UNIVERSITY OF LJUBLJANA

SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

FACTORS AFFECTING RESIDENTIAL REAL ESTATE MARKET PRICES IN SLOVENIA

Ljubljana, October 2025 TIMOTEJ GRM

AUTHORSHIP STATEMENT

The undersigned Timotej Grm, a student at the University of Ljubljana, School of Economics and Business (hereafter: SEB LU), author of this written final work of studies with the title Factors affecting residential real estate market prices in Slovenia, prepared under the supervision of Full Professor Dr Andreja Cirman, and Assistant Professor Dr Denis Marinšek

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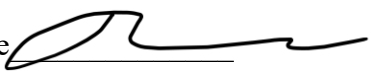
Ljubljana, 5.11.2025 Author's signature 

ABSTRACT

This Master's thesis investigates the determinants of the real estate market in Slovenia. The thesis begins with a review of existing literature on real estate, focusing on its unique characteristics as an asset class, the key drivers of supply and demand, and its interconnections with the rental market. It analyses the dynamics of selected macroeconomic and demographic factors, such as interest rates, building permits, construction costs, purchasing power parity, and population structure (in particular, the share of residents aged 65 and above), over the period from 2007 to 2023 in Slovenia and a set of peer countries. Finally, the study empirically tests the influence of these factors using two linear mixed-effects regression models: the first was applied to the full sample of all selected countries, and the second was designed to capture differences between Slovenia and its peers.

KEY WORDS: real estate, Slovenia, macroeconomic factors, demographics, mixed-effects regression

SUSTAINABLE DEVELOPMENT GOALS

POVZETEK

To magistrsko delo preučuje dejavnike, ki oblikujejo nepremičninski trg v Sloveniji. Najprej predstavi pregled obstoječe literature o nepremičninah, pri čemer se osredotoča na njihove značilnosti kot poseben razred premoženja, razlike v primerjavi z drugimi naložbenimi oblikami, ključne gonilnike ponudbe in povpraševanja ter povezave z najemnim trgom. Nato analizira gibanja izbranih makroekonomskih in demografskih dejavnikov, kot so obrestne mere, gradbena dovoljenja, stroški gradnje, pariteta kupne moči ter demografska struktura prebivalstva (posebej delež prebivalcev, starih 65 let in več), v obdobju med letoma 2007 in 2023 v Sloveniji in skupini primerljivih držav. V empiričnem delu magistrsko delo preveri vpliv teh dejavnikov z uporabo dveh linearnih modelov z mešanimi učinki: prvega na celotnem vzorcu vseh izbranih držav in drugega, ki je namenjen preučevanju razlik med Slovenijo in primerljivimi državami.

KLJUČNE BESEDE: nepremičnine, Slovenija, makroekonomski dejavniki, demografija, regresija z mešanimi učinki

CILJI TRAJNOSTNEGA RAZVOJA

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LIST OF ABBREVIATIONS

AGE65 – share of population aged 65 and above

BP – building permits

CAGR – compound annual growth rate

CEE – Central and Eastern Europe

Coint. – cointegration

CP – construction prices

COVID-19 – coronavirus disease

D-W model – DiPasquale & Wheaton model

ECB – European Central Bank

EU – European Union

GDP – gross domestic product

H – hypothesis

HICP – Harmonised Index of Consumer Prices

IO – interest-only

IR – interest rates

it – panel variables: country as a cross-sectional unit and year as a time variable

LRS – long-run supply

NOI – net operating income

PPP – purchasing power parity

Q-Q – quantile-quantile

S&P – Standard & Poor's

SORS – Statistical Office of the Republic of Slovenia

UK – United Kingdom

US – United States

VIF – Variance Inflation Factor

YOY – year-over-year

1 INTRODUCTION

The housing market is widely regarded as a crucial component of the economy, representing a significant share of individuals' net worth and being strongly interlinked with financial cycles. In Slovenia, for example, housing and land accounted for approximately 73% of total household non-financial wealth in 2023 (Meze, 2024). The housing market has broader economic relevance; when people feel wealthier, they tend to spend more, thereby boosting economic activity and growth. The housing market can also encourage banks to expand mortgage lending due to higher collateral values and lower perceived risk, while downturns can trigger the opposite effect, intensifying financial cycles.

After Slovenia's independence, the country transitioned from a centrally planned housing system to a market-driven one (Cirman, 2017). This shift was marked by the large-scale sale of social housing stock (Pahor, 2021). Housing prices were further influenced by Slovenia's accession to the European Union, which, through a stronger banking system, fuelled demand (Égert & Mihaljek, 2007). Following the global financial crisis in 2008, Slovenia experienced a significant downturn in its banking, construction, and housing sectors. Housing prices declined sharply during this period. Then, from 2015 onwards, the housing market entered a steady growth trajectory, gradually recovering from the earlier decline and reflecting improved economic conditions. In recent years, the housing market has experienced significant volatility, driven by factors such as historically low interest rates and pressure on input prices. Consequently, housing market challenges have become a subject of broader social debate, prompting greater state involvement (Government of the Republic of Slovenia, 2024).

The housing market is a unique asset class due to its specific characteristics, namely the heterogeneity of properties and the structure of market participants (Cirman et al., 1999). It is also closely interconnected with the rental market. Similar to financial assets, housing can generate returns through rental income. To capture these dynamics, DiPasquale and Wheaton (1992) and Colwell (2000) developed models that illustrate how factors such as demand, interest rates, and construction costs influence prices, rents, housing stock, and construction activity.

This thesis aims to analyse the underlying determinants of housing prices and trace their historical developments, with particular focus on the period following the global financial crisis up to the recent years (2008–2023).

The overarching purpose of this thesis is to identify the factors that influence housing prices and to empirically test their impact, assessing both their significance and the extent of their effect. In doing so, the thesis examines the unique characteristics of the housing market, analyses the key determinants shaping housing prices, and evaluates how strongly these factors affect price levels relative to one another. As the results will also be tested on a peer group of countries with political, cultural, geographical, and demographic similarities to

Slovenia, the thesis will compare Slovenia to this group. Accordingly, the following research questions were posed:

- Did the average annual interest rate affect housing prices in Slovenia?
- Did the number of building permits issued affect housing prices in Slovenia?
- Did producer prices in construction influence housing prices in Slovenia?
- Did purchasing power parity have an effect on housing prices in Slovenia?
- Did the share of the population aged 65 and above affect housing prices in Slovenia?

The research employs a quantitative methodology, utilising panel data from eight European countries over 15 years. The dataset includes six independent variables – average annual interest rates, the number of building permits issued, producer prices in construction, purchasing power parity (PPP), and the share of the population aged 65 and above. To analyse the data, a linear mixed-effects model was applied, which accounts for the panel structure of the dataset. Fixed effects represent the main explanatory variables, while the country and the year were included as random effects to control for unobserved heterogeneity. Based on the collected data and applied models, the empirical analysis tests the proposed research questions. It evaluates the influence of economic and demographic factors on housing prices, with a particular focus on Slovenia in comparison to other countries. For rephrasing and improving readability, I occasionally used ChatGPT. The tool was only applied for language polishing, while all research, data analysis, and interpretation were conducted independently.

The Master's thesis is structured into several sections. The introductory section defines the purpose and objectives of the research, outlining the key research questions that guide the study. The theoretical part provides a detailed discussion of the concepts of housing markets, price formation, and the influence of macroeconomic and demographic factors. It also presents relevant empirical findings from previous studies and provides an overview of housing market developments in the selected countries. The empirical part involves the quantitative analysis of panel data, utilising a linear mixed-effects model to examine the impact of selected factors on housing prices, with a particular focus on Slovenia in comparison to other countries. The concluding part summarises the key findings and addresses the research questions.

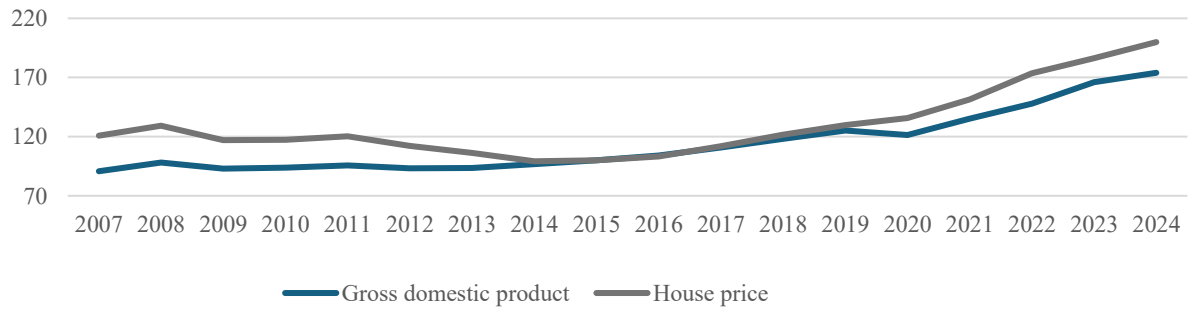
2 HISTORICAL OVERVIEW

The Slovenian housing market has undergone significant shifts shaped by diverse economic, social, and cultural developments. Before Slovenia's independence (as part of Yugoslavia), the housing market was governed by a centrally planned housing system. Most housing was socially owned and allocated to individuals through workplaces or the state. Following the independence in 1991 and a high fiscal pressure due to economic and social costs, the government was forced to withdraw from the housing sector (Cirman, 2017, p. 103). This shift was formalised with the introduction of the Housing Act (commonly known as the

Jazbinšek Law), adopted by the Government of the Republic of Slovenia on 11 October 1991 (Official Gazette of the Republic of Slovenia, No. 18/1991). The law was introduced to promote homeownership among Slovenians and facilitate the transition from a state-planned to a market-based housing system. Through the Act, the Housing Fund of Slovenia has sold 160,000 dwellings, or more than 90% of the country's social housing stock, as of 2010 (Pahor, 2021). The Act allowed tenants to purchase homes at a significant discount; thus, the rental market may become less appealing. This shift could have a substantial impact on housing supply and demand, both in the short and long term.

Twelve years later, in 2004, Slovenia joined the European Union (EU). The influx of foreign capital, along with increased trade and labour mobility, positively influenced the Slovenian economy (World Bank, n.d.). Economic growth and optimism strengthened the banking sector, boosting the mortgage market and further fuelling housing demand (Égert & Mihaljek, 2007). Housing prices continued to rise until the 2008 global financial crisis, which halted consumer spending (Cirman, 2017, p. 105) and likely contributed to a decline in housing demand. Between 2008 and 2014, housing prices in Slovenia fell by approximately 23%, reflecting the depth and duration of the downturn (Figure 1). In that time period, specifically in 2013, Slovenia faced the risk of a financial bailout and harsh austerity measures (Cirman, 2017, p. 105). The bailout was later avoided due to significant restructuring of the banking sector (Jazbec, 2015, p. 2). Economic confidence gradually returned in 2014 (Figure 1), although growth was somewhat fragile (Jazbec, 2015, p. 2). Consumer spending later picked up, interest rates remained near zero for nearly a decade, and the mortgage market experienced significant growth. Between 2015 and 2020, housing prices in Slovenia increased by approximately 36%, possibly driven by growing demand, favourable borrowing conditions, and limited new construction, as indicated by a decrease in building permits in 2018.

Figure 1: Housing price index and GDP, 2007–2024



Note: The housing price index is an average of quarters.

Source: SORS (n.d.).

In 2020, the COVID-19 pandemic brought safety restrictions and global supply chain disruptions. In response, institutions, such as the ECB and national governments, implemented monetary and fiscal measures to stimulate aggregate demand. These actions may have contributed to a resurgence in housing demand.

The increasing demand, coupled with inadequate supply, has likely contributed to worsening affordability, particularly for young people who have recently entered the workforce. Various media outlets have highlighted this issue, and it is increasingly being recognised as a serious political concern in Slovenia. Due to a significant shortage of housing for first-time home seekers, families with children, and single individuals, housing remains largely out of reach for employed individuals over 35 who cannot afford to buy homes, while rental prices remain excessively high.

To address these challenges, the government plans to implement several measures, including an annual allocation of €100 million in state funding, improving the financial stability conditions of the social housing fund, and creating a land reserve to ensure affordable land for housing projects. The state received €25.5 million in government transfers in 2024. The payment represented the first milestone in providing stability to the fund and reforming the rental market. Additionally, the state plans to allocate €100 million annually for the construction of public rental housing, signalling a strong commitment to revitalise a sector that has been largely neglected (Government of the Republic of Slovenia, 2024).

3 MARKET CHARACTERISTICS

The housing market is a crucial component of macroeconomics and requires special attention from researchers and policymakers due to: i) changes in residential housing prices can greatly influence aggregate demand, ii) the interdependence between house price booms and busts and financial cycles; sharp fluctuations can weaken financial stability, making it essential to understand the relationship between mortgage rates and housing prices, and iii) its implications for labour mobility, which in turn affects the supply side of the economy (European Central Bank, 2003).

Understanding the characteristics of the housing market is critical for understanding how it behaves and the external factors to which it responds. Unique features, such as differentiation and structure of market participants, differentiate it from financial or commodity markets. This chapter begins with a description of the hedonic pricing index, which will serve as the underlying independent variable for the further analysis of the impact of external factors in this thesis. Then, the structural differences between the housing market and the financial markets, including aspects of efficiency, liquidity, and predictability, are studied. The chapter concludes with an examination of the interdependence between the rental and housing markets, which will be described by the D-W and Colwell models.

At its core, the housing market serves as a meeting point where individuals with the intention of buying, selling, or trading housing come together. Compared to classical markets, the structure of the housing market is characterised by fewer buyers and sellers, dealing with immovable and heterogeneous products (Grum, 2012, p. 39).

The main functions of the housing market include the exchange of ownership and reallocation of housing use, the transfer of information since market participants require accurate data on prices and property values, and the adjustment of space quality and quantity to meet evolving economic and social needs (Cirman et. al., 1999, p. 8).

Overall, the housing market is characterised by localised competition. Due to the heterogeneity of properties, each with distinct characteristics, such as location, size, and quality, competition is fragmented and highly dependent on geographic location. This is further intensified by the limited mobility of individuals, often constrained (e.g., employment, children's schooling, or family ties). Demand in the housing market is also segmented, as users typically seek specific types of property. This has led to the specialisation of real estate agents and professionals, making transactions more complex and different. Additionally, market participants often lack sufficient information, which increases their reliance on expert assistance, thereby raising transaction costs. The market also faces short-term supply inflexibility. In contrast, supply and demand may balance over the long run; short-term housing supply is rigid and unable to respond quickly to changes in demand (Cirman et al., 1999, p. 9).

3.1 Housing price index

The heterogeneity of housing means that each unit has specific characteristics, such as size, location, number of rooms, and quality. To make prices comparable, Rosen (1974) values the differentiated goods by determining the importance of individual attributes. By regressing housing prices on measurable attributes (e.g., location, size), Rosen estimated the contribution of each component to the overall price. This approach helps avoid oversimplification and provides a clearer insight into price movements in the housing market. The primary purpose of Rosen's model is to derive the hedonic price function, which makes it possible to calculate the marginal price of individual characteristics (Rosen, 1974). In other words, the model provides insights into consumers' willingness to pay for one additional unit of a given attribute, for example, one more square meter of living space.

In addition to demand-side considerations, Rosen also incorporates the supply side, where producers (e.g., developers) bundle characteristics in ways that maximise their profit. The observed market price is thus the result of interactions between buyers and sellers, as buyers seek to maximise their utility and sellers aim to maximise their returns. This framework enables researchers to analyse various price effects, including inflation, quality change, and shifts in consumer preferences, all while controlling for the heterogeneity of the good being studied. This method provides insights into the relationship between prices and characteristics. Still, it cannot independently identify the structure of demand (consumer preferences) or supply (producer costs) without additional assumptions or data. The hedonic pricing model can also be applied to other markets of differentiated goods, such as labour and consumer goods, to better understand how characteristics drive prices.

Another commonly used price index for analysing residential housing is the Case-Shiller Index. This index focuses on tracking how the prices of the same properties change over time, which effectively controls for differences in housing characteristics. By relying on repeated sales of the same homes, it eliminates the need to account for variability in house features directly. The methodology assumes that the quality of the housing remains relatively consistent between sales. This repeat-sales approach ensures that the index captures price changes driven by broader market conditions, rather than differences in housing characteristics (Case & Shiller, 1989).

To analyse the Slovenian housing market, the Statistical Office of the Republic of Slovenia (SORS) and Eurostat apply the hedonic pricing model. The housing market is segmented by municipality, and each unit is assigned additional contextual variables, such as tourism capacity, regional gross domestic product (GDP) per capita, and so-called "property value" zones. Next, adjusted transaction prices are used in a hedonic regression model, where the adjusted price is regressed on a set of housing characteristics. These characteristics vary depending on the type of housing (e.g., new family homes, used family homes, flats). The regression coefficients obtained from this model are then used to estimate the price of a standardised housing unit. Finally, Laspeyres' formula is applied to compute a price index that captures the pure effect of changes in housing characteristics over time.

In this context, the main difference lies in the treatment of coefficients: for used dwellings, regression coefficients are updated annually to reflect current market conditions, whereas for new houses, fixed coefficients from 2008 are applied, meaning only the characteristics vary between periods, while the coefficients remain fixed. A potential drawback of using the new dwelling price index is that, if the average home size decreases while the price per square meter rises, the index may underestimate the true extent of price growth (Zavec, 2025).

3.2 Market efficiency

An essential aspect of the housing market is its efficiency. It is a key concept that helps us understand how well a market allocates investment and sets prices in response to available information. The central assumption of efficient market theory is that all known information is already reflected in current prices, making it impossible to consistently achieve returns above the average market rate through prediction or speculation (Fama, 1970). According to Fama, there are three degrees of efficiency: i) weak form, ii) semi-strong form, and iii) strong form.

The weak form of market efficiency suggests that it is not possible to predict future prices based solely on historical price movements. According to this theory, all past market information is already reflected in current prices. As a result, any new price changes are driven by the arrival of new, unforeseen information (Fama, 1970). This implies that

technical analysis, a trading strategy based on identifying patterns in historical prices, cannot consistently yield excess returns in a weak-form efficient market (Maverick, 2024).

The semi-strong form of market efficiency asserts that all publicly available information is rapidly and accurately reflected in the prices of assets. As a result, investors cannot consistently achieve excess returns by trading on newly released public information. In such a market, neither technical analysis nor fundamental analysis provides an advantage, as the market has already adjusted prices accordingly. Only access to non-public (insider) information could potentially yield above-average returns, which is typically illegal in regulated markets (Fama, 1970).

Finally, the strong form of market efficiency suggests that even non-public (insider) information is already incorporated into asset prices. Under this assumption, not even insiders, such as management, consultants, or others with privileged access, can earn excess returns by trading on confidential information (Fama, 1970).

Studies by DeBondt and Thaler (1985) challenge the notion that the US stock and bond markets are weak-form efficient. By analysing the performance of stocks that had significantly underperformed or outperformed between 1962 and 1982, the researchers aimed to determine whether financial markets tend to overreact to unexpected and dramatic news. Their findings revealed that "loser" stocks, those that had performed poorly, significantly outperformed "winner" stocks over the following three years. This return reversal suggests the presence of investor overreaction, contradicting the weak-form Efficient Market Hypothesis (EMH), which asserts that prices fully reflect all past market information and cannot be used to predict future returns (DeBondt & Thaler, 1985).

