratio of between 0.2 percentage point and 0.5 percentage point.

Introduction

The repercussions of COVID-19 deeply altered the macroeconomic scenario. The health concerns surrounding the pandemic led to the introduction of various mitigation measures and to a fall in business and consumer confidence across the world, leading to a steep fall in economic activity. This prompted national governments to intervene through unprecedented macroeconomic packages in an effort to prevent mass unemployment, stimulate demand and limit extensive defaults of private firms so as to maintain financial stability. In addition to these national stabilisation measures, EU-wide policy has responded in an unprecedented way to provide financial support for public investment and structural reforms.

Soon after the onset of the pandemic in Europe, the European Commission launched the Coronavirus Response Investment Initiative (CRII) and a follow-up program labelled CRII+. These were intended to assist governments of EU member states in beefing up national healthcare systems and enacting economic support measures. Governments were also given greater room for manoeuvre through the temporary lifting of debt and deficit ceilings with the suspension of the Stability and Growth Pact. In terms of monetary policy, the European Central Bank (ECB) introduced an additional asset purchase program, the Pandemic Emergency Purchase Program (PEPP), together with loosening of banks' capital requirements and other measures aimed to boost lending and economic activity within the bloc.

NextGenerationEU

The EU's flagship economic recovery program, termed NextGenerationEU or NextGenEU (NGEU) was subsequently adopted by the European Council in December 2020, together with the 2021-2027 Multiannual Financial Framework. NGEU comprises a total envelope of €750 billion in 2018 prices, of which €672.5 billion are allocated to the RRF.[1] The RRF makes available to member states a maximum of €360 billion in loans and €312.5 billion in

[1] The remainder of the funds were allocated to other (new and pre-existing) funding programs including React-EU, Horizon Europe and the Just Transition Funds (JTF).

grants (both in 2018 prices), allocated between member states in accordance with several socio-economic indicators.[2] 70% of the grants available under RRF are to be paid out by the end of 2022, and allocated according to member states' population, GDP per capita, and unemployment rates in the period 2015-2019. The allocation for the remaining 30%, which is to be disbursed in 2023, is to consider the path of real GDP in 2020 and 2021 instead of pre-pandemic unemployment rates, and has been revised in June 2022.

Broadly speaking, the RRF entails a two-pronged approach, whereby member states receive fiscal support for well-targeted productive government investment implemented together with structural reforms. This approach is aimed at exploiting the synergies between these two kinds of interventions. On the one hand, targeted fiscal interventions in terms of public investment are likely to boost demand in the short-run (thus reducing short-run output costs associated with structural reforms) while increasing productive capacity in the medium-to-long run. On the other hand, structural reforms can both facilitate the roll-out of public investment, thus increasing the absorption of EU grants, as well as strengthen the institutional framework. The latter should in turn improve the conditions for private investment complementing public investment, thus increasing further the productive capacity of member states.

In the months following the legal adoption of the RRF legislation in February 2021, countries were required to submit plans to the European Commission detailing their planned uses of the allocated funds, subject to the requirements of the Commission. Recovery plans submitted by member states were required to take into account challenges and country-specific recommendations for 2019 and 2020, identified and adopted by the European Council within the European Semester framework. Planned investments and reforms were to be consistent with one of six policy themes or pillars: (i) green transition; (ii) digital transformation; (iii) smart, sustainable and inclusive growth; (iv) social and territorial cohesion; (v) health and economic, social and institutional resilience, and (vi) policies for the next generation. Priority was given to the first two pillars, with plans required to allocate at least 37% of total expenditure to projects that support climate objectives, whereas at least a further 20% of funds were to be allocated to measures supporting the digital transition.

Malta's allocation under the RRF

Malta's recovery and resilience plan was adopted by the European Council in October 2021, with a subsequent update on overall allocation of funds enacted in June 2022. Under the updated package of close to 50 reforms and investments, subdivided into 138 milestones and targets to be completed by the end of 2026, Malta is to receive an allocation of €258.3 million in grants (in current prices) whilst no loans were requested.[3] As required, the planned measures focus significantly on green and digital 'twin transition', with over half of the funds earmarked for investments targeting climate objectives and another 25.5% of funds supporting the digital transition. The plan also addresses structural deficiencies identified in recent country-specific recommendations. In fact, several measures and reforms are intended to tackle issues relating to educational attainment and skill gaps, together with investments to strengthen the health and justice systems and foster greater institutional resilience.[4]

"Under the updated package of close to 50 reforms and investments, subdivided into 138 milestones and targets to be completed by the end of 2026, Malta is to receive an allocation of €258.3 million in grants"

This article seeks to estimate the direct macroeconomic effects of the agreed recovery and resilience plan on the Maltese economy. It is important to note that Malta will receive additional funds under NGEU programs other than the RRF. Specifically, Malta has been allocated €105 million (in 2018 prices) under React-EU, an additional €12 million (2018 prices) under the JTF, and €8.8 million (in current prices) under the European Agricultural Fund for Rural Development. Other funds may be obtained or utilised as needed by Maltese individuals and entities from funds such as Horizon Europe and InvestEU, which have been allocated increased funding under NGEU. In this paper, we consider solely the expected injection of investment spending relating to funds received under the RRF.

[2] Specifically, the allocation is proportional to each member state's population and unemployment rates, but inversely proportional to GDP per capita. For additional detail, refer to European Council (2021).

[3] See https://ec.europa.eu/info/sites/default/files/2022_06_30_update_maximum_financial_contribution_rrf_grants.pdf

[4] See https://ec.europa.eu/info/strategy/recovery-plan-europe_en for more information

Moreover, we only model the effects of aggregate grants allocated to Malta and do not estimate the impact of specific projects, nor do we seek to estimate the impact of reforms or other programs beyond those defined as public investment. Finally, we will only estimate the effects of investment projects that are directly financed through the RRF. Therefore, any additional investment made by government in the completion of these projects is not for the time being internalised in these estimates.

