

THE RELATIONSHIP BETWEEN PORTUGUESE ECONOMY INDICATORS AND HOUSING PRICES

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ABSTRACT

The housing market is an important industry not only in a country's economy but also for the living conditions of the population. Several studies explain how real estate is related to the main economic indicators of a country. Using the Engle-Granger cointegration methodology, this research studies the main drivers of the housing prices of a European country that suffered a financial crisis. Analysing the Portuguese housing market with quarterly data between 1998 and 2019, it is possible to show that in the long term, unemployment and interest rates are negatively related and that population, inflation and money supply are positively associated with housing prices. With this study, it is possible to conclude that economic issues are relevant to the housing market and mainly to home prices.

Keywords: Housing Prices, Long-Term Effects, Cointegration, Economic Factors.

JEL Classification: R30, R31, R32

1. INTRODUCTION

The economic conditions of a country have impacts on the housing market, both in terms of housing supply and demand and the prices borne by the population. Housing prices are formulated based on the population's ability to pay, which is dependent on the country's economy. This study analyses the real estate market in a European country that suffered a severe economic and financial crisis following the 2008 subprime crisis in the United States. Portugal requested foreign aid in April 2011 from a troika made up of the International Monetary Fund, European Commission and European Central Bank during the 3-year period, between April 2011 and May 2014. In view of this context, it seems relevant to verify the impact of the evolution of the economy over the last 30 years on housing prices. In this way, it is possible to analyse the significant effects of economic conditions on the housing prices of a European country that had experienced a strong financial shock during the last 10 years.

Housing prices are related to the intrinsic value of the properties, i.e., land and construction costs, but it is also important to understand the role of the main stakeholders in the real estate market, such as landlords, developers, builders, real estate agents, tenants and buyers. Through these stakeholders, this industry has important links with other economic activities, such as brokerage, counselling, appraisal, urban planning, education, management and finance (Cortesi, 2003).

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In this work, the main economic indicators of a country that potentially have impacts on housing prices are analysed. The idea is that in a country with more unemployment, higher long-term interest rates, higher inflation and money supply, the population would be expected to have less financial capacity to buy a house or the prices will be too expensive for most people. All these factors affect housing demand or supply. In addition, population growth is also a relevant factor for this analysis because it influences housing demand.

This study uses the Engle-Granger (EG) cointegration methodology and a quarterly sample of the Portuguese market. The results show that unemployment and interest rates are statistically negatively related to housing prices, but population, inflation and money supply are statistically positively related to the prices of houses in Portugal.

This paper is organized as follows. The next chapter presents the theoretical framework explaining how macroeconomic and microeconomic characteristics of a country may affect the housing market. Then, the methodology is presented. In the fourth section, the results are presented and discussed. Finally, the paper ends with the conclusion.

2. THEORETICAL FRAMEWORK

2.1 Country's Economy and Real Estate Prices

It is relevant to analyse the relationship between the real estate market and economic growth because of the effect of the real estate industry. Groot (2006) explains that a decrease in real estate prices can contribute to economic recessions and that in a recessionary period, the prices decrease, which leads to low economic growth. In this case, there is a lower interest rate. Then, in a recovery phase, there is low inflation, slow economic growth and a gradual increase in interest rates.

Therefore, Ren (2016) presents the relationship between economic growth and real estate based on the idea that investors contribute to the growth of this industry by putting their money in houses (real estate market) with the expectation of better returns. The real estate industry is also important because of its positive impact on construction activity and furniture manufacturing, for example. Łaszek, Leszczyński and Olszewski (2017) show that an increase in construction helps to reshape the local housing market and also helps to create jobs, which has a positive effect on the economy.

There are three areas in which the housing supply affects economic growth: labour markets, infrastructure and business (Glossop, 2008). The first is important because labour mobility is affected by the lack of availability and unaffordability of housing. The second is relevant because locations with higher housing demand have better infrastructure, while locations with lower housing demand often have poor infrastructure (for example, transportation). Third, locations with business buildings often have high demand, which leads to an increase in wages and higher rents. In contrast, poor housing locations make it difficult to attract people with higher financial capacities.

2.2 Microeconomic Perspective of the Real Estate Market

The housing market differs across locations, between countries, provinces, cities and towns, and its prices are influenced by several factors such as space, location, standard and type of ownership. Furthermore, the homebuyers can have the objective of being property owners or pure financial investors (Høvring & Parmo, 2016). However, location is an essential factor to analyse in this issue. For example, a house with good construction and excellent living conditions but in an undesirable location will possibly not have a very high price, while a

small house without great amenities and without great alternatives in a given location (and possibly with a lot of demand) will tend to have an excessively high price.