The housing market differs significantly from the financial market in several key ways. It is more illiquid, meaning assets cannot be quickly converted into cash without a significant loss in value. Housing assets are also more heterogeneous, as each house has unique characteristics, whereas stocks are generally uniform. Furthermore, the structure of market participants differs; financial markets are predominantly composed of institutional investors. For example, in 2017, institutions owned about 78% of the market value of the US broad-market Russell 3000 Index and 80% of the large-cap S&P 500 Index (Pensions & Investments, 2017). The demand for financial returns primarily drives institutional investors, whereas housing markets are mainly composed of households, whose decisions are often based on the need for shelter rather than investment. Therefore, due to these reasons, studies suggest that the housing market is less efficient than financial markets (Case & Shiller, 1989). If this is the case, traders could take advantage of it and earn abnormal returns since prices may not fully reflect past information.

George Gau (1984) studied the Vancouver housing market from 1971 to 1980. He tried to determine whether housing price changes were predictable over time. He concluded that the market followed a random walk, suggesting that past price movements could not reliably

predict future prices. A random walk implies that housing prices incorporate all past information, making it impossible to predict future price movements based on historical trends, which supports the notion of an efficient market (Gau, 1984).

Another pioneering study on housing market efficiency was conducted by Peter Linneman (1986), who used hedonic indices based on data from Philadelphia homeownersHe found that undervalued houses relative to their characteristics in one period experienced higher-than-average appreciation in the next. This suggests a momentum effect, indicating that the market is not weak-form efficient. However, he concluded that the market was not entirely inefficient in practice, as potential excess returns were swamped mainly by the high transaction costs involved in buying and selling homes. This made it difficult for investors to exploit inefficiencies. Linneman (1986) also found that public information was correlated with actual returns, suggesting that housing prices partially reflected available information, pointing toward semi-strong form efficiency.

Case and Shiller (1989) analysed repeat sales data from four major US cities—Atlanta, Chicago, Dallas, and San Francisco—for the years from 1970 to 1986. They constructed time series housing price indexes and regressed changes in prices against lagged values to test for market efficiency. In an efficient market, there should be no correlation between past and current returns. However, they found evidence of such a correlation, even after correcting for possible spurious relationships, suggesting some degree of weak-form efficiency. They also noted, in line with Linneman (1986), that transaction costs in housing markets are high and could absorb a significant portion of any potential profit. Moreover, they found that although some potential for excess profit exists (at least ex post), the noise in individual housing price movements makes it extremely difficult to forecast accurately. These factors, combined with the lack of short-selling and limited institutional investor presence, make exploiting inefficiencies in the housing market far more difficult than in stock markets (Case & Shiller, 1989).

Another study by Miller and Sklarz (2011) examined how housing prices adjust over time toward their long-term equilibrium using a simple error correction model. Their model predicts that when prices move away from this equilibrium, they gradually return – the adjustment is only partial and takes time. Corrections were found to be symmetrical, occurring at a similar rate regardless of whether prices were above or below equilibrium. Although larger deviations could potentially lead to stronger corrections, the evidence for this was not statistically significant. The study also found that regulations influenced the speed of adjustment: less regulated markets tended to return to equilibrium more quickly. The slower and incomplete price adjustment observed by Miller and Sklarz suggests that the housing market is not fully efficient. Prices do not instantly reflect new information, and regulation can further slow down this process (Miller & Sklarz, 1999).

Overall, researchers have found some evidence supporting the weak-form efficiency of the housing market in the past. For instance, Linneman (1986) observed that low-performing

housing assets tended to yield better returns in the following period compared to high-performing ones, indicating mean reversion. Similarly, Case and Shiller (1989) found a correlation between past and current returns, which also supports weak-form efficiency. Moreover, Miller and Sklarz (1999) noted that when prices deviate from equilibrium, they gradually return to it, a behaviour inconsistent with semi-strong efficiency. In conclusion, the housing market exhibits specific characteristics, such as the structure of market participants, the regulatory environment, and low liquidity, which prevent it from being as efficient as financial markets.

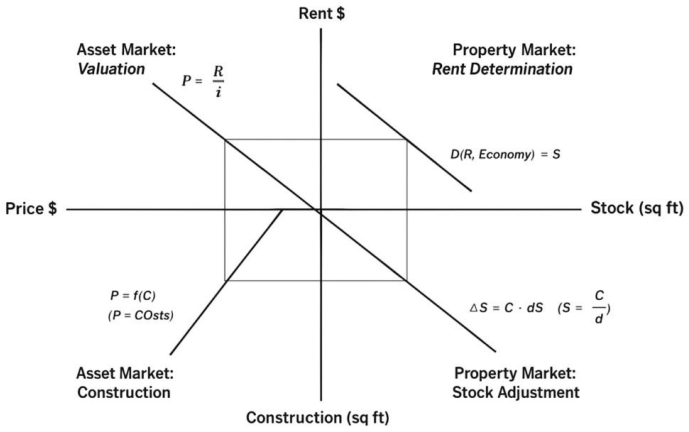
3.3 Real estate market models

The housing market is also closely interdependent with the rental market, as returns are tied to rental income in much the same way that financial market returns are linked to dividends. This relationship is effectively illustrated by the D-W model (Figure 2), which uses a four-quadrant diagram to demonstrate the interaction between the real estate space market (rental market) and the real estate asset market (housing market) (DiPasquale & Wheaton, 1992).

In the model, the right side represents the rental (space) market. Specifically, the top-right quadrant illustrates how buyers respond to rental conditions, showing the amount of rent they are willing to pay for a given stock of housing. As renters are willing to lease more space at lower prices, the demand curve is downward sloping (DiPasquale & Wheaton, 1992). From the demand curve, a vertical line connects the function to the bottom-right quadrant, where asset prices determine the level of new construction (DiPasquale & Wheaton, 1992).

The left side of the model represents the asset (investment) market. The top-left quadrant illustrates how asset prices are linked to rental income, reflecting investor expectations and return requirements (DiPasquale & Wheaton, 1992). The derived function reflects what the market is willing to pay for a given level of rent, linking rental income directly to asset values. In the D-W model, property prices are calculated by capitalising expected rents, which is achieved by dividing the rent by the yield. This yield, in turn, is shaped by several macroeconomic and policy-related factors. These include long-term interest rates, which serve as a baseline for expected returns, as well as anticipated rent growth, risk premiums to account for uncertainty, and specific policy variables, such as real estate tax rules in the US (DiPasquale & Wheaton, 1992).

Figure 2: D-W model



Source: DiPasquale & Wheaton (1992).

The bottom-left quadrant represents the supply side of the housing market through a curve that reflects replacement costs. This curve shows how responsive new construction is to changes in asset prices. Construction begins only when prices rise above a certain threshold, which covers the basic construction costs. Below that level, no new building occurs. The responsiveness, or elasticity, of this supply curve is affected by factors such as construction delays, limited land availability, government regulations, and rising material or labour costs (DiPasquale & Wheaton, 1992).

The D-W model helps us understand the dynamics of the real estate market, particularly how demand interacts with supply, construction activity, rental prices, and asset values. When the demand curve shifts due to factors like population growth or increased prosperity, rents rise for a given stock of space. Higher rents, when capitalised at a given rate, lead to higher property prices. If these prices exceed the threshold for construction feasibility, developers are incentivised to build new properties, adding supply to the rental market (DiPasquale & Wheaton, 1992).

As new supply enters the market, rents begin to decrease. However, due to construction delays and frictions, the market can overshoot or undershoot the ideal level of supply. In the long run, this adjustment process tends toward equilibrium, where all four quadrants of the model are interconnected and in balance: rents, asset prices, construction levels, and the stock of space align consistently (DiPasquale & Wheaton, 1992).

It is also possible to assume a more efficient or forward-looking market that does not overshoot its target. In such cases, expected price growth incorporates the anticipated future increase in construction, preventing prices from rising too sharply. This reflects rational investor expectations and a smoother path toward long-run equilibrium (DiPasquale & Wheaton, 1992).

Another example that is well illustrated by the D-W model is a change in yield. If the required yield increases, the asset price curve becomes steeper, meaning that, for a given level of rent, property values increase. Higher prices make new construction more attractive, which leads to an increase in the supply of space and a higher quantity of real estate in the rental market. Notably, even if rents remain unchanged, a reduction in the required yield alone can stimulate new construction, since investors are willing to accept lower returns, driving up property prices and encouraging development (DiPasquale & Wheaton, 1992).

This is an important insight, as new supply is not determined solely by prices or vacancy rates. Conditions also influence it in the broader capital markets. The rental market is connected to investor appetite and the relative attractiveness of real estate compared to other investment alternatives (DiPasquale & Wheaton, 1992).

The D-W model is helpful in real estate economics; however, several criticisms can be identified. The model assumes a fixed link between rent and price through the exogenous yield. Treating it entirely as exogenous oversimplifies the relationship between real estate returns and broader economic or market forces. It overlooks the fact that interest rates, inflation expectations, and risk premiums can evolve endogenously within real estate markets (Colwell, 2000).

Next, depreciation is assumed to be proportional to the total stock of assets. While intuitive, this oversimplifies depreciation, which can vary depending on the building's age, quality, maintenance, and obsolescence. The curve determining the construction of a new asset is assumed to be short-run and upward-sloping due to resource constraints. The rigidity in the supply curve means the model cannot fully capture real estate cycles caused by lagged supply responses, evolving production efficiencies, or high sensitivity to economic expectations. Furthermore, the model excludes “inverse construction,” where old or underperforming housing is demolished or scavenged at low prices. By ignoring this process, the model oversimplifies the downward adjustment of supply in response to persistent low prices. Finally, the model does not visually clarify how the system reaches long-run equilibrium across the four quadrants, as the equilibrium must be found through trial and error (Colwell, 2000).

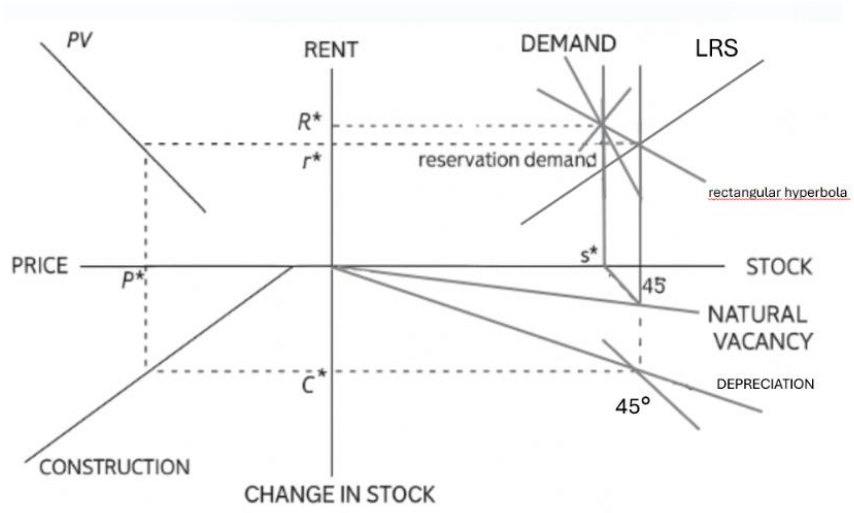
To address limitations in the original model and enhance its analytical usefulness, Colwell proposed several refinements (Figure 3). These include adjustments to the long-run equilibrium framework, as well as the incorporation of operating expenses, vacancies, expectations, and dynamic adjustment processes. One key addition is the introduction of a long-run supply (LRS) curve in the top-right quadrant of the model. Colwell’s approach involves constructing two rectangles that visually link the quadrants, allowing for clearer representation of relationships between rent, asset prices, construction, and stock adjustments. In this setup, a rectangle can be drawn that touches each of the three curves derived from the other three quadrants. The intersection point in the top-right quadrant,

where demand meets the newly introduced LRS curve, is marked by a circle. (Colwell, 2000).

The introduction of LRS simplifies the model by providing a stable reference for determining equilibrium. When demand shifts, the LRS remains fixed, and a new equilibrium is found where the new demand curve intersects the LRS. Conversely, if factors like the capitalisation rate, operating expense ratio, construction costs, or depreciation rate change, the LRS itself shifts.

The D-W model incorrectly suggests that the cap rate directly links rent and asset price, when in fact, it links price to net operating income (NOI). Thus, operating expenses are integrated into the price-rent relationship quadrant through NOI, which is calculated as rent multiplied by one minus the operating expense ratio. A key issue with the D-W model's omission of this factor is that operating expenses are often sticky – costs that do not adjust proportionally with rent. This stickiness can lead to a non-proportional relationship between rent and property prices, making prices more volatile than rents (Colwell, 2000).

Figure 3: Colwell's modified model



Source: Colwell (2000).

Moreover, as the D-W model lacks dynamical adjustment behaviour during protracted shifts, Colwell introduces net investment as the difference between gross investment and depreciation. A new capital stock is determined using a 45° line that shifts in response to changes in stock levels (Colwell, 2000).

Finally, Colwell introduced effective rent as the rent adjusted for vacancies, calculated by spreading the total rental income over the entire housing stock (both occupied and vacant). A rectangular hyperbola graphically represents this. The effective rent accounts for two types of vacancies: i) a natural vacancy rate, driven by tenant turnover and search processes, and ii) speculative vacancies, driven by landlords' myopic expectations:

- If rent is below the previous level, landlords hold units vacant, expecting future rent increases.
- If rent is above the previous level, landlords lease more units, reducing vacancies.

Both natural and speculative vacancies are illustrated through the reservation demand curve, which shifts in response to expectations and behaves like a flexible supply curve. The rectangular hyperbola connects the intersection of reservation demand and tenant demand to the point where effective rent intersects total stock, showing revenue consistency across different occupancy levels (Colwell, 2000).

Overall, the D-W model helps illustrate the interdependencies in the housing market, including the relationships between rent, price, construction, and stock. Colwell expanded the model by removing some of its simplifying assumptions, making it more realistic and insightful. In this refined version, the model no longer jumps instantly to a new long-run equilibrium. Instead, it allows for gradual convergence over time, capturing protracted adjustment processes. It also incorporates essential features, such as i) vacancies (both natural and speculative), ii) operating expenses, which affect how rents translate into prices, and iii) net investment, defined as gross construction minus depreciation, which drives capital stock changes from one period to the next.

Both models help us understand the interrelationships between key variables in the housing market and how different factors, such as demand, interest rates, or construction costs, influence core components, including price, rent, housing stock, and construction levels. While the D-W model simplistically displays this, Colwell's refinement allows a more robust and dynamic representation of realistic effects. This chapter has examined the unique features of the housing market and how these features shape the market's behaviour over time. Unlike financial markets, the housing market is characterised by heterogeneity, illiquidity, high transaction costs, and slow adjustment processes. These characteristics help explain why housing markets often deviate from perfect efficiency and why price movements may not fully reflect underlying fundamentals in the short run. Moreover, the D-W model provides a valuable framework for analysing housing market dynamics by linking the space (i.e., rental) market with the asset (i.e., investment) market. Through its four-quadrant structure, the model illustrates how changes in demand, construction costs, and investor expectations affect rents, prices, and the housing stock over time.

4 DEMAND

The demand for real estate represents the quantity of units sought at various price levels. According to the fundamental law of demand, a price decrease typically leads to an increase in the quantity demanded, while a price increase results in a decrease in demand. A critical aspect of the demand curve is its price sensitivity, or elasticity. The demand curve can be price inelastic, meaning the percentage change in quantity demanded is relatively unaffected by changes in price. It can also be unit elastic, where a percentage increase in price causes

an equivalent percentage decrease in quantity demanded, or elastic, where small price increases lead to significant reductions in demand (Fernando, 2024).

The availability of substitutes heavily influences the price elasticity of demand. For instance, luxury homes, which often lack comparable alternatives in the same area, tend to have an inelastic demand curve. Other factors, known as exogenous determinants, such as economic growth, demographic changes, household structure, disposable income, unemployment, interest rates, financial deregulation, taxation, and homeownership, also affect housing demand, highlighting that demand is influenced by more than just market prices (Mourouzi-Sivitanidou, 2020; Andrews et al., 2011).

In what follows, the focus will be on exogenous factors, as price and quantity dynamics are typically emphasised in microeconomic analyses, whereas this thesis takes a macro-level perspective.

4.1 Economic growth

Economic growth and housing prices are closely linked: economic growth increases demand for housing. At the same time, rising home values make people feel wealthier and expand their borrowing capacity, both of which further stimulate the economy.

Leung (2003) demonstrates that persistent economic growth, without population growth, can drive sustained increases in real housing prices. Using an endogenous growth model, they highlight how housing price trends are tied to underlying economic fundamentals (Leung, 2003).

Economic growth can lead to increased housing demand, which in turn drives up housing prices. As the economy grows, disposable income tends to increase and unemployment rates decrease, both of which raise the demand for housing. According to Aizenman and others (2016), house price appreciation is positively associated with economic growth. The relationship between economic growth and housing prices is interconnected: while rising housing prices can stimulate growth, they can also hinder it if not managed effectively. Interestingly, Aizenman and others (2016) found that large housing price depreciations, when not accompanied by banking crises, can actually enhance economic growth. This occurs by reducing capital market distortions and improving investment efficiency. These effects are particularly pronounced in countries lacking robust safety nets, civil law systems, or personal bankruptcy laws (Aizenman et al., 2016).

Miller and others (2009) examined how changes in declining house prices affect local economic growth, measured by gross metropolitan product, across US cities from 1980 to 2008. They identified two key effects: the wealth effect (people spend less because they feel poorer) and the collateral impact (people spend less because they have less access to credit). Both link housing prices to economic growth, but through different channels, with distinct

policy implications. For example, credit easing may be ineffective if the slowdown is driven by the wealth effect rather than credit constraints (Miller et al., 2009).

4.2 Demographic developments and changes

In developed economies, there is an increasing trend of an ageing population. Due to advancements in healthcare and pharmaceuticals, life expectancy is also increasing. Conversely, the fertility rate is in decline, with a historic low of 1.38 live births per woman (European Commission, n.d.), which is significantly below the replacement level of 2.1 (Romei, 2024). This demographic shortfall may pose serious long-term challenges for population sustainability and economic stability. In response, many EU governments are turning to immigration policies as a strategic tool to offset the declining birth rates and maintain a balanced and productive workforce. Projections indicate that by 2050, nearly 60% of urban regions in the EU are expected to experience population growth, while 80% of rural areas are projected to see a decline (European Commission, n.d.). All these trends have both retrospective and prospective implications on housing demand.

One of the pioneering studies on how population age structure affects housing prices was conducted by Mankiw and Weil (1989). They argued that an ageing population could negatively impact aggregate housing prices. Their analysis focused on the Baby Boom generation's entry into the US housing market as they reached middle age, when they started families and increased their housing consumption.

They proposed a "hump-shaped" consumption pattern, characterised by low housing demand in youth, peaking in middle age, and declining in older age. Based on this model, they predicted that as the share of middle-aged households declined, overall housing demand and prices would fall. In fact, they forecasted a 47% drop in housing demand by 2007. However, this prediction did not materialise. Instead, the housing market experienced substantial growth leading up to 2007, culminating in a housing bubble rather than a prolonged decline.

