ISCTE Business School
Instituto Universitário de Lisboa

AN EMPIRICAL INVESTIGATION OF THE PORTUGUESE HOUSING PRICES: EVIDENCE FROM THE PERIOD 2004-2018

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- Spine -

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Abstract

Housing market is an essential segment of the whole country's economy. Recently, the rising house prices in Portugal reflects a booming economy. This article presents an integrated macro view of the Portuguese housing market with macroeconomic indicators. Firstly, it compares the housing market and several macroeconomic indicators from 2004 to 2018. Then, the dynamic analysis of the housing prices by different regions in Portugal and its typology included. Also, the article is complemented with the regression analysis to identify the relationship between the house prices and macroeconomic indicators.

Several macroeconomic indicators are incorporated, such as GDP, unemployment rate, short-term interest rates, inflation, personal income, investments, immigration, and housing stock. Results show GDP and the housing prices might have a positive correlation. The unemployment rate might affect the income and continue its impact on consumer behaviour. The level of immigration and foreign investments continue to grow indebted. The current negative interest rates are increasing the demand for houses and the housing prices. The housing stock in Portugal is mostly fixed but may experience limited growth as the rebuild program and new constructions. The housing prices in the Algarve and Lisbon are markedly more expensive than the interior. The demand for the different type of houses tended to focus on personal's need during the recession period. From the regression analysis, the unemployment rate is the closest correlated variable among them. Overall, the housing prices are currently growing and the housing economy and macroeconomic closely related each other.

Keywords: Housing Prices, Housing market, Real estate, Portugal

JEL Classification: R30, R31

Resumo

O mercado imobiliário é um segmento essencial de toda a economia do país. Recentemente, o aumento dos preços da habitação em Portugal reflete uma economia em expansão. Este artigo apresenta uma visão macro integrada do mercado imobiliário português com indicadores macroeconómicos. Em primeiro lugar, compara o mercado da habitação e vários indicadores macroeconómicos de 2004 a 2018. Em seguida, inclui-se a análise dinâmica dos preços da habitação por diferentes regiões de Portugal e a sua tipologia. Além disso, o artigo é complementado com a análise de regressão para identificar a relação entre os preços da habitação e os indicadores macroeconômicos.

Diversos indicadores macroeconômicos são incorporados, como PIB, taxa de desemprego, taxas de juros de curto prazo, inflação, renda pessoal, investimentos, imigração e estoque habitacional. Os resultados mostram que o PIB e os preços da habitação podem ter uma correlação positiva. A taxa de desemprego pode afetar a renda e continuar seu impacto no comportamento do consumidor. O nível de imigração e investimentos estrangeiros continua endividado. As atuais taxas de juros negativas estão aumentando a demanda por moradias e os preços da moradia. O parque habitacional em Portugal é principalmente fixo, mas pode experimentar um crescimento limitado, como o programa de reconstrução e novas construções. Os preços da habitação no Algarve e em Lisboa são marcadamente mais caros do que o interior. A demanda pelos diferentes tipos de casas tendia a se concentrar nas necessidades pessoais durante o período de recessão. A partir da análise de regressão, a taxa de desemprego é a variável correlacionada mais próxima entre eles. No geral, os preços dos imóveis estão crescendo e a economia imobiliária e macroeconômica estão estreitamente relacionadas.

Palavras-chave: Preços da habitação, mercado imobiliário, imobiliário, Portugal

Classificação JEL: R30, R31

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1. Introduction

Apartadas assim da ardente costa

As venturosas naus, levando a proa

Para onde a Natureza tinha posta

A meta Austrina da Esperança Boa,

Levando alegres novas e resposta

Da parte Oriental para Lisboa,

Outra vez cometendo os duros medos

Do mar incerto, tímidos e ledos；

From: Luís Vaz de Camões *Os Lusíadas* O regresso Canto IX, Estrofes 16

Portugal is famous for its navigation and the spirit of exploration in the Age of Discover. This poem above described the scene when the ships returned Lisbon after an exploration journey of the eastern world. It depicted people's hope, fear, excitement, timid and joy. The exciting story happened in the 15th century. What is the life in Portugal now?

Located in southwestern Europe, its western coast makes it possible for Portuguese to enjoy the beautiful beaches and comfortable weather. Due to colonisation and immigration, it is normal that a Portuguese can speak two or three languages. The common foreign languages fluently speaking here are English and French. According to the report from Business Insider, Portugal regarded as 17th on the rank of a country where expats live the happiest lives. Besides, it ranks in the top 5 "dream destination" for expats (Brinded, 2017). The influx of expats has a two-sided impact on this country. It brings in the capital to stimulate the Portuguese economy but also adds burden to the local and increases the social tension.

An example on housing problem, when the increasing immovables under the name of foreigners, the tension between expats and the local emerged. Because a house is an essential need in every household, and it takes a significant portion of personal living expenditure. On the one hand, when it brings capital flowing from abroad, it helps to boom economy of the country. On the other hand, when the foreign investment rises the house prices, it also

becomes a burden of the domestic citizens, as over half of Portuguese rent their homes. Plus, the average salary in Portugal is below the average wage of the majority European countries.

From a country's economic view, the real estate market plays a significant role in its economy. In recent years, the housing prices in Portugal had a high rise since its lowest level in 2013. Nowadays, Portuguese housing market is booming, and the real estate market recovered and kept making new records on the housing prices. By noticing that, the phenomenon in the current Portuguese housing market drives us to the theme of this thesis. With more detail research, we structure this thesis and present an empirical investigation of the recent housing prices in Portugal.

Since the residential property is the most critical component of households' wealth, real estate market prices trends affected households' consumption and investment decisions via wealth effects (Lourenço & Rodrigues, 2015). The importance of asset price is because it affects economic activity (Helbling & Terrones, 2003). Moreover, there are vast studies on the financial crisis happened in 2008 to proof how large fraction of real estate to the overall capital in the economy (Covitz, Liang, & Suarez, 2013; Mishkin, 2011; Baily & Elliott, 2009; Schwarcz, 2008; Agnello, Castro, & Sousa, 2018). Giving the importance of the housing market, the scholars made significant efforts on estimating the housing market and even gave out the predictions to the future market. The housing market plays a crucial component in a country's economy. The regular measurement relies on the level and volatility of housing values, transactions, housing stocks and other administrative data from the government agency.

The thesis turns to the associations between housing prices on the one hand and macroeconomic and economic developments on the other side in Portugal from 2004 to 2018. There are many studies illustrated the significance of the housing market on the macroeconomy. Through the effect of housing wealth on household consumption, on construction activity and the financial sector, housing price movements may strengthen. And on occasion it even creates macroeconomic cycles (Oikarinen, 2014). Oikarinen also stated that the price difference between regions in the housing market could create diversification benefits not only for a housing investor but the whole nation as well. This statement reflects the housing prices inequality between the Algarve and the interior of mainland Portugal regions like the Alentejo and the Cento. Therefore, these issues in housing market motivated us to this thesis.

1.1 Research problem

With the increasing housing prices in Portugal recently, it is of relevance to investigate the current housing market of Portugal and to conceive our own opinions on the heating housing market. Therefore, the objectives of this thesis are to address the following research problems: What is the current performance of the housing market in Portugal? And what is the reason for the phenomenon? On the macroeconomic view, how the macroeconomic indicators and the housing market affect each other? What is the relationship between the indicators and the housing prices?

To answer the questions above, first, we developed research on the related events which had impacts on the Portuguese housing market. Then by collecting the macroeconomic dataset and real housing prices from OECD and Instituto Nacional de Estatisitica (INE) Statistics Portugal, comparisons in graphs and tables were presented to illustrate the situation of the housing prices and the economy. Besides, data analysis methodology was adopted to analyse the relationships further.

1.2 Structure of the thesis

The thesis divided into six governing chapters: Introduction, Literature review, Methodology, Results, Discussion, and Conclusion. The first chapter, Introduction, presents the motivation to the theme of this thesis, the importance of the subject, the research problem and the structure of the thesis. The second chapter, Literature review, provides a review of the literature on four areas of the arguments, Portugal country overview, related events, macroeconomics, housing market and its determinations, housing market studies in Portugal. The third chapter, Methodology, displays the evaluation methods in housing prices and our research strategy. The section initiates with the choices of relevant macroeconomic indicators and the data source. The fourth chapter, Results, represents the findings of our study. These findings further discussed in the chapter of Discussion, where they are additionally related to other reviews and theories. This chapter also implicates suggestions of the findings. Finally, the last chapter, Conclusion, we gave out our main conclusions based on the results and discussion and it follows by the managerial implications. The limitation and our future research also included in the final chapter.

2. Literature review

In this literature review, it includes four sections. In the first section, we present background information about Portugal and its economic overview. Then, we list relevant events which link to the housing market in Portugal. These events vary from politics, financial crisis and others which lead to a possible change of the nation. Thirdly, we concluded those references which illustrate the inner connections between macroeconomics and the housing market. And the further reviews include the housing market determinations. The last section is about the studies of Portuguese housing market, which refers to the housing stock, housing market comparisons, the determinants of housing prices in Portugal, the market evaluation, housing demand, etc.

2.1 Portugal country overview

"Where is the best place in the world for you to retire?" An article from Live and Invest Overseas website (2018) announced that Algarve got the only A+ place in their latest annual overseas retirement index ranking, and it won the first place of the global ranking. Apart from the Algarve, the capital city of Portugal, Lisbon is also on the top 10, which was ranked 7th. This American ranking compared in 13 categories, which has a completed consideration including cost of living, crime and safety, English speaking, entertainment, environmental conditions, expat community, health care, infrastructure, real estate affordability, real estate restrictions, recreation, residency options, and taxes. Their ranking is useful advice for investment purpose of companies and also individual investors. All in all, there is no doubt that Portugal has considered an excellent choice for living and entertainment.

Portugal or its official name Portuguese Republic located in southwestern Europe including the continental part and two autonomous regions (the Azores and the Madeira). Lisbon is the capital city of Portugal with the densest population of the national average. The figure of the Portuguese population in 2018 is 10,291,196 (Worldometers, 2018). With a territory surface area of 92,090 square kilometres, the population density indicates that the citizens prefer to live near the ocean and its coastlines such as the capital city Lisbon and the second largest city Porto. Located in the western edge of Europe, the climate of Portugal is Mediterranean climate, which leads it became one of the mildest countries in European. The average annual temperature in mainland Portugal ranges from 17 ℃ to 26℃. From winter until the early spring it has lots of rains, sometimes there are typically windy. But after this period,

Portugal's summers are mild and comfortable. Besides, the long period of sunny days attracts thousands of tourists to travel here, which has about 2500-3200 hours of sunshine a year.

The mildest climate and beautiful beaches contribute to its tourism industry, which is an integral part of the country's economy. As a capital city of European countries, Lisbon makes it possible to enjoy a high quality of living with a low cost of life expenditure. Recent years, it appears many times on different kinds of the top travel list. Last year, tourists were over 50 million. Some of them decided to settle down in Portugal or start a plan to invest their future retired life here. Based on a report of the World Travel & Tourism Council, the total contribution of travel and tourism to GDP in 2017 rise to 17.3% of GDP with EUR 33.5 billion (Turner, 2018).

According to the report of WEF's Global Competitiveness for 2017-2018, Portugal ranked 42nd. As per data from the World Bank and International Monetary Fund, Portuguese GDP is $326,029,976,815 in 2017 with the annual GDP growth rate of 2.68%. The main sector of its GDP is Trade and Service, which occupied 74.8% of the GDP. The following are Industry (22.6%) and Agriculture (2.6%) (World Bank, 2017; IMF, 2017). In 1986, Portugal joined the European Union and kept a stable pace to its modernisation. The country was awarded the European Monetary Union (EMU) status in 1998 and began to circulate the Euro with the other 11 EU member states since 2002.

In this Europe's far-western edge country, the long-term underestimated and neglect reserved its history and the traditional lifestyle of Portuguese, unfortunately, slumping the economy. In the European Sovereign Debt Crisis, Portugal became "famous" with its peer PIGS countries, which are Portugal, Italy, Greece, and Spain. In fact, before the crisis, the poor performance of the Portuguese economy was noted by The Economist magazine in April 2007. An article came out with a label that Portugal was "A new man sick in Europe". In April 2011, Portugal was bailed out by the IMF (International Monetary Fund). Owing to the consequence of the debt crisis, Portugal noticed, and it started to present itself in a new, opening, and modern way to step into the global stage.

After the three-year support package from the IMF, in May 2014, Portugal put its economy back on track with the economic reform. With several-year accumulation, there was positive news about this country. As the increasing investment and export, Portugal stated in 2016 that excessive deficit procedures no longer constrained it. The banking system was stable. The economy of Portugal was recovering. Compared to other PIGS countries, the performance of

Portugal in recent years standed out. Currently, Portugal is in a continuing growth with its outside investments and its internal entrepreneurs. There are many leading companies in Portugal with a worldwide reputation, such as The Navigator Company, Sonae Indústria, Amorim, Conservas Ramirez, Cimpor, EDP Renováveis, Jerónimo Martins, TAP Air Portugal etc.

2.2 Related events

2.2.1 Immigrants and tax treaties

The migration from the United Kingdom to Portugal started from the 1990s (BBC, 2018). And the number of immigrants rapidly increased after that. The Algarve was the most popular region among British retirement plan of Portugal, which showed the same result as the Live and Invests Overseas ranking website we mentioned above. The British citizens who want to set up their life in Portugal were also concerned about the taxation between two countries. To avoid double taxation, the United Kingdom and Portugal have an income tax convention since 1968, based on the government document published in 1968 (GOV.UK, 2013). These tax treaties allow British citizens who have the Tax residence in Portugal, do not pay tax on their income from their pensions for the first ten years. With the benefits of this treaties, groups of British merged to invest in the Algarve.

Gradually, these residential real estates in the Algarve became great expat English speaking communities, which helped it transfer to a famous tourist destination for people all over the world. People from Germany, Netherlands, Ireland etc. came to the Algarve to spend their holidays. In the meanwhile, there were more foreign investment flow in the Algarve as well as the whole country. Moreover, in recent years, the tourists extended from Europe to other continents, the number of tourists from Canada, American, Australia and Asia increased. Nowadays, besides British citizens, the tax benefits also extended to other foreign investors since 2009 when the non-habitual residence (NHR) tax regime introduced. This program aims to bring in the investment into Portugal. For the country and foreign businessperson, it is a win-win outcome. Because it benefits for an individual in their first ten years of residence tax in Portugal, meanwhile the foreign investment is an incentive for the Portuguese economy.

2.2.2 Golden visa

In order to recover from the Portuguese financial crisis (2010-2013), which followed the European Sovereign debt crisis, in 2012 the Portuguese government offers the golden visa to

encourage investment from non-EU/EFTA nationals. From October 8, 2012, the launch of this program, to January 2018, there is 5,717 total global investors applying for Portuguese golden visas. The Portuguese Immigration Service recently published the full total investment has now reached over 3.51 billion Euros. The investment in golden visas mainly come from China, Brazil, and South Africa. In 2017, according to data from SEF (Portuguese Immigration and Borders Service), the accumulated investment coming from China was over 2 billion Euros, which weighted five times more than other countries' investment (ECO News, 2018).

Through 6 years of Portugal's golden visa program, the data from SEF reveals that China remains the top source of investors. Besides, over 99% of the golden visas have issued through property investment. Only a small portion of the invests are for business set up. Nevertheless, these two ways can both increase the employment rate of Portugal and contribute to the national income. On the stage of recovering the economy, it is essential to accumulate the capital. Because based on the Solow-Swan growth model, a long-run economic growth deters by the interaction among the capital accumulation, the labour force or population, and advances in technology in an economy as well as the influence to a nation's total output of goods and services.

2.2.3 The crisis

The European Sovereign debt had a massive impact on the Portuguese economy, and it triggered the Portuguese financial crisis between 2011 and 2013. The European Sovereign debt crisis happened at the end of 2009 when the United States was beginning to recover from its economic crisis of 2008-2009. The impact is global because the globalisation connects the continents and penetrates countries among each other. When the United States suffered in the financial crisis, another crisis erupted in the Eurozone. The Eurozone is those countries who are using Euro as their currency. There are 19 countries of 28 entire countries who belong to the European Union using Euro as their common currency. Portugal is one of the earliest countries who joined in Eurozone in 2002.

The crisis stemmed from debt issued by the government called sovereign debt (Mankiw, 2016: 601-602). When the debt released, European banks and bank regulators bought and owned a significant amount of sovereign debt as they considered sovereign debt was as risk-free. William Parrott, a lecturer of Kaplan Financial (2014), said that the principle rules required Eurozone members to own that government debt did not exceed 60% of GDP and

any budget deficit should not exceed 3% of GDP. This requirement worked in the excellent credit rating countries, but not in low credit rating countries. The famous PIGS countries used too much of the available credit to buy and buy more. This large amount of acquisition showed an illusion of the generous social system and construction boom, while the payment deficits cannot be balanced.

When the financial crisis started in the United States, the problem of banks liquidity emerged. Plus, as years passed after the debt launching, the growth of the loans made the government, and some private organisation failed to repay to the debts. The failure of these countries is also linked back to the Eurozone. The standard single currency tied them to a united group with the same policies and rules. These countries do not have the power to devalue their money or the monetary policy flexibility to solve the situation by themselves. A currency was assumed to establish for a country while the Eurozone members are using the same currency, Euro. Like the old saying, every coin has two sides. The lack of firm and decisive action of member countries, which burdened the crisis. But the single currency provides its benefits for a stable trade circumstance for those countries.

On 13 July 2010, BBC News published that the Moody's Investors Service downgraded Portugal's sovereign bond, which had a massive impact on Portuguese government bonds. During this global financial crisis, interest rates for the various central banks in the United States and Europe moved close to zero. Because of the interest rates, consumers choose to avoid bonds and keep their funds in savings. The tightening credit numbers were an effect on both the supply and the demand during the debt crisis (Tavares, Pereira & Moreira, 2014).

Some economists, for instance, Krugman (2010) describe this situation as a liquidity trap. He announced that "You are in a liquidity trap when conventional open-market operations – purchases of short-term government debt by the central bank – have lost traction because short-term rates are close to zero." He also pointed out that almost all advanced countries at that time were in a liquidity trap. With no doubt, the Eurozone, who are governed by multiple states, cannot implement the way as Federal style.

