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Do market rents reflect user costs?

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Abstract

Although in many countries more than twenty percent of all households rely on the private rental market for housing, the research concerning the fundamentals of rental prices has been limited. Standard capital investment theory states that the market rental price of capital services will equal the user cost of capital in equilibrium. The empirical evidence in support of the rent-user cost equivalence theorem is, however, scarce if not non-existent. We examine the relationship between market rents and the user cost of rental properties based on a unique micro data set on the earnings and costs of Flemish landlords. Robust regression estimates of portfolio-average rental earnings on portfolio-average user costs point to a strong correspondence at the micro-level. In some cases, we find a user cost coefficient which is not significantly different from one together with an intercept estimate which is not significantly different from zero even when we control for landlord characteristics.

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1 Introduction

The fundamentals of house prices have always received a considerable amount of attention in the economics literature and this only increased after the burst of the housing bubble in the U.S. in 2007. However, a comparative study of the Harvard Joint Center for Housing Studies shows that in many developed countries more than twenty percent of all households rely on the private rental market for the provision of their housing services (Carliner and Marya, 2016). Furthermore, the majority of these households are often situated in the lower tiers of the income distribution and have to spend more than a quarter of their income on rent. Given its importance for such a large and economically vulnerable group of people, it is surprising that the research concerning the fundamentals of rental prices is limited. There exists, however, a fundamental which is often used as a proxy for market rents in theoretical and empirical work. Indeed, standard capital investment theory states that the rental price of capital services will equal the user cost of capital in equilibrium.¹ In case of the housing market, the theorem implies that the market rent should equal the user cost of the rental property.

The rent-user cost equivalence theorem has a long-standing history in housing economics. It was first of all used to assess the impact of shocks in tax and monetary policy on various outcomes like house prices (Poterba, 1984), capital allocation (Hendershott and Hu, 1981, 1983) and tenure choice (Hendershott and Shilling, 1982; Follain and Ling, 1988). As models of the housing market became more advanced, the user cost remained an important component. DiPasquale and Wheaton (1992) specify an econometric model of the rental market in which the user cost of owner-occupied and rental housing affect respectively the demand and the construction of rental housing. Alm and Follain (1994) examine the effect of tax reform on the price of rental housing in a structural model of the rental market using a short-form user cost formulation including the interest rate and depreciation. A similar formulation as Gervais (2002) uses in his study on the impact of the preferential tax treatment of owner-occupied housing.² These authors implicitly, or explicitly, assume that rents and user costs are strongly related and shocks in the latter translate one-to-one into the former. Whether market rents truly reflect the user cost of rental properties is essentially an empirical question.

The first study that looked directly at the relationship between market rents and user costs was Blackley and Follain (1996). The authors found that rental prices adjust only partially to shocks in user costs after a long period of time. Alarmed by surging house

¹See Jorgenson (1963, 1967) and Hall and Jorgenson (1967).

²Specifically, Gervais (2002) assumes that landlords are financial institutions that make zero profits in equilibrium.

prices, [Himmelberg et al. \(2005\)](#) investigate whether the housing market had departed from equilibrium by comparing the evolution in the annual user of housing relative to rents and income. Their results suggest that user costs and rents do not share a stable relationship but that both variables can strongly deviate from one another. [Verbrugge \(2008\)](#) show that user costs are indeed much more volatile than rents and that both variables diverge from each other over extended periods of time. The results of these studies suggest that the housing market departed from equilibrium, but given the length of the time period of these studies it may be unreasonable to believe that the market never once reached its steady state.

Hence, these findings might not indicate a permanent or structural departure from equilibrium but rather demonstrate that the theoretical model underlying the rent-user cost equivalence does not hold in reality. Hall-Jorgenson investment theory assumes that capital markets are frictionless, but in reality there are various frictions that make the assumption of a perfect competitive housing market less realistic. [Rosen and Smith \(1983\)](#) already suggested that transaction and search costs, supply restrictions, the existence of long-term contracts and credit-market imperfections can cause the market to adjust slowly and even prevent rents from reaching the market-clearing level. The equilibrium relationship of rents and user costs is thus based on a set of particular stringent assumptions concerning the efficiency of the housing market.

