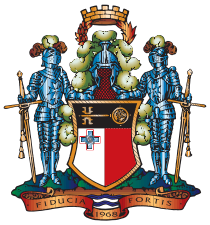

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HEDONIC HOUSE PRICE INDICES FOR MALTA: A MORTGAGE-BASED APPROACH

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HEDONIC HOUSE PRICE INDICES FOR MALTA: A MORTGAGE-BASED APPROACH[1]

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This study uses a novel dataset derived from mortgage contracts granted by the major credit institutions in Malta to compute a range of hedonic house price indices for the period 2010-2018. This dataset contains information about house prices and a number of important property characteristics, and is augmented by geographic and socio-demographic variables. On the basis of the two methodologies recommended by the literature for Malta, we find that growth in house prices was relatively muted over the period 2011-2014, ranging between 1.1% and 1.5%. House prices picked-up markedly thereafter, averaging between 7.8% and 8.4%. In particular, house price growth peaked in 2018, at between 14.2% and 14.6%.

Introduction

Due to the limited availability of land and the small size of financial markets, property has over generations served as an important store of wealth for the Maltese. A tightening of rent controls in the aftermath of the Second World War, along with successive policy initiatives aimed at supporting home-ownership, led to a surge in ownership rates throughout the 20th century.[3] For these reasons, reliable measures of property prices are important for both policy-makers, including the Central Bank of Malta, and the public, to be able to assess developments and trends in the housing market.

There are currently two measures of house prices in Malta. The National Statistics Office (NSO) publishes the official Property Price Index (PPI), based on actual contract prices. At the same time, the Central Bank of Malta publishes a complementary index based on advertised property prices on print media. Growth rates for both indices in recent years confirm a buoyant property market driven by a surge in demand, particularly since 2015.

Both these indices capture changes in the median price of property but do not control for changes in the quality and characteristics of the housing units traded. Hence, price trends may reflect changes in the quality and/or type of property being sold, rather than underlying price changes. This calls for a quality-adjusted price index, known in the literature as a hedonic price index, whereby changes in prices are adjusted for variations in the attributes of the transacted properties.

A property's price is determined by the mix of attributes which define it. These attributes reflect both its geographical characteristics, such as locality desirability and transport links, and its structural features, such as size and property type. Hedonic adjustment estimates the marginal contributions of each of these characteristics to the total price, thereby enabling the estimation of a quality-adjusted price index. The first empirical hedonic house price index

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1 This article applies the methodology in Ellul et al. (2019) to a longer dataset.

2 The authors acknowledge the important work done relating to the compilation and use of the data used in this paper by Karen Caruana, Daniel G. Gaskin, Jesmond Pulè, William Gatt Fenech, Joanna Borg Caruana and Erica Caruana. A special thanks also goes to Professor Andrew Narwold who consulted and peer reviewed this work as part of his visit as a Fulbright scholar at the Central Bank of Malta.

3 See Camilleri (2000) for further details on the historical evolution of housing policy in Malta.

was the US Census Bureau's "One-Family Houses Index", first published in 1968. Since then, a number of studies have made use of these methods, some examples being Narwold and Sandy (2010) for the city of San Diego and O'Hanlon (2011) for Ireland.

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This study applies the international methodological standards on hedonic house price indices developed by Eurostat (2017) to a novel dataset of anonymised mortgage contracts, collected from Malta's main mortgage lenders under Banking Regulation VI (BR/06). Although there have been previous attempts at constructing a hedonic property price index for Malta (Borg, 2004; Falzon and Lanzon, 2013), this is the first study to apply these methods to mortgage data, supplemented with additional geographic and socio-demographic variables.

Methodology

The basic form of a hedonic regression is shown in (1), where $p_{t,h}$ refers to the price of dwelling h sold at time t and X is a matrix of hedonic characteristics. The random error term $u_{t,h}$ is the unexplained part of dwelling prices.

$$\ln p_{t,h} = \mathrm{X}b_t + u_{t,h} \quad \textbf{(1)}$$

The methodology applied in this study is based on the international standards outlined in the Eurostat et al. (2013) Handbook on Residential Property Prices Indices. Three hedonic methods are considered, which are the time dummy variable (TDV) approach, the rolling time dummy (RTD) method and the average characteristics method. A detailed explanation on each of these methods can be found in Hill (2013) and Eurostat (2017).

