



Lisbon School
of Economics
& Management
Universidade de Lisboa

MASTERS IN MANAGEMENT (MIM)

MASTERS FINAL WORK

DISSERTATION

IS THERE EVIDENCE OF A HOUSING PRICE BUBBLE IN PORTUGAL?

NELSON MANUEL RODRIGUES MOTA

FEBRUARY - 2026



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Just over five years ago, a young man from Tondela, a small town in the countryside, pursued his dream of one day graduating and becoming a master at one of the best economics schools in the country, the prestigious ISEG – Lisbon School of Economics and Management.

Now, with my undergraduate degree completed, the preparation of this dissertation marks the end of a cycle. I would like to thank everyone who helped me throughout this process, creating the conditions that made it possible to submit this work and successfully conclude my academic journey.

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RESUMO

O comportamento do mercado imobiliário em Portugal tem-se tornado uma temática central no debate público, motivado pela subida incessante dos preços da habitação. Este fenómeno, cuja relevância cresce anualmente, afeta transversalmente a sociedade portuguesa, com especial incidência na população jovem que procura a sua independência.

A presente dissertação tem como objetivo analisar o mercado imobiliário nacional na última década, procurando aferir se a evolução dos preços é sustentada por fatores macroeconómicos e setoriais ou se, pelo contrário, existem evidências de especulação e sobrevalorização.

Numa fase inicial de abordagem a este tema, iremos proceder à análise e enquadramento individual de diversos indicadores macroeconómicos, demográficos e setoriais durante a última década. Posteriormente, é desenvolvido um modelo econométrico de dados em painel que permite relacionar parte destas variáveis e analisar o comportamento do mercado ao nível das regiões NUTS II.

Através deste enquadramento, pretende-se alcançar uma resposta concisa sobre a existência de uma bolha no mercado imobiliário em Portugal, distinguindo os fundamentos económicos das dinâmicas especulativas.

Palavras-Chave: Mercado Imobiliário, Preços das Casas, Sobrevalorização, Bolha Imobiliária, Dados em Painel, Efeitos Fixos.

ABSTRACT

The behavior of the real estate market in Portugal has become a central theme in public debate, motivated by the relentless rise in housing prices. This phenomenon, whose relevance grows annually, affects Portuguese society across the board, with a particular impact on young people seeking independence.

This dissertation aims to analyze the national real estate market over the last decade, seeking to assess whether price developments are supported by macroeconomic and sectoral factors or whether there is evidence of speculation and overvaluation.

In an initial phase of our approach to this topic, we will analyze and contextualize various macroeconomic, demographic, and sectoral indicators during the period under study. Subsequently, we will develop a panel data econometric model that allows us to relate some of these variables and analyze market behavior at the NUTS II regional level.

Through this framework, we aim to provide a concise answer as to whether there is a bubble in the real estate market in Portugal, distinguishing between economic fundamentals and speculative dynamics.

Keywords: Real Estate Market, House Prices, Overvaluation, Housing Bubble, Panel data, Fixed Effects.

GLOSSARY

AAR: *Azores Autonomous Region*

CPI: *Consumer Price Index*

ECB: *European Central Bank*

FE: *Fixed Effects*

GSADF: *Generalized Supremum Augmented Dickey-Fuller*

INE: *Instituto Nacional de Estatística*

MAR: *Madeira Autonomous Region*

NUTS: *Nomenclature of Territorial Units for Statistics*

PD: *Panel Data*

SDG: *Sustainable Development Goal*

WTV: *West and Tagus Valley*

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The author used GEMINI, an AI-assisted editing tool, to improve spelling, grammar, clarity, and readability during manuscript preparation. After using this tool, the author carefully reviewed and edited the text and takes full responsibility for the final content.

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CHAPTER 1 – INTRODUCTION

In recent years, housing markets throughout Europe have seen a significant increase in prices, transforming trends in affordability, investment, and social mobility. Portugal has been no exception. The nation has experienced one of the largest surges in housing prices in the Euro Area, with real estate values increasing dramatically since the mid-2010s. This issue has turned housing into a focal point in both public discussions and scholarly studies, as home affordability has become more challenging, especially for younger people and low-income families. This phenomenon directly challenges the United Nations Sustainable Development Goal 10 (Reduced Inequalities), as the barrier to housing access deepens the socioeconomic gap and limits equal opportunities. The ongoing increase in real estate prices has provoked essential inquiries regarding the fundamental factors influencing the market and whether present values are sustainable or indicative of a speculative bubble.

From a macroeconomic perspective, the evolution of the Portuguese property market cannot be detached from the broader global economic environment of the past two decades. The collapse of the United States housing market in 2008 triggered a global financial crisis that profoundly affected European economies, including Portugal. Following years of fiscal consolidation and slow recovery, the Portuguese economy entered a period of moderate growth supported by tourism, exports, and foreign investment. However, this recovery was interrupted by the COVID-19 pandemic, which temporarily froze real estate activity but was quickly followed by an even sharper rebound in prices once restrictions were lifted. The subsequent outbreak of war in Ukraine in 2022 and the resulting surge in energy prices and inflation added new layers of uncertainty, leading to tighter monetary policy across Europe and a rapid increase in interest rates. These changes have reshaped financing conditions for households and investors, making mortgage borrowing more expensive while simultaneously moderating, though not reversing, price growth.

In spite of these disruptions, the Portuguese housing market has shown impressive strength. Prices have persistently increased despite the variations in transaction volumes and mortgage lending. This resilience suggests that additional factors, apart from conventional macroeconomic variables, might be upholding the market. Changes in demographics, low unemployment rates, and the comparatively affordable nature of

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Portuguese real estate in relation to other Western European nations have continued to draw foreign interest. Simultaneously, supply side structural limitations, such as bureaucratic obstacles, building expenses, and urban planning restrictions, have hindered the market from responding to rising demand. In this context, the effectiveness of housing policies and urban planning becomes crucial to reaching the targets of SDG 11 (Sustainable Cities and Communities), which defends the necessity of ensuring access to adequate, safe, and affordable housing for all citizens.

Against this background, an important question arises: are current housing prices in Portugal justified by economic fundamentals, or are they being driven by speculative dynamics that could indicate the presence of a bubble?

The distinction is crucial. If prices reflect strong fundamentals, such as demographic growth, supply constraints, and sustained foreign demand, the market may simply be adjusting to new structural realities. However, if prices have become detached from these fundamentals, the risk of a sharp correction could pose significant challenges for households, investors and the financial system.

CHAPTER 2 – LITERATURE REVIEW

2.1 Definition and Theoretical Framework of Real Estate Bubbles

A bubble in the property market, as in any other asset market, happens when property prices rise unsustainably. Although house price increases may stem from multiple factors, speculative expectations are often identified as a key driver of housing bubbles. When market participants expect sustained price appreciation, demand increases as buyers acquire properties not only for consumption purposes, but also for resale or investment (Case & Shiller, 2003).

The theoretical framework for understanding housing bubbles draws from behavioural economics and market inefficiencies. Unlike stock market bubbles, which can burst quickly, housing bubbles tend to build over extended periods due to the illiquid nature of real estate and the influence of psychological factors. During a bubble, first-time buyers may feel pressure to purchase immediately out of fear that prices will become unattainable in the future. Additionally, many buyers may disregard fundamental indicators such as price-to-income and price-to-rent ratios, focusing instead on speculative gains (Case & Shiller, 2003).

During boom periods, optimism, herd behavior, and short-term profit expectations create self-reinforcing dynamics in which rising prices attract further demand, pushing values further away from fundamentals. These processes are amplified by factors such as easy credit, limited financial literacy, and lax regulation, which together foster excessive risk-taking and speculative investment. Importantly, behavioral distortions such as overconfidence, anchoring and the illusion of control lead agents to underestimate risk and dismiss signals of overvaluation (Brzezicka & Wisniewski, 2014).

However, quick price increases do not always imply a bubble. According to Case and Shiller (2003), a major feature of a bubble is the prevalence of speculative behavior, in which buyers believe in a nearly risk-free growth of property values. This mindset causes demand-driven price inflation, which can last as long as confidence stays high. Once price expectations shift and buyers begin to doubt continued appreciation, demand can drop sharply, leading to a market correction or crash.

The term "housing bubble" only became popular in the early 2000s, despite identical market dynamics that occurred in previous decades. Historically, real estate booms and busts have been associated with changes in income, interest rates, and supply limitations.

While Case and Shiller (2003) emphasize the role of speculative behaviour and irrational expectations in driving real estate prices to unsustainable levels, Lind (2009) criticizes traditional definitions that rely on the notion of “fundamentals”, arguing that the concept itself is too vague. Instead, he suggests defining a bubble purely based on price dynamics without necessarily attributing the cause to deviations from fundamental values.

Lind (2009) further expands the theoretical framework of housing bubbles by proposing that no single factor can fully explain their formation and collapse. Instead, bubbles emerge from the complex interaction of multiple economic, institutional, and psychological elements.

These include macroeconomic conditions, such as prolonged economic growth and low interest rates. Structural changes, such as deregulation and financial innovation, increase uncertainty in price evaluation, while financial market conditions, particularly credit availability and banks' tendency to relax lending standards, contribute to the formation and persistence of housing price bubbles.

Lind (2009) categorizes housing bubbles into three ideal types: pure speculative bubbles, where buyers knowingly enter an overheated market with the intention of selling quickly for a profit; irrational expectations bubbles, where buyers genuinely believe in a continued price increase based on recent trends; and institution-driven bubbles, where financial actors encourage risky lending and overinvestment, often assuming that losses will be absorbed or avoided by the intervention or support of external entities, such as governments or central banks.

The multidimensional view of housing bubbles provides a more nuanced framework for understanding how speculative dynamics evolve over time. The notion of a conversion point, marking the transition from fundamental-driven to speculation-driven price movements, helps explain why markets often remain overvalued for extended periods before adjusting. Such theoretical refinements contribute to the broader literature by linking traditional asset-pricing models to behavioral and systemic perspectives,

emphasizing that real estate bubbles are not uniform phenomena but vary according to their structure, drivers, and transmission mechanisms (Brzezicka, 2021).

In addition to the difficulties to identify housing bubbles, traditional indicators often fail to accurately predict the timing of market downturns. While housing bubbles are typically associated with rapid increases in property prices, fueled by expectations of continuous appreciation and facilitated by factors such as cheap credit and expansionary economic policies, the challenge of identifying bubbles solely through quantitative indicators remains significant, as market conditions vary across countries and economic contexts (Sjöling, 2012).