By following the steps of its peer PIGS countries, this liquidity trap drove Portugal to request a financial bailout from the International Monetary Fund (IMF) and the European Financial Stabilization Fund (EFSF). Even if the liquidity problem eased, the economic pain resulting from the crisis was nonetheless substantial and long-lasting. For example, the unemployment

rate from 2010 started to go up sharply and until its peak in 2013. Only then it began to drop down. During this period the Portuguese economy was suffered in the recession.

2.2.4 Rising house prices and the local

The trigger of the 2008 crisis was a substantial boom in the housing market of the United States. The Federal Reserve pulled down the interest rates to recover the recession of 2001 by making it less challenging to loan a mortgage for buying a home. This measurement rises the housing prices. In a short period, the more people bought houses, the more housing prices increased. In the end, the bubbles of the housing prices would burst, because the high cost of housing is unsustainable.

Back to the Portuguese real estate market these years, the housing prices were kept going up with low interest rates. On the one hand, it is helpful to the economic recovery. On the other side, the fast-growing housing prices should equip with the relevant facilities. Otherwise, it might cause the next crisis in the housing market. There was a large number of house purchases made by foreign investors. When the foreign consumers bought the houses at a high price, they might want to sell at a higher price to earn the difference. Recently, there was plenty of news reporting that the housing prices and the number of transactions in property made one after another new record. As the increasing purchases are making, the housing prices are rising as an outcome.

Nowadays, a vast number of formerly accessible areas of Portugal, especially in Lisbon are undergoing a rapid change in its international profile (Barchfield, 2018). When foreign visitors and home buyers like golden visa investors have widely credited Portugal and helped to lift it out of the debt crisis, the profile of Portugal is becoming more international. As in the booming of real estate and tourism of Lisbon, the city face is updating quickly, plenty of houses and buildings are renovating. This old and traditional capital on Europe's western-edge is changing. Patrícia Barão, the head of the residential department in company JLL of Portugal said that her firm's clients included citizens of 50 foreign countries, and her top clients are from Brazil, France, China, Turkey and South African instead of her native country.

The average salary in Portugal is low, which pushed the majority Portuguese citizen out of the city centres and into new developments in the suburbs. The local Portuguese cannot afford for the present high housing prices, which was made by the international investment. With a

national minimum wage of 580 Euros a month, Portugal remains an impoverished nation in Europe. On the other view of the living quality, life expenditure in Lisbon is quite low compared to other European capital cities. And the reason is because of its low wage. Ironically, that makes Portugal more attractive in the international investment list. The dilemma is that the house prices and cheap life expenditure are proper for foreign investors while unaffordable for the native citizens. Based on a government survey at the beginning of 2018 estimated that there are 26,000 families are living in "undignified" conditions.

Luckily, in April 2018, the mayor of Lisbon, Fernando Medina announced some measurements to ease the housing crunch for the locals. He mentioned turning the derelict building in the city centre to the rent-controlled apartment for people. The idea of the measurements from the city council was great. However, the house prices in the city centre are mainly the most expensive area. For example, the city centre of Lisbon is also a historic centre, like Castelo and Alfama. The housing price in this area increased up to 60% compared to the previous years. The cost of a house in this neighbourhood was almost as expensive as the houses in Paris.

2.2.5 Short-term rental business in the city centre

Another factor is short-term rental business. Similar to other well-known European travel destinations, Portugal and its cities are also popular on the tourist list. The emerging of short-term rental properties in the city centre is unavoidable. And the core competitiveness of this short-term rentals business is because the properties are located in the authentic historical region of each tourism city. Their business model is that the hosts or the owners who rent out their private property to short-term subletters, which has a different concept of the hotel industry. The room it offered is from private property, which let the tourists feel they are closer to the local families.

Because some investors bought houses as an investment, and the majority of them do not have a long period of stay in Portugal. They chose short-term rental business because it can maintain the apartment with a better profit on their investment. With the golden visa and other expat benefits, there are no doubts that the houses in the city centre are more attractive for foreigners to buy and transfer it to short-term rental houses.

Airbnb is the largest peer-to-peer exchange service for hospitality around the world. From a rapid growth of Airbnb in 2008, until now, it keeps growing. Along with an influence on the

residential real estate market and house prices, a report stated that the concentration of short-term rentals via Airbnb might depress the quiet residential neighbourhoods, which decreased the living satisfaction but at the meanwhile increased the housing prices (Sheppard, & Udell, 2016).

Due to the effects of short-term rental business, the houses from residences for families are transforming to short-term rentals. It added the tragedy because it is difficult for the local Portuguese neither to buy or to rent a house to live in the city centre when we link it with the above issue that the local cannot afford to live in the city centre. There is a comparison of the rental price from the real estate consultant CBRE, the increase rate of average rent in 2016 (av. €830/month) was 23% compared to its last year (Euronews, 2017), and the figure in 2017 was continuing in an increasing rate.

In recent years, the government noticed the severe problems of the short-term rental industry, as it might threaten the city born Portuguese outside of their city. In the latest news on 11 October 2018, it said that a new local accommodation law handled by the City Council of Lisbon, which comes into October 22, 2018, would suspend the new registrations of local accommodation in five districts of Lisbon. These five districts are Bairro Alto, Madragoa, Castelo, Alfama, and Mouraria, which are the historic downtown in Lisbon. And there are more areas on the monitoring list, which are Baixa, Avenida da Liberdade, Avenida da República, etc. (Francisco, 2018). These areas are the heart centre of the city of Lisbon. It indicates the government is on their actions.

2.3 Macroeconomics, housing market and its determinations

The housing industry is an essential segment of the whole country's economy. Take the golden visa as an example, its chief investment focus on the real estate market. Another significant evident is the 2008 financial crisis in the United States, which started from the housing market and spread to the other industry of the United States. Indeed, the real estate market is an indicator of its national economies. Because of the interconnection between the housing market and macroeconomics, we searched reviews and studies to identify the indicators.

Varies researchers analysed the link between macroeconomics and the housing market. An early study wrote by Fisher about the debt-deflation theory of Great depressions appeared in 1933. In this article, Irving Fisher related the macroeconomics and housing market (Fisher,

1933). Actually, in the early years, conventional housing economics and urban economics research virtually ignored interactions between housing markets and macroeconomy (Leung, 2004). Based on our study, the early stage of papers on macroeconomic variables which used as exogenous control variables in the theoretical and empirical analyses to analyse housing economics included inflation, GDP, and unemployment (Henderson, 2004; Cheshire & Mills, 1999; Mills, 1987; Nijkamp, 1986).

On the contrary, the researchers in finance area had more efforts to link macroeconomics to the housing market. They considered macroeconomy can rationally explain the housing market phenomenon. And they connected the macroeconomics and housing literature (Constantinides, Harris, & Stulz, 2003).

Recently, the investigation on the macroeconomics and real estate housing market are growing. And researchers tend to focus on linking the macro indicators with the housing economy (Álvarez & Cabrero, 2010; Adams & Füss, 2010; Tsatsaronis & Zhu, 2004; Goodhart & Hofmann, 2008; Andrews, 2010; Greiber & Setzer, 2007; Lee, 2009).

According to the conclusion of researcher Charles Leung (2004), the significant fluctuations in housing prices imply significant variations in wealth, and thus potentially significant household wealth effects. Housing prices are leading indicators to illustrate the real estate housing market.

In measuring the value of the domestic economic activity, GDP is considered the best measure of how well an economy is performing (Mankiw, 2016: 18). Additionally, an economic boom always comes along with the increase of national income which also drags the demand for housing. As the inflow of foreign investment in Portugal, a considerable income grows. Therefore, the GDP and household disposable income among Portuguese should include in the analysis.

Regarding the income, we also took aware of the unemployment rate, which influences the volatility of the national income. Some papers had investigated studies of the housing market and unemployment since years ago. The article, “The Housing Market and Europe’s Unemployment”, compared the unemployment rate in Spain and Switzerland to introduce the way how to put Europe citizens back to work by reducing home ownership (Oswald, 1999).

Regarding the homeownership, it is necessary to mention the immigration and housing problems. The model of the housing market was set up by two parts. First, the demand for the

existing houses determines the equilibrium housing prices. Then, the housing prices determine the flow of residential investment (Mankiw, 2016: 523). Due to the golden visa and tax benefits program, foreign investment flew in and new immigrants, which drives the demand for housing.

Mankiw (2016: 524) discussed the supply and demand of the housing market. It announced that the residential investment depends on the relative price of housing, in turn, the relative of the house depends on the demand for housing. The importance of interest rates is to stimulate the demand on house market, which is widely considered and agreed within many articles (Sutton, Mihaljek, & Subelyte, 2017; Tsatsaronis & Zhu, 2004; Kuttner & Shim, 2016; Andrews, 2010). The main reason for the importance of interest rates is because the mortgages which people used to buy houses.

Since the real estate market has a strong connection to the national economies, another factor is the monetary policy of the country (Greiber & Setzer, 2007). The monetary system is essential in a country scale because it contains the regulation in the trade market, tax policy, the credit availability and other political elements.

Considering the demand-supply model, the supply, housing stock in Portugal is also critical to the housing market. The number of new houses and its growth rate, the reconstruction from the city rebuild program. Along with the residential investment from the government and individuals also determined the housing supply.

2.4 Housing market studies in Portugal

Back to the housing market research in Portugal, there are published studies of the Portuguese real estate market. In 2009, Fátima Loureiro Matos concluded the housing conditions in Portugal. She provided insights by analysing the housing dynamic from 1991 to 2001. Based on her study, the rise in house number and quality have been improved by the government's housing programs, but there were still significant housing deficiencies. Meanwhile, during this period, there was a change in the housing occupancy and ownership by the growth of seasonal housing stock (Matos, 2009).

In her another study (Matos, 2012), the housing market in Portugal compared with the European Union. The characteristic of owner-occupied housing and the changed attitude of the housing market continued affected Portuguese, which drove to a rise in the importance of

location, the quality of materials and spaces, environmental sustainability, and architectural and urban innovation.

Another Comparison study in house prices (Lourenço & Rodrigues, 2014) is between Portugal and Spain. These two south-west countries have many commonalities as well as differences. In this article, they provided evidence on these differences and tried to explain the behaviour of their housing prices patterns. They announced the residential investment had been slowed down since the end of the 90's in Portugal, and the models showed the real disposable income, labour and real interest rates are relevant in determining the dynamics of house prices.

In 2017, after the debt crisis in Portugal, Lourenço and Rodrigues (2017) did another study on how the crisis affects the Portuguese house prices. They analysed the driving factors of house price movements from residential investment (GFCF), GDP, labour market, interest rates, housing loans, foreign direct investment in housing. From their study, interest rates and economic growth had highlighted for the impact on house price growth. They mentioned the rising house prices in 2017 were still below pre-crisis levels in real terms. The fell from the residential investment may prevent the house prices to drop more because it contracted the housing demand. Then the foreign investment may have stopped the continuous fall in house prices. Moreover, the low-interest rates might influence the future house prices. From their Probit model, the house prices would continue to grow.

Besides, an evaluation of the Portuguese residential real estate market in the decade of 2001-2011 wrote by Tavares, Pereira and Moreira (2014) gave us a full image of the Portuguese real estate market. In this paper, they analysed the average house prices by its locations and typologies, and they also considered the housing market with several macroeconomic indicators, which were GDP, interest rates, construction confidence index, unemployment etc. In their conclusion, the low-interest rates after entering the Eurozone was the cause of the increasing mortgage loans at that time. They concluded the fall of new houses made by the worrying construction confidence index and consumer confidence index. Besides, the youth unemployment rate is a damaging factor for the real estate market. The global market and the worldwide financial crisis burdened the Portuguese economy. On the other part of their study, the housing market in the Algarve was influenced by tourism and the demand for B1 and B2 led the increase of housing prices in the Algarve but not affected in the whole country.

In 2016, another paper was published by them. This time Tavares, Pereira and Moreira analysed the relationship between rental income and capitalisation rates in Lisbon and Porto. By using the income approach, they compared two types of the apartment (two-bedroom and one-bedroom) in Lisbon and Porto (Tavares, Pereira & Moreira, 2016). These three authors had some other studies on the appraisal of the Portuguese real estate market in Portuguese journals. One of their earlier studies in 2012, they conducted an assessment by using hedonic models to analyse the differences in housing prices in Portugal, and it published in Portuguese language periodicals.

With the same methodology, hedonic pricing model, Bhattacharjee and Marques (2012); Macdonald and Franco (2015) also used this method to analyse the Portuguese housing market in Aveiro; and Lisbon, respectively. Concerning the determinants of the housing prices, there were many types of research on it. An interesting study was done by the Portuguese researchers, Ferreira and Jalali (2015), focused on the home sales determinants. They used Fuzzy cognitive mapping method to identify its fundamental determinants, house prices and housing attributes were considered to have impacts on the home sales.

Also, there is a case study to investigate the patterns of housing demand under uncertainty in Lisbon (Pinto, 2012). The author constructed a questionnaire to find out several questions, such as the intention of people to move houses, buy or rent an apartment, and what is the most concerned factor for the respondents, etc. From her research, the demand for rental accommodation was growing with an uncertain and insecure economic and financial situation together with the real estate crisis. And the clarification of the economic environment appeared to be more critical than individual circumstances. Apart from that, she also discussed the constraints of the real estate market, and the new changed in the cultural and social context which influenced people's buy/rent decision.

Besides, there is information from local Portuguese journals, the statistics organisations and official institutions, such as Instituto Nacional de Estatisitica (INE) Statistics Portugal, PORDATA, Banco de Portugal etc. There are high-quality articles and reports in their periodical published works and the annuals.

3. Methodology

In this chapter, we first review on the methods of the housing market. Then we sort out the determinants leading to the housing prices by analysing the country macroeconomic indicators. And we clear the definition of the data source we used in this study. The research strategies focus on the dynamic analysis of the housing market as well as the statistical data analysis in constructing regression models to illustrate the indicators and housing prices further.

3.1 Methodology in housing evaluation

To give a proper assessment of a real estate price is difficult because it required the information from players in the different field of the housing market (Pagourtzi et al., 2003). The market players include real estate agents, property developers, brokers, appraisers, mortgage lenders, investors, and other specialists and consultants. Tavares, Moreira, and Pereira (2012), they stated in their study that the information asymmetry might cause the distortions of housing prices. A completed price evaluation of the housing market, it is difficult to achieve. Because it requires to collect all the information from the varies market players and confirm that all of them were correct. Despite the difficulties, the researchers in this field devoted themselves to develop proper valuation methods in order to lower down the chance of errors.

In general, the role of an accurate property value estimate should reflect the market culture and conditions at the time of the valuation (Pagourtzi et al. 2003). After viewing the methods of valuing the housing prices, we found there are two directions of evaluating the housing prices, which are conventional approaches and advanced ones. A group of researchers, Pagourtzi et al. (2003) gave a completed overview of those methods. They concluded the traditional valuation methods were comparable methods, investment/income method, profit method, development/residual method, the contractor's method/cost method, multiple regression method, and stepwise regression methods. On the other hand, in advanced valuation methods, it contains fuzzy logic, artificial neural networks (ANNs), hedonic pricing methods, and autoregressive integrated moving average (ARIMA).

The recent trend in the business appraisal was using the scientific methodology which relies on the foundation of quantitative data (Marcos, Luiz et al. 2005) or based on the geographical approaches (Adair & Hutchison, 2005; Olmo, 2007). In the business evaluation, the sales

comparative method commonly used. Because by comparing a property with recently sold properties with similar characteristics, it is easier to give out a proper appraisal within a short time period. Another important technique is the income method. This method focuses on the investment and profits aspects of the house value (Trojanek, 2010).

In terms of advanced methods, we found that there are a large number of housing price estimations based on hedonic pricing methods. According to a study by Engle, Lilien and Watson (1984), the hedonic indices are well-studied procedure initiated by Griliches (1961) and introduced into housing economics by Ridker and Henning (1967). In the following years, more researchers developed the hedonic pricing methods in its functional form, integration over markets and estimations (Butler, 1980; Linneman, 1980; Kain & Quigley, 1975; Grether & Mieszkowsiki, 1974, 1980; Straszheim, 1973 & 1975). This method requires a value of particular environmental attributes, such as the characteristics of the property, location, and environment, which are different aspect determinants of our goal.

Based on the classification of Pagourtzi et al. (2003), they grouped two type of regression methods, Multiple regression method and Stepwise regression method. Stepwise regression found when researchers adjusted and examined their regression model. A study conducted by Liebscher (2012), "A Universal Selection Methods in Linear Regression Models", figured out a new rule for the selection of a suitable sub-model which introduced from parameter tests. And by following this selection rule, the misselection error can be controlled uniformly.

The methods we used in this paper are multiple linear regression method. According to Aiken, West, and Pitts (2003), the multiple regression analysis (MR) is a highly flexible system for examining the relationship of a collection of independent variables (or predictors) to a single dependent variable (or criterion). As we know that the multiple regression analysis is based on the correlation analysis and the scatter plot, which is an extension of simple linear regression. A plot of single variable X and a single variable Y is known as simple linear regression. Linear regression uses the sample data to estimate the unknown model parameters by linear predictor functions to identify the relationship between a scalar response (or dependent variable) and one or more explanatory variables (or independent variables). Freedman (2009) refers to the difference between simple regression and multiple regression in his book that "A simple regression equation has on the right-hand side an intercept and an explanatory variable with a slope coefficient. A multiple regression equation has two or more

explanatory variables on the right-hand side, each with its slope coefficient." Therefore, in modelling the equation, we adopted a multiple linear regression model.

3.2 Relevant macroeconomics indicators and data source

Housing prices are affected by various factors, from interest rates, economic growth to its location and house attributes. No matter which methods we mentioned above, a reasonable valuation and a proper model both depend on the accurate collection of data. All the data we found here were from the official database websites, which included OECD database and Instituto Nacional de Estatisitica (INE) Statistics Portugal. We concluded the data described in Annexes 1 (except the dataset used in regression analysis). Based on the Literature review (2.3 & 2.4), we sorted the relevant macroeconomics indicators in nine groups, which are: GDP, Unemployment, Inflation and CPI, Housing market, Interest rate, Household disposable income, Investment, Immigration, and Housing stock. The explanation of indicators are as follows:

Gross domestic product (GDP):

GDP is a monetary measurement of a country's economic performance. Regarding the definition, the OECD defines it as "An aggregate measure of production equal to the sum of the gross values added of all resident and institutional units engaged in production." IMF gave another definition stated that "GDP measures the monetary value of final goods and service – that are bought by the final user-produced in a country in a given period (Callen, 2017)." Therefore, GDP is a reasonable metric to present the economic performance of a country. We used quarterly GDP from OECD (Q1 2004 - Q2 2018).

