

Domènech-Arumì, Gerard; Gobbi, Paula E.; Magerman, Glenn

Working Paper

Housing inequality and how fiscal policy shapes it: Evidence from Belgian real estate

NBB Working Paper, No. 423

Provided in Cooperation with:

National Bank of Belgium, Brussels

Suggested Citation: Domènech-Arumì, Gerard; Gobbi, Paula E.; Magerman, Glenn (2022) : Housing inequality and how fiscal policy shapes it: Evidence from Belgian real estate, NBB Working Paper, No. 423, National Bank of Belgium, Brussels

This Version is available at:

<https://hdl.handle.net/10419/273127>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Working Paper Research

20 & 21 October 2022 N°423

NBB conference 2022
Household Heterogeneity and Policy Relevance
Housing inequality and how fiscal policy shapes it:
Evidence from Belgian real estate
by Gerard Domènech-Arùmì, Paula E. Gobbi and Glenn Magerman



Editor

Pierre Wunsch, Governor of the National Bank of Belgium

Editorial

On October 20-21, 2022 the National Bank of Belgium hosted a Conference on *“Household Heterogeneity and Policy Relevance”*.

Papers presented at this conference are made available to a broader audience in the NBB Working Paper Series (www.nbb.be). This version is preliminary and can be revised.

Statement of purpose:

The purpose of these working papers is to promote the circulation of research results (Research Series) and analytical studies (Documents Series) made within the National Bank of Belgium or presented by external economists in seminars, conferences and conventions organized by the Bank. The aim is therefore to provide a platform for discussion. The opinions expressed are strictly those of the authors and do not necessarily reflect the views of the National Bank of Belgium.

Orders

The Working Papers are available on the website of the Bank: <http://www.nbb.be>.

© National Bank of Belgium, Brussels

All rights reserved.

Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

ISSN: 1375-680X (print)

ISSN: 1784-2476 (online)

Housing inequality and how fiscal policy shapes it: Evidence from Belgian real estate*

Gerard Domènech-Arumi[†] Paula E. Gobbi[‡] Glenn Magerman[§]

September 22, 2022

Abstract

We use detailed information on all real estate stock and transactions since 2006 to study housing inequality in Belgium and how a recent policy shaped it. We use the transactions to predict the market value of all dwellings in the country, to then estimate inequality in value or space at different levels of aggregation – from the federal to the local neighborhood level. Overall inequality is relatively low (Gini of 0.25), but significant heterogeneity exists across and within municipalities. Using a differences-in-differences framework, we study how Flanders’s recent 3% reduction in registration fees affected house prices and inequality. We estimate that the policy increased prices by 3% on average and reduced inequality in Flanders by 0.8% by compressing the price distribution from below. We argue that the primary winners of the policy are low-value homeowners, who see their estate’s valuation increase. The main losers are low-value renters, who might see rent increases in the short term. Both parts of the paper reveal significant geographic heterogeneities, thus highlighting the importance of granularity in the data for studying inequality.

Keywords: Inequality, housing market, fiscal policy.

JEL Classification Numbers: D31, R21, R31.

*This project initiated in the context of the National Bank of Belgium Colloquium 2022 on “Household Inequality and Policy Relevance.” We thank the National Bank of Belgium and the Federal Service of Finances for providing access to the cadastral data for this project. We thank workshop and seminar participants at the National Bank of Belgium, KU Leuven, and Université Libre de Bruxelles for useful comments. We are grateful for financial support through the BEL-SPO Brain-be 2.0 funded project BE-PARADIS. We thank David Kaminski for excellent research assistance.

[†]E-mail: gerard.domenech.arumi@ulb.be. Université Libre de Bruxelles (ECARES).

[‡]E-mail: paula.eugenia.gobbi@ulb.be. Université Libre de Bruxelles (ECARES) and CEPR.

[§]E-mail: glenn.magerman@ulb.be. Université Libre de Bruxelles (ECARES) and CEPR.

1 Introduction

Cadastral data is ideal for studying inequality, for at least four reasons. First, Housing is critical to understand wealth and income inequality (Silos 2007; Díaz and Luengo-Prado 2010; Kindermann and Kohls 2018; OECD 2022a). Second, cadastral data is highly replicable across contexts, as it exists in many countries. Third, cadastral data is geolocated and thus allows researchers to study inequality at any desired level of aggregation. And finally, because the year of construction is a variable typically available, the data allows studying inequality over time using a static cross-section, with some caveats to bear in mind.

Housing policies can shape income or wealth inequality through changes in real estate prices, and their impact can differ significantly across geographies. Several studies have analyzed the effects of such policies on house prices or wealth inequality in different contexts (Martínez-Toledano 2020; Damen and Goeyvaerts 2021), but these studies are typically focused on national-level outcomes. If housing markets exhibit significant differences across subnational units, we should expect heterogeneous effects on our outcomes of interest. To study those, cadastral data is especially well-suited.

In this paper, we use detailed real estate data from the Belgian cadastre to study housing inequality across different levels of aggregation. We then analyze the effects of a recent reduction in property registration fees in Flanders on house prices and their implications for housing inequality across different sub-national geographies.

We start by highlighting and expanding on the advantages that cadastral data has to offer in the study of inequality. We argue that its independence of administrative boundaries is the dimension where it really shines and what it makes particularly appropriate when the focus of research is on low levels of aggregation.

We then present our primary data source: the Belgian cadastre. We observe detailed information on all real estate in Belgium and the universe of transactions since 2006. We observe the standard features typically found in cadastral data. For example, for dwellings, we observe their living area, number of rooms, year of construction, and location, among other characteristics. We do not observe real estate's assessed or market value, so we use data on all (over two million) dwelling transactions and machine learning techniques to predict the value of all dwellings in Belgium.

Housing inequality in Belgium is relatively low, but there is significant heterogeneity across and within municipalities. We use predicted housing values and raw

housing surfaces to analyze disparities in the housing stock at different levels of aggregation, from the federal to the local neighborhood level, today and over time. National housing value inequality is relatively low (0.25, as measured by the Gini index) and coincides with existing estimates of after-tax income inequality for the country.¹ Further analysis reveals significant heterogeneities across geographies. While housing inequality is overall highest in Wallonia (0.26) and lowest in Flanders (0.21), an analysis at the municipality and statistical sector level reveals important disparities within these regions. In Brussels, inequality is high in the central areas of the city. In Flanders, inequality is especially high in Antwerp. In Wallonia, inequality is low in the South-East and high around Liège. Long-run housing (space) inequality exhibited a U-shape pattern. It was relatively high at the beginning of the twentieth century (Gini of 0.30 in Brussels). It progressively declined until the 1960s in Brussels and until 1990 in Flanders and Wallonia. It has slowly increased again in all three regions since then, with the trend accelerating in the past two decades.

Housing policies can affect housing inequality through changes in dwellings' price dispersion. In the last part of the paper, we exploit regional variation induced by a recent policy to study the effects of transaction fees on house prices and inequality in a difference-in-differences framework. The policy reduced fees from 6 to 3% in Flanders but left them intact in Brussels and Wallonia. We find that, on average, the policy increased house prices by approximately 3% in Flanders. However, quantile regressions reveal significant heterogeneity in price effects across the dwelling value distribution, with dwellings in the bottom-end increasing their value by almost 7% and those above the median remaining essentially unaffected. Using back-of-the-envelope calculations, we show how this compression in the dwelling value distribution reduced housing value inequality by almost 1% in Flanders with, yet again, significant geographic differences. We estimate that inequality decreased throughout most of the region, but it increased (less than 1%) in Halle-Vilvoorde (the limiting Flemish district with Brussels). We argue that the policy likely reduced wealth inequality through the real estate valuation mechanism and that low-value renters are likely to be the primary losers of the policy.

This paper contributes to two strands of literature. The first provides estimates for inequality at the national and local levels. The second strand of literature looks

¹The OECD estimates and after-tax income inequality Gini index of 0.26 for the year 2019 ([OECD 2022b](#)).

at the effects of housing policies on prices and inequality.

The paper’s main contribution is to the large and growing literature on the measurement of inequality. Measuring inequality is challenging. Data availability and quality were low until very recently. Thanks to the increased processing capacity of computers and the availability of high-quality administrative data, research on inequality has flourished in the past two decades, with a proliferation of studies analyzing contemporary and long-run trends in income or wealth inequality across different contexts and countries (Piketty and Saez 2003; Piketty and Saez 2006; Piketty and Zucman 2014; Blanco, Bauluz, and Martínez-Toledano 2021; Fuchs-Schündeln, Krueger, and Sommer 2010; André and Meslin 2021). In recent years, this literature has expanded its focus below the national borders. The realization that neighborhoods can determine short and long-run outcomes and (Chetty, Hendren, and Katz 2016; Kuhn et al. 2011; Chetty and Hendren 2018), again, high-quality administrative data have made it possible to significantly increase the granularity in the measurement of the inequality phenomena (Glaeser, Resseger, and Tobio 2009; Fogli and Guerrieri 2019; Domènech-Arumí 2022).

Our contribution to this literature is twofold. Most importantly, we provide novel estimates of housing (value and space) inequality at many different levels of aggregation using cadastral data. Cadastral data is vastly underutilized despite its great potential to study relevant dimensions of inequality. We hope our work will induce other scholars to measure or analyze the causes or consequences of inequality in future work. Secondly, we provide new insights into the state of inequality in Belgium, a high-income country that – despite hosting the capital of the European Union – knows very little about its overall and internal inequalities.²

The second contribution is to the literature studying the effects of housing policies. A large strand of work has studied policies aiming at a higher homeownership affordability.³ Among the policies, there are direct transfers such as housing vouchers (Davis et al. 2021), rent control (Autor, Palmer, and Pathak 2014), zoning changes (Favilukis, Mabilie, and Van Nieuwerburgh 2022), and transaction costs and tax re-

²For example, as of September 2022, Belgium is still not present in the World Inequality Database (Alvaredo et al. 2022).

³See recently Favilukis, Mabilie, and Van Nieuwerburgh (2022) who provide a structural model to assess the welfare consequences of such policies. Kaas et al. (2020) also use a structural model to explain how social housing, real estate transfer taxes, and mortgage tax deductions affect homeownership rates. They use the model to explain the low homeownership rates of Germany and make wealth accumulation and welfare considerations.

ductions (Poterba 1992; Kopczuk and Munroe 2015; Best and Kleven 2018; Sommer and Sullivan 2018).⁴ Most of the policies aim at facilitating housing accessibility for low-income households in particular, such as the Low Income Housing Tax Credit in the United States (Diamond and McQuade 2019), or the Scellier Tax Credit in France (Chapelle, Vignolles, and Wolf 2018). The literature, however, agrees that the efficiency of low-income housing tax credits for promoting rental investments is low (Malpezzi and Vandell 2002; Sinai and Waldfogel 2005). For example, for France, Chapelle, Vignolles, and Wolf (2018) shows a null effect on the evolution of the housing stock and that the income profile of tenants in new dwellings remained unchanged while the policy aimed at allowing more low-income households to rent. In the context of Belgium, Damen and Goeyvaerts (2021) use the same data to study the impact of a mortgage interest deduction in Flanders *woonbonus*. They find that land and housing prices declined in response to the policy.

More generally, the impact of housing policies might not directly benefit the buyers because the effect crucially depends on the elasticity of housing supply and demand to prices. With inelastic supply, a decrease in transaction fees leads to an increase in house prices, implying that existing homeowners will be the beneficiaries of the policy. Recently, Girshina, Koulischer, and von Lilienfeld-Toal (2021) estimated supply and demand elasticities based on the real estate market of Luxembourg. Their elasticity estimate, 0.27, suggests that buyers capture a significant proportion of the surplus from subsidies.

Our contribution to this literature is on three fronts. Most importantly, our work focuses strongly on the geographical heterogeneities induced by the policy. That is unusual in the literature and only possible thanks to the granularity of our data. Secondly, we go beyond prices and study the implications of the policy on housing inequality. Albeit informally, we also discuss the policy implications for wealth inequality and welfare by identifying the primary winners and losers in the housing market. Finally, we provide (yet) new evidence that a reduction in transaction fees leads to an increase in prices, possibly an unintended consequence of the original policy.

⁴See Apgar Jr. (1990) for a normative discussion on several types of housing policies and their effects and Olsen (2003) for a description of housing programs for low-income households over time in the United States.

2 Why using cadastral data to study inequality?

Cadastral data is ideal for studying inequality for at least four reasons.

First, housing is important. Except at the very top, real estate is the major component of assets and debt portfolios throughout the wealth distribution (Silos 2007; Díaz and Luengo-Prado 2010; Kindermann and Kohls 2018; Saez and Zucman 2016),⁵ so housing is crucial to understand wealth inequality. Also, as a consumption good, housing represents the highest spending category, taking approximately 20% of households' income in OECD countries (OECD 2022a). Thus, housing is crucial to understand income and consumption inequality. Finally, housing is the “door of entry” to neighborhoods, and therefore the only way to benefit (or be harmed) by the many short and long-run neighborhood effects documented in the literature (e.g., Chetty, Hendren, and Katz (2016)). Thus, housing is also crucial to understand inequalities in opportunities.

Second, studies with cadastral data are highly replicable, due to three reasons. First, cadastral data exists in many countries. It exists in high-income countries such as Belgium, France, Spain, or the United States, but also in middle-income countries such as Mexico or Colombia. Second, the data is typically very homogeneous, with very similar structures and the same items defined in the same way (e.g., a square meter in Brussels is the same as a square meter in Barcelona). Third, censoring is not a problem. The data contains information on the universe of properties, not just a small – possibly not representative – sample of properties. Thus, unlike studies based on survey data or other less homogeneous sources, research using cadastral data offers a high degree of comparability across contexts.

Third, cadastral data is independent of administrative boundaries. Typically, the cadaster contains the geolocation of all real estate present in the country. Thus, the researcher using cadastral data can easily adjust the data aggregation level (e.g., regional or municipality level) depending on the research question at hand. As a corollary, arbitrary or changing administrative boundaries (a recurring problem at low levels of aggregation) do not constitute a roadblock (Openshaw and Taylor 1979;

⁵This is true in most countries. In Belgium, according to the Household Finance and Consumption Survey (HFCS), it represents 73% of the assets of the bottom 20% of the wealth distribution, above 90% of the assets of the 20-80% of the wealth distribution, and 75% of the wealth of the top 20% of the wealth distribution (de Sola Perea 2020). See Appendix figure A1 for a visualization of the importance of real estate across the wealth distribution in the Belgian context.

Wong 2009). Thus, the geolocation of the data always makes it possible to construct aggregates at any existing (or new) level of aggregation.

Fourth, cadastral data is an excellent resource to perform an analysis over time with a static cross-section, with some caveats. Housing is (practically) immobile. Once constructed, it remains in the same location indefinitely. That means that one can easily construct a panel of the stock of housing and analyze new housing inflows from a static cross-section as long as the year of construction is available in the data – which typically is. That means that a researcher can analyze some dimension of real estate at any given location (because the data is geolocated) at any point in time (because the year of construction is available). There is an important caveat: a cross-section of the stock of housing suffers from survivor bias. One can observe and infer the inflows of housing, but not the outflows. That caveat is especially relevant when the focus is on the the very long run or when some area’s housing stock was affected by some significant shock (e.g., a war or natural disaster). Nevertheless, that feature of cadastral data represents a significant advantage over other data sources, and it is thus worth exploiting to the extent possible, while being aware of the data limitations.

3 Data

3.1 The Belgian cadaster

We exploit detailed data on all real estate properties and transactions in Belgium from the Federal Service of Finances. We combine two main datasets from the cadaster.