Moreover given Malta's open economy and substantial trade with countries which will also be benefitting from the RRF, the indirect economic impact of the RRF on the Maltese economy may be even more substantial, given that the NGEU is expected to increase Euro area GDP between 0.7% (Bankowski et al., 2022) and 1.2% (Pfeiffer et al., 2021) when considering only increases in public investment. These figures are expected to be even larger, estimated in the region of 1.5%, when taking in consideration the positive effects of the structural reforms that are part of the NGEU package (Bankowski et al., 2022).

Model

Simulations are performed using a general equilibrium New Keynesian model for the Maltese economy (MEDSEA) with a detailed fiscal block (Rapa, 2017). The model is specifically designed to account for Malta's characteristics. In particular, the production sector of the model allows to exactly pin down the import content of all aggregate demand components of Maltese output. In view of the very open nature of the Maltese economy, together with the considerable import content of its aggregate demand components, this feature is very important to correctly measure the impact of changes in government investment.

Public sector investment is assumed to enter both domestic and export-oriented sectors in Malta, in line with Elekdag and Muir (2022) and Baxter and King (1993):

$$\mathrm{Y_t^i} = \mathrm{A_t^i}\,\mathrm{K_t^{i\,1-\gamma_i}}\,\mathrm{N_t^{i\,\gamma_i}}\,\mathrm{K_t^{G\,\gamma_g}} \qquad for\ i \in [N, XD] \tag{1}$$

Where sector *i* refers to domestic (N) and export-oriented (XD) industries respectively, $\mathrm{A_t^i}$, K_t^i and N_t^i are technology, private capital stock and labour hours used in sector i, K_t^G is the public capital stock, while γ_i and $(1-\gamma_i)$ are the sector-specific pseudo shares of labour and capital inputs respectively. Finally, γ_g governs the productivity of public capital stock, which plays a crucial role in driving the results following public investment shocks

The baseline model documented in Rapa (2017) has been modified in two ways for the purposes of this study. First, the original fiscal version of MEDSEA models public investment while allowing for both implementation and time-to-build delays. The timeline of the projects modelled in this study are mostly dictated by strict deadlines. Thus, it is realistic to assume that Government will keep in line with the projected outlays in view of the tight deadlines posed by the RRF program. However, even in case of no implementation delays, investment projects will only become operational and thus positively affect the productivity of the economy when finalised and not when the initial investment outlays begin. In order to allow exclusively for time-to-build delays and remove any implementation delays, we modify the capital accumulation function within MEDSEA as follows and assume that public capital moves according to this law of motion:

$$K_{t+1}^G = \left(1-\delta_g\right)K_t^G + I_{t-N}^G \tag{2}$$

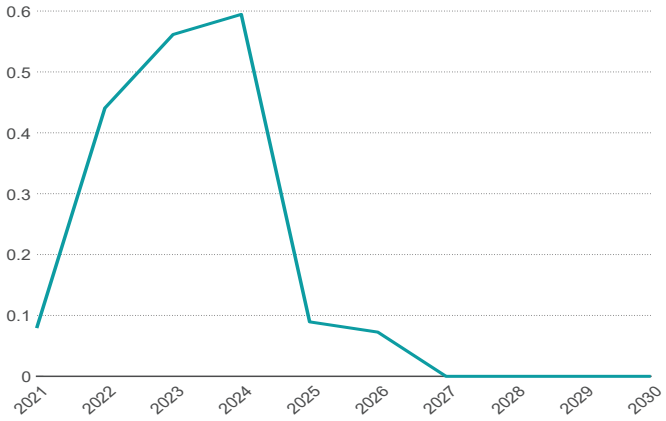
Where δ_g denotes public sector capital stock depreciation rate, I_t^G denotes public sector investment and N denotes the periods required by any investment outlays decided in time period t to start affecting the supply side of the economy. For the baseline results, we assume no time-to-build delays and set $N = 1$ and thus assume, that any investment outlay becomes immediately productive. It is important to note that in the specification of the model used for this study we abstract completely from the concept of planned investment I_t^{PG} which is used in Rapa (2017) to model implementation delays.

Secondly, we extend the model to allow for the fact that all of these investment projects are to be financed through external sources. This means that government investment outlays will not result in tax rises or expenditure cuts neither in the short or long run. Given the nature of these models, correctly capturing the financing requirements of any

government intervention is very important to correctly capture the macroeconomic effects of an increase in public investment.

The baseline calibration of the model utilised in this study is in line with Rapa (2017). With regards to the calibration of public sector capital stock productivity, baseline results are consistent with γ_g set to 0.1, in line with reduced form estimates published in Rapa and Rapa (2019).

Chart 1
PROJECTED ANNUAL RRF-FUNDED INVESTMENT
(per cent of 2019 nominal GDP)



Sources: European Commission; author's calculations.

Simulations

To simulate the effects of RRF funds, we introduce to the model a sequence of shocks to government investment scaled to the planned path of fund disbursement as a proportion of nominal output. Specifically, funds disbursed are normalised to 2019 GDP, to abstract from any base effects related to the 2020 figure. Figures for projected investment per quarter, from which we obtain the quarterly shocks, are based on internal estimates of the quarterly breakdown of the projected RRF-financed investment per annum as obtained from the 2022 Draft Budgetary Plan and rescaled to take in consideration the lower maximum allocation as described in the update of the maximum financial contribution published by the European Commission in June 2022. The bulk of the investment spending is projected to take place between 2022 and 2024. As seen in Chart 1, after initial low levels of spending up to the end of 2021, investment will ramp up to a peak of 0.59% of 2019 GDP in 2024 before stabilising at just below 0.1% of 2019 output in 2025 and 2026.