Unemployment:

Unemployment is also called joblessness, which means the situation of actively looking for employment but not being currently employed. The calculation of the unemployment rate is to divide the number of unemployed individuals by all individuals now in the labour force. Due to the different way of measuring unemployed workers, organisations adjust data on unemployment for comparability across countries. The statistical office of the European Union (Eurostat), defines "Unemployed as those persons age 15 to 74 who are not working, have looked for work in the last four weeks, and ready to start work within two weeks." This definition applies to the European Union countries, including Portugal. In this group, we

collected the data from OECD including the unemployment rate and the youth unemployment rate. The data reference period is also from Q1 2004 - Q2 2018.

Inflation and consumer price index:

In economics glossary, the inflation is a sustained increase in the price level of goods and services in an economy over a period (Wyplosz & Burda, 1997; Barro, 1997; Abel & Bernanke 1995). According to the definition of Investopedia, "The Consumer Price Index (CPI) is a measure that examines the weighted average of prices of a basket of consumer goods and services. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them." The CPI is widely used to measure the inflation and shows how the government's economic policy works.

The inflation is a percentage change in a price index over time. The inflation (CPI) dataset (Q1 2004 - Q2 2018) we used here is from OECD, this inflation measured by consumer price index (CPI) defined as "The change in the prices of a basket of goods and services that are typically purchased by specific groups of households. It measured concerning the annual growth rate and an index, 2015 base year with a breakdown for food, energy and total excluding food and energy (OECD, 2018)." Besides, we used the dataset form INE Statistics Portugal. We chose the harmonised index of consumer prices. This index reflects the amount paid by households when acquiring personal goods and services based on monetary transactions (INE MetaData, 2018). In the dimension of this index, they divided it by individual consumption by purpose. Based on the personal consumption purpose, we chose the total consumption index and the consumption index on housing, water, electricity, gas and other fuels. They are the monthly dataset, and the term we used is from January 2004 - August 2018.

Housing market:

The house prices are the most common indicators in the housing market. Another indicator we used is the purchase and sales of the houses. In statistics, house prices were used to identify the index price of residential property prices over time. There are different indicators of house prices, for example, House price index (HPI) or called Residential property price indices (RPPI). HPI or RPPI measures the price changes of residential housing, which widely used in hedonic regression models. In the definition of OECD indicators, the housing prices include rent prices, real and nominal house prices, and rations of cost to rent and cost to

income. To further explain, the nominal house price covers the sale of newly-built and existing dwellings. The quota of nominal price gives the real house price to the consumers' expenditure deflator in each country. The cost to income ratio is the nominal house price divided by the nominal disposable income per head and can consider as a measure of affordability (OECD, 2018). From the above indicators, we extracted Real house price from the OECD website. In the following studies, we would use the quarterly Real house price and yearly Real house price in Q1 2004 - Q2 2018 and 2004-2017 respectively.

From another data source, INE, the average housing prices evaluating by the bank collected. This housing prices indicator is a completed dataset of the Average value of bank evaluation (€/m^2) by geographic localisation and dwelling typology. The dataset we found is from September 2008 - July 2018. In geographic dimension, it includes Portugal (the whole country scale), Norte, Centro, Área Metropolitana de Lisboa, Alentejo, Algarve, Região Autónoma dos Açores, Região Autónoma da Madeira. Regarding typology, it contains B2 (two-bedrooms), B3 (three-bedrooms), and B4 (four-bedrooms). B2 stands for the houses that have two bedrooms, a living room and a kitchen. B3 represents one with three bedrooms, a living room, and a kitchen. B4 is the same but with four bedrooms. Due to the deficit of the dataset, we failed to collect the B1 or other types of buildings in the database of INE. However, according to the feedback from INE, the dataset of B2, B3, and B4 can fully explain the typology situation in Portugal.

Another dataset from INE is the yearly figure from 2004-2017 of the amount values in Purchase and sale contracts. This purchase includes any fraction of territory, including waters, plantations, buildings and constructions of any kind based there permanently. The Purchase and sale contracts provided that it is part of the assets of a natural or legal person. In normal circumstances, the territory has an economic value, together with waters, plantations, buildings and constructions in the above items with financial autonomy with the land on which they are located (Metadata INE, 2018).

Interest rates:

Interest rates had been profound that it has a significant influence on house prices, mainly because it changes the cost of mortgage payments. In the Business English definition of Cambridge Dictionary, "The interest rates are the percentage amount that you pay for borrowing money, or get for the lending money, for a period, usually a year." The fluctuation of the interest rates depend on varies factors, at the same time, it is also a vital tool of

monetary policy for accomplishing the government goals. In the OECD dataset, there are long-term interest rates and short-term interest rates. “Long-term interest rates refer to government bonds maturing in ten years (OECD, 2018).” “Short-term interest rates are the rates at which short-term borrowings effect between financial institutions or the rate at which short-term government paper is issued or traded in the market (OECD, 2018).” We used quarterly short and long-term interest rates from OECD, and the periods are from Q1-2004 to Q2-2018. To compare with mortgage number (Monthly), we also downloaded the monthly short-term interest rates from OECD, but for this dataset, the period is from January 2007 to August 2018. Rodrigues and Louren (2017) pointed out that “Most economic fundamentals have been affected by credit shortage and failure of many mortgage holders to meet their payments.” By considering the housing loan and the mortgage, we found the dataset, Interest rate on housing loan by the financial purpose of housing acquisition and Loan agreements with conventional mortgage number from INE statistics Portugal. The period is the same as the monthly short-term interest rate, which is also from January 2007 to August 2018.

Household disposable income:

The definition of national income generally adopts as the aggregate money value of all revenues earned by individuals and enterprises. Regarding household income, according to the description from Investopedia (2018), “It is a measure who combined gross income of all members of a household who are 15 years or older.” Household income is an economic indicator to find the standard of living of the citizens and also a measure for lenders to underwrite loans. The glossary from Eurostat (2017) of household disposable income is “The total amount of money household has available for spending and saving after subtracting income taxes and pension contributions.” The dataset we used is Household disposable income (Average growth rate %) from OECD, with yearly from 2004 to 2017. The indicator measures the net in annual growth rates and gross adjusted in USD per capita at current prices and PPPs (OECD, 2018).

Investment:

In macroeconomics, investment is the number of goods purchased per unit time which not consumes at present. Because of its volatile the GDP, investment spending plays a crucial role in both long-run and short-run growth business cycle. By understanding the fluctuations in investment in the IS-LM model, the function between the real interest rate and investment are: an increase in the real interest rate reduces investment (Mankiw, 2016: 507). There are three

type of investment, Business fixed investment, Residential investment, and Inventory investment. In our study, we focus on Residential investment. The indicator of investment in OECD is Investment (GFCF). It defined as the acquisition (including purchases of new or second-hand assets) and creation of assets by producers for their use, minus disposals of produced fixed assets. The indicator is in million USD at current prices and PPPs. The term is from 2004 to 2017.

Immigration:

There is a study about immigration and the house prices conducted by a UK researcher. He found that immigration hurts house prices to its sending countries because the people who leave the country are generally at the top of the wage distribution. The leaving of top wage people generated an adverse income effect on housing demand to its sending state (Sá, 2011). Based on the Oxford Dictionary, immigration describes the movement of a person into one country from another, while emigration is the action of leaving a resident country or place of residence with the intent to settle elsewhere. In our case, immigrants are the target group whom we want to investigate. Thus, we adopted the number of permanent immigrants from INE Statistics Portugal. In their explanation of the indicator, they define that "A person (national or foreign) who, in a certain period of reference, entered the country with the intention of remaining here for one year or more, having resided previously abroad continuously for one year or more." (Metadata INE, 2018). The term is only available from 2008 to 2017.

Housing stock:

Housing stock is the total number of constructions in an area. The definition of Building Permits in Investopedia (2018) is "A type of authorisation that must be granted by a government or other regulatory body before the construction of a new or existing building can legally occur." Different types of housing stock can give clues of growth or stagnation in particular segments of the economy. In the Instituto Nacional de Estatistica (INE) Statistics Portugal, Licensed Buildings were used to represent Building Permits. We collected the Licensed buildings number in yearly (1995-2017) as an indicator. Their concept of Building permits (Metadata INE, 2018) is that "The authorisation granted by local councils under the provisions of the specific legislation, for the execution of works (new construction, enlargements, conversions, refurbishments and demolition of buildings)." To compare the buildings number in new constructions, we collected the yearly dataset of Completed

dwellings number in new structures for family housing (1995-2017). In addition, we compare the new houses and the refurbished houses to find out more information about the housing stock situation in Portugal. Thus, we used the yearly indicators of Completed dwellings number and Proportion of total reconstructed area (%). The time of these two datasets is also from 1995 to 2017.

3.3 Research strategy

The research strategy of this paper based on three main approaches: an exploration of theoretical rationale on the reviews in Portugal housing market and the other researcher's experimental works in finding the relevant macroeconomic indicators with housing prices. And then, we collected the data of the relevant indicators. To further analyse the data, we extracted the information from the data by using graphs and regression methods. First, we graphed the dataset by combining different indicators and profound the info from them. Then, we conducted a statistical analysis to model the housing prices as the dependent variable and the relevant macroeconomic metrics as explanatory variables in multiple regression analysis.

Therefore, in this section, we presented our research strategy in statistical analysis, which includes Analysis of Variance (ANOVA), Correlation Analysis, Simple linear regression, Multiple Linear Regression Model (MLRM), Ordinary Least Squares Method (OLS), and the Durbin-Watson test. In the regression analysis, the dataset comprises quarterly time series from Q1-2004 to Q2-2018 in Portugal. Data on real housing price index is the dependent variable, and we extracted: GDP, Unemployment rate, Short-term interest rate, Inflation (CPI), Completed dwellings number as explanatory variables. We used Excel Version 16.17 as the calculator for the data analysis results. And our significance level is set at 5%.

Statistician and evolutionary biologist Ronald Fisher developed the Analysis of Variance (ANOVA). The ANOVA is an appropriate statistical procedure to test the equality of means of the same number of samples. It is a tool used in several ways to develop and confirm an explanation for the observed data. The hypothesis is that the samples come from populations with the same mean. Thus, our null hypothesis is the equality of the mean. And the alternative hypothesis is that there are at least two populations in which the means are different. In our sample tests, as the probability associated with the ANOVA F-test, when the probability (P-value) is less than a significance level (5%), that is a statistically significant result. The P-value showed we reject the null hypothesis and we can apply a parametric test. Otherwise, the alternative hypothesis is adopted which means P-value is higher than the significance level.

Correlation analysis can be used to quantify the linear association between two variables. The main tools from correlation analysis are the scatter diagram, the covariance and the Pearson Correlation Coefficient. The scatter diagram is a graph, which we will present in the results chapter. Because we tested five simple linear regression models and a multiple linear regression model, we made the scatter diagrams of the dependent variable and compared each explanatory variable and its Pearson Correlation Coefficient.

The general Simple linear regression model is given by:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \varepsilon_i \quad (1)$$

When Y is the dependent variable, β_1 and β_2 are the parameters or coefficients of the model. In our case, we tested five simple linear regression models, which means the X_{2i} is GDP, Unemployment, Short-term interest rate, Inflation (CPI), and Completed dwelling (No.) respectively. The **ε**i is an error term in the formula. Regarding the reality, we cannot expect the explanatory variables fully explain the variation of the dependent variable. Therefore, the error term represents the difference in the dependent variable that is not associated or does not result, from the mutations in the explanatory.

Our analysis also includes Multiple linear regression model. The Multiple linear regression is used to establish the direct relationship between a dependent and more than one explanatory variables. In the following Multiple linear regression model, we combined five explanatory variables above, to form the Multiple linear regression model. Thus, our multiple linear regression model is:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \varepsilon_i \quad (2)$$

Where Y_i is Real Housing Price Index, X_{2i} is GDP, X_{3i} is Unemployment, X_{4i} is the Short-term interest rate, X_{5i} is Inflation (CPI), X_{6i} is Completed dwelling (No.).

In fitting linear models by least squares, it is useful to determine how much influence or leverage each data Y value (Y_i) can have on each matched Y value ($\hat{Y}_i$) (Hoaglin, 1978). In statistics and mathematics, Ordinary least squares (OLS) is a method to estimate the unknown parameters in a linear regression model. The objective of the Ordinary least squares method is to find the estimator β̂ that minimise the Residual Sum of Square (RSS).

The total variation of the dependent variable of the mean comes from two parts, Explained Sum of Squares (ESS, the total variation explained by the model) and Residual Sum of Squares (RSS, the unexplained variation of the dependent variable):

$$\sum_{i=1}^{n}(Y_i - \bar{Y})^2 = \sum_{i=1}^{n}(\hat{Y}_i - \bar{Y})^2 + \sum_{i=1}^{n}(Y_i - \hat{Y})^2 \quad (3)$$

From the result of ordinary least squares and ANOVA in Excel data analysis of Regression, we have the t Stat and P-value for the regression model. This t-test is to know whether the estimates statistically significance, which means whether these explanatory variables has critical value in predicting the response variable. The standard null of this test is that the true coefficient is zero. The t-test is the ratio between the estimate for the coefficient and its standard error. When the t-statistic value is larger than the critical value of the significance level (5%), the null hypothesis is rejected, and the variable is profound to have explanatory value. Otherwise, we accept the null.

The Coefficient of determination (R^2) is a good measure of the observed replicated outcomes of the model, according to the proportion of total variation of results explained by the model (Steel & Torrie, 1960; Glantz, Slink, & Neilands, 1990; Draper & Smith, 1998). The Coefficient of determination (R^2) quantifies the percentage of the Total variation of a dependent variable (TSS) that is explained by the model considering the data in the sample, and it works as a goodness-of-fit measure:

$$0 \leq R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS} \leq 1 \quad (4)$$

The Multiple correlation coefficient (R Multiple) is the square root of the Coefficient of determination (R^2) and represents the linear association of the dependent and all the explanatory variables. The Adjusted R^2 ($\bar{R}^2$) compares the variance of residuals with the variance of the dependent variable and represents the proportion of the variance of the dependent variable that is explained by its relationship with the explanatory variables. By using Excel to analyse the studied data, we got these three statistical elements and standard error for each model. Based on the formula above, the R^2 can range from 0 to 1 where 1 represents a perfect correlation between the explanatory and dependent variables.

Apart from that, the dataset we used in the thesis is quarterly time series. Due to most regression problems involving time series data showed a positive autocorrelation, in the multiple linear regression of our study, we adopted the First-difference method into our variables. The First difference is an approach to solve the problem of omitted variables in an OLS estimation for a regression model. In our study, we applied it by using the period (quarter) figure deducted the previous one to gain the difference. Thus, the first difference of the original variables calculated in:

$$\Delta Y_{it} = Y_{it} - Y_{it-1} \qquad (5)$$

$$\Delta X_{it} = X_{it} - X_{it-1} \qquad (6)$$

Concerning the serial correlation among the explanatory variables and the independent variable, we detected the autocorrelation by interpreting the Durbin-Watson. The Durbin-Watson is a statistical test to test autocorrelation of the residuals in a statistical regression analysis. The Durbin-Watson Table is to check whether the result is significant, based on the regressors k and the sample size n. And the alpha we used here is 0.05. The calculation of the Durbin-Watson result comes from the residuals of an ordinary least squares regression. The equation is:

$$DW = \frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2} \qquad (7)$$

Where e_i is the residuals of the regression model $e_i = Y_i - \hat{Y}_i$ and n is the sample size. The Durbin-Watson number ranges from 0 to 4. A value near 2 indicates there is no autocorrelation. A value towards 0 means there is a positive autocorrelation while the value towards 4 shows a negative autocorrelation.

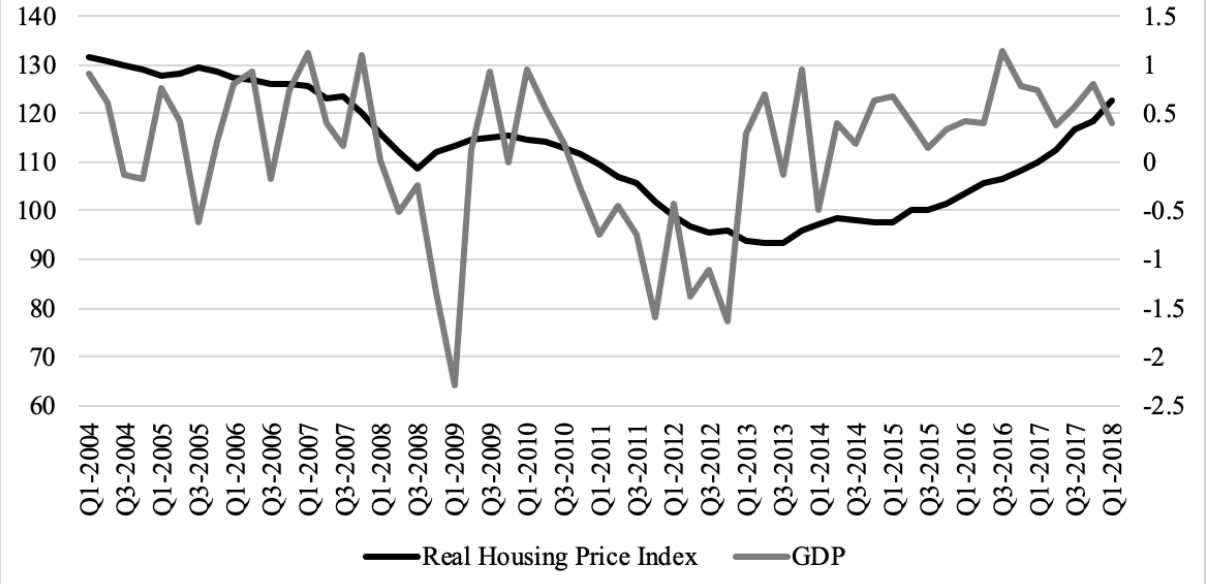
4. Results

In this chapter, we present the results of our study using graphs and statistical analysis. The first section is the performance of relevant macroeconomic indicators that we considered the determinants of house prices. The second part illustrates the housing prices situation in different geographical locations and their typology in Portugal. In the final section, we formulated a Pearson correlation and multiple regression analysis between data for GDP, Unemployment, Short-term interest rate, Inflation, New house numbers and the housing market price.