The *transactions* dataset contains the price of each real estate transaction from January 2006 to July 2022. In addition to the price, this database also includes the following key variables: a parcel identifier (*capakey* and *partnumber*), the date of the transaction, the exact address, the year of construction, the last year of renovation, the nature of the real estate (e.g., house, apartment, studio), the construction type (e.g., detached house), the floor in which the dwelling is located, a measure of quality (mediocre, normal, or luxurious), the number of garages, the number bathrooms, the number of housing units, whether there is an attic or not, the size of the living area, and whether there is central heating or not. The raw data contains over 5.4 million transactions. After dropping donations, and transactions of building land,

monuments, or private entities, we retain over 2 million transactions for analysis over the 16 years.

The *parcels* database contains detailed information on the universe of real estate (stock) in Belgium as of July 2022. It includes the same variables previously described, except for the sales price. The raw dataset contains over 11 million parcels. We drop all observations that do not relate to housing units (e.g., forests, office buildings, or train stations). The final dataset contains information on over 4.2 million dwellings.

Table 1 shows summary statistics for the sample retained from the *cadaster* and *parcels* datasets. Looking at transactions first, we see that the average dwelling sold in the period had 150 square meters and sold for 262 thousand euros. Over 85% of the dwellings sold were houses, with almost six rooms, 0.9 bathrooms, and 0.6 garages. 30% of the dwellings had a cellar, and half had central heating. The average year of construction was 1939, and most of the dwellings had not been renovated in over 55 years, although there was substantial dispersion on that dimensions. 30% of the dwellings were detached, and almost all of them were classified as having a normal quality.

Transactions over the past 16 years have been quite representative of the housing stock, with some exceptions. The share of houses, number of rooms, bathrooms, garages, the presence of a cellar, whether the dwelling was detached or not, and the quality variables are almost identical across the two datasets. The major difference is in terms of the average living area (163 vs. 150 square meters), and year of construction (1954 vs.) 1939.⁶

3.2 Dwelling prices

We estimate the price of all dwellings in Belgium, combining the transaction and parcel databases and machine learning techniques. In particular, we train a random forest model using all information available from the transactions in 2006-22 (over 40 variables). Our out-of-sample prediction error is 0.1805, a number in line with other studies predicting house prices using random forest (Fan, Ong, and Koh 2006; Mullainathan and Spiess 2017; Čeh et al. 2018). The most important variable for the prediction is the dwelling surface (square meters). Other variables with high relevance in the prediction include municipality, the year of the transaction, the number of

⁶Note that this 15-year difference is natural to some degree, as the transactions data includes dwellings sold back in 2006.

bathrooms, the year of construction, and the number of rooms. The data Appendix contains additional details about the estimation.

Predicted prices in Belgium align with what we know about the Belgian housing market. Figure 1 shows the predicted median house value across Belgian municipalities (*communes*) for the year 2022. The median house sells for approximately half a million euros in the Brussels region. Prices are also especially high in the main Flemish cities (Antwerp, Ghent, and Bruges) and the municipalities located between the North Sea and the Netherlands (Knokke-Heist). Prices drop sharply in Wallonia, with the median house selling just above 200,000 euros. These house prices are in line with what is now about the housing market in Belgium and recent estimates, for example, those in <https://www.notaire.be/prix-immobiliers>. This constitutes supporting evidence for our predictions.

4 Inequality in Belgium: new insights from real estate data

4.1 Housing inequality in 2022

Aggregate estimates: Figures 2 and A2 show geographical variation in housing value and space across different levels of aggregation for the year 2022. These include estimates at the province (NUTS 2) level (top-left), district (*arrondissement*, NUTS 3) level (top-right), municipality (*commune*) level (bottom-left), and statistical sector (bottom-right) level. Inequality estimates at the country and region (NUTS 1) level are reported in the figures footnote. Figures 3 and A3 provide a better visualization of housing value and space inequality estimates at the statistical sector level for the Brussels region only. These figures deliver two observations.

At low levels of aggregation, inequality in space closely tracks down inequality in value. The bottom-right panels in Figures 2 and A2, depicting inequality estimates at the statistical sector level, illustrate this point particularly well. Intuitively, the reason is that neighborhoods and local amenities are more comparable the lower the level of aggregation is, and therefore differences in value are primarily determined by differences in living space. For example, Flanders (North) and Brussels are less unequal than Wallonia (South), considering the value Gini coefficient. But Flanders and Wallonia have a similar level of space inequality. In contrast, Brussels has a

higher inequality in terms of the average surface of its dwellings (Figure A3).⁷ At the statistical sector level, the Pearson’s correlation coefficient between the two variables is 0.67.

Most importantly, there is substantial within-country heterogeneity; therefore, inequality estimates vary widely depending on the level of aggregation. As noted in the figures, the value and space Gini coefficients in Belgium in 2022 are 0.25 and 0.24, respectively. But within Belgium, where is inequality the highest? According to both Gini measurements, inequality is, on average, lower in Flanders than in Wallonia. Some municipalities, however, show high levels of inequality in Flanders, such as De Haan (value Gini equal to 0.30 and space Gini equal to 0.41) or Knokke-Heist (value and space Gini equal to 0.28). Antwerpen, Leuven, and Middelkerke also show high levels of inequality in terms of space (respectively 0.28, 0.31, and 0.32). In Wallonia, the highest levels of inequality are in Hastière in the province of Namur (value Gini equal to 0.36 and space Gini equal to 0.40), in Froidchappelle (value Gini equal to 0.32 and space Gini equal to 0.35). Brussels also stands out as a very unequal region, in particular at the center of the city (Figure 3 and A3). The capital’s city center has a Gini coefficient of up to 0.27 in value and 0.36 in space. The range of inequality varies substantially within Brussels. The variation in the value Gini coefficient across statistical sectors in the municipality of Brussels goes from 0.04 to 0.38 (from 0.01 to 0.56 if we look at the space Gini coefficient).

Differences in the support of the distributions are crucial to understanding disparities in inequality estimates across different levels of aggregation. In Brussels, a dwelling in the first percentile of the distribution costs 170,000 euros. A dwelling in the 99th percentile costs 1.25 million euros. In Wallonia and Flanders, these figures are 73,000 and 138,000 for a dwelling in the first percentile and 630,000 and 830,000 for a dwelling in the 99th percentile. Thus, housing value inequality in Brussels is not that high because even the cheapest dwellings are relatively expensive.⁸

Local estimates: The previous results made salient the importance of aggregation when studying inequality. We thus complement the previous inequality estimates with results informing about disparities in the most disaggregated level possible: the local

⁷The smallest dwellings in Brussels are expensive, but very small. A dwelling in the 5th percentile in Brussels has 45 square meters. This figure is 69 for Wallonia and 71 for Flanders.

⁸For reference, the same amount of money that buys a dwelling in the first percentile in Brussels gets a dwelling in the 30th percentile in Wallonia.

neighborhood of a building. We follow the methodology developed in [Domènech-Arumí \(2022\)](#) and construct the Local Neighborhood Gini (LNG) for the Brussels region (that we discuss below),⁹ and other main cities in the country.¹⁰ In this study, we produced results using a radius of 200 (LNG200) and 500 (LNG500) meters.

Figure 4 shows value LNG500 estimates for Brussels. Figure A4 shows the same results for space. The conclusions are similar but more nuanced to those we could take away from Figure 3. We see that local inequality is higher around the dwelling surrounding Avenue Louise and (especially) Bois de la Cambre. Local inequality is also relatively high in the core of the neighborhoods of Saint Gilles, Chatelain, and around the city center. Areas farther or in between these neighborhoods are darker (less unequal).

Looking at inequality in this way, in addition to the enhanced granularity, has the advantage of smoothing out artificial jumps arising due to arbitrary shapes or changing administrative boundaries, an important problem when looking at low levels of aggregation ([Openshaw and Taylor 1979](#); [Wong 2009](#)). This point is best illustrated when comparing the results from Figures 3 or A3 with aggregated LNG estimates in Figures A5 or A6. The smoother color (i.e., inequality estimates) transitions across geographically close statistical sectors are likely to better capture how local inequality varies across neighborhoods.

4.2 Housing inequality over time

We study housing inequality over time. The top panel in Figure 5 shows the evolution of housing value inequality from 2006 until 2022, which we can confidently compute as we observe the universe of transactions since 2006. The bottom panel shows housing space inequality since 1900. Appendix Table A1 provides the exact values of the estimates. We can estimate space inequality in the long run with a reasonable amount of confidence because cadastral data includes the year of construction (and thus, we know which dwellings were already present at any point in time) and because space

⁹As detailed in the paper, the LNG is constructed in five steps: 1. selecting a building plot, 2. choosing a radius that – together with the centroid of the building – determines a circle (i.e., the local neighborhood), 3., selecting all the buildings located within the circle, 4. computing the Gini coefficient for the buildings within the circle, and 5., repeating the previous steps for all buildings in the data.

¹⁰In the Flanders, we produced estimates for Antwerp, Ghent, Leuven, Brugges, Aalst, Mechelen, Hasselt, Saint-Nicolas, Kortrijk, and Ostende. In Wallonia, we produced estimates for Mons, Liege, Namur, La Louviere, Tournai, and Charleroi.

is not subject to inflation concerns.¹¹ The main caveat to our estimates is survivor bias, particularly the presence of demolitions. We observe the stock of housing today and can infer new inflows over time by looking at the year of construction. We do not observe outflows. Thus, the very long-run estimates need to be interpreted with caution.

Housing value inequality in Belgium has remained relatively stable in the past two decades, with a major shift around 2015 across all regions. We estimate a Gini of just below 0.26 in 2006. Inequality decreased, to 0.23 in Belgium, in the following years (especially during the worse years following the Great Recession). It then bounced back, to 0.26 nationally, in 2015. Since 2015, national inequality has remained more or less stable at that value. Still, the three regions have experienced different trends since then, which have diverged even more after the beginning of the COVID-19 pandemic in 2020. Housing value inequality has decreased significantly in Brussels. It has remained stable in Flanders (after an initial jump in 2020) and has kept growing in Wallonia (Gini of 0.265 in 2022). The first part of the time series is in line with the results for wealth inequality from [Martínez-Toledano \(2020\)](#) or [Kuhn, Schularick, and Steins \(2020\)](#), who argue that wealth inequality tends to decrease during busts due to differences in the composition of asset holdings of households across the distribution (with financial assets more prevalent at the top). The latter part of the time series could be explained by changes in the demand following the lockdowns associated with COVID-19.

Housing space inequality in Belgium has steadily decreased throughout the twentieth century, from a Gini of around 0.27 in 1900 to 0.23 in 2000, and it has increased slightly in the last two decades (Gini of 0.235 in 2022). The pattern across regions is similar, with some nuances. The decrease in inequality has been particularly stark in Flanders, with a Gini going from 0.29 in 1900 to 0.22 in 2000 (−25%). There has been some bounce back since (Gini of 0.23 in 2022). Wallonia experienced the same pattern, but with magnitudes only ranging from 0.25 to 0.23. Brussels has been the most stable region, with estimates only decreasing from 0.3 to 0.29 and starting the revert in the trend significantly earlier (1960). Although substantially more nuanced, the overall pattern in housing space inequality in Belgium is similar to that of income or wealth inequality in western other countries ([Saez and Zucman 2016](#); [Chancel et al.](#)

¹¹As is the case with house prices. To go beyond 2006 without the transactions database, we would need to make assumptions about the evolution of prices based on some aggregate statistics.

2021).

4.3 The relation between housing and income inequality

We study the relationship between housing and income inequality in Table 2. We provide the raw correlation between the pre-tax income interquartile range (IQR) and different measures of housing inequality.¹²

Housing value inequality is highly correlated with income inequality. The correlation between pre-tax income IQR and housing value IQR is 0.54 for Belgium and 0.61 for Brussels. These are significant numbers, especially considering that the income figures are for 2018 and the housing value estimates are for 2022. The correlation between the other inequality measures (Gini, LNG200, LNG500) is also positive but substantially lower (the highest correlation is 0.41 for the LNG500 in Brussels). These results are unsurprising given that the Gini index and the IQR are different inequality measures.

The correlation between housing space and income inequality appears to be relatively low. Unsurprisingly, the highest correlation is between housing and income IQR, with a value of 0.27 for Belgium but only 0.08 for Brussels. The correlation between income IQR and the other measures (versions of a Gini index) is essentially zero, or even negative. We would expect higher and positive correlations should the Gini index for income be available, but the values would likely be below those for housing value.

Because correlations between housing value and income are large, one can view our results as primarily speaking about income. That is a natural interpretation if housing consumption is approximately a constant fraction of income, which many would consider a reasonable assumption (Couture et al. 2019). Thus, this exercise helped connect our results to the more familiar concept of income inequality. Making statements about wealth inequality would require using information about ownership and real estate concentration, which we do not observe.

¹²The IQR is the only income inequality measure available at that level of aggregation.

5 The impact of reducing registration fees on housing prices and inequality

5.1 Institutional context

When a sales transaction takes place for an existing property in Belgium, buyers have to pay an *ad valorem* registration tax. These taxes only apply to sales transactions of existing properties. New properties are subject to (federal) VAT rates of 21% and are excluded from our data. Before 2002, registration taxes were set at the federal level. In 2002, the taxes were regionalized across the three Belgian Regions: Flanders, Brussels, and Wallonia. From then onwards, there has been a divergence in registration tax levels and changes over time and across Regions. We exploit this variation in our identification strategy below. Table 3 summarizes the most recent changes in registration taxes over time and across regions.

Registration fees have been reduced significantly in Flanders from 10% in 2002 to 3% after the most recent reform, implemented on January 2022. The rates in Brussels and Wallonia have remained constant at 12.5% over the whole period. The baseline rate applies if the property is the first – and only – residential property of the buyer, in which they also live.¹³

Other particular rates apply based on various criteria. As an example for monuments, a reduced rate of 1% applies in Flanders. This rate has been constant over our whole sample period. A reduced rate applies if the new owner invests in a well-defined “intensive energetic renovation” within a specific window after the sale. For Flanders, this rate has been declining from 6% to 1%. Finally, there are some reduced rates for small properties. For example, in Flanders and Wallonia, there was a reduced rate of 5% and 6%, respectively, for properties with a cadastral income below 745 euros. This reduced rate remained constant over the whole sample period for Wallonia. For Flanders, this requirement has changed to a lump sum reduction from June 2018 onwards, with variation in the amount and required maximum sales price over time.

¹³If not, an increased rate of 12% applies for properties in Flanders from 2022 onwards.

5.2 Theoretical predictions from the policy change

Appendix Figure A7 presents a simple conceptual framework to analyze the expected effects of the policy on dwelling prices.

With an inelastic housing supply, a sensible assumption in the short run, we expect prices to increase one-for-one with the decrease in registration fees (top panel). Lowering registration fees would shift the demand curve vertically, translating into higher equilibrium prices. With inelastic supply, it is theoretically clear that the primary winners of this policy are existing homeowners, who should see their properties rise in value.

New homeowners, especially those liquidity constrained at the bottom of the income distribution, could also gain from the policy. Because registration fees have to be disbursed at the time of purchase, lower fees (relaxed capital constraints) result in lower entry costs to the housing market for this population segment. Thus, enriching the previous model by adding capital constraints on a fraction of homeowners would increase price dispersion, and therefore housing inequality, with higher price increases on the dwellings at the bottom of the distribution.

With an elastic housing supply (bottom panel), a sensible assumption in the mid to long run, the effect on prices is theoretically ambiguous. In that case, the policy would shift both supply and demand curves, with the final effect on prices undetermined. The model suggests that the most inelastic party will benefit the most from the policy.

The empirical part below shows an increase in dwelling prices in the short run, most consistent with a housing market with an inelastic supply.

5.3 Main analysis

5.3.1 Empirical specification and identification

We employ a standard difference-in-difference approach to estimate the effects of the most recent reduction in registration fees. We compare the outcomes of Flanders, the treated region, with those from Brussels and Wallonia, the control regions. We restrict our attention to all dwelling transactions that occurred in Belgium from the last quarter of 2020 until July 2022.¹⁴

¹⁴As Table 3 showed, there was an earlier reform in Flanders implemented in January 2020, when the region decreased registration fees from 7 to 6%. By restricting our sample period, we address some concerns about spillovers from the earlier policy.