The interest rates, home construction, unemployment, population and household income are important explanatory factors for home prices (Barot & Yang, 2002; Barksenius & Rundell, 2012; Xu & Tang, 2014). The most important factors are related to the housing supply and demand (Høvring & Parmo, 2016), which are interrelated. The supply factors are related to the availability of land, construction activities and the local land-planning system, whereas the demand factors include interest rates, inflation, wages or income, mortgage loans, population and demographic dynamics in each country (Hofmann, 2003; Tsatsaronis & Zhu, 2004; Zhu, 2005; Stepanyan, Poghosyan & Bibolov, 2010).

2.2.1 The Demand for Housing

Regarding housing demand, it is important to analyse factors such as household wealth, economic growth, unemployment and population growth, general price level, the cost of borrowing, credit availability and interest rates (Tsatsaronis & Zhu, 2004; Stepanyan et al., 2010). Furthermore, in the long run, housing demand is related to, for example, expected or permanent income, structure of the population, real estate service companies, and the expected capital gains of home ownership (Meen, 2002). Thus, it is expected that housing demand will not be constant.

Zhu (2005) states that housing price variations are related to the overall changes in economic conditions. For example, economic growth has a positive impact on households' income, which can increase housing demand, and it is also positively related to housing prices. Selim (2009) the locational value is usually analyzed by hedonic methods that use multiple regression techniques on large data sets and require a formality based on microeconomic theory in the analyses. Because of potential non-linearity in the hedonic functions, artificial neural network (ANN) finds that investors also have a positive impact on housing demand. Considering that it is not easy to change the housing supply in the short term, the housing prices are mostly influenced by the demand.

Additionally, demographic factors, such as population size, migration patterns and level of urbanization, have positive impacts on housing demand, which is also directly related to home prices (Bujang, Zarin & Jumadi, 2010). Anenberg, Hizmo, Kung and Molloy (2015) also emphasize the impact of banks' lending rules. As buyers rely on mortgage loans to purchase their homes, any changes in the availability of loans and credit conditions have significant impacts on the demand for and prices of housing.

2.2.2 The Supply of Housing

In the short term, the housing supply tends to be inelastic, unstable and constrained due to lack of land and deadlines to finish new construction (Stepanyan et al., 2010). Hence, Selim (2009) and Adams and Füss (2010) conclude that supply inelasticity can be relatively adjusted with the construction of new houses. Thus, in the long term, the housing supply adjusts to the housing demand with the construction of new houses.

When the construction costs of new houses increase, construction declines because it has a positive impact on the house's final price, and few buyers have the financial capacity to buy them. An increase in construction costs has a positive impact on home prices (Xu & Tang, 2014).

In the long run, an increase in the supply tends to decrease housing prices because there is not enough demand to buy. Moreover, if there is an excess in the housing supply, it is possible to find negative impacts on the economy (Glindro, Subhanij, Szeto & Zhu, 2007).

2.3 Macroeconomic Analysis of the Real Estate Market

The real estate market is an important industry in a country's economy (Wang, 2003), and it is expected that a stable macroeconomic environment can cause an expansion in the real estate market (Alkali, Sipan & Razali, 2018). The macroeconomic factors mostly influence the owners' capacity to pay for a house, financial costs such as the interest rate and credit conditions that influence mortgage accessibility (Cohen & Karpavičiūtė, 2017).

Égert and Mihaljek (2007) and Adams and Füss (2010) present the supply and demand determinants of housing prices, which are related to economic and financial indicators such as Gross Domestic Product (GDP), unemployment, interest rate, credit conditions, and demographic indicators, e.g., population ageing and migration. Other studies identify several economic factors such as interest rates, economic growth, inflation, bank lending and equity prices (Hofmann, 2003; Tsatsaronis & Zhu, 2004); GDP, population, and unemployment (Égert & Mihaljek, 2007). The main ideas in this study are presented below.

2.3.1 Interest Rate

Real estate prices are strongly linked to the financial system. Considering that home acquisition usually requires external financing, the mortgage rate is an important factor that influences the buyer's decisions on whether to invest in a property. It is expected that an increase in the mortgage rate will have a negative impact on the buyer's decisions. However, Andrews (2010) suggests that due to the tax benefits granted for mortgage interest payments, home buyers may be attracted by governments to buy houses with loans and thus acquire more expensive houses. Furthermore, the mortgage interest rates and bank lending decisions can be affected by various factors that include the monetary policies and the houses' current market values (Goodhart & Hofmann, 2008). Finally, an increase in the availability of bank lending is expected to lower interest rates, which has a positive impact on property prices (Hofmann, 2003).

2.3.2 Inflation

Inflation is another factor that is expected to be negatively related to real estate demand. Bernardi and Rodenholm (2013) state that if inflation is expected, precautions can be taken to prevent financial losses, but if inflation is unexpected, it can provoke financial losses for the investors while certain groups can take advantage of this unexpected increase in prices.