The TDV method estimates equation (1) with the addition of a time dummy for each period, excluding the base period. Hence, a single hedonic equation is estimated over the whole dataset. The coefficients on the time dummies represent the underlying price change during the respective time periods, after controlling for the characteristics of the property, while the exponent of these coefficients gives the hedonic index. One disadvantage of this model is that the vector of shadow prices of the property attributes *(b)* is estimated only once and is hence assumed to be time independent. This assumption may be unreasonable for housing markets which experience substantial changes to the assumed worth of an attribute over time.

The RTD method, as developed by Shimizu et al. (2010), is based on the TDV method but estimates multiple regressions through the use of a rolling window procedure, with *Q* being the set window length. An initial regression model is estimated using the first *Q* periods, from which price indices for these periods are obtained. Subsequent regressions are then estimated by successively shifting the window *Q* by one period, such that each regression contains *Q* periods of data. As each new period enters the window, the rate of increase of the index is calculated and used to update the previous sequence of index values. The choice of window length *Q* is arbitrary. O'Hanlon (2011) argues that for a small economy with limited data points, a longer window would increase the robustness of the model. On the other hand, a shorter window ensures that the estimated *b* coefficients are updated more regularly.

Unlike the TDV method, where new period data is added to a single regression model, the coefficients derived from the RTD method are free from revisions (unless new observations are included for past periods). At the same time, because a new regression model is estimated per new period, the vector of coefficients *b* in the RTD method is time variant, a clear advantage over the TDV method in periods when the housing market is undergoing structural change. On the other hand, the TDV may have robustness and significance advantages over the RTD method when using small datasets, because the single regression uses all available observations.

Another way of deriving a hedonic index is the average characteristics approach. Using this method, a separate hedonic model is estimated for every period, thereby ensuring that the *b* coefficients on the property characteristics

are constantly updated. Using these coefficients, the average characteristics method then imputes a price for the 'average' house, given a set of characteristics. From this, the price index is calculated as the ratio of the imputed price of the average house at time *t+1* to the imputed price of the same 'average' house at time *t*. The index is then chained, using either one of the Laspeyres, Paasche, or Fisher chain-linking methods.

Data

The data used in this study are based on an anonymised mortgage contract dataset, which is collected by the Central Bank of Malta from the major domestic credit institutions under BR/06. After cleaning and removing outliers, the dataset consisted of over 28,000 observations, starting from 2010. Three categories of property were considered in the analysis, namely apartments and penthouses, maisonettes, and houses.[4]

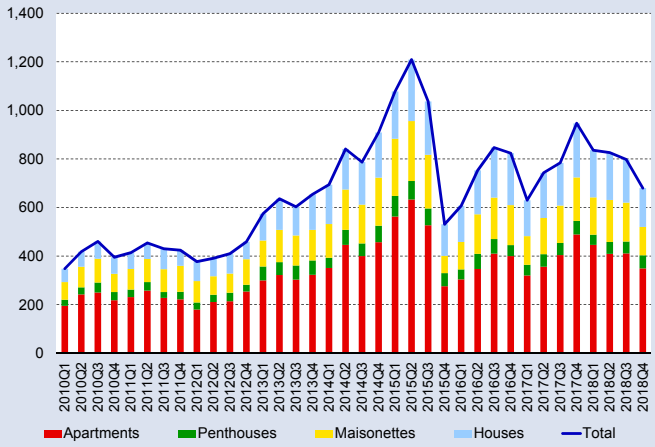
"The data used in this study are based on an anonymised mortgage contract dataset, which is collected by the Central Bank of Malta from the major domestic credit institutions"

The dataset comprises a number of attributes describing the structure and overall characteristics of each transacted property. Of particular importance are the contracted price, the size of the property (in square metres), the property state (shell or finished), and its location. Over the years other attributes have been made available by the data providers, including the presence of a garage/parking space, pool, garden, lift, and views. Since the latter do not span the full sample period, they are not included in the main results presented hereunder, though they do present an opportunity for augmenting the hedonic regression in the future.