Equation 1 below describes our main empirical specification

$$\ln(p_{itz}) = \beta post_t \times Flanders_i + \gamma X'_{it} + \delta_z + \epsilon_{itz}. \quad (1)$$

where $\ln(p_{itz})$ is the natural logarithm of the sales transaction price. $post_t$ is an indicator taking the value of 1 if transaction i occurred after January 1st, 2022. $Flanders$ is an indicator taking the value of 1 if the dwelling is located in the Flemish region. X_{it} is a vector of controls. It includes the following dwelling characteristics: year of construction, floor, number of rooms, number of garages, number of bathrooms, years since last renovation, and indicators for construction type, quality, attic, and central heating. It also includes geographic controls: log median pre-tax income in the statistical sector. It also includes a constant and the non-interacted indicators $post_t$ and $Flanders_i$. The specification also includes district (*arrondissement*) fixed effects, δ_j . Standard errors are clustered at the municipality (*commune*) level. β is the coefficient of interest which, under parallel trends, capturing the average causal effect of the policy on house prices.

Identification requires parallel trends across the three regions. The assumption is untestable as counterfactual trends cannot be observed, but we provide empirical support for it by estimating pre-trends through the specification below

$$\ln(p_{itz}) = \sum_{\substack{t=2022Q2 \\ t=2020Q4 \\ t \neq 2021Q4}} \beta_t I(t) \times Flanders_i + \gamma X'_{it} + \delta_z + \epsilon_{itz} \quad (2)$$

where $I(t)$ is an indicator taking the value of 1 if the transaction took place in quarter t . β_t captures the difference in prices in quarter t in Flanders relative to Brussels and Wallonia, relative to the last quarter of 2021. The rest of the variables are defined as above.

The COVID-19 pandemic or the Flemish “housing bonus” (*woonbonus*) policy should not pose a threat to our identification. Aggregate events such as the COVID-19 pandemic have been shown to impact housing prices (Yang and Zhou 2022), with a distinct increase in prices for properties outside the city and with a garden. We control for these macro shocks in our setup by looking at the within-region evolution of prices in Flanders compared to those in Brussels and Wallonia. Moreover, we consider the particular policy shock of January 2022, which takes place almost two

years after the emergence of COVID. If the COVID shock is homogeneous across all regions, this is captured in the parallel trends before the shock. Second, there have been changes in other fiscal policies, such as the “housing bonus,” which allowed owners to deduct mortgage interest expenses on their first property from personal income taxes (Damen and Goeyvaerts 2021). This policy was heterogeneous across the three regions and phased out in Flanders by 2020. Again, this effect should be captured in the pre-shock period.

5.3.2 The effects of the policy on house prices

We do not find evidence of differential trends across treated and control regions. The top panel in Figure 6 shows no significant differences in prices before (nor after) the implementation of the reform. Although non-significant, there appears to be an increase in prices in Flanders relative to Brussels and Wallonia after the reform.

There appears to be a minor reaction in prices following the announcement and before the implementation. The policy was announced on September 27, 2021, in the end of the third quarter of 2021. Therefore, we explore whether the market reacted before the policy implementation by re-estimating β_t using 2021q3 as the omitted time category. Again, we do not find significant differences in prices across regions before the policy announcement. We find evidence of a mild increase in prices in the subsequent quarters following the announcement.

The reduction in registration fees increased housing prices by approximately 3%. Table 4 shows the β estimates from Equation 1. Column 1 shows the results from a specification without controls and shows an average effect of over 4%. Columns 2-4 enrich the base specification by adding fixed effects (Column 2), and controls for income at the census tract (Column 3) and dwelling characteristics (Column 4). The estimated effect drops to 2.7% ($p < 0.05$) in the most demanding specification. Column 5 attempts to deal with possible preemptive responses pre-implementation hinted in Figure 6 by dropping transactions that occurred after the policy announcement and before its implementation. With that restriction, we estimate an average price increase of 3.3% ($p < 0.01$). Given that the average housing price in Flanders in 2021 was around 340,000 euros, a 3% increase corresponds to 10,200 euros.

The previous results are consistent with inelastic housing supply in the short run.

5.3.3 The effects of the policy on housing value inequality

We assess the impact of the policy on housing value inequality in two steps. In the first step, we study the differential effects of the policy across the dwelling value distribution using quantile regressions. In the second step, we compute the counterfactual prices and housing inequality in Flanders using the results from the quantile regressions. That allows us to compare our original housing inequality estimates introduced in the first part of the paper with those obtained from this exercise.

We study the policy effects on prices throughout the dwelling value distribution by estimating the following quantile regression:

$$\ln(p_{it}) = \beta_{\tau} post_t \times Flanders_i + \gamma_{\tau} X'_{it} + \epsilon_{it} \quad (3)$$

where all variables are defined as before, except that now β_{τ} captures the average effect of the policy on the τ -th percentile. Also, for this exercise we are interested in capturing the average effect (in a given percentile) on all dwellings in the Flemish region. Therefore, X now only includes a constant and indicators for *post* and *Flanders*.

The policy had highly heterogeneous effects across the dwelling value distribution. Figure 7 shows the estimated β_{τ} coefficients for each percentile τ . Appendix Table A2 shows the exact values and standard errors of the coefficients in the figure. Prices in the 10th percentile increased by almost 7% ($p < 0.01$). They increased by approximately 4% in the 20th and 30th percentiles and only by about 2% in the 40th percentile. They remained essentially unaltered for those dwellings above the median value. These results are consistent with the individuals purchasing dwellings in the low-end of the distribution being liquidity constrained.

To assess the effect of the policy on housing inequality, we use the previous estimates to estimate the pre-policy counterfactual prices of each dwelling in Flanders. For example, a dwelling worth 120,000 euros in 2021 (in the 10th percentile) would increase its value by approximately 8,000 euros (6.8%, Table A2) because of the policy. We apply similar computations to all dwellings in Flanders.¹⁵

We can finally estimate the effect of the policy on housing inequality, by comparing counterfactual inequality estimates with our original estimates from the first part of

¹⁵Unsurprisingly, Figure A8 shows that the counterfactual median price increases throughout Flanders between 1 and 3% (depending on the level of aggregation we study).

the paper. Figure 8 shows the percent change across different levels of aggregation.

The policy decreased housing value inequality on average, but with significant heterogeneity depending on the level of analysis. We estimate that inequality fell by 0.8% in Flanders on average. The top-left panel shows that it decreased by less than 1% in East Flanders, Antwerp, and Flemish-Brabant. It fell between 1 and 2% in West Flanders, and between 2 and 3% in Limburg. At the district level (top-right panel), we see effects overall going in the same direction. However, that level of aggregation reveals a minor increase (less than 1%) in inequality in Halle-Vilvoorde, the district immediately across the Brussels border. The bottom panels reveal further heterogeneities, with several municipalities (mainly close to Brussels) also experiencing mild increases in inequality. Overall, the reduction in registration fees reduced housing inequality, but the effect concentrates in the provinces of Limburg, West Flanders, and the districts of Aalst, Dendermonde, and Sint-Niklaas.

Thinking about wealth inequality, our analysis allows us to discuss two main points. First, as we already pointed out and the quantile regression estimates confirmed, the primary winners were low-value homeowners. Thanks to the policy, their housing assets value increased by up to 7%. Given that we estimate negligible price effects for dwellings above the median value, we can infer that wealth inequality decreased due to the compression in the housing value distribution. Secondly, if, as previously discussed, the policy induced a fraction of low-value liquidity-constrained renters to become homeowners, then wealth inequality should have also decreased through expanded homeownership.

Low-value renters are likely to be the main losers of the policy. Albeit possibly not immediately, higher housing values should eventually translate into higher rental prices. These individuals are likely to have close to zero wealth, so the wealth distribution would mostly remain unchanged in that regard. Nevertheless, higher rents would imply less non-housing consumption for these households.

6 Conclusions

Using cadastral and housing transactions data, we provided novel estimates and insights about housing inequality in Belgium at different levels of aggregation, ranging from the federal to the local neighborhood level. We showed that overall housing inequality in Belgium is relatively low (value Gini of 0.25), but with substantial het-

erogeneity across and within municipalities.

Our inter-temporal analysis revealed a significant increase in value inequality after 2015, that partly reverted in the Brussels region. In the more longer-run, we found that the three Belgian regions exhibited a U-shape pattern, with housing space inequality being relatively high at the beginning of the 20th century, followed by a slow decay in the subsequent decades and until 1980, and a partial recovery since.

In the last part of the paper, we found that the recent decrease in registration fees in Flanders by 3% increased house prices by approximately 3% on average and reduced housing inequality by 0.8%. Our analysis revealed substantial heterogeneity across and within municipalities and suggested that wealth inequality in Flanders decreased due to the compression in house prices from below.

This paper suggests that traditional inequality measures might hide significant heterogeneities masked in the aggregation. Housing value or space inequality estimates, as introduced in this paper, should be seen as a complement to traditional measures and be used to detect these heterogeneities and address research or policy questions in which granularity is a must.

Similarly, the second part of the paper suggests that housing policies can shape housing inequality differently across geographies depending on the relevant dwelling value distribution. Policymakers should consider those in advance to quantify and potentially compensate those losing from the policy (e.g., low-value renters in our specific context).

Future research should make use of the full potential of the cadastral data. For confidential reasons, our study was limited by not being able to observe all the attributes in the unrestricted version of the data. In particular, we did not have any variable identifying the owner (not even anonymously). Studying or making statements about wealth inequality is impossible without such information. Future studies focused on wealth inequality ought to use the full data. For that, ease of access will be crucial.

References

- Alvaredo, Facundo, Lucas Chancel, Thomas Piketty, Emmanuel Saez, and Gabriel Zucman. 2022. “World Inequality Database.” *URL: <https://wid.world>*.
- André, Mathias, and Olivier Meslin. 2021. “Et pour quelques appartements de plus:

- Étude de la propriété immobilière des ménages et du profil redistributif de la taxe foncière.” *document de travail, Insee*.
- Apgar Jr., William C. 1990. “Which housing policy is best?” *Housing Policy Debate* 1 (1): 1–32.
- Autor, David H., Christopher J. Palmer, and Parag A. Pathak. 2014. “Housing market spillovers: Evidence from the end of rent control in Cambridge, Massachusetts.” *Journal of Political Economy* 122 (3): 661–717.
- Best, Michael C., and Henrik J. Kleven. 2018. “Housing market responses to transaction taxes: Evidence from notches and stimulus in the U.K.” *The Review of Economic Studies* 85 (1): 157–193.
- Blanco, Miguel Artola, Luis Bauluz, and Clara Martínez-Toledano. 2021. “Wealth in Spain 1900–2017 A country of two lands.” *The Economic Journal* 131 (633): 129–155.
- Breiman, Leo. 2001. “Random forests.” *Machine learning* 45 (1): 5–32.
- Čeh, Marjan, Milan Kilibarda, Anka Lisec, and Branislav Bajat. 2018. “Estimating the performance of random forest versus multiple regression for predicting prices of the apartments.” *ISPRS international journal of geo-information* 7 (5): 168.
- Chancel, Lucas, Thomas Piketty, Emmanuel Saez, and Gabriel Zucman. 2021. “World inequality report 2022.”
- Chapelle, Guillaume, Benjamin Vignolles, and Clara Wolf. 2018. “Impact of a housing tax credit on local housing markets: evidence from France.” *Annals of Economics and Statistics*, no. 130:101–131.
- Chetty, Raj, and Nathaniel Hendren. 2018. “The impacts of neighborhoods on intergenerational mobility I: Childhood exposure effects.” *The Quarterly Journal of Economics* 133 (3): 1107–1162.
- Chetty, Raj, Nathaniel Hendren, and Lawrence F Katz. 2016. “The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment.” *American Economic Review* 106 (4): 855–902.
- Couture, Victor, Cecile Gaubert, Jessie Handbury, and Erik Hurst. 2019. “Income growth and the distributional effects of urban spatial sorting.” Technical Report, National Bureau of Economic Research.

- Damen, Sven, and Geert Goeyvaerts. 2021. "Housing market responses to the mortgage interest deduction." Unpublished.
- Davis, Morris A., Jesse Gregory, Daniel A. Hartley, and Kegan T. K. Tan. 2021. "Neighborhood effects and housing vouchers." *Quantitative Economics* 12 (4): 1307–1346.
- de Sola Perea, M. 2020. "First results of the third wave of Belgium's Household Finance and Consumption Survey." Technical Report, NBB Economic Review.
- Diamond, Rebecca, and Tim McQuade. 2019. "Who wants affordable housing in their backyard? An equilibrium analysis of low-income property development." *Journal of Political Economy* 127 (3): 1063–1117.
- Díaz, Antonia, and María José Luengo-Prado. 2010. "The Wealth Distribution with Durable Goods." *International Economic Review* 51 (1): 143–170.
- Domènech-Arumí, Gerard. 2022. "Neighborhoods, Perceived Inequality, and Preferences for Redistribution: Evidence from Barcelona." *ECARES Working Papers*, vol. 2022.
- Fan, Gang-Zhi, Seow Eng Ong, and Hian Chye Koh. 2006. "Determinants of house price: A decision tree approach." *Urban Studies* 43 (12): 2301–2315.
- Favilukis, Jack, Pierre Mabilie, and Stijn Van Nieuwerburgh. 2022. "Affordable housing and city welfare." *The Review of Economic Studies*. Forthcoming.
- Fogli, Alessandra, and Veronica Guerrieri. 2019. "The end of the american dream? inequality and segregation in us cities." NBER Working Paper 26143.
- Fuchs-Schündeln, Nicola, Dirk Krueger, and Mathias Sommer. 2010. "Inequality trends for Germany in the last two decades: A tale of two countries." *Review of Economic Dynamics* 13 (1): 103–132.
- Girshina, Anastasia, François Koulischer, and Ulf von Lilienfeld-Toal. 2021. "Housing affordability and transaction tax subsidies." Unpublished.
- Glaeser, Edward L, Matt Resseger, and Kristina Tobio. 2009. "Inequality in cities." *Journal of Regional Science* 49 (4): 617–646.
- Kaas, Leo, Georgi Kocharkov, Edgar Preugschat, and Nawid Siassi. 2020. "Low Homeownership in Germany—a Quantitative Exploration." *Journal of the European Economic Association* 19 (1): 128–164.

- Kindermann, Fabian, and Sebastian Kohls. 2018, October. “Rental Markets and Wealth Inequality in the Euro-Area.” Unpublished.
- Kopczuk, Wojciech, and David Munroe. 2015. “Mansion tax: The effect of transfer taxes on the residential real estate market.” *American Economic Journal: Economic Policy* 7 (2): 214–257.
- Kuhn, Moritz, Moritz Schularick, and Ulrike I Steins. 2020. “Income and wealth inequality in America, 1949–2016.” *Journal of Political Economy* 128 (9): 3469–3519.
- Kuhn, Peter, Peter Kooreman, Adriaan Soetevent, and Arie Kapteyn. 2011. “The effects of lottery prizes on winners and their neighbors: Evidence from the Dutch postcode lottery.” *American Economic Review* 101 (5): 2226–47.
- Malpezzi, Stephen, and Kerry Vandell. 2002. “Does the low-income housing tax credit increase the supply of housing?” *Journal of Housing Economics* 11 (4): 360–380.
- Martínez-Toledano, Clara. 2020. “House price cycles, wealth inequality and portfolio reshuffling.” *WID. World Working Paper* 2:8.
- Mullainathan, Sendhil, and Jann Spiess. 2017. “Machine Learning: An Applied Econometric Approach.” *Journal of Economic Perspectives* 31 (2): 87–106 (May).
- OECD. 2022a. OECD Affordable Housing Database. <https://www.oecd.org/housing/data/affordable-housing-database/>.
- . 2022b. OECD Income Inequality Database. <https://data.oecd.org/inequality/income-inequality.htm>.
- Olsen, Edgar O. 2003. Chapter Housing programs for low-income households of *Means-tested transfer programs in the United States*, edited by Robert A. Moffitt, 365–441. University of Chicago Press.
- Openshaw, S, and P Taylor. 1979. “Statistical applications in the spatial sciences, chapter A million or so correlation coefficients: three experiments on the modifiable areal unit problem.” *Wrigley N. Publishers, London, Pion*, pp. 127–144.
- Piketty, Thomas, and Emmanuel Saez. 2003. “Income inequality in the United States, 1913–1998.” *The Quarterly journal of economics* 118 (1): 1–41.