Nonetheless, several quantitative indicators are commonly used to assess whether a housing bubble is forming, namely the price-to-income ratio, which measures housing affordability relative to household earnings, and the price-to-rent ratio, which compares the cost of homeownership to potential rental income. Other widely used indicators are the real interest rate, which influences mortgage financing costs, and the elasticity of housing supply, which reflects how well the market can adjust the availability of new properties in response to rising demand.

However, Sjöling (2012) highlights that these indicators, when analyzed in isolation, may not be sufficient to accurately predict bubble bursts. His comparative study of the German, Swedish, Spanish, and UK housing markets between 2000 and 2010 illustrates this limitation. While Spain and the UK exhibited clear signs of a housing bubble, ultimately experiencing sharp market corrections, Sweden displayed similar trends in these indicators but did not suffer a downturn. This suggests that additional factors, such as the structure of mortgage markets and central bank interventions, play a crucial role in shaping housing price dynamics.

The concept of housing bubbles is closely linked to the inherent volatility of real estate markets, where short-term price momentum is often followed by long-term mean reversion. Glaeser and Nathanson (2014) highlight that this price behavior is one of the defining features of housing bubbles and differentiates real estate from other financial assets. They analyze the U.S. housing cycle between 2000 and 2012, a period marked by rapid price increases followed by a significant correction, illustrating the classic boom-and-bust dynamic characteristic of speculative bubbles.

A key debate in the theoretical framework of housing bubbles is whether their creation can be explained using rational models or if they are largely driven by irrational behaviors. Some theories try to rationalize housing bubbles by attributing price increases to factors like low interest rates and financial innovation. However, Glaeser and Nathanson (2014) suggest that while low interest rates and larger mortgage lending can contribute to rising house values, they do not entirely explain the extreme changes observed in housing markets. For rational bubbles to form, there must be a systematic mispricing of risk. In credit-driven housing markets, this often takes the form of an underestimation of default risk, leading to excessive credit expansion and unsustainable price growth. However, housing bubbles may also emerge in markets with limited leverage, driven primarily by speculative expectations rather than credit mispricing.

Another fundamental aspect that distinguishes real estate bubbles from those in other asset markets is the limited ability to arbitrage mispriced assets. Unlike financial securities, where traders can short sell overvalued stocks, the housing market lacks an efficient mechanism for betting against price increases. This limitation allows bubbles to persist for longer periods, as informed investors are unable to counteract excessive speculation effectively. Moreover, high transaction costs and homeowners' reluctance to sell at a loss contribute to price stickiness, further delaying the correction of overvalued markets (Glaeser & Nathanson, 2014).

2.2 How Macroeconomic effects impact the market

While speculative behavior, financial market inefficiencies, and institutional constraints contribute to the formation and persistence of housing bubbles, broader macroeconomic conditions also play a critical role in shaping real estate market dynamics. Factors such as interest rates, inflation, economic growth, and labor market conditions influence housing demand and investment behavior, affecting both short-term price movements and long-term market stability. Therefore, understanding the macroeconomic drivers of real estate markets is essential to contextualize price fluctuations and evaluate whether housing markets operate within sustainable economic fundamentals or are subject to speculative excesses.

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Case (2000) highlights the crucial role of housing wealth in driving consumer spending, a relationship commonly referred to as the housing wealth effect. Rising house prices increase household net worth, which may lead to higher consumption levels, as homeowners feel financially more secure and can access credit more easily. Conversely, when property values decline, households tend to reduce spending, which can contribute to broader economic downturns. This effect is particularly pronounced in economies with high homeownership rates and well-developed mortgage markets, where real estate represents a significant portion of household wealth.

The relationship between macroeconomic variables and real estate markets has been widely studied, with research consistently showing that housing prices are influenced by broader economic conditions.

Unlike in other asset markets, real estate prices have strong downward price stickiness, which means that homeowners are frequently hesitant to sell below a specific barrier, especially during economic downturns. As a result, housing markets frequently adjust through inflation. Instead of homeowners lowering their asking prices, prices remain stagnant while the general cost of living rises, meaning that the houses effectively become cheaper in comparison to other goods and services over time. This price inertia also contributes to the construction of property bubbles, since homeowners in flourishing markets may have unduly optimistic expectations about future price increases (Adams & Füss, 2010).

Adams and Füss (2010) also identify economic activity as the primary driver of home prices, with each 1 percentage point rise in economic growth resulting in an average increase in house prices over time by 0.6%. Higher employment, industrial production, and disposable income all contribute to increased demand for homes, raising prices. However, this effect differs by nation, as local market mechanisms and credit availability are significant in mitigating the impact of economic progress on real estate values.

Another important macroeconomic variable is long-term interest rates, which influence the affordability of mortgage financing and the appeal of real estate investments in comparison to other asset classes. Adams and Füss (2010) concluded that a 1 percentage point increase in long-term interest rates causes a 0.3% drop in housing prices. When interest rates rise, borrowing becomes more expensive, reducing demand for homes and

increasing the appeal of fixed-income instruments like bonds. The degree to which interest rate changes affect housing markets is determined by the proportion of fixed-rate vs adjustable-rate mortgages in each country. Monetary policy changes have a faster impact on home prices in markets with variable-rate mortgages, but the impacts are more gradual in economies with fixed-rate mortgages.

However, Case (2000) contends that monetary policy by itself might not be enough to bring stability to housing markets, especially during speculative times when prices differ substantially from underlying values. A similar point of view has been echoed throughout multiple studies subsequently. For instance, *Sari et al.* (2007) stress that in several developing countries, additional variables beyond the money supply and in addition to inflationary pressures could impact significantly on real estate investment patterns.

The traditional interest rate channel is steady over time, which means that lower interest rates reduce borrowing costs, making housing more accessible and encouraging demand. However, Wilhelmsson (2020) points out that the bank lending channel has grown in importance over time, particularly as family debt levels have climbed. This shows that fluctuations in interest rates have a stronger impact on housing markets than in the past, as more households use credit to finance home purchases. Bank lending channel became stronger, while the liquidity effect weakened. This shift suggests that, as mortgage markets evolved and more households took on variable-rate mortgages, the sensitivity of the housing sector to interest rate changes increased. At the same time, the role of stock markets in influencing housing investments diminished, likely due to regulatory changes and macroprudential policies implemented post-crisis.

Construction costs have a substantial impact on home market dynamics. Rising labour and material costs raise developers' financial burden, limiting new housing supply. This, in turn, results in larger rentals and property values. Adams and Füss (2010) estimate that a 1% increase in building costs leads to an average 0.6% increase in housing prices over time. They do however, point out that supply limits differ by country due to variables such as zoning regulations, land availability and bureaucratic delays in new development approvals. These structural distinctions help to explain disparities in housing market reaction to macroeconomic conditions.

While Adams and Füss (2010) emphasize the long-term impact of macroeconomic fundamentals on housing prices in various economies, a more immediate view is required to understand how short-term volatility affect real estate markets. Mohan *et al.* (2019) use a vector autoregression (VAR) model to investigate the short to medium-term effects of macroeconomic indicators. Their research quantifies the response of housing prices to changes in mortgage interest rates, unemployment, inflation, stock market performance and crude oil prices, offering a detailed understanding of how macroeconomic shocks affect real estate values. Their findings emphasize the relevance of interest rates and employment conditions as key drivers of house price variations, while also introducing other variables, such as stocks market movements and energy costs, as potential causes of volatility.

The study's major result is that mortgage interest rates have the greatest impact on home prices. This finding emphasizes the critical role of borrowing costs in housing demand: as interest rates rise, mortgage payments become more expensive, lowering affordability and cooling demand for real estate. Lower interest rates, on the other hand, make homeownership more accessible, which drives up prices.

The unemployment rate is the second most important macroeconomic factor in house prices, accounting for around 5.8% of the price variation after a year. As unemployment grows, consumer confidence falls and financial uncertainty discourages home purchases, resulting in lower housing demand.

Inflation, as measured by the Consumer Price Index (CPI), also influences home prices, albeit to varying degrees. The study discovers that inflationary shocks initially drive down house prices before contributing to progressive price increases over time.

The study's inclusion of crude oil prices as a predictor of housing price changes adds an important dimension to the investigation. Oil price shocks can affect housing markets through a variety of avenues, including inflation, transportation costs and overall economic stability. The study discovers that crude oil prices have a relatively small effect on house prices, accounting for only 1.7% of price variation after a year. However, in energy-dependent economies, this relationship may be more pronounced, particularly in places where rising oil prices have a direct impact on household disposable income and construction costs.

One of the most remarkable findings of Mohan *et al.* (2019) is that housing price changes have the greatest predictive capacity for future price movements, i.e. house prices seem to be autocorrelated. Their findings show that prior price swings account for up to 92.7% of the one-month variance in house prices, dropping to 74.5% after a year. This research implies that expectations are important in real estate markets. When prices rise, purchasers anticipate further growth and are more eager to acquire properties, continuing the upward trend. In contrast, during market downturns, negative price momentum can lead to lengthy falls as purchasers anticipate greater depreciation and postpone purchases.

2.3 Indicators and methodologies for detecting bubbles

Detecting housing bubbles requires sophisticated approaches capable of differentiating price rises caused by economic fundamentals from those fueled by speculative dynamics.

Wöckl (2019) provides a systematic summary of the practical approaches used to spot bubbles, notably in both property and monetary markets. The study distinguishes between established and emerging bubble identification approaches, while emphasizing the critical role of econometric strategies in the detection process. The strategies should not exclusively depend on fundamental value assessment to any degree. The detection framework includes variance bounds tests to compare price and fundamental volatility, alongside cointegration tests that evaluate the long-term equilibrium between asset prices and economic fundamentals. Still, such methods face limitations, such as the joint hypothesis problem, where faulty underlying assumptions may yield incorrect bubble detections.

Anundsen (2019) proposes a toolkit of four distinct econometric approaches to monitor housing imbalances, allowing for a clear distinction between temporary overvaluation and bubble behavior. The first approach focuses on calculating a theoretical fundamental value through an inverted demand equation, where persistent deviations between actual prices and projections based on income, housing stock, and user costs signal overvaluation. Complementarily, the second strategy employs dynamic forecasting models. Here, bubbles are inferred when the model consistently produces significant under-predictions, suggesting that price growth is being driven by market exuberance not captured by economic fundamentals.