Inflation is also important because of its impact on construction costs and the money supply, which are positively related to the real estate prices (Alkali et al., 2018). Finally, bank lending decisions can also be influenced by inflation, as lower inflation results in lower interest rates. Hence, bigger loans can be offered to households.

2.3.3 Population

Demographic factors can also be important for the housing prices (Égert & Mihaljek, 2007). Housing demand can be influenced by demographic conditions, for example, population growth by migration flows (short run) and new births (long run). In the short run, migration flows have a positive impact on housing prices because of the growth of populations in the receptive locations. However, in the long run, the growth of the population through births is only reflected in the housing demand twenty years later (Panagiotidis & Printzis, 2016).

2.3.4 Unemployment

The level of unemployment, theoretically, is negatively related to housing prices. When unemployment is high, there are fewer buyers in the market, thus leading to a decrease in

housing demand. The unemployment rate can have both a direct and an indirect effect on the housing prices (Gan & Zhang, 2013). Directly, the unemployed population fails to get a mortgage from the banks due to financial constraints, thus reducing the housing demand. In addition, the construction companies (that are the sellers) slow down the construction of new houses because of its expectation of a decrease in buyers. Indirectly, when the unemployment rate increases, it is possible to suppose a negative impact on the expected future incomes of the potential future owners, so they move away from home purchase decisions, causing a negative impact on housing demand and, consequently, on housing prices. However, when the unemployment rate decreases, it is possible to suppose a positive impact on the expected future incomes of the potential future owners, which has a positive impact on the housing demand and, consequently, on the housing prices.

2.3.5 Money Supply

The money supply has a positive influence on housing prices (Adams & Fuss, 2010; Barksenius & Rundell, 2012). Goodhart and Hofmann (2008) explain that an increase in the money supply can cause an increase in asset prices and that, theoretically, an increase in the money supply has a positive impact on housing prices (Goodhart & Hofmann, 2008). However, Xu and Tang (2014) found that the money supply has a negative effect on housing prices.

2.4 The Case of Portugal

2.4.1 The Portuguese Economy

The Portuguese economy has faced many economic changes in the last twenty years. Since entering the European Union, the Portuguese economy has been improving substantially, but it has had periods of lesser brilliance. The period after entering the Eurozone (between 2000 and 2007) was not very positive for the economy, and it was followed by the global great recession and a Eurozone crisis (Morais, 2018). An economic and financial crisis started in Portugal. The GDP growth for that period slowed down to 0.20% and inflation increased to 2.59%, which was also related to the oil prices. The Portuguese GDP decreased 1.83% and inflation increased to 3.65% in 2011 due to a severe financial crisis. Because of the financial and economic conditions, Portugal had to ask for foreign aid. In the following years, the economic situation of the country was not very good, with a high unemployment rate (that increased to 16.2% in 2013) and, because of that, more than 200,000 Portuguese emigrated between 2011 and 2014 (Morais, 2018).

After facing a collapse in the previous five years, the Portuguese economic conditions began to recover by the year 2014 (OECD, 2019). The improvement in economic conditions enabled economic growth of 2.7% to be achieved in 2017, with an increase of 2.3% in GDP in the following year (OECD, 2019), which are good indicators, considering its historic numbers. In these years, it is still possible to perceive a decrease in the unemployment rate and a substantial decrease in emigration (Puig & Sánchez, 2018). In addition, after declining each year between 2009 and 2013, real estate investments have also begun to increase, such as investments in new and existing homes (OECD, 2019).

Nevertheless, the OECD (2019) states that despite the improvement in economic conditions in Portugal, the effects of the previous crisis are still felt, and economic growth is still relatively low in the context of OECD countries. It should also be noted, for example, that public debt has increased a lot during the last few years and stands at 121% of GDP in 2018, which is too high. Araújo, Lourenço and Pereira (2016) expect that the Portuguese economy will continue to grow at a moderate pace in the coming years but be below the growth of the European Union.

2.4.2 Demographics of Portugal

The real estate market is sensitive to changes in the social, demographic, political and economic environments (Račka, 2017). Although there has been an increase in immigration, Portugal has seen a decrease in the total population, which is related to low fertility, declining birth rates, ageing population and migration flows (INE, 2014; Albuquerque, 2015). Hence, from 2008 to 2011, the population decreased from 10.5 million inhabitants to 10.3 million inhabitants. INE (2014) forecasts that the Portuguese population is expected to decline about 4.5% until 2030 and 17.3% until 2060.