Results

Baseline

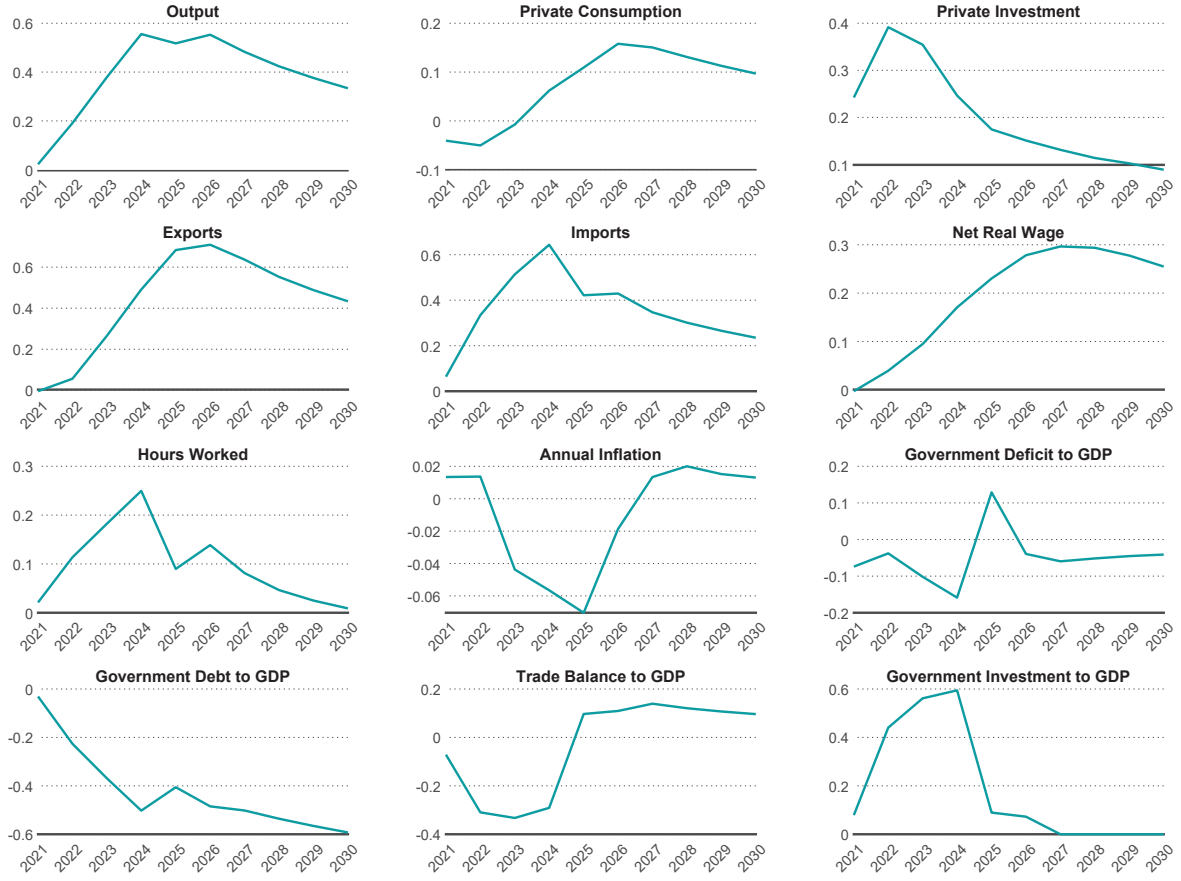
Baseline results shown in Chart 2 are estimated under the standard calibration of MEDSEA and show the effects of the RRF fully-funded government investment in the next decade. The baseline scenario assumes there are no delays in the government utilisation of RRF funds and that government capital stock becomes immediately productive. Furthermore, we assume that the government does not seek to balance any changes in the government debt-to-GDP ratio that occur as a result of utilising RRF funds.

An increase in government investment is expected to lead to immediate yet subdued demand-side effects driven by the production of government investment goods and services. The increased demand for factors of production leads to some subdued and brief inflationary pressures. Due to the considerable import content of government investment production, the demand-side effects of RRF in Malta are bound to be smaller than those of larger and relatively more closed economy member states.

"This leads to an increase in overall economic activity in Malta, which peaks at slightly less than 0.6% between 2024 and 2026"

However, as government capital stock starts to accumulate, these effects start to be outweighed by significant supply-side effects. Indeed, a higher government capital stock helps increase productivity of private factors of production, reducing marginal costs 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. This effect is clear in the trajectory of the trade balance. After a period of negative balance with imports outstripping exports due to an increase in imported investment goods, the trade balance turns positive

Chart 2
MACROECONOMIC EFFECTS OF RRF INVESTMENT – BASELINE
(per cent of steady state GDP)



Source: Author's estimates.

by 2025 and remains into positive territory till the end of the simulation horizon. This leads to an increase in overall economic activity in Malta, which peaks at slightly less than 0.6% between 2024 and 2026.

Despite an increase in hours worked and in net real wages, private consumption first dips briefly, driven by general equilibrium effects. The expected increase in government investment boosts expectations of private investment productivity, driving agents to immediately start increasing private investment, thus leading to a brief reduction in consumption as households save to finance the increased investment flows. However, strong income effects help to boost consumption considerably from 2024 onwards, reaching a peak increase of almost 0.2% in 2026. The Government balance improves as the fiscal stimulus increases aggregate demand and consequently tax receipts, leading to a reduction in the government debt-to-GDP ratio. This implies that the implementation of RRF investment grants is likely to lead to an increase in fiscal space that can be used either to consolidate the Maltese Government's fiscal position or else to further stimulate the economy should the need arise.