Unlike the previous methods that quantify the magnitude of the deviation, the third approach focuses on the loss of equilibrium correction by identifying the moment when a market shifts from a stable regime to an unstable one. In a stable market, prices tend to revert to their fundamental value after a shock, but this approach detects the specific point where that correcting force disappears. Finally, the fourth methodology adopts an asset pricing perspective, using recursive statistical tests to detect explosive trajectories in price-to-income ratios. While the first two techniques establish the degree of overvaluation, the latter two are particularly effective for detecting and dating in real time the regime shift toward a speculative bubble.

The most complex challenge associated with identifying bubbles in the housing market is to separate an upsurge in prices fuelled by economic activity from purely speculative investment. For accurate estimation of fundamentals, Shi and Phillips (2023) introduce the PSY-IVX test, which is based on the Instrumental Variable (IVX) method and the recursive approach of Phillips, Shi, and Yu (PSY). This methodology attempts to decompose the non-fundamental price-to-rent ratio into a fundamental component and a speculative one, thereby distinguishing robust economic growth from price behavior that is reminiscent of bubbles.

Sjöling (2012) investigates whether commonly used housing market indicators can effectively predict the formation of real estate bubbles. The study focuses on four fundamental-based indicators: the ratio of real house prices to real disposable income, real interest rates, population, and housing stock. Each indicator aims to detect imbalances by identifying when house prices deviate significantly from their underlying economic drivers. The real house price-to-income ratio measures affordability, while the real house price-to-interest rate ratio captures the influence of borrowing costs on demand. The comparison with population assesses whether demographic pressure supports price growth, and the housing stock indicator evaluates whether increasing supply helps moderate prices.

Sjöling's (2012) findings also align with Wöckl (2019), who cautions against relying solely on traditional fundamental ratios due to their limited ability to capture speculative dynamics. Instead, both authors support a broader detection framework that integrates fundamental, behavioral, and statistical indicators.

Hagemann and Wohlmann (2019) develop an early warning system to identify housing bubbles using a two-step approach. In the first stage, they apply the Generalized Supremum Augmented Dickey-Fuller (GSADF) test, this econometric tool is specifically designed to detect periods of explosive price behavior by using a recursive positioning of subsets of data, allowing it to identify multiple bubble episodes within the same time series. The authors applied the GSADF test to both real house prices and price-to-rent ratios, defining a bubble episode only when both series show explosive behavior. This procedure makes their classification more conservative and reduces the risk of false signals. In the second stage, they estimate logit and ordered logit models to predict both the probability and the phase of a bubble, offering policymakers a more nuanced tool than simple threshold indicators.

Their findings indicate that broad money, private credit, and financial deregulation are the most robust predictors of speculative episodes, while traditional fundamentals such as inflation and long-term interest rates appear weaker in explanatory power. This strong emphasis on liquidity and credit conditions is consistent with earlier contributions, such as Dreger and Kholodilin (2013), who also stressed the importance of monetary and financial variables in bubble formation. However, the contribution of Hagemann and Wohlmann (2019) lies in combining econometric bubble dating with probabilistic forecasting, thereby moving beyond static affordability ratios like price-to-income or price-to-rent measures commonly used in other studies.

2.4 The Portuguese Real Estate Market and the European Context

Evidence from the main European housing markets shows that price-to-rent ratios have repeatedly exhibited explosive dynamics since the 1970s, with all major economies experiencing episodes of price exuberance over time. More recently, the period of the COVID-19 pandemic intensified these pressures, with countries such as Germany, France, Spain, and the Netherlands entering phases of strong price exuberance despite the broader economic downturn. This contagion is particularly strong among the largest economies, with Germany and France often acting as transmitters of speculative dynamics. Such findings underscore that European housing markets have become more synchronized, meaning that purely national housing policies may be insufficient to

contain risks and coordinated strategies at the European level are necessary to address the systemic nature of housing bubbles (Bago *et al.*, 2021).

House prices in the euro area have increased significantly since 2013, with some countries recording growth above 30%, including Portugal. This surge has been driven mainly by accommodative monetary policy, abundant liquidity, and persistent supply constraints, rather than excessive credit expansion. As a result, affordability has deteriorated, with price-to-income ratios widening and house prices increasingly outpacing households' borrowing capacity, particularly in urban and touristic regions. Although macroprudential tools have limited credit risks, they remain insufficient to tackle the structural shortage of housing supply, pointing to the need for coordinated reforms in land-use regulation, social housing investment, and property taxation to ensure sustainable affordability in the long run (European Commission. Directorate General for Economic and Financial Affairs., 2022).

Recent developments in the euro area housing market reveal a cycle marked by rapid price growth from 2015 to 2022, powered by low interest rates, ample liquidity, and expanding credit, combined with structural supply limitations in several countries. Since mid-2022, the rise in interest rates has begun to slow price growth and reduce transaction volumes, although the adjustment varies by country depending on mortgage structures, housing supply, and labour market conditions (Hoyne *et al.*, 2025)

Pinto and Guerra (2019) examine the structural forces influencing the Portuguese housing market, highlighting the interplay among families, the State, and the market in promoting elevated ownership rates. They contend that, aside from cultural inclinations characteristic of Southern Europe, home ownership in Portugal embodies an economic logic influenced by income volatility, scant welfare assistance, and a weak rental market. Fast urban growth, do-it-yourself construction and the growth of the construction sector since the 1960s, along with credit deregulation and subsidized mortgage programs from the mid-1980s to 2002, made homeownership attainable to various social classes, increasing the ownership rate to approximately 73% by 2011. Although ownership has offered security to families, it has also intensified social inequalities and worsened current affordability issues, especially in Lisbon and Porto, where financialization and foreign investment influences are most pronounced, leading to a market driven by investor

expectations rather than local demand, which causes house prices to decouple from domestic economic reality.

Tavares *et al* (2014) provide a comprehensive overview of the Portuguese residential real estate market during the decade preceding the sovereign debt crisis. The study highlights how structural and macroeconomic factors, such as Portugal's integration into the Eurozone, the subsequent decline in interest rates and the expansion of mortgage credit, initially fueled a strong growth in demand and property prices. However, by the mid-2000s, the market began to show signs of oversupply and saturation, a situation that was aggravated by rising household indebtedness and a gradual decline in consumer confidence.

Lourenço and Rodrigues (2017) illustrated that real house prices fell significantly from 2007 to 2013 because of the relationship between economic downturn, increasing unemployment, and credit tightening, before recovering robustly from 2014 onwards. This rebound was mainly caused by economic expansion, record-low interest rates that heightened demand and made real estate more appealing than other savings options, along with a rise in foreign investments, especially in metropolitan and coastal regions. GDP growth stands out as the most reliable factor behind rising prices, whereas foreign demand contributed to stability during the crisis and amplified inflationary pressures in the recovery phase.

The housing market in Portugal has demonstrated a significant responsiveness to macroeconomic factors. Utilizing quarterly data spanning from 1998 to 2019, Rehman *et al.* (2020) employ the Engle-Granger cointegration approach, showing that unemployment and long-term interest rates adversely affect housing prices, whereas population growth, inflation, and money supply exert positive influences. Significantly, prices dropped steeply during the 2008–2013 financial crisis, then rebounded robustly after 2013 as interest rates decreased and economic conditions enhanced, emphasizing the market's cyclical characteristics.

The Portuguese real estate market is still restricted by a short housing supply and increasing construction expenses, as foreign interest from expatriates, retirees and digital nomads persists in applying upward pressure on prices, especially in Lisbon, Porto and the Algarve. Recent policy adjustments, including the termination of the golden visa

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program and updates to the non-habitual resident scheme, may temper this external demand, although their effects remain unclear. Even with the widespread use of floating-rate mortgages that have raised household vulnerability to elevated borrowing expenses, low unemployment, reasonable loan-to-value and debt-service to income ratios, following macroprudential recommendation, along with accrued home equity have contributed to sustaining stability (Soutinho & Thaker, 2024).

CHAPTER 3 – MACROECONOMIC AND MARKET FACTORS ANALYSIS

3.1 Consumer Price Index behavior and Inflation rate

Analysis of the CPI is essential to contextualize developments in the housing market, serving as an indicator of the cost of living and the real value of assets. According to the study by Katrakilidis and Trachanas (2012), house prices show an intrinsic relationship with macroeconomic fundamentals, where inflation plays a central role in shaping agents' expectations and protecting the real value of capital.

Regarding the recent evolution of the CPI in Portugal, shown in table 1, public and academic discourse has increasingly focused on inflation, particularly because price growth has accelerated substantially over the past five years. According to CPI data with 2012 as the base year, published by the Instituto Nacional de Estatística (INE), the prices of goods and services have risen markedly since 2020. By 2024 and 2025, the aggregate price level exceeded that of 2012 by more than 20 percent, signaling notably persistent inflationary pressures within the Portuguese economy.

An examination of table 2, describing the inflation evolution, measured by the year-on-year variation in the CPI, reveals that inflationary dynamics strengthened considerably from 2021 onwards, with the highest annual inflation rate achieved in 2022 within the period under analysis, due to the reopening of the economies after the pandemic lockdowns and the heightened geopolitical instability, following Russia's invasion of Ukraine in February 2022, which generated substantial shocks in global energy markets and supply chains, thereby exerting additional upward pressure on consumer prices.

3.2 Interest Rates

The interest rate is a pivotal variable, acting as the primary link between monetary policy and housing market dynamics. According to the financial accelerator framework developed by Aoki et al. (2003), changes in interest rates do not only affect the cost of borrowing but also influence the value of housing as collateral.

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As shown in the images 1 and 2, based on data obtained directly from the European Central Bank (ECB), 2015 marked a turning point for the 3 and the 6-month Euribor rates, as they moved into negative territory. This development reflected the ECB's accommodative monetary policy stance, which aimed to stimulate economic activity by encouraging financial institutions to expand credit provision and by fostering consumption and investment among households and firms. This expansionary monetary environment persisted over the subsequent seven years, during which interest rates remained exceptionally low. During the Covid-19 pandemic, Euribor rates declined even further compared to previous years, reinforcing the highly accommodative nature of monetary policy.

The beginning of 2022 represented a significant shift in monetary policy, as interest rates increased sharply throughout the year to tackle the inflation surge. In particular, the 3- and the 6-month Euribor rates rose from approximately minus 0.5 percent at the start of 2022 to values above 2 percent by the end of the year. The upward trend continued throughout 2023, with interest rates increasing further and reaching levels close to 4 percent.