4.1 Economic indicators related to the housing market

Before the results of the empirical analysis, it is useful to describe the evaluation in a macroeconomic context. Here we analysed ten charts to have a better understanding of the dynamics of the real estate market in Portugal. They refer to different categories of economic indicators. We classified those categories into nine groups in the methodology section (3.1), including GDP, Housing market, Unemployment, Interest rates, Inflation & CPI, Household disposable income, Investment, Immigration, and Housing stock.

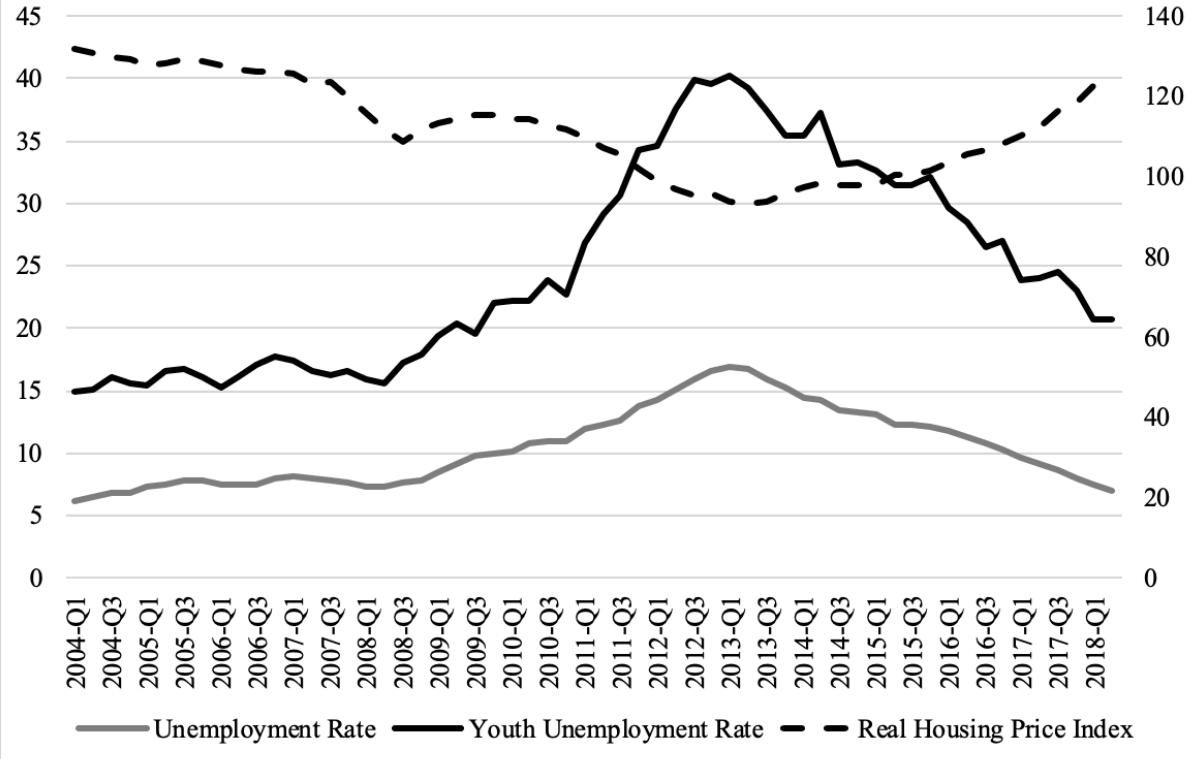
Figure 1 - GDP and Housing price index in Portugal



Source: Authors' elaboration based on data from OECD (2018).

Gross domestic product (GDP) is a measure to indicate a country's economic performance. We graphed the GDP and real housing price index in Figure 1. During the period from Q1-2004 to Q2-2018, Portugal's GDP percentage change per period fluctuated from 1.15% to minus 2.30% (See maximum and minimum in Table 1). The low point appeared in Q1-2009, where the financial crisis was about to finish in the United States, but the debt crisis spread within the Eurozone. Fortunately, the GDP recovered quickly, and its growth became a positive number (0.13%) in the next quarter (Q2-2009). A year later, from Q1-2010, GDP decreased again and remained negative until 2013. After that, GDP fluctuated to above zero in the remaining periods. Besides, with the base year of 2015, the situation of real housing price index had some correlation with the GDP trend. It had a slow decrease until the valley period (Q3-2008). Then it had a smooth plateau until 2010. From then on, the price went downward until the end of 2013 (the lowest house price), and since then, it started to increase slowly. The ending point price index was around 120.

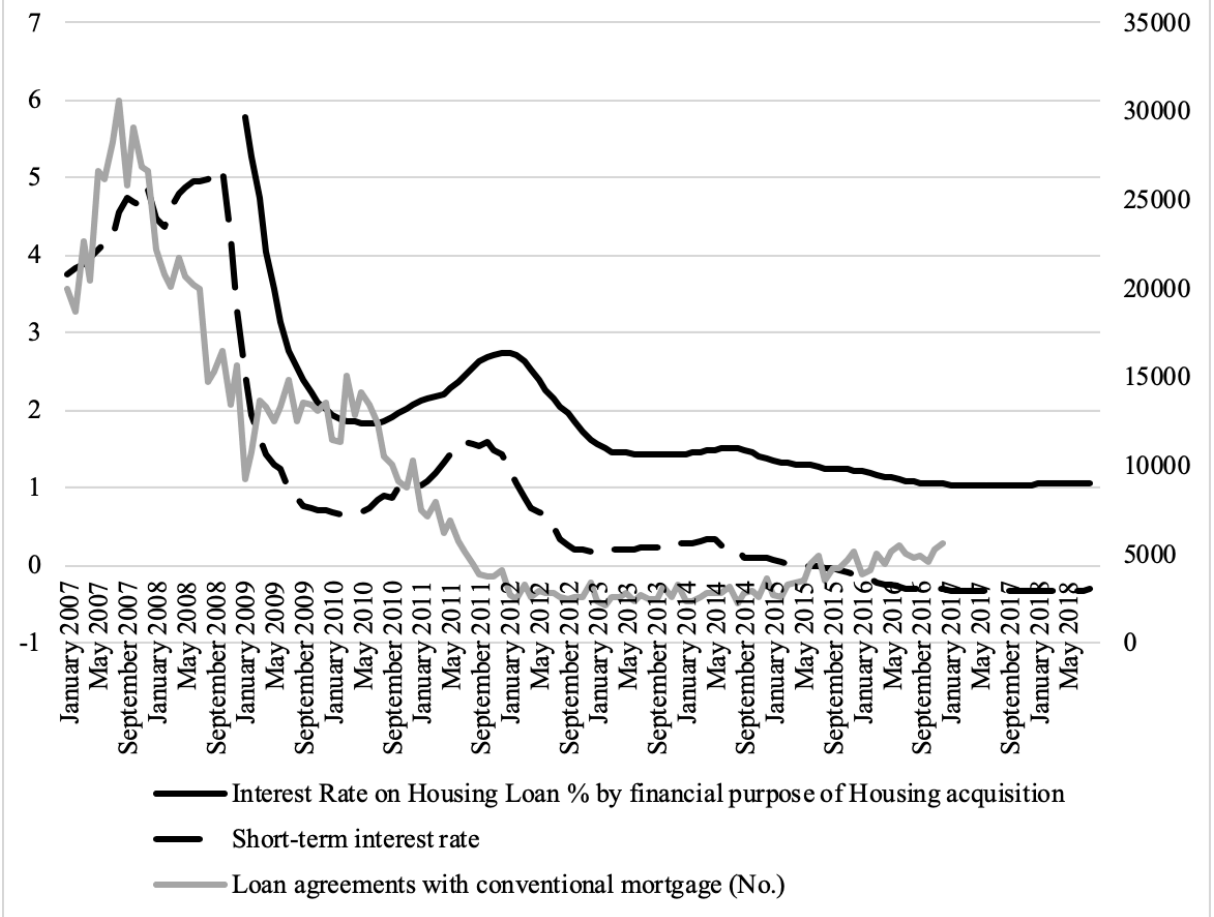
Figure 2 - Unemployment and Housing price index in Portugal



Source: Authors' elaboration based on data from OECD (2018).

An inverse relationship between housing prices and unemployment have stated in vast reviews, as outlined in Figure 2. Regarding the inverse relationship, we noticed that there was a clear instance when the unemployment rates were growing while the real housing price index was decreasing. And then they reversed after their extremely points. The two unemployment rates (Total and Youth) followed roughly the same movement. The youth unemployment rate started to increase at the end of 2008 and reached a peak around the end of 2012 and the beginning of 2013. After that, the youth unemployment rate rose in Q2 of 2014, and then, decreased. The overall unemployment rate also started to increase at the end of 2008. It took around a decade (2008-2018) for it to return to the long-term unemployment rate (approximately 5%). Concerning the youth unemployment rate, it still kept 20.68% until the ending point (2018 Q2).

Figure 3 - Interest rates and Loan agreements in Portugal

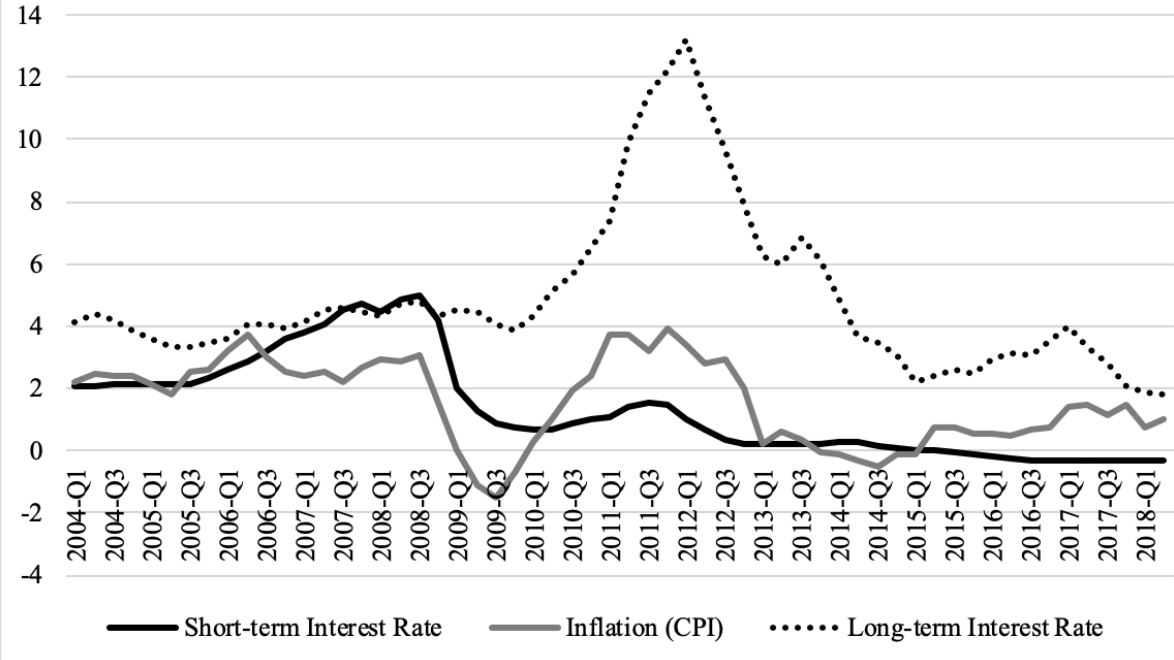


Source: Authors' elaboration based on data from OECD and INE (2018).

Regarding the level of interest rates, which is a vital factor of monetary policy and its impact on housing loans. We gathered data for interest rates and loan agreements in Figure 3. Data was not available for the variable "Interest Rate on Housing Loan % by the financial purpose of Housing acquisition" between 2007 and 2008. But from the rest of the data, we ascertained that the interest rates on housing loan and the short-term interest rate changed in tandem. But, the interest rate for housing loans has a time delay vis-a-vis the short-term interest rate. In that period, we use the short-term interest rate as a proxy on "Interest rate on housing loan %" in the later regression analysis.

Interest rates fell sharply from 2009, and in the latter part of 2010, they had a year of growth and then fell again. There was a plateau period from 2012 to 2014. In 2015 the short-term interest rate reached a negative value. Even now, the short-term interest rate (Euribor) is still negative. The house loan interest rate is around 1% now.

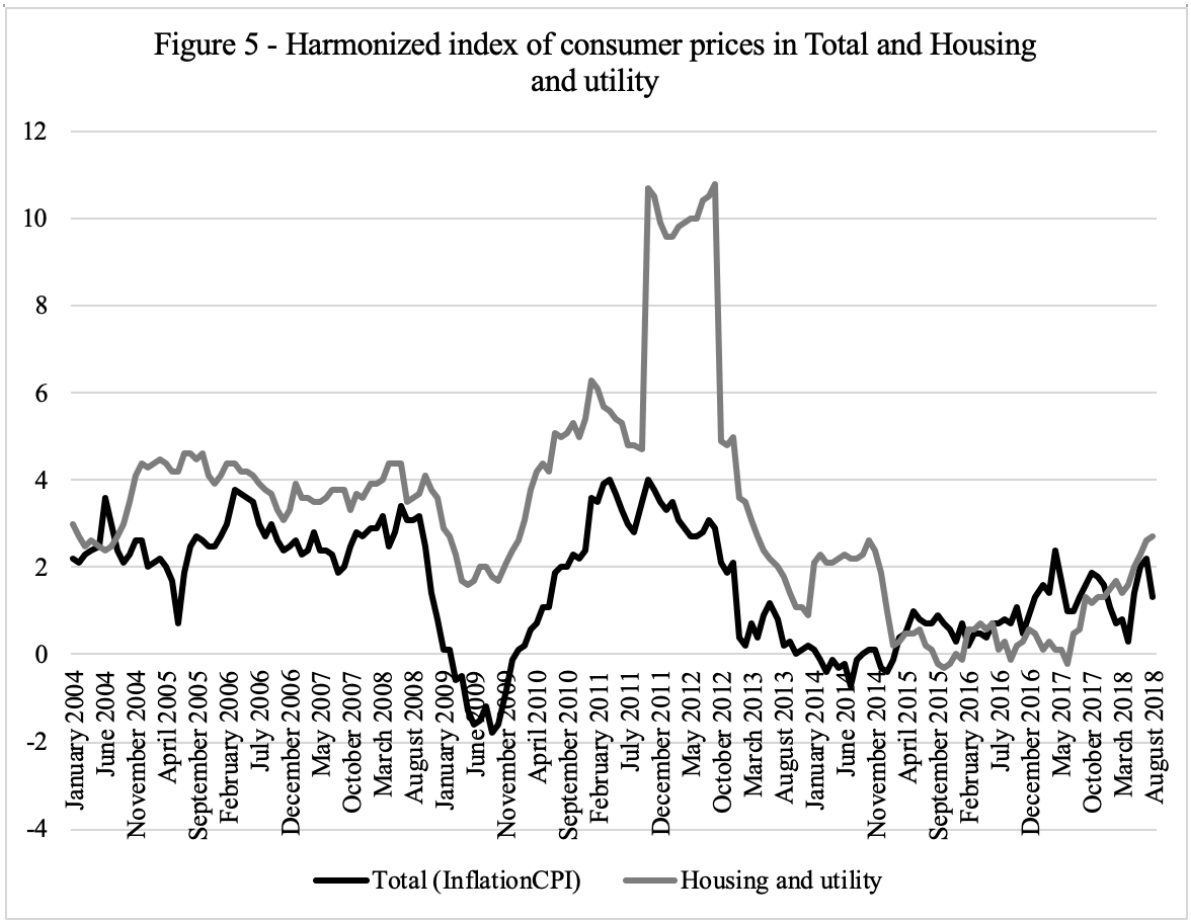
Figure 4 - Interest rates VS. Inflation (CPI) in Portugal



Source: Authors' elaboration based on data from OECD (2018).

Regarding the Loan agreement number, in Figure 3 this grew sharply at the beginning of 2007 and then fell until 2009. It stabilised around 13 thousand mortgages per month during the first valley period (2009 and 2010) of interest rates. At the end of 2011, when the interest rates reached another peak, the loan agreements were below 5,000 per month, and it remained until 2015.

There are extensive historical studies analysing the relationship of interest rates and inflation. In Figure 4, the long-term interest rate increased dramatically from Q4-2009. In 2010, the long-term interest rate rose while the short-term interest rate kept low. Also, the inflation was at the lowest point in 2010. As the increase of the long-term interest rate, the inflation (CPI) followed to an upward trend. The inflation had a peak period (2011). The long-term interest rate also reached a peak (13.22, see Annexes 1.) in 2012-Q1 and then went down in a straight line. In 2013 and 2017, it had pullbacks but still could not break the downward trend. It kept decreasing, and in the ending data point, the long-term interest rate was around 2%.

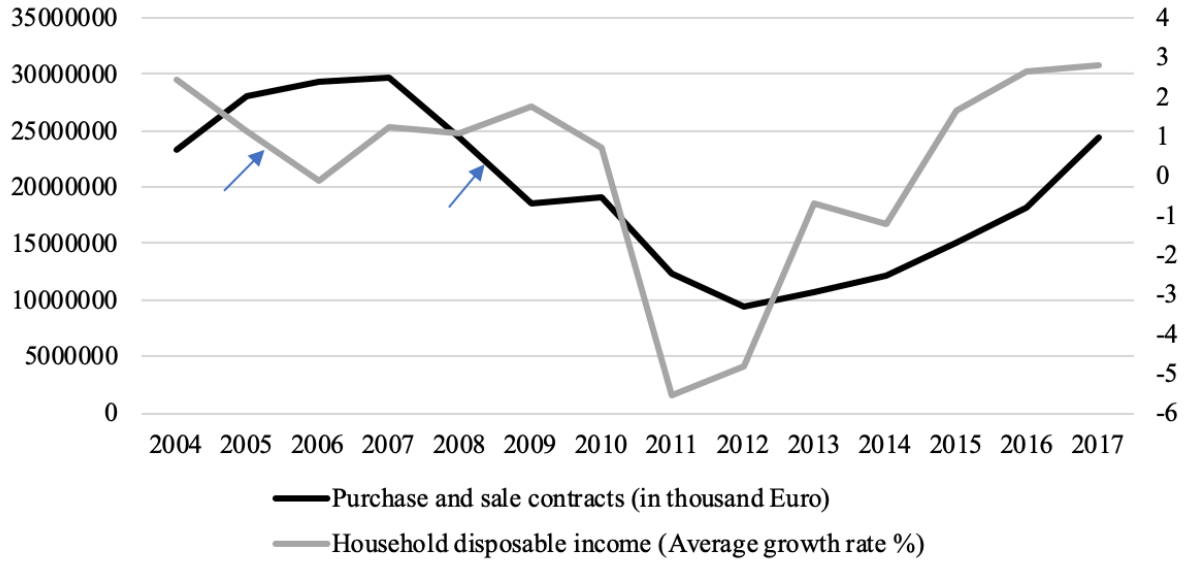


Source: Authors' elaboration based on data from INE (2018).

