Louvain School of Management

Heterogeneous impact of macroeconomic and fiscal variables on real estate prices in Belgium ?

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Description of AI tool usage in the Master Thesis

We recognize that AI tools can be valuable aids during the master's thesis, yet they are not infallible. Transparency fosters trust and enhances the credibility of academic work.

Therefore, when deciding to use such tools, we adhered to the following principles of responsible AI use:

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    - We acknowledge the use of artificial intelligence tools here, emphasizing that they contributed to, but did not replace human judgment.
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Declaration

During the preparation of this master's thesis, the authors utilized Claude Opus 4.6 and 4.8 (Anthropic) and ChatGPT pro (OpenAI) for the following purposes:

1. To help rephrase and improve clarity of the text, to help with R code.
2. To challenge the arguments of the thesis, and to help identify and improve weaknesses within its structure.

After using the aforementioned tools, the authors diligently reviewed and edited the content they produced. We take full responsibility for the final content presented in this thesis.

By signing this declaration, the authors affirm that the thesis reflects their original work augmented by the responsible use of AI.

Signed in Jodoigne on June 19, 2026

Abstract

For most people, the home they live in is the largest financial asset they will ever own, and in Belgium this is especially true: more than seven in ten Belgians live in a home they own (71.9% in 2023; Eurostat, 2024). For the majority of Belgian households, property is not merely a place to live but the cornerstone of their savings and their principal investment vehicle, often representing the greater part of their net wealth. As a result, the price of residential real estate reaches far beyond the property market itself: it shapes household prosperity and inequality, determines whether the next generation can become owners, and bears directly on the stability of the banking system that finances home purchases. Understanding what drives housing prices in Belgium is, for these reasons, a question of first-order economic and social importance, and a central one for anyone investing in Belgian real estate.

This thesis examines how taxation, economic conditions and population dynamics shape residential real estate prices in Belgium between 2010 and 2025, distinguishing houses from apartments throughout. These effects, however, are far from uniform. It finds that the taxes levied when a property changes hands rank among the most powerful price determinants, weighing most heavily on the single-family segment, while short-run price movements are driven above all by construction and input costs and by financing conditions. Apartments behave as the more financially sensitive segment, reacting to interest rates and household purchasing power, whereas houses absorb the bulk of tax and construction-cost pass-through; regionally, Brussels is the most exposed to macroeconomic swings.

Taken together, the results show that the fiscal and macroeconomic drivers of Belgian housing prices operate unevenly: their strength depends on whether the dwelling is a house or an apartment and, on the region, concerned, so that no single, market-wide effect adequately describes how taxation and the economy shape prices. These findings carry direct implications for the design of housing taxation and for real estate investment decisions across Belgium's regions.

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1. Introduction

In Belgium, owning your home is the norm rather than the exception: in 2023, 71.9% of Belgians lived in a dwelling they owned, one of the highest ownership rates in the European Union (Eurostat, 2024). For most of these households the home is their principal store of wealth and the single largest financial commitment of a lifetime. This is precisely why residential real estate prices are far more than a sectoral statistic. When prices rise faster than incomes, home-ownership drifts out of reach for younger and lower-income buyers, and the gap in wealth between those who already own and those who rent widens accordingly. At the same time, because house purchases are overwhelmingly financed by mortgage credit, the level and volatility of prices are tightly bound up with household indebtedness and with the health of the mortgage-lending sector. Housing is also a central channel through which monetary and fiscal policy are transmitted to the real economy, so that price movements feed back into consumption, construction activity and the broader macro-financial equilibrium (Andrews, 2010; Zwart, 2015). Understanding what drives these prices is, for all these reasons, a question of first-order economic and social importance rather than a narrow concern for market participants.

The Belgian market is distinctive along several dimensions that make it a particularly informative case. It is one of the most heavily transaction-taxed housing markets in Europe: registration duties levied at the moment of purchase are high and differ markedly across the three regions, while recurrent property taxation still rests on cadastral values that have not been fully revalued for decades. Fiscal authority, moreover, is spread across the federal, regional and municipal levels, producing a fine-grained patchwork of tax environments that can change from one commune to the next. The market has also faced persistent demographic pressure (continued population growth, ongoing urbanisation and a steady decline in average household size) and a stream of recent regional reforms to registration-duty rates (National Bank of Belgium, 2022; OECD, 2020; Goeyvaerts & Vandenbergh, 2025). Taxation on one side, and macroeconomic conditions (financing, prices, and demographic pressures) on the other, are the two families of forces most consistently identified as driving Belgian house prices, and they map directly onto the fiscal and macroeconomic variables examined in this dissertation.

Against this background, this dissertation asks a single, deliberately technical question: how heterogeneous is the impact of macroeconomic and fiscal variables on residential real estate prices in Belgium? The aim is not merely to establish that these variables move prices, but to measure whether their impact is uniform or differs systematically across regions and between houses and apartments. Our empirical design is built to answer this in two ways. First, throughout the period 2010-2025 we estimate houses and apartments separately, since the two segments attract different buyers, predominantly owner-occupiers on one side and a larger share of investors on the other, and are therefore likely to respond differently to the same shock. Second, because the fiscal and the macroeconomic channels operate at different spatial scales and through different mechanisms, we do not force them into a single specification but build two complementary panel models whose effects are allowed to differ across regions. Model 1 isolates the fiscal channel, exploiting the wide fiscal variation across Belgian communes to measure how taxes are capitalized into price levels, chiefly regional registration duties, the municipal surcharge on personal income tax, and the combined property-tax burden. Model 2 captures the macroeconomic channel, understood broadly to include the demographic drivers of demand, relating quarterly price growth to the mortgage rate, consumer and producer prices, construction costs, population, income, household size and employment. Together, the two models deliver a static, cross-sectional reading of fiscal capitalization and a dynamic, time-series reading of macroeconomic adjustment.

This two-model design is also where the dissertation seeks to add value. Much of the existing Belgian evidence looks either at the fiscal dimension or at the macroeconomic dimension in isolation and often pools all dwellings together. By analyzing both channels within a single, consistent framework, and by systematically contrasting houses with apartments, we can ask not only whether taxation and macroeconomic conditions matter, but which of them dominates where, and for which type of dwelling. This joint, segment-by-segment perspective is, to our knowledge, rarely adopted in the Belgian context, and it is what allows the two sets of results to be read against each other rather than in parallel.

Three high-level findings emerge. On the fiscal side, the registration duty paid by owner-occupiers stands out as the most robust price determinant: its effect is negative, strongly significant, and markedly larger for houses than for apartments, while the municipal surcharge on personal income tax weighs on both segments alike. On the macroeconomic side, producer prices, a proxy for construction and input costs, are the dominant driver of short-run price growth, whereas higher mortgage rates push prices down and the ongoing fall in average household size sustains demand. The two segments, however, do not line up the same way: single-family houses carry most of the fiscal and construction-cost pass-through, while apartments react far more strongly to financing conditions and household purchasing power, and among the regions Brussels is the one whose prices move most with the short-run macroeconomy.

The remainder of the dissertation is organized as follows. Section 2 reviews the international and Belgian literature on housing-price determinants and sets out our research hypotheses. Section 3 presents the research strategy, the econometric approach and the data, including the institutional detail of the Belgian property-tax system. Section 4 reports the results of the two models in turn, Model 1 first and Model 2 second. Section 5 draws them together in a comparative interpretation, and Section 6 concludes with the main implications, the limitations of the analysis, and avenues for future research.

2. Literature Review

2.1 Housing-price determinants and the uneven nature of their effects

The determinants of housing prices have been widely studied, because real estate markets are central to household wealth, financial stability, and macroeconomic fluctuations. The literature generally explains house prices by a combination of macroeconomic conditions, demographic trends, financial factors, and institutional characteristics. A recurring theme, however, is that these drivers do not act uniformly: the same shock produces different price responses depending on the supply, institutional, and regional context. This unevenness is the central concern of the present dissertation.

On the macroeconomic and financial side, Andrews (2010) finds, across OECD countries, that house prices are primarily driven by demand fundamentals, especially income growth and borrowing conditions, since lower interest rates raise purchasing power and stimulate demand. Importantly, he shows that the size of this response depends on supply: where supply is less elastic, additional demand translates more into higher prices than into new construction. Hilbers et al. (2008) reach a similar conclusion for Europe, associating housing booms with strong growth, falling interest rates, and rapid credit expansion, while stressing that the intensity and persistence of price movements vary across countries according to supply elasticity and the structure of mortgage markets. Goodhart and Hofmann (2008) add that house prices, credit, and money are jointly determined, with credit shocks feeding house prices and vice versa, which underlines the central role of financing conditions among the determinants of housing prices.

Demographic developments are also widely identified as demand drivers. The OECD (2020) stresses that shrinking household size and continuing urbanization raise housing demand even where overall population growth is moderate, because smaller households require more dwellings per capita, with particular pressure in supply-constrained urban areas.

The literature further emphasizes institutional and fiscal frameworks. Zwart (2015) shows that housing-related taxes and fiscal advantages can be capitalized into property values, so that part of a fiscal benefit is reflected in higher prices rather than in lower costs for buyers. In the same vein, the OECD (2020) notes that transaction and recurrent property taxes influence mobility, investment behavior, and price formation.

The heterogeneity most directly relevant to this dissertation is the one between dwelling types, namely houses and apartments, which need not respond to the same shocks in the same way. The literature points to a reason for this: the two segments are not bought by the same mix of buyers. Apartments and smaller units attract a comparatively larger share of investors, for whom a dwelling is above all a financial asset, whereas single-family houses are bought mainly by owner-occupiers, for whom it is primarily a good to live in. Bracke (2021), using matched transaction and rental data for England and Wales, shows that investors and owner-occupiers value housing differently and pay different prices for equivalent properties, with investor activity concentrated in smaller dwellings and in rising markets. For Belgium, Goeyvaerts and Vandenbergh (2025) find that changes in transaction taxes alter not only the timing but also the composition of purchases, precisely because they affect investor behavior, which confirms that investors form a distinct and policy-sensitive segment of demand. Because apartments carry more of this investment-driven demand and houses more of the owner-occupier demand, the two segments can be expected to react differently to interest rates, taxation, and construction costs. This dissertation does not observe buyers directly; it uses the house/apartment distinction as an observable proxy for these differing exposures, which is why the two segments are estimated separately throughout.

Taken together, this literature converges less on a single set of coefficients than on a conditional message: income, interest rates, and credit are consistently major demand drivers, and demographic and institutional factors reinforce or dampen them, but the strength of each effect depends on supply responsiveness, the institutional setting, regional conditions, and the type of dwelling and buyer. Andrews (2010) and Hilbers et al. (2008) both warn that comparable shocks can produce very different responses across contexts, and Zwart (2015) makes the same point for Belgium, where the price response depends on the fiscal framework and regional economic conditions. This is precisely why country-specific and, within a country, segment- and region-specific analysis remains indispensable.

2.2 The Belgian housing market and its regional heterogeneity

Studies focusing on Belgium emphasize institutional features that set it apart. Haffner and Winters (2014) and Zwart (2015) describe a system marked by a high homeownership rate, substantial fiscal support for owner-occupation, and a governance structure in which housing competences have progressively shifted to the regions. Zwart (2015) shows that these long-standing advantages to homeowners stimulate demand and are partly capitalized into prices, while Haffner and Winters (2014) stress that Belgium relies heavily on transaction taxes such as registration duties, which may reduce mobility and market efficiency. More recently, Goeyvaerts and Vandenbergh (2025) show that reductions in transaction taxes affect both the timing and the composition of purchases, especially by altering investor behavior.

A central theme in the Belgian literature is the regionalization of housing policy. Because taxation and housing support are increasingly set regionally, differences have emerged across Flanders, Wallonia, and Brussels in registration duties, abatements, and renovation incentives. Recent measures illustrate this: Brussels revised its abatement system for main residences in 2023, and Wallonia introduced a reduced 3% registration duty for qualifying purchases in 2025. As legal and market sources note (Brussels-Capital Region, 2024; Christie's Real Estate Belgium, 2025; Lexunion, 2024), these reforms are not uniform and create different incentives across locations. This regional heterogeneity makes national price developments harder to interpret, since they may reflect policy divergence between regions rather than common national trends.

Macroeconomic conditions matter as well. The National Bank of Belgium (2022) highlights the link between financing conditions and price dynamics, while cautioning that average price indices can be affected by changes in the characteristics of the dwellings sold, so that part of measured growth reflects composition rather than pure appreciation. Reusens and Warisse (2018) similarly relate Belgian house prices to broader macroeconomic conditions and growth. Demographic pressures, finally, are particularly relevant in dense and economically attractive urban areas, where population and household-formation dynamics concentrate demand.

2.3 Taxation and housing prices in Belgium

Belgian real estate taxation is organized across several layers of government, combining transaction taxes, recurrent property taxation, and local surcharges (Haffner and Winters, 2014). Loyens & Loeff (2023) stress that this taxation affects not only owner-occupiers but also investors and the relative attractiveness of property compared with other assets, so that it is a genuine determinant of mobility, tenure choices, and price formation rather than a mere background feature.

The registration duty paid on acquisition is one of the most significant transaction costs. It is a regional tax and therefore differs across the three regions, and several governments have recently reformed it to improve affordability (for instance the Walloon 3% rate from 2025 and Brussels abatements). Andrews (2010) and Hilbers et al. (2008) suggest more generally that lower transaction taxes may be partly capitalized into prices, while Goeyvaerts and Vandenbergh (2025) show for Belgium that such reductions alter the timing and composition of purchases, again especially through investor behavior.

Owners are also subject to a recurrent property tax based on the cadastral income, which, as the SPF Finances explains, was assessed on 1975 rental conditions and has since only been indexed rather than revalued. Haffner and Winters (2014) criticize this outdated base because it can create distortions between properties with similar market values today but different historical assessments. Because provinces and municipalities add local surcharges on top of the regional tax, the effective property-tax burden varies from one locality to the next, producing substantial spatial heterogeneity in effective housing taxation. Domènech-Arumì, Gobbi and Magerman (2022) show, in the Belgian context, that fiscal policy shapes housing inequality and the incentives households face. Taken together, regional reforms, local surcharges, and outdated cadastral values may all contribute to differences in housing valuations across municipalities and regions, so that taxation affects not only affordability after purchase but also price formation beforehand.

Recent legal and policy analyses (Loyens & Loeff, 2025; PwC Legal, 2024; RSM Belgium, 2025) confirm that governments increasingly try to reconcile affordability, fiscal sustainability, and investment neutrality through repeated reforms, while noting that frequent changes raise uncertainty for households and investors. Overall, the Belgian literature treats fiscal policy as a key determinant of housing outcomes, and the interaction between regional reforms and local surcharges as one source of the heterogeneity observed in Belgian house prices.

2.4 Research hypotheses

Based on the literature reviewed in the previous sections and on the econometric specifications retained for this study, several hypotheses can be formulated regarding the relationship between taxation, economic conditions, demographic factors, and residential real estate prices in Belgium. Since the final version of this study relies on two models, the hypotheses are organised around these two dimensions.

H1: Higher registration duties will decrease residential real estate prices in Belgium (see Goeyvaerts & Vandenbergh, 2025).

H2: Higher municipal surcharges related to property taxation will decrease residential real estate prices in Belgium (see Zwart, 2015).

H3: Higher municipal surcharges on personal income tax will decrease residential real estate prices in Belgium. (see Haffner & Winters, 2014).

H4: Higher interest rates will decrease residential real estate prices in Belgium (see Andrews, 2010).

H5a: Stronger construction-related price pressures will increase residential real estate prices in Belgium.

H5b: Higher inflation will increase residential real estate prices in Belgium.

H6: A larger population will increase residential real estate prices in Belgium (see OECD, 2020).

H7: A lower average household size will increase residential real estate prices in Belgium (see OECD, 2020).

H8: A higher employment rate will increase residential real estate prices in Belgium (see Reusens & Warisse, 2018).

H9: Higher median household income will increase residential real estate prices in Belgium (see Andrews, 2010).

If confirmed, these hypotheses would support the view that Belgian housing prices are shaped by a combination of fiscal incentives, macroeconomic conditions, and demographic as well as labour market pressures. More importantly, the comparison of the two models will make it possible to assess which set of factors appears to be more strongly associated with housing price dynamics in the Belgian context and see if some differences exist between regions.

3. Methodology and Data

3.1 Research strategy

The objective of this study is to identify and compare the main determinants of residential real estate prices in Belgium, with a particular focus on taxation, economic conditions, and demographic factors. Rather than analyzing all determinants simultaneously in a single specification, the empirical strategy relies on two distinct regression frameworks, each designed to isolate the relationship between housing prices and a specific set of explanatory factors. This approach allows for a clearer interpretation of the relative importance and correlation of different channels affecting real estate prices.

The analysis is conducted using a quantitative econometric methodology based on linear regression models estimated in RStudio. Depending on data availability and relevance, the empirical analysis is carried out at different levels of spatial aggregation, including the municipal, regional, and federal levels. If useful and when sufficiently detailed data are available, regressions are estimated at the municipal level, allowing for a fine-grained assessment of local fiscal and demographic effects. In other cases, the analysis is conducted at the regional or national level, particularly for macroeconomic variables and institutional measures that are uniform across municipalities. This flexible approach ensures that each variable is analysed at the level of aggregation that is both empirically feasible and economically meaningful.

Beyond its empirical contribution, the study is designed to provide policy-relevant insights. From a public policy perspective, the analysis can help governments assess the extent to which taxation policies, economic conditions, and demographic dynamics influence real estate prices, and whether certain fiscal or macroeconomic measures generate unintended effects on housing markets. The results may therefore contribute to the evaluation of existing policies and to the design of future measures aimed at achieving objectives such as housing affordability, market stability, or balanced territorial development.

