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Abstract

Since 2005, Belgian housing prices have strongly increased. As the timing coincides with the implementation of a new fiscal package in order to stimulate homeownership, our study attempts to provide an understanding whether the mortgage interest and capital deduction (MICPD) policy has had the side-effect of increasing housing prices while, at the same time, controlling for key housing price determinants. A fixed-effects regression model is used on a panel data set of the three Belgian regions over the 1995-2015 period. Estimations are carried out separately for different house types, being useful as our empirical analysis ascertains a significant price-increasing effect for ordinary houses and apartments, but a significant price-reducing effect for villas. These results are relevant for all governments willing to stimulate homeownership through fiscal stimuli. In addition, we find, among other things, that interest rates' influence has been less substantial than commonly thought.

Keywords: Fiscal Stimulus, Housing Price, House Type, Mortgage Interest Deduction, Mortgage Interest and Capital Deduction, Tax Relief

Introduction

For the last decades, it is observed that both Belgian nominal and real housing prices have clearly and almost exclusively recorded an upward trend. In this regard, at least two findings deserve particular emphasis. First, housing prices in the Brussels-Capital Region (BCR) are more volatile. Warisse (2017) explains this by the region's almost exclusive urban character and its relative compact size. Second, and perhaps more importantly, prices have risen more sharply since 2005. The size and timing of this increasing growth rate has provoked our interest as it coincides with a Belgian government's incentive to encourage homeownership. More specifically, a mortgage interest and capital deduction (MICPD)[1] was introduced, regrouping all former tax advantages into one single package. Although the past decennium has witnessed an increasing interest in fiscal stimuli, to date, there is little empirical evidence about the MICPD policy's effects. It would thus be of interest to learn whether the sharp increase in Belgian housing prices from 2005 could at least partly be attributed to the fiscal benefit.

Our paper focusses on which impact the MICPD policy has had on Belgian housing prices while, at the same time, controlling for macro-economic and demographic forces. With regard to the latter forces, it is built on various studies which provide a theoretical background of housing price determinants (see e.g. Égert and Mihaljek, 2007; Corradin and Fontana, 2013). We are - to the best of our knowledge - the first to research whether our investigated type of fiscal incentive has had a price-increasing effect based on a detailed observation of regional

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[1] The MICPD, or the so-called house bonus (*'Woonbonus'*), is a tax advantage that can be enjoyed when purchasing a 'sole and own' house, financed by a mortgage of at least ten years. Mortgage interest and capital payments, as well as mortgage insurance premiums can be deducted from taxable income. However, this deductible amount is limited and ultimately, the benefit depends on income: the percentage applied to the expenses, eligible for the tax deduction, is equal to the highest tax percentage that is paid on income (i.e. between 30% and 50%).

housing price data in Flanders, Wallonia and the BCR. Thereby, in contrast to prior work, prices of apartments, ordinary houses and villas in each of the three Belgian regions are looked at separately. After all, the overall rise in housing prices hides significant differences between regions and several housing types. The basic thesis explored is that the MICPD policy has had a price-increasing effect for ordinary houses and apartments in Belgium, whereas a price-reducing effect for Belgian villas.

The paper has six more sections and proceeds as follows. The next section presents the literature review which describes the foundations for our article. After developing our hypothesis, the key variables are constructed, followed by the methodology section where we discuss our empirical model. Under results and robustness check, we explore the main determinants that have influenced Belgian housing prices over 1995-2015. Finally, the paper concludes with policy and practical implications, limitations regarding our study and further research.

Literature

Fiscal stimuli and housing prices

Our present article seeks to advance the growing stream in the academic literature about fiscal stimuli and housing price trends. Houses being an essential asset, keeping housing affordable is a focal point of concern for governments and the use of fiscal stimuli are a popular method to pursue this. Moreover, it is crucial to have a deeper understanding of housing prices' behaviour, given its economic importance as illustrated by Corradin and Fontana (2013). First, the real economy may be affected because of housing prices' considerable impact on housing investment. Second, periods of housing price declines commonly precede an increase in the rate of mortgage defaults affecting banks' profits and thus the banking system (see Allen et al., 2009; Gan, 2007). Third, housing prices indirectly affect household consumption via its effect

on housing wealth composition. In the next two paragraphs, it is demonstrated how our paper relates to and builds on different strands in the literature.

A first strand of literature has evaluated whether a real estate market is under- or overvalued (see e.g. Smet and Van Gompel, 2014; Égert and Mihaljek, 2007). Traditionally, two methods are distinguished to test if and to what extent housing prices differ from their equilibrium level. One is based on a statistical analysis of various ratios; the other is based on the estimation of a long-term relationship between housing prices and explanatory variables. In this article, we do not try to evaluate the Belgian real estate market by comparing a derived fundamental price level with its actual level, but we learn from these studies as they provide a theoretical background of housing price determinants.

A second strand of literature has researched whether a mortgage interest deduction (MID)[2] is an effective policy to stimulate homeownership (see e.g. Hilber and Turner, 2014; Hoebeeck and Smolders, 2014). A MID is by far the most studied tax benefit and homeownership, in turn, is linked with beneficial externalities and socioeconomic effects (see e.g. Dietz and Haurin, 2003). However, overall, results suggest that a MID does not boost homeownership, most probable because of capitalisation effects. Verbruggen et al. (2005) give one popular and plausible explanation for the latter, based on elasticity-reasons: when housing costs decline, housing demand will rise in a supply-inelastic market with consequences for housing prices. Our present article researches whether a MICPD policy, likewise intended to stimulate homeownership, has led to higher housing prices in Belgium.