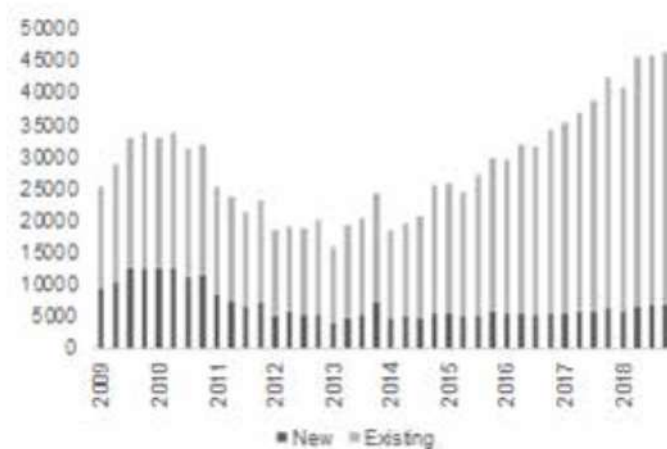
Today, Portugal has a wider variety of foreign inhabitants, which is related to immigration from Portuguese-speaking African Countries (PALOP), Brazil and Asia (Chinese, Indians and Pakistanis), and lately from Eastern European countries (Norte, Mortágua, Rosa, Silva & Santos, 2004). The foreign population is about 3.7% of the Portuguese population (INE, 2012).

2.4.3 Housing Market in Portugal

Between 1999 and 2006, the housing prices in Portugal rose on average less than 1% per year. Then, housing prices declined 4% on average per year between 2007 and 2013. After its lowest level in 2013, housing prices have been increasing by 4% on average per year (Lourenço & Rodrigues, 2017). Over the past few years, there has been a constant increase in housing prices, in nominal and real terms, and new loans continue to grow strongly and spreads have been progressively lower (Banco de Portugal, 2018). In a study about the Portuguese real estate market, Lourenço and Rodrigues (2017) show that housing prices are related to the country's economic growth and interest rates, and if the Portuguese economy continues to improve, the housing prices will also increase.

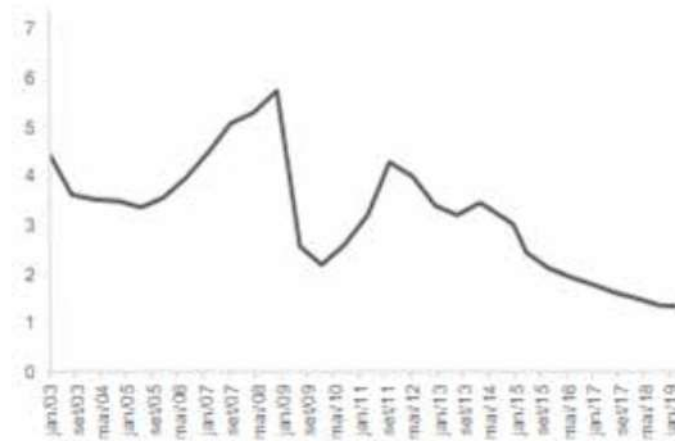
Additionally, Monteiro (2018) explains that the evolution of housing demand can be explained through the number of houses for sale, credit conditions and interest rates. Thus, Figure 1 shows the absolute number of real estate transactions which, on average, have increased since around 2013, showing significantly higher values in 2018 and 2009. Similarly, Figure 2 shows that interest rates have got low values recently. With lower interest rates, it is expected that the amount of loans will increase, which leads to a higher housing demand and the subsequent increase in housing prices.

Figure 1. Number of Transactions of Housing Units



Source: Own elaboration using data from INE

Figure 2. Interest Rates on New-Loan Households



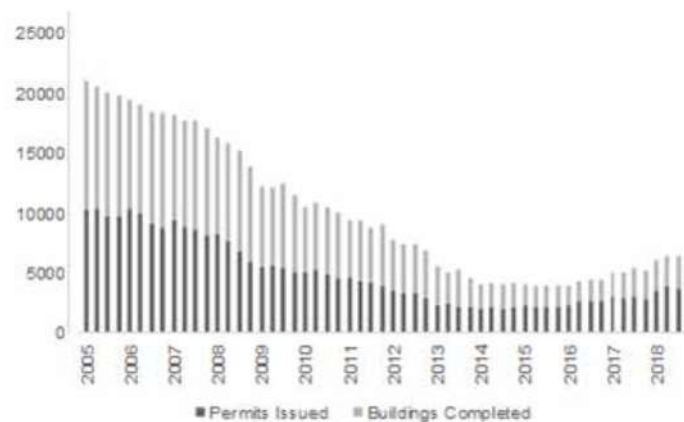
Source: Own elaboration using data from the Bank of Portugal

Figure 3 presents the housing supply in terms of the building permits and the completion of the properties. It can be seen that since 2005, there has been a negative trend in supply, with a gradual decrease until 2014 observed both in building permits and completions. According to the figure, after a stabilized period between 2014 and 2016, it has begun a slow increase (Monteiro, 2018).