At the same time, the study is relevant from an investment perspective. By identifying the factors most strongly correlated with real estate prices, the analysis provides useful information for investors seeking to better understand the drivers of property values. The results may help investors anticipate how changes in taxation, economic conditions, or population trends could affect the performance of their real estate portfolios, and inform decisions related to property acquisition, divestment, or long-term holding strategies. In this sense, the study aims to bridge academic analysis with practical decision-making in the Belgian real estate market.

3.2 Econometric approach

The empirical strategy consists of estimating two separate linear regression models, each corresponding to one of the main explanatory dimensions considered in the study : fiscal pressure model and economic conditions & demographic determinants model.

Model 1 : Taxation and fiscal pressure

$$Log(P_{m,i}) = \beta_0 + \beta_1 MPIT_{m,i} + \beta_2 MS_{m,i} + \beta_3 RD_{m,i} + \varepsilon$$

The dependent variable is the log of median property prices in municipality m during quarterly period i. The explanatory variables are defined as follows:

- RD: Regional registration duty. The transaction tax paid on acquisition, expressed as a rate on the purchase price and varying by region, period, and buyer profile (owner-occupier vs. investor). Transaction taxes may be partially capitalised into prices and can reduce residential mobility, thereby influencing market equilibrium outcomes (Andrews, 2010; Hilbers et al., 2008). Belgian evidence confirms that changes in registration duties affect the timing and composition of transactions (Goeyvaerts & Vandenbergh, 2025). H1: higher RD decreases prices.

- MS: Combined property-tax burden. The recurrent property tax, capturing not only the municipal surcharge but also the provincial and regional components, computed as:

$$MS = Regional\ rate * \left(1 + \frac{Provincial\ surcharge}{100} + \frac{Municipal\ surcharge}{100}\right)$$

MS is directly linked to real estate, but its intensity depends on the municipality, introducing spatial heterogeneity in effective tax burdens that may affect both location choices and property valuation. H2: higher MS decreases prices.

- MPIT: Municipal surcharge on personal income tax. The additional-percentage tax rate levied by each municipality on personal income. Although not directly linked to real estate, MPIT can affect the relative attractiveness of a municipality compared to another, which may in turn affect local real estate prices. H3: higher MPIT decreases prices.

Belgium’s multi-layered real estate tax system, combining registration duties, recurrent property taxation, and municipal surcharges (Haffner & Winters, 2014), provides the institutional backdrop for these three channels. Regional interaction terms and region-specific regressions are added to assess how fiscal capitalisation differs across Flanders, Wallonia, and Brussels-Capital.

Model 2 : Economic conditions

$$\Delta log\ P_{r,t} = \beta_0 + \beta_1\ \Delta CR_t + \beta_2\ \Delta log\ CPI_t + \beta_3\ \Delta log\ PPI_t + \beta_4\ \Delta log\ CstrPI_t + \beta_5\ \Delta log\ Pop_{r,t} + \beta_6\ \Delta log\ MedInc_{r,t} + \beta_7\ \Delta log\ HS_{r,t} + \beta_8\ \Delta ER_{r,t} + \alpha_r + \varepsilon_{r,t}$$

The subscript r indexes the three Belgian regions and t indexes quarterly periods over Q1 2010 – Q4 2023. The dependent variable Δlog P_{r,t} is the log-difference of the median transaction price. Variables subscripted with t alone are national series; variables subscripted with r,t vary by region and quarter. α_r is a region-specific fixed effect absorbing time-invariant regional heterogeneity; ε_{r,t} is the idiosyncratic error term, with cluster-robust standard errors (HC1, Arellano 1987) computed at the regional level.

- CR: Mortgage interest rate (Δ, percentage points). New housing loans with fixation above ten years (NBB MIR statistics). It captures the cost of financing faced by buyers; higher rates raise the user cost of housing and reduce borrowing capacity. H4: higher CR decreases price growth.
- CPI: Consumer Price Index (Δlog, all items, 2015=100). It captures general inflation and its effect on households' real disposable income. H5b: higher CPI increases price growth.
- PPI: Producer Price Index (Δlog, industrial total domestic, 2015=100). It captures the transmission of intermediate-goods inflation to housing prices (cost-push channel).
- CstrPI: Construction Price Index (Δlog, Section F, seasonally adjusted, 2015=100). It captures supply-side pressures associated with construction costs, in line with the emphasis placed by Hilbers et al. (2008) on the interaction between demand shocks and housing supply responsiveness. H5a: stronger construction-cost pressure increases price growth.
- Pop: Resident population (Δlog, mid-year, by region). It reflects demand pressure in local housing markets. H6: larger population increases price growth.
- MedInc: Median net taxable income per fiscal declaration (Δlog, EUR/year, by region). It proxies the purchasing power of economically active households; higher income increases borrowing capacity and willingness to invest in housing. H9: higher MedInc increases price growth.
- HS: Average household size (Δlog, persons/household, by region). It influences the number of dwellings required per capita, since smaller households increase housing demand even without population growth (Mankiw & Weil, 1989). H7: lower HS increases price growth.

- ER: Employment rate (Δ, 15–64 population, ratio, by region). It captures labour-market conditions; stronger employment generally increases households' borrowing capacity. H8: higher ER increases price growth.

The two models adopt different econometric strategies because the nature of their explanatory variables differs fundamentally. The fiscal variables of Model 1 vary primarily across municipalities, motivating a level specification with two-way fixed effects to exploit this cross-sectional variation. The macroeconomic variables of Model 2 are predominantly national and non-stationary in levels, motivating a quarterly-growth-rate transformation (Granger and Newbold, 1974) with cluster-robust standard errors (Arellano, 1987). As a result, the two models estimate fundamentally different economic quantities, equilibrium elasticities of the price level for Model 1, dynamic elasticities of quarterly price growth for Model 2, and direct numerical comparison of their coefficients is therefore avoided; the comparative interpretation of Chapter 5 proceeds through structural patterns rather than numerical confrontation.

3.3 Data

3.3.1 Data sources and overview

The empirical analysis relies predominantly on official Belgian statistical data, ensuring a high level of consistency and reliability across variables. The vast majority of the dataset is sourced from STATBEL, the Belgian statistical office, which provides detailed and harmonised information on real estate prices, demographic indicators, labour market conditions, and macroeconomic variables. Data on mortgage interest rates are taken from the National Bank of Belgium (NBB), which publishes the Monetary Interest Rates (hereafter: MIR) statistics on new housing loans to households, used as a proxy for the financing conditions faced by buyers. Finally, information on municipal surcharges, including both surcharges on personal income tax and surcharges applied to the cadastral income used in the calculation of the property tax, is obtained from official administrative data published by the Belgian Federal Public Service Finance (SPF Finances).

While the data are reported at different temporal frequencies, such as annual, quarterly, or monthly levels, all variables are harmonised to a common time dimension prior to estimation. This temporal alignment ensures the internal consistency of the dataset and allows the econometric regressions to be conducted on a coherent and comparable basis.

3.3.2 The Belgian property tax framework

The empirical analysis relies on a quarterly panel covering 2010Q1–2025Q3, organised at two levels of aggregation: the regional level (Flanders, Wallonia, and Brussels-Capital) and the municipal level. Real estate prices are sourced from STATBEL (2025), which publishes median transaction prices, quartiles, and transaction counts for houses and apartments based on registered sale deeds. These data offer broad geographical coverage at quarterly frequency, but observed price changes may partly reflect compositional effects rather than pure appreciation, a caveat emphasised by the National Bank of Belgium (2022). Fiscal variables are collected from official administrative sources: regional registration duties from the regional tax administrations (Vlaamse Belastingdienst, 2025; SPW Finances, 2025; Brussels Fiscalité, 2025), municipal surcharges on personal income tax and on the property tax from the SPF Finances (2025), and provincial surcharges from the annual tax regulations of the ten provinces and, for Wallonia, from the Union des Villes et Communes de Wallonie (2025). The regional base rate of the property tax is taken from the relevant fiscal codes (Vlaamse Codex Fiscaliteit, 2013; CIR 1992, art. 255).

The Belgian property tax (précompte immobilier / onroerende voorheffing) is a recurrent regional tax levied on the indexed cadastral income of immovable property. As the cadastral income is assessed on the 1975 rental market and merely indexed since, it is often disconnected from current market values, a structural weakness underlined by Haffner and Winters (2014). The total tax due combines a regional base rate, provincial surcharges, and municipal surcharges, following the formula presented in Section 3.2. The regional base rate remained at 1.25% in Wallonia and Brussels-Capital throughout the entire period, while Flanders raised it from 2.5% to 3.97% on 1 January 2018.

This 2018 Flemish reform constitutes the central structural break of the dataset, but it is essentially mechanical. The Flemish Decree of 18 November 2016 (« afslanking van de provincies ») transferred person-related provincial competences to the Region and the municipalities; to finance these, the regional base rate was raised and provinces were instructed to divide their surcharges by 1.5897 so as to keep their revenues constant (Belfius, 2017; Flemish Parliament, 2016). The reform therefore corresponds to a redistribution between layers of government rather than a genuine change in the burden borne by taxpayers, a feature that matters directly for the identification of the MS variable in Model 1, since the bulk of the Flemish variation over the period is fiscally neutral. Subsequent Flemish provincial adjustments do, however, reflect genuine policy decisions, most notably the increases voted by Limburg from 2019 onwards. By contrast, the Walloon provincial surcharges are considerably more stable, with only three documented adjustments over the entire period (Liège in 2013, Hainaut in 2016, and a first decrease in Luxembourg in 2024), reflecting the absence of any reform comparable to the Flemish « afslanking ». The Brussels-Capital agglomeration applied a constant surcharge of 989 centimes throughout (Brussels Fiscalité, 2025).

For 2010–2017, no exhaustive public source documents the exact annual Flemish provincial surcharges; only the East Flanders (295 opcentiemen, 2015–2017) and West Flanders (355, 2015) values can be directly verified. In the absence of complete series, this study treats the Flemish provincial surcharges as constant over 2010–2017. This is an explicit modelling assumption rather than a verified fact, justified by the stability of the regional base rate before 2018, the annual-renewal practice of provincial tax regulations, and the documented stability of municipal opcentiemen over the same period (Flemish Government, 2024). The post-2018 robustness verifies that the main results do not depend on these assumed values.

While the Flemish reform concerned recurrent taxation, the main source of regional divergence lies in transaction taxes (droits d'enregistrement). Flanders reformed its registration duty for owner-occupiers repeatedly: from 10% under the dual « klein/groot beschrijf » system, the rate was cut to 7% in June 2018, 6% in 2020, 3% in 2022, and 2% in 2025, while the investor rate rose from 10% to 12% in 2022 and the « meeneembaarheid » portability mechanism was abolished in 2024 (Vlaamse Belastingdienst, 2024; Goeyvaerts & Vandenbergh, 2025). Wallonia maintained a 12.5% rate from 2010 to 2024, supported by the temporary « chèque habitat » introduced in 2016, before the decree of 4 December 2024 cut the owner-occupier rate to 3% for the acquisition of a single own-use residence from 1 January 2025, abolishing the chèque habitat in parallel (Walloon Parliament, 2024; Christie's Real Estate Belgium, 2025). In the dataset, the Walloon owner-occupier rate accordingly falls from 0.125 to 0.03 from 2025Q1, while the investor rate remains at 0.125. Brussels-Capital retained a 12.5% rate throughout but progressively raised the abatement granted to first-time buyers, from 60,000 EUR to 175,000 EUR in 2017 and 200,000 EUR by 2023, the latter subject to a price ceiling of 600,000 EUR (Brussels-Capital Region, 2024), an approach less likely to be capitalised into prices than a uniform rate cut (Goeyvaerts & Vandenbergh, 2025). The abatement schemes are not encoded as separate variables, since they depend on buyer-specific criteria that cannot be observed at the level of aggregated quarterly municipal transactions; the dataset therefore encodes only the headline rate applicable to each region and buyer profile, which may slightly overstate effective entry costs for eligible Brussels buyers, a caveat acknowledged when interpreting the regional comparison (Goeyvaerts & Vandenbergh, 2025; Domènech-Arumì et al., 2022).

These successive reforms, the repeated Flemish rate cuts, the 2025 Walloon reform, and the 2018 structural break, generate substantial heterogeneity in the fiscal treatment of identical transactions across the Belgian territory and over time, providing a rich empirical setting for analysing the capitalisation of taxation into residential real estate prices (Andrews, 2010; Goeyvaerts & Vandenbergh, 2025; Domènech-Arumì, Gobbi & Magerman, 2022). For readers wishing to trace the exact annual values of each fiscal instrument, summary tables reporting the full evolution of regional base rates, provincial surcharges, and registration duty rates over 2010–2026 are provided in the Appendix

3.3.3 Sample description and descriptive statistics – Model 1

Both estimation samples are constructed from the STATBEL quarterly municipal database. For each commune-quarter cell, a row is retained only when (i) STATBEL publishes a non-missing median transaction price for the relevant property category and (ii) all fiscal variables of interest are available. STATBEL's confidentiality threshold prevents the publication of medians when the underlying number of transactions falls below fifteen, so all observations included in the samples reflect a sufficiently dense local market for the median to be statistically meaningful (STATBEL, 2025). After applying these filters, the houses sample contains 23,991 commune-quarter observations covering 507 municipalities, while the apartments sample contains 5,785 observations covering 189 municipalities. The smaller size of the apartments sample reflects the lower density of apartment transactions in rural municipalities, which never meet the STATBEL publication threshold.

Communes are assigned to their region of belonging on the basis of the official Belgian REFNIS code, which uniquely identifies each municipality and encodes its province and region.

The houses sample is dominated by Flemish and Walloon communes in roughly comparable proportions, with 275 Flemish communes and 216 Walloon communes meeting the STATBEL publication threshold over the period. The apartments sample is more balanced between Brussels-Capital and Flanders, with Wallonia contributing a smaller share. The much higher density of observations per commune in Brussels (53.6 quarters for houses and 62.9 for apartments) reflects the highly liquid character of the Brussels real estate market relative to the rest of Belgium. The number of communes differs between the two samples within each region, which is a direct consequence of the STATBEL publication threshold: a commune may have enough quarterly apartment transactions to be included in the apartments sample but not enough house transactions to appear in the houses sample, or vice versa. This is particularly visible for the Brussels-Capital Region, where the 19 communes are all present in the apartments sample but only 16 are present in the houses sample, the three most densely urbanised central communes do not have enough houses to generate publishable medians in most quarters.

Table 1. Geographical distribution of the two samples

Region	Houses			Apartments		
	Obs.	**Comm.**	**Avg Q.**	**Obs.**	**Comm.**	**Avg Q.**
Brussels-Capital	858	16	53.6	1,195	19	62.9
Flanders	14,452	275	52.6	3,611	132	27.4

Wallonia	8,681	216	40.2	979	38	25.8
Total	**23,991**	**507**	**47.3**	**5,785**	**189**	**30.6**

Source: authors' computations based on STATBEL (2025)

Table 1 reports the descriptive statistics of the dependent variables and of the main explanatory variables. Median house prices have a mean of 248,309 EUR and a median of 230,500 EUR, while median apartment prices are slightly lower with a mean of 199,148 EUR and a median of 190,000 EUR. The combined property tax burden (MS) displays a very similar distribution in both samples, with a median of approximately 0.49 for houses and 0.48 for apartments. The municipal surcharge on personal income tax has a median of 7.7% in the houses sample and 7.0% in the apartments sample, reflecting the slightly more urban (and therefore lower-tax) composition of the apartments sample. The number of transactions per commune-quarter is on average higher for apartments (82.7) than for houses (52.3), reflecting the greater volume of apartment transactions in dense urban areas.

Table 2. Descriptive statistics of the two samples

Variable	**Houses**				**Apartments**			
	Min	**Median**	**Mean**	**Max**	**Min**	**Median**	**Mean**	**Max**
Price (EUR)	35,000	230,500	248,309	1,200,000	35,000	190,000	199,148	645,000
MS	0.272	0.489	0.487	0.676	0.272	0.483	0.481	0.660
surch_pit (%)	0.00	7.70	7.43	9.00	0.00	7.00	6.78	8.90
rd_owner	0.020	0.100	0.092	0.125	0.020	0.100	0.089	0.125
Transactions	16	36	52.3	1,260	16	40	82.7	2,103

Source: authors' computations based on STATBEL (2025) and own fiscal variables. All values rounded for readability.

Before turning to the regression results, Figures 1 and 2 visualize the raw bivariate relationship between log prices and the combined property-tax burden (MS), separately for houses and apartments. The unconditional correlation appears negative in most cases, providing a first informal indication consistent with hypothesis H2. This relationship is, however, far from uniform: the steepness of the fitted slope varies markedly across the three regions, and the regional pattern itself differs between the houses and the apartments samples. These visualizations should nonetheless be interpreted with caution, as they do not control for unobserved heterogeneity across communes or for common time shocks; they merely describe the variation present in the data rather than a causal relationship. The causal interpretation must rely on the fixed-effects regression results presented in the results section. The same relationships with the other explanatory variables are available in the annexes if need be.