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[2] Several countries, within and outside the EU, try to increase its percentage of homeowners with similar systems as the MICPD (i.e. a MID). A MID allows homeowners to subtract the amount of interest paid on mortgage loans from their taxable income.

The Belgian case

The majority of housing studies concentrate on the American real estate market, whereas our attention is focussed on Belgium. Analogue to Hoebeeck and Smolders (2013), we briefly discuss two – for our research relevant – reasons why international evidence about fiscal stimuli cannot be generalized for Belgium.

First, Belgium is a country with very high transaction costs compared to other OECD countries, mainly because of its high transaction fees. These costs may therefore lower other fiscal stimuli's effects. After all, as Capéau et al. (2004) state, these costs play a role in families' decisions whether and when to become homeowner.

Second, Damen et al. (2014) define the MICPD as a complex and rather unique fiscal package. Hoebeeck and Inghelbrecht (2017) show why the imposed MICPD differs from other countries' mortgage interest subsidies. Capital and interest costs can be jointly deducted and –as far as we know- no other country offers a similar system to their first-time homebuyers. Thereby, in Belgium, a fixed-interest mortgage is the preferred type of residential loan. In contrast to the majority of MID policies, the fixed-interest mortgage's benefit does not diminish over time, but depends on the monthly repayment of a fixed amount over the loan's lifetime.

Hypothesis

The Belgian tax reform from 2005 is particularly interesting, however, hitherto, relatively little attention has specifically been paid to the MICPD policy. A logit-analysis of Hoebeeck and Smolders (2014) indicates that this fiscal benefit has partly reached its goal as low-income families would be more stimulated to acquire a house. However, Table 1 presents the homeownership rates in each of the three Belgian regions at four different times.

TABLE 1 HERE

The table clarifies that the share of homeowners has not significantly increased over the observed period. It is indeed generally accepted that this mortgage tax relief does not promote affordable housing, likewise, because of capitalisation into higher housing prices (see e.g Hoebeeck and Inghelbrecht, 2017). Prior research from Damen et al. (2014) – based on data for eight countries including Belgium – shows that house prices are in the long-run determined by one's ability to pay. Their results indicate implicitly that tax benefits are fully capitalized. A divergent research approach was taken by Hoebeeck and Inghelbrecht (2017), studying the transmission of the capitalisation: findings suggest that the MICPD policy has had a direct effect on the amount borrowed and thus indirect on, among other things, housing prices. However, empirical proof about MICPD's price-increasing effect remains scarce and existing approaches have failed to recognize differences in housing price dynamics between both regions and housing types. Figure 1 presents the evolution of average nominal house prices for separate housing categories in each Belgian region over 1995-2015.

FIGURE 1 HERE

Therefore, based on this figure that shows that regional housing prices for each housing type have witnessed remarkable increases after 2005, we test the hypothesis that the MICPD has had a significant positive influence on housing prices in Belgium, for each housing type, controlling for housing price determinants.

Methodology

A significant part of literature about the influence of fiscal stimuli employ a research design based on treatment groups and control groups in order to assess counterfactual outcomes (see e.g. Mian and Sufi, 2012; Li et al., 2013; Berger et al., 2016). These outcomes approximate what would have happened in absence of the policy, allowing for the marginal impact of a fiscal stimulus to be estimated. However, as Mian and Sufi (2012) admit, it may be extremely difficult

to construct a valid control group in a difference-in-differences framework. In our setting, it would require that the tax relief is not enjoyed in certain areas after MICPD's implementation[3]. In addition, this control group should undergo the same changes in all other factors that influence house prices as the treatment group (i.e., in our case, all areas where homebuyers benefit from the MICPD). Finally, before the MICPD is introduced, the two groups' house prices should experience a parallel trend.

Because this is not straightforward, the strategy behind our paper is to use a fixed-effects regression model. This model allows us (1) to study the causes of house price changes within a region (instead of between regions) and (2) to control for unobserved and time-invariant characteristics of individual regions[4]. Furthermore, by rejecting the null hypothesis, the Hausman test (1978) supports our choice for fixed-effects over random-effects. In short, our regressions provide evidence whether the tax reform of 2005 has had a significant impact on Belgian housing prices and, at the same time, allow to identify influencing macro-economic and demographic variables.

As we are interested in what influence the MICPD has had on Belgian housing prices, a fiscal stimulus dummy takes the value '1' for all years since 2005. In order to specify the control variables, we primarily relied on the vast literature with general agreement on the determinants that underlie housing prices. Table 2 gives an overview of the fundamentals used in a non-

[3] However, it is also possible to 'estimate' a control group: for example, based on the number of potential (first-time) homebuyers living in areas (see Berger et al., 2016).

[4] As such, it is controlled for the 'uniqueness' of the BCR area: beyond the capital of Belgium, it is the capital of the EU. However, the EU expanded significantly in 2004: 10 countries joined the EU (which is the largest number since its formation), and sent their delegations and representatives to the BCR for permanent presence. This may have affected house prices in this region in addition to the local policies. We thank an anonymous reviewer for this insight.

exhaustive set of relevant international housing literature, inspired by the study of Verbruggen et al. (2005).