- . 2006. “The evolution of top incomes: a historical and international perspective.” *American economic review* 96 (2): 200–205.
- Piketty, Thomas, and Gabriel Zucman. 2014. “Capital is back: Wealth-income ratios in rich countries 1700–2010.” *The Quarterly journal of economics* 129 (3): 1255–1310.
- Poterba, James M. 1992. “Taxation and housing: Old questions, new answers.” *The American Economic Review, Papers and Proceedings* 82 (2): 237–242.
- Saez, Emmanuel, and Gabriel Zucman. 2016. “Wealth inequality in the United States since 1913: Evidence from capitalized income tax data.” *The Quarterly Journal of Economics* 131 (2): 519–578.
- Silos, Pedro. 2007. “Housing, Portfolio Choice and the Macroeconomy.” *Journal of Economic Dynamics and Control* 31:2774–2801.
- Sinai, Todd, and Joel Waldfoegel. 2005. “Do low-income housing subsidies increase the occupied housing stock?” *Journal of Public Economics* 89 (11-12): 2137–2164.
- Sommer, Kamila, and Paul Sullivan. 2018. “Implications of US tax policy for house prices, rents, and homeownership.” *American Economic Review* 108 (2): 241–274.
- Wong, David. 2009. “The modifiable areal unit problem (MAUP).” *The SAGE handbook of spatial analysis* 105 (23): 2.
- Wright, Marvin N, and Andreas Ziegler. 2015. “ranger: A fast implementation of random forests for high dimensional data in C++ and R.” *arXiv preprint arXiv:1508.04409*.
- Yang, Minhua, and Junni Zhou. 2022. “The impact of COVID-19 on the housing market: Evidence from the Yangtze river delta region in China.” *Applied Economics Letters* 29 (5): 409–412.

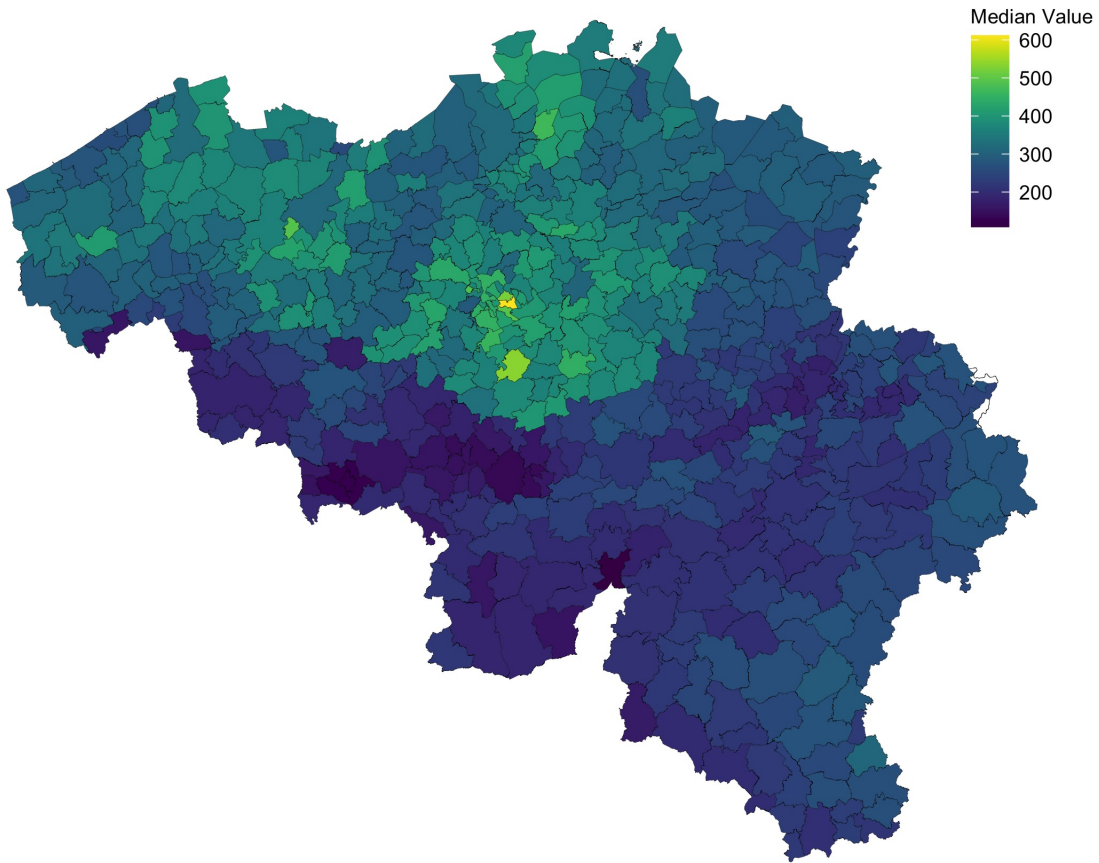
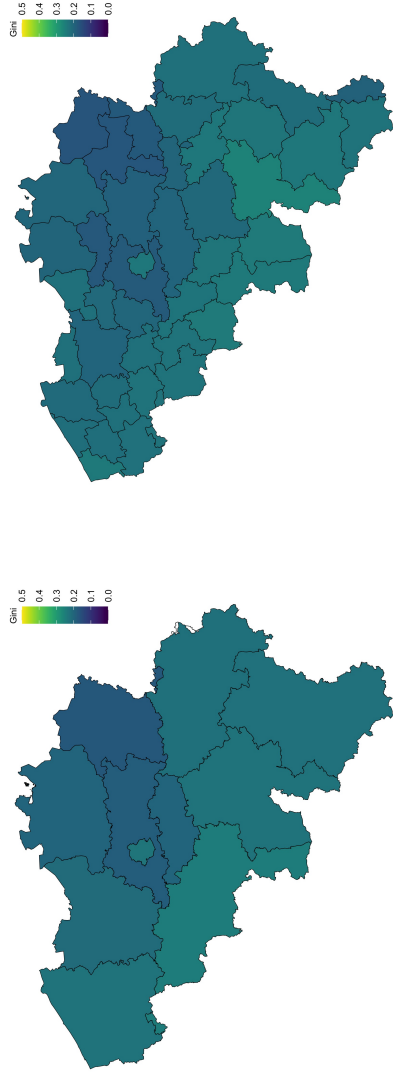
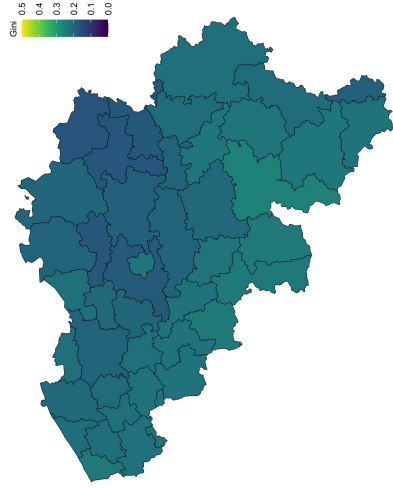


Figure 1: Median housing value across Belgian municipalities

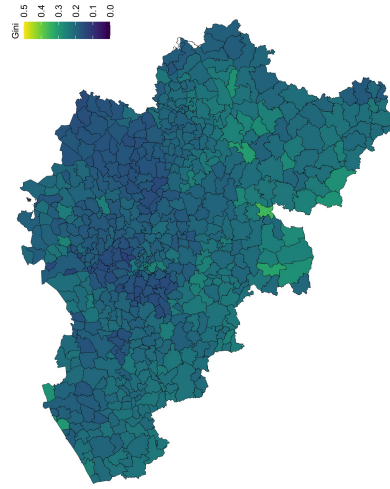
Notes: This figure shows the predicted median house value across all municipalities in Belgium for the year 2022. Darker colors represent lower housing values. Lighter colors denote higher values.



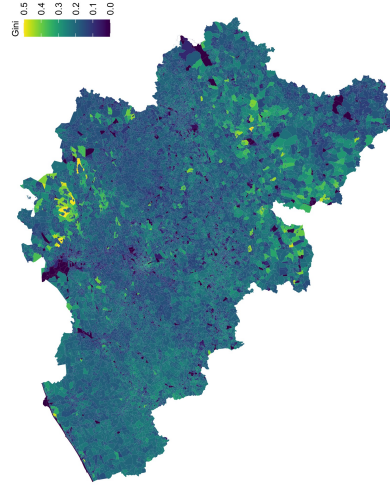
(a) Province



(b) District



(c) Municipality



(d) Statistical sector

Figure 2: Housing value inequality in Belgium

Notes: Each map illustrates housing value inequality at a given subnational level. Darker colors describe geographic units with lower levels of local inequality. Brighter colors denote higher levels of inequality. Housing value inequality in Belgium is 0.253. The figures are 0.226, 0.265, and 0.208 for Brussels, Wallonia, and Flanders.

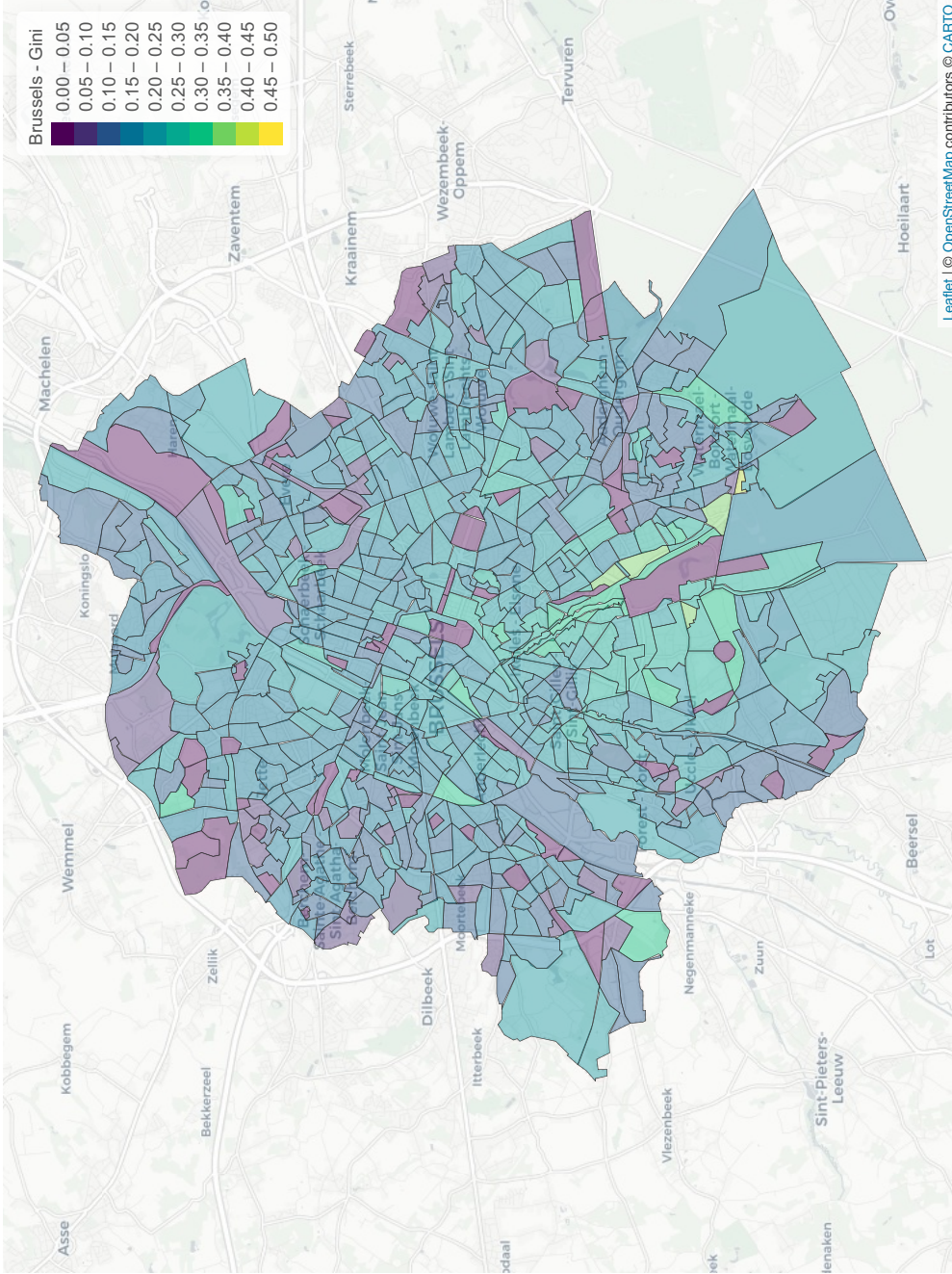


Figure 3: Housing value inequality in Brussels

Notes: Value Gini across Brussels statistical sectors. Darker colors denote statistical sectors with lower levels of local inequality. Brighter colors denote higher levels of inequality.