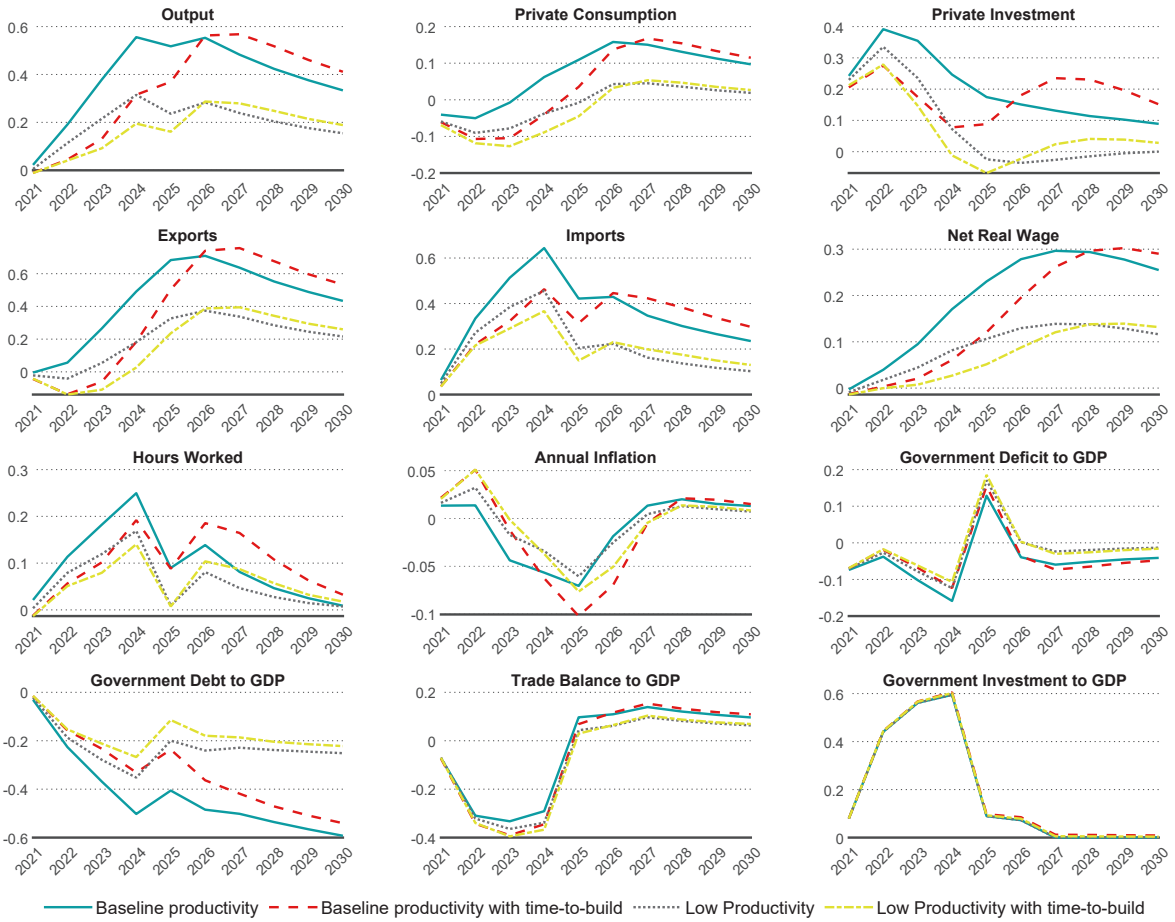
Sensitivity to productivity and time-to-build assumptions

The above results assume that government investment does not experience any delay between the announcement made by government and implementation of such investment and that public capital becomes immediately operational and can contribute to the supply side of the economy. Even when assuming no implementation delays, time-to-build assumptions could have important implications on the dynamics of prices, private consumption and therefore output (Leeper et al., 2009).

To better study this factor, in these sensitivity simulations we assume that it can take up to 6 quarters since the start of the investment outlays for a project to become productive, and therefore set N in equation 2 to 6. Results in Chart 3 show that under time-to-build delays (red broken line) there are similar peak effects, especially when looking at overall output, private consumption and exports. Despite similar peak effects, results show that the dynamics of the main variables of interest are considerably altered. Most importantly, the period of increased inflation which characterised the first six months since the start of the RRF programme under the baseline calibration, is significantly lengthened also reaching a higher peak in the process, taking a toll on exports and in turn partly outweighing the positive demand-side effects of government investment on output. Indeed, the negative impact on the trade balance is exacerbated as the impact on exports turns marginally negative for the first three years of the simulation. The delays associated with time-to-build assumptions have a knock-on effect on delaying the increase in the productivity of private factors of production, translating into significantly lower increases in private investment and to a less extent, hours worked. These developments in macro variables translate into a less pronounced improvement in government finances, with the drop in the public debt to GDP ratio standing at half of that measured under the baseline assumptions by 2025.

"The delays associated with time-to-build assumptions have a knock-on effect on delaying the increase in the productivity of private factors of production, translating into significantly lower increases in private investment and to a less extent, hours worked"

Chart 3
MACROECONOMIC EFFECTS OF RRF INVESTMENT – SENSITIVITY
(per cent of steady state GDP)



Source: Author's estimates.

Shocks to government investment are very sensitive to the efficiency parameter $\gamma_t^{K^G}$. Lower productivity of public capital stock implies that the positive supply-side effects of government investment remain fairly muted. This implies that there is a lower reduction in economy-wide marginal costs and consequently limited crowding-in effects on private factors of production.

To assess this we set $\gamma_t^{K^G}$ to 0.05, half the value found in the baseline scenario and equal to less than half of the average estimate found in a meta-study by Bom and Lighart (2014). Results in black dotted lines show that the peak impact of the RRF on the Maltese economy is considerably lower when allowing for the possibility of a lower level of public capital stock productivity. Under no building and implementation delays, the peak effect of the RRF programme on the Maltese economy rests at around 0.3%. Under such a scenario there is also a short-lived fall in exports as the demand for factors of production used to produce investment goods crowds out resources utilised by the private sector, temporarily leading to an increase in inflation and a marginal and short-lived fall in international competitiveness. Due to lower falls in economy-wide marginal costs in the medium-to-long run when compared to the baseline results, the increases in hours worked, in net real wages and in private investment are considerably more muted under this scenario. Limited productivity effects also lead to subdued positive wealth effects, which barely outweigh the negative distortionary effects associated with government expenditure, leading to an almost unchanged profile for private consumption in the medium run. Despite the fact that in this case public investment is fully financed through external sources, thus having no impact on the current or future borrowing requirements of Government investment decisions, it still has important distortionary effects. Indeed, the Government's decision to increase its investment outlays leads to a less than optimal allocation of factors of production, as resources are diverted from the production in the private sector to the production of government investment goods. In case of low public capital productivity, this effect almost completely outweighs the falls in marginal costs and gains in productivity brought about by the accumulation of public capital stock. In this respect, this result shows the importance of adequately targeting government investment decisions and to ensure that the projects undertaken are truly able to boost private sector productivity in the medium run, even when these public projects are almost fully financed through EU funds. Adding time-to-build delays to a low productivity scenario (solid green lines), produces an even more prolonged and pronounced drop in economic activity in the short-run, driven by a short-lived overheating of the economy which hurts international competitiveness. The magnitude and timing of the peak effects of RRF-financed public investment under a low productivity with time-to-build assumptions are in line with the other scenarios considered.