Gong and Yao (2022) expanded on the demographic implications for the housing market by exploring how various long-term trends influence housing prices in the United States. Their analysis focused on the following key factors:

- Rising life expectancy over the past few decades has been accompanied by an increase in homeownership rates among senior households. This suggests that older adults are staying in their homes for more extended periods, which contributes to sustained housing consumption.
- A growing share of households living in rural areas, which affects regional housing dynamics.
- The demographic impact of international immigration, assessed by comparing actual census data with a simulated population structure that excludes international immigrants.

In contrast to Mankiw and Weil (1989), who focused on changes in the population's age structure while assuming that housing demand behaviour by age group remains fixed, Gong and Yao (2021) believe that longer life expectancy actively increases housing demand. Their finding, using a supply-demand framework, shows that four demographic drivers collectively account for 40.54% of the house price growth in the US between 1970 and 2010 (Gong & Yao, 2021).

According to Égert and Mihaljek (2007), between 2002 and 2006, the increase in the workforce in post-socialist countries played a key role in driving demand for housing. Although overall population growth remained stagnant, the effects of a baby boom in the 1970s and 1980s became evident, as a large cohort of individuals entered the labour market during this period. As more young adults secured jobs and gained financial independence, the demand for housing rose, driven by the need for homeownership or rental accommodation.

4.3 Disposable income and unemployment

Unemployment and the associated level of disposable income – the amount of money an individual or household can spend or save after taxes and mandatory charges – could have a significant impact on housing demand. According to the Permanent Income Hypothesis, developed by economist Milton Friedman, a household's current consumption and spending behaviour are influenced not only by current income but also by expected long-term average income (Friedman, 1957).

The 2008 financial crisis was primarily attributed to the bursting of the American housing bubble, which followed a period of rapid price increases in the housing market. The housing boom, fuelled by subprime mortgages and speculative homebuyers, came to a halt when default rates began to rise. As the housing market collapsed, construction activity declined sharply, leading to increased unemployment in the sector. This slowdown spilled over into other industries, pushing the overall unemployment rate even higher. With rising joblessness, many homeowners were unable to keep up with their mortgage payments, forcing them to sell their homes and contributing to further declines in housing prices.

Rising unemployment has a psychological effect on consumer sentiment. When individuals are unemployed or know others who have recently lost their jobs, they often adjust their spending habits due to financial uncertainty. The reduced confidence makes them more hesitant to make significant purchases, such as buying a new home (Mueller, 1966).

Égert and Mihaljek (2007) used quarterly data from 27 countries in Central and Eastern Europe (CEE), estimating a dynamic ordinary least squares model. They found a negative correlation between unemployment and housing market prices. They suggested that interest rates, unemployment rates, household income, and housing construction are essential drivers of housing prices (Égert & Mihaljek, 2007). Moreover, Grum and Govekar (2016) used multiple linear regression to find a strong correlation between unemployment and house

prices in the real estate markets of Slovenia, Greece, France, Poland, and Norway (Grum & Govekar, 2016).

However, the relationship is not symmetric, as real-world dynamics are complex and involve time lags. One key reason is price stickiness in the housing market: sellers are often hesitant to reduce prices, whereas buyers typically show less resistance to increasing prices (Case & Shiller, 1988).

Higher disposable income leads to greater housing demand. Fraser and others (2009) suggest, based on time series analysis, that there is a long-term relationship between house prices and income in New Zealand, the UK, and the US. However, significant and prolonged deviations from this relationship can occur. Both the long- and short-run elasticities, as well as the speed at which house prices adjust, are not constant. They vary over time, likely due to the influence of various internal and external economic forces. Income and house prices can be affected by both permanent and temporary shocks, which influence how house prices respond to these changes. Permanent shock is defined as real shock, which has the potential to permanently change both housing and income, while temporary shock is a disturbance that is expected to dissipate. Using a structural vector autoregression approach, Fraser and others (2009) found that in New Zealand and the UK, house prices respond more strongly to permanent income shocks. However, temporary shocks also have a significant impact. In contrast, US house prices are primarily influenced by temporary shocks, with permanent shocks having minimal immediate or sustained effects.

Hofman (2005) finds that Dutch house prices strongly react to income, with a stable model that accurately fits past trends. He warns that if fundamentals change, this could lead to a downward correction in house prices.

The relationship between disposable income and housing prices is interrelated. As housing prices rise, people tend to feel wealthier and therefore spend more. Shiller and others (2005), using data from US states and other industrialised countries, concluded that a 10% increase in housing wealth leads to approximately a 1% increase in consumption across a panel of Western countries. They argued that housing prices have a larger and more significant impact on household consumption than changes in the stock market, both in the US and in other developed economies (Shiller et al., 2005).

4.4 Interest rates, financial deregulation, and mortgage innovations

The banking industry plays a significant role in shaping demand fundamentals. Households typically rely on credit to finance housing investments, enabling them to defer future cash flows and savings. In return, they incur interest charges on the borrowed funds.

From the Great Depression in 1931 through the late 1970s, housing in the US was primarily financed through savings accounts at banks. During this period, interstate banking prohibitions, restrictions on branching, caps on deposit rates, and limits on interest for

checking accounts resulted in significant inefficiencies. These constraints compelled banks to finance long-term assets (e.g., mortgages) with short-term liabilities, a mismatch that created systemic vulnerabilities (Gerardi et al., 2007). Improvements in the housing finance market emerged in the early to mid-1980s, driven by a combination of innovative mortgage products, financial deregulation, and the growth of a secondary mortgage market (Gerardi et al., 2007).

The housing boom that led to the Great Recession in 2008 was thoroughly analysed by Zhang and Xu (2020). Using a dynamic stochastic general equilibrium model with embedded mortgage lending, they examined the impact of monetary policy on housing prices. Their findings show that monetary policy is more effective at driving asset price inflation than the use of liquidity-enhancing financial products. They argue that monetary policy was the primary driver of the US housing boom leading up to the crisis.

On the other hand, Bäckman and Lutz (2024), through an analysis of the Danish housing market, suggest that mortgage innovation can significantly contribute to housing booms. This is important because interest-only (IO) loans and similar mortgage innovations make it easier for borrowers to access credit, expand lending, and drive up housing prices. Starting in 2003, the introduction of IO mortgages in Denmark, which allowed borrowers to postpone up to 20% of their mortgage payments for the first ten years, was associated with a 36% increase in housing prices, based on ex-ante estimates. However, the effects varied across local markets, depending on the elasticity of housing supply. The study also highlights that credit is not just about interest rates or borrower risk; it also relies heavily on the structure of mortgage contracts, including how and when payments are made.

The expansion of housing finance by banking institutions is both theoretically and empirically linked to rising house prices. This link was evident in Western Europe during the late 1980s and early 1990s, notably in the UK, which experienced a significant housing boom during financial liberalisation (Attanasio & Weber, 1994; Ortalo-Magné & Rady, 1999). Until the early 2000s, financial institutions in the CEE region, along with the housing finance sector, remained underdeveloped. Under socialism, urban housing was provided for minimal compensation by employers and local authorities, minimising the need for housing finance. However, with the increasing trend of EU accession, the housing finance landscape began to change. The banking sector underwent restructuring, driven by a rise in mergers and acquisitions by strategic investors seeking to acquire smaller banks. These investors not only brought strong balance sheets but also valuable expertise in retail banking. Additionally, regulatory reforms facilitated the easier seizure of real estate collateral, further strengthening the financial sector. Overall, these changes enhanced housing finance, resulting in a higher loan-to-value ratio, lower mortgage rates, and increased accessibility to the general population. Between 2000 and 2006, the compound annual growth rate (CAGR) of housing loans averaged 59%, with commercial bank lending to households expanding significantly (Égert & Mihaljek, 2007).

According to an ECB report, from the 1980s to the early 2000s, mortgage contracts became increasingly flexible, removing many of the constraints that previously limited borrowing. As housing prices rose and collateral values increased, banks began issuing larger mortgage loans. This occurs because an initial rise in house prices, triggered, for example, by a drop in interest rates, raises the collateral value of housing assets, improving access to mortgage-backed loans. This, in turn, leads to house equity withdrawal, where homeowners borrow against the increased value of their homes, improving their net wealth and allowing them to invest in additional financial assets. An important economic factor behind this increased demand was the falling interest rates in the 1990s, which made homeownership more financially attractive than renting. The study also highlights that fluctuations in housing prices could trigger credit cycles. As household indebtedness rises, so does their vulnerability to income shocks and interest rate changes, factors that can ultimately threaten the stability of financial institutions (European Central Bank, 2003).

4.5 Taxation

Poterba's study introduces the concept of 'user cost' to explain how tax policies and inflation influence the cost of homeownership, housing prices, and real estate investment decisions in the US. By using a dynamic housing market model, the research highlights that mortgage interest deductibility, combined with rising inflation, contributed to a 30% increase in real housing prices during the 1970s. This is because higher inflation rates lower the user cost for homeowners, as nominal mortgage interest payments, which increase with inflation, are tax-deductible. At the same time, capital gains from rising home values are largely untaxed. Thus, tax-deductibility makes homeownership more appealing, potentially shifting demand from renting to owning (Poterba, 1984).

In addition, the ECB (2003) identified housing taxation and subsidy systems as key factors influencing housing price trends from the 1980s to the 2000s. In most EU countries during this period, these systems tended to favour immovable assets over financial assets, owner-occupiers over landlords, and, in some cases, new dwellings over older ones. In many EU countries, housing policies were designed to encourage people with low incomes to buy homes. Homeowners often received tax breaks based on the value of their home, access to low- or zero-interest loans, or tax deductions on mortgage interest.

During this period, EU governments either reduced or maintained measures favouring owner-occupation but shifted toward more targeted policies for low-income households. The bias toward homeownership incentives remained strong, often at the expense of the rental sector. Some countries experimented with micro-management policies, such as the introduction of transaction taxes. Still, these measures frequently had adverse outcomes and were reversed within a short time, leading to additional economic instability, as interventions reduce economic efficiency by making transactions more expensive. In many cases, policy changes were pro-cyclical, meaning they exacerbated housing market fluctuations rather than stabilising them (European Central Bank, 2003).

5 SUPPLY

The principles of supply and demand fundamentally drive the economics of real estate. Supply reflects the number of sellers willing to offer housing at various price points, typically exhibiting an elastic relationship with price (Fernando, 2024). The housing supply function also has some unique characteristics that distinguish it from other markets. In the long run, housing prices are primarily driven by the rising cost of land. Since land is a scarce resource with an inelastic supply, its availability cannot easily expand to meet growing demand. As a result, increases in factors such as disposable income, demographic shifts, and other demand-side influences can push prices higher because the supply side does not respond effectively.

The crucial part of the supply function is its responsiveness to price changes, as it indicates how the market responds to an increase in demand, either through higher prices or increased construction. The latter makes housing more abundant and affordable. For example, in the short to medium term, when housing demand rises, areas where new housing can be built easily will experience smaller increases in real house prices (Sánchez & Johansson, 2011).

It is essential to distinguish between long-run aggregate supply, short-run aggregate supply, and new construction. Long-run aggregate supply represents the relationship between prices and the total quantity of units or square footage supplied over the long term. In contrast, short-run aggregate supply refers to the total amount of tangible goods and services available in the market at a specific point in time. In the short run, the real estate stock remains fixed due to the construction lag, which is the time required to plan and develop a building. This lag typically ranges from 6 to 12 months for residential and industrial properties. For instance, even if there is a sudden 20% increase in office demand in a given market, the total stock of office space will remain unchanged in the short term due to the time required to complete new developments (Mourouzi-Sivitanidou, 2020).

The responsiveness of new construction to changes in asset prices or rents is measured by the elasticity of supply, which is primarily influenced by the cost and availability of production factors. When these factors are expensive or difficult to obtain, the supply becomes less elastic. Additionally, external factors, such as the availability and cost of production inputs, expectations about future real estate demand and prices, and perceived market risks, significantly impact new construction. The factors of production necessary to complete any real estate development project include capital (financial resources), labour (both skilled and unskilled workers), land suitable for development, and building materials. These elements collectively determine the feasibility and responsiveness of real estate supply in both the short and long run (Mourouzi-Sivitanidou, 2020).

5.1 Historical determinants

Dröes and van de Minne (2017) used a tailor-made methodology and a re-estimated Herengracht Index to examine housing prices and developments over the last 200 years in Amsterdam. They found that, before 1900, when population growth accelerated, housing prices were determined by population, unemployment rates, construction costs, and the new housing supply. After 1900, income became the key factor, as the development of the mortgage market and interest rates gained importance until World War II. Following the war, post-war reconstruction efforts, increased demand driven by the baby boom generation, as well as deurbanization, made housing supply and, especially, population growth once again important determinants of house prices. From the 1970s onward, income and interest rates became crucial, most likely due to financial innovation and market liberalisation (Dröes & van de Minne, 2017).

Following the fall of the Berlin Wall and the transition of CEE countries from centrally planned economies to market-driven systems, a fundamental shift occurred in public expenditure, particularly in the housing sector. Under socialist regimes, housing was largely state-financed, with governments directly funding the construction and allocation of residential units. However, as these countries transitioned to a market economy, public funding for housing was abruptly withdrawn, leaving a substantial gap in housing supply. This withdrawal of government expenditure was driven by broader economic reforms aimed at reducing fiscal burdens, privatising state assets, and fostering private sector involvement. The housing sector, which had long been dependent on state funding, lacked the immediate institutional and financial capacity to transition smoothly. Private developers and financial institutions were not yet fully established or capable of filling the void left by the state, leading to a period of stagnation in housing construction (Égert & Mihaljek, 2007).

Borowiecki (2009) studied housing price developments in Switzerland from the 1980s to the 2010s. Switzerland faces strict supply-side constraints that negatively impact construction activity, including: i) the country's topography, with over 70% consisting of mountainous regions; ii) heavy regulations on new constructions, resulting in time-consuming zoning procedures and restricted building authorisations; iii) strong protection of the construction sector by regulators; and iv) significant restrictions on the employment of foreign labour and contracting with foreign developers. By analysing a self-constructed housing quality index and using a VAR model, Borowiecki (2009) found that construction prices have a significantly positive effect on housing prices. In contrast, housing construction has a significantly adverse effect (Borowiecki, 2009).

5.2 Market dynamics

Melecky and Paksi (2024) found, based on a panel data regression of 15 European countries from 2000 to 2020, that in addition to demand-side factors, construction costs and supply chain problems had a statistically significant positive effect on housing prices. On the other

hand, construction output and building permits should be interpreted with caution, as they reflect the impact of various variables. They also concluded that GDP, unemployment, wages, and population have a strong influence on housing prices (Melecky & Paksi, 2024).

According to Parrott and Zandi (2021), the main factors contributing to the US housing shortage since the 2008 financial crisis include a scarcity of land, lending, labour, and materials. These constraints have increased costs and reduced profit margins for builders, diminishing their motivation to construct more homes, especially those with lower-priced and smaller profit margins (Parrott & Zandi, 2021).

Additionally, Adams and Füss (2010), who studied housing prices in 15 countries over the period from 1975 to 2007 using panel cointegration analysis, concluded that a 1% increase in construction costs has an average long-term impact of a 0.6% increase in house prices, resulting from reduced housing supply. Conversely, a 1% increase in interest rates results in a 0.3% decrease in house prices, because other fixed-income assets become more attractive relative to residential property (Adams & Füss, 2010).

Glaeser and others (2005) investigated the reasons behind the surge in housing prices, noting that between 1970 and 2000, the increases were primarily driven by a decline in housing supply. They found that new construction has since plummeted while housing prices have soared in small but growing areas. These changes do not appear to result from a decline in land availability, but rather from a shifting regulatory environment that has made large-scale development increasingly difficult in expensive regions of the country. Changes in housing supply regulations may be the most significant transformation to have occurred in the American housing market. In particular, obtaining regulatory approval for new housing construction has become much harder. Local governments and residents had gained greater power to block new development through zoning laws, building permit restrictions, environmental reviews, and political opposition (Glaeser et al., 2005).

5.3 Housing quality

Housing prices are closely linked to the quality of the available housing stock. In many countries, improvements in housing quality have contributed to rising prices over time. This connection is especially evident in CEE countries, where housing conditions lagged behind those in wealthier EU nations in the early 2000s, characterised by smaller average home sizes and limited access to essential amenities, such as piped water and fixed baths. As newer, higher-quality homes became available, overall housing prices began to rise. This increase was not only due to growing demand but also because the composition of the housing market shifted: a larger share of the market was now made up of better-quality, more expensive homes, which pushed average prices upward (Égert & Mihaljek, 2007).

6 RENT

In the EU, in 2023, 30.8% of dwellings were rented (Eurostat, n.d.). Overall, rental markets have significant spillover effects on housing prices. A strong demand for rental housing can drive up rents, which in turn raises the attractiveness of purchasing housing as an investment, pushing house prices higher. Supposing rental markets are heavily regulated or underdeveloped, this can distort housing demand, either by reducing incentives for new construction or by encouraging homeownership (European Central Bank, 2003).

Rent plays a crucial role in the housing market by providing liquidity, lowering mobility costs, and serving as a component of the Harmonised Index of Consumer Prices (HICP). Since the 1980s, the share of rental dwellings has been declining across many EU countries. Tax subsidies, regulations, the structure of financial markets, and the availability of social housing all have a significant impact on the rental market. For example, tax subsidies and lower credit costs may stimulate the attractiveness of homeownership and distort the rental market. In Slovenia, for instance, in 2023, 75.2% of people were homeowners (Eurostat, n.d.), which has contributed to a smaller rental sector. In some EU countries, strict rent controls have reduced the supply of rental accommodation by making renting less attractive for landlords (European Central Bank, 2003).

In the 2000s, modern systems mostly allowed rents to rise with inflation (consumer prices), but still regulated aspects such as eviction and rent increases during the term of ongoing leases. Most EU countries had deregulated rents for new tenants, while sitting tenants were often still protected by older regulations. This has led to a split, with old tenants usually paying significantly lower rent than new tenants (European Central Bank, 2003).

Before the 2000s, real rents (rents adjusted for inflation) increased over time for several reasons. First, the rising cost of construction land has made housing services more expensive. Additionally, new dwellings are often of better quality. In some countries, the relaxation of strict rent controls also allowed rents to catch up to more realistic, higher market levels. Compared to house prices, rents tend to be much less volatile. This is because rents for sitting tenants usually adjust slowly, often following inflation or changes in new contracts with a delay. Some significant shifts in rent trends can be attributed to regulatory reforms. For example, in Finland, rent controls were removed in the 1990s, and since then, the number of rental housing units has increased, despite high rent inflation (European Central Bank, 2003).

Historically, rent controls were introduced to ensure equal access to housing and to prevent segregation of different socioeconomic groups. They also aimed to reduce rent volatility and to balance the power between landlords and tenants. However, over time, controlled rents often fell in real terms. These declining real rents likely discouraged landlords from offering rental housing, resulting in a decrease in supply. Strict rent controls may protect tenants in the short term, but in the long run, they tend to shrink the size of the rental market and harm its overall functioning. This could reduce the efficiency and liquidity of the broader housing

market, with negative impacts on factors such as labour mobility (European Central Bank, 2003).