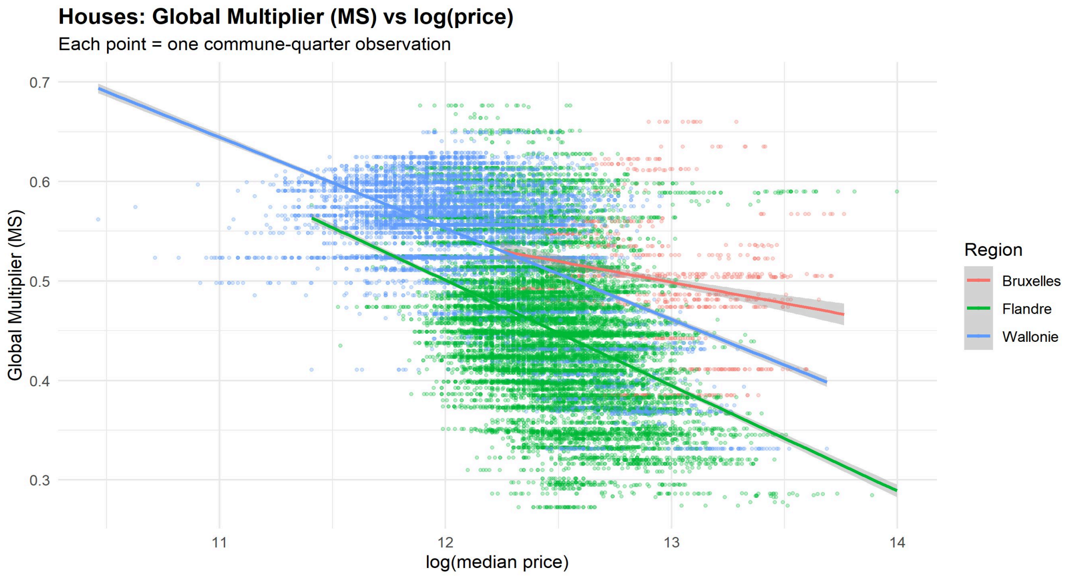

Figure 1. Houses: Global Multiplier (MS) vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

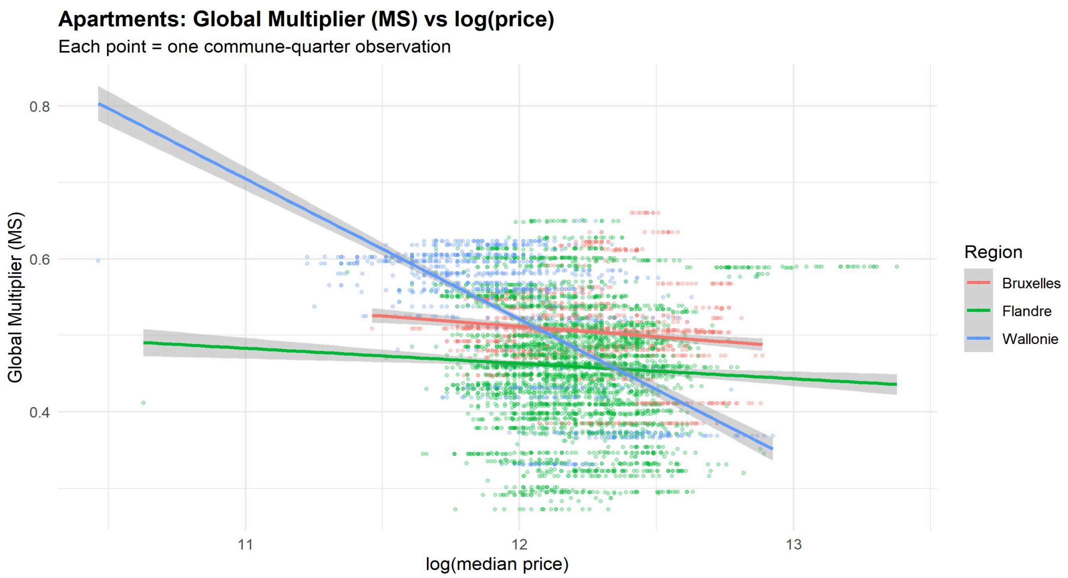

Figure 2. Apartments: Global Multiplier (MS) vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

3.3.4 Variable construction and descriptive statistics – Model 2

Both estimation samples are built from the same STATBEL quarterly regional database used in the methodology section. Quarterly data on median transaction prices are collected at the regional level for houses (all types combined) and for apartments, yielding a balanced panel of 3 regions × 56 quarters = 168 observations per sample. The post-2023 quarters are excluded because the median income series published by the FPS Finance and the regional employment rate released by STATBEL have a typical publication lag of 18 to 24 months. After first-differencing, the effective sample for estimation is 3 × 55 = 165 quarterly observations.

Variables in monetary units or in index form enter the regression in log-difference form, computed as $\Delta \log X_t = \log X_t - \log X_{t-1}$. Log-differences are the standard stationary transformation for non-stationary price indices (Granger & Newbold, 1974) and admit a direct interpretation as continuously compounded quarterly growth rates. The mortgage rate and the employment rate are already expressed in percentage points and are therefore simply first-differenced. CPI, although nominally a rate of change, is published in our raw data as an index (base 2015 = 100) and is therefore expressed in log-difference form for consistency with the other price indices.

All series are drawn from official Belgian statistical sources. The dependent variables are the median transaction prices published by STATBEL at the regional and quarterly level, for all houses combined and for apartments, both entering in log-difference form. The mortgage rate (CR) is taken from the NBB MIR statistics on new contracts with an initial rate fixation above ten years, expressed in percent per annum and entering in first difference. The three price indices, the consumer price index (CPI, all items), the producer price index (PPI, industrial total domestic), and the construction price index (CstrPI, Section F, seasonally adjusted), are all published by STATBEL on a 2015 = 100 basis and enter in log-difference. The demographic and income block is likewise sourced from STATBEL: the mid-year resident population (Pop, in persons), the median net taxable income per fiscal declaration (MedInc, in EUR per year, from the fiscal statistics), and the average household size (HS, in persons per household) enter in log-difference, while the employment rate of the 15–64 population (ER, from the Labour Force Survey, expressed as a ratio) enters in first difference. A summary table of variable definitions, units, sources, and transformations is provided in the Appendix

The construction of the mortgage rate variable deserves a specific note, because the NBB MIR database offers several dimensions that must be explicitly filtered. The rate is measured on new contracts rather than on the outstanding stock of loans, since price formation reflects the financing conditions of transactions concluded in a given quarter; the sector is restricted to households and the instrument to mortgage credit for house purchase; and the maturity is restricted to an initial rate fixation longer than ten years, the segment that dominates the Belgian market (more than 80% of new loans in recent years according to NBB statistics) and best represents the cost of financing faced by typical buyers. The monthly series is averaged to a quarterly frequency to match the dependent variable. Because the NBB does not publish MIR statistics at the regional level, all three regions share the same national mortgage rate, a feature that reinforces the importance of the regional fixed effects, which absorb the time-invariant component of regional differences in housing affordability.

Three further data-treatment decisions deserve explicit justification. First, the income measure is the median net taxable income per tax declaration rather than the average income per inhabitant: per-capita income mechanically incorporates children and elderly individuals who do not participate in the housing market, and would mix a pure income signal with the regional demographic composition already captured by the Population and Household-size variables. The median income per declaration isolates the purchasing power of economically active households and aligns with the median-price specification of the dependent variable (Glaeser & Gyourko, 2003; Andrews, Caldera Sánchez & Johansson, 2011). Second, the construction price index is computed as the arithmetic mean of the three monthly indices within each quarter rather than the end-of-quarter observation, because the raw monthly series exhibits a pronounced intra-annual seasonal pattern, December values are systematically depressed by the winter slowdown, that would otherwise inject deterministic seasonality into the regressor. Third, the population and median-income series, published by STATBEL only annually, are linearly interpolated between annual anchors (set at the first quarter of each year) to obtain quarterly observations. Without this treatment, both variables would repeat the same value for four consecutive quarters and then jump discretely every first quarter, generating spurious annual seasonality in the log-differences; linear interpolation distributes the annual change evenly across quarters, consistent with the gradual nature of demographic and income evolution, while the annual STATBEL observations themselves remain exact and serve as anchors.

Table 3 reports descriptive statistics on the level of the dependent variable and of the main explanatory variables for the three Belgian regions over the sample period. The regional heterogeneity of prices is substantial: Brussels-Capital displays median house prices roughly 2.4 times higher than the Walloon Region, with the Flemish Region in between. This persistent regional gap motivates the systematic inclusion of regional fixed effects in the pooled specifications and the estimation of region-specific regressions in Section 5.5.

Table 3. *Descriptive statistics by region (levels, Q1 2010 – Q4 2023).*

Region	**N**	**Mean P (€)**	**SD**	**Min**	**Max**	**Median income (€)**	**Empl. rate**
Brussels-Capital	56	397,134	61,351	320,000	520,000	20,196	0.606

Flemish Region	56	249,152	38,717	195,000	330,000	26,655	0.736
Walloon Region	56	164,067	21,496	136,000	212,500	23,407	0.634

Source: authors' computations based on STATBEL (2025) and NBB. Median P refers to median transaction price for all houses combined.

Before turning to the regression results, Figure 3 superimposes the median Belgian house-price level on the mortgage rate, providing a visual rendering of the negative co-movement at the heart of hypothesis H4.

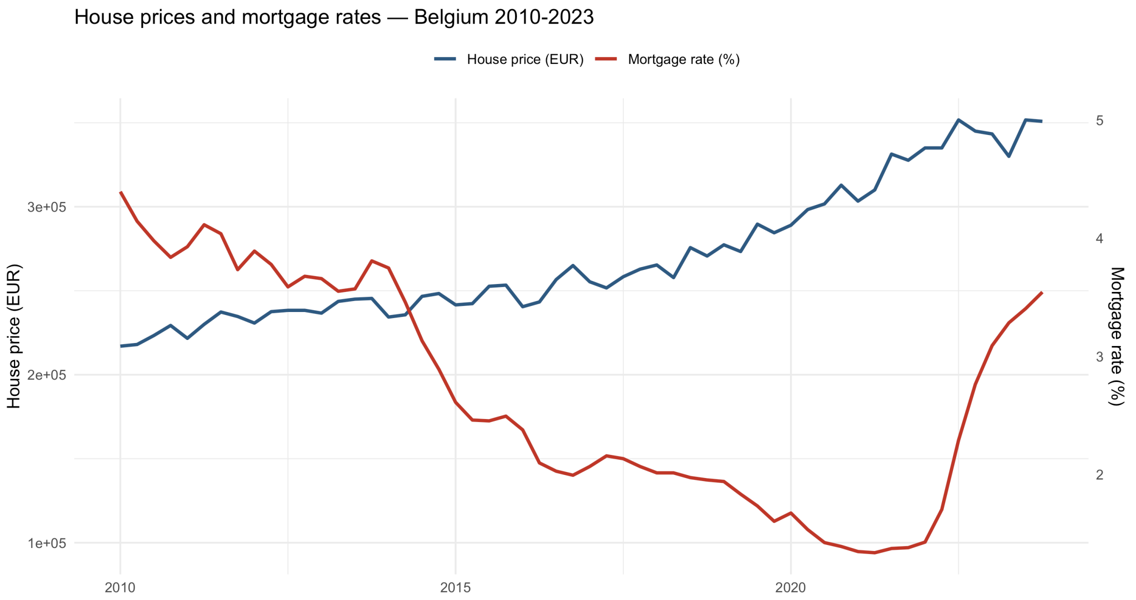

Figure 3. House prices and mortgage rates on a dual-axis chart (national averages, 2010-2023). The visual co-movement is broadly consistent with the negative effect predicted by hypothesis H4. Sources: STATBEL (prices); National Bank of Belgium (mortgage rate).

4. Results

This chapter presents the empirical results of the two models. Section 4.1 examines the relationship between fiscal pressure and residential price levels at the commune level over 2010Q1–2025Q3 (Model 1); Section 4.2 turns to the macroeconomic and demographic determinants of quarterly price growth at the regional level over Q1 2010 – Q4 2023 (Model 2). Both models are estimated in parallel on houses and apartments, a choice motivated by the structurally different nature of the two markets: houses are predominantly occupied by their owners, whereas apartments concentrate a larger share of investor activity and display different price dynamics. Reporting both segments jointly throughout allows for a systematic comparison and reveals patterns that would remain hidden in a single-segment analysis.

4.1 Model 1: Fiscal pressure and municipal residential real estate prices

Model 1 is estimated by Ordinary Least Squares with two-way fixed effects, where commune fixed effects absorb all time-invariant unobserved heterogeneity (such as location, prestige, climate, or proximity to economic centres) and period fixed effects absorb all common time shocks (such as movements in interest rates, inflation, or national macroeconomic conditions). The regressions are weighted by the number of underlying transactions in each commune-quarter cell, giving more weight to medians computed on a larger number of sales. Standard errors are computed using the default specification of the fixest package in R. Table 4 reports the main results, with houses and apartments displayed side by side for direct comparison.

Table 4. Main estimation results, Houses and Apartments

Variable	**Houses (coef.)**	**Houses (s.e.)**	**Apartments (coef.)**	**Apartments (s.e.)**
MS	+0.011 n.s.	(0.037)	+0.020 n.s.	(0.056)
surch_pit	−0.014***	(0.002)	−0.019***	(0.003)
rd_owner	−0.737***	(0.038)	−0.357***	(0.064)
Observations	23,971		5,756	
Communes (FE)	487		160	
Within R^2	0.018		0.013	
Adjusted R^2	0.956		0.944	

*Notes: dependent variable is log(median price). Standard errors in parentheses. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, n.s. = not significant. Sample weighted by number of transactions.*

The two samples deliver partially convergent and partially divergent results, which is itself a finding of substantive interest. Both samples confirm that the municipal surcharge on personal income tax has a strong negative and significant effect on prices: a one-percentage-point increase in surch_pit is associated with a 1.4% reduction in median house prices and a 1.9% reduction in median apartment prices. This finding provides strong support for Hypothesis H3 across both property segments, suggesting that the fiscal attractiveness of a commune is internalised in housing valuations regardless of the type of dwelling. The slightly weaker effect for houses may reflect the broader geographical scope of the houses sample, which includes peri-urban and rural communes where the link between local fiscal pressure and housing valuations is partly diluted by other locational amenities. The result is nonetheless cohesive with the spatial heterogeneity argument of Haffner and Winters (2014) and Zwart (2015), and both estimates are highly significant ($p < 0.001$).

The effect of registration duties is also negative and highly significant in both samples, but its magnitude differs substantially between segments. The coefficient on rd_owner is more than twice as large for houses (−0.737) as for apartments (−0.357), suggesting that the capitalisation of transaction taxes into prices is stronger for the houses market than for the apartments market. This is consistent with the dominant role of owner-occupiers in the houses market, who are the direct beneficiaries of the rd_owner rate, whereas the apartments market is shared between owner-occupiers and investors, whose decisions are governed by a different effective tax (rd_investor). Both estimates support Hypothesis H1, with the magnitude of the houses coefficient broadly aligned with the benchmark estimates of Goeyvaerts and Vandenbergh (2025) and Domènech-Arumì, Gobbi and Magerman (2022), who report capitalisation rates of approximately 2.4% and 3% respectively for Belgian transaction tax reforms.

Hypothesis H2, which predicts a negative effect of the combined property tax burden MS, is not supported in either baseline specification. The coefficient is small, positive, and insignificant for houses (+0.011, $p = 0.77$), and similarly small, positive, and insignificant for apartments (+0.020, $p = 0.72$). This unexpected result will be examined more closely in the robustness and heterogeneity analyses below, where two important qualifications emerge. As a preliminary observation, the within R^2 is substantially lower for apartments (0.013) than for houses (0.018), suggesting that the pooled apartment specification is less well identified, a feature that will be confirmed by the heterogeneity analysis.

4.1.2 A note on registration duties for investors

Both baseline specifications were initially augmented with the registration duty applicable to investors (rd_investor) to capture the differential tax treatment introduced by the 2022 Flemish reform. The estimation results of these augmented specifications are reported in Table 5 for both segments.

Table 5. Augmented specifications with rd_investor

Variable	Houses (coef.)	Houses (s.e.)	Apartments (coef.)	Apartments (s.e.)
MS	−0.009 n.s.	(0.037)	+0.048 n.s.	(0.056)
surch_pit	−0.012***	(0.002)	−0.016***	(0.003)
rd_owner	−0.551***	(0.048)	+0.129 n.s.	(0.093)
rd_investor	**+1.016*** **	**(0.162)**	**+2.305*** **	**(0.321)**

Observations	23,971		5,756	
Within R^2	0.020		0.022	

Notes: dependent variable is log(median price). The rd_investor row is highlighted in orange because its coefficients are positive and statistically significant in both samples, a result contrary to economic theory and that should not be interpreted causally (see discussion below).

In both samples, the coefficient on rd_investor is large, positive, and highly significant, contrary to the theoretical prediction that higher transaction taxes depress prices, and markedly larger for apartments (+2.305) than houses (+1.016), consistent with the apartment market's greater exposure to investor activity. Its inclusion also destabilises rd_owner in the apartments specification, which loses significance and changes sign (−0.357 to +0.129). Both features indicate that rd_investor cannot be reliably identified in the present panel.

The result reflects a spurious identification problem: rd_investor exhibits almost no within-region variation outside the single Flemish transition of 1 January 2022 (0.10 → 0.12), which coincides with the post-Covid rebound, the 2022–2023 inflation episode, and the simultaneous cut of rd_owner to 3% in Flanders. The estimator therefore mechanically attributes part of the Flemish price upturn to rd_investor, while the true channel is macroeconomic. A second concern, acute for apartments, is that the dependent variable pools owner-occupier and investor transactions; isolating an investor-specific effect would require transaction-level microdata (Goeyvaerts & Vandenbergh, 2025). For these reasons rd_investor is omitted from the main specifications, and Table 4 provides the principal estimates of Model 1.