Regarding Inflation (CPI), we further graphed it against housing and utility cost. By using the harmonised index of consumer prices, we selected the individual consumption expenditure on housing, water, electricity, gas, and other fuels (We abridge it to housing and utility CPI.) and its total index, which is the Inflation measure in Figure 4. From a general overview from this chart, it seems that the index of housing and utility CPI was higher than the total CPI before 2015. The most significant differential between them, the CPI of housing and utility in late 2011 jumped up above 10%, and it fell back to follow the total CPI in later 2012. In other words, the housing and utility CPI was extremely high in 2011 and 2012.

On the other hand, the overall CPI gradually decreased in this period (2011 and 2012). Another point is that total CPI experienced a deflation (negative figures) in 2009 and was negative again in 2014. However, the housing and utility CPI oscillated between negative and positive only during the later 2015 to early 2017.

Figure 6 - Purchase of houses and Household disposable income in Portugal

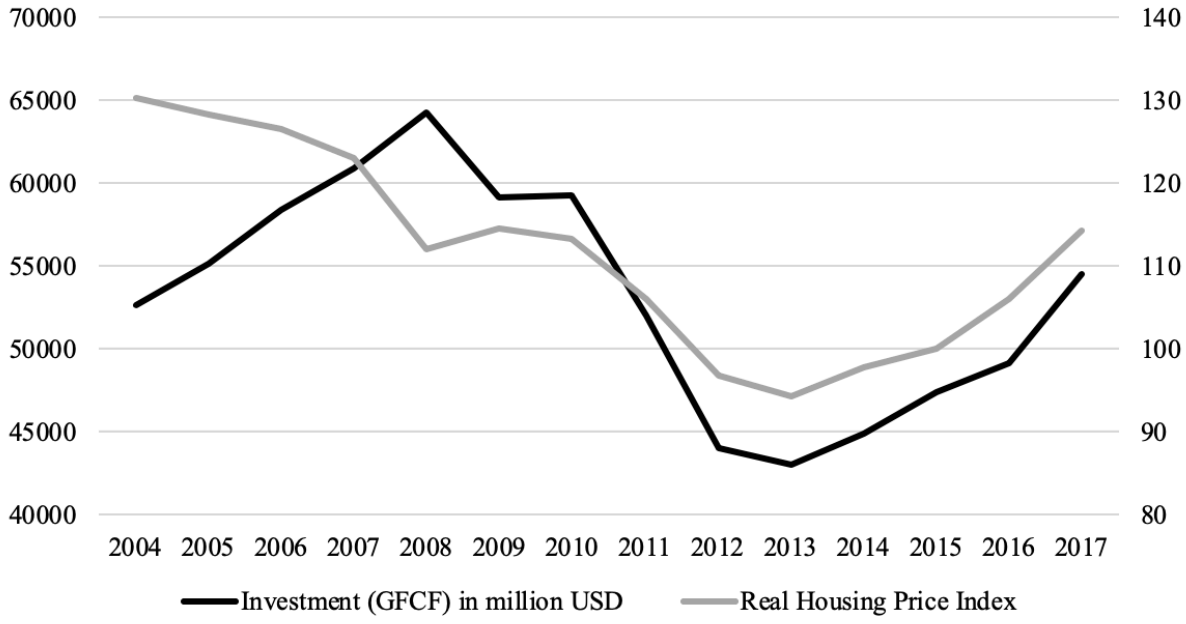


Source: Authors' elaboration based on data from OECD and INE (2018).

From another point of view, the level of consumption also depends on the growth rate of disposable income of the household. When we compared the purchase of houses and the household disposable income, it is evident in Figure 6 that these two variables might have a

relationship. When household disposable income decreased during the period from 2004 to 2006, there was a corresponding parallel shift[1]happened in the purchase of house value from 2007 to 2009. As household disposable income saw in a subtle platform (2006-2010), the acquisition of houses also started to have a platform in the period with a three-year delay. However, when household disposable income dropped sharply in 2011, it shortened the corresponding platform period of purchase of houses and led it into a downward trend as well. After 2011, household disposable income began to rise and speeded up in 2012 and 2013. The acquisition of house value started its recovery in 2013 and steadily grew, which was following it with a lag of about three years of accumulation household disposable income.

Figure 7 - Investment and Housing price index in Portugal



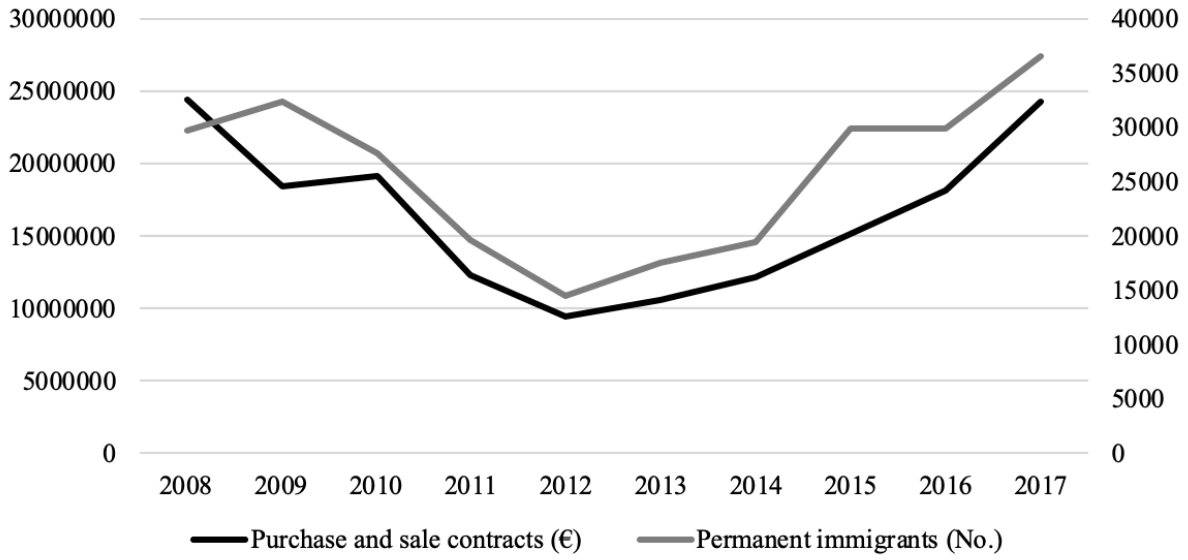
Source: Authors' elaboration based on data from OECD (2018).

Amongst the determinants of housing prices, residential investment cannot be ignored. We considered the Gross fixed capital formation (GFCF) as an indicator for the level of residential investment. From 2004 to 2008, the GFCF grew steadily. In 2009, it contracted by USD 5 billion. The amount of GFCF maintained in 2010, but it continued the contraction (15

[1] The corresponding parallel shift was pointed out by the arrows in Figure 6.

billion USD) in 2011. During the Portuguese financial crisis, GFCF suffered a severe decrease. Growth commenced again from 2013, and the GFCF slowly began on an upward trend. The GFCF in 2017 (54 billion USD) recovered to almost the same amount as in 2005. By comparing it with the yearly real housing price index, it was seen that they moved contrary to one another between 2004 and 2009. When GFCF increased, the housing prices decreased. However, their general trajectories have been synchronous since 2009 (Figure 7).

Figure 8 - Permanent immigrants and Purchase and sale contracts in Portugal

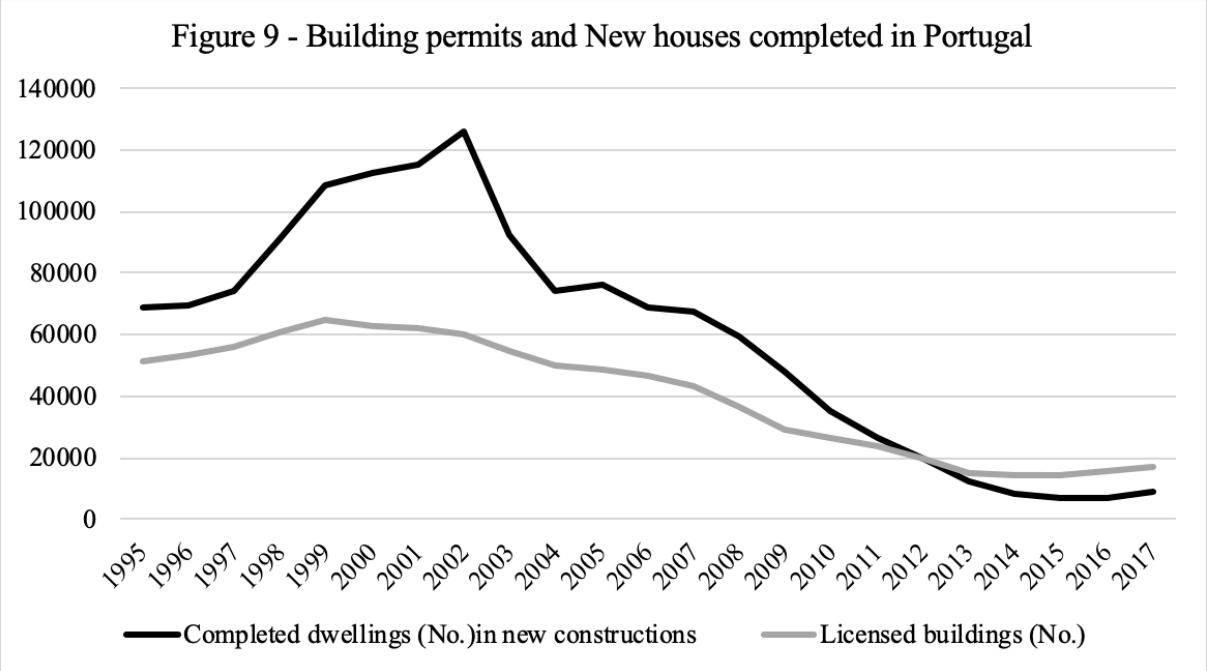


Source: Authors' elaboration based on data from INE (2018).

The next determining variable to consider is the foreign inflow. Figure 8 depicts the permanent immigrant population and the purchase of houses. From 2009 to 2012, the population of permanent immigrants decreased. The turning point was in 2012, which indicated the permanent immigrants figure started a steady increase. Immigrant numbers increased quickly in 2015 and maintained in 2016; then it rose again in 2017. By comparing this variable with the purchase and sale contracts, they had different correlation before 2010. But since 2010, they had followed similar paths.

The housing market based on the supply and demand. From the supply side, the rise of the housing stock situation in Portugal is also essential to our study. Figure 9 shows building

permits and new constructions in Portugal including the yearly datasets from 1995 to 2017. In Figure 9, the licensed buildings (NO.) means the total building number that is permitted by the government. This figure includes new buildings and other construction. And completed dwellings number represents new structures. From this chart, completed houses were increasing in the 1990s and reached a peak in 2002. In the beginning ten years of the 21st century, the new buildings decreased from 120 thousand to 30 thousand, while the decline in licensed buildings number was smaller than the decline in new buildings.

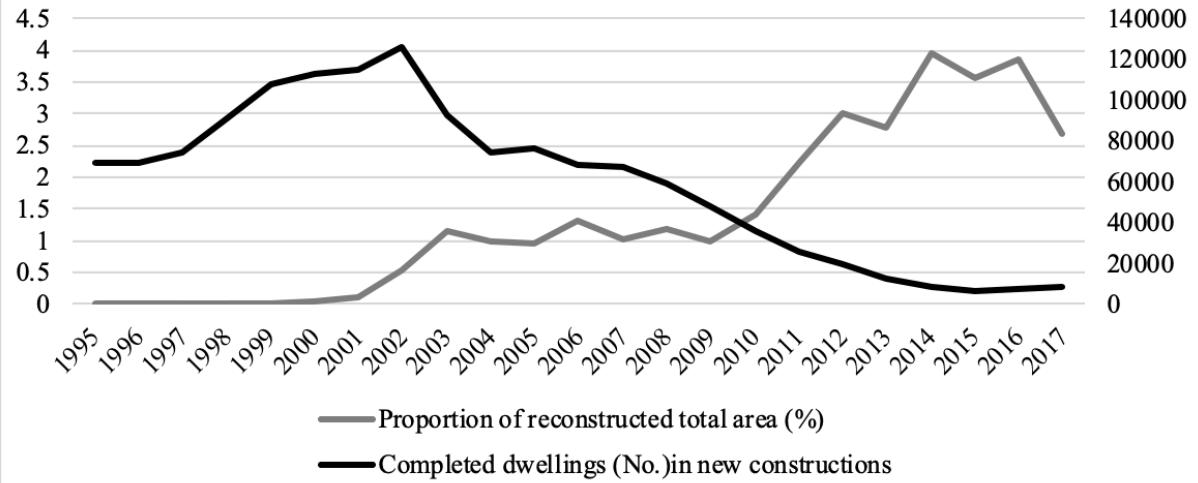


Source: Authors' elaboration based on data from INE (2018).

Moreover, the decline of the building numbers lasted until now. From graph 9, the completed dwellings numbers were significantly high before 2008, which all being over 60 thousand. Considering the massive difference of completed houses in the study period, we identified its maximum and the minimum values in Annexes 1, where the ceiling was in 2002 with 125,708 new buildings per year, and the minimum was in 2015, and the new buildings were 6,794. From 2004 (74 thousand) to 2017 (8.9 thousand), the new houses decreased over eight times. Another point is that the completed dwellings numbers were higher than the licensed building number before 2012. Since 2012, the number of completed dwellings and licensed buildings have been lower than 20 thousand per year.

The number in the new building and other constructions constitute the housing stock. To further represent the housing stock, we gathered the data of proportion of total reconstructed area in Portugal to compare with completed dwellings in Figure 9. The utterly opposite trend between reconstructions and new constructions showed the total housing stock might remain about the same amount. The proportion of reconstructions started to grow from 2001, after a plateau period (2002-2009), and then speeded up in 2010. As we describe in Figure 9, there was a speedy development of new buildings in the 1990s and then shrank in 2000s. On the contrary, the proportion of reconstructions remained at 1% at the period of 2003-2009, then multiplied. From 2014 to 2016, the percentage kept around 4%. But it started to slow down recently, with a steep decline appearing in 2017.

Figure 10 - The reconstruction and New completed houses in Portugal



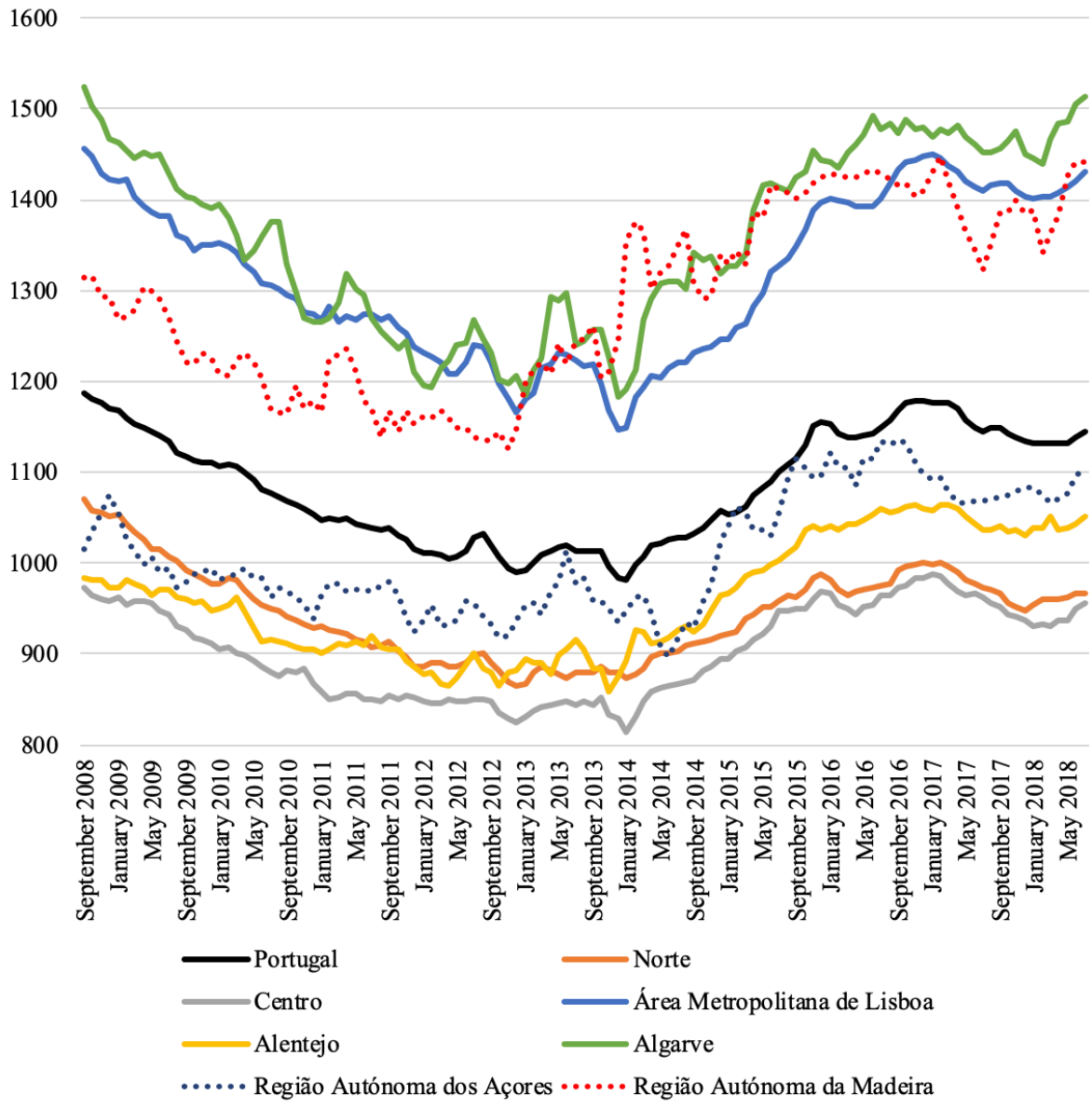
Source: Authors' elaboration based on data from INE (2018).