7 MARKET SIZE

In Slovenia, housing (including land) accounts for approximately 73% of total household non-financial wealth (financial wealth refers to money-based assets, while non-financial wealth encompasses physical or intangible property) as of the end of 2023, with dwellings representing around 35% and land accounting for around 38%. It should, therefore, not come as a surprise that economists and policymakers are highly interested in developments in the housing market (Meze, 2024).

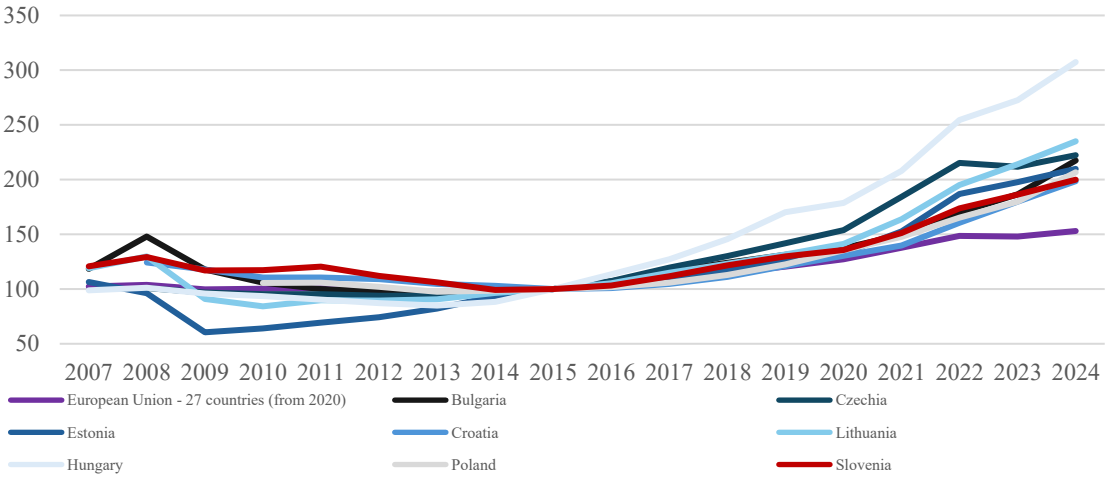
The Slovenian real estate market evolved slowly until the late 1990s, then grew rapidly due to rising demand, but faced significant supply constraints. The 2008 financial crisis led to a sharp decline in transactions and prices, followed by a gradual recovery driven by low interest rates and economic growth. Since 2022, transaction volumes have declined again due to rising costs and structural supply issues, though prices have remained high.

7.1 Transactions and prices in comparable countries

The study by Égert and Mihaljek (2007) analyses housing price developments in eight CEE transition countries – Bulgaria, Croatia, Czechia, Estonia, Hungary, Lithuania, Poland, and Slovenia – up to 2007. These countries are compared due to their shared characteristics: rapid economic growth, transition from centrally planned economies, increasing financial sector development, and EU integration processes (Égert & Mihaljek, 2007). This study will use the same set of countries for comparison, given the relevance of these standard features.

Despite the common macroeconomic trends, housing price growth varied significantly (Figure 4). In Poland, prices remained relatively flat over the five years leading up to 2007. Croatia, Czechia, Hungary, and Slovenia saw price increases similar to those in many Western European countries. However, Bulgaria, Estonia, and Lithuania were notable exceptions, with housing prices surging by a range of 22% to 36% year-over-year (YOY) since 2002, far outpacing both regional and Western European countries. Only Spain had seen comparable housing price increases during that period (Égert & Mihaljek, 2007).

Figure 4: Housing price index (2015 = 100) in Slovenia and comparable countries



Source: EUROSTAT (n.d.).

Following the global financial crisis in 2008, housing markets in these countries diverged significantly. For instance, Hungary and Czechia experienced relatively stable housing prices with limited volatility until around 2015. In contrast, Estonia, Slovenia, Lithuania, and Bulgaria underwent more pronounced fluctuations during this time. Between 2015 and 2024, the countries exhibited sharply different long-term trajectories: Hungary recorded the most significant increase, with housing prices rising by 207%, followed by Lithuania at 135%, and Czechia at 122%. Slovenia, on the other hand, saw prices surge by 100%, just ahead of Croatia at 99%. In contrast, across the EU-27, the average increase in housing prices over the same period was 55%, indicating that several CEE countries significantly outpaced the broader EU trend.

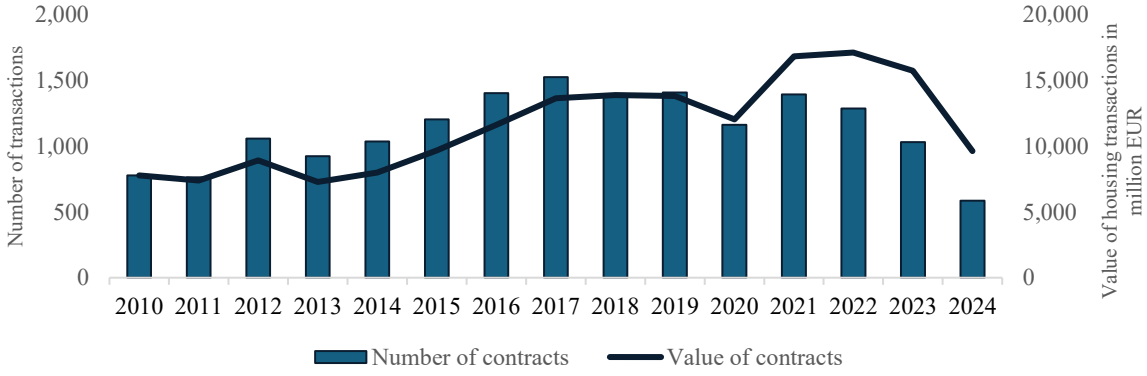
7.2 Market transactions in Slovenia

The Slovenian real estate market's growth lagged behind that of other EU countries, such as Lithuania, Latvia, Czechia, and Poland, until the late 1990s (Geodetska uprava Republike Slovenije, 2008). Following 1998, rising purchasing power and internal migration led to a sharp increase in housing demand. However, the market's growth in terms of volume was constrained by unresolved property ownership, lengthy legal procedures, the absence of a market-based real estate tax, and a high share of state-owned land (Geodetska uprava Republike Slovenije, 2008). These structural challenges kept housing prices persistently high until the global financial crisis of 2008, when Slovenia began experiencing a contraction in its GDP, tighter credit conditions, and a rise in bankruptcies. Demand dropped significantly, and 2009 marked a particularly severe downturn in transaction volumes, widely recognised as a crisis year for Slovenian real estate (Geodetska uprava Republike Slovenije, 2010). The crisis triggered a decline in both residential and commercial transactions, with prices beginning to fall in late 2008 and continuing into the first half of 2009. This period represented the statistical low point for both prices and transaction volumes (Geodetska uprava Republike Slovenije, 2010). Demand plummeted due to limited

access to home loans and a surplus of new residential developments. In response, investors scaled back construction projects, leading to a sharp decline in construction activity in 2009 (Geodetska uprava Republike Slovenije, 2009, 2010).

From 2009 to 2014, housing prices steadily declined, weighed down by unsold inventory and persistent financial instability, which severely impacted the construction sector (Geodetska uprava Republike Slovenije, 2010, 2015). A gradual recovery began in 2015 (Figure 5), supported by low interest rates and renewed economic growth. Nevertheless, new housing supply remained limited. The market peaked in 2017 in terms of transaction volume but slowed in 2018 due to high construction costs and supply shortages (Geodetska uprava Republike Slovenije, 2018). Between 2015 and 2019, transactions experienced a steady 4.0% CAGR. In 2020, housing transactions declined by 17.5% YOY during the first COVID lockdown, mainly due to government-imposed restrictions on real estate activity (Geodetska uprava Republike Slovenije, 2021). Despite a sharp drop during the early COVID-19 lockdowns in 2020, the market rebounded in the second half of the year. The market then rebounded with a 19.9% increase in 2021.

Figure 5: Annual house sales and transaction values in Slovenia from 2010 to 2024



Note: SORS does not report transaction data before 2010.

Source: SORS (n.d.).

At the beginning of 2022, the market experienced a cooling period due to rising input costs. Transaction volumes declined again in 2024, while prices remained elevated, indicating a structurally constrained supply caused by slow permitting, weak infrastructure, and ineffective land and tax policies (Geodetska uprava Republike Slovenije, 2022, 2024).

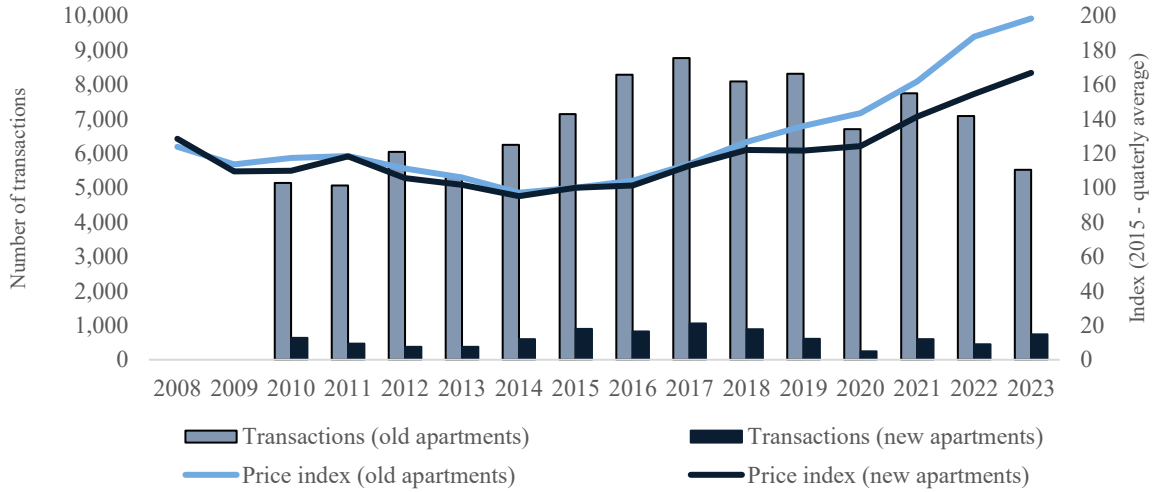
7.2.1 Flats

The number of transactions for old flats showed a strong upward trend starting in 2010, with notable growth of 19% YOY in 2012, 17% YOY in 2014, and 16% YOY in 2016, reaching a peak in 2017 (Figure 6). After this peak, transactions gradually declined, with a significant drop in 2020 by 19% YOY, and further declines in 2023 by 22% YOY. New flats, which represented only 8% of total flat sales from 2010 to 2023, hit a low in transactions in 2012. Growth was notable in 2014 at 62% YOY, and the number of transactions peaked in 2017.

Following this, new flat transactions also declined sharply in 2020 by 59% YOY but rebounded strongly in 2021 with an increase of 143% YOY and again in 2023 with 66% YOY.

Price movements for both old and new flats followed a similar pattern, with a decline until 2014, then a period of increase. For old flats, significant price index declines occurred in 2009 by 15% YOY and 2012 by 11% YOY, while for new flats, declines were seen in 2009 by 8% YOY, 2012 by 6% YOY, and 2014 by 8% YOY. The price increase was more pronounced for old flats than for new ones, with the most substantial increases recorded for old flats in 2017 at 11% YOY and in 2021. For new flats, the growth was the highest in 2021 at 13% YOY and in 2022 at 16% YOY.

Figure 6: Number of transactions and price movement of flats from 2008 to 2023



Note: SORS does not report transaction data before 2010.

Source: SORS (n.d.).

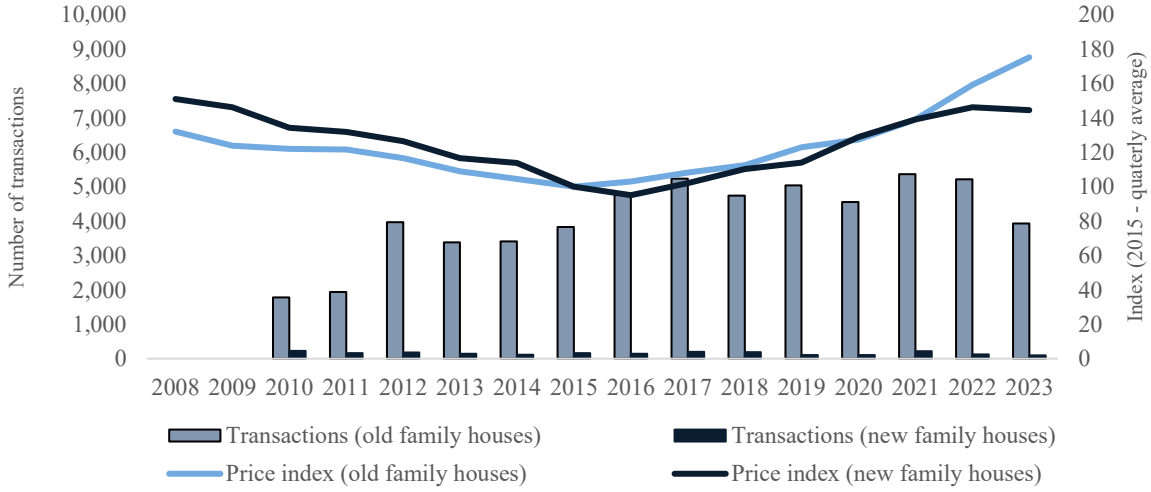
7.2.2 Family houses

The trend in family house transactions mirrored the patterns observed in the flat market. Transactions of old family houses surged from 2010 until reaching a peak in 2017, with the most notable of 104% YOY in 2012 (Figure 7). Following the peak in 2017, a decline of 15% YOY occurred, and transactions continued to decrease gradually until 2021, when they returned to the 2017 levels. Afterwards, a decline resumed, with a significant drop of 23% YOY in 2023. New family house transactions made up only a small portion of total family house transactions, accounting for 4%, so higher relative YOY volatility is expected. This segment reached its lowest point in 2014, then experienced growth until 2017. It again reached low points in 2019 and 2020, followed by a sharp increase in 2021, with YOY growth of 102%.

Price trends for both old and new family houses followed a similar trajectory, with declines until 2016, followed by a period of growth. For old family houses, substantial price index

declines were observed in 2009 by 6% YOY and in 2013 by 6% YOY. For new family houses, notable price drops occurred in 2010 by 8% YOY, in 2013 by 8% YOY, and in 2015 by 12% YOY. After 2016, the price increase was more substantial for old family houses than for new ones, especially following 2021.

Figure 7: Number of transactions and price movement of new and old family houses



Note: No data on transactions in 2008 and 2009 were available.

Source: SORS (n.d.).

8 EVOLUTION OF RELEVANT FACTORS

8.1 Macroeconomics

The economy plays a significant role in housing prices, as economic growth and housing values are closely connected. For example, Leung (2003) shows that housing prices can rise sustainably even without population growth. Economic growth increases household incomes, boosts consumer confidence, and raises demand for real estate, all of which can contribute to upward pressure on housing prices.

Slovenia is an attractive destination for foreign investment due to its modern infrastructure, strong connections to EU transport routes, and a well-educated workforce. Its membership in the European Union, the Schengen Area, and the Eurozone makes it easier to do business and trade across borders; thus, it is not surprising that the Slovenian economy heavily relies on international trade. Until 2020, it had grown faster than most other EU countries, driven by rising incomes, increased consumer spending, low unemployment rates, stable prices, and a growing confidence in the economy (US Department of State, 2020).

Between 2007 and 2023, the Slovenian GDP grew at a CAGR of 3.9% (Figure 8). The growth was constant except for 2009, 2012, and 2020. The decline in 2009 has been attributed to high export dependence, an unfavourable technological structure, and the fall

of the construction cycle (Institute of Macroeconomic Analysis and Development, 2010). The private sector responded to challenging business conditions and declining orders in 2009 by adjusting wages and reducing labour demand, leading to an increase in unemployment from 4.3% to 6.4% (Institute of Macroeconomic Analysis and Development, 2009). In 2012, GDP fell by 2.3% due to stagnant exports, continued declines in investment activity, and a drop in final consumption. Export growth, which had been the main driver of economic recovery from 2011 to 2012, stalled in 2013, primarily due to slower growth or decreased economic activity among major trading partners. The decline in final consumption, driven by worsening labour market conditions and a necessary fiscal consolidation, also significantly contributed to the GDP decrease (Institute of Macroeconomic Analysis and Development, 2013).

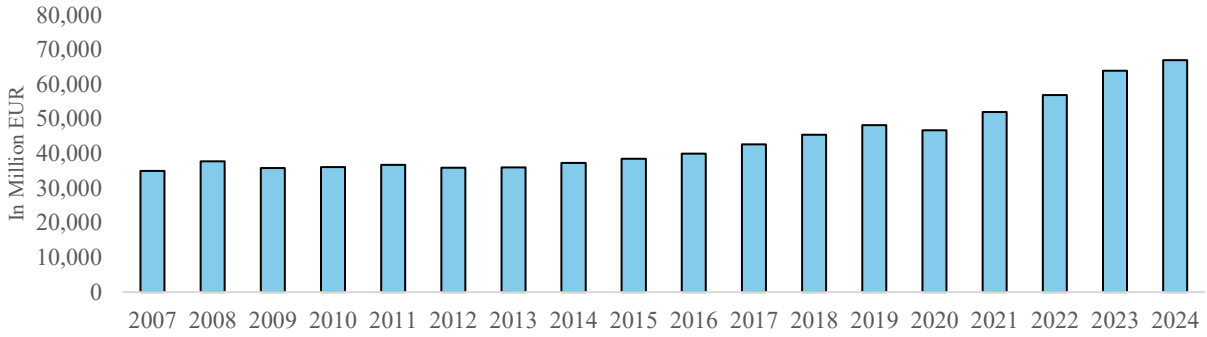
By 2014, unemployment had continued to rise, reaching a peak of 9.6%. It then gradually declined to 4% by 2019, before slightly increasing at the end of 2020 due to the pandemic's impact. A period of robust economic expansion began in 2017, marked by a significant GDP growth of 6.5%, followed by increases of 6.7% in 2018 and 5.9% in 2019.

In 2020, due to the COVID-19 pandemic and associated restrictions, nearly all components of Slovenia's GDP declined, except for government spending, which rose due to epidemic-related measures. Limited movement and service availability during lockdown, along with heightened uncertainty, resulted in a significant decline in private consumption. Household income remained largely stable, supported by government aid, which also helped prevent a steep rise in unemployment. International and domestic containment measures, particularly in the spring, significantly impacted both exports and imports. Reduced demand and uncertainty also led to a sharp decline in business investments in buildings, equipment, and machinery, while public investment saw a slight increase (Institute of Macroeconomic Analysis and Development, 2021).

Slovenia's economy rebounded quickly in 2021, supported by substantial government measures that helped maintain the financial and material stability of the population. While these efforts led to a significant general government deficit and an increase in public debt, particularly in 2020, they played a crucial role in mitigating the impact of the pandemic. The stronger recovery in 2021 was driven by faster growth across all components of GDP – consumption, investment, exports, and government spending (Institute of Macroeconomic Analysis and Development, 2022). Following the pandemic, strong demand for labour contributed to a significant drop in unemployment, reaching 4.5% by the end of 2022 (Institute of Macroeconomic Analysis and Development, 2022).