4.1.3 Robustness checks

Two robustness checks are performed for both samples. The first restricts the estimation to the post-2018 period, which removes the years for which Flemish provincial surcharges were assumed constant in the absence of fully documented annual data (see Section 3). The second excludes the Brussels-Capital Region, which contributes a distinct and concentrated set of observations and may impose its own dynamics on the pooled estimates. Table 6 reports the results of these specifications alongside the main models for direct comparison.

Table 6. Robustness checks, Houses and Apartments

Variable	Houses			Apartments		
	Main	**Post-2018**	**No Brussels**	**Main**	**Post-2018**	**No Brussels**

MS	+0.011	−0.089	+0.013	+0.020	−0.174*	−0.201*
surch_pit	−0.014***	−0.015**	−0.013***	−0.019***	−0.018***	−0.015***
rd_owner	−0.737***	−0.521***	−0.746***	−0.357***	−0.499***	−0.948***
Observations	23,971	12,192	23,113	5,756	3,261	4,561
Within R^2	0.018	0.009	0.018	0.013	0.022	0.025

*Notes: dependent variable is log(median price). Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Within R^2 reported in the bottom row.*

The post-2018 restriction delivers a contrasted pattern between the two samples. For apartments, the coefficient on MS becomes negative and statistically significant (−0.174, $p < 0.05$), and the same conclusion holds once Brussels is excluded (−0.201, $p < 0.05$). These two results jointly suggest that the insignificance of MS in the apartments baseline is at least partly attributable to the use of assumed values for Flemish provincial surcharges over 2010–2017, and that the combined property tax burden does exert a statistically detectable negative effect on apartment prices once the analysis is restricted to a period for which all fiscal variables are directly documented in official sources. For houses, the post-2018 coefficient on MS (−0.089) is negative but not statistically significant ($p = 0.18$). This contrast between the two segments will be discussed in more detail in the heterogeneity analysis below.

The results for surch_pit and rd_owner are remarkably stable across all three specifications, which provides direct evidence of the robustness of the two main findings. surch_pit retains its negative significant effect in every column (between −0.013 and −0.018 across both segments and both restrictions), and rd_owner remains strongly negative and highly significant throughout, although its magnitude shrinks somewhat in the post-2018 specifications (−0.521 for houses, −0.499 for apartments), consistent with the smaller variation available in the shorter time window.

The exclusion of Brussels produces a more modest but informative change. For houses, the impact is small: the coefficients on MS (+0.013), surch_pit (−0.013) and rd_owner (−0.746) remain very close to the main model, and the within R^2 stays at 0.018. This stability is consistent with the limited weight of Brussels in the houses sample (only 16 communes out of 507 and 858 observations out of 23,971) and confirms that the main houses results are not driven by the Brussels-Capital Region. For apartments, the picture is somewhat different. The exclusion of Brussels turns MS significantly negative (−0.201) and amplifies the rd_owner coefficient substantially (from −0.357 to −0.948). The within R^2 also rises from 0.013 to 0.025. This pattern indicates that the Brussels-Capital Region introduces specific dynamics into the apartments market that partly dilute the identification of fiscal effects in the pooled specification, a feature that will be confirmed by the heterogeneity analysis below.

4.1.4 Heterogeneity across regions

The pooled specifications impose a homogeneity restriction that may mask regional differences in how fiscal variables are capitalised into prices. Two complementary approaches relax it. First, Model 1 is re-estimated with full interaction terms between each fiscal variable and the regional dummies, which lets each region have its own coefficient while retaining common commune and period fixed effects (Table 7). Second, three separate regressions are estimated, one per region, with region-specific fixed effects (Table 8). The interaction specification is statistically more powerful but pools the time dynamics across regions; the region-by-region specification offers cleaner regional identification at the cost of statistical power and of the ability to identify registration duties.

A methodological point governs the reading of Table 8. The registration duty rate applies uniformly to all communes of a region in any given quarter, so in a single-region regression that includes period fixed effects, rd_owner is mechanically collinear with the period dummies and is automatically removed by fixest. Table 8 therefore reports only MS and surch_pit; the identification of rd_owner relies entirely on the cross-region differential variation exploited in Table 7. The two tables are thus complementary, Table 7 identifies all three channels jointly, Table 8 isolates the within-region capitalisation of MS and surch_pit, and a coefficient significant in **both** can be considered robust ("double-evidence"), whereas one significant only in Table 7 depends on cross-region pooling and warrants caution.

Table 7. Heterogeneous effects by region (interaction terms), Houses and Apartments

Variable	**Houses**			**Apartments**		
	Brussels	**Flanders**	**Wallonia**	**Brussels**	**Flanders**	**Wallonia**
MS	−0.011	+0.091*	−0.596***	+0.172*	−0.203*	−0.762**
surch_pit	−0.017	−0.018***	+0.017**	−0.024***	−0.010*	−0.014
rd_owner	*collinear*	−0.713***	−0.494***	*collinear*	−0.598***	+0.017
Within R^2	0.022			0.022		

*Notes: dependent variable is log(median price). Each variable is interacted with regional dummies. "collinear" indicates that the coefficient could not be identified separately from the commune fixed effects due to the constancy of the variable across periods within the Brussels-Capital Region. Significance: *** p < 0.001, ** p < 0.01, * p < 0.05.*

Table 8. Region-specific separate regressions, Houses and Apartments

Variable	**Houses**			**Apartments**		
	Brussels	**Flanders**	**Wallonia**	**Brussels**	**Flanders**	**Wallonia**

MS	+0.112	+0.054	+0.015	+0.135 †	−0.237*	+0.116
surch_pit	−0.004	−0.017***	+0.020***	−0.011 †	−0.007	+0.006
rd_owner	*collinear*	*collinear*	*collinear*	*collinear*	*collinear*	*collinear*
Observations	858	14,446	8,667	1,195	3,588	973
Communes	16	269	202	19	109	32
Within R^2	0.001	0.003	0.001	0.008	0.002	0.000

*Notes: dependent variable is log(median price). Each regression is estimated on a single regional sub-sample with commune and period fixed effects. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$. "collinear" indicates that rd_owner is mechanically collinear with the period fixed effects in any single-region specification (see methodological note above), and is therefore automatically removed from the regression by the fixest package.*

Combined property-tax burden (MS). The interaction specification identifies MS primarily in Wallonia, where the effect is large, negative, and highly significant (−0.596*** houses, −0.762** apartments), implying that a 0.01 increase in the burden lowers the median price by roughly 0.6% (houses) and 0.8% (apartments). For Flanders the coefficient is weakly positive for houses (+0.091*) and significantly negative for apartments (−0.203*); for Brussels it is weakly positive for apartments only (+0.172*). These contrasts follow directly from the nature of the variation: in Wallonia MS moves because of genuine political decisions, so the negative effect is sharply identified, whereas in Flanders the bulk of the variation stems from the fiscally-neutral 2018 reform (Section 3) and is mechanically inflated, and in Brussels the base rate has been fixed throughout. The counter-intuitive Flemish and Brussels signs should therefore not be read as contradicting H2; they reflect the absence of a meaningful fiscal shock. Crucially, the strong Walloon effect does **not** survive the region-by-region specification (+0.015, $p = 0.90$ houses; +0.116, $p = 0.69$ apartments): once cross-region time variation is no longer pooled, within-Wallonia variation alone is insufficient to identify it. The only MS coefficient satisfying the double-evidence criterion is therefore MS × Flanders apartments, confirmed in both Table 7 (−0.203*) and Table 8 (−0.237*).

Registration duties (rd_owner). The effect is concentrated in Flanders for both segments (−0.713*** houses, −0.598*** apartments), reflecting the repeated Flemish reforms (10% → 7% → 6% → 3% → 2%) that generate exploitable variation. In Brussels the coefficient is collinear with the commune fixed effects (constant 12.5% rate); in Wallonia it is significant and negative for houses (−0.494***) but insignificant for apartments (+0.017), reflecting the single 2025 reform identified on only three quarters and the smaller Walloon apartment sample. As noted above, rd_owner cannot be identified in any single-region regression, so its identification rests entirely on Table 7.

Municipal surcharge on personal income tax (surch_pit). In the houses sample, surch_pit × Flanders is clearly negative (−0.018***), Brussels is negative but insignificant (−0.017), and Wallonia is unexpectedly positive and significant (+0.017**). This positive Walloon sign survives the region-by-region specification at near-identical magnitude (+0.020***), confirming it is a genuine feature of the data rather than an interaction artefact: the affluent peri-urban communes of Brabant wallon combine high median prices with relatively low income-tax surcharges, so the within-commune variation captures local economic dynamism rather than a fiscal channel. In the apartments sample, surch_pit × Brussels is strongly negative (−0.024***) and surch_pit × Flanders significant (−0.010*), while Wallonia is insignificant. The contrast between the strongly significant pooled coefficient and the region-specific estimates shows that the pooled value should be read as an average that masks real regional differences. surch_pit × Flanders houses meets the double-evidence criterion (−0.018*** in Table 7, −0.017*** in Table 8).

The region-interacted specification raises the within R^2 to 0.022 for both samples (from 0.018 and 0.013 pooled), confirming that the homogeneity restriction masks heterogeneous transmission, with the larger gain for apartments. The very low within R^2 of Table 8 (0.0005–0.008) is itself informative: once the regionally-set channels, registration duties in particular, are absorbed by the period fixed effects, only the finer commune-quarter variation of MS and surch_pit remains, confirming that registration duties were the dominant fiscal channel in the pooled specification.

4.1.5 Discussion

The joint analysis of houses and apartments across the pooled, robustness, and heterogeneity specifications allows several conclusions to be drawn on the role of fiscal variables, while clarifying the level of confidence attached to each.

First, both segments confirm H1 (negative effect of registration duties) and H3 (negative effect of the personal-income-tax surcharge at the pooled level), with magnitudes aligned with the recent Belgian transaction-level literature (Goeyvaerts & Vandenbergh, 2025; Domènech-Arumì et al., 2022). The rd_owner channel is stronger for houses than apartments, which is economically intuitive: owner-occupiers, who dominate the houses market, are the direct payers of the rate, whereas the apartments market is shared with investors facing a different effective tax. The robustness of rd_owner makes it the most firmly established fiscal effect of the chapter.

Second, MS receives partial but credible support for H2, and it is the result that benefits most from the double-evidence reading. Its baseline insignificance is largely an artefact of two features identified in Section 3: the mechanical Flemish variation generated by the fiscally-neutral 2018 reform, and the limited Brussels variation. Once attention is restricted to genuine fiscal shocks, the effect emerges, negative and significant for apartments post-2018 (−0.174) and strongly negative in Wallonia in the interaction specification. The fact that the Walloon effect does not survive in isolation, while the Flemish apartments effect does, conveys a substantive lesson rather than a mere statistical caveat: the price impact of the property-tax burden is detectable only when its variation reflects real changes in fiscal pressure and when cross-region comparison supplies enough identifying variation.

Third, once the regional dimension is accounted for, houses and apartments display more similarity than divergence in their fiscal mechanics: MS effects concentrate in Wallonia (and in Flemish apartments under both specifications), registration-duty effects in Flanders, and surch_pit effects vary in regional intensity. Two segment-specific features deserve mention. The Brussels apartment market is somewhat more fiscally responsive than its houses market, consistent with its higher liquidity and more diverse buyer profile; and the positive MS × Brussels apartments coefficient, attenuated and insignificant in Table 8, is best read as an identification artefact rather than a genuine positive effect. The positive surch_pit × Wallonia houses coefficient, by contrast, survives both specifications and is therefore genuine: it does not contradict H3 at the national level but reflects the affluent peri-urban dynamics of Brabant wallon, where high prices coexist with low income-tax surcharges.

Taken together, taxation clearly matters for Belgian house prices, but the strength and detectability of fiscal effects depend on five dimensions: the tax instrument considered, the property segment, the structure of the variation in the data, the regional context, and the identification strategy. These dimensions frame the policy reading of recent and forthcoming reforms and inform the interpretation of Model 2 in the following chapter.

4.2 Model 2: Economic conditions and demographic determinants

This part presents the empirical results of Model 2, which examines the effect of macroeconomic and demographic variables on Belgian residential real estate prices over the period Q1 2010 – Q4 2023. The estimation is conducted on a quarterly panel covering the three Belgian regions. As the macroeconomic and demographic variables identified in the methodology are exogenous to individual transactions, the dependent variable is transformed into a log-difference (Δlog) form to address non-stationarity and to avoid spurious regression issues identified in the early panel literature (Granger & Newbold, 1974). Each explanatory variable enters the regression in log-difference (Δlog) form for indices and quantities, and as a simple first difference (Δ) for variables already expressed in percentage points (the mortgage rate and the employment rate). The construction price index (CstrPI) is taken in its seasonally-adjusted form (STATBEL Indice désaisonnalisé) to remove the deterministic intra-year pattern that would otherwise induce a spurious negative correlation with house-price growth. Standard errors are clustered at the regional level (Arellano, 1987) for the pooled specifications and computed using a Newey-West heteroskedasticity- and autocorrelation-consistent (hereafter: HAC) estimator with a one-quarter lag for the region-specific regressions.

4.2.1 Main results

Model 2 is estimated by ordinary least squares with regional fixed effects on three samples in parallel, all houses combined, ordinary houses with two or three façades, and apartments, to assess both the robustness of the macroeconomic relationships and the existence of segment-specific patterns. Standard errors are heteroskedasticity- and cluster-robust by region (HC1 cluster-robust variance). The dependent variable is the log-difference of the median transaction price, Δlog P_t, and all regressors enter either as a log-difference (for indices and quantities, denoted Δlog X) or as a first difference (for variables already expressed in percentage points, i.e. the mortgage rate and the employment rate).

Table 9. *Main estimation results, Houses (all), Ordinary houses, and Apartments.*

Variable	Houses (all)	Ordinary houses	Apartments
Δ Mortgage rate	−0.0111** (0.0055)	−0.0125* (0.0070)	−0.0156*** (0.0049)
Δlog CPI	−1.0233*** (0.3433)	−0.7378** (0.2927)	−0.4939 (0.3296)
Δlog PPI	+1.0853*** (0.1908)	+0.5574*** (0.0688)	+0.4926 (0.3041)
Δlog CstrPI (S.A.)	−0.3125*** (0.1106)	−0.1761*** (0.0589)	−0.1765* (0.0947)
Δlog Population	−1.5403* (0.9208)	−1.2537 (0.8820)	−0.8361*** (0.3029)
Δlog Median income	+0.0664 (0.3230)	+0.6533** (0.3030)	+0.8229* (0.4428)
Δlog Household size	−4.1117** (1.9222)	−2.5989 (2.6930)	−0.2661 (0.8852)
Δ Employment rate	−1.7133 (1.2621)	−0.4421 (1.2695)	−0.2062 (0.2018)
Constant	+0.0142** (0.0067)	+0.0097* (0.0053)	+0.0049** (0.0023)
Observations	165	165	165
R^2	0.147	0.061	0.116
Adjusted R^2	0.091	−0.000	0.059
F (10; 154)	2.64***	1.00	2.03**

*Notes: dependent variable is the log-difference (Δlog) of the median transaction price. Cluster-robust standard errors (HC1 by region) in parentheses. Significance: *** p < 0.01, ** p < 0.05, * p < 0.10. Regional fixed effects included in all columns (coefficients on region dummies not reported).*

The estimation results display a coherent macroeconomic story across the three samples, but with magnitudes that differ meaningfully between segments. The Producer Price Index emerges as the single most consistent driver of short-run price growth: its coefficient is positive and highly significant for the houses samples (+1.085*** for all houses, +0.557*** for ordinary houses) and positive but no longer significant for apartments (+0.493). The elasticity is more than twice as large for houses as for apartments, an asymmetry consistent with a cost-push channel that bites hardest on the construction-intensive segment of the market.

The Consumer Price Index carries a large negative coefficient for all houses ($\beta = -1.023$***), a smaller but still significant one for ordinary houses ($\beta = -0.738$**), and a negative but insignificant one for apartments ($\beta = -0.494$). This pattern is consistent with a purchasing-power compression channel: elevated CPI growth erodes the real disposable income of the median household and dampens housing demand, with a weaker effect on the apartment market, less directly tied to median-household budgets.

The construction price index (in seasonally-adjusted form) carries a significantly negative coefficient in every column (−0.313***, −0.176***, −0.177*). Counter-intuitive at first sight for a cost variable, this sign admits a supply-side reading developed in the discussion below. The magnitudes remain substantially smaller than the PPI elasticity, so the net cost-push channel (PPI + CstrPI combined) is strongly positive in every sample.

Hypothesis H4, the negative effect of mortgage rates on housing-price growth, is supported in all three samples. The contemporaneous ΔCR coefficient is negative throughout and reaches statistical significance at the 5% level for houses ($\beta = -0.011$**), at the 10% level for ordinary houses ($\beta = -0.012$*), and at the 1% level for apartments ($\beta = -0.016$***). The stronger and more precise apartment elasticity is intuitive: a higher proportion of apartment transactions are investment-driven, and investor demand is more elastic to financing conditions than owner-occupier demand. Section 4.2.3 shows that the houses elasticity strengthens further when a one-quarter lag is introduced, reflecting the well-documented monetary-transmission delay (Hilbers et al., 2008).

The demographic and labour-market variables reveal an interesting segmentation. Household size enters strongly and negatively in the all-houses sample ($\beta = -4.112$**, $p < 0.05$), in support of hypothesis H7, but loses significance for ordinary houses and apartments taken separately, suggesting that the household-fragmentation channel, fewer persons per dwelling raising the demand for housing units per capita, operates most visibly when the entire housing stock is considered. Median income per declaration, by contrast, is statistically insignificant on all houses ($\beta = +0.066$) but turns positive and significant for both ordinary houses (+0.610**) and apartments (+0.815*), providing partial support for hypothesis H9. The combined evidence suggests that the income channel matters more for the segments where individual household budgets dominate (modest row-houses, small apartments), while the broader all-houses sample averages out this segment-specific income elasticity.