Conclusion

Our baseline estimates indicate that the direct effects of the RRF-funded government investment projects on Maltese economic activity lie at around 0.6% of steady-state output. These peak output gains are expected to materialise between 2025 and 2027, depending on any capital gestation delays that might affect the timing of the supply-side effects associated with public investment. Under the assumption of a lower productivity of public capital, the peak figure is expected to fall to less than 0.3%. These figures are expected to translate to a fall in government debt between 0.2 and 0.6 percentage points when compared to GDP by 2030.

At the current juncture, this study abstracts from several factors. First, apart from the funds falling under the RRF, the NGEU package also foresees the introduction of a number of structural reforms, which are expected to lead to improvements in economic output in the long-run. Moreover, in view of the coordinated nature of the RRF programme, Malta's national output is expected to be further boosted by the effects of international spillovers, which are likely to propagate through the trade and financial channels. This effect is expected to take place since the increase in public spending in the rest of the EU should create import demand which drives up output in the trading partners' economies, including that of Malta. Moreover, the drop in public debt ratio could also drive down government spreads providing further relief to public finances.

Our study does not model neither the structural reforms which are part of the NGEU deal nor the spillover effects. With regards to the former, at the moment it is still early to reliably calibrate the extent to which these structural reforms and the exact timing when these will be taking place. With regards to the spillover effects, apart from the potential issues in calibrating such shocks in a small open economy model with no multi-country elements (such as MEDSEA), one would need to carefully assess the extent to which such spillover effects would really positively

impact the Maltese economy. This point is especially important given the nature of investment that is being proposed under the NGEU funding scheme. Given the nature of Maltese exports, an increase in our trading partners' public spending in green initiatives, infrastructure and digitisation might not necessarily directly translate in an increase in the demand for Maltese output.

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MEDSEA-FIN: SOME RESULTS FROM AN ESTIMATED DSGE MODEL[1]

WILLIAM GATT FENECH

This article documents the estimation of MEDSEA-FIN, a medium scale Dynamic Stochastic General Equilibrium (DSGE) model with household heterogeneity, housing and borrowing constraints. The model is estimated using Bayesian methods on Maltese data, and delivers reasonable identification of the structural parameters and shock variances. The article shows the dynamic responses of several macroeconomic variables to a monetary policy shock and uses the estimated model to decompose observed house price movements into the underlying structural drivers. The model delivers results that are in line with expectations and other findings in the literature.

Introduction

The Central Bank of Malta has a suite of structural, semi-structural and reduced form models that it uses for policy analysis and forecasting. DSGE models nowadays play a central role in the analysis of policy due to their theoretical underpinnings and microfounded structure which allows for structural analysis (Christiano et al., 2018; Gürkaynak and Tille, 2017). Consequently, they form part of the Bank's policy toolkit. MEDSEA-FIN is a DSGE model developed at the Central Bank of Malta for policy analysis, with the primary aim to capture linkages between the real estate sector, banks, and the Maltese macroeconomy (Gatt et al., 2020). This model is thus well suited to study the role of macroprudential policy tools, particularly limits on loan-to-value and bank capital ratios.

"This article estimates MEDSEA-FIN using Bayesian methods, thus making it the first medium-scale DSGE model to be estimated using a rich set of observables for the Maltese economy"

MEDSEA-FIN has a rich structure, featuring credit-constrained households, multiple savings instruments including deposits, foreign bonds, capital and housing, a segmented labour market, a domestic non-tradable goods sector, an export sector, a construction sector, banks and a macroprudential authority. This makes the model highly policy relevant, ideal for the study of issues related to the real estate sector, household leverage and the conduct of macroprudential policies. Hence, it is imperative that the behaviour of the model is disciplined by the data. This article estimates MEDSEA-FIN using Bayesian methods, thus making it the first medium-scale DSGE model to be estimated using a rich set of observables for the Maltese economy.

The rest of the article is organized as follows. The first part documents the estimation of a subset of the model's parameters and the implied behaviour of the model to a monetary policy shock. The estimated model is then used to describe the structural forces that were behind the observed dynamics of house prices in Malta over the past 20 years.

MEDSEA-FIN: a bird's eye view

MEDSEA-FIN is a multi-sector, medium-scale open-economy DSGE model featuring nominal, real and financial frictions. It is based on the Two-Agent New Keynesian (TANK) model framework (Bilbiie, 2008; Campbell and Mankiw, 1989; Debortoli and Galí, 2017; Galí et al., 2007) that imposes limited household heterogeneity, distinguishing between patient and unconstrained households (savers), and impatient and constrained households (borrowers). The presence of limited enforcement on debt repayment means that borrowers face a collateral constraint that is binding, with a borrowing limit that fluctuates with house prices over the business cycle. The limited household heterogeneity is sufficient to capture first order effects, such as amplification due to financial frictions and stabilization from macroprudential policy. Households supply a differentiated labour service and therefore exercise some degree of monopoly power over the real wage rate for labour hours worked in each production sector.

[1] The author would like to thank Alexander Demarco, Aaron G. Grech, Wendy Zammit and Brian Micallef for helpful comments and suggestions. Any remaining errors are the author's own. The views expressed in this paper are the author's own and do not necessarily reflect the views of the Central Bank of Malta.

The model features a real estate sector, a banking sector, and a rich production environment with local intermediate and final goods producers, importers and exporters, and an exogenous sector representing the rest of the world. It distinguishes between three main production sectors, producing intermediate non-tradable goods, intermediate export goods and domestic housing construction. All production sectors use labour and capital as factors of production. Capital used in the domestic non-traded and housing sectors is accumulated through investment by saver households, while capital used to produce the export good is determined exogenously, to reflect the reality that in very small and open economies investment in the tradeable sector is largely determined by foreign direct investment. Importers are local agents representing foreign producers and distribute imports to final goods producers. The latter use a mix of this imported good and the non-tradable good to produce final consumption and investment goods. Exporters combine imports and the domestically produced export good to produce the final export good. The presence of nominal and real rigidities means than some prices, wages, hours, and volumes cannot freely adjust in the wake of shocks.