Chart 1 gives a general overview of the dataset, plotting the number of transactions per quarter by property type. The number of transactions has increased considerably over time, reflecting the increased activity in the property market over the sample period. In particular, 2015 was a buoyant year in terms of property transactions, probably reflecting house purchase timing decisions relating to the government's first-time buyer scheme.[5] Apartments on average comprised 52% of total transactions over the whole sample period.

The strong increase in property transactions was matched by robust growth in non-quality adjusted house prices. Price growth of contracted mortgages stood at an average rate of 2.0% between 2011 and 2014 (see Chart 2). Growth strengthened thereafter, standing at 7.3% in 2016 and 5.0% in 2017, before accelerating sharply to 12.4% in 2018.[6] The rest of this study attempts to discern whether this acceleration reflects a pure price change or is simply due to changes in the quality and nature of the transacted properties.

Chart 1
NUMBER OF TRANSACTIONS
(counts in the CBM mortgage dataset)



Source: Authors' calculations.

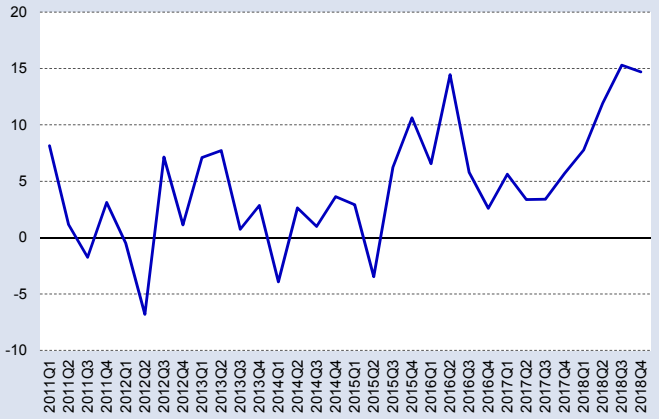
[4] Flats and apartments are defined as units with a communal entrance, with penthouses being the topmost unit in a block of apartments. Maisonettes are units in a block with an independent access. The "house" category comprises houses of character (built before 1900), townhouses (pre-1968 houses), terraced houses (post-1968), and farmhouses (parts of dwelling originally intended to house farm animals). Bungalows, villas, and palazzos were excluded from the dataset.

[5] The scheme allowed first-time buyers to be exempt from the stamp duty on the purchase of immovable property, up to the first €150,000 spent. This is equivalent to savings of up to €5,000 in stamp duty.

[6] Given the low number of observations in each quarter, the data can be volatile. If one compares the index with official figures using moving averages, they are not so different. See Ellul et al. (2019) for further details.

Despite the presence of numerous structural characteristics, the mortgage dataset was somewhat lacking in the geographical attributes of the transacted housing units. The only available variable is "property location", covering 67 different localities across Malta and Gozo. Since assigning dummy variables to each of these locations would have been impractical given the short sample period, localities were grouped into the 13 electoral regions used in the 2017 general election. The advantage of such a grouping is that electoral districts tend to be divided into contiguous geographical areas consisting of broadly equal-sized populations of voters. However, we acknowledge some degree of heterogeneity in property prices between the localities included in an electoral district.

Chart 2
HOUSE PRICE GROWTH IN CONTRACTED MORTGAGES (NON-QUALITY-ADJUSTED)
(annual percentage changes)



Sources: CBM; authors' calculations.

The "property location" variable allowed for the construction of a number of proxy variables capturing the desirability of a property's location. In order to capture attributes such as the frequency and length of transport links and available employment opportunities, each locality was equated with a specific "distance from centre" variable. The economic and political centre for Malta was defined as the localities of Valletta and Sliema/St Julian's, as well as the surrounding areas. For each locality, the distance from centre was calculated as being the road distance to the mid-point of these central areas.