There are several studies about how macroeconomic factors influence the housing market in Portugal. Tavares, Pereira and Moreira (2014) studied the Portuguese real estate market between 2001 and 2011, and they found negative impacts of loans, the interest rate and the unemployment rate on housing prices and a positive impact of GDP and construction confidence on housing prices. Besides, Lourenço and Rodrigues (2014) show a positive impact of real disposable income, labour and real interest rates on the Portuguese housing prices.

In another study, Lourenço and Rodrigues (2017) found that housing loans increased 25% in the 1990s and 90% in 2007 due to lower interest rates and higher disposable income, without any impact on the housing prices. With the financial crisis, the interest rates reached the highest values in 2008. Between 2011 and 2017, the interest rates decreased to low levels, which induced an increase in housing demand and, consequently, higher prices.

Figure 3. Building Permits and Completions



Source: Own elaboration using data from the Bank of Portugal

Finally, because Portugal and its cities are becoming more and more important tourist destinations, short-term rentals have emerged in the city centre (Leilani, 2017). Alternatively, foreign investors can buy houses as investments.

3. METHODOLOGY

There are a lot of authors who have studied real estate markets. Barot and Yang (2002) studied the Swedish and United Kingdom (UK) housing markets between 1970 and 1998, and they conclude that household mortgage debt has a positive impact on housing prices because more available loans increase housing demand. This is more important for the housing prices in the UK than in Sweden in the short term but less important in the long term. In a study of the Swedish market between 1987 and 2011, Barksenius and Rundell (2012) found evidence that the bank lending rate, financial wealth, disposable income, unemployment and the money supply are important in relation to the housing prices, both in the short and long terms. Based on a UK database between 1971 and 2012, Xu and Tang (2014) show that construction costs, credit and the GDP have positive impacts on UK housing prices, while money supply and disposable income have a negative impact on housing prices. Analysing the long-term German housing market between 1989 and 2017, Toome (2018) determine the fundamental factors that have influenced housing prices and provide evidence of the cyclicity of German housing market. The perspective of this study is relevant for real-estate investors and home-buyers alike. It can serve as a guideline for navigating in the German housing market and provides insight for investment decisions. This study provides a thorough overview of the German real estate market and housing market in particular. The mechanics of the real estate and housing markets are explained in detail. Furthermore, the difference of fundamental and speculative aspects of housing prices is outlined. The resulting cyclical behavior of real estate markets is elaborated and the formation of bubbles within the real estate markets is discussed. For the econometric analysis Engle-Granger two-step approach is used. In the first step cointegration relationship between variables is determined and the residuals from the regression used as an input for the error correction model (ECM) found that the real long-term interest rate, real construction costs, the unemployment rate and real disposable income are negatively associated with housing prices and that population and housing permits are positively associated with housing prices. All these studies have used the EG method.

3.1 Research Methodology

This work specifically follows the EG cointegration methodology (Engle & Granger, 1987) that is explained by Barot and Yang (2002) and Xu and Tang (2014). The first step involves the analysis of stationarity of all variables after taking the first difference. If stationarity is confirmed, a cointegration regression can be applied. This cointegration regression only studies long-term behaviour and does not analyse short-term effects. Following the cointegration regression, White's test of heteroskedasticity is performed to determine whether the variance of errors in a regression model is constant. At the end, heteroskedasticity-corrected cointegration regression is performed.

In this study, the house price index is the dependent variable in the following specification model:

$$l_nHPI_t = \alpha + \beta_0(l_UNEMP_t) + \beta_1(l_POP_t) + \beta_2(l_LTIR_t) + \beta_3(INF_t) + \beta_4(l_M3_t) + \varepsilon_t \quad [1]$$

The definition of variables in model [1] and its theoretical relationship is presented in Table 1.

3.2 Data Description and Sources

Secondary data have been collected from different databases: the OECD, Instituto Nacional de Estatística (INE) and Banco de Portugal. This study uses quarterly data between the first quarter of 1998 and the second quarter of 2019. The house price index is the dependent variable that is explained by the unemployment rate, population, long-term interest rate, inflation rate and money supply. All variables used in this study are explained in Table 1, along with a description, the sources of the data and the theoretical relationship with house prices. The variables used in this work are based on the specification model of Xu and Tang (2014) and Toome (2018) determine the fundamental factors that have influenced housing prices and provide evidence of the cyclicity of German housing market. The perspective of this study is relevant for real-estate investors and home-buyers alike. It can serve as a guideline for navigating in the German housing market and provides insight for investment decisions. This study provides a thorough overview of the German real estate market and housing market in particular. The mechanics of the real estate and housing markets are explained in detail. Furthermore, the difference of fundamental and speculative aspects of housing prices is outlined. The resulting cyclical behavior of real estate markets is elaborated and the formation of bubbles within the real estate markets is discussed. For the econometric analysis Engle-Granger two-step approach is used. In the first step cointegration relationship between variables is determined and the residuals from the regression used as an input for the error correction model (ECM).