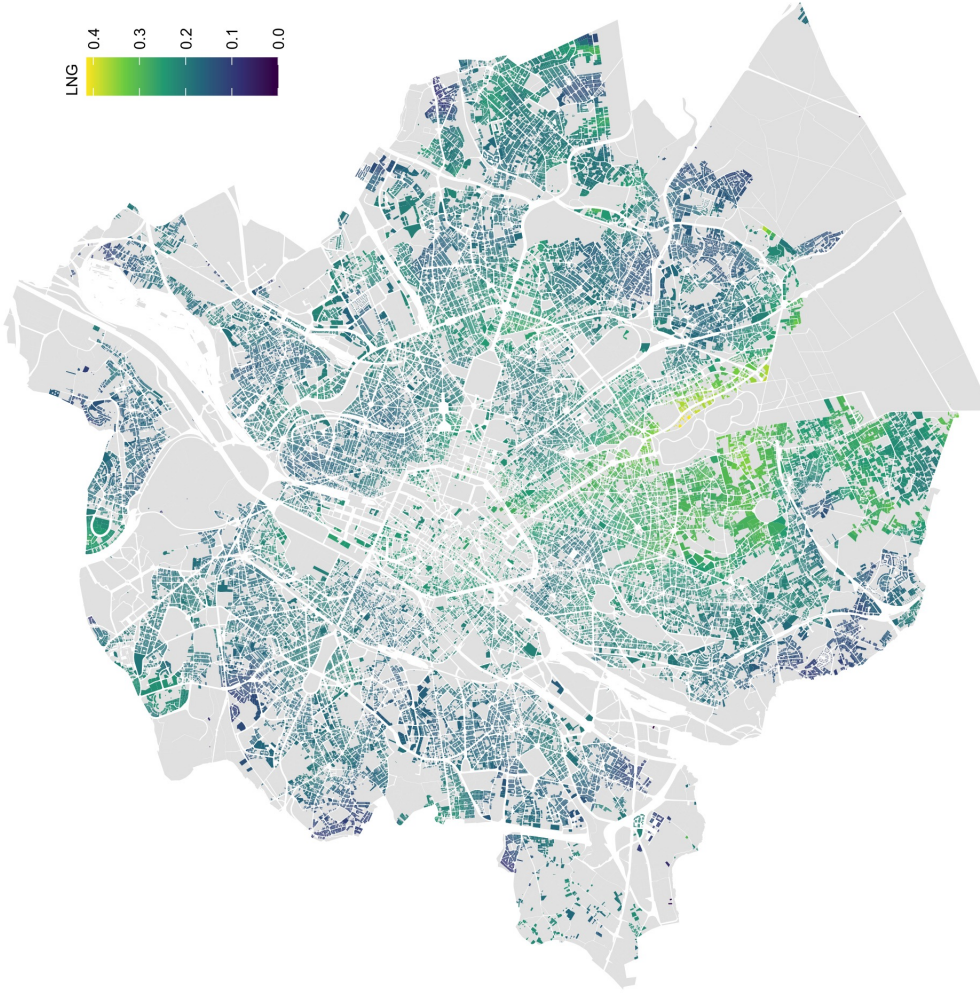
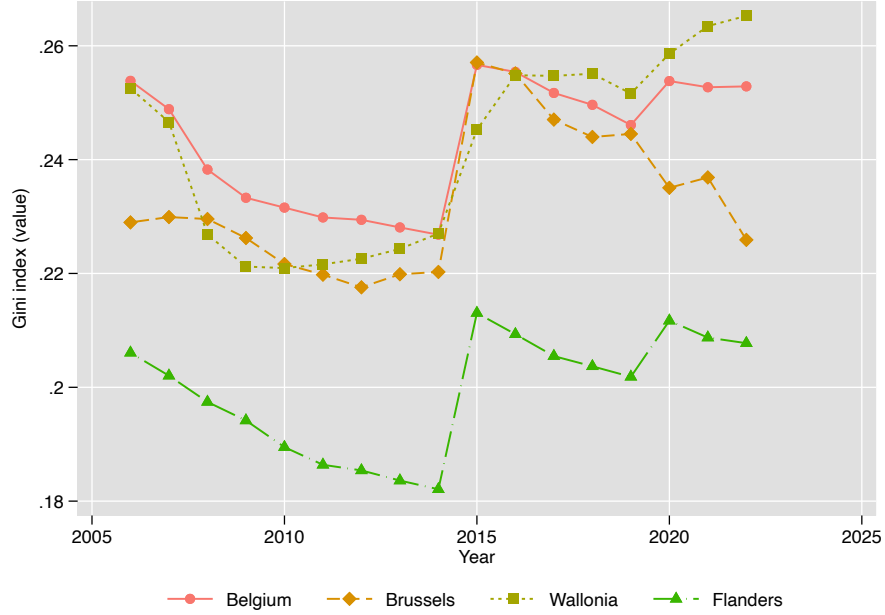
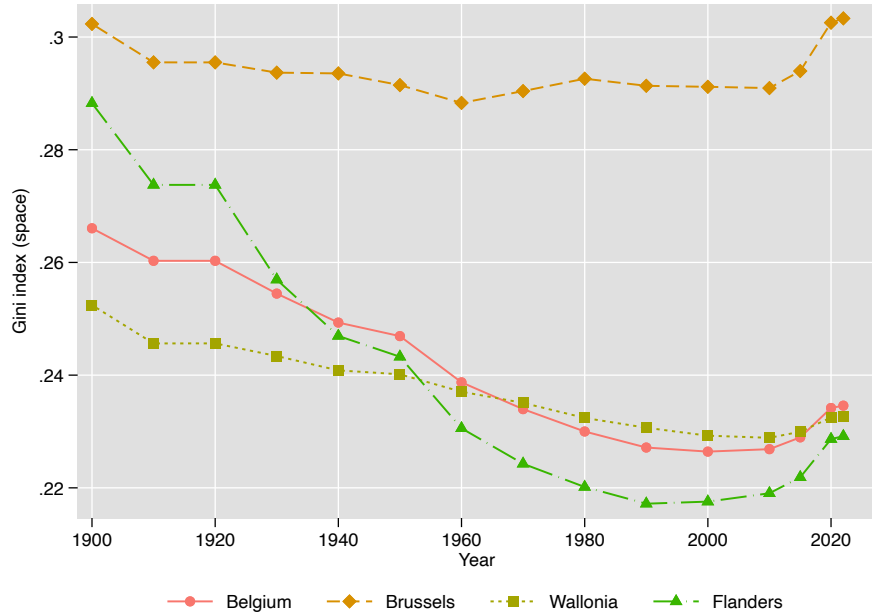


Figure 4: Local Inequality in housing value in Brussels

Notes: This figure shows value LNG500 (radii of 500 meters) estimates for Brussels. Each colored polygon in the map is a parcel with dwellings. Darker colors depict parcels with lower levels of local inequality. Brighter colors depict parcels with higher levels of inequality.



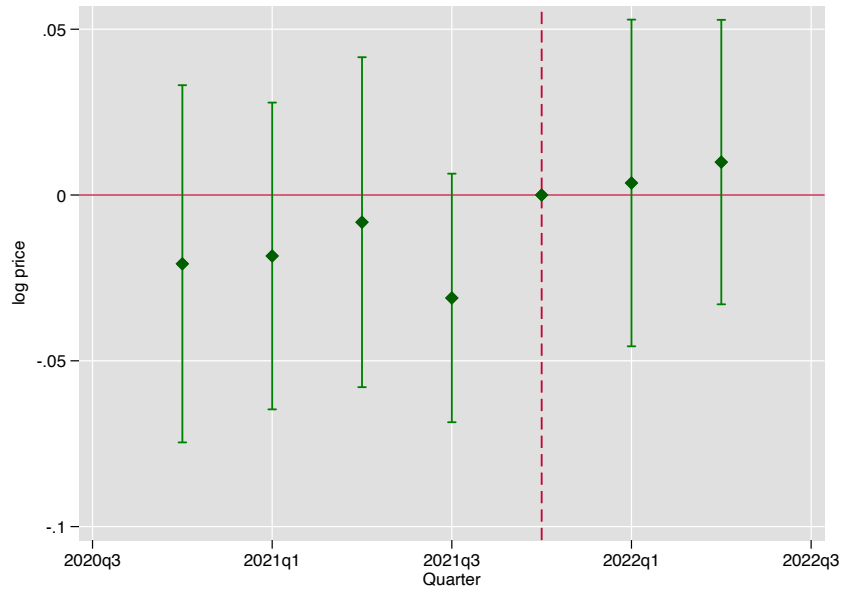
(a) Value



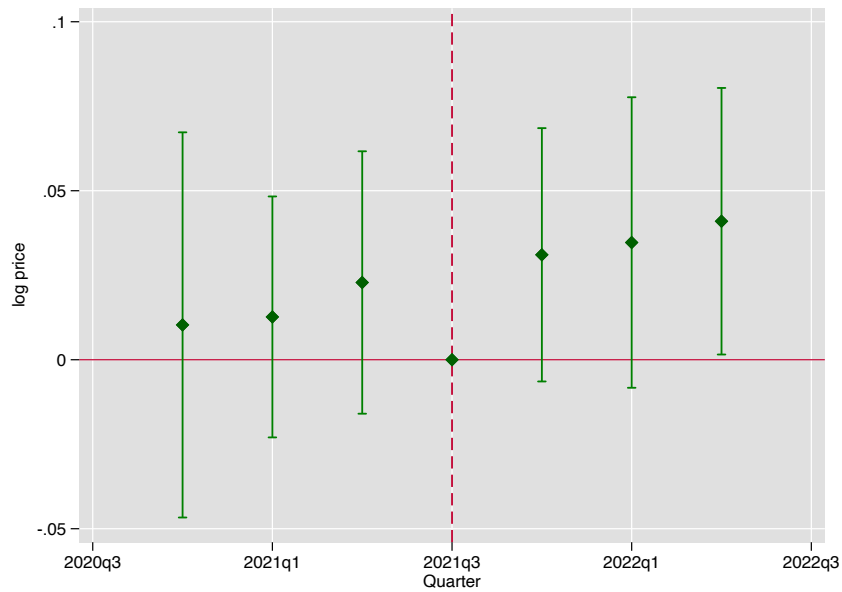
(b) Space

Figure 5: Housing inequality in Belgium over time

Notes: This figure illustrates the evolution of housing inequality in Belgium and its regions over time. The top panel shows housing value inequality since 2006. The bottom panel shows housing space inequality since 1900.



(a) Relative to the policy implementation



(b) Relative to the policy announcement

Figure 6: Trends in log prices in Flanders relative to Brussels and Wallonia

Notes: Each coefficient illustrates the β_τ estimate in the τ -th percentile, as defined in Equation 3. Green vertical bars denote 95% confidence intervals. Housing price percentiles are (in 1000s EUR) 120 (10th), 165 (20th), 198 (30th), 230 (40th), 260 (50th), 296 (60th), 340 (70th), 400 (80th), and 530 (90th).

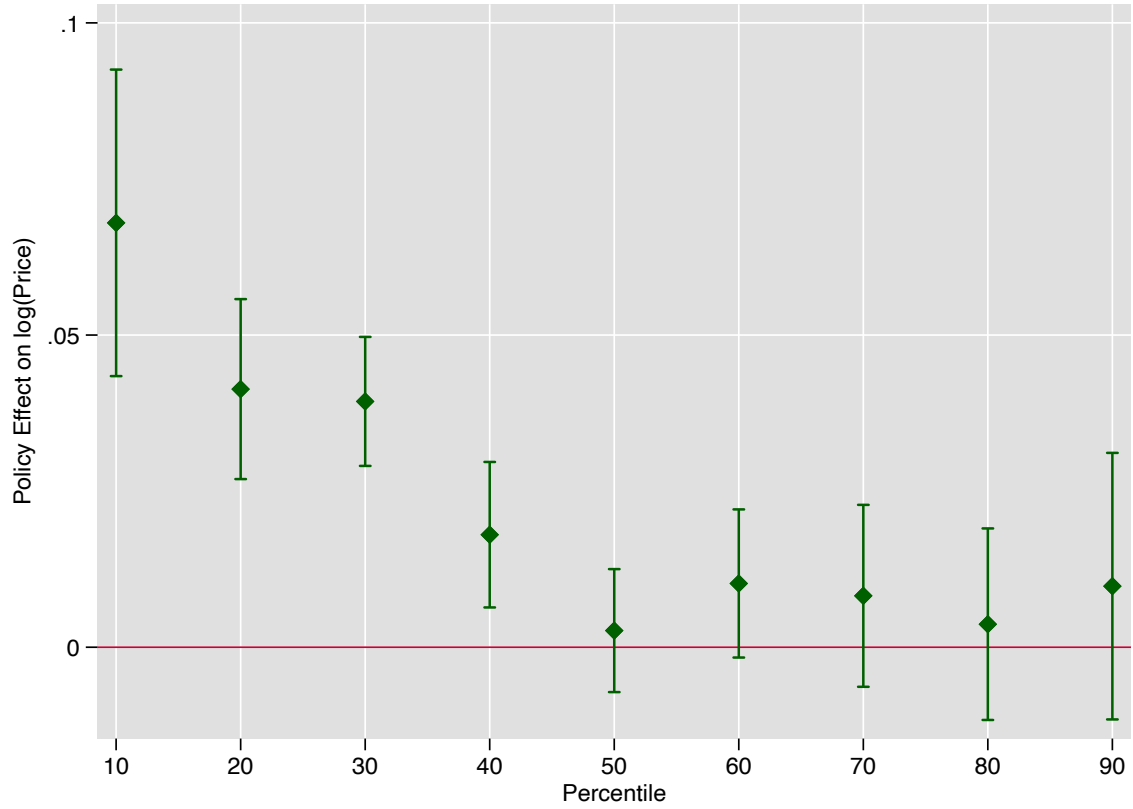
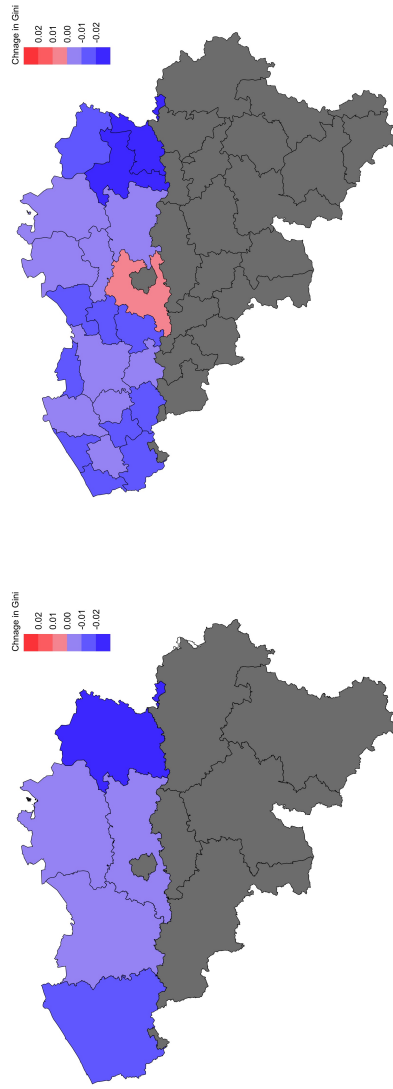
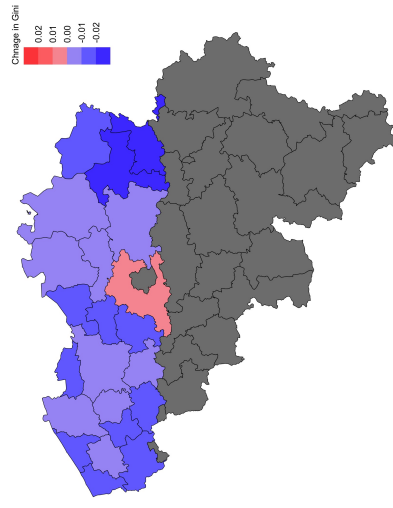


Figure 7: Policy effects by percentile

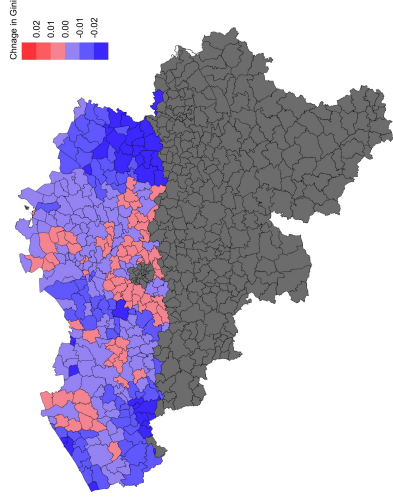
Notes: Each coefficient illustrates the β_τ estimate in the τ -th percentile, as defined in Equation 3. Green vertical bars denote 95% confidence intervals. Housing price percentiles are (in 1000s EUR) 120 (10th), 165 (20th), 198 (30th), 230 (40th), 260 (50th), 296 (60th), 340 (70th), 400 (80th), and 530 (90th).



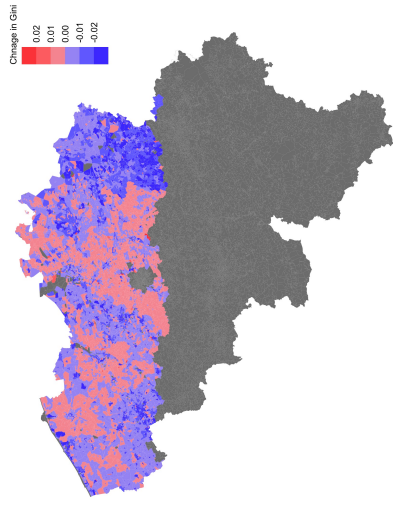
(a) Province



(b) District



(c) Municipality



(d) Statistical sector

Figure 8: Predicted change in housing value inequality in Belgium

Notes: Each map illustrates the predicted change in housing value inequality after the reduction in registration fees introduced in the Flanders region in 2022. Results are obtained comparing our original inequality estimates for 2021 with new inequality estimates using 2021 policy-counterfactual prices obtained from the quantile regressions in Table A2. The overall predicted change in housing value inequality is -0.14% for Belgium and -0.8% for Flanders.