All in all, the most intense tightening cycle of ECB's monetary policy was observed between 2022 and 2023, with the reference rates increasing by 5 percentage points, after the main lending facility rate moved from 0% to 4.5%.

As the ECB managed to bring back inflation closer to its target of 2%, an interest rate reduction cycle followed, between 2024 and mid-2025, with the main lending facility rate decreasing to 2,15%, while the deposit rate (that became the key ECB reference rate) reaching 2%.

Consequently, the financial burden on borrowers in meeting their financial obligations was alleviated, facilitating the credit growth that was been observed in the Euro Area.

3.3 Unemployment Rate

The inclusion of the unemployment rate in this analysis is justified by its role as a key indicator of macroeconomic stability and household solvency. Unemployment is a critical determinant in the formation of real estate cycles, as changes in the labor market directly

impact consumer confidence and their ability to bear long-term financial burdens, such as mortgage loans (Agnello & Schuknecht, 2009).

In what concerns to the unemployment rate, which is directly linked to the economic cycles, table 3 shows a steady decline between 2015 and 2019, falling almost by half, from 12.9% to 6.6%. Between 2019 and 2020, the unemployment rate increased slightly, reaching 7%, as a consequence of the pandemic but resumed its downward trend over the following two years, reaching around 6% in 2022.

In 2023, the unemployment rate increased to 6.5 percent, while in the subsequent year it declined again by one tenth of a percentage point. Overall, this analysis indicates that the current unemployment rate presents a markedly different scenario compared to 2015, as it is now approximately half of the level observed at the beginning of the period under analysis.

3.4 Demographic and Migratory context

When analyzing the real estate market and its behavior in recent years, it is important to examine portuguese migration patterns, including inflows, outflows, and the net migration balance. This demographic analysis is crucial because population growth and shifts in the working-age population create immediate housing needs that the construction sector often struggles to meet, acting as a fundamental determinant of long-term housing demand and a key driver of market cycles (Tyrcha & Abreu, 2019).

According to the table 4, historical records indicate that 2015 and 2016 were characterized by a net population loss, with negative migration balances of 3,528 and 629 individuals, respectively. In the subsequent years leading up to 2019, this trend reversed, displaying a consistent and positive growth trajectory. This shift was particularly notable between 2018 and 2019, when the net migration balance surged from approximately 23,700 to 67,100 people. Although the balance remained positive in 2020, there was a contraction of approximately 10,000 individuals compared to the previous year, a decline likely attributable to the global disruptions caused by the COVID-19 pandemic.

In 2021, the net migration balance rose again to approximately 72,000 people, while in the following year this figure almost doubled to over 136,000, reflecting a substantial

increase within a single year. In 2023, the net migration balance rose even further, to around 155,000, with this increasing trend being slightly reversed in 2024, to 143,000 people.

Overall, an analysis of the net migration balance over the past four years shows a positive difference of more than 500,000 new residents in Portugal. Additionally, regarding the regions that attracted the highest number of new residents, the Greater Lisbon area stands out, accounting for approximately 17 percent of total arrivals.

3.5 New Residential Construction in Portugal

The analysis of new construction, particularly through the lens of housing supply, is vital to assess the responsiveness of the residential market to economic shocks. Examining the volume of completed buildings allows for an understanding of market heterogeneity, as differences in supply elasticity determine whether positive growth shocks manifest as expanding housing stock or primarily through higher prices and wages (Gyourko, 2009).

The construction of new buildings, referenced in table 5, followed a consistent and steady increase in the number of new residential buildings can be observed between 2015 and 2024, with the number of newly completed constructions rising from around 4,900 to 11,500, showing a gradual and sustained recovery of the annual investment in the sector.

Once again, the Lisbon metropolitan area, including Greater Lisbon and the Setúbal Peninsula, stands out as a key region, accounting for roughly 20% of new residential buildings in the country over these years.

On the other hand, if we consider buildings that have been licensed but are not yet constructed, the numbers are relatively higher compared to those that have been completed. As demonstrated in table 6, the trajectory of residential construction licenses in Portugal between 2015 and 2024 reveals a multi-stage evolution. This momentum proved resilient even during the onset of the pandemic, with the upward trend continuing until the sector reached a period of maturity in the 2021–2022 biennium, maintaining a steady volume of approximately 15,700 licenses. This peak was followed by a temporary contraction in 2023, driven by a combination of macroeconomic uncertainty and domestic political instability. Most recently, 2024 data indicates a recovery, as licensing activity

rebounded toward previous levels, although the total volume remains slightly below the historical highs of the preceding cycle.

3.6 Volume of Real Estate Market Transactions

The volume of real estate transactions is essential to understand market liquidity and the intensity of demand within the sector. This indicator often acts as a precursor to broader market shifts, as transaction volumes typically surge during expansionary phases and serve as a key metric for identifying housing booms and the overall health of the asset market (Agnello & Schuknecht, 2009). By monitoring these patterns, it is possible to gauge whether the frequency of sales supports the observed price levels or if it signals a potential overheating in market participation.

The evolution of the number of transactions has been more volatile, as the volume of market activity in Portugal has not always followed an upward trend.

In fact, between 2015 and 2019, the market experienced a positive trajectory, with annual transactions increasing from 90,500 to 154,800, reflecting a growing level of investment in this sector and an increasing demand. However, the volume of transactions declined considerably in 2020 (the initial year of the pandemic), to approximately 137,500. The market recovered in the following year, reaching around 165,600, which means a recovery from the economic shock caused by the health crisis.

The volume of real estate transactions in Portugal exhibited significant volatility between 2022 and 2024, reflecting the market's sensitivity to macroeconomic shifts. After reaching a robust level of approximately 167,900 transactions in 2022, the market entered a pronounced cooling phase in 2023, with activity dropping by nearly 19% to approximately 136,400 sales. This contraction serves as a clear indicator of the credit tightening and inflationary pressures of the period. However, the trajectory shifted again in 2024 toward a notable recovery, with transactions rebounding to 156,300, signaling a restoration of market liquidity and a realignment of buyer expectations despite the higher interest rate environment.

3.7 Housing Price per Square Meter

The analysis of the average price per square meter serves as the primary measure of asset valuation and is the most direct indicator of housing market dynamics. Monitoring this variable is essential because persistent and significant deviations from long term price trends often indicate that current valuations are being driven by expectations of future appreciation rather than by underlying economic fundamentals (Case & Shiller, 2003).

The trajectory of housing prices in Portugal, proxied by the median value of bank appraisals per square meter, reveals a decade defined by sustained and accelerating growth. While the national average more than doubled during this period, the appreciation was not geographically uniform, reflecting deep-seated regional disparities. In high-demand hotspots such as Greater Lisbon, the Algarve, and the Madeira Autonomous Region (MAR), prices followed a more aggressive path, nearly or entirely tripling in value since 2014.

This upward trend can be segmented into three distinct velocity phases. The initial period, spanning from 2015 to 2018, was characterized by a moderate but consistent recovery following the post-crisis stabilization. During this phase, the market began to absorb excess supply, setting the stage for the more intense valuation cycles that followed.

The second phase, from 2019 to 2021, marked a period of accelerated expansion. During this interval, the growth rate intensified significantly, with annual national variations averaging approximately 100 euros per m². Even the global disruptions caused by the pandemic failed to curb this momentum, signaling a strong structural demand and a tightening of the housing supply.

The final stage, from 2022 to 2025, represents a period of speculative escalation. In this most recent cycle, the pace of appreciation became galloping, with national growth exceeding the 100 euros threshold. More notably, regional hotspots recorded surges near or above 200 euros per m² annually.

CHAPTER 4 – METHODOLOGY

4.1 Research objectives

The primary purpose of this research is to analyze the contemporary dynamics of the Portuguese housing market, aiming to understand the complex interactions between economic fundamentals and property price evolution (Algieri, 2013). The study intends to evaluate how specific macroeconomic and market driven variables influence housing prices and, more importantly, to determine the extent to which current price behavior has become decoupled from economic reality.

By examining the period between 2014 and 2024, the research seeks to identify whether recent price trajectories are sustained by tangible factors such as interest rate fluctuations, inflationary pressures and labor market conditions, or if they reflect a growing imbalance that transcends traditional market determinants.

Furthermore, this investigation adopts a regional perspective to capture the diverse realities within the country, exploring how these price misalignments manifest differently across geographic areas. Ultimately, the study aims to provide a clear diagnosis of the market's current state, distinguishing between justified growth and speculative trends that may signal a potential housing bubble.

4.2 Methodology

This study adopts a framework centered on the fundamental-based approach, designated as Approach 1 in the comprehensive study by Anundsen (2019). As described previously in the literature review, this methodology assumes that housing prices should ideally reflect a long-run equilibrium with variables such as household income, interest rates and employment conditions.

Following the methodological framework established by Cevik and Naik (2024), this study adopts a disaggregated approach by analyzing the Portuguese housing market at the regional level, specifically focusing on Nomenclature of Territorial Units for Statistics

(NUTS) II divisions. This choice is motivated by the profound demographic, social, and economic disparities that characterize the Portuguese territory.

By shifting from a single aggregate national perspective to a multi-regional analysis, the model captures local market dynamics that are often masked by national averages. Consequently, this regional granularity provides a more robust and nuanced understanding of price formation, avoiding the oversimplification of treating the country as a monolithic and homogeneous entity.

To conduct the empirical estimation, the dataset is organized into a balanced Panel Data (PD) structure, following the methodological approach of *Liu et al. (2017)*. Given the time-series dimension of the study and the cross-sectional division by NUTS II regions, this structure is particularly advantageous. From a statistical perspective, utilizing PD significantly increases the number of observations, thereby enhancing the statistical power of the econometric tests and providing greater degrees of freedom. This expanded sample size leads to more efficient and reliable estimates. Furthermore, the panel framework is essential for capturing regional heterogeneity, as it allows the model to account for specific characteristics within each region that influence housing price dynamics over time, which would be unattainable through a purely aggregate or cross-sectional analysis.