Table 1. Description of Variables

Variable	Abbreviation	Definition	Source	Theoretical relationship
House Price Index	l_nHPI_t	Logarithm of nominal index of residential property prices over time in period t , which is measured by the OECD real house price index. This house price index refers to the sale of new and existing homes, following the recommendations from the Residential Property Prices Indices manual (with data from 1990).	OECD	
Unemployment rate	l_UNEMP_t	Logarithm of the ratio of the working age population who are not employed and thus do not generate income in period t .	INE	-
Population	l_POP_t	Logarithm of the number of inhabitants of a place in period t .	INE	+
Long-term interest rate	l_LTIR_t	Logarithm of long-term interest rates, measured by the government bonds' maturity in ten years. Rates are mainly determined by the price charged by the lender, the risk from the borrower and the fall in the capital value in period t .	OECD	-
Inflation	INF_t	General price increases of goods and services in period t .	Banco de Portugal	+
Money supply	l_M3_t	Logarithm of the money supply is the total value of money available in an economy at a point in time in period t .	INE	+

Source: Own Elaboration

The unemployment rate is negatively related to the housing prices (Égert & Mihaljek, 2007; Adams & Füss, 2010). The housing demand decreases when the unemployment

rate increases because potential buyers do not have the financial capacity to buy a home. However, Xu and Tang (2014) found a positive relationship between these variables because in the UK, the housing market has no obvious correlation between housing prices and unemployment. Hence, further investigation is needed to understand the behaviour of the Portuguese housing prices in relation to changes in the unemployment rate.

Égert and Mihaljek (2007) and Borowiecki (2009) show that population is important to the housing prices. Égert and Mihaljek (2007), Borowiecki (2009), Adams and Fuss (2010), and Xu and Tang (2014) found a strong negative association between interest rates and housing prices. Although there are few studies about the relationship between housing prices and inflation, Hofmann (2003) found that inflation was important in determining housing prices in a pool of industrialized countries. Tsatsaronis and Zhu (2004) showed that a change in the inflation rate has more impact on the total variation in housing prices than real disposable incomes and interest rates. Regarding the monetary factors, Adams and Füss (2010) found a positive effect of the money supply on housing prices in the short term. The following section presents the main results.

4. RESULTS

4.1 Descriptive Statistics

To understand the data used in this study, the descriptive statistics of variables used are in the table below. The nominal house price index has a maximum value of 140.73 in the second quarter of 2019 and the minimum value of 83.62 in the first quarter of 1998. The unemployment rate has a mean of 8.69% and a maximum value of 17.50% in 2013, and it was decreasing until the second quarter of 2019. The Portuguese population stabilized in the period under study at about 10,413,000 inhabitants, with a standard deviation of 125. After increasing slightly until 2009, it started to decrease slightly since 2010. The long-term interest rate reached the maximum values in 2011 and 2012 during the financial crises, and from then on, it fell to very low values, until reaching the minimum value of 0.93 in the last period under analysis. The inflation rate has a relatively low mean of 1.97% and the higher values were in 2001. During the period under analysis, there were negative inflation rates in 2009 and 2014. The money supply had a mean of 144,660 and a standard deviation of 25,662.

Table 2. Descriptive Statistics

	Mean	Median	Standard Deviation	Minimum	Maximum
nHPI	105,73	106,37	10,72	83,62	140,73
UNEMP	8,69	7,80	3,68	3,70	17,50
POP	10 413	10 443	125,15	10 138	10 574
LTIR	4,72	4,36	2,25	0,93	13,22
INF	1,97	2,29	1,42	-1,51	4,79
M3	144 660	147 000	25 662	95 116	207 200

Note: This table presents the database of descriptive statistics, analysing the period between 1st quarter 1998 and 2nd quarter 2019. The variables used are the following: nominal house price index (nHPI); unemployment rate (UNEMP); population or number of inhabitants (POP); long-term interest rates (LTIR); inflation rate (INF); and money supply (M3). See Table 1 for the description of all variables. Number of observations: 86.

Source: Own Elaboration

Table 3 shows the correlation coefficients between the variables used in this study. I_{nHPI} has a strong positive relationship with I_{M3} (0,632) and with I_{LTIR} (0,622). These correlations support the idea that a set of variables can explain the housing prices in Portugal, mainly I_{M3} , I_{LTIR} and INF .

Table 3. Correlation Matrix

Correlation coefficients using all observations 1998:1 - 2019:2
5% critical value (bilateral) = 0,2120 where, n = 86

I_{M3}	I_{UNEMP}	I_{POP}	I_{LTIR}	I_{nHPI}	INF	
1,0000	0,591	0,326	0,348	0,632	0,501	I_{M3}
	1,000	0,420	0,147	0,101	0,524	I_{UNEMP}
		1,000	0,407	0,138	0,093	I_{POP}
			1,000	0,622	0,438	I_{LTIR}
				1,000	0,060	I_{nHPI}
					1,000	INF

Note: This table presents Pearson correlation coefficients that are statistically significant at 5%. See Table 1 for the description of all variables. Number of observations: 86.