TABLE 2 HERE

Table 2 shows the empirical studies that explain house prices by both macroeconomic and demographic variables. We notice that the traditionally used determinants are income, interest rate and a demographic variable. Other determinants are selected based on the study's specific aim. Real estate prices are furthermore commonly modelled as a function of demand factors only. Koetter and Poghosyan (2010) clarify that these studies make use of the rigid supply assumption.

Against this background, we attempt to explain Belgian housing prices with a fiscal stimulus dummy, gross domestic product (GDP) per capita as a proxy for income, a long-term interest rate referring to the ten-year government bond yield, population density and inflation for which the consumer price index (CPI) is used. First, we follow Hossain and Latif (2009) and Tsatsaronis and Zhu (2004) by explicitly using inflation as an explanatory variable, although most reviewed housing price determinant studies have deflated its nominal variables in order to control for the influence of the general price level. By doing so, (1) we can 'measure' the influence of inflation on Belgian housing price dynamics and (2) some nominal variables – such as interest rate – are more useful in explaining housing prices than their real equals, see Tsatsaronis and Zhu (2004) and Sutton (2002). Second, as tested supply-side variables - such as the number of dwellings per person – do not seem to have had a significant influence, we solely implement demand-side variables. Third, housing prices being regionally investigated in our study, we adjust the demographic factor 'population' by dividing it by the surface of the region in order to have a good comparison point between the regions. Fourth, concerning interest rate, we prefer to use the ten-year government bond yield for the same reasons as Damen

et al. (2014): the rate makes our research comparable as it is consistently measured across countries and over time, and commonly used in housing literature.

Table 3 summarizes all our control variables, together with their expected relation to house price. For this, we took into account that Belgium has a low responsiveness of housing supply, see Caldera and Johansson (2013). However, in general, the coefficients' expected signs are in line with prior housing price determinant studies (see e.g. Glindro et al., 2011; INR, 2015).

TABLE 3 HERE

Based on the above discussion, the following regression model is estimated for each housing type category:

$$Housing\ Price_{it} = \beta_1\ Fiscal\ Stimulus_t + \beta_2\ Income_{it} + \beta_3\ Interest\ Rate_t + \beta_4\ Population_{it} + \beta_5$$
$$Inflation_t + \alpha_i + u_{it}$$

where i represents the region and t the year. The dependent variable *Housing Price*$_{it}$ is the average nominal housing price in 1000 euros. *Fiscal Stimulus*$_t$ is a dummy variable representing the tax reform of 2005. As such, the dummy variable takes the value '1' for all years since 2005. *Income*$_{it}$ is the GDP per capita as a proxy for the disposable income per household in 1000 euros. *Interest Rate*$_t$ is the Belgian long-term interest rate referring to the nominal ten-year government bond rate. *Population*$_{it}$ represents the population density. Lastly, *Inflation*$_t$, is the CPI with 1996 as base year.

The regional fixed-effect α_i controls for unobserved regional characteristics that do not change over time, whereas u_{it} is the error term. *β_1* is of particular interest regarding the aim of this study and a positive sign is expected as it is argued under hypothesis that the fiscal stimulus has had a significant positive influence on Belgian housing prices.

Data

The current paper evaluates whether the growth in Belgian housing prices since 2005 has been driven by the MICPD. In addition, our method controls for housing price determinants including GDP per capita that measures income, a long-term interest rate, inflation and population density. We use regional data provided by multiple quantitative sources, however, interest rate is included at the country-level due to availability constraints. Most data is obtained from Statistics Belgium (Statbel), the Belgian statistical office. This source was consulted for the yearly average nominal house prices, the CPI and the population. Additional data for the regional surface in km² was needed to calculate population density, which we obtained from the website of the Flemish government[5]. For the GDP per capita, data was attained from the econometric model HERMREG. Lastly, we used OECD data for the Belgian long-term interest rate, which refers to the ten-year government bond yield.

A balanced panel data set is constructed from yearly data for the period 1995-2015. Because real estate data and data about their determinants usually have low frequency, Koetter and Poghosyan (2010) claim that employing a panel data set in housing studies is commonly used. Thereby, as the fiscal stimulus was implemented in 2005, the examined range allows us to study symmetric pre-and post- MICPD periods. Table 4 provides an overview for all our control variables' mean, standard deviation, minimum and maximum value, whereas Figure 2 shows the control variables' evolution over 1995-2015 and their coefficient of variation (standard

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[5] For Flanders: https://www.vlaanderen.be/en/discover-flanders
For Wallonia: https://www.vlaanderen.be/nl/vlaamse-overheid/organisatie-van-de-vlaamse-overheid/de-regionale-overheden-gemeenschappen-en-gewesten/het-waalse-gewest
For Brussels-Capital Region: https://www.vlaanderen.be/nl/gemeenten-en-provincies/brussel/het-brusselse-hoofdstedelijke-gewest

deviation divided by the mean), allowing to make a comparison between the variables'
volatility.

<center>***TABLE 4 AND FIGURE 2 HERE***</center>

In our study, effects on housing prices are examined for each housing category separately. The
first category solely consists of ordinary houses. Apartments, flats and studios together form
the second one. The last category contains all the villas, bungalows and country houses[6]. Figure
3 presents the yearly number of villa transactions in each region.