Throughout the model's development, a Fixed Effects (FE) estimator was employed to account for unobserved variables that vary across regions but remain constant over time (Adams & Füss, 2010). This methodological approach is essential to mitigate omitted variable bias, which is particularly relevant in the Portuguese context due to the intrinsic regional characteristics such as geographical attributes and historical urban development that influence local housing prices. By utilizing this estimator, the analysis focuses on within region variation, providing a more accurate and robust estimation of how shifts in economic fundamentals drive house price dynamics across the NUTS II divisions.

To mitigate the risk of obtaining spurious regressions, a panel unit root test was conducted to evaluate the stationarity of the variables (Levin et al., 2002). Since the data in levels reveal strong evidence of non-stationarity, the variables were transformed into First-Differences (Anundsen, 2015). This procedure ensures that the series are stationary, allowing the model to accurately estimate the relationship between the annual variations

in housing prices and their respective economic fundamentals. By focusing on these differences, the analysis captures the short-term dynamics and co movements of the variables, providing a statistically sound basis for identifying potential speculative deviations through the analysis of the model residuals.

The market overheating is finally identified by analyzing the model residuals, which represent the portion of price variation that cannot be explained by economic fundamentals. Following the framework of a reduced form diagnostic thermometer (Shi & Phillips, 2023), these residuals isolate the non-fundamental component of the housing market. Persistent and sharp positive deviations in the residuals are interpreted as evidence of overvaluation or speculative behavior, signaling that prices have decoupled from their underlying economic drivers. This approach ensures that the detected signals reflect genuine market exuberance rather than justified adjustments to supply and demand dynamics.

4.3 Data Presentation

In the context of the housing market, the database plays a pivotal role in the collection and analysis of macroeconomic indicators. The dataset has an annual frequency, covering the period from 2014 to 2024. This period is particularly significant as it encompasses the aftermath of the Troika's intervention in Portugal and the subsequent economic recovery, extending to the most recent year for which data for all variables could be retrieved. The period covered is also essential to identify long term market trends and identify potential structural shifts in the Portuguese housing landscape.

4.3.1 Types of data and variables

Table 8 presents the data utilized in this research. For the analysis of the housing market, the following domestic macroeconomic variables are employed:

- Inflation
- Interest Rates
- Unemployment Rate

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The utilization of these macroeconomic variables allows for a broad assessment of market trends and their corresponding impacts.

Regarding housing market indicators, the model analyzes the behavior of the endogenous variable, defined as the price per square meter based on bank appraisals, alongside the following exogenous variables:

- Number of market transactions
- Number of completed buildings

Table 1: Data Description

Variables	Unit	Frequency	Source
Inflation	%	yearly	INE
Interes Rate (Euribor 6m)	%	calculated as an annual average	ECB
Unemployment Rate	%	yearly	INE
Price per Square Meter	€	yearly	INE
Market Transactions	Number	yearly	INE
New Buildings	Number	yearly	INE

4.4 Data sources

The information utilized in the model construction was retrieved from institutional sources, namely the ECB and INE. These institutions provide a standardized and reliable basis for the variables under study, ensuring the consistency and transparency of the empirical analysis.

4.5 Data Alignment

While Chapter 3 detailed the historical evolution of the indicators used in this model, this section justifies their functional role within the econometric framework. Macroeconomic data are fundamental to this research, providing the necessary basis to contextualize the behavior of the endogenous variable, namely the price per squared meter.

Regarding the macroeconomic indicators, the inflation rate reflects the erosion of household purchasing power through real disposable income, while the 6-month Euribor rate measures the cost of capital and the financial burden of mortgage credit. This rate is

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essential as it represents the primary lever for property acquisition. Additionally, the unemployment rate serves as a proxy for labor market stability and household solvency, which is crucial for assessing the capacity of borrowers to sustain financial obligations over the long term.

In the case of variables specific to the sector, the objective is to directly monitor the market pulse and trends over time. The price per squared meter is defined as the endogenous variable and the core metric of asset valuation for identifying price trajectories. Furthermore, the number of transactions serves as a measure of market liquidity and momentum, while the number of completed buildings represents the responsiveness of the supply side, allowing the model to assess whether the construction sector output aligns with existing market demand.

CHAPTER 5 – DISCUSSION OF RESULTS

We now move to the data analysis chapter, following the model estimation, to interpret the obtained results. As evidenced by the output, a total of 90 observations were collected, organized annually by region. Prior to the application of the Multiple Linear Regression model with PD and FE, variables expressed in absolute values (price per square meter, number of transactions, and number of completed new constructions) were transformed into logarithms.

Upon analyzing the model output, we observe a within R squared of 38.25 percent, indicating that approximately two-fifths of the variance in housing prices per square meter is explained by the independent variables. Given the model structure based on first-differences, this represents a solid value as this approach focuses on short-term volatility rather than long-term trends (Adams & Füss, 2010). Furthermore, it suggests that other variables not included in the current specification, such as market speculation and foreign investment, may also be exerting a significant influence on price dynamics.

As evidenced by the outputs, the null hypothesis regarding the presence of a unit root and the lack of stationarity can be rejected for all variables at a 99 percent confidence level (95% for the number of completed buildings).

Table 2: Variables Outputs

Model Variables	Coefficients	P> t
d_inflation	.003509	0.007
d_euribor	.0138277	0.003
d_unemployment	.0041244	0.161
d_ln_transactions	-.0278003	0.409
d_ln_builds	.0702756	0.006
_cons	.066137	0.000

Regarding the behavior of the average coefficients, see table 9 above, for the explanatory variables across the nine regions, the model presents rather interesting results. Primarily, it can be observed that the test for the presence of regional FE yielded a p-value of 0.0735. Although this indicates that regional effects are only marginally significant at the 10 percent significance level, the FE estimators were retained, focusing on the variation within each region over time, providing a more consistent estimation. This choice is

justified by the necessity of controlling for unobserved heterogeneity that is constant over time, such as geographic characteristics or structural regional differences, which could otherwise bias the coefficients if a standard Pooled Ordinary Least Squares regression were used.

Turning to the analysis of the interest rate variable ($d_euribor$), the model reveals a positive coefficient, which stands as a theoretically counter-intuitive result, since a negative correlation to house prices would typically be expected, as under standard economic conditions, a rise in interest rates is expected to exert downward pressure on housing prices, namely through the credit channel.

However, this outcome may be attributed to structural factors such as the prevalence of own capital property acquisitions, significant inflows of foreign investment, and a chronic supply shortage that sustained price appreciation despite the increased cost of borrowing. This is aligned with the findings of Pinto and Guerra (2019), who highlight the increasing financialization of the market and the weight of international demand, create a segment of buyers that is less sensitive to local interest rate fluctuations, thereby maintaining the upward momentum in prices.

The coefficient for the unemployment rate variable ($d_unemployment$) does not play a statistically significant role in the model. This result is consistent with the theoretical framework of Glaeser and Nathanson (2014), who argue that housing market dynamics often become detached from standard economic proxies during periods of high momentum. Although a visual analysis of the raw data shows a general downward trend in unemployment alongside with rising prices, this output may be attributed to several factors. First, the lack of significance suggests a decoupling between local labor market conditions and housing demand, reinforcing the perspective that the market is increasingly driven by foreign investors and buyers who are less sensitive to domestic employment fluctuations.

Furthermore, the timing of these changes is crucial, as the unemployment rate experienced a sharp decline followed by a period of relative stabilization, it may have ceased to be the main driver of price growth during the specific period analyzed.

The inflation rate ($d_inflation$) presents a positive coefficient of 0.0035, indicating that a 1 percentage point increase in inflation is correlated with a 0.35 percent rise in housing

prices per square meter, which is in line with the results of *Rehman et al* (2020). This indicator directly relates to construction, materials and labor costs, which are eventually integrated into the final property price. Furthermore, inflation reflects the real devaluation of the currency and, as previously mentioned, many individuals view real estate investment as a viable alternative for wealth preservation through real assets.

Moving forward to the number of market transactions ($d_ln_transactions$), this variable shows no significant impact on price fluctuations, suggesting inertia in price behavior, as prices continued to rise regardless of the volume of market liquidity. Such a dynamic also suggests a supply shortage in the market, as well as the possibility that housing values are being driven mostly by expectations, in accordance with Case and Shiller (2003) conclusions.

Regarding the variable measuring the annual number of completed buildings (d_ln_builds), we observe a positive coefficient of approximately 0.07. This is another explanatory variable that contradicts standard economic theory, which suggests that increased market supply should lead to a reduction in prices. Since this is not the case, several hypotheses can be raised, namely that new construction in the market is not targeted at the mass market, but rather toward the luxury, tourism, and foreign investor segments. This output aligns again with Adams and Füss (2010) findings, who observed that construction activity can act as a proxy for rising development costs and land scarcity, where the higher costs of new units set a new, elevated price floor for the entire market.

Furthermore, it is possible to hypothesize that builders only complete projects when price dynamics are favorable. In this sense, construction is not leading the market, but rather following the upward price trend. Lastly, one may question whether the completion of new and modern buildings in degraded or older areas might generate an appreciation effect on the surrounding neighborhood.

Finally, looking at the model constant ($_cons$), it presents a positive coefficient of 0.0661 and a high level of significance. This result is again consistent with Case and Shiller (2003), suggesting that even when controlling for interest rates, inflation, and supply dynamics, there is a strong expectation underlying the upward trend in the Portuguese real estate market.

In summary, the empirical results presented in this chapter paint a picture of a real estate market characterized by significant structural and price pressures.

The positive coefficients for interest rates and housing completions, combined with the lack of significance for unemployment and market transactions, suggest a profound decoupling from traditional economic fundamentals (Glaeser & Nathanson, 2014). These findings, supported by a significant autonomous growth rate of 6.61 percent, provide robust evidence that the Portuguese housing market has been influenced by exogenous factors and speculative expectations that have shielded it from standard corrective macroeconomic mechanisms (Case & Shiller, 2003).

Moving on to the analysis of residuals by region, shown in the Output 8 of the Model Appendix, the visual representation reveals significant disparities in how the model fits different geographical areas. By examining the distance of each region's residuals from the zero axis, we can discern where the Portuguese housing market follows macroeconomic and market trends and where local anomalies begin to emerge.

Beginning the analysis with the regions that align most closely with the model, we can highlight the North, Centre, Alentejo and Azores Autonomous Region (AAR), as throughout the analyzed timeframe, the price behavior in these areas remained broadly consistent with the explanatory variables used, with similar patterns, notably an proximity to zero axis until 2019. This proximity indicates that the model's error term was minimal, suggesting that the observed housing price movements were effectively predicted by the macroeconomic and sectorial fundamentals. Nevertheless the turning point in 2020, due to the economic impacts of the pandemic (in the AAR, this deceleration was only felt in 2021, diverging from the previously mentioned zones as it experienced a slight peak in overvaluation in 2020).