Source: Own Elaboration

4.2 Stationarity Test

Before the analysis, it is important to understand whether the time series is stationary or not. Thus, the Augmented Dickey-Fuller (ADF) unit root test is carried out (see Table 4). When the time series data is not stationary, at a significance level of 10%, it should be done the first (or higher) difference of the series until a stationary time series is obtained.

Table 4. Unit Root Test Results

	At level			First difference		
	Test Statistic	p-value	Analysis	Test Statistic	p-value	Analysis
I_{nHPI}	0,219	0,998	Constant and trend	-3,853	0,018	Constant and trend
I_{UNEMP}	0,420	0,999	Constant and trend	-9,220	0,000	Constant and trend
I_{POP}	-3,300	0,073	Constant and trend	-5,213	0,000	Constant and trend
I_{LTIR}	0,325	0,999	Constant and trend	-4,663	0,002	Constant and trend
I_{INF}	-1,346	0,869	Constant and trend	-14,600	0,000	Constant and trend
I_{M3}	-1,373	0,862	Constant and trend	-7,790	0,000	Constant and trend

Note: This table presents the ADF unit root tests of all the variables, at level and after taking the first difference; Null hypothesis of the unit root test: there is a unit root (non-stationary time series). See Table 1 for the description of all variables.

Source: Own Elaboration

The results allow us to understand that only the population variable is stationary at the level. Then, the unit root of the first difference is studied. These results show that all time series are significant and that they are stationary. Thus, the series are stationary after taking the first difference. This means that the EG cointegration method can be applied.

4.3 Engle-Granger Cointegration

To understand the impact of the macroeconomic variables on housing prices, firstly, it is necessary to know whether it is possible to use the cointegration method. The ADF test in Table 5 shows that it is possible to use this method because the *p*-value for this test is lower than the significance level used.

Table 5. Cointegration Estimation

1 st step: Cointegration regression				
Ordinary least Squares, using observations 1998:1-2019:2 (n = 86)				
Dependent variable: <u>1_nHPI</u>				
Variables	Coefficient	Standard error	t-test	p-value
Const	-30,323	3,863	-7,849	<0,001
1_UNEMP	-0,280	0,027	-10,46	<0,001
1_POP	3,360	0,438	7,676	<0,001
1_LTIR	-0,065	0,013	-5,170	<0,001
1_INF	0,922	0,162	5,687	<0,001
1_M3	0,036	0,075	0,485	0,629

R-square: 0,882 / Adjusted R-square: 0,875

2nd step: Unit root test for residuals

Augmented Dickey-Fuller test

Included 4 lags

t= 81

Null hypothesis: a = 1

Statistic test: tau_c(6) = -4,5077

Asymptotic p-value: 0,082

Coefficient of 1st order: 0,055

Lag differences: F (4,76) = 8.368 [0.0000]

Note: This table presents the cointegration test results. The 1st step shows the cointegration regression, with the dependent variable that is the first difference of the nominal house price index (nHPI) and the independent variables are the following: unemployment rate (UNEMP); population (POP); long- term interest rate (LTIR); inflation rate (INF); and money supply (M3). The 2nd step shows the ADF unit root test, with the following null hypothesis: time series is non-stationary, and the variables are non-cointegrated. See Table 1 for the description of all variables.

Source: Own Elaboration

Then, it is important to understand whether the regression results have heteroscedasticity problems. In this way, the White test in Table 6 allows us to understand that there is that kind of problem to solve. Because the null hypothesis must be rejected, there are heteroscedasticity problems. Therefore, the correction of this problem is the following step.

Table 6. White test

White test for heteroscedasticity
Null Hypothesis: without heteroscedasticity
Statistic test: LM = 60,383
p-value = p (Qui-square (20) > 60,383) = <0.001

Note: This table presents the White test. Null hypothesis: Homoscedasticity.

Source: Own Elaboration

Table 7 shows the results of the correction of heteroscedasticity regression regarding the impact of macroeconomic factors on housing prices in Portugal. Results show that, as

expected, unemployment and the interest rate are statistically negatively related to housing prices, but population, inflation and money supply are statistically positively related to the prices of houses in Portugal. These independent variables can explain more than 92% of the variation in housing prices.