<center>***FIGURE 3 HERE***</center>

It was decided to exclude villas in the BCR from our dataset as the above figure shows that the
number of villa transactions in this region has been negligible over the observed period, what
could eventually lead to false general conclusions. For reasons described under methodology,
we use a fixed–effects regression model, composed of two particular types of explanatory
variables: a fiscal stimulus dummy that takes into account all the fiscal changes in 2005 and
control variables.

Results

Results for the regression analyses are reported in Table 5[7]. We start by discussing the fiscal
stimulus dummy's coefficient for each housing category. After all, in the first place, the present

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[6] These three categories are the same as those in Statbel, according to the dwelling's nature stated in the
land register. However, we are aware that this nature is based on the (subjective) judgment of the land
register's estimator. Throughout the text, the different categories are simply referred to as 'ordinary
houses', 'apartments' and 'villas'.

[7] Potentially, the variables 'income' and 'population density' have a slower effect on the price level of
real estate. Therefore, we also ran our empirical model with these variables lagged for one year (t-1).
Similar results were yielded, except for interest rate's effect on villa prices which turned out to be no
longer significant. Moreover, results also did not change when we used the median house price as the

article tries to find evidence whether Belgian housing prices have been affected by the MICPD policy. Ex-ante, we expected a positive significant sign before the fiscal term in each regression, supporting our hypothesis and indicating that the fiscal advantage has had a price-increasing effect. Afterwards, it is checked whether the other coefficients' signs confirm our predicted ones as under key variables.

TABLE 5 HERE

Our results for ordinary houses and apartments present evidence that the MICPD policy has played a significant role in the rate of increasing housing prices since 2005. The finding of a positive sign confirms our hypothesis stating that the fiscal benefit has had a price-increasing effect. The coefficients are in line with our expectations: the fiscal benefit of the MICPD policy can increase to around € 54,000 for a couple on a twenty-year period, and around € 26,600 for a single on a twenty-year period[8]. As such, an overall effect from € 49,100 on ordinary houses (preferred by couples) and € 18,860 for apartments (preferred by singles) is not illogical.

Against expectations, Table 5 reports a significant negative relation between the fiscal benefit and prices of villas. The result is surprising as it is observed that villa prices have continued to rise fairly stable in Flanders and Wallonia since the implementation of the fiscal benefit in 2005 (cf. Figure 1). In an attempt to interpret this result, based on Figure 3 showing that demand for villas has increased in Flanders and Wallonia since 2005, we hypothesize that the implementation of the MICPD has provoked a renewed interest in villas, however, depressing

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dependent variable instead of the average house price, except for the effect of population density on villa prices which turned out to be significant positive.

[8] The maximum deductible amount per person (and thus not per couple) per year is limited to 2,280 euros. During the first ten years of the loan, this amount is increased by 760 euros. In addition, for those having three or more dependent children on January 1 after the year in which the mortgage loan is taken out, an additional 80 euros is added. To calculate the fiscal benefit: the percentage applied to this sum depends on income and varies between 30 and 50%.

the general price level. After all, for the last decades, villas have become less attractive to buy, as they are often outdated and require major renovation work. In addition, Baby Boomers have been selling their big houses in favour of apartments, causing demand and supply to be unbalanced. Our control variables are evaluated in the next two paragraphs.

In line with ex-ante expectations, a positive and strongly significant sign for GDP per capita is reported in all regressions: the higher the income, the higher the housing prices. With regard to housing type, not so surprisingly, the income effect is strongest for villas as demand for larger houses should be influenced by budgetary constraints, see INR (2015). Furthermore, except for villas (where no significant relation is found), we see that population density is positively associated with house prices.

Table 5 reveals mixed evidence regarding inflation's impact on Belgian housing prices: the expected significant and positive correlation is found only for apartments[9]. Finally, interest rate seems surprisingly not to have had a significant impact on prices of ordinary houses and apartments. From Figure 2, we learn that annual inflation, as indicated by CPI, followed a relatively stable path over the observed period, without big outliers. Likewise, it is shown that the Belgian long-term interest rate remained fairly stable during the period 1998 and 2011. It is therefore acceptable that both inflation and interest rate have not played the most important role in Belgian housing price dynamics during the observed period. However, a significant positive relation is found between interest rate and villa price. This remarkable result is consistent with

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[9] Alternatively, 'expected' inflation, rather than the (current) inflation, may play a role in real estate prices. Therefore, as a robustness check, we also ran our empirical model with the variable 'expected inflation', instead of inflation, as an explanatory variable. The results for all explanatory variables are similar, also for 'expected' inflation i.e. it only has a significant impact on the prices of apartments. The conclusion from this robustness analysis is, therefore, that both 'current' and 'expected' inflation have not played a major role in Belgian housing price dynamics over 1995-2015. And moreover, the results for the other explanatory are robust with respect to inflation measurement.

the finding of Nollet and Pattyn (2014) who investigated house prices in Flanders over 1998-2011. They argue that wealthy people search for other investment opportunities – such as real estate – when interest rates go up because it lowers their bond portfolio's value.