In the following years, a market recovery was observed across these regions. More recently, it is evident that even these areas are beginning to experience market overvaluation, as all these regions concluded the final year of the analysis with residual values above zero.

Moving forward to the broader Lisbon, West and Tagus valley (WTV) and Setúbal Peninsula, the outputs warrant particular attention. Initially, Grande Lisboa experienced a peak in overvaluation between 2016 and 2019, followed by a market correction in 2020,

from which it began to recover in subsequent years. Furthermore, it is notable that residuals in Grande Lisboa frequently detach from the zero axis, a behavior primarily attributed to its high exposure to international capital and tourism.

As housing in Lisboa became increasingly inaccessible for the resident population, a displacement of demand is observed towards the Setúbal Peninsula and the WTV regions, which have been facing growing pressure, evidenced by more consistent periods of overvaluation in the Setúbal Peninsula, particularly between 2017 and 2022, with only a minor market correction in 2023.

Meanwhile, the WTV region exhibited more restrained behavior, characterized by accelerations followed by small corrections until 2020, with the market rhythm accelerating from 2021 onwards. Ultimately, both regions exhibited overvaluation according to the model, reflecting the growing pressure on these markets.

Finally, we highlight two regions in Portugal that have experienced the most significant market overheating: Algarve and the MAR. These two areas deserve particular attention due to the decoupling of their residuals from what the model was able to predict, as they have become increasingly prominent on an international level due to tourism and foreign investment.

In the case of the MAR, residuals values remained slightly below zero with relatively contained behavior until 2020. However, after a slight deceleration in 2020, the following years saw substantial market overheating, particularly after 2022, when growth became practically vertical.

In Algarve, a price acceleration was observed until 2022, with the exception of 2020, the initial year of the Covid-19 pandemic lockdowns. In 2023 a slowdown in the market was observed, followed by stabilization in 2024, which may be partially related to the legislative changes regarding Golden Visas and the termination of real estate investment as an eligibility criterion, given that this was one of the most coveted regions in Portugal for foreign investors.

CHAPTER 6 – CONCLUSION

6.1 Discussion

The primary objective of this investigation was to analyze the behavior of housing prices in Portugal, given the sharp growth observed across the entire territory in recent years. To achieve a deeper understanding of these market dynamics, a model was constructed to encompass the evolution and analysis of 9 Portuguese regions, accounting for the significant economic and demographic disparities within the country. Consequently, the central focus of this study was determine whether the rise in Portuguese property prices is sustained by economic fundamentals or if there are discernible signs of overvaluation and speculation.

Based on the results and the subsequent analysis, the findings of this study point toward signs of significant and structural overvaluation. This is evidenced by a clear decoupling of housing price behavior from traditional explanatory macroeconomic variables, such as interest rates (Euribor) and variable illustrating labor market performance, which no longer appear to be the primary drivers of market valuations.

Furthermore, this study obtained an estimate for the independent term of the model used that is statistically significant and being equal to 6.6%, which suggests an inertia in the market about the price increase expectations held by market players. Additionally, the role of new housing supply is not only proving to be insufficient to meet demand, but is also contributing to price increases, which may be due to the increasing offer in the luxury/foreign market segments, or because manufacturers are taking advantage of the momentum of rising prices.

Aligned with these factors, it is also important to emphasize that the real estate market serves as a hedge against currency devaluation. Its consistent and significant annual appreciation, combined with its status as a tangible asset, makes it a highly attractive market for potential investors seeking security and capital preservation.

Finally, the residual analysis confirms that this overvaluation is a national phenomenon, as most of the analyzed regions concluded the final year of the study with positive residuals. However, this trend is particularly acute in specific "hotspots." The Autonomous Region of Madeira and the Algarve stand out as the most critical cases,

where the detachment from the model's predictions reveals a market overheating driven by international demand.

6.2 Academic Contributions

This study provides a relevant contribution to the deepening of studies on the Portuguese Real Estate Market. Since it bridges the gap between macroeconomic theory and the empirical market behavior by integrating diverse indicators such as inflation, unemployment, and interest rates into a single econometric framework. By doing so, the aim was to understand the role of each variable in the market and to determine whether other factors (particularly speculative ones) are influencing it.

Additionally, the methodology established in this thesis serves as a starting point for further academic inquiry. Researchers can build upon this framework to explore additional variables, such as the impact of housing policies or international investment flows, thereby expanding the collective knowledge of urban economics and financial stability in the housing sector.

6.3 Practical Indications

The results of this research lead to several recommendations, starting with a critical point for policymakers regarding the role of new housing completions in ensuring market equilibrium. The research demonstrates that supply scarcity is a primary driver of price resilience even during periods of high interest rates. To promote market stability and housing affordability, there is a practical need for administrative reforms that streamline construction licensing. Increasing the pace of new completions is essential to prevent severe price increases caused by chronic inventory shortages.

Additionally, it is recommended that the authorities establish a public registry to enhance transparency in Real Estate transactions. Requiring the disclosure of taxpayers' residency along with the profile and objectives of the parties involved is essential to mitigate the information asymmetries that drive irrational market expectations. Furthermore, this mechanism would facilitate the precise identification of regional investment hotspots.

Leveraging this transparency, policymakers should consider increasing the fiscal pressure on vacant properties and short-term speculative deals, commonly known as property flipping, to discourage the use of housing as a purely financial asset.

6.4 Limitations

By employing first differences to ensure stationarity and address unit root issues the model estimated focuses on annual variations rather than absolute levels. While this approach is essential for identifying short-term shocks and volatility, it inherently filters out long-run equilibrium relationships between economic fundamentals and housing prices. Consequently, the results primarily capture the immediate responsiveness of the market, potentially overlooking persistent structural trends that develop in the long-run.

Another critical limitation concerns the presence of endogeneity, particularly driven by simultaneity bias within the housing market dynamics. In this model, variables such as the number of transactions and new housing completions are treated as independent predictors of price, despite these relationships being inherently bidirectional. While increased transactions may drive prices upward, high price expectations simultaneously influence the volume of buyers entering the market. Similarly, while new supply affects price levels, high market prices serve as a signal that incentivizes further construction. This reciprocal causality means that some explanatory variables may be correlated with the error term, potentially biasing the estimated coefficients.

6.5 Further Research

Regarding recommendations for future research, it is suggested that subsequent studies be conducted with a higher degree of geographic granularity, focusing specifically on Portuguese municipalities. This approach would allow for a more precise segregation between high-density population centers and rural areas.

It is also recommended the rental market in Portugal to be analyzed, as this would enable a direct comparison between two closely interconnected markets. Finally, obtaining and disclosing more detailed data on the profile of homebuyers in Portugal, specifically

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regarding their residency status and purchase intentions, would be essential for a deeper understanding of housing price behavior and for the development of more targeted academic investigations.

REFERENCES

- Adams, Z., & Füss, R. (2010). Macroeconomic determinants of international housing markets. *Journal of Housing Economics*, 19(1), 38–50.
<https://doi.org/10.1016/j.jhe.2009.10.005>
- Agnello, L., & Schuknecht, L. (2009). Booms and Busts in Housing Markets: Determinants and Implications. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.1433198>
- Algieri, B. (2013). House Price Determinants: Fundamentals and Underlying Factors. *Comparative Economic Studies*, 55(2), 315–341.
<https://doi.org/10.1057/ces.2013.3>
- Anundsen, A. K. (2015). Econometric Regime Shifts and the US Subprime Bubble: Regime Shifts And The US Subprime Bubble. *Journal of Applied Econometrics*, 30(1), 145–169. <https://doi.org/10.1002/jae.2367>
- Anundsen, A. K. (2019). Detecting Imbalances in House Prices: What Goes Up Must Come Down?*. *The Scandinavian Journal of Economics*, 121(4), 1587–1619.
<https://doi.org/10.1111/sjoe.12349>
- Aoki, K., Proudman, J., & Vlieghe, G. W. (2003). House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.392300>
- Bago, J.-L., Rherrad, I., Akakpo, K., & Ouédraogo, E. (2021). Real Estate Bubbles and Contagion: Evidence from Selected European Countries. *Review of Economic Analysis*, 13(3). <https://doi.org/10.15353/rea.v13i3.1823>
- Brzezicka, J. (2021). Towards a Typology of Housing Price Bubbles: A Literature Review. *Housing, Theory and Society*, 38(3), 320–342.
<https://doi.org/10.1080/14036096.2020.1758204>
- Brzezicka, J., & Wisniewski, R. (2014). Price Bubble In The Real Estate Market—Behavioral Aspects. *Real Estate Management and Valuation*, 22(1), 77–90.
<https://doi.org/10.2478/remav-2014-0010>
- Case, K. E. (2000). Real Estate and the Macroeconomy. *Brookings Papers on Economic Activity*, 2000(2), 119–145. <https://doi.org/10.1353/eca.2000.0011>
- Case, K. E., & Shiller, R. J. (2003). Is There a Bubble in the Housing Market? *Brookings Papers on Economic Activity*, 2003(2), 299–362.
<https://doi.org/10.1353/eca.2004.0004>
- Cevik, S., & Naik, S. (2024). Bubble detective: City-level analysis of house price cycles. *International Finance*, 27(1), 2–16. <https://doi.org/10.1111/inf.12441>
- Dreger, C., & Kholodilin, K. A. (2013). An Early Warning System to Predict Speculative House Price Bubbles. *Economics*, 7(1), 20130008.
<https://doi.org/10.5018/economics-ejournal.ja.2013-8>
- European Commission. Directorate General for Economic and Financial Affairs. (2022). *Housing market developments in the euro area: Focus on housing affordability*. Publications Office. <https://data.europa.eu/doi/10.2765/74242>
- Glaeser, E. L., & Nathanson, C. G. (2014). Housing Bubbles. *NBER Working Paper No. W20426*. <https://ssrn.com/abstract=2490304>
- Gyourko, J. (2009). Housing Supply. *Annual Review of Economics*, 1(1), 295–318.
<https://doi.org/10.1146/annurev.economics.050708.142907>
- Hagemann, D., & Wohlmann, M. (2019). An early warning system to identify house price bubbles. *Journal of European Real Estate Research*, 12(3), 291–310.
<https://doi.org/10.1108/JERER-03-2019-0006>