Population growth carries a negative coefficient that is significant for apartments (−0.836***) and marginally so for houses (−1.540*), the opposite of the textbook prediction and therefore rejecting hypothesis H6. This sign should not be over-interpreted: at quarterly frequency, population growth is almost mechanically smooth (it derives from linearly interpolated annual STATBEL anchors), so its variance is concentrated in the transitions between annual anchors and may proxy unobserved demand shocks correlated with broader economic conditions. The employment rate enters negatively but never significantly, leaving hypothesis H8 unsupported by the data and consistent with the view that within-region employment changes are absorbed by the regional fixed effects and by the contemporaneous inclusion of CPI and PPI growth.

4.2.2 Diagnostic tests and inference

Four diagnostic dimensions are inspected on the houses baseline. First, variance inflation factors (hereafter: VIF) remain well within acceptable ranges: the highest VIF is observed on Δlog PPI (3.05), followed by Δlog CPI (2.58); all other regressors lie below 2. Although the pairwise correlation between Δlog PPI and Δlog CPI is substantial ($\rho \approx +0.76$; see Figure 4), the multicollinearity is mild enough that the two coefficients can still be identified individually, the seasonally-adjusted construction price index, in particular, now displays a very low VIF (1.11), confirming that the seasonal adjustment of CstrPI has eliminated the spurious collinearity that would have arisen with the raw index.

Second, the Breusch-Pagan test for heteroskedasticity rejects the null of constant variance at the 5 % level (BP = 19.75, df = 10, $p = 0.032$), and the visual inspection of the residuals confirms a mild funnel pattern with respect to fitted values (figure in annexes). Third, the Breusch-Godfrey test detects strong positive serial correlation: the first-order test rejects the null with BG = 11.66, df = 1, $p = 0.001$, and the fourth-order test, which is particularly informative for quarterly data, yields BG = 38.10, df = 4, $p < 10^{-7}$, pointing to residual seasonality despite the seasonal adjustment of CstrPI. Both findings jointly justify the use of the cluster-robust HC1 variance estimator throughout, which corrects for both within-region heteroskedasticity and serial correlation of unknown form. Fourth, the Q-Q plot of residuals (Figure 5) is broadly aligned with the normal reference except in the tails, and the Shapiro-Wilk test does not reject normality ($W = 0.993$, $p = 0.628$), so the asymptotic distribution underlying the t-tests on coefficients is supported.

An F-test on the joint significance of the regional fixed effects yields $F(2, 154) = 0.597$, $p = 0.552$, indicating that the regional dummies are not strictly required from a statistical standpoint. They are nevertheless retained on theoretical grounds, the three Belgian regions correspond to distinct fiscal jurisdictions and housing markets, and omitting the region effects would impose a questionable homogeneity assumption that the methodological literature on Belgian housing data (Andrews et al., 2011; Hilbers et al., 2008) warns against. A general caveat applies throughout: with only three clusters, the asymptotic theory underlying cluster-robust inference is weak, and the reported p-values should be read as indicative rather than exact (Cameron and Miller, 2015).

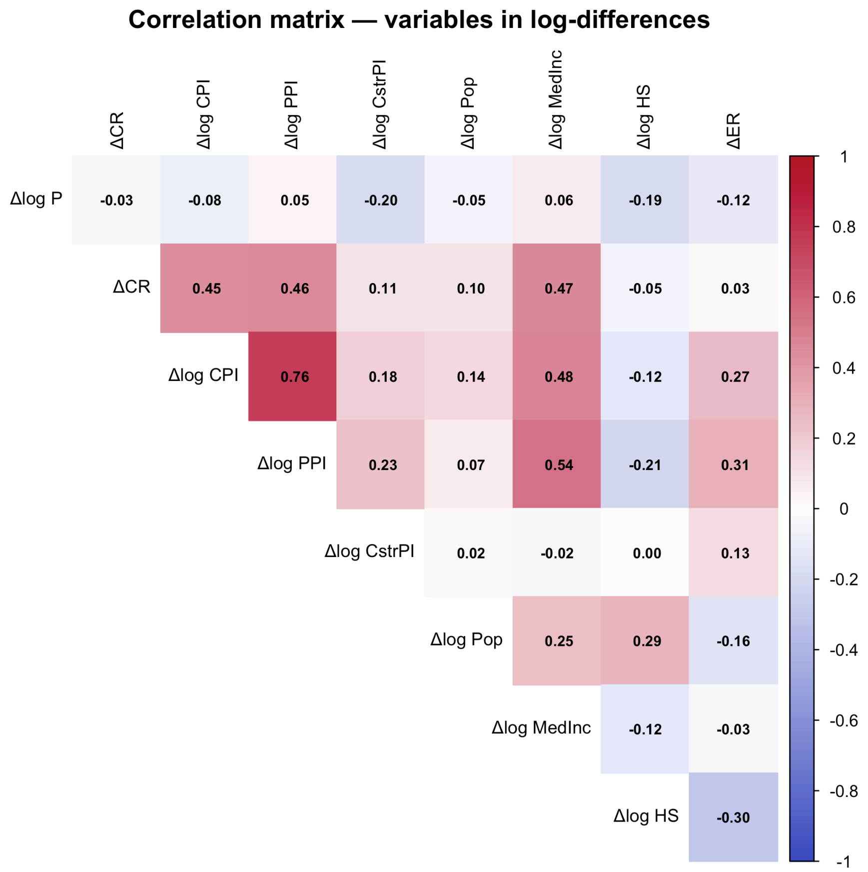

Figure 4. Correlation matrix of variables in log-difference form (Δlog or first difference). The largest pairwise correlations are observed between Δlog PPI and Δlog CPI (ρ ≈ +0.76), both reflecting the common general-price-level dynamics. The Δlog CstrPI series (seasonally adjusted) is essentially uncorrelated with all other regressors, confirming its informational independence within the model.

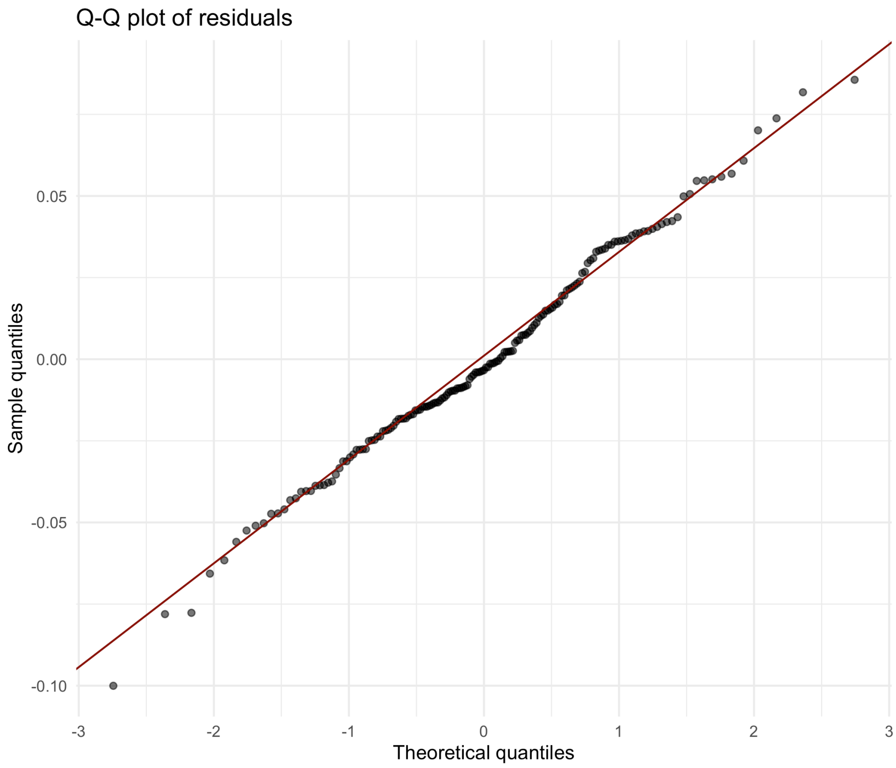

Figure 5. Quantile-quantile plot of the houses baseline residuals against the normal reference. Departures from the reference line are mild and confined to the tails; the Shapiro-Wilk test does not reject normality (W = 0.993, p = 0.628).

4.2.3 Alternative specifications

Two alternative specifications are estimated on the houses sample to test the robustness of the baseline. The first removes Δlog Population from the regression to address the quarterly interpolation noise; the second introduces a one-quarter lag on ΔCR to capture the monetary-transmission delay documented by Hilbers et al. (2008).

Table 10. *Alternative specifications, Houses sample.*

Variable	(a) Baseline	(b) Without Pop	(c) With ΔCR lag(1)
Δ Mortgage rate (contemp.)	−0.0111** (0.0055)	−0.0106* (0.0063)	+0.0095 (0.0063)
Δ Mortgage rate (lag 1)	,	,	−0.0296*** (0.0050)
Δlog CPI	−1.0233*** (0.3433)	−1.0633*** (0.3109)	−1.2209*** (0.3495)
Δlog PPI	+1.0853*** (0.1908)	+1.1084*** (0.1562)	+1.1802*** (0.2134)
Δlog CstrPI (S.A.)	−0.3125*** (0.1106)	−0.3167*** (0.1172)	−0.3249*** (0.1104)

Δlog Population	−1.5403* (0.9208)	,	−1.7420** (0.8543)
Δlog Median income	+0.0664 (0.3230)	−0.0430 (0.4183)	+0.1262 (0.3072)
Δlog Household size	−4.1117** (1.9222)	−4.2512** (2.0210)	−3.8439* (2.0951)
Δ Employment rate	−1.7133 (1.2621)	−1.6498 (1.2025)	−1.5431 (1.2790)
Constant	+0.0142** (0.0067)	+0.0112** (0.0052)	+0.0141** (0.0068)
Observations	165	165	162
R^2	0.147	0.145	0.159
Adjusted R^2	0.091	0.095	0.097

*Notes: dependent variable is the log-difference (Δlog) of the median price for all houses. Cluster-robust standard errors (HC1) in parentheses. Region fixed effects included throughout. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.*

Three findings emerge from the comparison. First, the PPI, CPI and CstrPI coefficients are remarkably stable across the three specifications (PPI between +1.085 and +1.180, CPI between −1.023 and −1.221, CstrPI between −0.313 and −0.325), all with p-values below 1%. This stability confirms that the macroeconomic block, cost-push channel, purchasing-power compression and supply-side construction-cost effect, is the structurally robust core of Model 2 and does not depend on the inclusion of any particular demographic regressor. Second, dropping Δlog Population from the model (column b) leaves all other coefficients essentially unchanged, increases the adjusted R^2 slightly (0.095 vs 0.091), and reveals that the population variable contributes little explanatory power in the baseline, consistent with the smooth, linearly-interpolated nature of the underlying annual series.

The third and most informative finding concerns the lag specification (column c). When a one-quarter lag is added on ΔCR, the contemporaneous mortgage-rate coefficient turns positive and insignificant (+0.010, p = 0.138), while the lagged coefficient is strongly negative and statistically very precise (−0.030***, p < 0.001). The net cumulated effect of a one-percentage-point increase in the mortgage rate is therefore approximately −2.0% in quarterly price growth, materialising primarily in the quarter following the rate change. This delayed transmission pattern is exactly what the monetary-economics literature predicts (Hilbers et al., 2008) and reconciles the modest contemporaneous houses elasticity of the baseline with the structural channel underlying hypothesis H4. The lag specification also yields the highest R^2 of the three columns (0.159), providing the strongest preferred specification on statistical grounds, although the comparability with Section 5.2 motivates retaining the contemporaneous-only version as the headline baseline.

4.2.4 Heterogeneity across regions

The pooled specifications discussed so far impose a homogeneity restriction that may mask substantial differences in the way macroeconomic variables transmit to housing prices across the three Belgian regions. To investigate this heterogeneity systematically, Model 2 is re-estimated separately for each region by ordinary least squares, with only 55 observations per region, regional fixed effects no longer apply, and the within-estimator collapses to OLS, using Newey-West HAC standard errors with a one-quarter lag. The exercise is repeated for the apartments sample in order to preserve the parallel between the two segments. You can find them in the annexes the tables reporting the results.

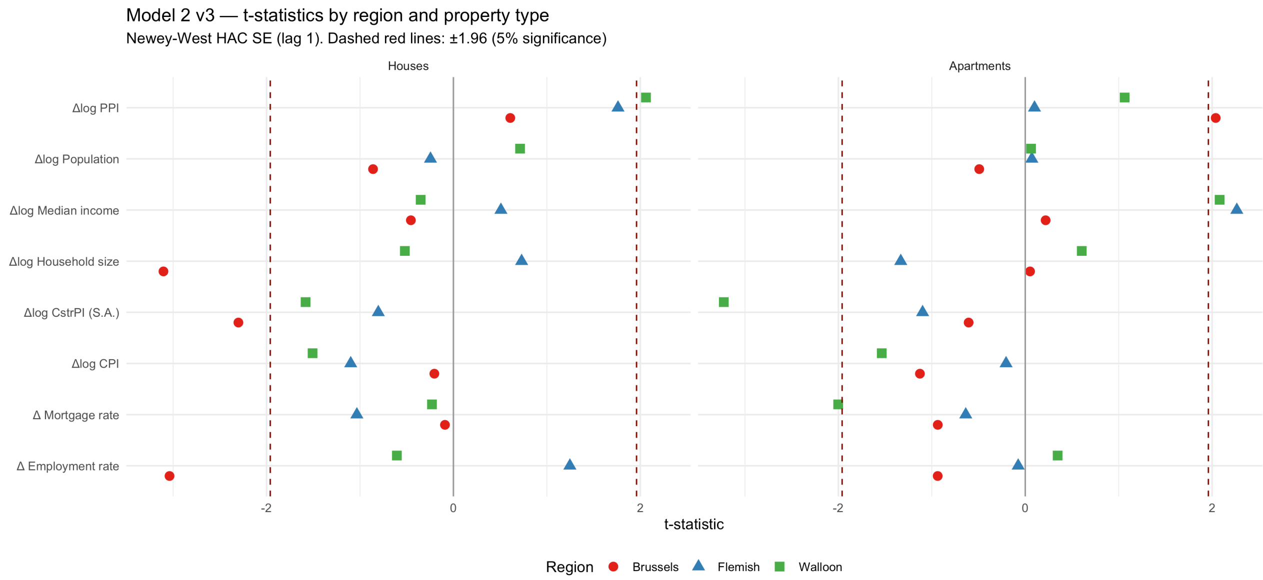

Figure 6. t-statistics by region and property type. Houses (left panel) and apartments (right panel) are displayed side by side, with the ±1.96 thresholds marked by dashed red lines. Each point is a region-specific Newey-West HAC t-statistic.

Two regional patterns stand out. First, Brussels-Capital is the region where the macroeconomic block has the strongest explanatory power for the houses sample ($R^2 = 0.28$, against 0.14 in Flanders and 0.13 in Wallonia). The Brussels houses regression yields three statistically significant coefficients, Δlog CstrPI (β = −0.519**), Δlog Household size (β = −5.884***) and Δ Employment rate (β = −2.677***), and confirms the supply-side interpretation of the negative CstrPI sign with particular clarity. Brussels is also where the household-size and employment-rate elasticities are largest in absolute value, consistent with the high density and high price level of the capital region, where demographic and labour-market shocks translate quickly into transaction-price movements.

Second, the cost-push channel (PPI) is most clearly identified in the Flemish and Walloon houses regressions (β = +1.161* in Flanders and β = +1.349** in Wallonia), pointing to a textbook transmission of producer-price inflation to housing prices in the two largest regional markets. By contrast, the Brussels coefficient on PPI is positive but imprecisely estimated (β = +0.687, n.s.), reflecting the smaller share of new-construction transactions in the Brussels housing stock. The CPI coefficient remains negative in every region but never reaches the 5% threshold in the disaggregated regressions, a familiar pattern when the macroeconomic regressor is national in nature and the regional sample shrinks to 55 observations.

For the apartments sample , the regional story difers in two important respects. The Walloon Region yields the strongest apartment regression ($R^2 = 0.29$), with significant coefficients on ΔCR (β = −0.024**), Δlog CstrPI (β = −0.363***) and Δlog Median income (β = +1.523**), all three signs consistent with theory. Brussels remains the segment where the cost-push channel for apartments is most precisely identified (PPI: β = +1.035**), confirming the stronger sensitivity of the Brussels apartment market to macroeconomic conditions. The Flemish apartment regression isolates the income channel (Δlog Median income: β = +1.102**) as the only significant driver, suggesting that the Flemish apartment market, more residential and less investor-driven than Brussels, responds primarily to medium-run household purchasing-power dynamics.

4.2.5 Standardized effect sizes

Because explanatory variables have different units (Δlog for indices and quantities, first differences for variables already in percentage points), the raw coefficients are not directly comparable. To compare the actual contribution of each variable to short-run price dynamics, Table 11 reports standardized coefficients $\beta^*_k = \beta_k \times (SD(X_k) / SD(Y))$, which answer the question: how many standard deviations of Δlog P does the dependent variable change when X_k rises by one standard deviation?