4.2 Housing prices in Portugal

Housing prices in Portugal have been increasing in recent years. Through the analysis of relevant macroeconomic indicators, we obtained a background knowledge of macroeconomics situation in Portugal. In this section, we went back to our foundation housing prices of Portugal in order to collect detailed prices information for it. To illustrate the housing prices situation in Portugal, we studied other researchers' work (Tavares, Pereira, & Moreira, 2014) and then decided to show the housing prices in Portugal in two dimensions.

The first dimension is geographic location and the second one is from its topological dimension. The dataset we used was the average monthly value of bank evaluation (€/m²) of living quarters by its geography and typology from INE, and the term was from September 2008 to July 2018.

Figure 11 - Average Unit Prices (€/m2) of Houses by Regions in Portugal

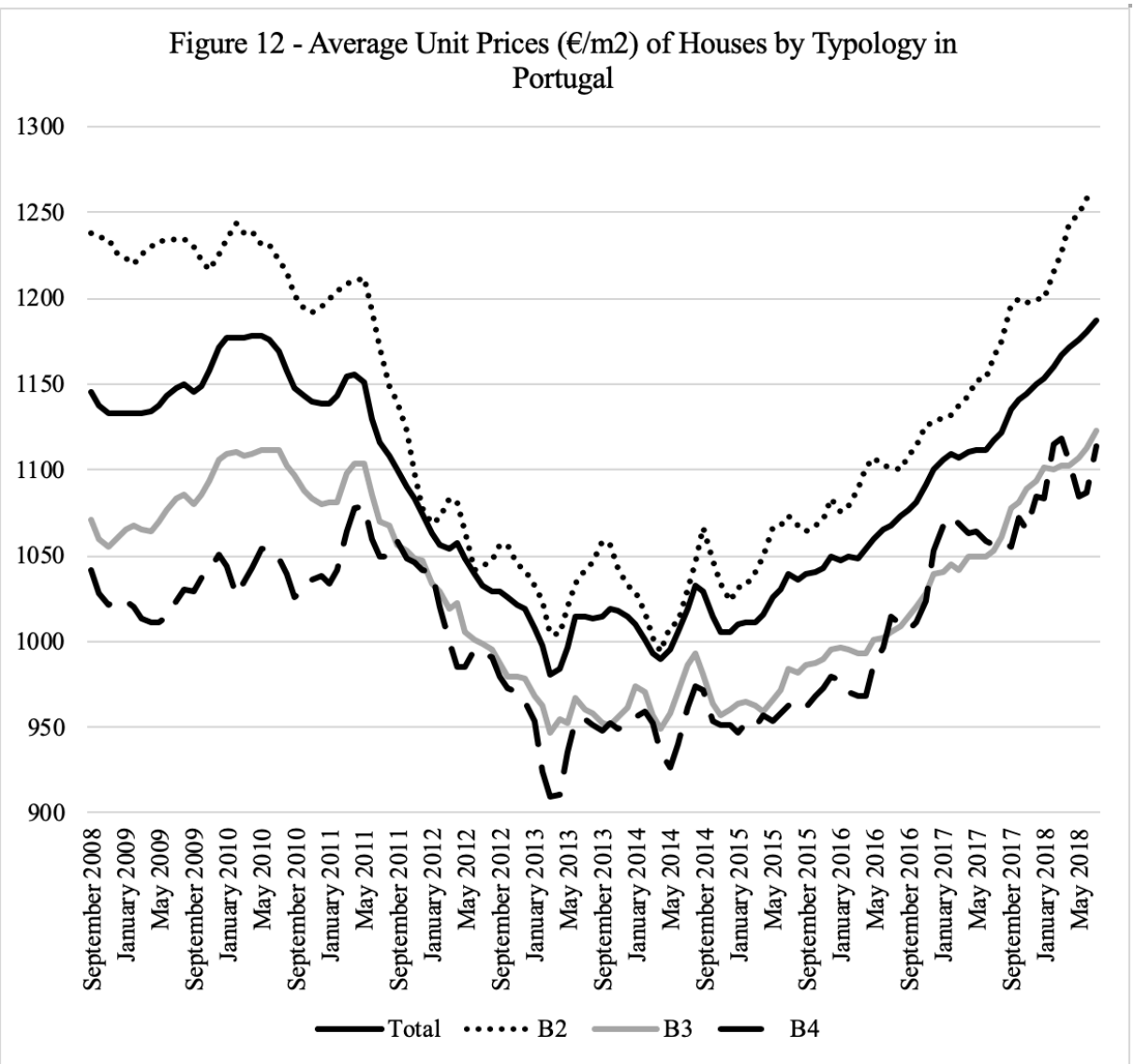


Source: Authors' elaboration based on data from INE (2018).

In Figure 11, we presented the evolution of the housing prices per square meter in different regions. The regions selected are Norte, Centro, Área Metropolitana de Lisboa, Alentejo, Algarve, Região Autónoma dos Açores, Região Autónoma da Madeira, and together with its whole country level. In a general overview of the graph, all the lines followed a similar V shape, which means they had been subject to a decrease, accompanied by an increase. After 2016, the housing prices tended to be at a stable level. There were three regions which exceeded the cost of the country level (Portugal), which were Algarve, Área Metropolitana de Lisboa, and Região Autónoma da Madeira. There are gaps among these three regions and the rest of the regions in the picture. It means the housing prices in Algarve, Área Metropolitana de Lisboa, and Região Autónoma da Madeira were far higher than the average country level.

Although the Região Autónoma da Madeira and the Área Metropolitana de Lisboa were trying to challenge for the highest housing price, the Algarve was the leading region by this criterion. In July 2018 the point for the Algarve was 1514 €/m² while the cost for Portugal as a whole was 1154 €/m², and in the cheapest housing prices region (Centro) it was in 957 €/m². As the comparison above reveals, the lowest housing prices region was the Centro, and its lowest point was in January 2014, with a value of 814 €/m². Not only in the region of the Centro, in the period from 2012 to 2014, but all the housing prices were in decline as the financial crisis in Portugal to hold. After the valley in 2013, the recovery of the housing prices began in 2014. During the restoration, prices fluctuated but kept in a growth trend. In 2016, some regions almost reached the value before the crisis. In the most recent two years, the housing prices appeared to pause.

On the other hand, the situations from the typology dimension revealed the price-quality ratio of houses. In Figure 12, there are four types of residence, which are the Total, B2 (two-bedrooms), B3 (three-bedrooms), and B4 (four-bedrooms). In Figure 12 the overall housing price trend was the same as the one by geography (V shape), as they experienced depression and recovery to its normal level in the later years. B2 was the highest price house among them as measured €/m². On the other hand, B4 was the lowest one by the measure. The price of different typologies was in a stable period from late 2008 to early 2011. By comparing the differential between each type of houses, the difference narrowed after 2011. From Figure 12, the difference value between B2 and B3 was more significant than the price difference between B3 and B4. The difference between B3 and B4 of house prices per square metre has gone almost the same amount since 2011. For example, in July 2018, the cost of B2 was 1258 €/m² while B3 and B4 were both 1114 €/m².



Source: Authors' elaboration based on data from INE (2018).

Table 1 summarises the comparison between the average housing prices per square meter in geography and typology in Portugal from September 2008 to July 2018. Based on the property data, we calculated each region's and its typology's average housing prices over the study period. From the whole country level, the average housing price per square metre in this decade period was 1085.35 €/m². And the values in Portugal of B2 was 1128.25 €/m², B3 was 1031.35 €/m², and B4 was 1009.89 €/m². B2 was the most expensive housing price per square metre at the country scale. In its leading role, the housing prices of the Algarve were the highest in all types of apartment except B3 (1305.04 €/m²), which was just below the Lisbon

region (1317.21 €/m²). The average prices per square metre in Alentejo, Norte, and Centro were below 1000 €/m² during the study period, plus the B4 in the Açores. Apart from B2, the average value of Centro was all at the lowest price per square metre of the table. Additionally, both the maximum and the minimum were in the column of B4. The maximum was 1430.22 €/m² in the Algarve while the minimum was 869.67 €/m² in the Centro.

Table 1 Average Unit House Prices (€/m2) in Portugal

Average Unit House Prices (€/m2)	Total	B2	B3	B4
Portugal	1085.35	1128.25	1031.35	1009.89
Algarve	1360.01	1337.87	1305.04	1430.22
Área Metropolitana de Lisboa	1315.30	1291.45	1317.21	1347.44
Região Autónoma da Madeira	1289.74	1274.69	1301.26	1288.10
Região Autónoma dos Açores	1011.29	1181.98	1044.84	989.25
Alentejo	961.10	977.42	956.52	972.66
Norte	945.04	942.84	919.35	939.56
Centro	903.17	971.36	873.91	869.67

Source: Authors' elaboration based on data from INE (2018).

4.3 Date analysis results

In the majority of regression analysis studies of real estate prices, the dependent variable usually used is the market prices of property. The prices vary from the house price indexes, the sales prices and rental prices. The real housing price index used in our study. For the independent variable group, we selected GDP, the Unemployment rate, the Short-term interest rate, Inflation (CPI), and Completed dwellings absolute number in new constructions in our study. As we mentioned in the last chapter 3.3 Research strategy, our dataset used in the data analysis comprises quarterly time series from Q1-2004 to Q2-2018 for Portugal.

To begin with, we assessed the descriptive statistics (Table 2) for each sample, in order to have a general overview of the dataset. In table 2, we present each variable's Represent Group (See the classification in the Methodology chapter 3.2.), Mean, Median, Standard Deviation,

Minimum, Maximum, and Observations. The observations in each variable are 58. The Real housing price index is an index price dataset with its base year in 2015. It represents the housing market condition, and we used it as our dependent variable.

Table 2 Descriptive Statistics of Variables

Name	**Real Housing Price Index**	**GDP**	**Unemployment Rate**	**Short-term Interest Rate**	**Inflation (CPI)**	**Completed dwellings (No.)**
Represent Group	Housing Market	GDP	Unemployment	Interest Rate	Inflation & CPI	Housing stock
Mean	112.11	0.13	10.47	1.38	1.57	9072.83
Median	112.26	0.36	9.97	0.87	1.68	6728.00
Std. Dev.	11.90	0.76	3.11	1.60	1.37	6686.20
Min	93.41	-2.30	6.19	-0.33	-1.51	1559.00
Max	131.77	1.15	16.88	4.98	3.91	20153.00
Obs.	58	58	58	58	58	58

Source: Authors' elaboration based on data from OECD and INE (2018).

During Q1-2004 to Q2-2018, the maximum real housing price index was 131.77, and the minimum was 93.41. The mean and the median were close to one another, and both were around the value 112. The standard deviation of housing price index was the second highest with a value of 11.90, which was just below the completed dwellings number. Regarding GDP, it had the lowest standard deviation (0.76). In the minimum row, there were three negative numbers of Table 2, which were GDP (-2.30), short-term interest rate (-0.33), and inflation (CPI) (-1.51). The last variable, completed dwellings number in new buildings, had the highest standard deviation, which was 6,686.20. The difference between its maximum and minimum reached over 18 thousand (18,594) in the study period.

Figure 13 GDP Scatter diagram

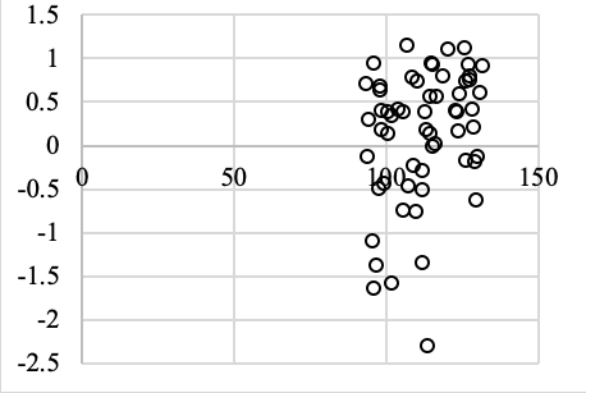


Figure 14 Unemployment Rate Scatter diagram

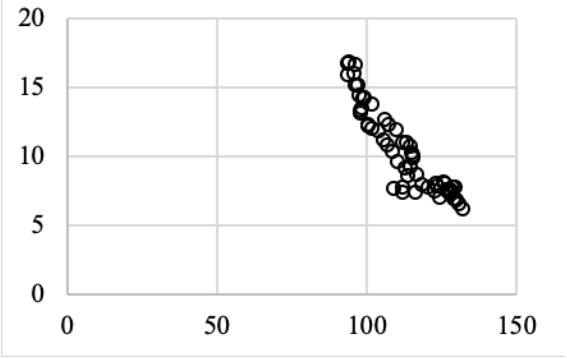


Figure 15 Short-term Interest Rate Scatter diagram

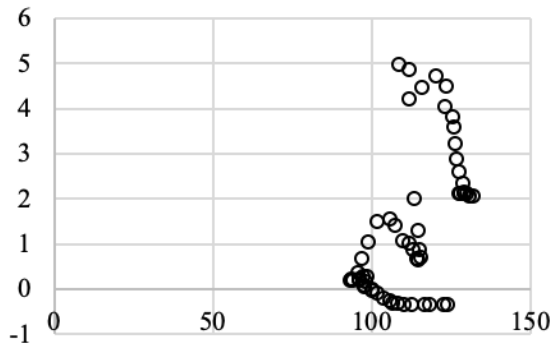


Figure 16 Inflation (CPI) Scatter diagram

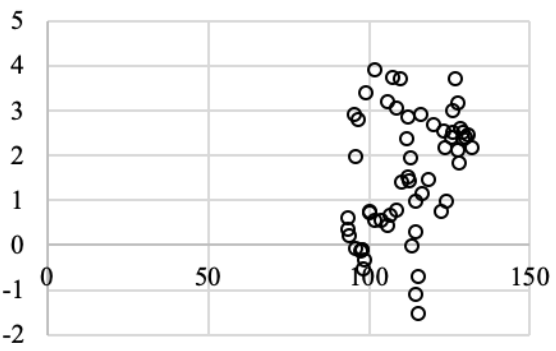
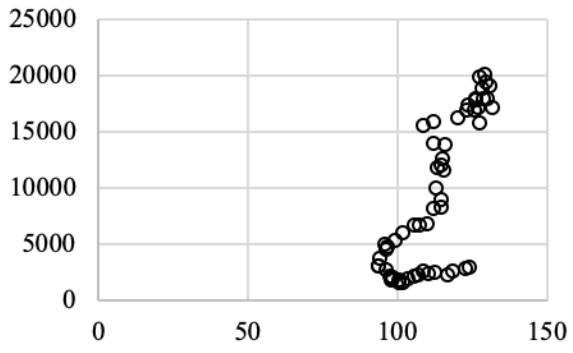


Figure 17 Completed dwellings (No.) Scatter diagram



Source: Authors' elaboration based on data from OECD and INE (2018).

To illustrate the relationship between each independent variable and the dependent variable, we conducted scatter diagrams of each variable. The results are in following scatter diagrams (Figures 13 to 17). In Figure 13, the GDP scatter diagram, the sample variables had a vertical

dispersion between 1.5 and -2.5. On the horizontal axis, because of the housing prices, all the scatter diagrams were concentrated between 90 to 140. The unemployment rate scatter chart was the best fit which indicated a negative linear correlation. On the other hand, the scatter diagram for short-term interest rate had some relatedness but did not follow a linear function. Similar to the scatter diagram for GDP, the scatter diagram for inflation (CPI) also had a vertical dispersion while between -2 and 4. In the case of completed dwellings number, there was in the upper post linear trend. But in its lower part, it has a horizontal aggregation.

Table 3 Static Simple Linear Regression Analysis - Results

Coefficients of Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
GDP	4.27				
Unemployment Rate		-3.53			
Short-term Interest Rate			3.90		
Inflation (CPI)				3.15	
Completed dwellings (No.)/1,000					1.43
Constant	111.56	149.11	106.74	107.18	99.14
Correlation	0.27	-0.92	0.53	0.36	0.80
R Square	0.08	0.85	0.28	0.13	0.65
P-value	0.04	0.00	0.00	0.01	0.00
Observations	58	58	58	58	58

Source: Authors' elaboration based on data from OECD and INE (2018).

After analysing the scatter diagrams, we ran a correlation analysis among all the variables. We listed the correlation coefficients between each independent variable and the dependent variable in Table 3 correlation row. We also attached the more detailed results of the correlation analysis in Annexes 2. In table 3, we noticed that the unemployment rate (Model 2) had the strongest correlation with the real housing price index and that it is a negative correlation (-0.92). The next closest one was the completed dwelling number (Model 5),

which had a high positive figure, 0.80. According to the ranking of correlation, the following were Model 3 (Short-term interest rate), Model 4 (Inflation CPI), and Model 1 (GDP), which had figures of 0.53, 0.36, and 0.27 respectively.

The next step was the simple linear regression model. We managed to fit each variable with the dependent variable. Thus, we have Model 1 (GDP), Model 2 (Unemployment rate), Model 3 (Short-term interest rate), Model 4 (Inflation CPI), and Model 5 (Completed dwelling number). We attached all the simple linear results in Annexes 3-7. Here we selected to list the Coefficients, Constant, R Square, the P-value of each model, and Observations in Table 3.

In Model 1, we set GDP as the independent variable. From the result, the P-value is 0.04, which is lower than our critical significance level (0.05). In this case, the effect is statistically significant. From this, we rejected the null hypothesis and could apply the parametric test result to the simple linear regression model of GDP. However, R Square in this model is close to 0 (0.08), which indicates the repeatability of the model is too low.

In Model 2, the Unemployment rate is the independent variable. All the result in this model is reassuring. For example, the P-value is low enough to reject the null hypothesis, and there is a higher R Square, which is 0.85. Thus, the applied result to the simple linear regression model of Unemployment rate:

$$RHPI_i = 149.11 - 3.53Une._i + \varepsilon_i \qquad (8)$$

Where Y_i is Real housing price index (RHPI), X_{2i} is Unemployment rate (Une.). The constant in this model is 149.11, and the coefficient is minus 3.53.