- Hoyneck, C., Roma, M., & Kathinka, S. (2025). *Developments in the recent euro area housing prices*. https://www.ecb.europa.eu/press/economic-bulletin/articles/2025/html/ecb.ebart202502_01~2f59dafb26.en.html
- Katrakilidis, C., & Trachanas, E. (2012). What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration. *Economic Modelling*, 29(4), 1064–1069. <https://doi.org/10.1016/j.econmod.2012.03.029>
- Levin, A., Lin, C.-F., & James Chu, C.-S. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1–24. [https://doi.org/10.1016/S0304-4076\(01\)00098-7](https://doi.org/10.1016/S0304-4076(01)00098-7)
- Lind, H. (2009). Price bubbles in housing markets: Concept, theory and indicators. *International Journal of Housing Markets and Analysis*, 2(1), 78–90. <https://doi.org/10.1108/17538270910939574>
- Liu, F., Liu, D., Malekian, R., Li, Z., & Wang, D. (2017). A measurement model for real estate bubble size based on the panel data analysis: An empirical case study. *PLOS ONE*, 12(3), e0173287. <https://doi.org/10.1371/journal.pone.0173287>
- Lourenço, R. F., & Rodrigues, P. M. M. (2017). *House prices in Portugal—What happened since the crisis?*
- Mohan, S., Hutson, A., MacDonald, I., & Lin, C. C. (2019). Impact of macroeconomic indicators on housing prices. *International Journal of Housing Markets and Analysis*, 12(6), 1055–1071. <https://doi.org/10.1108/IJHMA-09-2018-0070>
- Pinto, T. C., & Guerra, I. (2019). *Housing policies, market and home ownership in Portugal*.
- Rehman, S., Moutinho, N., & Alves, J. (2020). *The Relationship Between Portuguese Economy Indicators And Housing Prices* [Journal]. (Journal of Tourism, Sustainability and Well-Being, 8(4), 271–286.). <https://journals.cinturs.pt/jtsw/article/view/248>
- Sari, R., Ewing, B. T., & Aydin, B. (2007). [Http://www.jstor.org](http://www.jstor.org) Macroeconomic Variables and the Housing Market in Turkey. *Emerging Markets Finance & Trade*, 43(5), 5–19.
- Shi, S., & Phillips, P. C. B. (2023). Diagnosing housing fever with an econometric thermometer. *Journal of Economic Surveys*, 37(1), 159–186. <https://doi.org/10.1111/joes.12430>
- Sjöling, B. (2012). *Indicators for Bubble Formation in Housing Markets* [Master of Science Thesis]. KTH Royal Institute of Technology.
- Soutinho, A., & Thaker, K. (2024). RMBS: Portuguese House Prices not in ‘Bubble’, but in ‘Ceiling’ Territory. *Morningstar DBRS*. <https://dbrs.morningstar.com/research/427691/rmbs-portuguese-house-prices-not-in-bubble-but-in-ceiling-territory>
- Tyrcha, A., & Abreu, M. (2019). Migration Diversity and House Prices—Evidence from Sweden. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3394234>
- Wilhelmsson, M. (2020). What Role Does the Housing Market Play for the Macroeconomic Transmission Mechanism? *Journal of Risk and Financial Management*, 13(6), 112. <https://doi.org/10.3390/jrfm13060112>
- Wöckl, I. (2019). Bubble Detection in Financial Markets—A Survey of Theoretical Bubble Models and Empirical Bubble Detection Tests. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3460430>

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TABLES APPENDIX

Appendix 1: Consumer Price Index

	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Portugal	123,960	121,129	118,271	113,383	105,147	103,833	103,846	103,496	102,477	101,094	100,483

Source: Instituto Nacional de Estatística (INE)

Appendix 2: Inflation Rate

	2025	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Portugal	2,336	2,416	4,311	7,833	1,265	-0,013	0,338	0,994	1,368	0,608	0,487

Source: Instituto Nacional de Estatística (INE)

Appendix 2: Unemployment Rate

	Portugal	Continente	Norte	Centro	Oeste e Vale do Tejo	Grande Lisboa	Península de Setúbal	Alentejo	Algarve	Região Autónoma dos Açores	Região Autónoma da Madeira
	%	%	%	%	%	%	%	%	%	%	%
2025	6	6	6,3	5	5,2	6,3	8	5,5	5,6	4,9	5,4
2024	6,4	6,5	6,5	5,8	6,7	6,5	8	5,8	5,7	5,6	5,6
2023	6,5	6,5	7	5,3	5,4	6,7	8,3	5,9	5,6	6,5	6
2022	6,1	6,1	5,9	4,7	5,5	6,8	9,6	4,8	5,9	6,1	6,8
2021	6,7	6,7	6,6	5,4	6	6,8	8,7	6,8	8,5	7	7,7
2020	7	7	7	5,9	5,7	8,1	7,8	6,1	8,3	6	7,9
2019	6,6	6,6	6,8	5,1	5,3	6,7	8,3	7,3	7	7,8	7,3
2018	7,2	7,1	7,5	6,1	6	6,9	9,2	7,9	6,5	8,4	9
2017	9,2	9,1	10,1	7,3	7,7	8,8	11,7	9,4	7,8	8,9	10,8
2016	11,5	11,4	12,5	8,5	10,9	11,7	12,9	12,1	9,4	11	13,5
2015	12,9	12,8	14,2	9,9	11,4	12,2	15,5	13,4	12,8	12,6	15,4

Source: Instituto Nacional de Estatística (INE)

Appendix 3: Net Migration

	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Portugal	143641	155701	136144	72040	57768	67163	23757	14896	-629	-3528

Source: Instituto Nacional de Estatística (INE)

Appendix 4: Number of Concluded Buildings

	Portugal	Continente	Norte	Centro	Oeste e Vale do Tejo	Grande Lisboa	Península de Setúbal	Alentejo	Algarve	Região Autónoma dos Açores	Região Autónoma da Madeira
	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
2024	11537	10890	4322	1944	1270	1332	1144	458	420	396	251
2023	10985	10306	4148	1929	1176	1092	1090	443	428	386	293
2022	10779	10231	4173	1953	1007	1244	961	447	446	315	233
2021	10169	9589	4044	1820	889	987	990	438	421	353	227
2020	8930	8435	3441	1584	838	738	987	405	442	304	191
2019	7614	7166	2949	1503	702	562	708	376	366	286	162
2018	6635	6295	2655	1305	678	460	534	334	329	225	115
2017	5633	5347	2318	1223	535	316	378	282	295	194	92
2016	5197	4920	2222	1148	516	276	277	260	221	194	83
2015	4974	4685	2160	1075	482	297	216	263	202	165	114

Source: Instituto Nacional de Estatística (INE)

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Appendix 5: Number of New Licenses in Real Estate Market

	Portugal	Continente	Norte	Centro	Oeste e Vale do Tejo	Grande Lisboa	Península de Setúbal	Alentejo	Algarve	Região Autónoma dos Açores	Região Autónoma da Madeira
	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
2024	15414	14545	5948	2689	1798	1733	1154	611	612	500	369
2023	14268	13515	5591	2461	1535	1626	1109	539	654	439	314
2022	15707	14905	6221	2601	1565	1807	1433	626	652	477	325
2021	15639	14853	6079	2735	1503	1765	1475	622	674	493	293
2020	13508	12824	5427	2529	1174	1403	1175	565	551	442	242
2019	13267	12650	5173	2395	1163	1418	1285	575	641	399	218
2018	11995	11408	4664	2266	1022	1170	1152	515	619	393	194
2017	9218	8781	3843	1965	741	689	717	396	430	308	129
2016	7559	7212	3123	1598	743	483	482	385	398	230	117
2015	6208	5876	2643	1466	568	326	277	314	282	229	103

Source: Instituto Nacional de Estatística (INE)

Appendix 6: Median Bank Valuation on Price per Square Meter

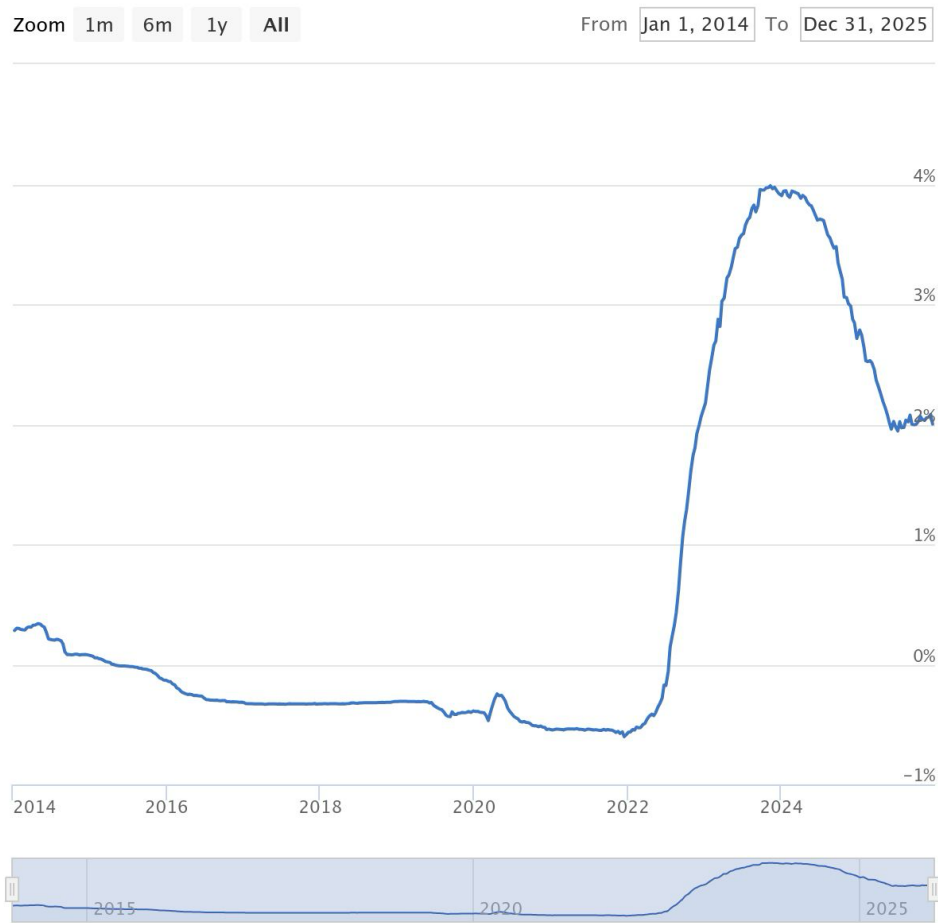
	Portugal	Continente	Norte	Centro	Oeste e Vale do Tejo	Grande Lisboa	Península de Setúbal	Alentejo	Algarve	RA Açores	RA Madeira
	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²	€/ m²
2025	1949	1954	1667	1253	1490	2941	2319	1250	2604	2249	1415
2024	1662	1665	1427	1111	1259	2457	1886	1105	2229	1265	1904
2023	1521	1527	1289	1022	1125	2264	1730	1047	2105	1161	1658
2022	1400	1411	1187	962	1011	2104	1575	945	1905	1054	1379
2021	1231	1240	1061	860	894	1849	1367	877	1633	969	1233
2020	1129	1135	985	824	839	1729	1239	851	1519	929	1147
2019	1049	1053	909	775	806	1621	1110	847	1414	870	1096
2018	946	948	825	727	743	1447	1009	780	1252	824	1031
2017	871	871	763	686	706	1284	905	757	1117	778	970
2016	811	810	707	643	662	1151	843	720	1021	753	915
2015	774	772	676	620	636	1082	801	701	975	748	914