Table 1: Summary statistics for the *transactions* and the *parcels* databases.

Variable	<i>transactions</i> database		<i>parcels</i> database	
	Mean	SD	Mean	SD
Sale price (1000s EUR)	262.379	3555.733		
Surface (m ²)	150.100	151.644	163.325	90.256
Share of houses	0.870	0.336	0.869	0.337
Share of apartments	0.130	0.336	0.131	0.337
Number of rooms	5.781	8.795	5.544	3.514
Number of bathrooms	0.838	0.623	0.955	0.754
Number of garages	0.559	0.721	0.661	0.705
Cellar	0.300	0.458	0.328	0.470
Floor number	0.973	0.829	1.411	0.800
Central heating	0.511	0.500	0.709	0.454
Construction year	1939.3	40.317	1954.8	46.317
Last renovation (years)	57.921	42.149	44.128	41.437
Detached dwelling	0.276	0.447	0.343	0.475
Normal quality	0.985	0.122	0.988	0.110
Number of observations	2,012,145		4,255,457	

Notes: The sample of transactions and parcels only includes real estate in the dwelling category. It excludes other real estate (e.g., office buildings).

Table 2: Correlations between income and housing inequality

Panel A. Housing Value		Belgium				Brussels				
	Income IQR	IQR	Gini	LNG200	LNG500	Income IQR	IQR	Gini	LNG200	LNG500
Income IQR	1					1				
IQR	0.5402	1				0.6096	1			
Gini	0.2094	0.5742	1			0.3134	0.7578	1		
LNG200	0.1408	0.4588	0.8094	1		0.3118	0.6659	0.8329	1	
LNG500	0.2009	0.4758	0.748	0.8689	1	0.4137	0.6466	0.7086	0.8761	1

Panel B. Housing Space		Belgium				Brussels				
	Income IQR	IQR	Gini	LNG200	LNG500	Income IQR	IQR	Gini	LNG200	LNG500
Income IQR	1					1				
IQR	0.2745	1				0.0803	1			
Gini	0.0219	0.6662	1			-0.082	0.6711	1		
LNG200	-0.03	0.5918	0.8946	1		-0.1142	0.6025	0.8232	1	
LNG500	-0.0123	0.535	0.8313	0.9365	1	-0.1307	0.4513	0.6764	0.8617	1

Notes: This table shows raw correlations between different inequality estimates at the statistical sector level. The taxable income Inter-quartile range (IQR) for the year 2018 (the last year available in the data) was obtained from Statbel. The housing inequality estimates describe inequality in 2022.

Table 3: The reduction in registration fees policy in Flanders in January 2022

Implementation date	2002	June 1, 2018	Jan 1, 2020	Jan 1, 2022
Baseline rate				
Flanders	10%	7%	6%	3%
Brussels	12.50%	12.5%	12.5%	12.5%
Wallonia	12.50%	12.5%	12.5%	12.5%
Announcement date Flanders			Sep 30, 2019	Sep 27, 2021
Exceptions				
Flanders				
for properties with Cadastral Income < 745€	5%		5600€ deduction	2800€ deduction
price < 200.000€ and outside ‘core’ (220k from 2022 onwards)			5600€ deduction	2800€ deduction
price < 220.000€ and inside ‘core’ (240k from 2022 onwards)			5600€ deduction	2800€ deduction
Intensive energy renovation			6%	5% 1%
Wallonia				
for properties with Cadastral Income < 745€	6%	6%	6%	6%

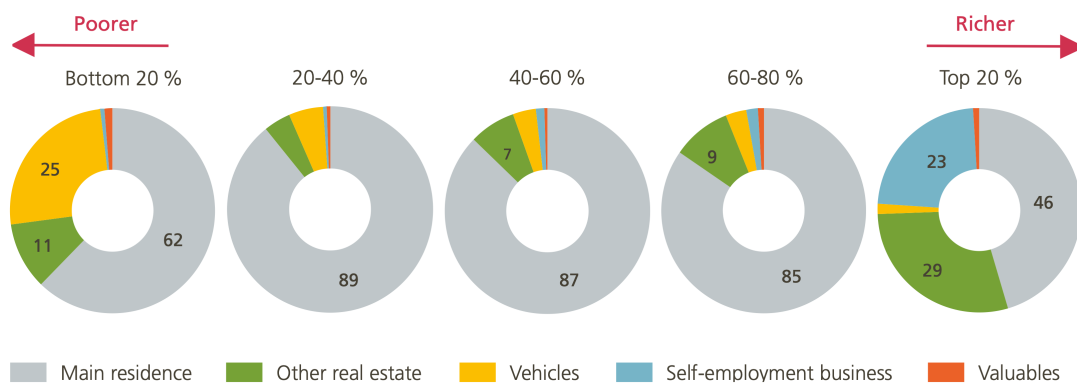
Notes: List of cities in ‘core’: <https://www.vlaanderen.be/uw-overheid/werking-en-structuur/hoe-werkt-de-vlaamse-overheid/belastingen-en-begroting/vlaamse-belastingen/registratiebelasting/kernsteden-en-steden-in-de-vlaamse-rand-rond-brussel>. Some additional small changes exist in “abattement” in Brussels, which we ignore here.

Table 4: The effects of a reduction of registration fees on house prices

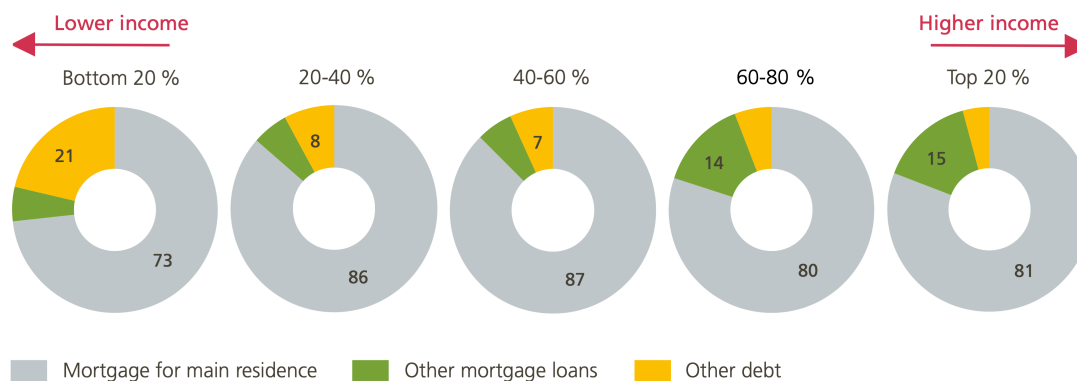
	log Price				
	(1)	(2)	(3)	(4)	(5)
After × Flanders	0.042*** (0.015)	0.035** (0.014)	0.031** (0.014)	0.027** (0.014)	0.033*** (0.007)
R2	0.037	0.139	0.154	0.269	0.275
N	254721	254721	254721	254721	219023
District FE		X	X	X	X
N'hood Income			X	X	X
Dwelling Controls				X	X
Exclude Pre-implement					X

Notes: This table shows β estimates from Equation 1. The baseline sample in columns 1-4 includes all dwelling transactions from 2020Q4 until 2022Q2. The dependent variable is the log price of the transaction. *N'hood Income* controls include the log median pre-tax income in the statistical sector. *Dwelling Controls* include the year of construction, floor, number of rooms, number of garages, number of bathrooms, years since the last renovation, and indicators for construction type, quality, attic, and central heating. *Exclude Pre-implement* is the subsample that excludes the transactions in the last quarter of 2021 (post-announcement and pre-implementation). Heteroskedasticity-robust standard errors clustered at the municipality level in parenthesis. *p<0.1, **p<0.05, ***p<0.01.

A Additional figures and tables



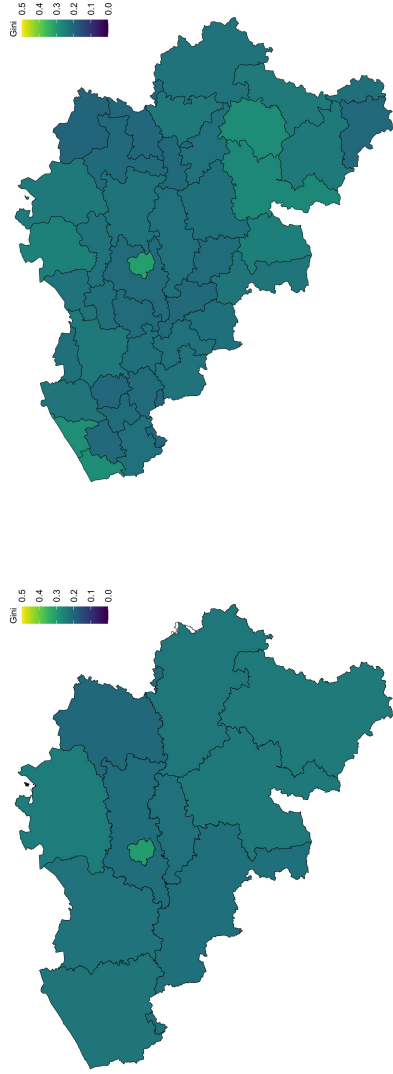
(a) Asset portfolios



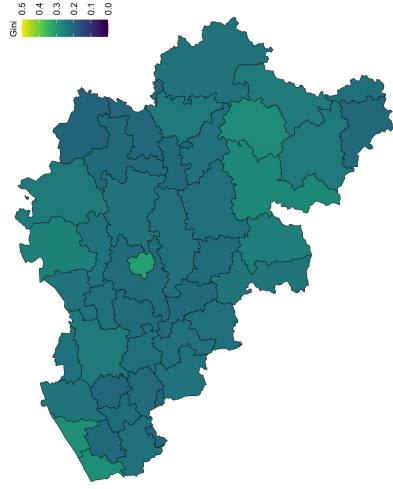
(b) Debt portfolios

Figure A1: Asset and debt portfolios throughout the income distribution

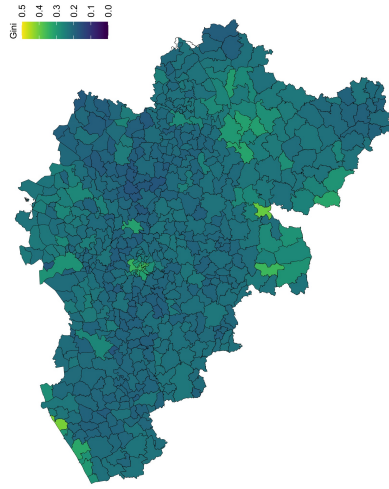
Notes: This figure shows the holdings of real assets by net wealth quintile (top) and holdings of debt by income quintile (bottom). Source: National Bank of Belgium and Household Finance and Consumption Survey.



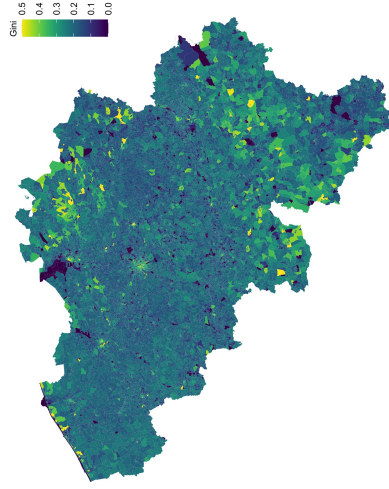
(a) Province



(b) District



(c) Municipality



(d) Statistical sector

Figure A2: Housing space inequality in Belgium

Notes: Each map illustrates housing space inequality at a given subnational level. Darker colors depict geographic units with lower levels of inequality. Brighter colors illustrate higher levels of inequality. Housing space inequality in Belgium (as measured by the Gini index) is 0.234. The figures are 0.303, 0.233, and 0.229 for Brussels, Wallonia, and Flanders.

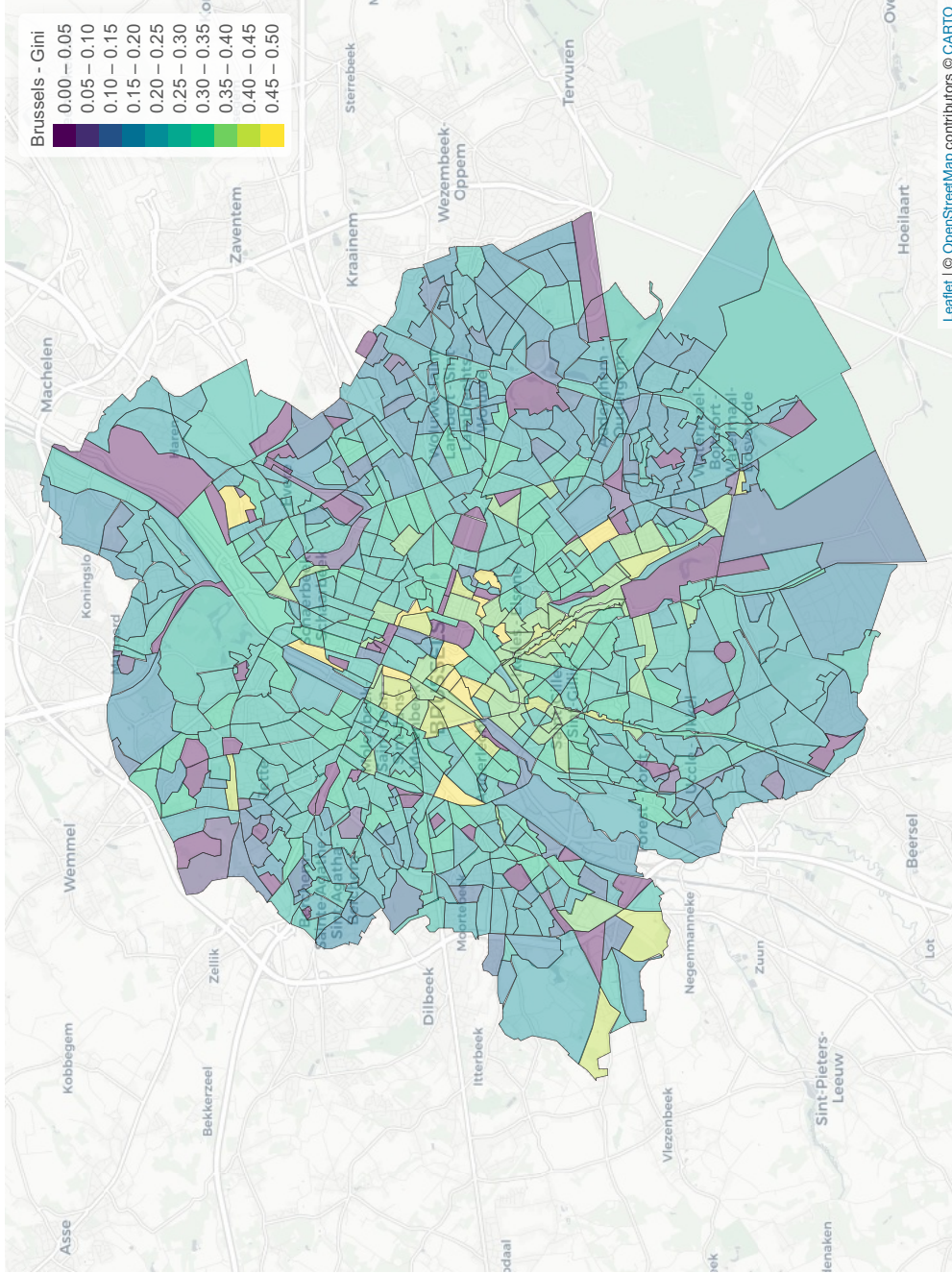


Figure A3: Housing value inequality in Brussels

Notes: Space inequality (as measured by the Gini index) across Brussels statistical sectors. Darker colors denote statistical sectors with lower levels of local inequality. Brighter colors illustrate higher levels of inequality.