Robustness Check

Mortgage interest rate

As houses are typically not solely financed through own resources, the mortgage interest rate should influence housing demand and consequently housing prices (given a supply-inelastic market). For the reasons described under key variables, we have approximated the latter rate by the Belgian long-term interest rate which refers to the ten-year government bond yield. As Table 5 indicates and as discussed in the previous section, overall, we find evidence that our proxy has not played a key role in Belgian housing price dynamics over 1995-2015. In order to make sure that all our coefficients are robust, our former analysis is repeated but now with the yearly average nominal Belgian mortgage interest rate. Because complete data series on mortgage interest rates were unfortunately not available to us, we were forced to link two different time series in order to cover the entire period, as is done in the article of INR (2015). More specifically, Retail Interest Rates (RIR) from the ECB for 1995-2002 and the NBB's Monetary Financial Institutions Interest Rate (MIR) survey for 2003-2015 were combined[10]. Table 6 presents the regression results.

<div align="center">***TABLE 6 HERE***</div>

The above table shows that our previous obtained results are not altered, strengthening prior conclusions. Specifically with regard to the mortgage interest rate, again, the only significant

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[10] RIR: Mortgage loans with amortisation. MIR: Loans for house purchase (with over ten years initial rate fixation).

sign is found for villas. In summary, our robustness results provide further evidence that (1) interest rates have not been mainly responsible for the Belgian housing price increase over the last decades and (2) the MICPD has had a price-increasing effect for ordinary houses and apartments, whereas a price-decreasing effect for villas.

Conclusion

The current article contributes to the housing literature in several ways. In essence, it presents evidence of a side-effect of a particular type of fiscal benefit by developing and testing a hypothesis about the price-increasing effect of a MICPD. Thereby, the paper advances the growing stream of literature about housing price determinants. As far as we know, and as far as Belgium is concerned, this is the first study in the field (1) to use regional data and (2) to control for three different housing types separately.

First and foremost, our findings confirm the general belief that the acceleration of the Belgian housing prices' growth rate since 2005 is at least partly attributable to the MICPD policy, which is relevant for all governments willing to boost homeownership through fiscal stimuli. However, it has been shown that it is useful to control for different house types separately since our results indicate that prices of Belgian villas have been influenced by the fiscal benefit in the opposite way, being an interesting avenue for further research. Second, it is observed that not all traditional housing price determinants have influenced Belgian house prices in the generally expected way: interest rates have played a far less important role than commonly thought.

We feel however a strong need to make some caveats regarding our study. The main difficulty turned out to be the limited availability of Belgian regional data causing us to be not able to control for all possibly influencing variables such as housing rents, and distances from key areas

(e.g. city centre, main markets/shopping areas, EU offices, etc.) next to population density[11]. We were therefore forced to use some proxies and multiple information sources as described under data. For the same reason, we were not able to find out a homebuyer's type of employment, which would help to detect if they are diplomats and/or government employees. After all, the expansion of the EU in 2004 may have affected house prices in the BCR area in addition to the local policies[12]. Moreover, the classification between apartments, ordinary houses and villas is based on the judgement of the land register's estimator, and therefore subjective. Finally, we are aware that our data set is relatively small and that this is not an example of a natural experiment study.

Despite these limitations, regional studies about fiscal stimuli appear to be extremely relevant, and certainly true for Belgium: as part of the sixth State reform[13], fiscal competence has successfully been regionalized since 2015. Studying the three different systems next to each other not only has national, but some international relevance too as it would provide a good example of fiscal stimuli's positive and negative effects.

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[11] We thank an anonymous reviewer for this suggestion.

[12] We thank an anonymous reviewer for this insight and suggestion.

[13] After the federal elections of 2010 in Belgium, and subsequent negotiations of nearly eighteen months, a government was formed and it was agreed on a new state reform (i.e. the sixth State reform). The implementation of this reform included, among other things, a reform of the Senate, and a transfer of competences from the federal level to the federated states (i.e. the communities and regions) (see e.g. Goossens, 2017).

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Table 1. *Regional homeownership rates*

Year	Region		
	Flanders	Wallonia	BCR
1991	69.2%	67.1%	39%
2001	73.8%	69.9%	42.7%
2009	71.8%	66.7%	38.9%
2011	71%	66%	39%

Notes: This table presents the homeownership rates (% of households) for each Belgian region at four different years.

Sources[14]: Census 1991, SEE 2001, EU-SILC 2009 and Census 2011.

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[14] We supplement homeownership data from censuses in Belgium (Census 1991, Census 2011) by data from the Social-Economic Survey (SEE) 2001 by the National Institute of Statistics (NIS) and calculations on European Union Statistics on Income and Living Conditions (EU-SILC) 2009 by Eurostat.

Census 1991:

https://statbel.fgov.be/sites/default/files/Over_Statbel_FR/1991%20Monografie%20nr.%2010%20-%20Huisvesting%20in%20sociaal-economisch%20en%20geografisch%20perspectief%20-%20Algemene%20Volks-%20en%20woningtelling.pdf

SEE 2001: https://statbel.fgov.be/sites/default/files/Over_Statbel_FR/Sociaal-Economische%20Enqu%C3%AAte%202001%20-%20monografie%202%20Woning%20en%20woonomgeving%20in%20Belgi%C3%AB.pdf

EU-SILC 2009: see e.g. Verbist and Vanhille (2012)

Census 2011: http://www.census2011.be/data/fresult/buildingsownerliving_nl.html

Table 2. *International literature on fundamentals of housing prices*

Author(s)	Fundamentals							
	Income	Interest rate	Demographic variable	Stock of residential dwellings	Un-employment rate	Housing investment	Equity price (index)	Other
Caldera and Johansson (2013)	X	X	X	X				
Corradin and Fontana (2013)	X	X			X			
Égert and Mihaljek (2007)	X	X	X		X		X	X
Gattini and Hiebert (2010)	X	X				X		
Glindro et al. (2011)	X	X	X				X	X
Hossain and Latif (2009)	X	X	X					X
Philiponnet and Turrini (2017)	X	X	X			X		
Sutton (2002)	X	X					X	
Tsatsaronis and Zhu (2004)	X	X						X
Verbruggen et al. (2005)	X	X	X	X				X

Notes: This table gives an overview of the fundamentals of housing prices used in a non-exhaustive set of relevant international housing literature. Hossain and Latif (2009)'s focus is on the volatility of housing prices, rather than on the level.