However, one thing these previous studies all have in common is that their empirical analysis of the equilibrium relationship is based on rent and house price indices. A flawed theoretical outcome could explain their empirical findings, but it is also possible that the aggregate data hide a much tighter relationship at the micro level. Not only are rent and price indices often constructed in a different manner, the average rental property differs in its characteristics and location from the average property that is being sold.³ These inconsistencies lead to what [Smith and Smith \(2006\)](#) refer to as a comparison of apples to oranges. The latter concerns urged researchers to look for property-level data. [Garner and Verbrugge \(2009\)](#) examine the relationship between rents and user costs of owner-occupied housing using property-specific cost components from the Consumer Expenditure Survey (CES). The authors find that the reported rents are closely related to a user cost measure in which imputation is used as a proxy for the expected capital gain. Using a large data set of prices and rents from Sydney, [Hill and Syed \(2016\)](#) estimate several hedonic models to impute 'quality-adjusted' price-to-rent ratios of individual properties. In the end, the authors compare the median price-to-rent ratio to their measure of the per dollar user cost of owner-occupied housing. They conclude that the price-to-rent ratio was above its equilibrium level nearly the entire sample period.

³See [Garner and Verbrugge \(2009\)](#) for a point by point overview of the weaknesses of aggregate data.

Although these studies use micro data to analyse the rent-user cost relationship, each has its own limitations. The analysis of Garner and Verbrugge is based on owners' equivalent rent (OER) which do not represent market rents at arm's length. Their results depend on the ability of owner-occupiers to assess the market rent of their own house. The findings of Hill and Syed might not be informative if rental and owner-occupied markets are strongly segmented and the user cost of owner-occupied housing differs from the user cost of rental housing. If these markets are segmented, it is theoretically unclear whether the market rental price should indeed reflect the former and not the latter. [Díaz and Luengo-Prado \(2008\)](#) show that the preferential tax treatment of owner-occupied housing can create a large wedge between rental prices and user costs in the U.S. Moreover, segmentation makes the imputation of rental prices for owner-occupied housing less reliable despite the efforts of the authors to correct for possible biases.

In this paper, we are able to study the relationship between rents and user costs of rental properties thanks to a new survey called the Flemish Housing Survey (FHS). The survey was executed on behalf of the Flemish government and questions over 10,000 Flemish households about their housing conditions. Landlords in the FHS report the gross earnings of their rental portfolio, its market value, the property tax, expenses on maintenance and repairs, and the fire insurance. We use this information together with what we believe to be reasonable values for the other cost components to compute portfolio-specific user costs. Using robust regression methods to control for the presence of outliers in the sample, we then formally test whether rental earnings are on average equal to user costs.

Our results show that rents and user costs are much stronger related than what has been apparent in the empirical work up to now. In some cases, we even find a user cost coefficient which is not significantly different from one together with an intercept estimate which is not significantly different from zero. These results can be considered as evidence of the equivalence theorem since they suggest that rental earnings are, on average, equal to user costs. Controlling for landlord characteristics does not alter this conclusion. A closer look at the relationship between the earnings and the individual cost components reveals that observing both the rental price and the market value of the same property is one of the key ingredients for an accurate analysis.

The rest of this article is organised as follows. Section 2 discusses the annual user cost of a Belgian rental property and two important frictions that can affect its relationship with rents. Section 3 presents the data of the main empirical analysis of which the results are discussed in section 4. Section 5 presents the results of the time-series analysis. We conclude in section 6 and discuss a couple of avenues for future research.

2 Institutional background and theory

In this section, we address two institutional features of the Belgian rental market that can have an important effect on the relationship between user cost and rents: transaction costs and rent control. In our analysis of how these features might affect the equilibrium relationship, we take the perfect competitive rental market as the benchmark model. Our choice for the competitive framework is based on information from the Flemish Housing Survey 2013. Several indicators suggest that the rental market mainly exists of small landlords owning just one or two properties. First of all, about 70% of the rental properties are owned by a private landlord. Secondly, the vast majority of these private landlords own just one property (63%). It thus seems safe to assume the market is rather competitive.⁴

Before we discuss these institutional features, we present our specification of the annual user cost of a Belgian rental property. The specification is based on the derivation by Jorgenson (1963) and the advances made in the housing literature later on.⁵ We adjust this basic user cost to take the Belgian tax treatment of rental housing into account, which has been altered several times over the last decades.

2.1 The annual user cost of a Belgian rental property

First of all, rental earnings are only taxable if the tenant uses the property for professional activities. If it is only used as a place of residence then landlords do not pay taxes on their actual earnings, but they are taxed on the 'cadastral income'. The cadastral income is an estimate of the annual rental value of a property net of expense. The last assessment dates back from 1975 and they have never been re-estimated since. Naturally, the assessed value started to deviate from the market rent over time. As a measure to close the gap, the cadastral incomes were adjusted for overall inflation from 1991 onwards. Moreover, as part of the fiscal consolidation efforts during the early nineties, they were increased with 25% in 1994 and two years later with 40% for the rental income taxation.