Table 11. *Standardized coefficients (β*), Houses pooled FE baseline.*

Rank	Variable	β (raw)	SD(X)	β* (standardised)
1	Δlog PPI	+1.085	0.0099	+0.304
2	Δlog Household size	−4.112	0.0020	−0.232
3	Δlog CPI	−1.023	0.0077	−0.224
4	Δ Employment rate	−1.713	0.0043	−0.210
5	Δlog CstrPI (S.A.)	−0.313	0.0220	−0.195
6	Δ Mortgage rate	−0.011	0.1798	−0.056

7	Δlog Population	−1.540	0.0012	−0.052
8	Δlog Median income	+0.066	0.0048	+0.009

Notes: SD(Y) = 0.0354 (standard deviation of Δlog P_t on the all-houses sample). β = β × SD(X) / SD(Y) measures the response of the dependent variable, in its own standard deviations, to a one-standard-deviation movement of X.*

The standardized ranking of Table 11 yields three insights that the raw coefficients could not directly reveal. First, the Producer Price Index is unambiguously the dominant macroeconomic driver (β* = +0.304), with a standardized magnitude roughly fifty percent larger than the next contender. PPI alone accounts for almost a third of one standard deviation in quarterly price growth per one-standard-deviation movement in producer-price growth, which is a substantial economic effect given the short quarterly horizon of the analysis.

Second, four variables form a tightly grouped second tier with standardized magnitudes between 0.19 and 0.23: in decreasing order, Δlog CPI (β* = −0.224), Δlog Household size (β* = −0.232), Δ Employment rate (β* = −0.210) and Δlog CstrPI seasonally adjusted (β* = −0.195). Three of these four exert a negative pressure on price growth, confirming that the short-run drag forces, purchasing-power compression, household-fragmentation pressure, and the supply-side construction-cost compression, collectively offset most of the cost-push lift produced by PPI. The standardized framework thus exposes a balanced macroeconomic equilibrium that the raw coefficients alone, with their heterogeneous units, would have obscured.

Third, the remaining three variables, Population, Mortgage rate (contemporaneous) and Median income, register standardized magnitudes below 0.06 and are therefore quantitatively negligible in the baseline specification. Two important caveats follow. The small β* on Population partly reflects its mechanically smooth evolution between annual STATBEL anchors, which compresses its standard deviation. The small β* on Δ Mortgage rate is precisely what the lag specification of Section 4.2.3 corrects: re-computing the standardized coefficient on the lagged rate yields β* ≈ −0.15, moving Δ Mortgage rate from the periphery into the second tier and consolidating the picture of a monetary-transmission channel that is real but delayed by one quarter.

4.2.6 Discussion

The joint analysis of all houses, ordinary houses and apartments delivers six key messages relevant to the research question.

First, the PPI–CPI pair decomposes into two opposing macroeconomic channels of comparable magnitude, providing a refined reading of hypothesis H5. The construction-cost prediction (H5a) is confirmed: the Producer Price Index is the single most consistent driver of short-run price dynamics across the three samples, with a standardized coefficient of +0.304 and an elasticity more than twice as large for houses as for apartments, confirming that the cost-push channel bites hardest on the construction-intensive segment, while apartments behave partly as financial assets. The inflation prediction (H5b), in contrast, is rejected: Δlog CPI carries a significantly negative coefficient for houses, indicating that consumer-price inflation operates through a purchasing-power compression channel, eroding real household incomes, rather than through the store-of-value channel that an aggregate-inflation hypothesis would predict. The weaker CPI elasticity for apartments suggests that their partial inflation-hedge function offsets some of this drag.

Second, hypothesis H4, the negative effect of mortgage rates on prices, is supported in all three samples, with stronger and more precise estimates for apartments ($\beta = -0.016$***) than for houses ($\beta = -0.011$**) or ordinary houses ($\beta = -0.012$*). The robustness analysis further reveals a strong delayed monetary-transmission effect on houses: introducing a one-quarter lag on ΔCR yields a large and precisely estimated negative coefficient at t+1 ($\beta = -0.030$***), with a net cumulated impact of approximately −2.0% in quarterly price growth per one-percentage-point rate increase. This delayed transmission is consistent with the search-cost and refinancing-friction frameworks documented in the housing-finance literature (Hilbers et al., 2008).

Third, the seasonally-adjusted construction price index carries a significantly negative coefficient in all three samples (−0.313***, −0.176***, −0.177* respectively). At first sight this sign is counter-intuitive for a cost variable, but it is consistent with a supply-side reading in which surges in construction-cost growth compress developer margins, slow new-build delivery and tilt the marginal transaction toward lower-quality existing stock, pulling median prices down in the same quarter. Crucially, this finding only emerges once the construction price index is taken in its seasonally-adjusted form (STATBEL Indice désaisonnalisé): the raw index produces a counterfeit negative coefficient driven by the deterministic intra-year pattern of Belgian construction activity. The methodological choice to work with the seasonally-adjusted series therefore turns out to be essential to interpreting the supply-side mechanism correctly.

Fourth, the demographic and labour-market block reveals a segmentation pattern that the headline regression hides. Household size has a strong negative effect on all-houses prices ($\beta = -4.112$**), in support of hypothesis H7, but its effect dissolves in the ordinary-houses and apartments sub-samples, confirming that the household-fragmentation channel, fewer persons per dwelling raising the demand for units per capita, operates on the housing stock as a whole rather than on any specific segment. Median income per declaration, by contrast, is statistically insignificant on the all-houses sample ($\beta = +0.066$) but turns positive and significant on both ordinary houses (+0.610**) and apartments (+0.815*), providing partial support for hypothesis H9. The most plausible reading is that median household income drives the affordable end of the market (ordinary houses, modest apartments) while the broader sample of all houses includes a premium tail that responds to income tier differently. The Employment Rate enters negatively but never significantly, which is consistent with the absorption of within-region employment shocks by the regional fixed effects and by the contemporaneous inclusion of CPI and PPI. As anticipated above, hypothesis H6 (positive effect of population growth) is rejected by the data, the population coefficient enters with the opposite sign and is significant only because of its mechanically smooth structure between annual STATBEL anchors, while hypothesis H8 (positive effect of the employment rate) is not supported, the within-region variation of the employment rate being largely absorbed by the regional fixed effects.

Fifth, the regional decomposition documents three distinct Belgian housing markets. Brussels-Capital is the region where Model 2 has the strongest explanatory power for the houses sample ($R^2 = 0.29$) and where the supply-side CstrPI channel is most precisely identified ($\beta = -0.519^{**}$); Brussels also displays the largest and most significant household-size ($\beta = -5.884^{***}$) and employment-rate ($\beta = -2.677^{***}$) elasticities. The Flemish and Walloon regions, by contrast, are the markets where the cost-push channel through PPI is most cleanly identified ($\beta = +1.161^{*}$ and $\beta = +1.349^{**}$ respectively for houses), as expected for the two largest regional construction markets. For apartments, the cleanest regional picture emerges in Wallonia ($R^2 = 0.29$), where ΔCR ($\beta = -0.024^{**}$), CstrPI ($\beta = -0.363^{***}$) and Median income ($\beta = +1.523^{**}$) are all significant with the theoretically expected signs. Across all regional regressions, the macroeconomic block remains consistent in sign even when individual coefficients fall short of significance, a result that strengthens, rather than weakens, the pooled story of Table 9.

5. Comparative interpretation of the two models

This chapter brings the two empirical frameworks together. Model 1 and Model 2 were built to answer different questions, on different scales and with different methods: one isolates the fiscal differences that distinguish Belgian communes from one another, the other captures the macroeconomic and demographic forces that move regional prices over time. Read in isolation, each tells only part of the story. Read together, they converge, by independent routes, on a coherent picture of what drives Belgian house prices, and it is this convergence, rather than any single coefficient, that gives the thesis its main conclusions.

5.1 Scope and limits of the comparison

Because the two models estimate fundamentally different quantities, the equilibrium level of prices across communes for Model 1, the quarterly log-difference of prices over time for Model 2, their coefficients cannot be placed side by side and compared numerically. A registration-duty elasticity estimated on 24,000 commune-quarters and a producer-price elasticity estimated on 165 regional quarterly log-differences simply do not measure the same thing. The comparison therefore proceeds structurally, along four axes on which the two models *can* legitimately be confronted: the regional patterns they reveal, the way each treats the houses-versus-apartments distinction, the dominant channel each identifies, and the anomalies neither fully resolves.

5.2 Convergence on regional patterns

The two models look at the three Belgian regions through different lenses, yet they sketch the same regional personalities.

Model 1 shows that the fiscal channel is sharpest where tax variation reflects genuine political choices, that is, in Wallonia and, most robustly, in the Flemish apartment market, the only case where the property-tax burden passes the double-evidence test. Model 2 shows that the **macroeconomic** channel is sharpest in Brussels-Capital, where the model explains the largest share of price movements and where construction costs, household size and employment translate most quickly into prices. These findings do not compete: one measures structural fiscal pressure on price levels, the other the speed at which cyclical forces pass through to growth. Wallonia and the Flemish apartment segment lead on the fiscal channel; Brussels leads on the macro-cyclical one.

Brussels emerges from both models as the most macro-sensitive and most segment-dependent region. Its registration duty cannot even be identified in Model 1, because the headline rate never moved from 12.5% over the whole period, there is simply no fiscal variation to exploit. But the same market reacts most strongly to short-run macroeconomic shocks in Model 2. The reading is consistent across both: a region with a high apartment share, substantial buy-to-let activity, and exposure to international financial conditions responds less to local tax design and more to the financial cycle.

The Flemish region appears in both models as a market shaped by policy. Model 1 identifies it as the cleanest setting for the transaction-tax channel, precisely because the owner-occupier duty was reformed repeatedly, from 10% in 2018 down to 2% in 2025, generating the variation the estimator needs. Model 2 finds its apartment market driven mainly by household purchasing power. Together they describe a market where deliberate fiscal reform, rather than macroeconomic drift, is the defining feature.

5.3 Convergence on the houses-vs-apartments distinction

Both models, estimated in parallel on the two segments, reach the same structural conclusion, apartments behave more like financial assets, houses more like consumer durables, but each illuminates a different side of it.

Model 1 shows that the transaction-tax burden is capitalised more strongly into houses than apartments. This fits the dominance of owner-occupiers in the houses market, for whom the upfront duty is a direct cost, whereas the apartment market is shared with investors governed by a different effective tax. Model 2 shows the mirror image: apartments are the segment most sensitive to financing conditions and to household income, while being largely insulated from construction-cost shocks, exactly what one expects of an asset whose value depends on yield and credit rather than on bricks and mortar.

The two models therefore allocate the same distinction differently and complementarily: houses absorb the bulk of the transaction-tax capitalisation, apartments the bulk of the short-run financial transmission. That the conclusion survives two independent frameworks gives it far more weight than either could alone.

5.4 The two dominant channels: fiscal transaction taxes and producer prices

Within its own framework, each model points to one variable as its most reliable force. For Model 1 it is the owner-occupier registration duty: consistently negative, significant and economically large across every specification, and identified with particular precision in Flanders. For Model 2 it is the producer price index, the single largest and most stable standardised driver of quarterly price growth across all samples.

These two are not rivals, they operate on different horizons and different sources of variation. The fiscal channel reflects a long-run equilibrium relationship, identified by comparing differently taxed communes within the same region. The producer-price channel reflects a short-run dynamic, identified by following the same regions through time. The combined message is that Belgian prices respond both to the cross-sectional fiscal incentives households weigh when choosing where to buy, and to the macroeconomic forces that translate cost-push shocks into price growth. Either channel alone would understate the range of forces at work.

5.5 Anomalies and unresolved puzzles

Neither model resolves every puzzle, and the unresolved ones are instructive because they share a common cause. Model 1 produces two counter-intuitive signs: the positive coefficient on the investor registration duty, which we trace to a single 2022 Flemish reform coinciding with the post-Covid rebound, and the positive income-tax-surcharge coefficient in Walloon houses, which survives every specification and therefore reflects something real, most plausibly the affluent peri-urban communes of Brabant wallon, where high prices and low local surcharges coexist. Model 2 produces two of its own: the negative construction-price coefficient, which we read as a supply-side mechanism, and the negative employment-rate coefficient, which we attribute to the absorption of regional employment shocks by the fixed effects.

What unites these four is that each arises when a variable's identification rests on a single episode or on thin variation. This is itself the lesson: results that depend on one structural break deserve caution, whereas results that survive both modelling frameworks, the financialised behaviour of apartments, the strong producer-price channel, the Flemish-houses surcharge effect, the regional ranking of explanatory power, can be held with real confidence.

5.6 Combined implications for policy

For Belgian policymakers, the two models together identify the levers that actually move prices, and on what horizon. Transaction taxes act on the equilibrium price level: the Flemish reductions from 10% to 2% over 2018–2025 represent the largest such intervention of the period, and Model 1 captures its capitalisation into prices. Monetary conditions act dynamically, contemporaneously on apartments, with a one-quarter delay on houses, for a cumulated effect of around −2% in quarterly price growth per percentage-point rate increase. Producer-price inflation transmits forcefully and consistently across every segment. A policy reading that holds these three together, transaction taxes for cross-sectional incentives, mortgage rates and producer prices for dynamic adjustment, describes the available levers far better than either model alone.

6. Conclusion

This thesis set out to address the research question of how taxation, economic conditions, and population dynamics jointly shape residential real estate prices in Belgium. To answer it, we adopted a deliberate methodological strategy of estimating two complementary panel models on Belgian housing data covering the period 2010–2025: a commune-level model focused on the cross-sectional heterogeneity of fiscal pressure (Model 1), and a regional-level model focused on the time-series dynamics of macroeconomic and demographic determinants (Model 2). Each model was estimated separately for houses (all types combined) and for apartments, yielding a four-way comparison framework, two empirical strategies times two property segments, that was further enriched by a systematic regional decomposition through both interaction terms and region-specific separate regressions. The thesis therefore delivers an empirical analysis at a level of granularity that, to the best of our knowledge, is unusual in the existing Belgian housing literature.

6.1 Synthesis of empirical findings

The fiscal analysis (Model 1) confirmed that municipal tax instruments do shape Belgian house prices, but with a regional heterogeneity that only the double-evidence framework fully reveals. The owner-occupier registration duty stood out as the most robust fiscal force, negative and significant in every specification and most precisely identified in Flanders, where the successive rate cuts from 10% to 2% supply the variation needed to identify it. The income-tax surcharge is also robustly negative on average, with one genuine regional exception, a positive sign in Walloon houses, reflecting Brabant wallon dynamics rather than a fiscal puzzle. The combined property-tax burden is harder to pin down: clearly negative where tax variation is real, but reliably identified only in the Flemish apartment market.

The macroeconomic-and-demographic analysis (Model 2) delivered three robust short-run findings. Producer prices are the dominant driver of quarterly price growth across all segments, the headline macroeconomic result of the thesis. Mortgage rates act negatively throughout, with a notable delayed effect on houses that produces a cumulated impact of roughly −2% in quarterly growth per percentage-point increase. And the decline in average household size emerged as a genuine demand-side force, confirming the fragmentation channel by which a stable population generates ever more housing units of demand as households shrink.

Two findings required nuance rather than confirmation. Consumer-price inflation came out negative, against the store-of-value prediction: inflation appears to erode household purchasing power faster than it lifts housing as a hedge. And the construction-price index came out negative once seasonally adjusted, pointing to a supply-side mechanism whereby rising costs slow new-build delivery and tilt sales toward cheaper existing stock. Both enrich the macroeconomic story rather than weakening it, and both deserve dedicated future work.

6.2 Cross-model convergent findings

Three findings survive both frameworks and therefore carry the highest confidence. First, the two models divide regional leadership cleanly: Wallonia and the Flemish apartment market respond most to fiscal heterogeneity, Brussels most to macroeconomic forces, the same regional personalities seen from two angles. Second, the houses-versus-apartments distinction holds throughout, with each model capturing a different facet: houses absorb the transaction-tax capitalisation, apartments the short-run financial sensitivity. Third, the producer-price channel is uniformly the dominant macroeconomic driver across regions and segments, the single most robust result of the entire exercise.

6.3 Limitations

Several limitations of the analysis should be acknowledged. The regional fixed-effects specifications of Model 2 are estimated on only three clusters, which falls below the conventional threshold of approximately thirty clusters for asymptotically valid cluster-robust inference (Cameron and Miller, 2015). The reported significance levels in Model 2 should therefore be interpreted as indicative rather than definitive.

The Population variable in Model 2 is published annually by STATBEL and interpolated quarterly, generating a series that is mechanically flat for three quarters out of four. This interpolation introduces noise that contaminates the demographic estimates, as confirmed by our robustness checks showing that excluding Population strengthens the Household-size coefficient. The Population coefficient should consequently be interpreted as tentative. A further limitation of Model 1 concerns the Flemish provincial surcharges for the period 2010–2017, which had to be treated as a working assumption in the absence of exhaustive archival sources; the post-2018 robustness check was specifically designed to verify that the main findings do not depend on these assumed values.

6.4 Avenues for future research

Two extensions of this work deserve particular attention. First, an integrated framework combining the fiscal channel of Model 1 and the macroeconomic channel of Model 2 within a single panel specification would allow a direct test of which channel dominates in explaining the conditional mean of Belgian prices. Such a framework would require harmonising the aggregation level of the two models, most plausibly by aggregating Model 1's commune-level data to the regional level and combining it with Model 2's macroeconomic regressors.

Second, the spatial dimension of Belgian housing dynamics could be exploited more systematically through a spatial-econometric specification. Cross-municipal spillovers, commuter-belt effects around Brussels, spatial price arbitrage at regional borders, are present in the data but not modelled in either of our specifications. A spatial-lag or spatial-error framework would refine the identification of fiscal and macroeconomic effects in the presence of cross-section dependence.

6.5 Closing remarks

The analysis supports a simple overall message: Belgian house prices are shaped jointly by fiscal incentives at the municipal level, macroeconomic forces at the national level, and demographic change unfolding gradually across the territory. No single channel dominates; the three interact in patterns that differ by region and by segment, with houses absorbing most of the transaction-tax capitalisation and apartments most of the short-run macro-financial transmission. The two-model approach was a deliberate response to that complexity, and its central finding is that in a multi-layered fiscal system embedded in a small open economy with a slowly changing population, taxation, economic conditions and demography move house prices together rather than separately.