Slovenia's real GDP expanded by 2.1% in 2023, driven by strong domestic demand and resilient construction investment, which increased by nearly 25% over the year. Imports decreased more rapidly than exports, resulting in a positive contribution to the trade balance from net exports. Employment growth continued into 2023, further reducing the unemployment rate to 3.7% (European Commission, 2025).

Figure 8: Gross domestic product in the period from 2007 to 2023

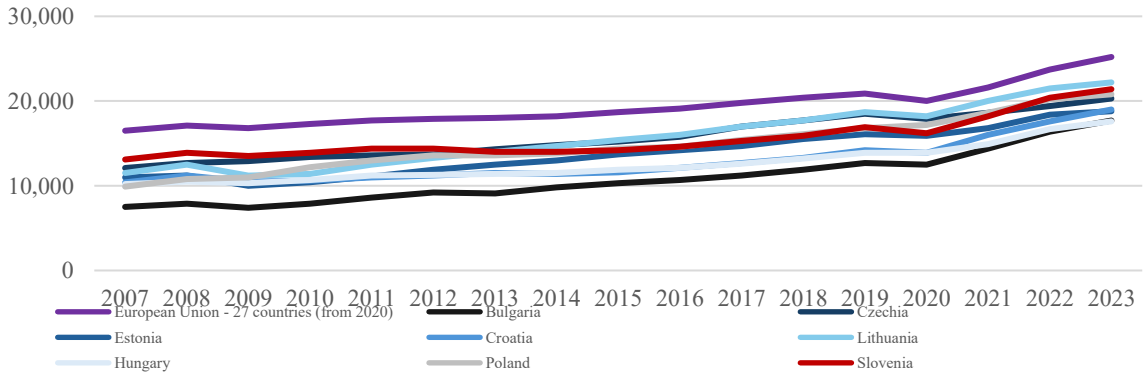


Source: SORS (n.d.).

Average inflation peaked at 5.7% in 2008. By 2015, inflation had stabilised around 1%, with the country experiencing a deflation of 0.5% in both 2015 and 2016. From 2017 to 2020, inflation fluctuated between 1% and 2%, with an average deflation rate of 1% recorded in 2020, driven primarily by lower prices for petroleum products, vacation packages, clothing, and footwear. In 2022, average inflation rose to 8.8% due to increased cost pressures in raw material markets (Institute of Macroeconomic Analysis and Development, 2022). By 2023, inflation reached 7.2%, though it declined over the year as energy prices dropped.

Purchasing power parity (PPP) is a good indicator of housing effects across countries because it adjusts for differences in price levels and currency values, allowing for an accurate reflection of purchasing power differences (Eurostat, n.d.). When comparing Slovenia's PPP to its peers, it grew steadily between 2007 and 2023 (Figure 9), converging toward the EU-27 average (i.e. Slovenia's PPP rose from 79% of the EU average in 2007 to 85% in 2023).

Figure 9: PPP in the period from 2007 to 2023



Source: EUROSTAT (n.d.).

From 2012, likely due to the banking crisis and the related economic downturn, some peers (e.g., Lithuania and Czechia) outperformed Slovenia. However, following a strong post-COVID recovery, Slovenia demonstrated stronger growth than Czechia, for example.

8.2 Demographic structure

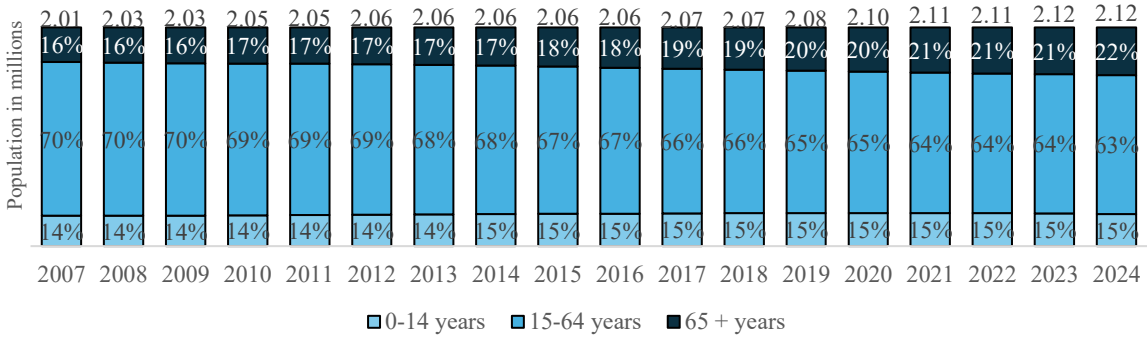
Demographic changes have a pivotal influence on housing demand. For instance, Gong and Yao (2022) highlighted how long-term demographic trends, such as increased life expectancy, rising homeownership among seniors, shifts in rural populations, and international immigration, significantly influence housing prices in the United States by shaping housing demand.

In 2023, Slovenia's population reached 2.12 million, an increase of 91,000 since 2008. Between 1992 and 1999, Slovenia's population initially decreased due to negative net migration and later due to an extended period of negative natural growth. In recent years, however, population growth has been driven primarily by positive net immigration. The number of foreign nationals in Slovenia has increased significantly. As of April 1, 2008, there were 58,000 foreign residents, accounting for 2.9% of the population. By January 1, 2023, this number had risen to 190,000, or 9.0%. In 2022, a slight decline in population was observed, primarily due to high COVID-19-related mortality rates in 2020 and 2021. However, by early 2023, the population had rebounded to levels above the previous year, attributed to high net migration in 2022, including nearly 6,000 Ukrainian citizens who arrived in Slovenia following the onset of the war (Bratuž Ferk, 2023).

In 2008, people aged 65 and above represented 16% of the total population, a share that increased to 21% by 2023 (Figure 10). This shift is driven by declining fertility and birth rates, which altogether result in rising average life expectancy. This trend has evolved over several decades. For instance, in 1982, the population of children aged 0–14 was twice as large as that of individuals over 65; by 2023, this had completely reversed, with the 65+ age group being approximately 40% larger than the 0–14 age group.

The average age is also expected to rise in the future, with projections indicating that those aged 65 and older will comprise 32.1% of the population by 2100, up from 10.8% in 1991 and 21.1% in 2022. Simultaneously, the working-age population is expected to decrease to 50.2%, down from 61.3% in 1991 and 59.3% in 2022, after peaking at 64.2% between 2005 and 2012. Consequently, society will face rising demands to support the elderly. This projected imbalance in age groups suggests that the elderly dependency ratio (which compares the number of older people to the number of people of working age) will increase from 35.6 to 63.9 by 2100. This rise highlights the anticipated financial pressures on public revenues and expenditures, particularly for pensions, healthcare, and long-term care, as it reflects the widening gap between potential retirees and those who contribute through taxes and social contributions (Bratuž Ferk, 2023).

Figure 10: Structure of the Slovenian population in the period from 2008 to 2023

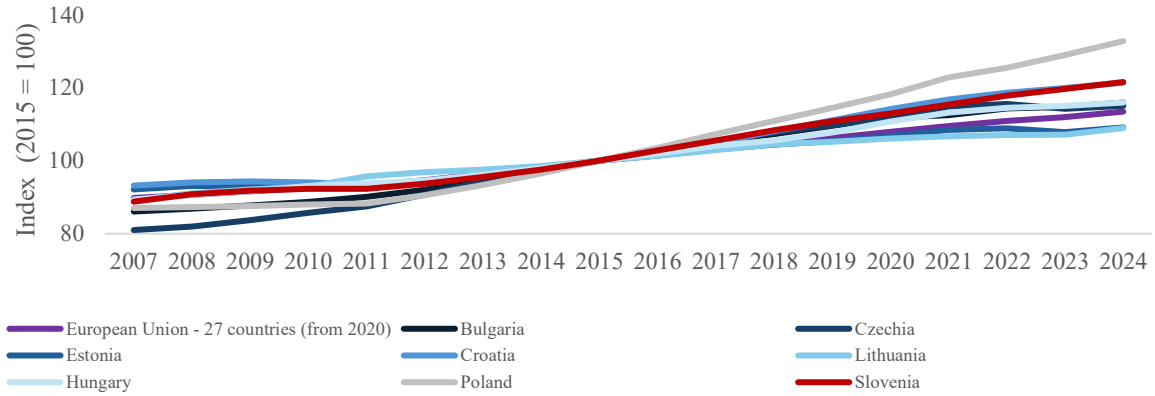


Source: SORS (n.d.).

The average age of the Slovenian population has increased by 10 years over the past four decades. In 2023, the largest generations were between 39 and 58 years old. By 2060, it is expected that a generational decrease in population numbers will happen, with the largest age groups projected to be around 50 years old. The ageing population will primarily consist of individuals around 80 years old, as the largest generation, born around 1980, reaches that age (Bratuž Ferk, 2023).

Moreover, across the EU, the share of the population aged 65 and older has been steadily increasing, reflecting broader demographic shifts tied to ageing populations, lower birth rates, and increased life expectancy. In 2007, the EU average for the 65+ age group stood at 17.1%. At that time, Slovenia, despite sharing a comparable trajectory of post-socialist transition and EU accession with other CEE countries, had a slightly lower proportion of older residents, at 15.9%. Poland, likewise, underwent similar transformations and recorded an even lower percentage at 13.4%. By 2024, however, these countries will have not only caught up but also exceeded the EU average (Figure 11). The share of people aged 65 and above in the EU reached 21.6%, while Slovenia climbed to 21.8%, and Poland, which recorded the highest growth in the share of older people, rose to 20.5%. This reflects a typical trajectory of population ageing across the EU, with potential implications including growing pressure on pension systems and healthcare expenditures, as well as a possible increase in demand for housing (Gong & Yao, 2021).

Figure 11: Index (2015 = 100), based on the share of the population aged 65 and above



Source: EUROSTAT (n.d.).

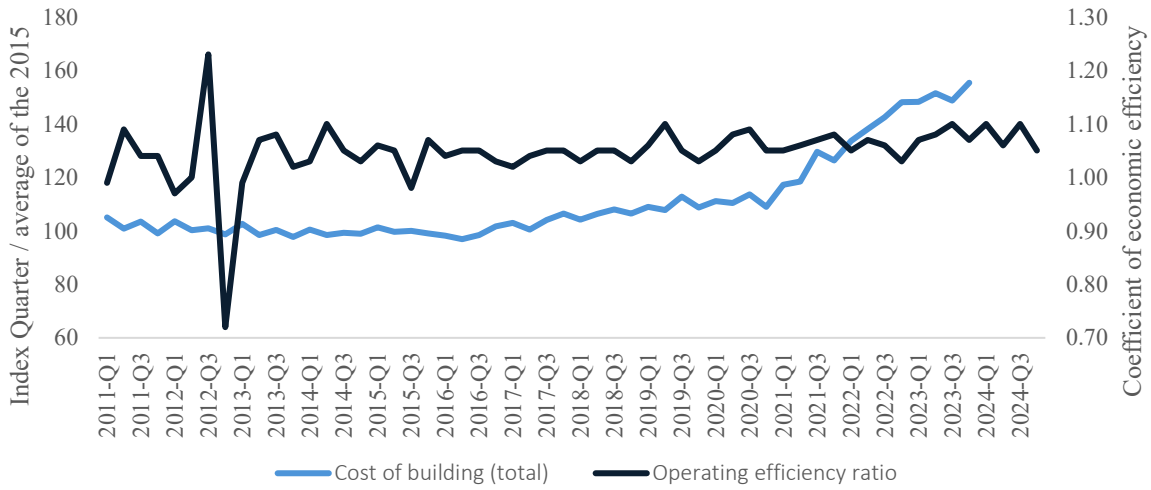
8.3 Building costs in the construction sector

Among other supply-side factors, higher construction costs significantly impact housing availability, increase producer prices, and constrain housing supply (Parrott & Zandi, 2021; Melecky & Paksi, 2024). Since 2020, construction costs in Slovenia have increased beyond the EU average (OECD, 2024). Rising construction expenses have contributed to a decline in housing availability, with price increases closely following cost increases. This trend is particularly evident from 2021 to 2023, a period marked by substantial cost hikes, whereas construction costs remained relatively stable from 2008 to 2020. Following the COVID-19 pandemic, construction costs surged due to multiple factors.

One key driver has been labour costs. With high employment levels, the labour market is experiencing a severe shortage (Institute of Macroeconomic Analysis and Development, 2023). In 2023, the construction industry faced a significant number of unfilled job positions, underscoring the workforce supply issue (Institute of Macroeconomic Analysis and Development, 2023). High occupational entry barriers, combined with limited competition in sectors related to residential construction, such as the construction industry and engineering and architectural services, have led to significant skill shortages and rising wage pressures. Additionally, material costs have been affected by post-COVID supply chain disruptions and increasing energy prices, primarily driven by the ongoing war in Ukraine (Institute of Macroeconomic Analysis and Development, 2023).

After the Great Recession in 2008 and the aftermath of the Slovenian banking crisis, construction was one of the most affected industries in Slovenia. Following the 2008 downturn, the sector saw substantial declines in revenue, employment, and company numbers. It only began to recover in 2013. Initially, profits declined sharply, likely due to the restructuring of the majority of Slovenian construction companies (Figure 12). After that, margins returned to the previous level, although some volatility remained throughout the years due to the cyclical nature of the business (Figure 12).

Figure 12: Building cost index and operating efficiency ratio from 2011 to 2024

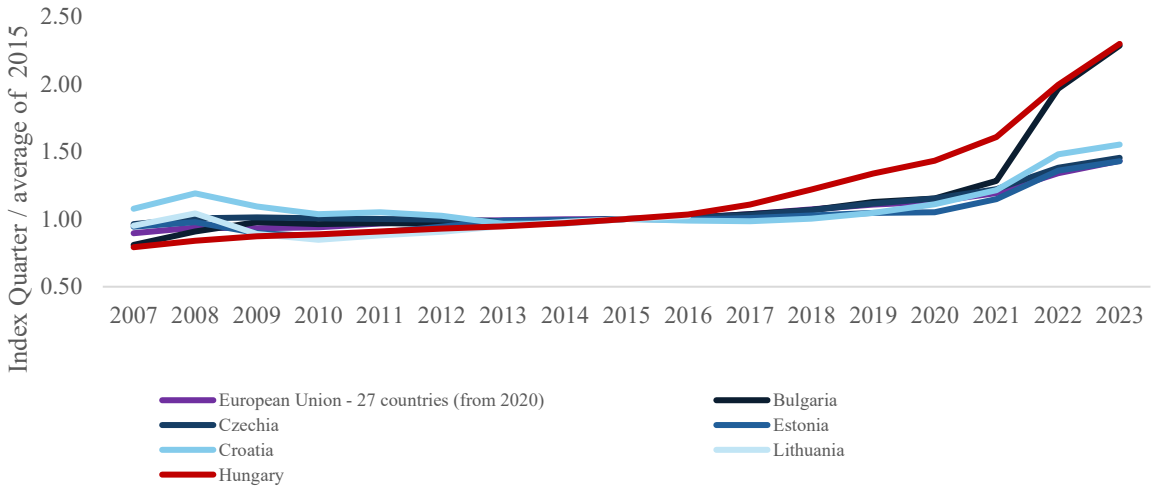


Note: The operating efficiency ratio is calculated as the ratio of gross profit to operating expenses.

Source: SORS (n.d.).

The construction producer prices or costs for new residential buildings, based on quarterly data from 2007 to 2023, moved relatively in sync across most countries until 2020 (Figure 13).

Figure 13: New residential buildings cost index of Slovenian peers



Source: EUROSTAT (n.d.).

Hungary was an exception, experiencing a notable increase in costs as early as 2017. After the onset of COVID-19 in 2020, all countries saw a significant surge in construction costs. Bulgaria recorded the most dramatic YOY growth, with prices rising by 53% in 2022. In comparison, the EU average rose more moderately, with gains of 6% YOY in 2021, 12% YOY in 2022, and 7% YOY in 2023.

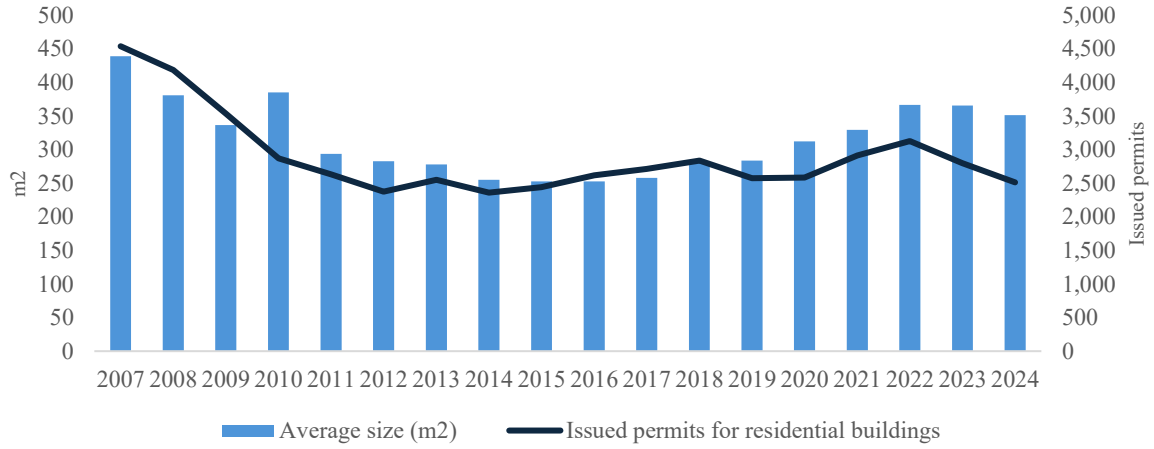
8.4 Construction activity and building permits

Both demand and supply factors shape housing markets, but the supply side plays a critical role in determining housing availability and affordability. As noted by Glaeser and others (2005), changes in housing supply regulations, particularly the increasing difficulty of obtaining approval for new construction, have been among the most transformative developments in the American housing market.

Building permits in Slovenia began to decline around 2007 (Figure 14), primarily due to the global financial crisis and its severe impact on the construction sector. Building for the open market remained highly risky and offered relatively low returns, making it unattractive to private investors. The construction of buildings is closely tied to private sector investment, which, due to Slovenia's economic and political climate, remained at a very low level until 2015.

Building permits then started to increase gradually until 2022, likely supported by a recovering construction sector, improved investor confidence, low interest rates, and overall economic growth. A drop in 2018 was observed due to negative confidence in the construction sector, which temporarily disrupted building activity. Then in 2023, permit numbers began to decline again. Reasons for this could include rising interest rates and increasing prices of construction materials, which discouraged investors from starting new projects.