In Model 3 and Model 4, Short-term interest rate and Inflation (CPI) were the explanatory variables respectively. The regression outcomes are in Annexes 5 and Annexes 6. Both of these two models are statistically significant because their significance F values are lower than 5% in their models. Another determinant in Table 3, the R Square of them are 0.28 and 0.13, respectively. The constant of the short-term interest rate is 106.74, and its coefficient is 3.90. In terms of Inflation, the constant is 107.18, and the coefficient is 3.15.

In Model 5 Completed dwellings number in new constructions for family housing, was set as the independent variable. Owing to the original figures of completed dwellings (No.) were too large to compare with the real housing price index, we divided the initial values with 1,000

and then ran the regression. The regression results of R square and P-value are good (R^2=0.65 and P-value is far lower than 0.05.). According to its OLS results, Model 5 is:

$$RHPI_i = 99.14 + 1.43\frac{ComD._i}{1{,}000} + \varepsilon_i \quad (9)$$

Where Y_i is Real Housing Price Index (RHPI), X_{2i} is Completed dwellings/1,000 (ComD. /1,000). The constant is 99.14, and the coefficient is 1.43.

Based on the simple linear model results, we combined all the explanatory variables above to the multiple linear regression model. However, in order to solve the time series explanatory variables, we use the First difference estimator to process the sample. The usual First difference operator was applied to the independent variables and the dependent variable. Therefore, in our multiple linear regression model, the independent variables were ∆GDP, ∆Unemployment rate, ∆Short-term interest rate, ∆Inflation (CPI), and ∆Completed dwellings/1,000 on the right-hand side of the equation. On the other side of the equation was ∆Real housing price index. The parameter regression model is:

$$\Delta RHPI_i = \beta_0 + \beta_1\Delta GDP_i + \beta_2\Delta Une._i + \beta_3\Delta STIR_i + \beta_4\Delta Inf._i + \beta_5\Delta\frac{ComD._i}{1{,}000} + \varepsilon_i \quad (10)$$

Where Y_i is ∆Real housing price index (RHPI), X_{2i} is ∆GDP, X_{3i} is ∆Unemployment rate (Une.), X_{4i} is the ∆Short-term interest rate (STIR), X_{5i} is ∆Inflation (Inf.), X_{6i} is ∆ Completed dwellings/1,000 (∆ ComD. /1,000).

Due to the time series data's deficit, before the analysis of the multiple linear regression results, we used the Durbin Watson test to detect the autocorrelation. By using the equation (7) to calculate the residuals (See Annexes 8) of this regression in Excel, we first subtracted the previous residual to obtain the difference of the residuals and then squared the difference of the residuals and the residuals itself. Next, we summed the two residuals squares (Sum of squares difference of residuals and Sum of squared residuals). The last step was that Sum of squares difference of residuals divided the Sum of squared residuals.

By using Excel to calculate, we got the Durbin Watson statistic, which was 1.30. In Durbin Watson table, when K=5, n=55, the dL is 1.209 and the dU is 1.592. When n=60, the dL is 1.248, and the dU is 1.598. In our case, the n=57 considered in the interval of n=55 and n=66.

By comparing the number in the Durbin Watson table, the value (1.30) indicated there is no autocorrelation in this model.

Table 4 presents the Ordinary least squares estimates of the multiple regression model. From the estimation results for the study period, we rejected the null hypothesis because the significance F in Table 4 is lower than 0.05. Additionally, we had an R Square in 0.42, and an adjusted R square is 0.37. However, the P-value of coefficients among the explanatory variables is range from 0.91 to 0.00.

The ∆Unemployment rate and ∆Short-term interest rate are statistically significant (P-value=0.00), but the others are not. The coefficient of the ∆Unemployment rate is -2.37 and the ∆Short-term interest rate is -2.08. It shows an increase in the ∆Unemployment rate or the ∆Short-term interest rate would cause a decrease in ∆Real housing price index. Regarding the rest of the variables, the coefficient of ∆GDP is 0.03, the coefficient of ∆Inflation is -0.37, and the coefficient of ∆Completed dwellings is 0.30. But the P-values of these three variables show their coefficients are not statistically significant. With the sample size of 57 observations, we observe that the probability of ∆Unemployment rate and ∆Short-term interest rate had statistically significant negative effects on the ∆Real housing price index. In the end, all the calculations were estimated in Excel.

Table 4 Multiple linear regression output

Regression Statistics	
Multiple R	0.65
R Square	0.42
Adjusted R Square	0.37
Standard Error	1.55
Observations	57

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	89.66	17.93	7.48	0.00
Residual	51	122.22	2.40		
Total	56	211.88			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.12	0.21	0.58	0.56	-0.30	0.55	-0.30	0.55
∆GDP	0.03	0.27	0.11	0.91	-0.52	0.58	-0.52	0.58
∆Unemployment rate	-2.37	0.44	-5.37	0.00	-3.25	-1.48	-3.25	-1.48
∆Short-term Interest rate	-2.08	0.69	-3.03	0.00	-3.46	-0.70	-3.46	-0.70
∆Inflation	-0.37	0.38	-0.98	0.33	-1.14	0.39	-1.14	0.39
∆ComD/1,000	0.30	0.22	1.35	0.18	-0.14	0.74	-0.14	0.74

Source: Authors' elaboration based on data from OECD and INE (2018).

5. Discussion

This chapter discussed the result findings from the last chapter and the empirical researches of Portugal's economy. Our study area is in the Portuguese housing market with its country economy situation from 2004 onwards. The time series dataset comprises mainly from 2004 to 2017. In the multiple regression analysis, the data is quarterly time series from Q1-2004 to Q2-2018.

5.1 Housing economy and macroeconomics

In classical business cycles, there are contraction and expansion periods. "Before the economy gets into a recession, there is a deceleration of activity, and it usually accelerates before attaining an expansionary phase (Rua, 2017)." In our study period, we also found contraction and expansion periods. There are enormous economic activities involved in, and that affects the business cycle and its financial performance. For example, the growth rate of GDP, which provides a measure of the state of the business cycle and household income (Tsatsaronis & Zhu, 2004).

When comparing the GDP with real housing price index, in some period of Figure 1, they seem related. Davis and Heathcote (2005) gave a study of the residential properties value in the United States, and it showed that consumption, non-residential investment, residential investment and GDP all co-move positively. In order to figure out their relationship, we developed a simple linear regression between GDP and the real housing price index. Based on the Pearson correlation analysis, there is a positive correlation between them with a correlation coefficient of 0.274. The results from the simple linear regression show the relationship between GDP and housing price index is statistically significant, but the repeatability of the model is not convinced because of its extremely low R Square. However, there is a report done by Rodrigues and Louren (2017), proofed the positive statistical relationship between real per capita GDP and the real house price index by using multiple regression analysis with a bigger data sample size, which was from Q1-1996 to Q2-2017. Thus, here we consider the GDP and the house prices might have a positive correlation.

Concerning the Unemployment rate, there are extensive studies on how unemployment affects the economy. We also consider it is a vital factor for the housing prices. In Figure 2, it shows an upward trend of unemployment while the housing price was going down. Moreover, the unemployment rate of youth was worse than the whole country level's unemployment rate.

During the Portuguese recession period, the youth employment rate reached around 40 per cent, which indicates almost half of the young workers lost their jobs. Tavares, Pereira, and Moreira (2014) pointed out that the youth unemployment rate was one of the damaging aspects of the real estate market. Based on the definition of youth, this is a group of people who are from 15 to 24 years old and active in the labour market. Youth workers have insufficient experience or skills, which makes them less competitiveness in the labour market. However, we do not think this group of people are willing to purchase a house in the early stage of their career. On the contrary, we figure that the youth might prefer to rent an apartment instead of buying a house. In terms of this, their consumption behaviours might influence the rental housing prices.

The high unemployment rate causes not only economic problems but also social issues. Because the loss of a job means reduces in living standard and increased psychological distress (Mankiw, 2016: 183). Mankiw indicated the serious problems cause by jobless. We explain it in two aspects, the consumer confident index and the income level of the citizen. In Figure 4, the situation in the unemployment rate was a bit better than the youth unemployment rate, but it still had a considerable amount of growth during the recession period. As the number of jobless people adding up, the household disposable income would decrease by following the unemployment rate. In Figure 6, we observed a sharp shrink of the household income during the recession period. And next, with lower revenue in a household, people have to consider their buy/rent decision. In the context of an uncertain economic circumstance, consumers tend to have a basic living standard to get over the recession. In Figure 5, the housing and utility CPI were extremely high during the financial crisis period. That, on the other hand, confirm the consequence of higher unemployment rate on household income and consumer behaviour.

In order to find out the relationship between the unemployment rate and the housing prices, we examined the simple linear regression between the unemployment rate and the real housing price index. The correlation results show there is a strong negative correlation between them with a Pearson coefficient -0.92. In Model 2, simple linear regression results indicate that the negative relationship between the unemployment rate and the real house price index is statistically significant. Its negative coefficient shows that an increase in the unemployment rate would cause a decrease in the real housing price index.

Another important indicator of the housing prices is interest rates. After joined in the European Union, Portugal adopted the Euribor interest rate. The integration increased the competitiveness of the financial market but resulting the decline in bank intermediation margins (Tavares, Pereira, & Moreira, 2014). When the European Sovereign debt erupted in Europe, there was a sudden decline in the interest rates. BBC reported under the effect of that global crisis, the interest rates for central banks in both the United States and Europe headed towards zero. Moreover, in Figure 4, the short-term interest rate from 2015 to the present has been in negative values for three years. With the low interest rates, the housing prices are soaring among European countries, which might trigger the next crisis in the real estate market (Koranyi & King, 2018).

The importance of interest rates based on its effect on loans and credit. The number of loan agreements showed a lag from interest rates in Figure 3. The amount of mortgage was very high before 2007 due to the loose monetary policy at that time. In another view, the large mortgages in 2007 indicated the consumers have confidence in the housing market. But soon, as the arrival of the debt crisis, the interest rates fell and together with a shrank in the loan agreements. The lower level of interest rates maintained the loan agreements number for a while. But it still cannot break the dropping of loan agreement number, with below 5,000 per month loan agreements from 2012 to 2015.

The crisis affected people's willingness to require a mortgage. According to Pinto's survey study in 2012 among Portuguese, consumers are easier to be affected by the uncertain economic climate than the individual circumstance (Pinto, 2012). It shows that the uncertainty of the country's economy might have a stronger influence on consumer confidence. During the crisis, even though the interest rates are effective methods to stimulate the demand, it still cannot overcome the losing confidence of consumers. Even at the ending point of our study, in Figure 3, when the interest rates went down to below 0%, the loans started to grow. It indicates an inefficient monetary policy on interest rates in the study period. Additionally, the long-lasting negative interest rates might be a big concern of the housing market.

Concerning the relationship between interest rates and the housing prices, we carried a Pearson correlation and a simple linear regression of them. The result showed a positive statistically association in housing prices and the short-term interest rate. We doubt the result of simple linear regression as the lower interest rates are ought to drive the demand on loans. However, as we listed the reality above that currently there might be an ineffective monetary

policy of the negative interest rates. Besides, the small sample size might be another reason. Because when we eliminated the time series attributes of the dataset, the results in the multiple regression model reversed. The impact of interest rates on housing prices became negative. But the coefficient is not statistically significant. Therefore, we consider the regression results are affected by the ineffective monetary and the small sample size.

Barda and Sardianou (2010) profound there were deep changes in consumer behaviour due to the very sharp rise in unemployment, loss of income, uncertainties in assessing the value of assets and the safety of savings. The case is represented by the index of housing and utility CPI in Figure 5. During the Portuguese financial crisis period (2011-2013), the index of housing and utility CPI was extremely high. Also, the bailout period that began in May 2011, which required necessary adjustments in the Portuguese economy and austerity measures which strongly affected families and enterprises (Castro, 2016). They had to cut their spending on leisure products to maintain their essential living standard. The higher index on housing and utility CPI reflects people spent more on essential living expenditure like housing, water, gas, etc. during the recession period. In the year of 2014, Portugal finished the bailed out by IMF and brought in more foreign investments. In 2015 the index of housing and utility CPI was caught up by the total CPI index. The situation on expenditure preference changed again. This time, the change might be a signal of the recovery economy.

By comparing with the household income with the house purchases in Figure 6, we found there might be correlation since there was a three-year lag corresponding parallel shift between them. Nowadays, as the growth of household disposable income, people tend to be optimistic about the housing market, which indicates the continued growth of house transactions. From another point of view, the increase of the purchase of houses might cause by foreign buyers.

According to the published number from the SEF, 3.51 billion Euros investment came from those foreigners who invested in obtaining the Golden visa, and they showed over 99% of the Golden visa invested in property. The curve of permanent immigrants in Figure 8 proofed the efficient of Golden visas and tax benefits programs. As we know, the Golden visas program was launched in 2012. The decrease of immigrants (2009 - 2012) turned to increase in the next year after 2012 in Figure 8. And the number of immigrants continued growth in the following years. According to Mankiw (2016: 523), an economic boom raises the national income and increase the demand for housing as it brings in a large number of the population

probably because immigration also raises the demand for housing. As the Golden visas policy and the tax benefit, the foreigner investment flew into Portugal's economy and helped the economy to recover. It did not only boost the cash flow into Portugal, but it also increases the jobs opportunity and housing demand. This growing investment come together with a substantial increase in housing prices.

The housing boom was also encouraged by government policies that promoted homeownership (Mankiw, 2016: 589). In Rodrigues and Louren's work (2014) announced the residential investment had been slow down since the end of the 90s. However, in their later study in 2017, they found that the housing investment by non-residents has been increasing since the 1990s. This investment from foreigner was not affected by other exogenous factors, and it keeps rising. In Figure 7, after the debt crisis, the residential investment (GFCF) began to accelerate and recovered steadily. In the meanwhile, the housing prices are rising as well.

When people bid up the cost of an asset above its fundamental value, it creates a bubble (Mankiw, 2016: 589). Among the foreigner domain buyer market, the housing prices usually were deviated from its fundamental value. With limited background information about this country, they tend to make their decisions without a completed understanding of the local housing market. There might be some foreign buyers consider the housing prices in Portugal were the same as the one in their own country, which led to the prejudice evaluation of Portuguese housing prices, and most of the time housing prices were overestimated. Over time, if the foreign homeowners realised they brought in a high cost, they might hope to sell it in another value which was higher than the previous price. And these everyday transactions speed up the housing bubbles.

The housing stock also confirms the changing residential investment in the study period. In Figure 7, the investment (GFCF) was increased steadily between 2004 and 2008, but in this period the housing price was going down. According to the accumulated housing stock from the 1990s in Figure 9 and 10, the decrease of housing prices at that time might influence by the increasing housing supply. In addition, the utterly opposite trend between reconstructions and new constructions in Figure 10 indicates the decrease in government residential investment reduced by the crises and increased by the foreign investment for the economic recovery. In the instruction of Golden visa investment, the city rebuild also considers as a fair investment program, which also mixed in the residential investment and grew the housing stock.

The growing amount of rebuild program might bring problems. We considered there are two issues involved. The first one is the short-term rental business, the apartments in the city centre are more attractive for their business. And the rebuild programs are mainly located in the city centre. When the rebuild program adds the house price to high demanding city centre houses, it speeds up the increase rate of the city centre housing prices. The second issue is about the total housing stock in the market. In the current housing market, there is no price difference in the housing type of the new house and rebuilt construction. In this case, the decrease in new buildings together with the increase in reconstructed old buildings indicates the total housing stock might maintain in the same amount or probably with limited growth. Regarding the short-term rental issue, the control from the government is vital to deal with the rising housing prices in the city centre and the local housing problems.

5.2 Housing prices by geography and typology

When the debt crisis erupted in Eurozone, it caused sub crisis in PIGS countries, which includes Portugal. The overall curves of the housing prices in the different regions were all in a V shape in our study period. The Algarve was the highest housing price region among them while the Centro was the lowest one. The outstanding performance of the Algarve reflected the contribution of foreign investment as the Algarve region has mainly influenced by tourism. As the capital city of Portugal, the Lisbon region also considered as an expensive region. Unexpectedly, the island of Madeira (Região Autónoma da Madeira) grew quick in 2012. When the continent Portugal was suffering from the severe economic recession, the housing prices of the Madeira caught up and were even over the Algarve.

Comparing to the interior regions in the mainland, the Açores region (Região Autónoma dos Açores) also surpassed the interior continent regions. Similar to the population density of this country, the housing prices appeared that the regions near coastline were more expensive than the inland. Oikarinen (2014) concluded that the increasing difference in the housing prices between a few growing centres and the rest of the country is also likely to hinder the movement of labour force thereby disturbing the operation of the labour market. Comparing to the Algarve and the capital city, Lisbon, the industrial structure of the interior is mainly agriculture. We consider the inequality between coastal and inland region still exist.

From the typology perspective, B2 was the highest housing price per square while B4 was the last one. There is no doubt the bigger house space, the smaller cost per square metre ratio. Because by multiple the floor area, the total amount to buy a bigger house is more expensive

than a small one. Before the crisis, the prices differential in typology had a visible partition. In Figure 12, the price ratio was much higher in B2 before the crisis erupted, which means the demand for B2 was higher before the recession. We consider the transforming family structure of residence was another reason for the higher need for B2. In the past, people lived in a big family, while nowadays young couples prefer to live alone.

But the price figures during the recession told us another story. The partitions among the price per square ratio were narrowed down during the recession period. As time went by, when the market recovered, the price differential appeared again. From the ending point in the study period, the demand went to B2 again, which almost recovered as before the crisis level. Therefore, we conclude that in the regular economic period, the housing demand of B2, or fewer bedroom houses were more attractive. Another thing we found is that the price differential has eliminated between B3 and B4 since 2011. From Figure 12, it has been overlapped each other since the crisis.

The evidence of shifted demand also revealed in Table 1. In the two most famous regions, the Algarve and Lisbon (Área Metropolitana de Lisboa), appeared their highest average housing price €/m² in B4, which indicated the demand drove to the B4. Without expectation, the B4 in Algarve was the highest type of house and region in our study period in Table 1. By the opposite, the house prices €/m² in those poor performance regions (Açores, Alentejo, Norte, and Centro), the B2 still took the leading place, and B4 was the lowest.