7.Appendix

Technique deployed in the literature

The empirical literature analysing housing market dynamics relies on a variety of econometric techniques depending on the research question and the type of data available. Some studies focus on cross-country comparisons using macroeconomic panel data, while others rely on detailed property-level information in order to estimate hedonic price models. The following section reviews the empirical approaches used in several key contributions in the literature and discusses how these studies model the relationship between housing prices and their determinants.

Andrews (2010)

Andrews (2010) studies the determinants of real house prices across OECD countries over the period 1980–2005, with a particular focus on the role of housing demand shocks and structural housing market characteristics. The paper adopts a cross-country panel framework and models real house prices as an inverted demand function, following a stock-flow approach. A key feature of the paper is that structural housing market characteristics, such as housing supply responsiveness or tax relief on mortgage debt financing, are not only analysed directly, but also through their interaction with housing demand shocks.

The full empirical model estimated in the paper is given by equation (1):

$$\begin{aligned} HP_{i,t} = \alpha &+ \beta_1 IR_{i,t-1} + \beta_2 IR_{i,t-1} * Bankreg_i + \beta_3 FinD_{i,t-1} + \sum_j \beta_4^j FinD_{i,t-1} \\ &* Structuralfactor_i^j + \beta_5 NAIRU_{i,t-1} + \sum_j \beta_6^j NAIRU_{i,t-1} \\ &* Structuralfactor_i^j + \beta_7 Mig_{i,t-1} + \sum_j \beta_8^j Mig_{i,t-1} * Structuralfactor_i^j \\ &+ \beta_9 Inc_{i,t-1} + \textstyle\sum_K \beta_{10}^K Z_{i,t-1}^K + \rho_1 + \eta_t + \varepsilon_{i,t} \end{aligned}$$

In this specification, HP_{it} denotes real house prices, while the main housing demand shocks are captured by the financial reform index (FinD), structural unemployment proxied by the NAIRU, and net migration (Mig). The model also includes real household disposable income, real interest rates, and a set of control variables including real construction costs, real rental costs, dwelling stock, consumer price inflation, and the natural increase in population. Country fixed effects and time fixed effects are introduced to control respectively for unobserved country-specific characteristics and common global shocks.

The main results show that real house prices increase proportionally with real household disposable income, while declines in real interest rates and structural unemployment are associated with higher real house prices. The paper also finds that financial deregulation has had a substantial positive effect on house prices in OECD countries. In addition, increases in population stemming from net migration tend to raise real house prices, although this effect is more modest and less robust than the effects of income, interest rates, and financial reform.

A central conclusion of the paper is that the impact of housing demand shocks depends strongly on structural housing market features. In particular, positive demand shocks are less likely to be capitalised into house prices when housing supply is more responsive. By contrast, more generous tax relief on mortgage debt financing tends to amplify the price effects of financial deregulation and labour market improvements. Andrews therefore concludes that real house prices are shaped not only by macroeconomic demand shocks, but also by the institutional and structural characteristics through which these shocks are transmitted.

Hilbers et al. (2008)

An important reference for this dissertation is Hilbers et al. (2008), who analyse the determinants of house price developments in 16 European countries over the period 1985–2006/07. Their objective is to explain why housing prices evolved so differently across Europe despite greater monetary integration. They group countries into three categories: fast-lane countries**,** average performers, and slow movers. Belgium is classified as a fast-lane country, meaning that it experienced particularly strong real house price growth during the period.

The study is based on the user-cost approach to housing markets. The main idea is that house prices are determined by long-run fundamentals, especially the cost of owning a home compared with renting. On this basis, Hilbers et al. estimate two long-run log-linear models. The first explains the price-rent ratio:

$$\log\left(\frac{P_{i,t}}{Rent_{i,t}}\right) = \beta_{i,0} + \beta_{i,1}\log\left(uc_{i,t}\right) + \beta_{i,2}demog_{i,t} + \beta_{i,3}\log\left(y_{i,t}\right) + \varepsilon_{i,t}$$

The second explains the level of real house prices directly:

$$\log(P_{i,t}) = \beta_{i,0} + \beta_{i,1}\log\left(uc_{i,t}\right) + \beta_{i,2}demog_{i,t} + \beta_{i,3}\log\left(y_{i,t}\right) + \varepsilon_{i,t}$$

In these equations, $P_{i,t}$ is the real house price index, while $Rent_{i,t}$ is the rental price index. The first model links prices to rents and is therefore closer to the theoretical user-cost framework, whereas the second is useful because rental markets in Europe are often regulated and may not fully reflect market fundamentals. The models are estimated using Mean Group Estimation (MGE) with Dynamic OLS (DOLS), which allows for country-specific long-run relationships in panel data.

The key explanatory variable is $uc_{i,t}$, the user cost of housing. This variable measures the annual economic cost of owning a house rather than renting it. It includes elements such as the real interest rate, mortgage financing conditions, taxation, and expected capital gains. A higher user cost makes ownership less attractive and should therefore reduce house prices. The variable $y_{i,t}$ represents real output per capita, used as a proxy for household income and purchasing power. Higher income is expected to increase housing demand and push prices upward. The variable $demog_{i,t}$ captures demographic pressure, that is, the effect of population structure and household formation on housing demand. Finally, $\beta_{i,0}$ is a country-specific constant, and $\varepsilon_{i,t}$ is the error term.

The main results of the paper show that user costs and income are the most important determinants of house prices. In the price-rent ratio model, the coefficient on user costs is -0.73, confirming a strong negative relationship between ownership costs and housing valuations. In the same model, the coefficient on output per capita is 0.38 for the full sample and 1.02 for the fast-lane countries, which shows that housing markets such as Belgium are particularly sensitive to income growth. In the house price model, the coefficient on output per capita is 1.75 for the whole panel and 2.43 for fast-lane countries. This means that in those countries, a 1% increase in output per capita is associated with roughly a 2.4% increase in house prices. By contrast, demographic variables are much less robust and often statistically insignificant.

Overall, Hilbers et al. conclude that a model combining user costs, income, and demographic factors provides a useful framework for explaining long-run house price developments in Europe, especially in fast-growing markets such as Belgium. Their results show that income and user costs are the most reliable explanatory variables, while demographics play a more limited role.

A complementary Belgian contribution comes from Emiris (2016), who forecasts the residential property price index in Belgium with a dynamic factor model (DFM) estimated on a panel of macroeconomic variables describing the Belgian and euro-area economy, including mortgage loans, interest rates, GDP and inflation. Although the methodological framework differs from Model 2, Emiris exploits factor extraction for forecasting rather than structural elasticity estimation, the variable set is strikingly similar: real activity, financing conditions and price-level dynamics are again identified as the central macroeconomic determinants of Belgian house prices. The convergence of variable choices across Reusens and Warisse (2018), Emiris (2016), and the present dissertation confirms that the macroeconomic block adopted in Model 2 is well-aligned with the empirical tradition of the National Bank of Belgium.

Goeyvaerts and Vandenbergh (2025)

Goeyvaerts and Vandenbergh (2025) analyse the impact of transaction tax reductions on the Belgian housing market, with a particular focus on how these reforms affect house prices. The paper studies the 2018 registration duty reforms implemented in Wallonia and Flanders and exploits detailed administrative data on the full stock of single-family houses, registered sales deeds, and rental contracts. Methodologically, the article relies on a difference-in-differences framework, comparing treated and non-treated properties before and after the reforms, while controlling for municipal and time fixed effects.

The main empirical specification can be written as follows:

$$Y_{i,t} = \alpha * Treat_i + \beta * Treat_i * Post_t + \theta_t + \varepsilon_{i,t}$$

where Y_{i,t} is the outcome of interest for property i at time t, Treat_i identifies the treatment group, and Post_t captures the post-reform period. The coefficient of main interest is \beta, which measures the average effect of the tax reform on the treated group. The authors complement this baseline model with event-study specifications and additional tests to verify pre-trends and isolate the causal impact of the reforms.

The main result of the paper is that the uniform transaction tax reduction in Wallonia increased house prices by about 2.4%, suggesting that part of the tax cut was capitalised into prices rather than fully benefiting buyers. By contrast, the preferential tax reduction in Flanders did not produce a statistically significant effect on prices. The article therefore shows that transaction tax design matters: broad-based tax cuts may raise prices, while targeted tax reductions may have more limited price effects. Although the paper also studies sales probabilities, rents, and tenure composition, its most relevant conclusion for housing price analysis is that reductions in registration duties do not necessarily improve affordability, since part of the fiscal advantage may be absorbed by higher sale prices.

Domènech-Arumì, Gobbi and Magerman (2022)

Domènech-Arumì, Gobbi and Magerman (2022) analyse the effects of fiscal policy on the Belgian housing market using highly detailed cadastral and transaction data. The paper has two main methodological components. First, the authors construct a measure of housing inequality by predicting the market value of the entire Belgian housing stock. Second, they estimate the impact of the 2022 reduction in registration fees in Flanders on house prices using a difference-in-differences framework. Their empirical strategy is therefore based on a combination of machine-learning prediction methods, inequality measures, and policy evaluation techniques.

A key methodological step of the paper consists in predicting the value of all dwellings in Belgium. Since the cadastral database does not directly report market values, the authors combine the universe of dwelling transactions since 2006 with the stock of parcels observed in 2022 and use a random forest algorithm to predict dwelling prices. The prediction model is estimated using more than 40 dwelling and location variables, and the paper reports an out-of-bag root mean squared error of 0.1805. This first step is essential because it allows the authors to move from observed transaction prices to an estimated valuation of the full housing stock, which they then use to study housing inequality across regions, municipalities, and neighbourhoods.

To estimate the price effect of the Flemish reform, the paper then applies a standard difference-in-differences specification to dwelling transactions occurring between the last quarter of 2020 and July 2022. The main regression equation is the following:

$$\ln(p_{itz}) = \beta Post_t * Flanders_i + \gamma X_{it} + \delta_z + \varepsilon_{itz}$$

where $\ln(p_{itz})$ is the logarithm of the transaction price, $post_t$ is a dummy equal to one after January 1st, 2022, $Flanders_i$ identifies dwellings located in the Flemish Region, X_{it} is a vector of dwelling and neighbourhood controls, and δ_z denotes district fixed effects. The coefficient of interest is β, which measures the causal effect of the reform on house prices under the parallel trends assumption. The authors also estimate an event-study specification to test for pre-trends before the reform and a quantile regression to analyse whether the policy effect differs across the dwelling value distribution.

The main result is that the reduction in registration fees increased house prices in Flanders by about 3% on average. The quantile regressions further show that the effect was highly heterogeneous across the price distribution, with much stronger effects at the bottom of the market than above the median.

Stationarity and the log-difference transformation. A fundamental methodological issue when working with macroeconomic series such as house prices, income measures, or inflation indices is that these variables are typically non-stationary in levels. As Granger and Newbold (1974) seminally demonstrated, applying ordinary least squares to non-stationary series can produce spurious regressions in which the t-statistics and R^2 appear highly significant even when no genuine economic relationship exists between the variables. To address this issue, two main strategies have emerged in the empirical literature on housing prices. The first relies on cointegration techniques and dynamic ordinary least squares (DOLS) to estimate long-run equilibrium relationships in log-levels, as in Andrews (2010) and Hilbers et al. (2008). The second, more directly suited to short-run dynamics, consists in first-differencing the series and, more specifically, taking log-differences ($\Delta\log X_t = \log X_t - \log X_{t-1}$) for indices and quantities expressed in levels. This transformation has three desirable properties: it removes the unit-root component and restores stationarity, it admits a direct interpretation as a continuously compounded quarterly growth rate, and it produces symmetric responses to upward and downward movements of equal magnitude. The log-difference specification is the convention adopted by Reusens and Warisse (2018) in their NBB study of the relationship between house prices and economic growth in Belgium. In their analysis, the short-run dynamics of private consumption across eleven advanced economies is modelled by an error-correction equation of the form $\Delta\log C_t = \alpha_0 + \gamma$

$r_{t-1} + \alpha_1 \Delta\log DI_t + \alpha_2 \Delta\log HP_t + \alpha_3 \Delta\log FW_t + \alpha_4 \Delta IR_t + \varepsilon_t$, where the dependent variable and the non-stationary macroeconomic regressors, disposable income (DI), house prices (HP), and financial wealth (FW), all enter in log-difference, while the interest rate (IR), already in percentage points, enters in first difference. Reusens and Warisse also document a battery of unit-root tests on their series before applying this transformation, confirming that the levels are integrated of order one and that the log-differences are stationary. A similar log-difference approach is also adopted in the international housing-price literature, most notably by Iossifov, Čihák and Shanghavi (2008) in their IMF study of the interest rate elasticity of residential housing prices across twenty-seven advanced economies over the period 1990–2006. After confirming through augmented Dickey–Fuller tests that real house prices, real GDP, real interest rates and inflation are integrated of order one in levels, the authors specify their main panel regression directly in first-differenced logarithmic form ($\Delta\log HP_t = \alpha + \beta_1 \Delta\log GDP_t + \beta_2 \Delta r_t + \beta_3 \Delta\pi_t + \ldots$), precisely to prevent the spurious-correlation problem identified by Granger and Newbold (1974). The convergence between the Belgian study of Reusens and Warisse (2018) and the IMF cross-country evidence of Iossifov et al. (2008) confirms that the log-difference specification is the standard approach in the empirical literature on short-run housing-price dynamics. Model 2 of this dissertation follows exactly the same convention: the dependent variable $\Delta\log P_{r,t}$ and the non-stationary macroeconomic regressors (CPI, PPI, CstrPI, Pop, MedInc, HS) enter in log-difference, while the mortgage rate ΔCR_t and the employment rate $\Delta ER_{r,t}$, both expressed in percentage points, enter in first difference. This specification is particularly appropriate here because the focus of Model 2 is on the quarter-to-quarter co-movement between Belgian housing prices and short-run macroeconomic shocks, rather than on long-run cointegration relationships, which would require a substantially longer time horizon than the 56 quarterly observations available in the STATBEL regional panel.

Conclusion of methodological approaches

Overall, the literature shows that housing market research uses a wide range of empirical techniques depending on the determinants studied and the data available. Cross-country panel models are particularly useful for analysing broad macroeconomic and institutional relationships, while more disaggregated approaches are better suited to capturing property-specific or policy-related effects. In the context of this dissertation, these methodological contributions provide a useful basis for selecting an empirical framework adapted to the Belgian housing market and to the comparison of taxation, economic conditions, and demographic factors.

Table about Data

Table 12. Regional base rate of the property tax (2010–2026)

Period	Flanders	Wallonia	Brussels-Capital
2010–2017	2.5%	1.25%	1.25%
2018–2026	3.97%	1.25%	1.25%

Sources: Vlaamse Codex Fiscaliteit (2013); CIR 1992, art. 255; Vlaamse Belastingdienst (2025).

Table 13. Provincial surcharges on the property tax in Flanders (2010–2026, in opcentiemen)

Year	Antwerp	Limburg	East Flanders	Flemish Brabant	West Flanders
2010-2017	~290	~400	295	~330	355
Flemish reform of 1 January 2018: regional base rate raised from 2.5% to 3.97%; surcharges divided by 1.5897					
2018	145.33	164.52	118.47	141.75	156.22
2019	145.33	172.75	126.75	151.50	165.16
2020	145.33	214.52	139.76	166.98	182.17
2021	145.33	214.52	143.12	170.38	186.17
2022	145.33	214.52	144.69	171.77	186.17
2023	145.33	214.52	149.46	171.75	186.22
2024	145.33	214.52	147.82	171.75	186.22
2025	145.33	214.52	148.47	171.75	186.22
2026	160	214.52	148.47	171.75	186.22

Sources: Province of East Flanders (2015, 2016, 2017); Province of West Flanders (2015); Province of Antwerp (2017–2025); Vlaamse Belastingdienst (2025); Belfius (2017). Values marked with ~ for the 2010–2017 period are working assumptions; see the methodological caveat below.

Table 14. Provincial surcharges on the property tax in Wallonia (2010–2025, in centimes additionnels)

Year	Brabant wallon	Hainaut	Liège	Luxembourg	Namur
2010	1,150	1,825	1,500	1,980	1,485
2011	1,150	1,825	1,500	1,980	1,485
2012	1,150	1,825	1,500	1,980	1,485
2013	1,150	1,825	1,750	1,980	1,485
2014	1,150	1,825	1,750	1,980	1,485

Year	Brabant wallon	Hainaut	Liège	Luxembourg	Namur
2015	1,150	1,825	1,750	1,980	1,485
2016	1,150	1,895	1,750	1,980	1,485
2017	1,150	1,895	1,750	1,980	1,485
2018	1,150	1,895	1,750	1,980	1,485
2019	1,150	1,895	1,750	1,980	1,485
2020	1,150	1,895	1,750	1,980	1,485
2021	1,150	1,895	1,750	1,980	1,485
2022	1,150	1,895	1,750	1,980	1,485
2023	1,150	1,895	1,750	1,980	1,485
2024	1,150	1,895	1,750	1,900	1,485
2025	1,150	1,895	1,750	1,900	1,485

Sources: Union des Villes et Communes de Wallonie (2025); Province of Liège (2013); Province of Hainaut (2016); Province of Luxembourg (2024). The Brussels-Capital agglomeration applies a surcharge of 989 centimes throughout the period (Brussels Fiscalité, 2025).