There may also be instances where a locality is in high demand for reasons other than its proximity to the economic centre of the island. For example, localities such as St Paul's Bay and Mellieħa are popular destinations for residents and tourists alike due to the large availability of amenities and leisure activities such as restaurants, shops and beaches. A good proxy for the desirability of certain locations due to their entertainment and/or historical heritage is the presence of hotels, data on which was made available on an annual basis by the Malta Tourism Authority.

Property prices in a locality may also reflect social factors, such as education or poverty levels within the neighbourhood. To capture these social effects, we augment our dataset with NSO data on benefits intended to combat social exclusion, which are available as a single-point observation per locality.

Apart from residential demand, property in Malta has increasingly been demanded for its rental potential. The rent-likelihood of a locality was captured by the share of foreign residents in each locality, taken as the difference between the total population and the total Maltese population from the NSO's annual Demographic Review. Following Sweeny (1974) and Jackson (1979), the sign on this coefficient is expected to be negative. Although this may seem counter-intuitive, it reflects underlying differences in the characteristics of properties rented to foreign nationals, which could have different characteristics than those demanded by residents.

Results

A number of hedonic indices were computed using each of the methodologies described above (TDV, RTD and average characteristics). In the case of the RTD method, indices were computed using two, three, and five-period rolling windows, while the index derived from the average characteristics method was chained using each of the Fisher, Paasche, and Laspeyres methods. The results shown hereunder are thus presented as a range of estimates incorporating each of these methods.

Table 1 presents a sample of regression results relating to the fourth quarter of 2016. The benchmark property against which these results should be interpreted is a shell apartment in Region 10 (Sliema/St Julian's/Gżira). For

all equations depicted in Table 1, the in-sample fit exceeds 50%, suggesting that they are generally a good representation of house prices in Malta. Moreover, the time dummies in the TDV and the RTD methods (not shown here) are mostly statistically significant, meaning that after controlling for property characteristics we can still satisfactorily capture the time series evolution of house prices in Malta.

With regard to the coefficients on property attributes, these are mostly statistically significant in the right direction. Size positively affects a property's price, while finished units command a higher price compared to those in shell form. Penthouses and houses tend to be purchased for higher prices than apartments, though the coefficient on maisonettes is only statistically significant in one of the three methods. In the latter cases, this implies no statistically significant difference between prices for maisonettes and apartments.

Table 1
REGRESSION RESULTS

	Time-Dummy Variable method	Five-quarter rolling window method (2016Q4)	Average Characteristics Model (2016Q4)
Constant	9.87 ***	9.93 **	10.34 ***
Size	0.55 ***	0.55 ***	0.50 ***
Property State			
Shell (benchmark category)			
Finished	0.11 ***	0.18 ***	0.19 ***
Property Type			
Apartments (benchmark category)			
Penthouses	0.10 ***	0.08 ***	0.01
Maisonettes	0.03 ***	0.00	0.01
Houses	0.18 ***	0.09 ***	0.10 ***
Regions			
Region 1	-0.19 ***	-0.26 ***	-0.26 ***
Region 2	-0.18 ***	-0.28 ***	-0.32 ***
Region 3	-0.23 ***	-0.30 ***	-0.36 ***
Region 4	-0.26 ***	-0.39 ***	-0.49 ***
Region 5	-0.16 ***	-0.15 ***	-0.22 ***
Region 6	-0.14 ***	-0.21 ***	-0.23 ***
Region 7	-0.08 ***	-0.16 ***	-0.19 ***
Region 8	-0.08 ***	-0.06 **	-0.11 *
Region 9	-0.10 ***	-0.08 **	-0.07
Region 10 (benchmark category)			
Region 11	-0.04 ***	-0.11 ***	-0.09
Region 12	-0.20 ***	-0.22 ***	-0.16 **
Region 13	-0.19 ***	-0.21 ***	-0.2 ***
Geographic and socio-demographic			
Collective accomodation units	0.06 ***	0.12 ***	0.14 ***
Distance from centre	-0.01 ***	-0.02 ***	-0.02 ***
Social exclusion	-0.17 ***	-0.16 ***	-0.16 ***
Share of foreigners in a locality	-0.24 ***	-1.12 ***	-1.70 ***
Observations	28,691	3,938	866
Adjusted R-squared	0.53	0.52	0.53

* significant at the 10% level.
** significant at the 5% level.
*** significant at the 1% level.