Table 3. *Summary of our control variables*

Variable name	Definition	Calculation	Level	Expected Sign[a]	Source
Income	GDP per capita	Nominal GDP per capita / 1000	Regional	+	HERMREG
Interest rate	Long-term interest rate	Nominal ten-year government bond yield	Country	-	OECD
Population	Population density	Population (Statbel) / Surface (website of Flemish government[b])	Regional	+	Statbel & website of Flemish government
Inflation	CPI	1996 = base year	Country	+	Statbel

Notes: This table presents an overview for our control variables. GDP = gross domestic product; CPI = consumer price index; Statbel = Statistics Belgium.

[a]House Price is the dependent variable.

[b]For Flanders: https://www.vlaanderen.be/en/discover-flanders

For Wallonia: https://www.vlaanderen.be/nl/vlaamse-overheid/organisatie-van-de-vlaamse-overheid/de-regionale-overheden-gemeenschappen-en-gewesten/het-waalse-gewest

For Brussels-Capital Region: https://www.vlaanderen.be/nl/gemeenten-en-provincies/brussel/het-brusselse-hoofdstedelijke-gewest

Table 4. *Descriptive statistics for our control variables*

	LT IR (%)	CPI (Index[a])	GDP per capita (1000 €)			Population density (Persons/km²)		
			Flanders	Wallonia	BCR	Flanders	Wallonia	BCR
Mean	4.23	119.29	29.16	21.37	55.61	451.21	203.20	6368.77
SD	1.53	14.92	5.48	3.77	7.19	14.16	5.64	488.52
Min	0.80	97.98	20.47	15.50	42.16	433.85	196.68	5852.61
Max	7.50	141.94	37.03	26.54	63.37	476.60	213.12	7254.15

Notes: This table presents the mean, standard deviation, minimum and maximum value for all our control variables over 1995-2015. Units are in parentheses. GDP per capita is a proxy for income, long-term interest rate refers to the ten-year government bond yield and CPI is used for inflation. LT IR = long-term interest rate; CPI = consumer price index; GDP = gross domestic product; BCR = Brussels-Capital Region; SD = standard deviation; Min = minimum value; Max = maximum value.

[a]1996 = 100

Table 5. *Determinants of House Price*

Dependent Variable: House Price

Explanatory Variables	House type		
	Ordinary houses	Apartments[a]	Villas[b]
Fiscal stimulus	49.10***	18.86***	-38.08***
	(7.75)	(3.65)	(5.09)
Income	4.34***	2.29***	14.03***
	(0.99)	(0.47)	(1.27)
Interest rate	2.80	1.62	3.36**
	(2.48)	(1.17)	(1.54)
Population	0.12***	0.01***	-0.33
	(0.12)	(0.00)	(0.31)
Inflation	0.50	2.04***	-0.18
	(0.43)	(0.20)	(0.34)
Regional fixed-effects	Yes	Yes	Yes
Adjusted R-Squared	0.97	0.98	0.97
No. of observations[c]	63	63	42

Notes: The above table shows the regression results for our fixed-effect model for each house type. The Hausman test (1978) supports our choice for fixed-effects over random-effects by rejecting the null hypothesis. Standard errors are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. 'Fiscal Stimulus' is a dummy variable representing the implementation of the MICPD in 2005. For definitions of 'Income', 'Interest Rate', 'Population' and 'Inflation', see Table 3.

[a]Apartments include all the apartments, flats and studios.

[b]Villas include all the villas, bungalows and country houses.

[c]The number of observations is lower for villas as the ones in the Brussels-Capital Region were excluded from our dataset.

Table 6. *Determinants of House Price (Mortgage interest rate)*

Dependent variable: House Price

| Explanatory variables	House type		
	Ordinary houses	Apartments[a]	Villas[b]
Fiscal stimulus	51.59***	19.69***	-34.11***
	(7.74)	(3.62)	(5.01)
Income	4.17***	2.21***	13.56***
	(1.00)	(0.47)	(1.26)
Interest rate	1.19	-1.17	4.30**
	(3.47)	(1.57)	(2.06)
Population	0.12***	0.01***	-0.24
	(0.01)	(0.00)	(0.31)
Inflation	0.31	1.82***	-0.23
	(0.42)	(0.20)	(0.33)
Regional fixed-effects	Yes	Yes	Yes
Adjusted R-Squared	0.97	0.98	0.97
No. of observations[c]	63	63.	42

Notes: The above table shows the regression results for our fixed-effects model for each house type. The Hausman test (1978) supports our choice for fixed-effects over random-effects by rejecting the null hypothesis. Standard errors are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. 'Fiscal Stimulus' is a dummy variable representing the implementation of the MICPD in 2005, whereas 'Interest rate' is the yearly average Belgian mortgage interest rate. For definitions of 'Income', 'Population' and 'Inflation', see Table 3.