Figure 14: Building permits for residential buildings and their average size from 2007 to 2024

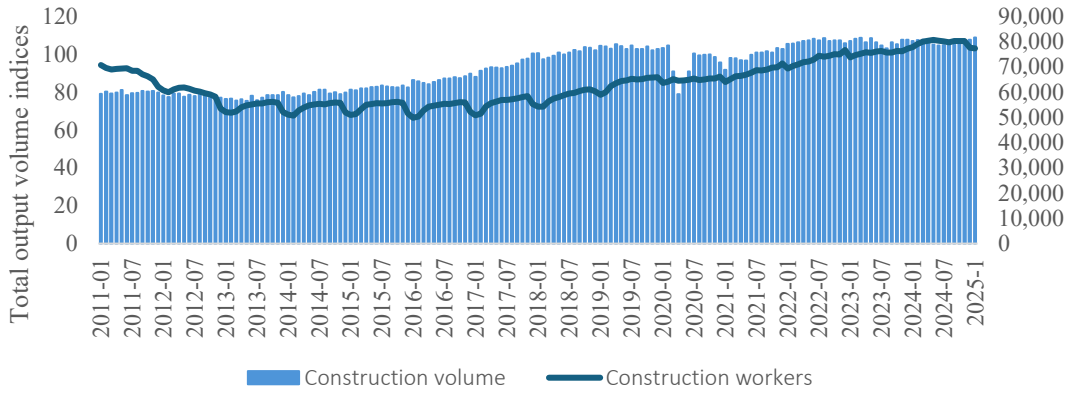


Source: SORS (n.d.).

Construction activity, measured by the value of construction work performed (expressed in current prices and adjusted using a deflator to reflect fundamental changes), along with the number of workers employed in construction classified as the main activity, declined gradually until 2015 (Figure 15). That year marked the beginning of a recovery, supported by improved economic conditions and increased investor confidence. From May 2015 to

May 2023, construction volume increased by 40%, while the number of workers rose by 22% over the same period. This rebound could highlight growing confidence in the construction industry and an overall increase in supply.

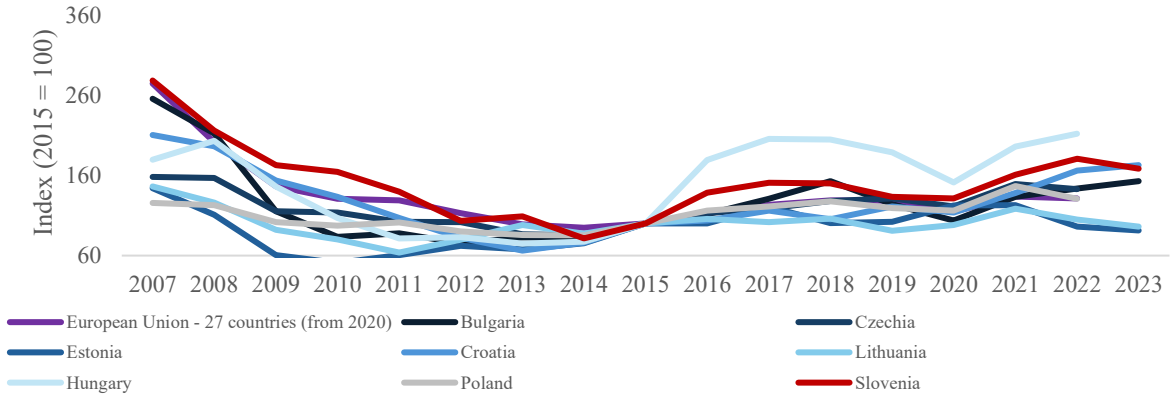
Figure 15: Construction volume index and the number of people working in the construction industry



Source: SORS (n.d.).

Building permits across the EU followed a clear pattern over the past two decades. After peaking in 2007, permit levels dropped sharply in most countries following the financial crisis, reaching a low point around 2013. From 2014 onward, activity began to recover across the board (Figure 16).

Figure 16: Building permits index in Slovenia and its peers from 2007 to 2023



Note: Data for 2023 is not available for the EU average, Czechia, Hungary, and Poland.

Source: EUROSTAT (n.d.).

Slovenia stood out early on, with the highest level of permits in 2007 compared to its 2015 baseline. Among the selected countries, permit numbers increased significantly from 2015 to 2018, indicating a period of broad growth in construction activity. Following the 2015 period, Hungary experienced the most dramatic rise, with building permits more than doubling by 2017 compared to 2015. However, in most countries since 2018, the trend shifted downward, reaching a low point in 2020 during the COVID-19 pandemic. Since then,

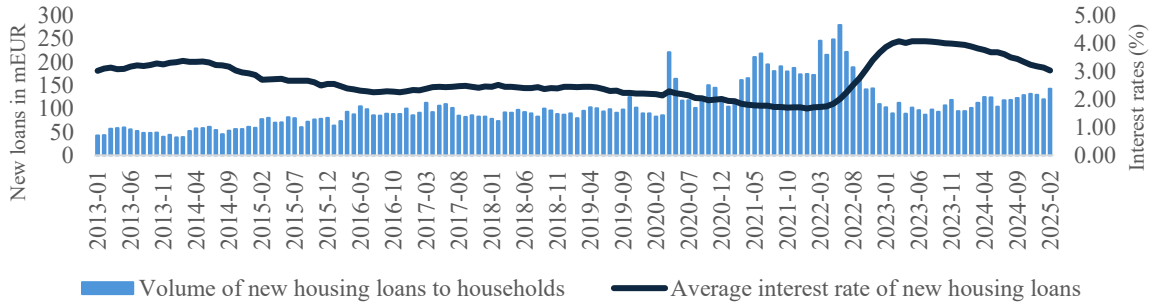
permits have rebounded. Notably, in the most recent year, Slovenia, Estonia, and Lithuania recorded a decrease in building permits, suggesting renewed cooling in parts of the region.

8.5 Interest rates and residential lending

Financial developments play a crucial role in shaping housing demand, as easier access to credit, expanded lending, and mortgage innovation tend to push up housing prices (Bäckman & Lutz, 2024). Both theory and empirical evidence support the link between the expansion of housing finance by banking institutions and rising house prices (Attanasio & Weber, 1994; Ortalo-Magné & Rady, 1999; Égert & Mihaljek, 2007). In Slovenia, the volume of mortgage lending steadily increased from 2013, peaking in 2022. Although household indebtedness in Slovenia remained at low levels following the banking crisis, this could lead to a significant increase in the volume of new housing loans, reaching record highs in early 2022. It is essential to know that mortgage lending, in the sense of house-purchase loans secured on housing, was introduced in Slovenia in 1997. Before that, housing loans were secured by insurance or a guarantor (Scanlon & Whitehead, 2004, p. 27).

During the COVID-19 pandemic, central banks further reduced interest rates, driving a steady increase in mortgage lending. This downward trend in mortgage rates continued until 2022, when inflationary pressures prompted central banks to tighten monetary policy. As a result, rising mortgage rates curbed borrowing activity and led to a decline in new lending. By 2025, however, volumes are beginning to recover as interest rates have started to decline again (Figure 17).

Figure 17: New housing loans volume and interest rates in Slovenia from 2013 to 2025



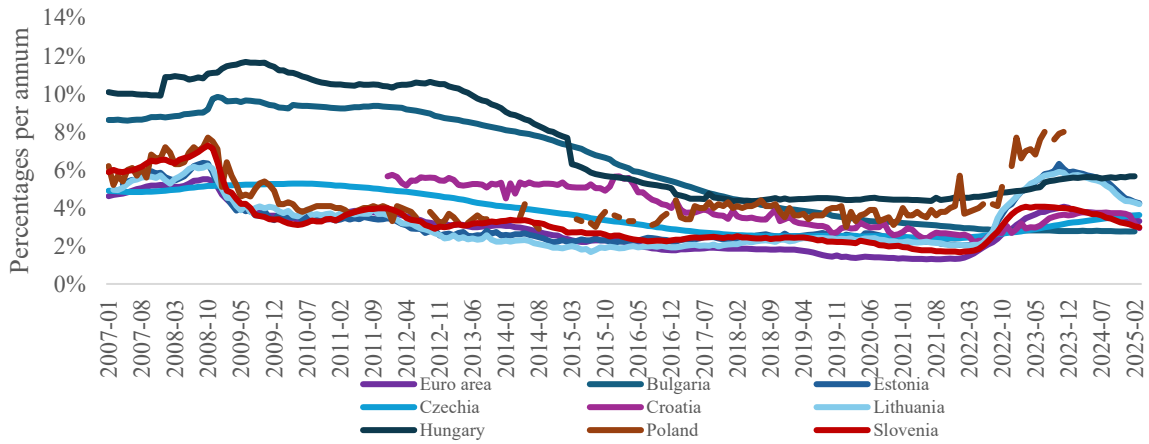
Note: Data before 2013 are not available.

Source: Bank of Slovenia (n.d.).

When comparing developments in interest rates for housing purchases across countries, similar patterns emerge, although some differences are evident (Figure 18). At the beginning of 2007, Slovenia reported the highest interest rate, around 6%, which peaked at 7.3% in November 2010. Before the Great Recession and the subsequent drop in rates, Slovenia's interest rates were about 0.5 to 1 percentage point higher than those in Lithuania and Estonia. Compared to the Euro area average, Slovenia's rates were typically 1 to 1.5 percentage points

higher. Following the financial crisis, interest rates dropped sharply, and Slovenia's rates fell below those of its Baltic peers and the Euro area. From 2011 to 2014, Slovenian rates stabilised at around 3–3.5%, eventually dropping below 3% and reaching a low of 1.7% at the end of 2021. During this period, Slovenia's interest rates generally followed the same trend as those in the Euro area. However, the Euro area rates were consistently slightly lower, especially between 2017 and 2021, when the difference ranged from 0.5 to 0.9 percentage points. Following the ECB's rate hike in 2022 in response to inflationary pressures, interest rates increased across all countries. However, notable differences emerged: in Lithuania and Estonia, rates rose more sharply, and the gap between these countries and Slovenia widened to between 1 and 2 percentage points. Croatia, which adopted the Euro at the beginning of 2023, had relatively high interest rates in 2012. These gradually converged with those of other Euro area countries by 2022, when the ECB's policy rate hikes took effect across the region.

Figure 18: Interest rates on new housing loans in Slovenia and its peers, 2007–2025



Note: Data for Croatia from 2007 (1M) – 2011 (M11) are not available. Poland, Bulgaria, Czechia, and Hungary do not report data to the ECB. The Euro area refers to countries that have adopted the Euro as their official currency.

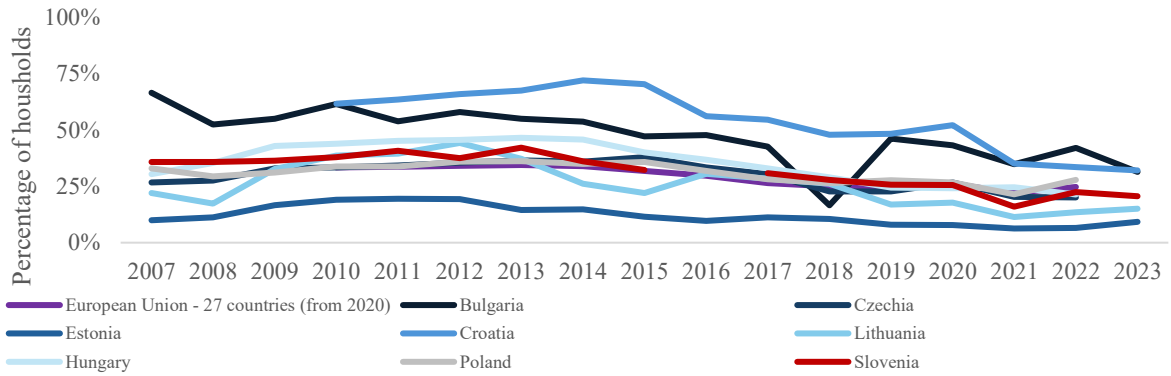
Source: ECB (n.d.); GlobalEconomy (n.d.); Narodowy Bank Polski (n.d.).

Understanding how households perceive the burden of housing costs provides essential insights into affordability and financial stability. The "heavy burden" of housing loans and expenses is a self-reported measure, meaning it reflects how people feel about their financial strain rather than actual financial ratios. As such, some bias or subjectivity may be present. Still, it provides valuable insights into the perceived affordability of housing across different populations.

The trend suggests that households in the EU are experiencing a lower financial burden from housing-related expenses (Figure 19), possibly due to improved economic conditions, income growth, or stabilising housing costs. In the EU-27, the share of households reporting a heavy burden from housing costs fell from 33.5% in 2010 to 26.3% in 2023. The most striking improvement occurred in Croatia, where 72.1% of households felt heavily burdened

in 2014, dropping sharply to 32.1% in 2023. Similarly, in Slovenia, the peak was 42.2% in 2013, falling to 20.7% by 2023. In general, the data suggest a decline in perceived financial stress related to housing across the EU. The trend of a declining "heavy burden" could indicate a modest improvement in economic stability regarding housing costs, which is a positive sign for mortgage repayment capacity and household financial resilience.

Figure 19: Housing cost and loan repayment burden in Slovenia and its peers, 2007–2023



Note: Data for the EU average and Croatia from 2007 to 2009 are not available. Slovenia did not report the 2016 data.

Source: EUROSTAT (n.d.).

8.6 Social housing

The Slovenian government's intervention has always played a significant role in shaping the housing market. The introduction of the Housing Act in 1991, followed by the privatisation of social housing, marked a turning point. As a result, the share of social housing dropped dramatically, from 33% to 11%, within just two years of the Act's implementation (Cirman, 2017, p. 103).

The new model of government involvement established a shift in role, from provider to enabler. The remnants of the social housing stock that remained after the implementation of the Housing Act were designated to meet the housing needs of socially vulnerable groups. In addition, a non-profit housing scheme was introduced, primarily aimed at serving the middle-income population. Low rents in the social rental sector, combined with a lack of subsidies, severely harmed the financial health of housing associations, leading them to sell off their housing stock as a response. As a result, the social and non-profit rental sectors merged in 2001, together representing 6% of the total housing stock (Cirman, 2017, p. 103).

In 2003, a new Housing Act was introduced, establishing a nationwide legal framework for the social rental sector. The Housing Act introduced non-profit rent, calculated as a fixed percentage of a housing unit's administrative value, replacing earlier variable rent rates and unifying the system. Additionally, tenants with incomes below a means-tested threshold became eligible for rent subsidies of up to 80%, funded by municipal budgets. However, the system faced significant challenges. Housing providers, receiving insufficient subsidies and

forced to charge below-cost rents, often had to sell properties to remain financially viable, thereby reducing their capacity to meet future housing needs. Furthermore, the rent calculation method ignored the cost of land and infrastructure. The value of the rent point, initially indexed in euros, ceased to be adjusted when Slovenia adopted the euro as its official currency. As a result, the rent level became non-cost-recoverable (Cirman, 2017, pp. 104–105).

Following the Great Recession, unemployment began to rise, putting increased pressure on the social housing sector. But, as social housing was already under strain due to its poor condition and limited capacity, it was unable to meet growing demand. In response, the government amended the Housing Act to introduce subsidies for individuals renting in the private sector, as well as support for covering utility bills through public funds in cases of inability or unwillingness to pay (Cirman, 2017, pp. 105–107).

Due to the housing fund's lack of resilience, the Resolution of the National Housing Programme 2015–2025 was adopted. The Resolution aimed to reverse the negative trend in the shrinking housing stock and to establish a sustainable and efficient housing system. But it was not legally binding, and ultimately, it failed to bring about any significant legal changes. As a result, key issues, particularly the failure to achieve cost recovery in the social housing sector, remain unresolved (Cirman, 2007, pp. 117–110).

According to Ziemann (2024), the Slovenian social rental market is underdeveloped compared to its EU neighbours. Ziemann also stated that "a revised social rent formula, coupled with incentives for potential providers, including limited-profit housing associations, could pave the way for increased investment in social housing, providing affordable options for low-income families and individuals". This highlights the ongoing issue of non-cost-recovery in the current system, which continues to deter investment and expansion in the sector.

The Slovenian government has proposed amendments to the Housing Act to increase non-profit rent levels and allow more borrowing by public housing funds. It also plans to create a public rental service to acquire and renovate empty private flats for affordable use, build 5,000 new units, and renovate 2,000 vacant ones (Government of the Republic of Slovenia, 2023). However, as of May 2025, these amendments have not yet been formally adopted and remain under consideration.

9 DATA ANALYSIS

This chapter examines the factors influencing housing prices using panel data analysis from six European countries over 17 years. The goal of the structural analysis is to determine how various macroeconomic determinants, such as interest rates, building permits, producer prices in construction, purchasing power parity, and the proportion of the population aged 65 and above, influence housing prices. Housing represents a significant component of

household wealth in Slovenia and plays a key role in maintaining the stability of the banking sector. In recent years, housing prices have seen unprecedented growth, increasing the need for such studies in Slovenia. Younger generations entering the job market and seeking independence from their parents face increasing difficulty in finding affordable housing. The issue has also gained considerable media attention. This thesis aims to enhance the assessment of the housing market situation by deepening the understanding of key macroeconomic determinants and to support policymakers in designing more effective housing strategies. The analysis is conducted using two models: the first examines the general effect of macroeconomic variables on housing prices, while the second includes interaction terms to assess whether Slovenia differs significantly from the other countries. To efficiently conduct the study, five hypotheses were developed for each model.

Model 1:

- H1.1: Average annual interest rates affect housing prices in the peer sample;
- H1.2: The number of building permits issued affects housing prices in the peer sample;
- H1.3: Producer prices in construction influence housing prices in the peer sample;
- H1.4: Purchasing power parity affects housing prices in the peer sample;
- H1.5: The share of the population aged 65 and above affects housing prices in the peer sample.

Model 2:

- H2.1: The effect of average annual interest rates on housing prices in Slovenia;
- H2.2: The effect of building permits on housing prices in Slovenia;
- H2.3: The effect of producer prices in construction on housing prices in Slovenia;
- H2.4: The effect of purchasing power parity on housing prices in Slovenia;
- H2.5: The effect of the population aged 65 and above on housing prices in Slovenia.

Panel data analysis of other similar studies implied that panel data analysis is performed using several alternative approaches. One approach is to pool the data and apply a panel data estimation technique that allows for group-specific intercepts (e.g., fixed-effect panel data estimator). The primary issue with this approach is that it assumes all countries respond uniformly to changes in the explanatory variables. However, if countries actually react differently, this assumption can lead to inaccurate or unreliable results (Stepanyan et al., 2010).

We used a linear mixed-effects model to account for the panel data structure (countries observed repeatedly over 15 years). As Hall (2022) explains, mixed models include both fixed and random effects. Fixed effects represent the independent variables that are assumed to have a systematic influence on the dependent variable, about which conclusions will be drawn. In this study, the fixed effects include factors such as interest rates, building permits, construction producer prices, purchasing power parity, and the proportion of the population

aged 65 years or older. Random effects, in contrast, are grouping variables added to control for differences that are not directly observed.. In this study, country and year were specified as random effects, since they are categorical variables that were included to be controlled for rather than to draw conclusions about.

The model includes fixed effects for key explanatory variables, such as the average annual interest rate, building permits, producer prices in construction, purchasing power parity (PPP), and the share of the population aged 65 and above, all measured using 2015 as the base year (except for the average annual interest rate). Additionally, to assess whether Slovenia exhibits unique housing market dynamics, interaction terms with a Slovenia dummy variable were included. These interactions allow the model to test whether the relationship between the predictors and housing prices in Slovenia differs significantly from that in the other countries in the sample. Similar studies on housing have used panel data analysis to assess the impact of macroeconomic factors on housing prices. For example, Tripathi (2019) employed a random-effects model to examine how these factors influence housing prices.