The time dependency characteristic of the RTD and the average characteristics methods allows us to observe which attributes have increased/decreased in importance over time. In particular, the results indicate that, post-2015, there has been a growing premium attached to penthouses and to properties with a higher state of finish.

In terms of geography, the coefficients on most regions are negative with respect to the benchmark Region 10. This implies that dwellings in the Sliema/St Julian's/Gżira area are purchased at a premium over other areas. These negative coefficients become larger in absolute value the further away the property purchased is from Region 10, while the coefficients on regions close to Region 10 (such as Regions 9 and 11) become smaller and/or insignificant. Indeed, the results of this study show that, over the years, the coefficients attached to regions geographically close to Region 10 have been declining, suggesting some form of price convergence in the surrounding area.

The coefficient on the "distance from centre" variable is negative, capturing the negative premium created by a longer travel distance from the political and economic centre of the island. Conversely, the availability of amenities and leisure activities, captured by the number of collective accommodation units, positively affects property prices. Locations with a higher concentration of households which depend on social benefits tend to have lower property prices.

The coefficient on the "share of foreigners" variable, capturing the rent-likelihood of a locality, is negative and statistically significant. This finding is in line with Sweeny (1974) and Jackson (1979), and is due to rental units and tenants having different characteristics than non-rental units and owner-occupied housing. Another strand of the literature suggests that this negative coefficient is partly due to residential segregation.

Indices

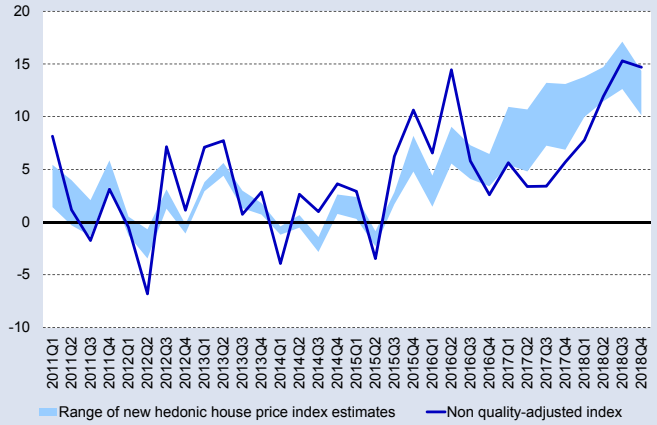
As explained above, the hedonic regressions such as those shown in Table 1 are used to estimate quality-adjusted house price indices. Chart 3 presents the range of house price growth rates obtained from the TDV, the RTD (using three different window lengths) and the average characteristics (using each of the Laspeyres, Paasche, and Fisher methods for chain-linking) methods, and compares it to the non-quality adjusted growth rates shown in Chart 2.

In general, the time series evolution of the indices is broadly similar across methods, implying that the results are quite robust to different hedonic methodologies. With few exceptions, the dynamics of the hedonic and the non-quality adjusted growth rates tend to follow similar trends, though the hedonic indices are less volatile. Overall, hedonic growth in house prices was muted during the period 2011-2014, with an average range of between 0.3% and 2.2% across all the different methods. House price growth picked up markedly in the final three years of the sample period, averaging between 6.9% and 11.3% across all the different methodologies.

Between 2016 and 2017, house price inflation as measured by the hedonic indices exceeded that tracked by the non-quality adjusted index. This indicates that the characteristics of the transacted properties, such as size, changed during the period. By 2018, these differences between the hedonic and the non-quality adjusted indices had largely disappeared.