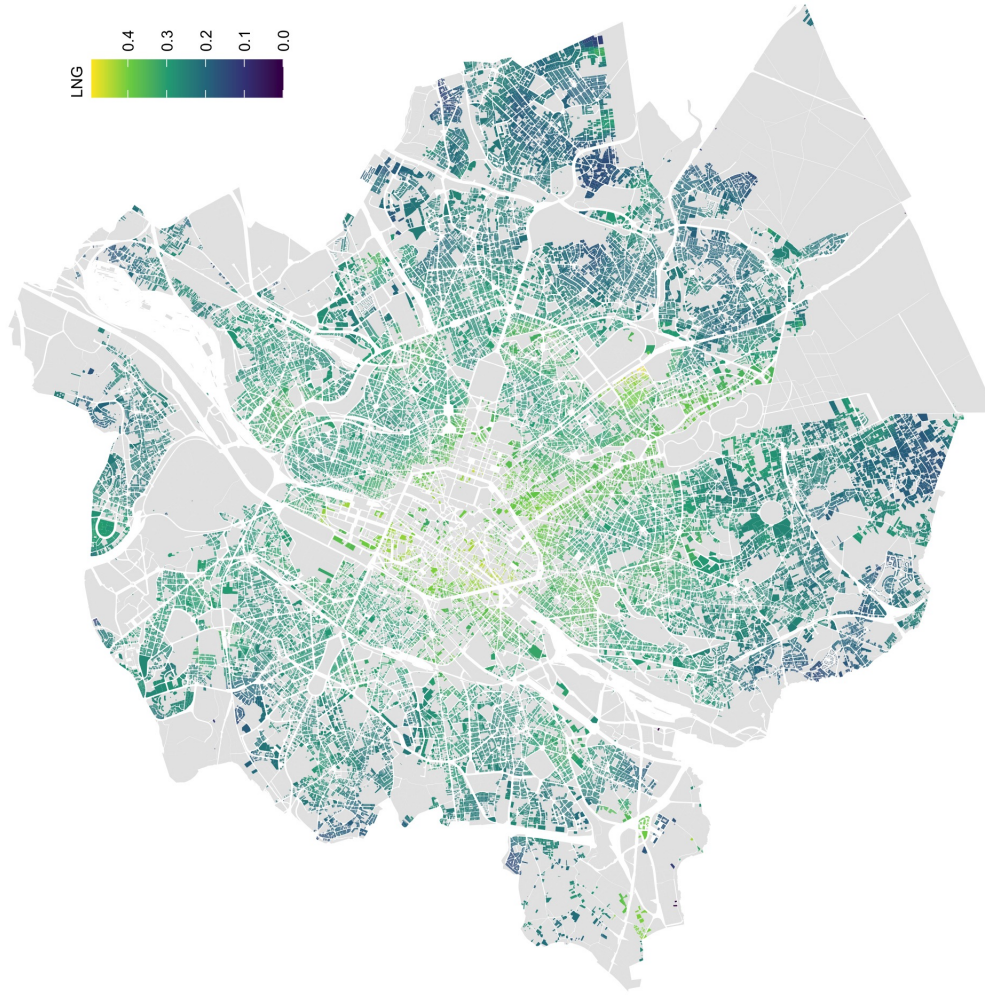


Figure A4: Local inequality in housing space in Brussels

Notes: This figure shows space LNG500 (radii of 500 meters) estimates for Brussels. Each colored polygon in the map is a parcel with dwellings. Darker colors describe parcels with lower levels of local inequality. Brighter colors illustrate higher levels of inequality.

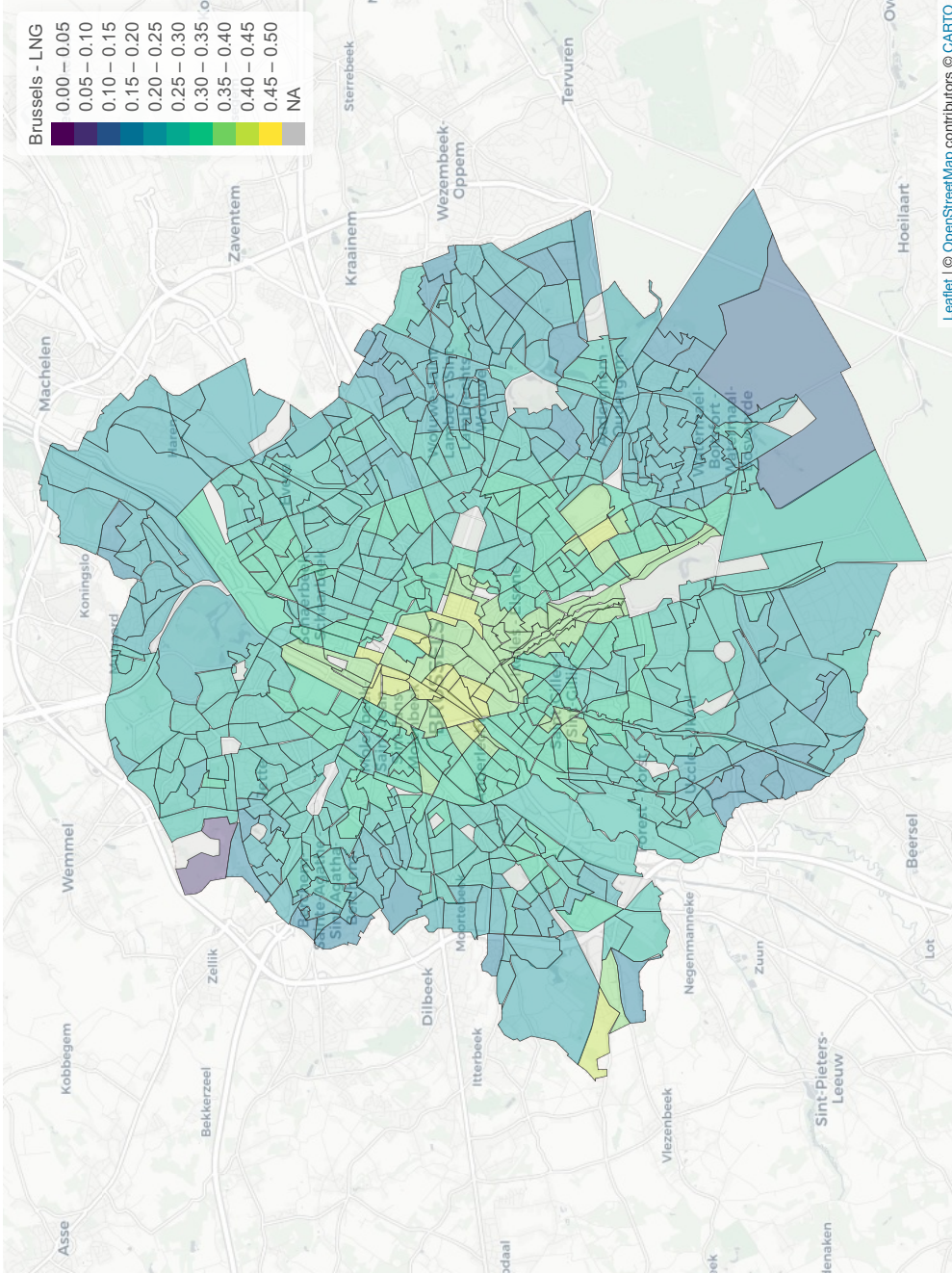
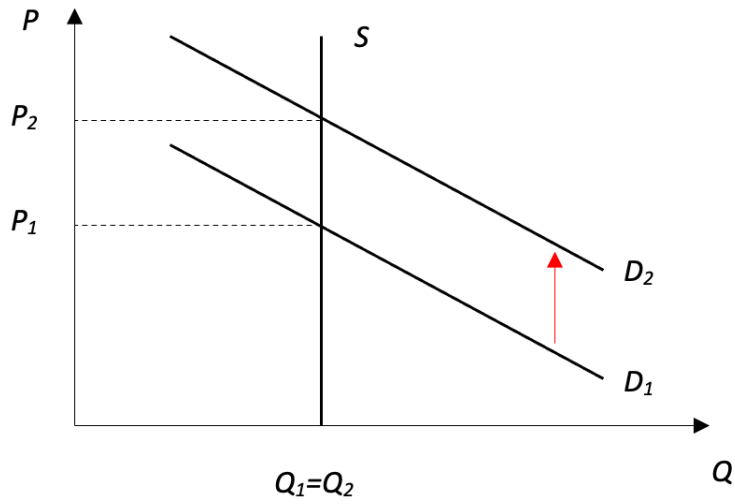
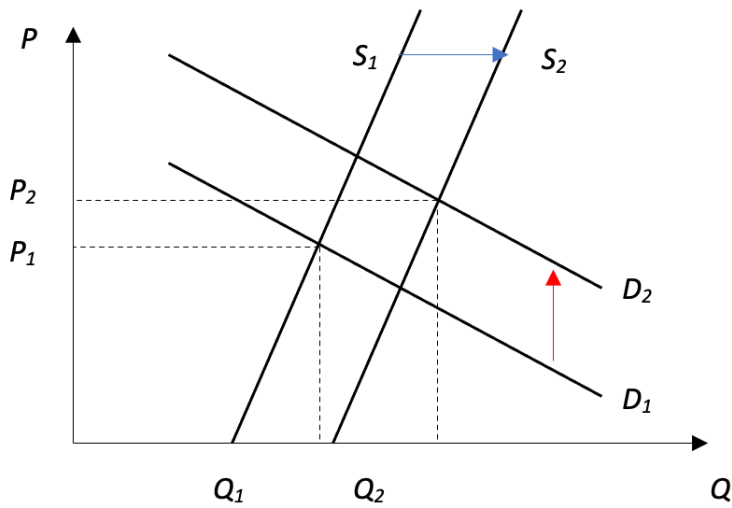


Figure A6: Local Inequality in housing space in Brussels (statistical sector)

Notes: This figure shows space LNG500 (radii of 500 meters) estimates for Brussels aggregated at the statistical sector level. Darker colors describe statistical sectors with lower levels of local inequality. Brighter colors illustrate higher levels of inequality.



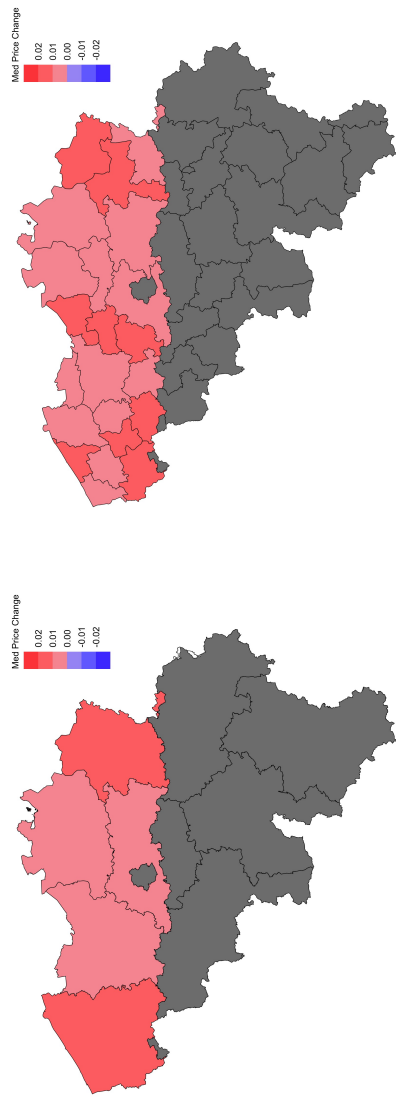
(a) Inelastic supply



(b) Elastic supply

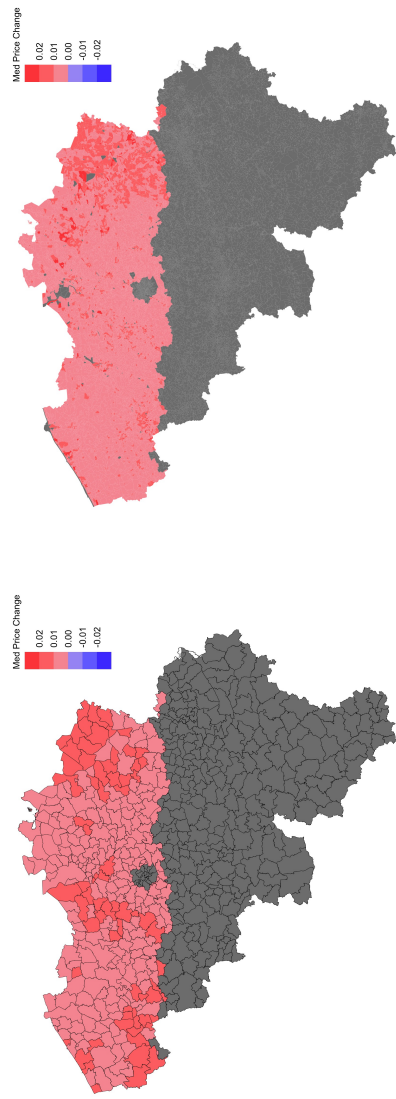
Figure A7: Theoretical effects of a reduction in registration fees

Notes: This figure shows the theoretical effects of a reduction in registration fees on equilibrium housing prices. The top panel assumes a perfectly inelastic housing supply and predicts a full pass-through of the tax reduction on equilibrium prices. The bottom panel considers a more elastic supply curve and predicts an ambiguous effect on equilibrium prices. The sign will depend on the elasticities of supply and demand.



(a) Province

(b) District



(c) Municipality

(d) Statistical sector

Figure A8: Predicted change in median housing value in Belgium after the policy

Notes: Each map illustrates the predicted change in the median housing value after the reduction in registration fees introduced in the Flanders region in 2022. Results are obtained comparing our original estimates for 2021 with 2021 policy-counterfactual prices obtained from the quantile regressions in [Table A2](#).

Table A1: Housing value and space inequality in Belgium today and over time

Year	Region	Space Gini		Value Gini	
		Regional	National	Regional	National
1900	Flanders	0.288	0.266		
	Wallonia	0.252			
	Brussels Capital	0.302			
1910	Flanders	0.274	0.260		
	Wallonia	0.246			
	Brussels Capital	0.296			
1920	Flanders	0.274	0.260		
	Wallonia	0.246			
	Brussels Capital	0.296			
1930	Flanders	0.257	0.254		
	Wallonia	0.243			
	Brussels Capital	0.294			
1940	Flanders	0.247	0.249		
	Wallonia	0.241			
	Brussels Capital	0.294			
1950	Flanders	0.243	0.247		
	Wallonia	0.240			
	Brussels Capital	0.291			
1960	Flanders	0.231	0.239		
	Wallonia	0.237			
	Brussels Capital	0.288			
1970	Flanders	0.224	0.234		
	Wallonia	0.235			
	Brussels Capital	0.290			
1980	Flanders	0.220	0.230		
	Wallonia	0.232			
	Brussels Capital	0.293			
1990	Flanders	0.217	0.227		
	Wallonia	0.231			
	Brussels Capital	0.291			
2000	Flanders	0.218	0.226		
	Wallonia	0.229			
	Brussels Capital	0.291			
2006	Flanders	0.218	0.227	0.206	0.254
	Wallonia	0.229		0.253	
	Brussels Capital	0.290		0.229	
2010	Flanders	0.219	0.227	0.189	0.232
	Wallonia	0.229		0.221	
	Brussels Capital	0.291		0.222	
2015	Flanders	0.222	0.229	0.213	0.257
	Wallonia	0.230		0.245	
	Brussels Capital	0.294		0.257	
2020	Flanders	0.229	0.234	0.212	0.254
	Wallonia	0.232		0.259	
	Brussels Capital	0.303		0.235	
2022	Flanders	0.229	0.235	0.208	0.253
	Wallonia	0.233		0.265	
	Brussels Capital	0.303		0.226	

Table A2: Policy quantile effects

Percentile	Effect	SE
10	0.068***	0.013
20	0.041***	0.007
30	0.039***	0.005
40	0.018***	0.006
50	0.003	0.005
60	0.010	0.006
70	0.008	0.007
80	0.004	0.008
90	0.010	0.011

Notes: This table shows the β_τ estimates from Equation 3, with log price as the dependent variable. Housing price percentiles are (in 1000s EUR) 120 (10th), 165 (20th), 198 (30th), 230 (40th), 260 (50th), 296 (60th), 340 (70th), 400 (80th), and 530 (90th). *p<0.1, **p<0.05, ***p<0.01.