[a]Apartments include all the apartments, flats and studios.

[b]Villas include all the villas, bungalows and country houses.

[c]The number of observations is lower for villas as the ones in the Brussels-Capital Region were excluded from our dataset.

**Figure 1:** *Belgian regional house prices*
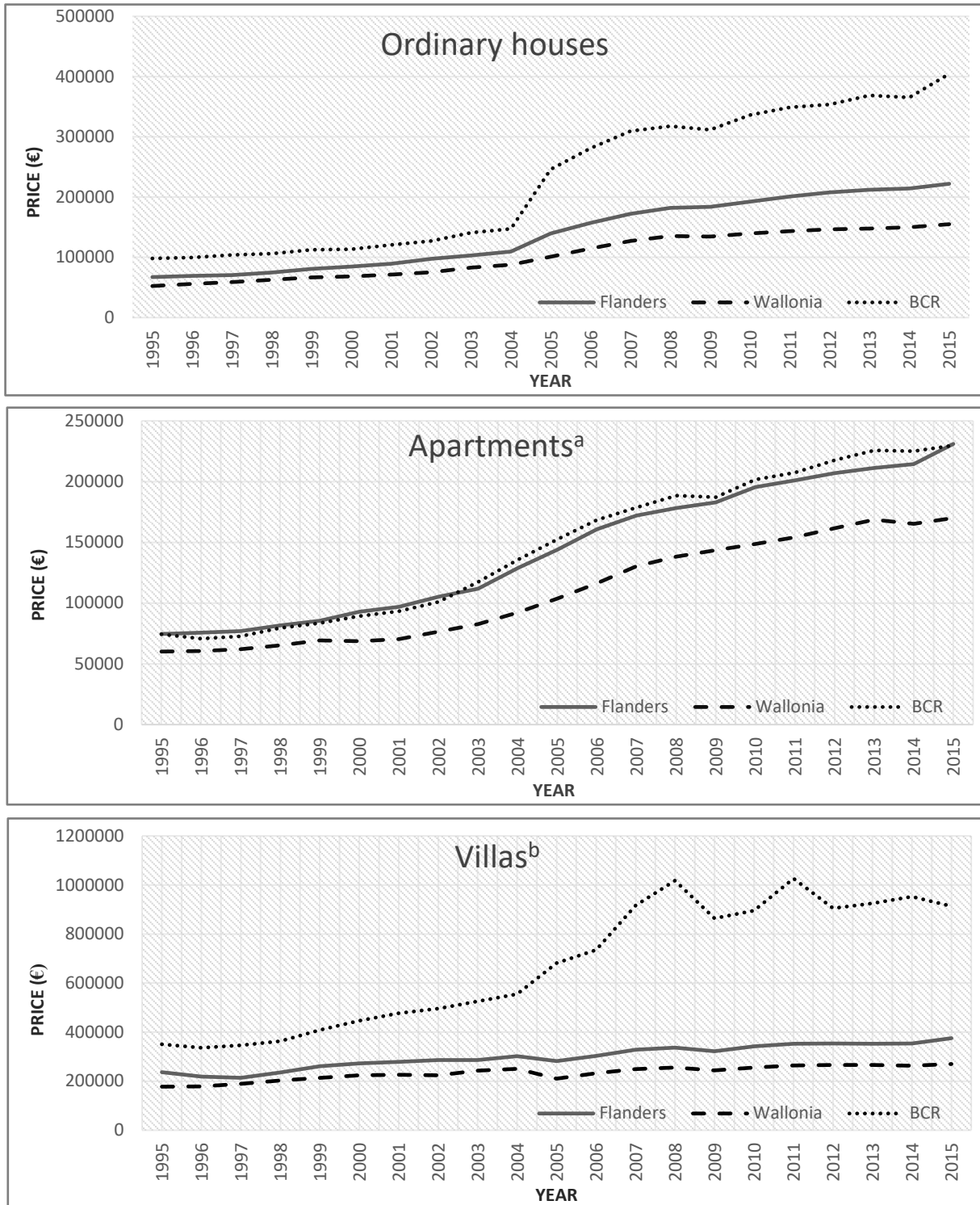
Notes: The figure shows the trend of Belgian ordinary houses', apartments' and villas' yearly average nominal prices per region over the period 1995-2015. BCR = Brussels-Capital Region. Source: Statistics Belgium (Statbel).

[a]Apartments include all the apartments, flats and studios.

[b]Villas include all the villas, bungalows and country houses.