Source: Instituto Nacional de Estatística (INE)

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GRAPHICS APPENDIX

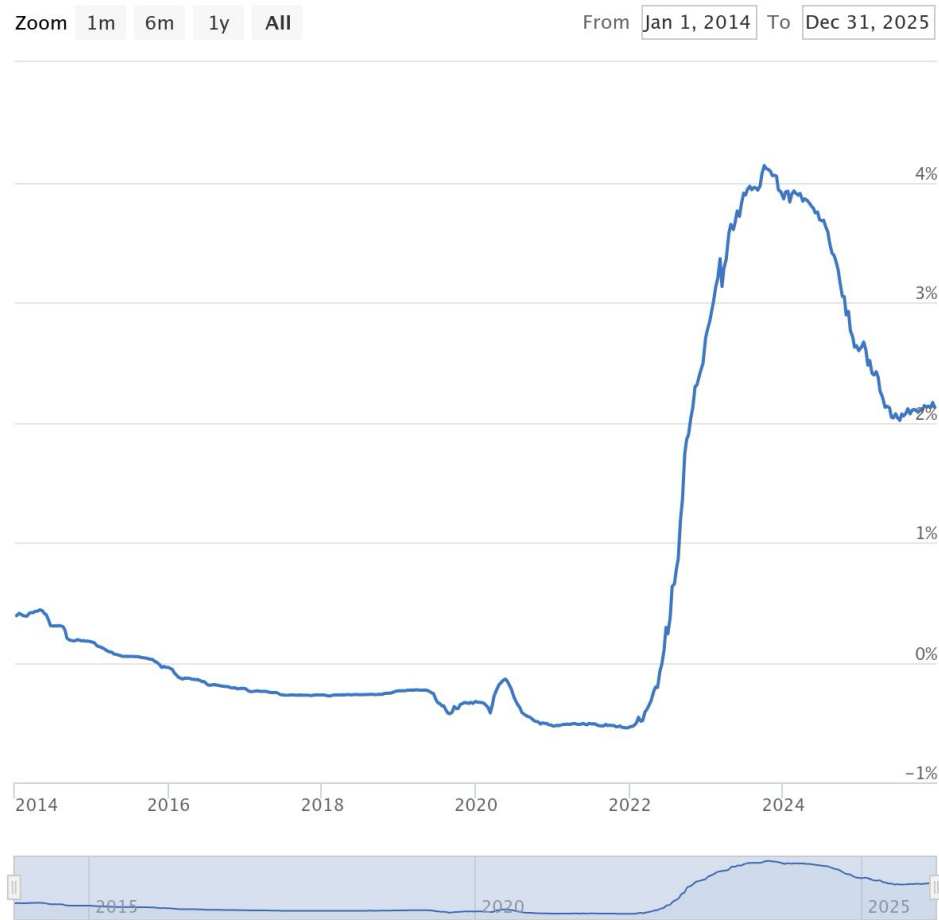
Appendix 1: Euribor (3 month)



Source: Euribor Rates EU

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Appendix 2: Euribor (6 month)



Source: Euribor Rates EU

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MODEL APPENDIX

Output 1: Regressed Model with FE

Fixed-effects (within) regression
 Group variable: **id_region**

Number of obs = **90**
 Number of groups = **9**

R-squared:
 Within = **0.3825**
 Between = **0.5805**
 Overall = **0.3667**

Obs per group:
 min = **10**
 avg = **10.0**
 max = **10**

F(5, 76) = **9.41**
 Prob > F = **0.0000**

corr(u_i, Xb) = **0.0898**

d_ln_price	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
d_euribor	.0138277	.0045491	3.04	0.003	.0047674	.0228881
d_unemployment	.0041244	.0029171	1.41	0.161	-.0016855	.0099343
d_inflation	.003509	.0012693	2.76	0.007	.0009809	.0060371
d_ln_transactions	-.0278003	.0334964	-0.83	0.409	-.0945141	.0389136
d_ln_builds	.0702756	.0249306	2.82	0.006	.0206221	.1199292
_cons	.066137	.0057907	11.42	0.000	.0546038	.0776703
sigma_u	.01257974					
sigma_e	.0283702					
rho	.16430996	(fraction of variance due to u_i)				

F test that all u_i=0: F(8, 76) = **1.89** Prob > F = **0.0735**

Output 2: Unit Roots Test

. xtunitroot llc d.ln_price

Levin-Lin-Chu unit-root test for **D.ln_price**

H0: Panels contain unit roots
 Ha: Panels are stationary

Number of panels = **9**
 Number of periods = **10**

AR parameter: **Common**
 Panel means: **Included**
 Time trend: **Not included**

Asymptotics: **N/T -> 0**

ADF regressions: **1** lag
 LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-7.9231	
Adjusted t*	-5.5939	0.0000

Is There Evidence of a Housing Price Bubble in Portugal?

Output 3: Unit Roots Test

```
. xtunitroot llc d.euribor
```

Levin-Lin-Chu unit-root test for **D.euribor**

H0: Panels contain unit roots	Number of panels =	9
Ha: Panels are stationary	Number of periods =	10
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		

ADF regressions: **1** lag

LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-15.1235	
Adjusted t*	-6.5384	0.0000

Output 4: Unit Roots Test

```
. xtunitroot llc d.unemployment
```

Levin-Lin-Chu unit-root test for **D.unemployment**

H0: Panels contain unit roots	Number of panels =	9
Ha: Panels are stationary	Number of periods =	10
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		

ADF regressions: **1** lag

LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-5.5056	
Adjusted t*	-2.8857	0.0020

Is There Evidence of a Housing Price Bubble in Portugal?

Output 5: Unit Roots Test

```
. xtunitroot llc d.inflation
```

Levin-Lin-Chu unit-root test for **D.inflation**

H0: Panels contain unit roots	Number of panels =	9
Ha: Panels are stationary	Number of periods =	10
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		

ADF regressions: **1** lag

LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-10.7141	
Adjusted t*	-6.1642	0.0000

Output 6: Unit Roots Test

```
. xtunitroot llc d.ln_transactions
```

Levin-Lin-Chu unit-root test for **D.ln_transactions**

H0: Panels contain unit roots	Number of panels =	9
Ha: Panels are stationary	Number of periods =	10
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		

ADF regressions: **1** lag

LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-7.2098	
Adjusted t*	-3.3079	0.0005

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Output 7: Unit Roots Test

```
. xtunitroot llc d.ln_builds
```

Levin-Lin-Chu unit-root test for **D.ln_builds**

H0: Panels contain unit roots

Number of panels = **9**

Ha: Panels are stationary

Number of periods = **10**

AR parameter: **Common**

Asymptotics: **N/T -> 0**

Panel means: **Included**

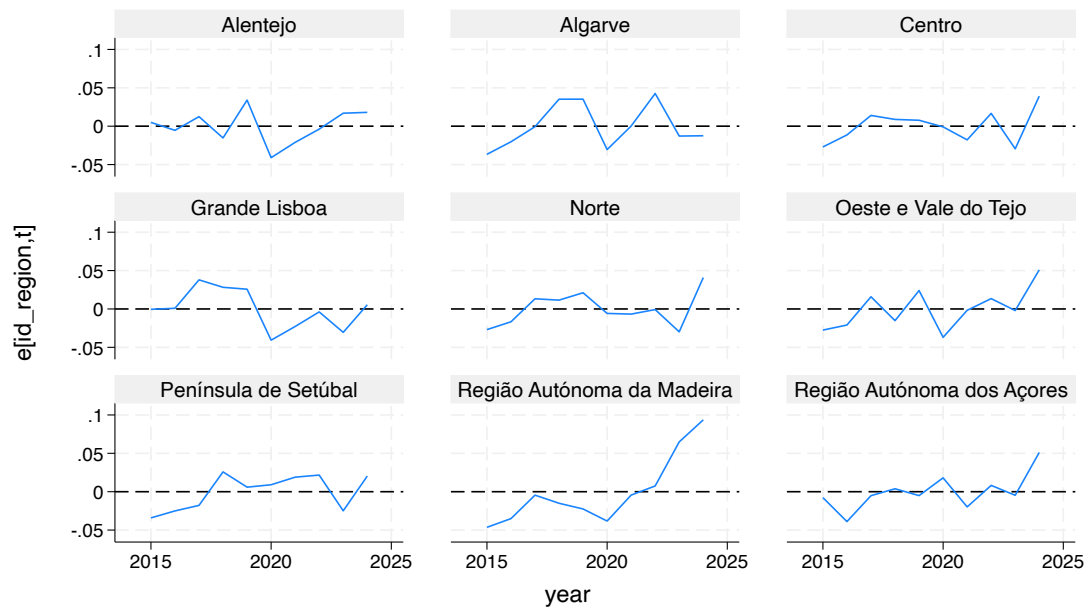
Time trend: **Not included**

ADF regressions: **1 lag**

LR variance: **Bartlett** kernel, **7.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	-6.9284	
Adjusted t*	-2.0228	0.0215

Output 8: Residuals evolution by region



Graphs by region