B Data appendix

B.1 Data description and cleaning

Transactions: We have information on the universe of real estate transactions in Belgium from January 2006 to July 2022. We observe the exact price of each transaction, which we later use to predict the value of the housing stock (see the following subsection). In addition to the price, we also observe the following key variables: parcel identifier (*capakey* and *partnumber*), the exact date of the transaction, location, year of construction, last year of renovation, nature of the real estate (e.g., house, apartment, studio), construction type (e.g., detached house), the floor of the dwelling, quality of the dwelling (mediocre, normal, or luxurious), number of garages, number bathrooms, number of units, whether the dwelling has an attic or not, living area, whether the dwelling has central heating or not. We also have some information on the old and new owners of the dwelling (e.g., whether it is a physical person or a company).

The raw data contains over 5.4 million transactions, including transactions of building land or private entities. It also includes donations. For the analysis, we exclude those and only keep dwelling transactions. After applying these restrictions, we are left with over 2 million transactions over the 16-year period.

Parcels: We have information on the universe of real estate (stock) in Belgium as of July 2022. The raw data contains over 11 million observations. These include all sorts of real estate, from housing to forests. For our analysis, we only keep observations describing housing units. These include over 4.2 million dwellings. For each dwelling, we observe the same variables described above.

Imputations: A small fraction of observations has missing information. Whenever that is the case, we impute a value applying the rules described in Table B1. Whenever we make an imputation, we record it with an indicator variable specific to the variable imputed (e.g., we generate the variable *floor_mi*, which would take the value of 1 if we imputed the number of floors). We add all such variables in our prediction model, described below.

B.2 Dwelling price prediction

We use the Ranger package in R ([Wright and Ziegler 2015](#)) to implement the [Breiman \(2001\)](#) random forest algorithm and predict the (log) price of each dwelling in Belgium.¹ The prediction model uses the 2,024,358 real estate transactions that take place in Belgium from 2006 to 2022. The base model includes 40 variables describing dwelling characteristics (e.g., number of rooms) and location (e.g., municipality).

We implement the algorithm using hyperparameter tuning (sample split, variables per split, nodes). The final prediction grows 500 trees, five nodes, an 80% sample split, and 16 variables to split in each node. We allow the algorithm to assess each variable’s importance based on the reduction of node impurity after each split. The algorithm’s prediction error (Out of Bag Root Mean Squared Error, OOB RMSE) is 0.1805.

The most important variable for the prediction is the dwelling surface (square meters). Other variables with high relevance in the prediction include municipality, the year of the transaction, the number of bathrooms, the year of construction, and the number of rooms. [Figure B1](#) provides a visualization of the relative importance of the top 25 variables used by the algorithm.

¹Several studies suggest that random forests typically overperform standard hedonic price regressions and other machine learning methods such as LASSO ([Fan, Ong, and Koh 2006](#); [Mullainathan and Spiess 2017](#); [Čeh et al. 2018](#)).

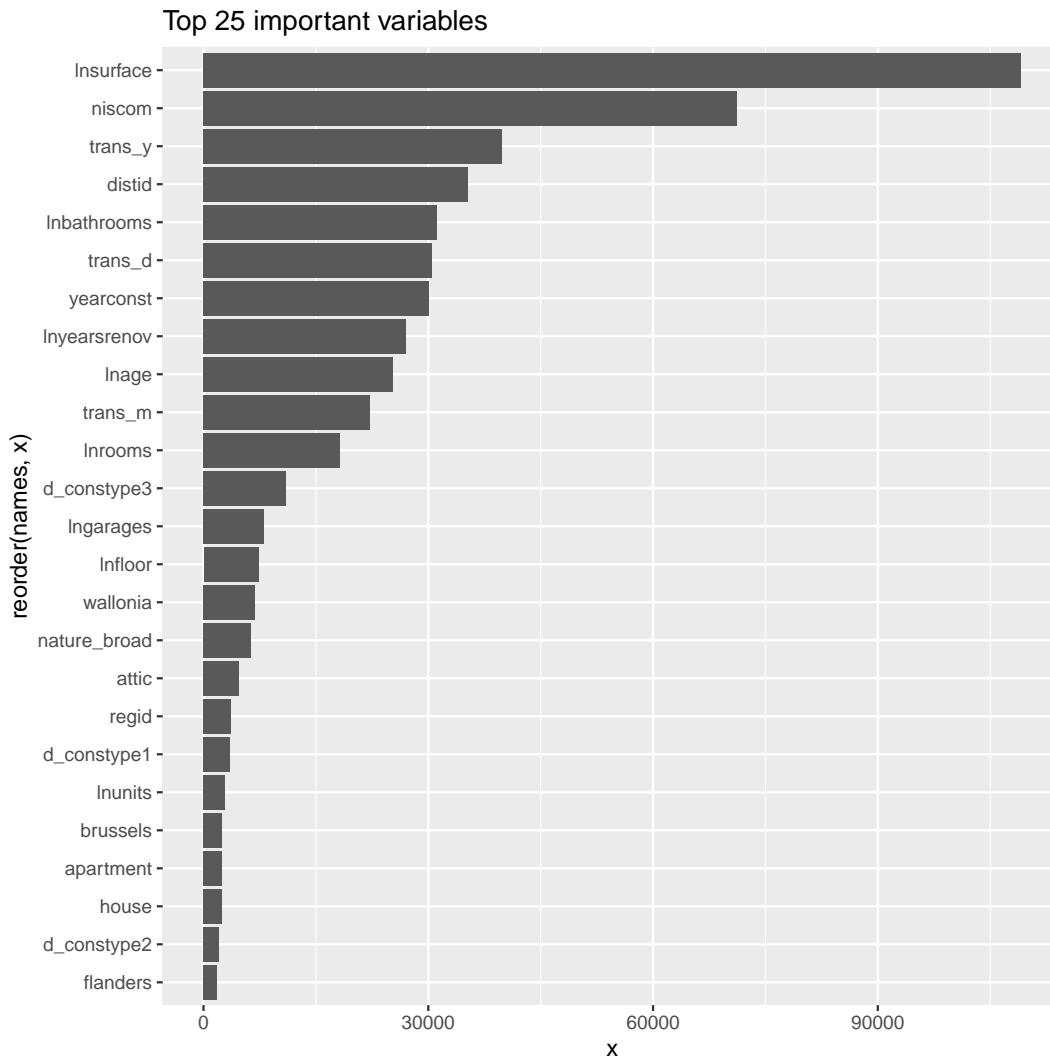


Figure B1: Top 25 predictive variables

Notes: This figure shows the relative importance of the top-25 variable in predicting housing value. The ranking is (in descending order) living area, municipality, transaction year, district, number of bathrooms, transaction day, year of construction, years since last renovation, age, transaction month, number of rooms, detached dwelling, number of garages, number of floors, Wallonia, type of dwelling indicator, indicator for attic, dwelling with two frontages indicator, number of units, Brussels region indicator, apartment indicator, house indicator, dwelling with one frontage indicator, Flanders region indicator.

Table B1: Imputation rules for missing values

Variable	Imputation rule
Floor	Assign a value of 0 if missing
Construction quality	Assign the quality “normal” if missing
Number of garages	Assign a value of 0 if missing
Number of bathrooms	Assign a value of 1 if missing
Number of units	Assign a value of 1 if missing
Number of rooms	Assign the most common value (5) if missing
Indicator for attic	Assign a value of 0 if missing
Year of construction	Predict based on covariates above and municipality fixed effects
Central heating	Predict based on covariates above and municipality fixed effects.

Notes: This table describes the imputation rules followed when dealing with missing values in both the *parcels* and *transactions* databases.

NATIONAL BANK OF BELGIUM - WORKING PAPERS SERIES

The Working Papers are available on the website of the Bank: <http://www.nbb.be>.

381. "The heterogeneous employment outcomes of first- and second-generation immigrants in Belgium", by C. Piton and F. Rycx, *Research series*, January 2020.
382. "A Dane in the making of European Monetary Union – A conversation with Niels Thygesen", by I. Maes and S. Péters, *Research series*, May 2020.
383. "Multi-product exporters: Costs, prices and markups on foreign vs domestic markets", by Catherine Fuss, *Research series*, June 2020.
384. "Economic importance of the Belgian maritime and inland ports – Report 2018", by I. Rubbrecht and K. Burggraeve, *Document series*, July 2020.
385. "Service characteristics and the choice between exports and FDI: Evidence from Belgian firms", by L. Sleuwaegen and P.M. Smith, *Research series*, July 2020.
386. "Low pass-through and high spillovers in NOEM: What does help and what does not", by G. de Walque, T. Lejeune, A. Rannenberg and R. Wouters, *Research series*, July 2020.
387. "Minimum wages and wage compression in Belgian industries", by S. Vandekerckhove, S. Desiere and K. Lenaerts, *Research series*, July 2020.
388. "Network effects and research collaborations", by D. Essers, F. Grigoli and E. Pugacheva, *Research series*, July 2020.
389. "The political economy of financing climate policy – evidence from the solar PV subsidy programs", by O. De Groot, A. Gautier and F. Verboven, *Research series*, October 2020.
390. "Going green by putting a price on pollution: Firm-level evidence from the EU", by O. De Jonghe, K. Mulier and G. Schepens, *Research series*, October 2020.
391. "Banking barriers to the green economy", by H. Degryse, T. Roukny and J. Tielens, *Research series*, October 2020.
392. "When green meets green", by H. Degryse, R. Goncharenko, C. Theunisz and T. Vadasz, *Research series*, October 2020.
393. "Optimal climate policy in the face of tipping points and asset stranding", by E. Campiglio, S. Dietz and F. Venmans, *Research series*, October 2020.
394. "Are green bonds different from ordinary bonds? A statistical and quantitative point of view", by C. Ma, W. Schoutens, J. Beirlant, J. De Spiegeleer, S. Höcht and R. Van Kleeck, *Research series*, October 2020.
395. "Climate change concerns and the performance of green versus brown stocks", by D. Ardia, K. Bluteau, K. Boudt and K. Inghelbrecht, *Research series*, October 2020.
396. "Daily news sentiment and monthly surveys: A mixed-frequency dynamic factor model for nowcasting consumer confidence", by A. Algaba, S. Borms, K. Boudt and B. Verbeken, *Research series*, February 2021.
397. "A bigger house at the cost of an empty fridge? The effect of households' indebtedness on their consumption: Micro-evidence using Belgian HFCS data", by Ph. Du Caju, G. Périlleux, F. Rycx and I. Tojerow, *Research series*, March 2021.
398. "Low interest rates and the distribution of household debt", by M. Emiris and F. Koulischer, *Research series*, March 2021.
399. "The interplay between green policy, electricity prices, financial constraints and jobs. Firm-level evidence", by G. Bijmens, J. Hutchinson, J. Konings and A. Saint Guilhem, *Research series*, April 2021.
400. "Economic importance of the Belgian maritime and inland ports – Report 2019", by I. Rubbrecht, E. Dyne and C. Duprez, *Research series*, May 2021.
401. "The return on human (STEM) capital in Belgium", by G. Bijmens and E. Dhyne, *Research series*, July 2021.
402. "Unraveling industry, firm and host-region effects on export behaviors of international new ventures and established exporters", by I. Paeleman, S. A. Zahra and J. W. B. Lang, *Research series*, July 2021.
403. "When trust is not enough: Bank resolution, SPE, Ring-fencing and group support" by M. Dewatripont, M. Montigny and G. Nguyen, *Research series*, August 2021.
404. "Bank specialization and zombie lending", by O. De Jonghe, K. Mulier and I. Samarin, *Research series*, November 2021.
405. "Robert Triffin, Japan and the quest for Asian Monetary Union", I. Maes and I. Pasotti, *Research series*, February 2022.
406. "The impact of changes in dwelling characteristics and housing preferences on house price indices", by P. Reusens, F. Vastmans and S. Damen, *Research series*, May 2022.
407. "Economic importance of the Belgian maritime and inland ports – Report 2020", by I. Rubbrecht, *Research series*, May 2022.

408. "New facts on consumer price rigidity in the euro area", by E. Gautier, C. Conflitti, R. P. Faber, B. Fabo, L. Fadejeva, V. Jouvanceau, J. O. Menz, T. Messner, P. Petroulas, P. Roldan-Blanco, F. Rumler, S. Santoro, E. Wieland and H. Zimmer, *Research series*, June 2022.
409. "Optimal deficit-spending in a liquidity trap with long-term government debt", by Charles de Beaufort, *Research series*, July 2022.
410. "Losing prospective entitlement to unemployment benefits. Impact on educational attainment", by B. Cockx, K. Declercq and M. Dejemepe, *Research series*, July 2022.
411. "Integration policies and their effects on labour market outcomes and immigrant inflows", by C. Piton and I. Ruysen, *Research series*, September 2022.
412. "Foreign demand shocks to production networks: Firm responses and worker impacts", by E. Dhyne, A. K. Kikkawa, T. Komatsu, M. Mogstad and F. Tintelnot, *Research series*, September 2022.
413. "Economic research at central banks: Are central banks interested in the history of economic thought?", by I. Maes, *Research series*, September 2022.
414. "Softening the blow: Job retention schemes in the pandemic", by J. Mohimont, M. de Sola Perea and M.-D. Zachary, *Research series*, September 2022.
415. "The consumption response to labour income changes", by K. Boudt, K. Schoors, M. van den Heuvel and J. Weytjens, *Research series*, October 2022.
416. "Heterogeneous household responses to energy price shocks", by G. Peersman and J. Wauters, *Research series*, October 2022.
417. "Income inequality in general equilibrium", by B. Bernon, J. Konings and G. Magerman, *Research series*, October 2022.
418. "The long and short of financing government spending", by J. Mankart, R. Priftis and R. Oikonomou, *Research series*, October 2022.
419. "Labour supply of households facing a risk of job loss", by W. Gelade, M. Nautet and C. Piton, *Research series*, October 2022.
420. "Over-indebtedness and poverty: Patterns across household types and policy effects", by S. Kuypers and G. Verbist, *Research series*, October 2022.
421. "Evaluating heterogeneous effects of housing-sector-specific macroprudential policy tools on Belgian house price growth", by L. Coulier and S. De Schryder, *Research series*, October 2022.
422. "Bank competition and bargaining over refinancing", by M. Emiris, F. Koulischer and Ch. Spaenjers, *Research series*, October 2022.
423. "Housing inequality and how fiscal policy shapes it: Evidence from Belgian real estate", by G. Domènech-Arudi, P. E. Gobbi and G. Magerman, *Research series*, October 2022.

National Bank of Belgium
Limited liability company
RLP Brussels – Company's number: 0203.201.340
Registered office: boulevard de Berlaimont 14 – BE-1000 Brussels
www.nbb.be

Editor

Pierre Wunsch

Governor of the National Bank of Belgium

© Illustrations: National Bank of Belgium

Layout: Analysis and Research Group
Cover: NBB CM – Prepress & Image

Published in October 2022