Figure 2: *Descriptive graphs for our control variables*
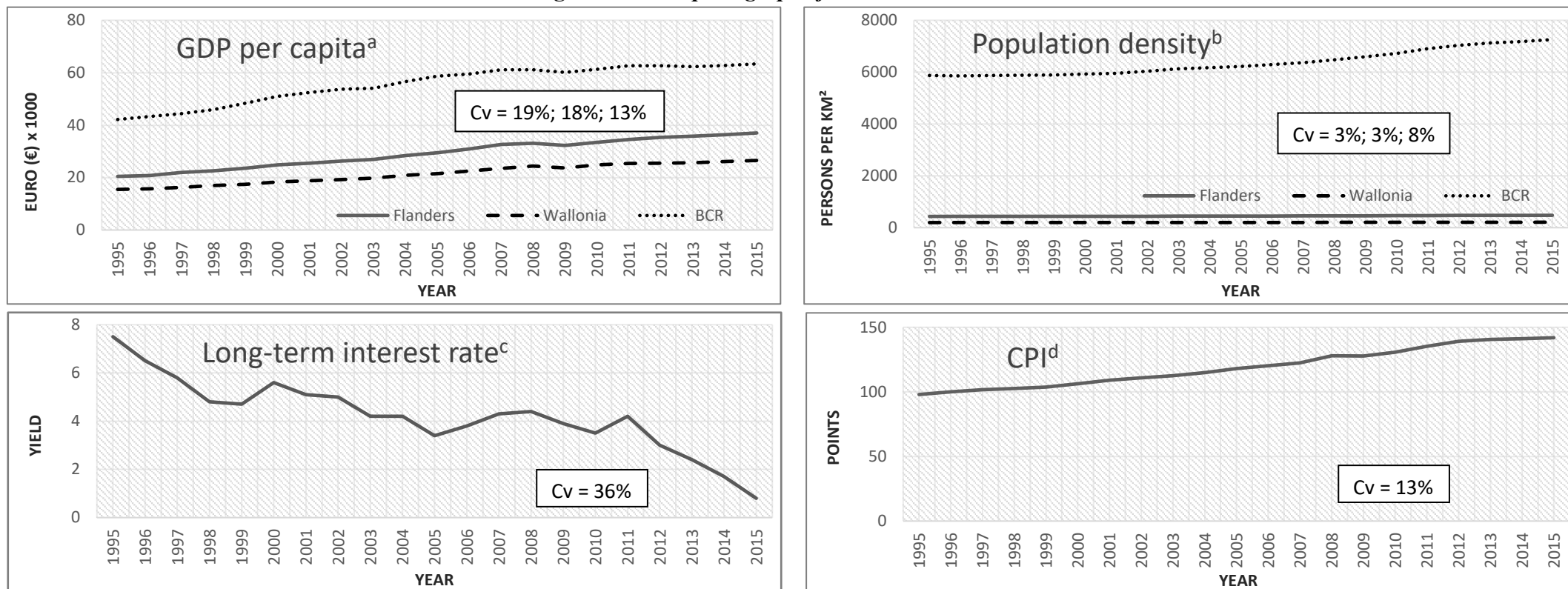
Notes: The figure shows the trend of our control variables over the period 1995-2015. Cv = Coefficient of variation (standard deviation divided by the mean) for our control variables in Flanders, Wallonia and the BCR, respectively (GDP per capita and Population density) or in Belgium (Long-term interest rate and CPI).
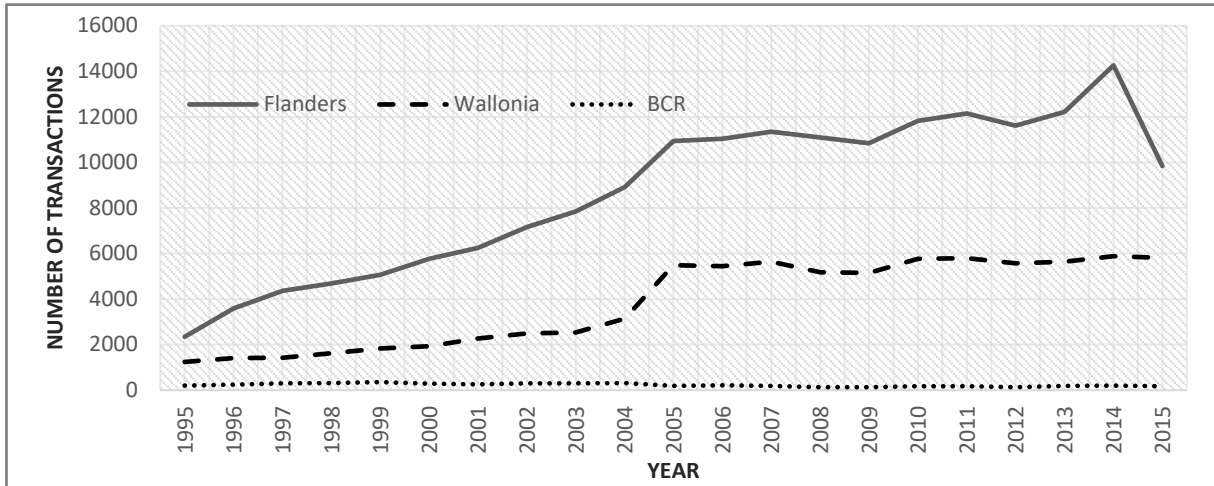
[a] Gross domestic product (GDP) per capita is a proxy for income. Source: HERMREG.

[b] Sources: own calculations; Statistics Belgium (Statbel), website of Flemish government (see Table 4).

[c] Long-term interest rate refers to the ten-year government bond yield. Source: OECD.

[d] CPI is used for inflation. Source: Statistics Belgium (Statbel).

Figure 3: *Regional villa transactions*

Notes: the figure shows the trend of yearly number of villa transactions per region over the period 1995-2015. BCR = Brussels-Capital Region.

Source: Statistics Belgium (Statbel).