"The model features a real estate sector, a banking sector, and a rich production environment"

Banks intermediate financial resources between savers and borrowers. Both households and banks are subject to regulatory restrictions that take the form of limits on household loan-to-value and bank capital-to-asset ratios, respectively. A macroprudential authority, driven by financial stability objectives, uses these limits as policy tools and changes them over the financial cycle to exert some influence on the economy. The authority systematically tightens (loosens) these requirements when the credit-to-GDP ratio is above (below) trend. Since these macroprudential policy tools were only recently implemented, the loan-to-value and bank capital ratio rules were switched off throughout the estimation. The government consumes a fixed amount of the non-tradable good in every period. It balances the budget in each period by levying non-distortionary lump sum taxes on households. Finally, the foreign (euro area) economy is modelled as a stylised 3-equation system that has a demand equation, a supply equation, and a Taylor rule that characterises euro area monetary policy and closes the model.

The model economy is perturbed by several structural shocks that can be broadly grouped into domestic demand and supply, foreign demand and supply, financial and monetary policy shocks.[2] Further details on the model and the results discussed below can be found in Gatt (2022).

Bayesian estimation

The estimation of MEDSEA-FIN relies on Bayesian methods as discussed in An and Schorfheide (2007) and Fernández-Villaverde (2010). The linear rational expectations solution of the model has a state space representation, which is composed of the transition equation (1) and the measurement equation (2):

$$s_t = As_{t-1} + \nu_t, \qquad \nu_t \sim N(0, Q) \tag{1}$$

$$y_t = Bs_t + \varrho, \qquad \varrho_t \sim N(0, R) \tag{2}$$

where s_t is the vector of the states of the model, y_t is the vector of observed variables, the elements of matrix A are functions of the structural parameters of the model and the elements of matrix B map the states of the model to the data. The vector ν_t represents the structural shocks of the model with variance-covariance matrix Q, while the vector ϱ_t represents measurement errors that capture both data measurement errors as well as the potentially imperfect mapping of model to actual variables due to statistical definitions. Both Q and R are assumed to be diagonal.

The objective of Bayesian estimation is to construct the posterior distribution of the parameters (and shock variances) θ given the data sequence $\mathcal{Y} = \{y\}_1^T$, represented as $p(\theta|\mathcal{Y})$. The log posterior is proportional to the log of the prior distribution of the parameters $(\log p(\theta))$ and the log likelihood formed by the model given the data $\log L(\theta|\mathcal{Y})$):

$$\log p(\theta|\mathcal{Y}) \propto \log p(\theta) + \log L(\theta|\mathcal{Y}) \tag{3}$$

[2] Some of these shocks, such as labour supply, foreign risk premia and foreign direct investment shocks proved difficult to identify and estimate given the available data. These shocks were shut off during estimation.

Since the log posterior distribution does not admit a closed-form solution, Monte Carlo Markov Chain methods (the Metropolis-Hastings algorithm) are used to trace the posterior distribution.

Eleven macroeconomic variables – eight for Malta and three for the euro area – are used as observables over the period 2000Q1-2019Q4, which are real consumption per capita, real house prices, the HICP index, the services HICP index, credit to households per capita, investment in dwellings per capita, the import price deflator, real GDP per capita, euro area GDP, euro area HICP and the short-term shadow rate estimate of the ECB policy rate.[3,4] The short-term shadow rate is a proxy for both conventional and unconventional monetary policy stances adopted by the ECB. The observables enter the model as demeaned annual growth rates, except for the interest rate, which is only demeaned. These data make up the vector of observed variables that are mapped to the model states, as shown in equation (2). The first four years of data are used to initialise the Kalman filter, so the posterior distributions are based on data spanning the period 2005Q1-2019Q4.

A total of 39 parameters and shock variances (including measurement errors) are estimated. For the sake of brevity, this article does not show the prior and the resulting posterior distributions but discusses them briefly instead. The priors on most of these parameters follow the convention in the literature; the Beta distribution is used for parameters bound between 0 and 1, Gamma distributions for the adjustment cost parameters and Inverse Gamma distributions for shock variances. Most of the priors are neither loose nor overly tight and are centred around the calibrated values of the parameters documented in Gatt et al. (2020). A more conservative approach is adopted for parameters whose values were somewhat arbitrarily set in the calibrated version of the model, such as for the persistence of shocks, and centre the distribution around lower persistence. Since Maltese macroeconomic data tend to be particularly volatile and noisy, the mean of the prior on the measurement errors is calibrated such that these account for up to 10% of the variance of the observables, similar to the approaches of Adolfson et al. (2013) and Schmitt-Grohé and Uribe (2012). These priors are imposed relatively tightly.

"A total of 39 parameters and shock variances are estimated"

The data are generally informative on most parameters, in particular the persistence of shock processes, although some parameters remain unidentified and therefore at their prior distribution. The mean values of some parameters are in line with estimates from other studies; wage and price indexation are like those estimated in the ECB's New Area Wide Model II (NAWM-II, Coenen et al., 2018), while the mean inertia in the stock of household loans is close to that estimated in Iacoviello (2015) and Guerrieri and Iacoviello (2017). All structural shocks are identified except for the markup shock in the non-tradable goods sector. The posterior distributions for the measurement errors are mostly reasonably close to their priors, such that the measurement errors do not explain a sizeable share of the fluctuations observed in the data.