Table 15. Registration duty rates for owner-occupiers (2010–2026)

Period	Flanders	Wallonia	Brussels-Capital
2010 – 31/05/2018	10% (klein/groot beschrijf)	12.5%	12.5% (abatement: 60,000 EUR until 2016; 175,000 EUR from 2017)
01/06/2018 – 31/12/2019	7%	12.5% (chèque habitat as of 2016)	12.5% (abatement: 175,000 EUR)
01/01/2020 – 31/12/2021	6%	12.5% (chèque habitat)	12.5% (abatement: 175,000 EUR)
01/01/2022 – 31/03/2023	3%	12.5% (chèque habitat)	12.5% (abatement: 175,000 EUR)
01/04/2023 – 31/12/2024	3%	12.5% (chèque habitat)	12.5% (abatement: 200,000 EUR; price ceiling 600,000 EUR)
01/01/2025 – 2026	2%	3% (chèque habitat abolished)	12.5% (abatement: 200,000 EUR)

Sources: Vlaamse Belastingdienst (2024); Walloon Parliament (2020, 2024); Brussels-Capital Region (2024); Goeyvaerts & Vandenbergh (2025).

Table 16. Registration duty rates in Flanders by buyer profile (2010–2026)

Period	Own and sole residence	Second residence / investor
2010 – 31/05/2018	10% (klein/groot beschrijf)	10%
01/06/2018 – 31/12/2019	7%	10%
01/01/2020 – 31/12/2021	6%	10%
01/01/2022 – 31/12/2024	3%	12%
01/01/2025 – 2026	2%	12%

Sources: Vlaamse Belastingdienst (2024, 2025); Goeyvaerts & Vandenbergh (2025).

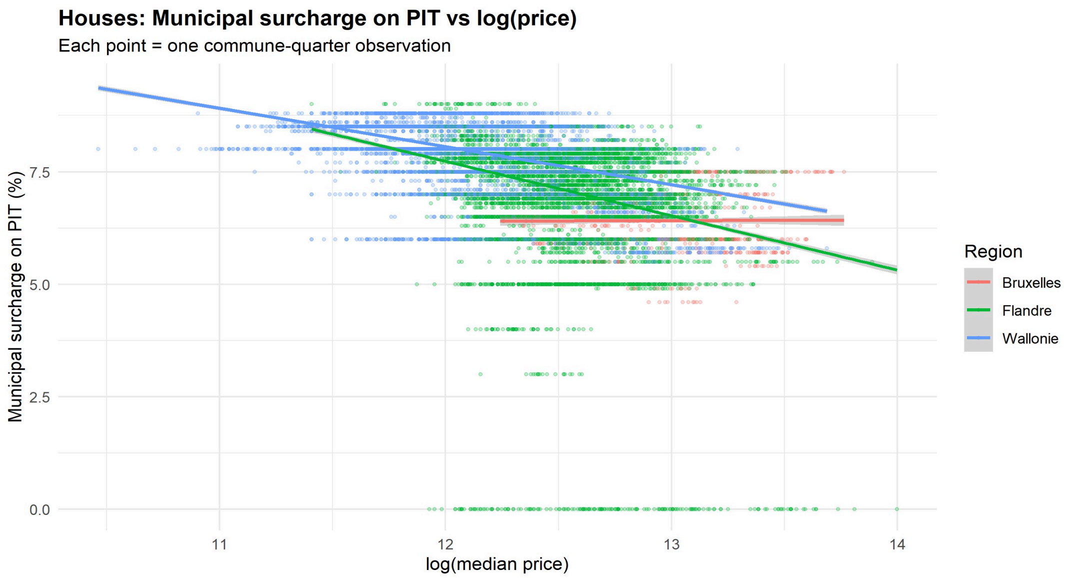

Figure 7. Houses: Municipal surcharge on PIT vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

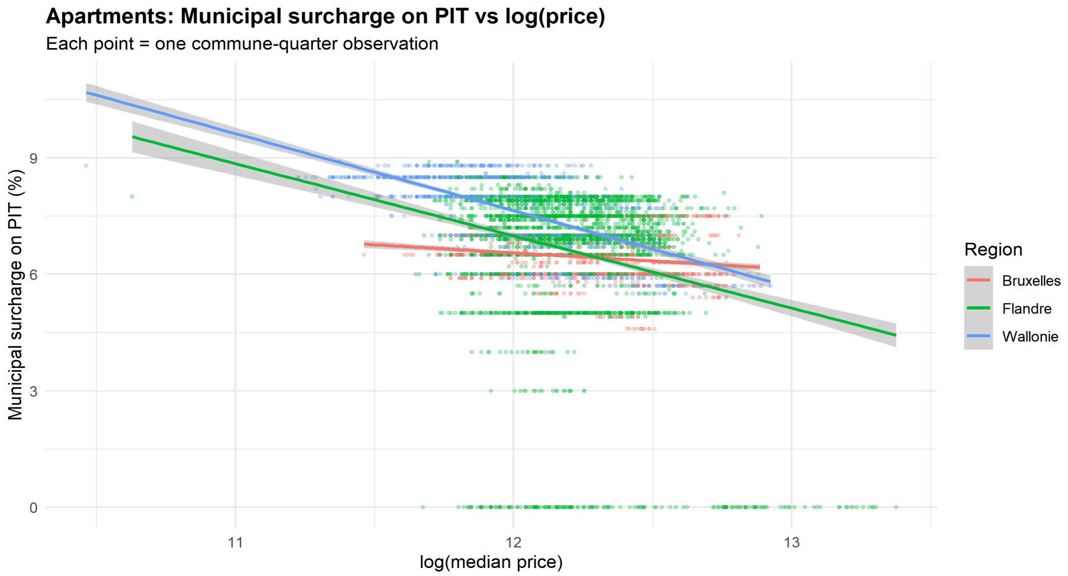

Figure 8. Apartments: Municipal surcharge on PIT vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

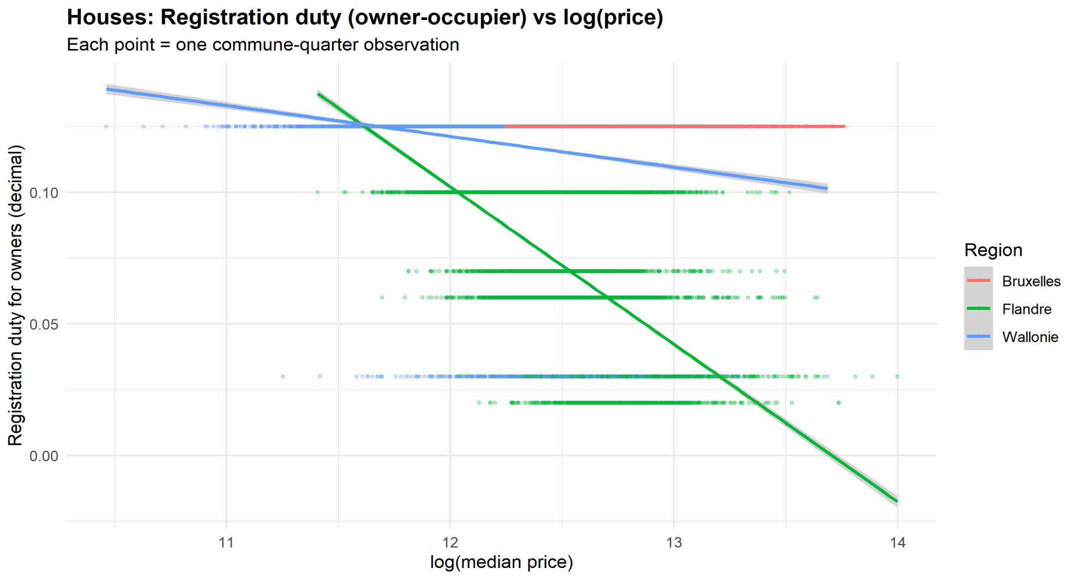

Figure 9. Houses: Registration duty (owner-occupier) vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

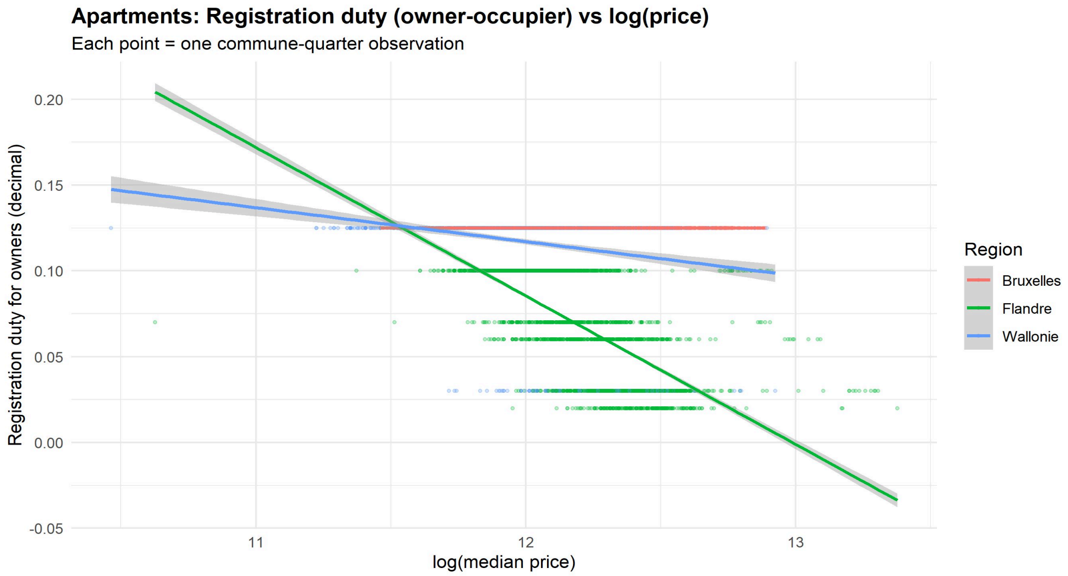

Figure 10. Apartments: Registration duty (owner-occupier) vs log(median price)

Source: authors' computations. Each point represents a commune-quarter observation. Trend lines are estimated by Ordinary Least Squares within each region without controlling for fixed effects.

Table 17. *Variable definitions, units, sources, and transformations.*

Variable	Description	Unit	Source	Transformation
P_houses	Median transaction price (all houses, by region and quarter)	EUR	STATBEL	Δlog
P_apart.	Median transaction price (apartments, by region and quarter)	EUR	STATBEL	Δlog
CR	Mortgage rate (NBB MIR, new contracts, > 10 yrs)	% per annum	NBB (MIR)	Δ

CPI	Consumer price index, all items	Index (2015=100)	STATBEL CPI	Δlog
PPI	Producer price index, industrial total domestic	Index (2015=100)	STATBEL	Δlog
CstrPI	Construction price index, Section F (seas. adjusted)	Index (2015=100, S.A.)	STATBEL	Δlog
Pop	Resident population, mid-year	Persons	STATBEL	Δlog
MedInc	Median net taxable income per declaration	EUR / year	STATBEL (fiscal stats)	Δlog
HS	Average household size	Persons / household	STATBEL	Δlog
ER	Employment rate (15–64)	Ratio (0–1)	STATBEL LFS	Δ

Source: authors' compilation. The Mortgage rate variable was assembled from the monthly NBB MIR statistics and averaged to a quarterly frequency. All other series are sourced from official Belgian statistical offices.

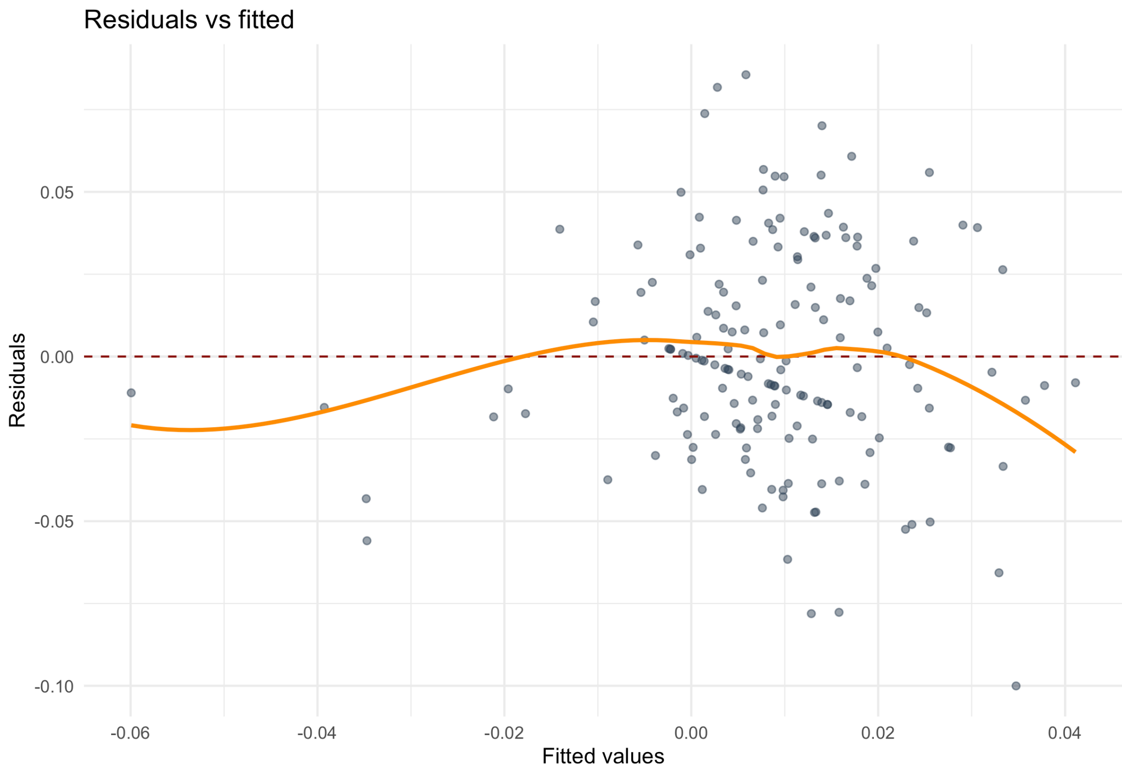

Figure 11. Residuals versus fitted values for the houses baseline. The mild funnel-shaped dispersion is consistent with the Breusch-Pagan rejection of homoskedasticity and justifies the cluster-robust variance estimator.

Table 18. *Region-specific estimates, Houses sample.*

Variable	Pooled (FE)	Brussels-Capital	Flemish Region	Walloon Region
Δ Mortgage rate	−0.0111** (0.0055)	−0.0029 (0.0325)	−0.0220 (0.0213)	−0.0055 (0.0238)
Δlog CPI	−1.0233*** (0.3433)	−0.3074 (1.5074)	−0.9103 (0.8283)	−1.4549 (0.9653)
Δlog PPI	+1.0853*** (0.1908)	+0.6874 (1.1293)	+1.1607* (0.6589)	+1.3491** (0.6545)
Δlog CstrPI (S.A.)	−0.3125*** (0.1106)	−0.5193** (0.2257)	−0.1097 (0.1365)	−0.2962 (0.1872)
Δlog Population	−1.5403* (0.9208)	−2.1712 (2.5242)	−2.3337 (9.5161)	+7.0910 (9.9372)

Δlog Median income	+0.0664 (0.3230)	−0.4694 (1.0312)	+0.5709 (1.1227)	−0.4781 (1.3641)
Δlog Household size	−4.1117** (1.9222)	−5.8836*** (1.8958)	+3.1201 (4.2741)	−1.4532 (2.7958)
Δ Employment rate	−1.7133 (1.2621)	−2.6766*** (0.8810)	+1.8513 (1.4851)	−1.2303 (2.0330)
Constant	+0.0142** (0.0067)	+0.0206** (0.0098)	+0.0050 (0.0137)	+0.0026 (0.0100)
Observations	165	55	55	55
R^2	0.147	0.289	0.137	0.128
Adj. R^2	0.091	0.165	−0.013	−0.02

*Notes: column (1) is the pooled regression with regional fixed effects, cluster-robust SE (HC1). Columns (2)-(4) are region-specific OLS with Newey-West HAC SE (lag 1) in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.*

Table 19. *Region-specific estimates, Apartments sample.*

Variable	Pooled (FE)	Brussels-Capital	Flemish Region	Walloon Region
Δ Mortgage rate	−0.0156*** (0.0049)	−0.0159 (0.0170)	−0.0068 (0.0107)	−0.0236** (0.0118)
Δlog CPI	−0.4939 (0.3296)	−0.8764 (0.7774)	−0.0788 (0.3840)	−0.8482 (0.5523)
Δlog PPI	+0.4926 (0.3041)	+1.0349** (0.5077)	+0.0296 (0.2992)	+0.4812 (0.4524)
Δlog CstrPI (S.A.)	−0.1765* (0.0947)	−0.0893 (0.1473)	−0.1079 (0.0982)	−0.3627*** (0.1124)
Δlog Population	−0.8361*** (0.3029)	−0.8539 (1.7343)	+0.4134 (5.8705)	+0.4482 (7.2231)
Δlog Median income	+0.8229* (0.4428)	+0.1856 (0.8503)	+1.1020** (0.4867)	+1.5229** (0.7321)

Δlog Household size	−0.2661 (0.8852)	+0.0415 (0.8088)	−3.3900 (2.5441)	+1.5237 (2.5194)
Δ Employment rate	−0.2062 (0.2018)	−0.5082 (0.5422)	−0.0578 (0.7640)	+0.2886 (0.8324)
Constant	+0.0049** (0.0023)	+0.0071 (0.0054)	−0.0002 (0.0078)	−0.0009 (0.0063)
Observations	165	55	55	55
R^2	0.116	0.104	0.202	0.293
Adj. R^2	0.059	−0.052	0.063	0.170

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