The relatively wide range in the hedonic indices, particularly toward the end of the sample, is primarily driven by the relatively low growth rates derived from the TDV method. This growing divergence underlines the significant evolution of the housing market in recent years, which the

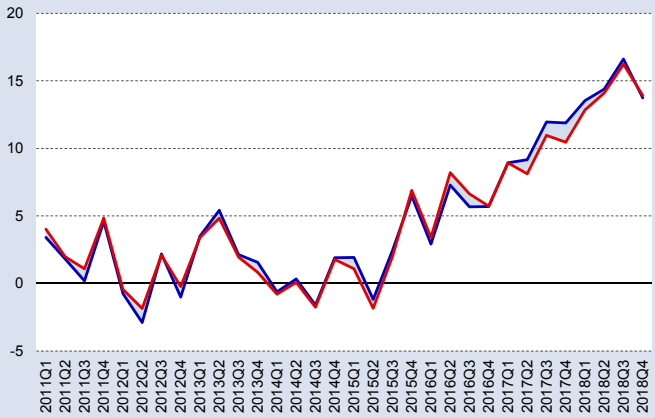
Chart 3
RANGE OF HEDONIC HOUSE PRICES COMPARED TO MORTGAGE NON-QUALITY ADJUSTED INDEX
(annual percentage change)



Source: Authors' calculations.

TDV method is unable to capture due to its constant implicit prices assumption. Chart 4 depicts a much narrower range for the hedonic indices by plotting only the two methods considered as "ideal", namely the RTD method with a five-quarter rolling window, and the average characteristics Fisher-chained index. The five-quarter window for the RTD is more suited for a small economy like Malta with a low number of observations per period, when compared with narrower window lengths (O'Hanlon, 2011). At the same time, the Fisher chained index in the average characteristics method is simply a geometric average of the Paasche and the Laspeyres indices.

Chart 4
HEDONIC HOUSE PRICE RANGES
(annual percentage change)



Source: Authors' calculations.

Using just these two methods, the range of hedonic indices is much narrower and shows a clear upward trend in prices from 2015 onwards. For the years 2011 and 2014, the measures averaged between 1.1% and 1.5%. From 2015 onwards, the measures indicate average house price inflation of between 7.8% and 8.4%, respectively. In 2018, house price growth averaged between 14.2% and 14.6%.[7]

Conclusion and limitations

During the past decade, the Maltese housing market has gone through considerable change, in terms of prices but also, and more importantly, in the underlying characteristics that define the value of a housing unit. This study introduces a novel dataset of mortgage contracts that allows us to gain a deeper understanding of this evolution. Three hedonic computation methods are used based on the international standards outlined in Eurostat (2017), namely the TDV, the RTD, and the average characteristics methods.

"House price growth remained relatively muted over the period 2011-2014 and picked up markedly after 2015"

Overall, the different hedonic measures depict a broadly similar picture of house price growth in Malta over the past few years. House price growth remained relatively muted over the period 2011-2014 and picked up markedly after 2015. The wide range estimated between the hedonic indices in the latter years suggests that the implicit prices attached to a property's attributes have undergone a significant change over the past years, which are better captured by some methods than others.

Although the mortgage dataset used in this study is quite rich, it does have certain limitations which may have impacted on the results presented above. The main limitation is that the mortgage market typically covers only around half of the property market in Malta, with the other half dominated by cash and other transactions. The latter transactions are more common with second-time buyers and in the buy-to-let market, while mortgage transactions tend to be dominated by first-time buyers. If preferences between these groups diverge significantly, then the mortgage dataset might not be fully representative of the property market in Malta. At the same time, the short time-series of the dataset meant that certain property characteristics were unable to be used in the study; this could provide scope for future improvement of the hedonic indices. Similarly, results need to be treated with caution due to the small sample size and the low number of observations per period.

[7] For a comparison with existing house price indices, please refer to Ellul et al. (2019).

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