The transmission of a monetary policy shock

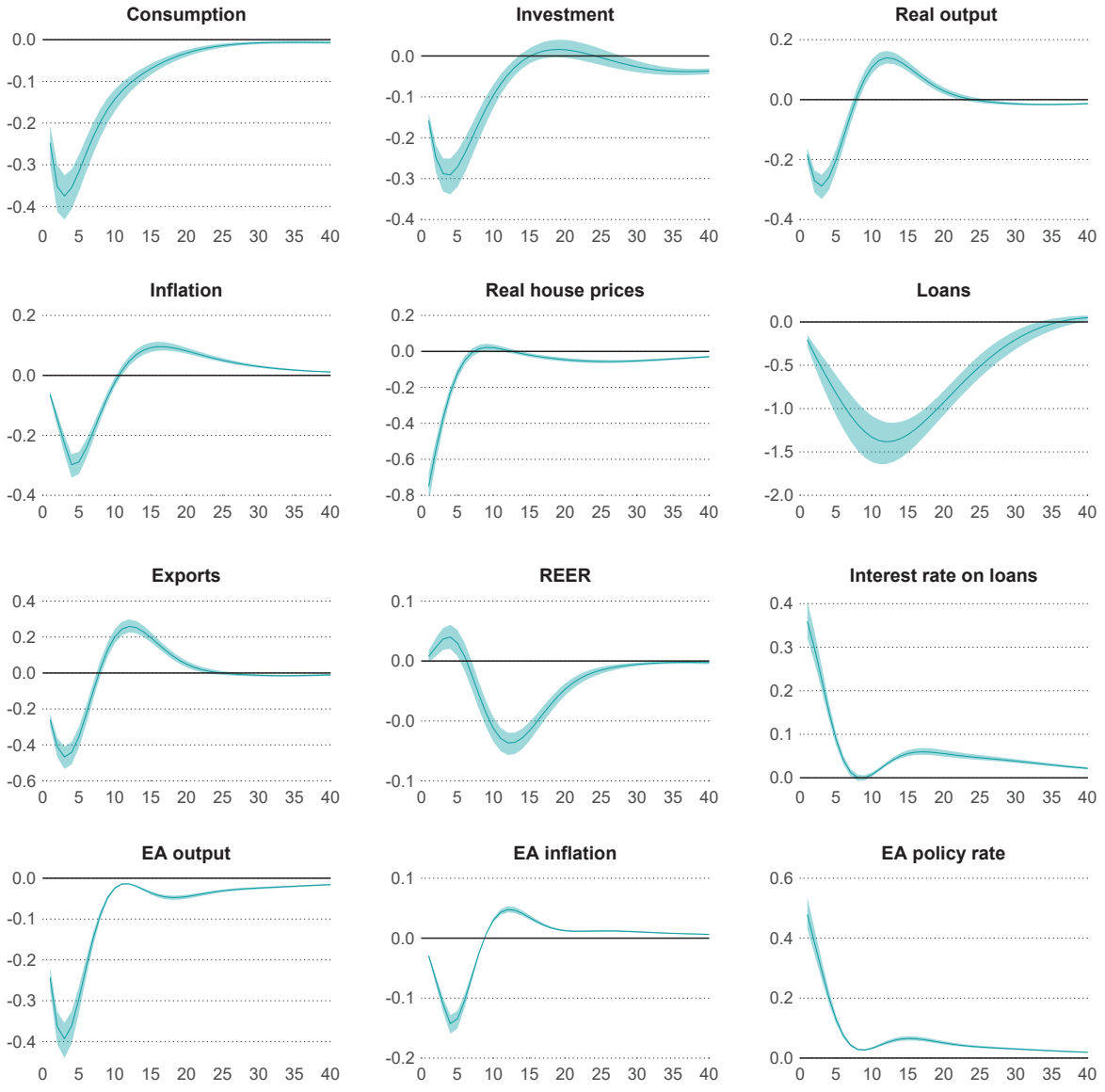
The estimated model can be used to trace the expected reaction of the model variables to a temporary shock through impulse response functions (IRFs). Chart 1 shows the Bayesian IRFs to a euro area monetary policy shock. This shock is particularly relevant for the current environment given the monetary policy normalisation effort announced by the ECB. In the model, the shock raises the ECB policy rate by around 50 basis points on impact, which is high relative to a 'typical' response of around 30 basis points as documented in Coenen et al. (2018), but within the ballpark of recent monetary policy tightening decisions. As discussed above, the shadow rate used in the estimation captures both conventional and unconventional monetary stances adopted by the ECB over the past 15 years, so the impact on the shadow rate will be larger than what would prevail under typical conventional monetary tightening. The effects of the shock on euro area variables are as expected, with a persistent decline in both output and prices. The contraction in euro area output and inflation are similar to those in the NAWM-II, bottoming out at around 0.35% and 0.15 percentage point, respectively.

[3] The short-term shadow rate estimate is based on the methodology of Krippner (2013).

[4] The estimation period does not cover the COVID-19 pandemic since this can lead to a significant effect on the results if the statistical properties of the structural shocks are not adjusted. See Cardani et al. (2022) for a discussion and application.

A monetary policy shock transmits to the Maltese economy through trade and financial channels. Demand for the export good falls, leading to a drop in nominal wages in that sector and hitting households' income. The drop in euro area inflation transmits via reduced import prices, which lowers inflation in the price of the final consumption good. At the same time, the rise in the nominal interest rate transmits to the local economy, and coupled with the decline in inflation, leads to a rise in (real) borrowing costs.[5] The increase in the real deposit rate (not shown below) is even

Chart 1
IRFs TO A MONETARY POLICY SHOCK



Source: Author's calculations.

Notes: The chart shows Bayesian dynamic responses of the variables to a monetary policy shock, generated using 5,000 draws from the posterior distributions of the estimated parameters. The solid line is the median response, while the shaded region represents the 90% credible interval. The responses are in percentage deviations from the steady state level for all variables except for inflation and interest rates, which are in percentage point deviations. Inflation and interest rates are in annual terms. The horizontal axis measures quarters after the impact of the shock.

[5] The interest rate pass-through is higher on impact than that estimated in Micallef et al. (2016), although their empirical estimates should be interpreted with caution as they represent unconditional interest rate changes, whereas here the shock is defined as an unexpected monetary tightening.

larger, which stimulates a rise in deposits and lowers investment in capital and housing demand. Investment, house prices and household credit all fall, leading to a peak median contraction in real output of around 0.29% relative to its steady state value.