The figures in Table 1 reversed the statement of Tavares et al.'s work in 2014. In their study, "The higher average prices of the apartment in Algarve region for B1 and B2 can be explained by the huge foreign investment in real estate in Algarve." Because the housing market in Algarve was mainly for foreigners to enjoy their leisure time or for its coastline location (Tavares, Pereira & Moreira, 2014). In Tavares, et al.'s study, the prices were in a regular economy. While during 2011-2013, Portugal was in a massive recession and the housing market was included. When there was less demand in the market, all the housing prices went down. Considering to the narrowest gap in this recession period, it showed the order in each type apartment was similar. In other words, people buy their houses based on their needs, which also match the higher housing and utility CPI in the recession period of Figure 5.

5.3 Housing prices regression

In statistics data analysis, we evaluated a group of specific quarterly variables related to the housing prices. They are GDP, Unemployment rate, Short-term interest rate, Inflation (CPI), and Completed dwellings (NO.). By gathering the figures, we tested them by using ANOVA, Pearson correlation analysis, Simple regression, Durbin-Watson test and Multiple regression analysis. We removed the models that were not statistically significant, or R squares were low. The multiple regression was detected that there was no autocorrelation problem.

The simple linear regression analysis was carried out in model 1 to model 5; all the P-values were lower than 5% significance level. While the R squares varies, some of them had higher R squares; the others did not have. In their scatter diagrams, the unemployment rate was outstanding, and its correlation coefficient was high. With the method of the simple linear regression model, the R square of unemployment was 0.85 with statistically significant results (Model 2), which also proofed the relationship between unemployment rate and the housing prices in Portugal could be explained. It could be considered as the more people lose their jobs; the more people cannot afford to buy a house, which leads to the decrease of housing prices. Thus, we conclude the unemployment rate might lead to a negative impact on housing prices based on the study period.

While in Model 5, completed dwellings (NO.) has a statistically significant positive influence on the housing prices. The results showed a reverse impact on common sense. As we all know, if we assume the demand is fixed, the increase in supply should cause a decrease in product price. However, the opposite results of Model 5 show that when increasing a new building, the housing prices would rise as well. In order to explain this issue, we moved back to Figure 9 or Figure 10. Based on the chart, the number of new buildings significantly decreased in the last fourteen years.

We consider there are four reasons cause the positive relationship between housing prices and new buildings. First are the government's control and the accumulation of the housing stock from the last century. The less control by the government was evident in Figure 9. The number of completed dwellings were above the number of licensed buildings from 1995 to 2012, which revealed less control by the relevant institutions. Second, the living communities are close to the coastlines, which limits the residential land area. Moreover, the enormous growth of reconstruction buildings did not include into the regression variable. The increasing proportion of reconstruction buildings further limiting the new buildings. From another point

of view, the decrease in housing prices between 2004 and 2008 suffered from the Portuguese slump economic performance. Later on, the financial crisis further compressed the whole country's development, which led to a total ten-year decline in the housing prices in our study period (2004-2018). By comparing it to a fourteen-year reduce in new buildings number, the decrease explained the correlation problem of Model 5. Plus, the small sample size of 58 observations indicates all the simple linear regression models were weak regressions.

In processing the multiple regression model, we comprised these five indicators by using their First order difference as independent variables. The results from the Durbin Watson test show that there is no autocorrelation in this model. In this multiple regression model, the main drivers of ∆real housing price index are the ∆unemployment rate and the ∆short-term interest rate. The coefficients and an acceptable R square indicate an increase in the ∆unemployment rate would have a negative impact on the ∆real housing price index. Besides, the case in the ∆short-term interest rate also causes an adverse effect on ∆real housing price index. Unfortunately, the relationships between the ∆real housing price index and ∆GDP, ∆Inflation, ∆Completed dwellings cannot be explained by their constants from the study results.

6. Conclusion

The chapter deals with the main conclusion of the discussion chapter and then gives out the managerial implication of the study. At the end of the chapter, it lists the limitations of the present study and elucidates the possible directions for future research.

6.1 Main conclusion

This paper investigated the current Portuguese housing prices with the macroeconomic context. From the reviews and the interpretation of official statistics, we analysed the indicators and linked discussion to related events. The results show that the housing market in Portugal was affected differently by the macroeconomics during the study period in 2004-2018. By concluding the discussion chapter, we summarised our findings as follow:

The macroeconomic indicators show: GDP and the housing prices might have a positive correlation. The higher youth unemployment might influence rental costs. As the number of jobless people adding up, the decrease interferes to the income and continue its impact on consumer behaviour. The current negative interest rates are rising the demand for houses and increasing the housing prices. The consumption preference changed to maintain the essential products during the recession period due to the high housing and utility CPI. And the higher total CPI after 2015 gave a signal of the recovery economy. The increasing number of immigrants and investment might be affected by the Golden visa and tax benefit program. In the meanwhile, the growing investment and housing prices might cause a housing bubble. Plus, the continuing negative interest rates, these three elements might lead to the next crisis in the real estate market. The housing stock in Portugal is mostly fixed but may experience limited growth as the rising of the rebuild program.

On the other hand, the housing prices in regions and typology also have implications. The Algarve was the most expensive region, and the Lisbon region was the second one. The cheaper areas mainly located in the interior, and the Centro was the cheapest one. The housing prices in Madeira grew in 2012 and even continue its growth in the recession period. By comparing the coastal regions and the inland regions, the economic inequality still exists. By analysing in typology, the demand of B2 was higher, especially in a regular economic period. During the recession period, the housing demand for the different type of houses tended to focus on consumer's needs. Besides, the average housing price €/m² differential between B3 and B4 seems to be eliminated since 2011.

Through the data analysis results, the unemployment rate considered as the most potent determinants on housing prices among the variables in our study, which has a strong negative linear relationship with real housing price index.

6.2 Managerial implications

From paper to reality, the meaning of this research is to transform the theoretical results to our real life. This empirical study on the Portuguese housing prices is expected to contribute to the field of the housing market in suggesting suitable strategies for organisations. Since the study area is in the context of a country's perspective, the findings might be useful for management practitioners as well as for investors. Following are the managerial implications of this study:

Implications for management practitioners:

It was found that the housing prices have a negative correlation with unemployment rates, which highlights the importance of lower and stable the long-term unemployment rates (around 5%). Hence, management practitioners could consider their strategies on improving citizens professional skills, especially for young workers. Also, education is essential to the citizens' personal growth. Apart from that, the government could encourage local start-ups by launching benefits policies. For instance the unicorn company not only stimulates the employment positions, but also brings in the advanced technologies, which is a upward spiral to the country's economy.

Regarding the housing prices in the city centre were occupied by short-term rental business, and the rental prices are increasing. In this case, it might be useful to offer it to local start-ups as their offices with the benefits policies. Last, for the regions which are famous for its tourism industry, such as the Algarve, the long-term sustainable tourism service is always good for its prospect.

Implications for investors:

It was found that the housing prices are growing, the transaction is growing, and the immigrants are growing. While the Euribor interest rate is negative, this phenomenon depicts a concern about the future housing market. It might cause housing bubbles or might lead to a crisis. If the investors who invested their properties since the lowest prices period around 2013, currently it is a considerable chance to gain profits in the prosperity market.

However, there are opportunities in the housing market. As the ending of 6-year golden visa, the golden visa holders might exit the market. Another point of view from the short-term rental business. Recent years, the negative impacts from the short rental business appeared, especially in the elite neighbourhoods (Sullivan, 2018). Thus, it is possible those owners would like to end it. From the evidence in the typology aspect, in the growing housing market, consumers tend to purchase the "small house". It might indicate the opportunity on larger utility square meters properties.

6.3 Limitations and future research

As with all research studies, this study has its flaws. Firstly, the literature review relies on the articles and country information we could found. There are plenty of articles in Portuguese which we are not able to understand due to the language barrier. And concerning an evaluation on a country scale, the study area still needs to be extended. It should fully explain the country's history, culture, citizens preference, lifestyle, fiscal policy, and the country's other leading industries, etc.

Another limitation is in the methodology. The analysis in real estate is complexity, and it needs more detail data and sensitive information from the realistic real estate agents. It is better if our investigations could include the interviews with the people who work in the housing market industry.

Third is in our data analysis part, the small sample size of our regression dataset leads us to a weak regression model. When we researched other articles, we agree that a great study or research paper based on a great dataset or complete materials. A meaningful data analysis requires accurate data. The fundamental data is crucial evidence for the research.

Regarding the macroeconomic indicators, the forth is that we should make more efforts on identifying the messages it passed to, the component element of the index, preliminary or late indicator, etc. It is useful in discussing the situation now and prepares for the future scenario.

In future research, it would be of relevance to focus on the residential investment, especially the foreign investment into the housing market of Portugal. Due to tourism is an essential industry of the country, we would spend more effort on investigating and combining tourism and the housing prices. Therefore, the future study would analyse the determinants related to foreign investment and tourism factors with the housing prices.

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8. Annexes

8.1 Annexes 1 Data summary and statistic description

Annexes 1 Data summary and statistic description

Data name	Group	Source	Time	Mean	Median	Std. Dev.	Min	Max	Obs.	Mode
Youth Unemployment Rate	Unemployment	OECD	Q1-2004-Q2-2018	24.81	22.80	8.20	14.91	40.24	58	
Long-term Interest Rate Quarterly	Interest rates	OECD	Q1-2004-Q2-2018	4.86	4.15	2.58	1.79	13.22	58	
Harmonized index of consumer prices (Total)	Inflation & CPI	Statistics Portugal	January 2004 - August 2018	1.59	1.90	1.35	-1.80	4.00	176	
Harmonized index of consumer prices (in Hosing, Water, Electricity, Gas, and other fuels)	Inflation & CPI	Statistics Portugal	January 2004 - August 2018	3.25	3.10	2.46	-0.30	10.80	176	
Interest Rate on Housing Loan % by financial purpose of Housing acquisition	Interest rates	Statistics Portugal	January 2007 - August 2018	1.75	1.46	0.84	1.03	5.77	116	
Loan agreements with conventional mortgage (No.)	Interest rates	Statistics Portugal	January 2007 - December 2016	9030.09	5073.50	7618.26	2138.00	30567.00	120	
Short-term Interest Rate Monthly	Interest rates	OECD	January 2007 - August 2018	1.07	0.31	1.66	-0.33	5.11	140	
Purchase and sale contracts (in thousands Euro) Yearly	Housing market	Statistics Portugal	2004-2017	19619436.14	18834126.50	7024347.13	9490407.00	29630074.00	14	
Household disposable income (Average growth rate %)	Household disposable income	OECD	2004-2017	0.21	1.10	2.58	-5.57	2.80	14	
Real Housing Price Index Yearly	Housing market	OECD	2004-2017	111.71	112.78	12.13	94.23	130.33	14	
Investment (GFCF) in million USD	Investment	OECD	2004-2017	53217.07	53608.30	6756.29	43046.04	64215.17	14	
Permanent immigrants (No.)	Immigration	Statistics Portugal	2008-2017	25740.30	28646.50	7321.87	14606.00	36639.00	10	
Licensed buildings (No.)	Housing stock	Statistics Portugal	1995-2017	40389.17	46577.00	18555.34	14030.00	64969.00	23	
Proportion of reconstructed total area (%)	Housing stock	Statistics Portugal	1995-2017	1.39	1.01	1.32	0.01	3.94	23	
Completed dwellings (No.) in new constructions for family housing Yearly	Housing stock	Statistics Portugal	1995-2017	59830.83	68764.00	38236.78	6794.00	125708.00	23	
Average value of bank evaluation (€/ m²) of living quarters by Geographic localization (NUTS - 2013), and Dwelling typology; Monthly	Housing market	Statistics Portugal	September 2008 - July 2018							
Portugal				1085.35	1083	61.77	981	1187	119	1014
Norte				945.04	951	49.88	866	1071	119	890
Centro				903.17	904	50.65	814	987	119	930
Área Metropolitana de Lisboa				1315.30	1308	89.19	1146	1456	119	1221
Alentejo				961.10	956	64.41	858	1065	119	1037
Algarve				1360.01	1375	100.65	1183	1524	119	1451
Região Autónoma dos Açores				1011.29	987	64.62	897	1137	119	969
Região Autónoma da Madeira				1289.74	1292	99.72	1126	1447	119	1429
B2				1128.25	1114	81.94	994	1258	119	1199
B3				1031.35	1039	54.68	947	1122.5	119	1081
B4				1009.89	1015	49.63	910	1118	119	951

8.2 Annexes 2 Correlation coefficient results

Annexes 2 Correlation coefficient results

	Real Housing	*GDP*	*Unemployment Rate*	*Short-term Interest Rate*	*Inflation (CPI)*	*Completed dwellings (No.)*
Real Housing Price Index	1.00					
GDP	0.27	1.00				
Unemployment Rate	-0.92	-0.26	1.00			
Short-term Interest Rate	0.53	-0.11	-0.56	1.00		
Inflation (CPI)	0.36	-0.28	-0.28	0.56	1.00	
Completed dwellings (No.)	0.80	0.01	-0.71	0.83	0.47	1.00

8.3 Annexes 3 Summary of simple linear regression output of GDP (Model 1)

Annexes 3 Summary of simple linear regression output of GDP (Model

Regression Statistics	
Multiple R	0.27
R Square	0.08
Adjusted R Square	0.06
Standard Error	11.55
Observations	58

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	605.32	605.32	4.54	0.04
Residual	56	7465.55	133.31		
Total	57	8070.86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	111.56	1.54	72.53	0.00	108.48	114.64	108.48	114.64
GDP	4.27	2.00	2.13	0.04	0.26	8.29	0.26	8.29

8.4 Annexes 4 Summary of simple linear regression output of Unemployment Rate (Model 2)

Annexes 4 Summary of simple linear regression output of Unemployment Rate (Model 2)

Regression Statistics	
Multiple R	0.92
R Square	0.85
Adjusted R Square	0.85
Standard Error	4.64
Observations	58

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	6864.37	6864.37	318.61	0.00
Residual	56	1206.49	21.54		
Total	57	8070.86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	149.11	2.16	69.02	0.00	144.78	153.44	144.78	153.44
Unemployment Rate	-3.53	0.20	-17.85	0.00	-3.93	-3.14	-3.93	-3.14

8.5 Annexes 5 Summary of simple linear regression output of Short-term Interest Rate (Model 3)

Annexes 5 Summary of simple linear regression output of Short-term Interest Rate (Model 3)

Regression Statistics	
Multiple R	0.53
R Square	0.28
Adjusted R Square	0.26
Standard Error	10.21
Observations	58

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2230.00	2230.00	21.38	0.00
Residual	56	5840.86	104.30		
Total	57	8070.86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	106.74	1.77	60.18	0.00	103.19	110.30	103.19	110.30
Short-term Interest R	3.90	0.84	4.62	0.00	2.21	5.59	2.21	5.59

8.6 Annexes 6 Summary of simple linear regression output of Inflation (CPI) (Model 4)

Annexes 6 Summary of simple linear regression output of Inflation (CPI) (Model 4)

Regression Statistics	
Multiple R	0.36
R Square	0.13
Adjusted R Square	0.12
Standard Error	11.19
Observations	58

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1059.64	1059.64	8.46	0.01
Residual	56	7011.23	125.20		
Total	57	8070.86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	107.18	2.24	47.77	0.00	102.68	111.67	102.68	111.67
Inflation (CPI)	3.15	1.08	2.91	0.01	0.98	5.32	0.98	5.32

8.7 Annexes 7 Summary of simple linear regression output of Completed dwelling NO. (Model 5)

Annexes 7 Summary of simple linear regression output of Completed dwelling NO. (Model 5)

Regression Statistics	
Multiple R	0.80
R Square	0.65
Adjusted R Square	0.64
Standard Error	7.15
Observations	58

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5208.97	5208.97	101.93	0.00
Residual	56	2861.89	51.11		
Total	57	8070.86			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	99.14	1.59	62.30	0.00	95.95	102.33	95.95	102.33
Completed dwelling	1.43	0.14	10.10	0.00	1.15	1.71	1.15	1.71

8.8 Annexes 8 Multiple linear regression residual output

Annexes 8 Multiple linear regression residual output

Observation	Predicted rp-dif	Residuals	Observation	Predicted rp-dif	Residuals
1	0.565820512	0.5971419	30	1.117929604	0.3939385
2	1.237793775	-0.554446	31	3.143028673	0.7545268
3	-0.351134641	1.2401159	32	0.264588815	2.5069429
4	1.017453437	0.455617	33	1.49005568	0.7866287
5	0.644318061	-1.129657	34	1.368399727	-0.138501
6	0.977129671	-2.227979	35	1.175712634	-1.638418
7	1.085418548	-0.315116	36	0.121581345	1.8919168
8	0.90112669	0.087639	37	0.134819987	0.4017063
9	0.41200862	0.3724065	38	-1.851617599	1.6580982
10	0.487998484	0.1248851	39	-1.609495773	-0.7495
11	1.755418484	-1.603522	40	-1.261885318	-0.069491
12	1.152167753	-0.633531	41	-0.425050397	-0.738959
13	0.572724157	1.8599597	42	-2.09827772	2.3920416
14	0.348748212	-0.844991	43	-0.321488444	0.7149013
15	0.669870273	2.6574971	44	-0.337025737	0.2816598
16	-0.423860886	4.6211276	45	-1.559541053	-0.871162
17	0.398018803	3.6642194	46	0.01837245	-0.027646
18	1.220679212	2.0384787	47	-0.582533252	-0.812304
19	-1.39087289	-1.889135	48	-0.661151321	-1.270845
20	-2.449004989	1.0666297	49	-1.552963767	-0.422661
21	-0.317075459	-0.857853	50	-0.911488921	-0.169313
22	0.418797673	-1.045114	51	-1.120516556	-0.579673
23	0.861249885	-0.995074	52	-1.259829574	-0.537453
24	1.505325551	-0.847551	53	-0.952762574	-1.462897
25	1.939216863	-1.660577	54	-1.155290789	-2.844411
26	1.021387345	0.3678878	55	-1.53726739	-0.32491
27	1.14494325	0.0818428	56	-1.302373878	-2.843721
28	3.295097964	-1.277473	57	-0.97416419	-0.442249
29	1.720669911	0.8083225			