Table 7. Correction of Heteroscedasticity Regression

Heteroscedasticity corrected, using observations 1998:1-2019:2 (n = 86)

Dependent variable: **I_nHPI**

<i>Variables</i>	<i>Coefficient</i>	<i>Standard error</i>	<i>t-test</i>	<i>p-value</i>
Const	-30,265	3,3072	-9,151	<0,001
I_UNEMP	-0,236	0,0193	-12,17	<0,001
I_POP	3,231	0,3815	8,470	<0,001
I_LTIR	-0,057	0,0096	-5,931	<0,001
I_INF	0,503	0,1399	3,599	0,001
I_M3	0,281	0,0717	3,921	0,000

R-square: 0,930 / Adjusted R-square: 0,926 / F (5,80): 212,357 / p-value (F): <0,001

Note: This table presents the results of the cointegration regression, with the dependent variable that is the first difference of the nominal house price index (nHPI) and the independent variables are the following: unemployment rate (UNEMP); population (POP); long-term interest rate (LTIR); inflation rate (INF); and money supply (M3). See Table 1 for the description of all variables.

Source: Own Elaboration

These results allow us to confirm the Gan and Zhang (2013) ideas about unemployment because an increase in the unemployment rate lowers a household’s expected future income and induces lower construction of new homes; thus, the housing prices decrease. In addition, Tavares *et al.* (2014), Égert and Mihaljek (2007) and Adams and Füss (2010) found similar results. This study also shows that lower interest rates to finance home acquisitions are related to an increase in housing prices, in which is similar to the findings by Andrews (2010), Égert and Mihaljek (2007), Borowiecki (2009), Adams and Fuss (2010), and Xu and Tang (2014).

In Portugal, in the period of this study, it is evident that the housing prices increased and that it was related to inflation. In addition, Hofmann (2003) and Alkali *et al.* (2018) found that inflation has a positive impact on the construction costs and on real estate prices. Goodhart and Hofmann (2008) studied the impact of the money supply and demonstrated that an increase in it leads to an increase in asset prices, such as housing prices. This study and Adams and Füss (2010) reach the same conclusion. Finally, because of the demand for houses, population is an important factor since there are short-term and long-term positive impacts of population on housing prices. Égert and Mihaljek (2007) and Panagiotidis and Printzis (2016) also state the same.

5. CONCLUSION

The aim of this work was to evaluate which factors have impacts on the housing prices in Portugal. The housing prices in this country rose on average less than 1% per year until the beginning of the international financial crisis in 2007. Then, the housing prices decreased until 2013, and they recovered quickly until reaching the highest value in 2019. Hence, a study to determine the macroeconomic factors that can explain housing prices in Portugal and whether these factors can fully explain the latest price developments is appropriate.

A lot of studies in the last thirty years have used the EG method to analyse how the real estate market is related to the main economic issues of a country. Barot and Yang (2002) showed that in UK and Sweden, debt financing of houses is positively related to housing demand. The impact is more pronounced in the UK in the short term and is greater in Sweden in the long term. Barksenius and Rundell (2012) also showed that in Sweden, the bank lending rate, financial wealth, disposable income, unemployment and the money supply are important in relation to the real estate prices. Xu and Tang (2014) found evidence that construction costs, credit, GDP and the unemployment rate are positively related to UK housing prices and that disposable income and money supply are negatively related to housing prices. Toome (2018) determine the fundamental factors that have influenced housing prices and provide evidence of the cyclicity of German housing market. The perspective of this study is relevant for real-estate investors and home-buyers alike. It can serve as a guideline for navigating in the German housing market and provides insight for investment decisions. This study provides a thorough overview of the German real estate market and housing market in particular. The mechanics of the real estate and housing markets are explained in detail. Furthermore, the difference of fundamental and speculative aspects of housing prices is outlined. The resulting cyclical behavior of real estate markets is elaborated and the formation of bubbles within the real estate markets is discussed. For the econometric analysis Engle-Granger two-step approach is used. In the first step cointegration relationship between variables is determined and the residuals from the regression used as an input for the error correction model (ECM showed that the real interest rate, real construction costs, real disposable income and the unemployment rate are negatively associated and that population and housing permits are positively linked with long-term housing prices in Germany.

In order to understand the determinants of housing prices in Portugal, this paper used data from 1998 to 2019 at a quarterly frequency. To understand the impact of the economic factors on real estate, this paper studied whether inflation, unemployment, population, the long-term interest rate and the money supply were relevant. The EG cointegration methodology was used to reach the empirical results. The cointegration test shows that all factors are significant for studying the real estate market. The results allow us to understand that there is a negative long-run relationship between housing prices and unemployment and between housing prices and the interest rate, while population, inflation and the money supply have positive impacts on housing prices.

In the future, it is important to use other variables to justify housing price evolution, e.g., foreign population or the flow of tourists. Although this study has analysed the impact of economic variables in housing prices in the long term, it would also be very important to understand that impact in the short term. In addition, in order to investigate longer-term dynamics, it would be useful to include longer time series into the analysis. It would also be important to use Vector Error Correction or Vector Autoregressive methodologies.

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