Table 1: Overview of similar studies made on housing prices

Study	Type	Data	Description
Adams and Füss (2010)	Panel coint.analysis	15 countries; 30 years	The paper examines the long-term impact and short-term dynamics of macroeconomic variables on international housing prices. Pooling the observations allows it to overcome the data restrictions that researchers face when testing long-term relationships among single real estate time series. The empirical results indicate that house prices are expected to increase by 0.6% in the long run in response to a 1% increase in economic activity. In comparison, construction costs and the long-term interest rate exhibit average long-term effects of approximately 0.6% and 0.3%, respectively.
Stepanyan and others (2010)	Pooled mean group estimator	12 countries (the start varies – mostly around 2000; ends in Q3 2009)	The study employs the pooled mean group estimator to analyse the determinants of house prices in the countries of the Commonwealth of Independent States. The study used real GDP as the primary factor driving house prices.

Table continues

Table 1: Overview of similar studies made on housing prices (Continued)

Tripathi (2019)	The random-effect models' analysis	43 countries; 1970–2017	The random-effects model analysis of the study suggests that rent, price-to-income ratio, price-to-rent ratio, urbanisation, per-capita GDP, inflation, the share of the population aged 15–64, GDP growth rate, broad money, and real exchange rate have a positive and statistically significant effect on real house prices. In contrast, the percentage share of employment in services has a negative impact on real house prices.
Tsatsaronis and Zhu (2004)	Vector autoregression	17 countries; 1970–2003	The study employs a vector autoregression (VAR) model, which enables capturing the salient aspects of the dynamic interaction between inflation-adjusted housing prices and the selected mortgage variables, based on a minimal number of assumptions about the overall economic structure. The model includes five endogenous variables besides house price growth: i) the growth rate of GDP, which provides a measure of the state of the business cycle and household income; ii) the rate of inflation in consumer prices, which is the only nominal variable in the system; iii) the real short-term interest rate, which is closely linked with the monetary policy stance; iv) the term spread, defined as the difference in yield between a long-maturity government bond and the short rate; and v) the growth rate in inflation adjusted bank credit.
Oikarinen and Engblom (2014)	Fixed-effects panel models	Finland's regions; 1988–2012	The study concentrates on examining the momentum dynamics and the reversion speed towards the fundamental price level. The analysis can be viewed as a test of the validity of conventionally used fixed-effects panel models in analysing regional housing price dynamics. Based on data from 1988 to 2012, the findings indicate that the regional differences are generally relatively small in the Finnish market. The study finds a notable difference between Helsinki, the largest city in Finland, and the other cities regarding the strength of the momentum effect. The results also provide evidence of cointegration between regional housing prices and income.

Source: Own work.

The analysis is based on a sample of 102 observations spanning six countries over 17 years. The peer group includes Slovenia, Hungary, Czechia, Bulgaria, Lithuania, and Estonia. This selection is based on the study by Égert and Mihaljek (2007), which compared housing price

dynamics in OECD countries with those in eight transition economies in the CEE region, specifically Czechia, Hungary, Poland, Slovenia, Bulgaria, Croatia, Estonia, and Lithuania. Due to missing data on interest rates, Poland and Croatia were later excluded from the analysis. All selected countries are considered transition economies that have successfully integrated into the European Union. Slovenia, Hungary, Czechia, Lithuania, and Estonia joined the EU in 2004, followed by Bulgaria in 2007. The time period from 2007 to 2023 was used because data availability was sufficient across all selected countries, and this period captures key developments in housing markets following the EU accession. It includes the aftermath of the global financial crisis, the recovery phase, and more recent economic shocks. This model allows for random intercepts by country and year, capturing unobserved differences between countries and accounting for time-specific effects that may influence housing prices.

The variables included in the analysis were selected based on their relevance to housing market dynamics, drawing on previous studies and expert judgment. The chosen variables represent both demand-side and supply-side factors, offering a comprehensive view of the key drivers influencing housing prices (Table 2). All variables are expressed as indices with the base year set to 2015, except for the interest rate, which is measured as the annual average of monthly interest rates. This method was chosen because the available databases do not directly provide annual averages; therefore, the calculated values serve as proxies for these averages. A detailed overview of the dataset is provided in the Appendix.

Table 2: Overview of variables used in the model

Variable	Type	Reasons to include	Source
House price	Index (2015 = 100)	Dependent variable	Eurostat
Interest rate	Annual average of monthly interest rates (0% = 100)	Affects mortgage affordability and demand for housing	Eurostat, GlobalEconomy
Building permits	Index (2015 = 100)	Proxy for housing supply and construction activity	Eurostat

Table continues

Table 2: Overview of variables used in model (Continued)

Construction prices	Index (2015 = 100)	Influences the cost of building new homes and affects housing supply	Eurostat

Purchasing power parity (PPP)	Index (2015 = 100)	Measures relative affordability, the standard of living across countries, and demand	Eurostat
Share of population older than 65	Index (2015 = 100)	Captures demographic shifts affecting housing demand (i.e., ageing population)	Eurostat

Source: Own work.

The dataset used for the model includes six independent variables, each with a sample size of 102 (see Table 3).

Table 3: Data description

Variable	N	Mean	SD	Min	Max
House Price Index (2015 = 100)	102	123.81	40.01	60.47	272.54
Average Annual Interest Rate Index (0% = 100)	102	104.54	2.54	101.78	111.55
Building Permits Index (2015 = 100)	102	107.69	31.08	50.80	278.80
Producer Prices in Construction (2015 = 100)	102	109.92	27.03	79.22	229.56
PPP (2015 = 100)	102	104.66	21.04	71.84	171.84
Share of Population Aged 65+ (2015 = 100)	102	100.37	9.14	81.00	119.69

Source: Own work.

A linear mixed-effects regression model was applied to analyse the determinants of house prices in peer CEE countries. Model 1 is specified as follows:

$$HP_{it} = b_0 + b_1 IR_{it} + b_2 BP_{it} + b_3 CP_{it} + b_4 PPP_{it} + b_5 AGE65_{it} \quad (1)$$

In this equation (1), HP_{it} represents the house price index (2015 = 100) for country *i* in year *t*, serving as the dependent variable. Each component refers to a selected index: IR_{it}, average interest rate index; BP_{it}, building permits index; CP_{it}, producer prices in construction; PPP_{it}, purchasing power parity index; $AGE65_{it}$, the share of those aged 65 and above.

Model 2 is specified as follows:

$$HP_{it} = b_0 + b_1 IR_{it} + b_2 BP_{it} + b_3 CP_{it} + b_4 PPP_{it} + b_5 AGE65_{it} + b_6(IR_{it} D\_SLO) + b_7(BP_{it} D\_SLO) + b_8(CP_{it} D\_SLO) + b_9(PPP_{it} D\_SLO) + b_{10}(AGE65_{it} D\_SLO) \quad (2)$$

To examine whether the relationship between independent variables differs in Slovenia compared to other peer countries, the baseline model was extended by including interaction terms with a Slovenia dummy variable (D_SLO) in equation (2).

9.1 Results

The estimated relationships between real house prices and their macroeconomic determinants are presented in Table 4. The results indicate that several variables have statistically significant effects on housing prices. Specifically, the average annual interest rate (IR_{it}), building permits (BP_{it}), producer prices in construction (CP_{it}), and the share of the population aged 65 and above ($AGE65_{it}$) all exhibit significant positive associations with the house prices index. In contrast, purchasing power parity (PPP_{it}) does not appear to have a substantial effect, as indicated by its high p-value. To assess whether the model assumptions are satisfied, diagnostics were conducted, including the Variance Inflation Factor (VIF), a Q–Q plot, and the Residuals and Fitted plot. The VIF measures the strength of correlation between each variable and the other predictors in the model. VIF values below five generally indicate that multicollinearity is not a serious concern, which is the case here (see Table 4). While the VIF for PPP approaches the threshold of 5, it remains within acceptable limits.

Table 4: VIF results

Variable	VIF
IR_{it}	1.318
BP_{it}	1.112
CP_{it}	2.479
PPP_{it}	4.739
$AGE65_{it}$	3.062

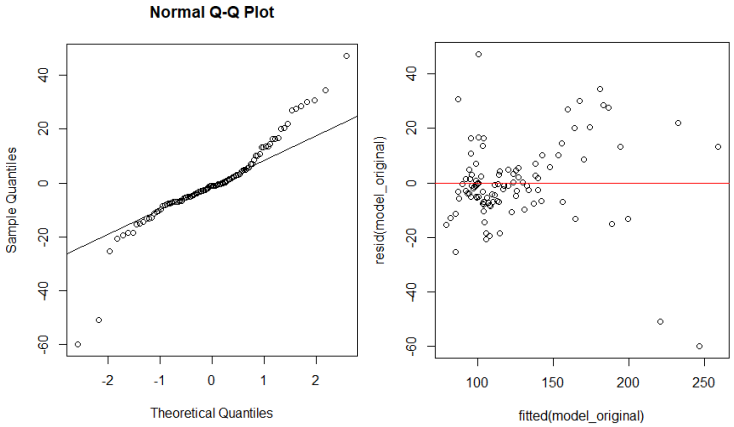
Source: Own work.

Next, we assessed whether the residuals in the model are normally distributed – the Q-Q plot compares the quantiles of the residuals against the theoretical quantiles of a normal distribution (Figure 20). If the residuals are normally distributed, the points will lie roughly along the 45-degree line of reference. Based on the analysis, there is some deviation at the

tails (both lower and upper), especially in the lower-left corner. This suggests that the normality assumption is broadly satisfied, though mild outliers may be present.

The Residuals and Fitted plot shows whether residuals are spread evenly across fitted values. Ideally, residuals are randomly scattered around zero with no clear pattern. There is no apparent systematic curve, which suggests that linearity is somewhat acceptable. The plot used for purposes of this analysis shows a slight increase in the spread of residuals at higher fitted values, which may indicate mild heteroscedasticity and the presence of a few outliers. However, the overall pattern remains sufficiently random, and the assumption of linearity appears reasonably met.

Figure 20: Diagnostic charts for regression model assumptions



Source: Own work.

Table 5 presents the results of the linear mixed-effects regression model, which includes interaction terms to examine whether Slovenia exhibits distinct housing market behaviour compared to other countries. Among the main effects, the average annual interest rate, building permits, and producer prices in construction are all statistically significant and positively associated with housing prices. Conversely, purchasing power parity shows a significant negative relationship. The share of the population aged 65 and above does not have a statistically significant effect on its own.

The interaction terms reveal how Slovenia differs from other countries. Interest rates have a significantly more substantial positive effect on housing prices in Slovenia, while the impact of building permits is weaker. No significant differences are observed for construction prices or PPP. However, the share of the elderly population shows a substantial adverse effect on housing prices in Slovenia.

Table 5: Summary of statistical analysis

Model 1					
Variable	Est	p-value	Variable	Est	p-value
(Intercept)	-391.376	0.011	*(Intercept)*	-129.294	0.286

IR_{it}	2.505	0.038	IR_{it}	2.680	0.010
BP_{it}	0.1599	0.028	BP_{it}	0.228	0.025
CP_{it}	0.923	< 0.001	CP_{it}	0.779	< 0.001
PPP_{it}	-0.094	0.713	PPP_{it}	-1.668	< 0.001
$AGE65_{it}$	1.440	0.003	$AGE65_{it}$	0.364	0.410
			$IR_{it}D\_SLO$	2.880	< 0.001
			$BP_{it}D\_SLO$	-0.282	0.016
			$CP_{it}D\_SLO$	-0.374	0.790
			$PPP_{it}D\_SLO$	1.648	0.348
			$AGE65_{it}$ D_SLO	-3.816	< 0.001

Source: Own work.

The finding that interest rates are statistically significant does not align with the results of Égert and Mihaljek (2007), who observed a significant negative relationship between real interest rates and house prices in CEE countries. The Model 1 coefficient on the interest rate index is approximately 2.50. This implies that if the (unweighted) average monthly interest rate index increases by one index point (base rate = 0%, indexed to 100), the house price index (base year = 2015, indexed to 100) increases by about 2.50 index points. The findings support the hypothesis that interest rates have a direct and substantial effect on house price dynamics in selected countries. According to Model 2, which includes interaction terms between the independent variables and the Slovenia dummy, the interaction term for the interest rate is positive and statistically significant, with a coefficient of 2.88. The combined (total) effect of interest rates on housing prices in Slovenia is positive and statistically significant (see Appendix 6).

Although Melecky and Paksi (2024) recommend interpreting building permits with caution, as their model may reflect the effects of other variables, they were still included in the analysis, as they importantly reflect supply-side dynamics. According to Model 1, the coefficient on building permits is 0.16. This implies that if the building permits index (base year = 2015, indexed to 100) increases by one index point, the house price index increases by about 0.16 index points. Model 2 indicates that the coefficient on the interaction is negative and statistically significant at -0.28. The total effect of building permits on housing prices in Slovenia is not statistically significant (see Appendix 6). As building permits contribute to an increase in the total housing stock, and since Belke and Keil (2018) identified housing stock as a significant supply-side determinant of housing prices, the

findings that building permits increase housing prices may appear inconsistent with prior research. The time lag could explain this discrepancy, as permits represent future additions to the stock rather than the current supply. Consequently, their effect on housing prices may only materialise later due to construction lags (Mourouzi-Sivitanidou, 2020). DiPasquale and Wheaton (1992) demonstrated that rising housing prices can serve as an incentive for increased construction activity, which could also help explain this outcome.

Construction prices, in line with findings by Adams and Füss (2010), Parrott and Zandi (2021), and Melecky and Paksi (2024), play an essential role in influencing housing supply and, consequently, housing prices. This is consistent with Model 1 (which does not include interactions with the Slovenia dummy), where the coefficient on construction prices is 0.92. This implies that if the construction price index (base year = 2015, indexed to 100) increases by one index point, the house price index (also base year = 2015, indexed to 100) increases by about 0.92 index points. The result of Model 2 indicates that the main effect remains positive and statistically significant at 0.78. However, the interaction term for Slovenia is not statistically significant. The total effect of construction costs on housing prices in Slovenia is not significant (see Appendix 6).

Following Fraser and others (2009), who show that rising disposable income increases housing demand, the inclusion of a purchasing power parity index in the model is justified. In the first model, PPP was not statistically significant. In the second model (with interactions), the main effect becomes essential, but the Slovenian interaction term remains insignificant. The combined effect of purchasing power parity in Slovenia is effectively zero and statistically insignificant.

Gong and Yao (2022) argue that rising life expectancy leads to higher homeownership rates among senior households, thereby increasing housing demand. In Model 1, the coefficient on the share of the population aged 65 and above is 1.44. This suggests that if the index of the population over 65 years old (base year = 2015, indexed to 100) increases by one index point, the house price index increases by about 1.44 index points. The total effect of the elderly population share on housing prices in Slovenia is strongly significant and negative (see Appendix 6).

To formally test these relationships, the hypotheses and their statistical support are summarised below. Where p-values indicate significance ($p < 0.05$), the null hypothesis is rejected; otherwise, it cannot be rejected.

Model 1:

- H1.1: Average annual interest rates affect housing prices in peer countries → statistically significant; the null hypothesis is rejected, and H1.1 is supported.
- H1.2: The number of building permits issued affects housing prices in peer countries → statistically significant; the null hypothesis is rejected, and H1.2 is supported.

- H1.3: Producer prices in construction influence housing prices in peer countries → statistically significant; the null hypothesis is rejected, and H1.3 is supported.
- H1.4: Purchasing power parity has an effect on housing prices in peer countries → not statistically significant; the null hypothesis cannot be rejected, and H1.4 is not supported.
- H1.5: The share of the population aged 65 and above affects housing prices in peer countries → statistically significant; the null hypothesis is rejected, and H1.5 is supported.

Model 2:

- H2.1: The effect of average annual interest rates on housing prices in Slovenia is significant → statistically significant; the null hypothesis is rejected, and H2.1 is supported.
- H2.2: The effect of building permits on housing prices in Slovenia is significant→ not statistically significant; the null hypothesis cannot be rejected, and H2.2 is not supported.
- H2.3: The effect of producer prices in construction on housing prices in Slovenia is significant → not statistically significant; the null hypothesis cannot be rejected, and H2.3 is not supported.
- H2.4: The effect of purchasing power parity on housing prices in Slovenia is significant → not statistically significant; the null hypothesis cannot be rejected, and H2.4 is not supported.
- H2.5: The effect of the population aged 65+ on housing prices in Slovenia is significant → statistically significant; the null hypothesis is rejected, and H2.5 is supported.

10 CONCLUSION

The housing market plays a crucial role in macroeconomics, as it affects individual wealth, financial stability, and labour mobility. Its unique structural features, such as high transaction costs, rapid differentiation due to each property's distinct characteristics, supply inefficiencies, and localised demand, make it fundamentally different from other markets, including financial markets. The housing market is generally less efficient, with prices exhibiting some predictability through momentum or mean reversion; however, frictions, such as high transaction costs, make these inefficiencies difficult to exploit.

Moreover, the housing market is closely linked to the broader economy; the D-W model illustrates how demand and supply are integrated with asset market behaviour. It demonstrates how rents, housing values, construction, and the housing stock interact with one another over time, supporting the validity of the approach in testing the impact of the macroeconomic environment on housing prices.

Real estate demand reflects the quantity of housing units buyers seek at different price levels and is influenced by price sensitivity. While price plays a key role, demand is also influenced by various exogenous factors, including economic growth, demographics, disposable income, unemployment, interest rates, financial regulation, and taxation. On the other hand, prices can rise in a high-demand environment if the supply side fails to respond effectively. Construction costs, regulatory constraints, and the availability of land influence housing supply. Moreover, rental markets also impact housing prices; strong rental demand can drive up home values, while excessive regulation may distort demand and limit new construction.

The analysis was based on two models. Model 1 assessed the impact of macroeconomic and demographic variables on housing prices across a group of countries comparable to Slovenia, given their shared historical context. Model 2 included interaction terms to test whether these effects differ in Slovenia relative to the border group sample. The findings show that interest rates (positive), building permits (positive), construction prices (positive), and the population aged 65 and above (positive) statistically significantly affect housing prices overall, while in Slovenia, interest rates (positive), building permits (negative), and demographic factors (negative) exhibit distinct, statistically significant effects compared to peer countries.

For Slovenia, the results indicate that only the average annual interest rate and the share of the population aged 65 and above have a statistically significant effect on housing prices. The positive relationship between nominal interest rates and housing prices is somewhat unexpected and not fully consistent with the findings in most existing literature. This outcome may, however, be partly explained by the inflationary component embedded in nominal interest rates, which can obscure the true relationship between real borrowing costs and housing demand. The negative and statistically significant effect of the elderly population share suggests a potential supply-side influence: as the population ages, property inheritance and downsizing may increase the availability of housing stock, exerting downward pressure on prices. For the remaining variables—building permits, producer prices in construction, and purchasing power parity—the effects in Slovenia are not statistically significant, and no firm conclusions can therefore be drawn regarding their role in the Slovenian housing market. The main limitations of this analysis lie in the specification of variables and data availability. Future research could test real (inflation-adjusted) interest rates instead of nominal ones, expand the country and year sample if comparable data become available, and include robustness checks, such as a dynamic OLS model and other independent variables (e.g., immigration), to verify the stability of results.