"A monetary policy shock transmits to the Maltese economy through trade and financial channels"

The profile for consumption in Malta is very similar to the corresponding estimates for the euro area reported in Coenen et al. (2018), with a peak drop of just above -0.4% in the first year of the shock. The easing of domestic price pressures leads to a gradual decline in the real effective exchange rate (REER), which boosts exports after the initial decline. This props up real output in the medium term despite the monetary policy tightening in the euro area; a result consistent with Vector Autoregression (VAR) evidence documented in Gatt and Ruisi (2022), who find that a euro area monetary policy shock causes a drop in inflation but a rise in output.

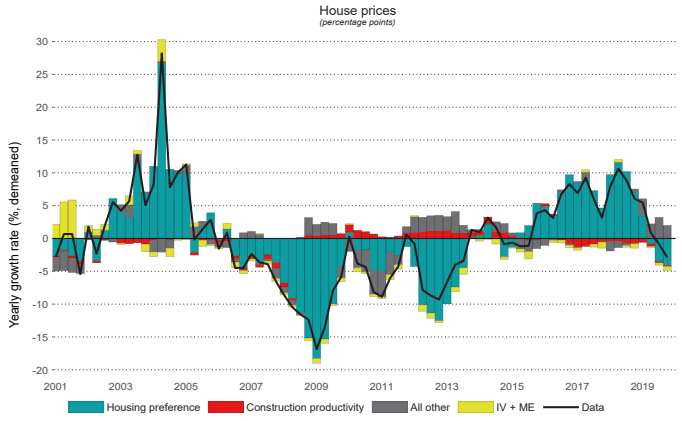
A historical decomposition of house price movements

The estimated model can be used to provide an economic narrative on the drivers of house price movements over time around their long run average growth rate.[6] Recall that the model economy can be perturbed away from its steady state equilibrium when it is hit by one or more of the exogenous structural shocks discussed above. Chart 2 shows that the key driver of house prices over the period 2001-2019 were housing preference shocks which shift the demand for housing, in line with *a priori* expectations and the findings in the literature (Iacoviello and Neri, 2010; Iacoviello, 2015).

The decomposition shows both the direct and general equilibrium effects of the shocks as they transmit through the entire economy. The increase and correction in house prices in the 2000s, the lower-than-average growth in 2012-2013, and the more recent increase in prices since 2015 are largely interpreted by the estimated model as being demand-driven. Housing supply (through shocks to construction productivity) played a much more limited role throughout the entire period, although they contributed marginally (negatively) during the boom that started in late 2015, with the increase in dwelling investment. Towards the end of 2019 the model interprets the lower-than-average house price growth as being driven by a contraction in housing demand, although other factors (including monetary policy shocks) pushed somewhat in the opposite direction.

This narrative on the drivers of house price growth is based on a theoretical model with tight cross-equation restriction, and therefore can be model-dependent. To assess the extent of model dependence of the results, the estimated time series of the housing preference shock referred to above were cross-checked with a similar estimate from the empirical model of Gatt and Ruisi (2020). The empirical model is a Structural Vector Autoregression (SVAR) estimated using Bayesian methods and, importantly, imposes far fewer restrictions in the identification of the structural shocks than in MEDSEA-FIN. Despite these differences, Chart 3 shows that the two methodologies deliver very similar time paths for the housing preference shock. Strictly speaking, in a Bayesian context, the output from both models is a distribution of the structural shock at each point in time.

Chart 2
HISTORICAL DECOMPOSITION OF HOUSE PRICE DYNAMICS

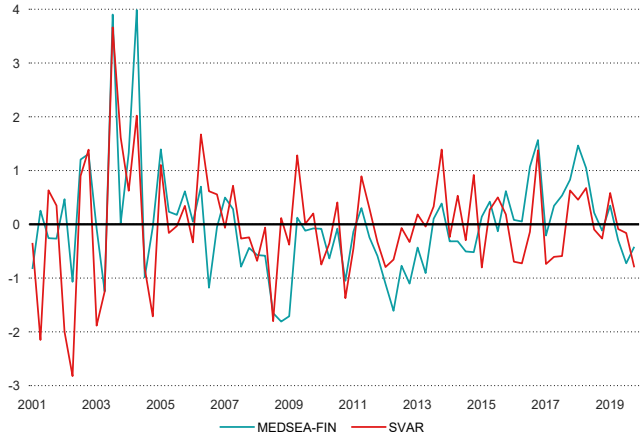


Source: Author's calculations.
Notes: The chart shows the historical decomposition of observed year-on-year demeaned house price growth into the structural shocks. The contributions of these shocks are based on the posterior median of the structural parameters and shock variances. The 'All other' bar groups the following shocks: intertemporal preference shocks, goods productivity and price mark-up shocks, and euro area demand, supply, and monetary policy shocks. 'IV + ME' represents the grouping of the role of initial values in the Kalman smoother and measurement errors.

[6] The model is stationary around a level steady-state and therefore captures business cycles.

Chart 3 shows the mean or median value of the shock for legibility. Therefore, the full degree of overlap of these two estimates is higher than what the chart conveys. This provides an important validation test for the results presented above based on MEDSEA-FIN.[7]

Chart 3
HOUSING PREFERENCE SHOCKS ACROSS DIFFERENT MODELS



Source: Author's calculations.
Notes: The structural shocks from MEDSEA-FIN are the smoothed shocks at the posterior mean of the parameters. The shocks from the Bayesian SVAR are the median from their underlying distribution. The SVAR is estimated using data from 2000Q3 to 2019Q4. Both shocks are standardised.

Conclusion

This article documents the Bayesian estimation of MEDSEA-FIN, an estimated medium-scale DSGE model for Malta, and shows some simulation results and structural output. The implied dynamic responses of Maltese macroeconomic variables to a monetary policy shock are reasonable and match findings from other studies. The historical decomposition showed that the housing preference (demand) shock was the key driver of the observed cycles in house prices. Overall, the estimation of this model makes its suitable to address policy-relevant questions.

Model development is a continuous process. Future development of the model is likely to include efforts to estimate the parameters using more recent data that covers also the COVID-19 pandemic, an enhanced structure for the foreign block, further development of the bank structure and the introduction of more macroprudential policy tools. Efforts are also underway to expand the energy block of the model to allow the Bank to address policy questions related to environmental targets and energy transition.

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[7] See Gatt (2022) for other similar validation exercises.

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