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APPENDICES

Appendix 1: Dataset

Country	Year	House price index (2015 = 100)	Average annual interest rate	Building permits (2015 = 100)	Producer prices in construction (2015 = 100)	PPP (2015 = 100)	Share of population aged 65+ (2015 = 100)
Estonia	2007	106,54	5,6%	144,2	94,5	80,3	92,1
Estonia	2008	96,29	5,8%	110,8	97,8	81,8	93,1
Estonia	2009	60,47	3,9%	60,5	89,7	73,0	92,9
Estonia	2010	63,9	3,5%	50,8	87,3	75,9	92,9
Estonia	2011	69,32	3,4%	60,4	90,2	81,0	93,0
Estonia	2012	74,37	2,9%	72,3	94,3	86,9	94,4
Estonia	2013	82,29	2,6%	67,7	98,9	91,2	96,1
Estonia	2014	93,58	2,5%	75,2	99,2	94,9	98,0
Estonia	2015	100	2,3%	100,0	100,0	100,0	100,0
Estonia	2016	104,75	2,3%	100,3	99,5	103,6	101,4
Estonia	2017	110,51	2,4%	121,1	100,8	107,3	103,1
Estonia	2018	117,07	2,5%	100,7	102,6	113,1	104,4
Estonia	2019	125,27	2,6%	102,0	104,6	117,5	105,4
Estonia	2020	132,79	2,5%	122,8	105,0	116,1	106,8
Estonia	2021	152,78	2,2%	122,9	114,8	122,6	108,5
Estonia	2022	186,76	2,7%	96,0	135,7	134,3	108,9
Estonia	2023	197,72	5,5%	91,3	142,8	137,2	107,9
Lithuania	2007	119,06	5,4%	146,4	95,1	74,7	89,2
Lithuania	2008	129,76	5,8%	126,3	104,2	81,2	91,0
Lithuania	2009	90,92	4,2%	92,0	89,0	72,7	92,2
Lithuania	2010	84,2	3,7%	80,2	84,7	74,0	92,9
Lithuania	2011	89,77	3,7%	63,8	88,0	81,2	95,7
Lithuania	2012	89,56	3,0%	79,9	90,6	86,4	96,9
Lithuania	2013	90,65	2,4%	98,0	94,8	90,9	97,6
Lithuania	2014	96,47	2,1%	87,2	97,8	95,5	98,5
Lithuania	2015	100	1,9%	100,0	100,0	100,0	100,0
Lithuania	2016	105,4	2,0%	105,8	102,1	103,9	101,4
Lithuania	2017	114,8	2,0%	101,9	106,4	110,4	103,0
Lithuania	2018	123,18	2,2%	106,2	110,1	114,9	104,5
Lithuania	2019	131,61	2,4%	91,1	115,5	121,4	105,2
Lithuania	2020	141,18	2,3%	98,0	117,8	118,2	106,1
Lithuania	2021	163,84	2,2%	118,4	125,6	129,9	106,7
Lithuania	2022	195,05	2,8%	105,0	148,2	139,6	107,0
Lithuania	2023	214,2	5,4%	96,3	158,9	144,2	107,2
Slovenia	2007	120,85	6,1%	278,8	89,5	92,3	88,8
Slovenia	2008	129,31	6,7%	216,4	95,4	97,9	90,8
Slovenia	2009	117,06	4,1%	173,1	92,5	95,1	91,8
Slovenia	2010	117,21	3,3%	164,7	97,7	97,9	92,3
Slovenia	2011	120,39	3,8%	139,7	102,2	101,4	92,3
Slovenia	2012	112,09	3,3%	103,2	101,0	101,4	93,7
Slovenia	2013	106,21	3,2%	108,9	99,9	98,6	95,5
Slovenia	2014	99,20	3,2%	81,5	99,4	98,6	97,6
Slovenia	2015	100,00	2,7%	100,0	100,0	100,0	100,0
Slovenia	2016	103,25	2,3%	138,8	98,9	102,8	102,8
Slovenia	2017	111,79	2,4%	151,0	103,5	107,7	105,5
Slovenia	2018	121,55	2,4%	150,4	106,3	112,0	108,4
Slovenia	2019	129,69	2,3%	133,5	109,6	119,0	110,9
Slovenia	2020	135,66	2,1%	131,3	111,0	114,1	113,0
Slovenia	2021	151,32	1,8%	161,1	122,8	128,2	115,4
Slovenia	2022	173,65	2,4%	181,2	140,5	143,7	117,9
Slovenia	2023	186,22	4,0%	168,6	150,8	150,7	119,7

Table continues

Appendix 1: Dataset (continued)

Bulgaria	2007	118,42	8,7%	86,1	80,9	72,8	86,1
Bulgaria	2008	147,97	9,1%	86,9	90,9	76,7	86,9
Bulgaria	2009	117,79	9,6%	87,8	97,8	71,8	87,8
Bulgaria	2010	105,81	9,3%	88,7	96,4	76,7	88,7
Bulgaria	2011	99,98	9,3%	90,1	97,1	83,5	90,1
Bulgaria	2012	98,07	9,1%	92,0	96,6	89,3	92,0
Bulgaria	2013	95,92	8,4%	94,8	98,0	88,3	94,8
Bulgaria	2014	97,29	7,8%	97,4	98,7	95,1	97,4
Bulgaria	2015	100,	6,9%	100,0	100,0	100,0	100,0
Bulgaria	2016	107,02	5,8%	102,9	100,8	103,9	102,9
Bulgaria	2017	116,3	4,9%	105,3	103,6	108,7	105,3
Bulgaria	2018	123,96	4,2%	107,3	106,7	115,5	107,3
Bulgaria	2019	131,42	3,7%	109,6	112,6	123,3	109,6
Bulgaria	2020	137,41	3,3%	111,8	115,2	121,4	111,8
Bulgaria	2021	149,33	3,1%	112,6	128,3	139,8	112,6
Bulgaria	2022	169,92	2,9%	114,4	196,5	159,2	114,4
Bulgaria	2023	186,67	2,8%	114,8	228,3	171,8	114,8
Czechia	2007	89,32	4,9%	81,0	96,3	79,6	81,0
Czechia	2008	100,8	5,1%	82,0	100,5	83,6	82,0
Czechia	2009	96,9	5,2%	83,7	101,3	84,9	83,7
Czechia	2010	95,2	5,3%	85,7	100,6	88,2	85,7
Czechia	2011	95,3	5,1%	87,5	100,1	89,5	87,5
Czechia	2012	93,9	4,8%	90,8	99,6	90,1	90,8
Czechia	2013	93,9	4,3%	94,2	98,5	94,1	94,2
Czechia	2014	96,2	3,9%	97,3	98,9	97,4	97,3
Czechia	2015	100,	3,5%	100,0	100,0	100,0	100,0
Czechia	2016	107,2	3,1%	102,6	101,0	103,9	102,6
Czechia	2017	119,7	2,7%	105,4	102,8	111,8	105,4
Czechia	2018	130,	2,5%	107,8	106,6	116,4	107,8
Czechia	2019	141,9	2,5%	109,8	111,5	121,7	109,8
Czechia	2020	153,9	2,5%	111,7	115,3	117,8	111,7
Czechia	2021	184,2	2,4%	114,9	122,0	122,4	114,9
Czechia	2022	215,3	2,6%	115,6	138,0	127,6	115,6
Czechia	2023	211,7	3,0%	114,3	145,3	133,6	114,3
Hungary	2007	98,91	10,0%	89,4	79,2	85,7	89,4
Hungary	2008	101,26	10,9%	90,6	84,1	88,2	90,6
Hungary	2009	95,95	11,6%	91,6	87,3	86,6	91,6
Hungary	2010	93,66	10,9%	93,1	88,7	89,9	93,1
Hungary	2011	90,45	10,5%	93,8	90,9	94,1	93,8
Hungary	2012	87,1	10,5%	94,6	93,0	95,0	94,6
Hungary	2013	84,87	9,8%	96,1	94,7	95,8	96,1
Hungary	2014	88,43	8,5%	98,1	97,0	96,6	98,1
Hungary	2015	100,	6,2%	100,0	100,0	100,0	100,0
Hungary	2016	113,38	5,3%	102,0	103,4	101,7	102,0
Hungary	2017	127,24	4,6%	104,1	110,6	105,9	104,1
Hungary	2018	145,5	4,4%	105,6	121,9	110,9	105,6
Hungary	2019	170,17	4,5%	107,8	133,6	116,8	107,8
Hungary	2020	178,58	4,5%	110,8	143,1	116,8	110,8
Hungary	2021	208,04	4,4%	113,2	160,6	125,2	113,2
Hungary	2022	254,52	4,7%	114,5	199,3	140,3	114,5
Hungary	2023	272,54	5,2%	115,1	229,6	147,9	115,1

Source: Own work.

Appendix 2: Summary of Model 1 results

Variable	Est	SE	df	t	p-value
(Intercept)	-391.376	127.063	10.246	-3.080	0.011
IR	2.505	1.039	9.357	2.410	0.038
BP	0.1599	0.070	38.239	2.288	0.028
CP	0.923	0.132	93.414	6.973	< 0.001
PPP	-0.094	0.256	86.479	-0.368	0.713
AGE65	1.440	0.473	94.791	3.047	0.003

Source: Own work.

Appendix 2: Summary of Model 2 results

Variable	Est	SE	df	t	p-value
(Intercept)	-129.294	116.968	15.452	-1.105	0.286
IR	2.680	0.908	14.263	2.952	0.0103
BP	0.228	0.099	70.999	2.293	0.0248
CP_{it}	0.779	0.103	55.634	7.576	< 0.001
PPP_{it}	-1.668	0.213	78.038	-7.844	< 0.001
$AGE65_{it}$	0.364	0.438	77.896	0.829	0.410
$IR_{it}D\_SLO$	2.880	0.507	69.695	5.683	< 0.001
$BP_{it}D\_SLO$	-0.282	0.114	68.285	-2.472	0.016
$CP_{it}D\_SLO$	-0.374	1.398	66.698	-0.267	0.790
$PPP_{it}D\_SLO$	1.648	1.745	66.775	0.945	0.348
$AGE65_{it}D\_SLO$	-3.816	0.940	68.755	-4.059	< 0.001

Source: Own work.

Appendix 3: Model 1 results generated in R

```
> summary(lmer_model)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: fmla
   Data: data

REML criterion at convergence: 875.8

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.6849 -0.4241 -0.0676  0.3338  2.9073

Random effects:
 Groups   Name        Variance Std.Dev.
 Year     (Intercept)  69.77    8.353
 Country  (Intercept)  26.47    5.145
 Residual             264.44   16.262
Number of obs: 102, groups:  Year, 17; Country, 6

Fixed effects:
                                          Estimate Std. Error         df t value Pr(>|t|)
(Intercept)                             -391.37609  127.06259   10.24596  -3.080   0.0113 *
`Average annual interest rate index`       2.50458    1.03942    9.35653   2.410   0.0383 *
`Building permits (2015 = 100)`            0.15988    0.06989   38.23903   2.288   0.0278 *
`Producer prices in construction (2015 = 100)`  0.92299    0.13236   93.41448   6.973 4.36e-10 ***
`PPP (2015 = 100)`                        -0.09416    0.25562   86.47906  -0.368   0.7135
`Share of population aged 65+ (2015 = 100)`  1.44003    0.47268   94.79088   3.047   0.0030 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Source: Own work.

Appendix 4: Model 2 results generated in R

```
> summary(model2)
Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
Formula: `House price index (2015 = 100)` ~ `Average annual interest rate index` +
    `Building permits (2015 = 100)` + `Producer prices in construction (2015 = 100)` +
    `PPP (2015 = 100)` + `Share of population aged 65+ (2015 = 100)` +
    slovenia_dummy + `Average annual interest rate index`:slovenia_dummy +
    `Building permits (2015 = 100)`:slovenia_dummy + `Producer prices in construction (2015 = 100)`:slovenia_dummy +
    `PPP (2015 = 100)`:slovenia_dummy + `Share of population aged 65+ (2015 = 100)`:slovenia_dummy +      (1 | Country) + (1 | Year)
   Data: data

REML criterion at convergence: 825.5

Scaled residuals:
     Min       1Q   Median       3Q      Max
-2.48590 -0.45106  0.01037  0.44500  3.05652

Random effects:
 Groups   Name        Variance Std.Dev.
 Year     (Intercept) 3005.62  54.824
 Country  (Intercept)   31.82   5.641
 Residual              87.96   9.379
Number of obs: 102, groups:  Year, 17; Country, 6

Fixed effects:
                                                    Estimate Std. Error         df t value Pr(>|t|)
(Intercept)                                      -170.53169  119.24418   15.45157  -1.430  0.17260
`Average annual interest rate index`                3.04845    0.92685   14.33275   3.289  0.00523 **
`Building permits (2015 = 100)`                     0.19980    0.09795   70.18432   2.040  0.04514 *
`Producer prices in construction (2015 = 100)`      0.79269    0.10143   53.92166   7.815 1.98e-10 ***
`PPP (2015 = 100)`                                 -1.71904    0.20839   76.59263  -8.249 3.49e-12 ***
`Share of population aged 65+ (2015 = 100)`         0.45451    0.43347   75.60067   1.049  0.29774
slovenia_dummy                                    946.38553  463.13078   67.84734   2.043  0.04489 *
`Average annual interest rate index`:slovenia_dummy  -5.56648    4.16901   67.52426  -1.335  0.18629
`Building permits (2015 = 100)`:slovenia_dummy      -0.14423    0.12977   68.80619  -1.111  0.27027
`Producer prices in construction (2015 = 100)`:slovenia_dummy  -0.08987    1.36955   66.34405  -0.066  0.94788
`PPP (2015 = 100)`:slovenia_dummy                    1.86207    1.70262   66.35901   1.094  0.27806
`Share of population aged 65+ (2015 = 100)`:slovenia_dummy  -5.24687    1.14597   69.17666  -4.579 2.01e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Source: Own work.

Appendix 5: Combined (total) effect of the variables for Slovenia

```
> linearHypothesis(
+     model2,
+     "Average.annual.interest.rate.index + Average.annual.interest.rate.index:slovenia_dummy = 0"
+ )

Linear hypothesis test:
Average.annual.interest.rate.index  + Average.annual.interest.rate.index:slovenia_dummy = 0

Model 1: restricted model
Model 2: House.price.index..2015...100. ~ Average.annual.interest.rate.index +
    Building.permits...2015...100. + Producer.prices.in.construction..2015...100. +
    PPP..2015...100. + Share.of.population.aged.65...2015...100. +
    Average.annual.interest.rate.index:slovenia_dummy + Building.permits...2015...100.:slovenia_dummy +
    Producer.prices.in.construction..2015...100.:slovenia_dummy +
    PPP..2015...100.:slovenia_dummy + Share.of.population.aged.65...2015...100.:slovenia_dummy +
    (1 | Country) + (1 | Year)

  Df  Chisq Pr(>Chisq)
1
2  1 24.698  6.705e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
> linearHypothesis(
+     model2,
+     "Building.permits...2015...100. + Building.permits...2015...100.:slovenia_dummy = 0"
+ )

Linear hypothesis test:
Building.permits...2015...100.  + Building.permits...2015...100.:slovenia_dummy = 0

Model 1: restricted model
Model 2: House.price.index..2015...100. ~ Average.annual.interest.rate.index +
    Building.permits...2015...100. + Producer.prices.in.construction..2015...100. +
    PPP..2015...100. + Share.of.population.aged.65...2015...100. +
    Average.annual.interest.rate.index:slovenia_dummy + Building.permits...2015...100.:slovenia_dummy +
    Producer.prices.in.construction..2015...100.:slovenia_dummy +
    PPP..2015...100.:slovenia_dummy + Share.of.population.aged.65...2015...100.:slovenia_dummy +
    (1 | Country) + (1 | Year)

  Df  Chisq Pr(>Chisq)
1
2  1 0.4088     0.5226
> linearHypothesis(
+     model2,
+     "Producer.prices.in.construction..2015...100. + Producer.prices.in.construction..2015...100.:slovenia_dummy = 0"
+ )

Linear hypothesis test:
Producer.prices.in.construction..2015...100.  + Producer.prices.in.construction..2015...100.:slovenia_dummy = 0

Model 1: restricted model
Model 2: House.price.index..2015...100. ~ Average.annual.interest.rate.index +
    Building.permits...2015...100. + Producer.prices.in.construction..2015...100. +
    PPP..2015...100. + Share.of.population.aged.65...2015...100. +
    Average.annual.interest.rate.index:slovenia_dummy + Building.permits...2015...100.:slovenia_dummy +
    Producer.prices.in.construction..2015...100.:slovenia_dummy +
    PPP..2015...100.:slovenia_dummy + Share.of.population.aged.65...2015...100.:slovenia_dummy +
    (1 | Country) + (1 | Year)

  Df  Chisq Pr(>Chisq)
1
2  1 0.0833     0.7728
```

```
> linearHypothesis(
+     model2,
+     "PPP..2015...100. + PPP..2015...100.:slovenia_dummy = 0"
+ )

Linear hypothesis test:
PPP..2015...100.  + PPP..2015...100.:slovenia_dummy = 0

Model 1: restricted model
Model 2: House.price.index..2015...100. ~ Average.annual.interest.rate.index +
    Building.permits...2015...100. + Producer.prices.in.construction..2015...100. +
    PPP..2015...100. + Share.of.population.aged.65...2015...100. +
    Average.annual.interest.rate.index:slovenia_dummy + Building.permits...2015...100.:slovenia_dummy +
    Producer.prices.in.construction..2015...100.:slovenia_dummy +
    PPP..2015...100.:slovenia_dummy + Share.of.population.aged.65...2015...100.:slovenia_dummy +
    (1 | Country) + (1 | Year)

  Df Chisq Pr(>Chisq)
1
2  1 1e-04      0.991
> linearHypothesis(
+     model2,
+     "Share.of.population.aged.65...2015...100. + Share.of.population.aged.65...2015...100.:slovenia_dummy = 0"
+ )

Linear hypothesis test:
Share.of.population.aged.65...2015...100.  + Share.of.population.aged.65...2015...100.:slovenia_dummy = 0

Model 1: restricted model
Model 2: House.price.index..2015...100. ~ Average.annual.interest.rate.index +
    Building.permits...2015...100. + Producer.prices.in.construction..2015...100. +
    PPP..2015...100. + Share.of.population.aged.65...2015...100. +
    Average.annual.interest.rate.index:slovenia_dummy + Building.permits...2015...100.:slovenia_dummy +
    Producer.prices.in.construction..2015...100.:slovenia_dummy +
    PPP..2015...100.:slovenia_dummy + Share.of.population.aged.65...2015...100.:slovenia_dummy +
    (1 | Country) + (1 | Year)

  Df  Chisq Pr(>Chisq)
1
2  1 12.015  0.0005279 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Source: Own work.