Since the cadastral income is an estimate of net rental earnings, landlords cannot deduct depreciation nor their actual expenses on maintenance and repairs. They are, however, allowed to deduct interest payments.⁶ Given the limited size of the cadastral income, landlords only have to borrow a small amount of capital in order to fully erode their tax base. However, no further tax credit is granted if the interest exceeds the total amount

⁴To be completely transparent, we find that the 10% landlords with the largest portfolios own 35% of the rental properties. However, these numbers still significantly differ by those reported in for example Basu and Emerson (2003).

⁵See for example Dougherty and Order (1982) and Poterba (1984).

⁶The only condition is that the mortgage has to be used to acquire or retain the rental units that render the income from which the interest is deducted.

of rental earnings. Aside from the rental income taxation, owners of real estate have to pay some kind of property tax known as the ‘immovable withholding tax’. Contrary to its name, it is levied by assessment⁷. Just like the rental income tax it uses the cadastral income as tax base. Since 1989 the immovable withholding tax is under the control of the regions. The applicable tax rates are very low, ranging from 1.25 % in the Brussels-Capital and Walloon Region to 2.5 % in the Flemish Region which increased the rate in 1990. The provinces and municipalities are, however, entitled to levy surtaxes which significantly increase the total immovable withholding tax due. They raised their surcharges regularly over time. In 2013, the Flemish provinces and municipalities imposed an average surtax of 334 and 1.353 cents per euro of immovable withholding tax, respectively.

When a landlord wants to sell a property, he will have to pay capital gains tax under certain conditions. These conditions are, however, not that strict. The value of the property has to increase with more than 30% in one year to be taxable, but the tax code defines the capital gain as the difference between the sales price and the purchasing price increased with 25 percent or with the effective costs of acquiring the property if these are larger than 25 percent of the purchasing price. Moreover, the purchasing price is further increased with 5 percent for every year between the acquisition and the sale of the property. Lastly, capital gains are only taxed if the property is sold within five years after its purchase and the investor did not occupy the property herself for at least a year. Because of these stringent conditions, we will not take capital gains taxation into account when computing the annual user cost although we include it in the specification.

Finally, landlords are granted a tax cut based on the capital payment, which we define as the annual amount with which the outstanding mortgage debt is paid down. This is called the ‘long-term savings tax reduction’. The annual capital payment that is eligible for the cut, is limited to the first share of 50,000 euro of the principal with a maximum of 1,500 euro. These figures get adjusted for overall inflation every year.⁸ Once the mortgage agreement is signed, however, the share of the principle remains fixed during the entire term. The size of the reduction was computed using the average personal income tax rate of the taxpayer, but after 2012 it was adjusted to a fixed rate of thirty percent. Based on these tax provisions, we can define the user cost of a Belgian rental property i of landlord j as follows:

$$U_{ij} = P_i[(1-d)i^m - d(1-\tau^r)r - \delta - (1-\tau^c)E(\pi^h)] - M_{ij} - F_{ij} - \tau_m^p I_i - \tau_j^y I_i - D_{ij} \quad (1)$$

⁷ Originally, it was meant as an advance payment for the income tax on rental earnings, but over the years it gradually transformed in a common property tax.

⁸In 2012 they equalled 73,190 and 2,200 euros respectively.

Where P_i is the current market value of the property, d is the share of equity in the property's value, i^m the mortgage interest rate on the outstanding mortgage balance, τ^r the tax rate on capital income, r the required return of the landlord, δ is the depreciation rate; τ^c the tax rate on capital gains and $E(\pi^h)$ is the expected appreciation rate. These components are all based on the market value of the property. Henceforth, we will refer to these components as the 'value-based' costs while the costs that are directly reported in the FHS are referred to as the 'portfolio-specific' costs or something similar. M_i are expenditures on maintenance and repairs; F_i the fire insurance; $\tau_m^p I_i$ denotes the immovable withholding tax with the property tax rate τ_m^p which is a function of the regional tax rate τ^r and the surtaxes of the provinces S_p and the municipalities S_m : $\tau_m^p = \tau^r (1 + \frac{S_p}{100} + \frac{S_m}{100})$; $\tau_j^y I_{ij}$ captures the personal income taxation on the cadastral income net of mortgage interest expenses with $I_{ij} = (1 - g)I_i - (1 - d)i^m P_i^0$ in which I_i is the cadastral income adjusted for inflation, g are the aforementioned increases in the tax base, i^m the mortgage interest rate and the plus sign in the superscript indicates that $I_{ij} = 0$ if $I_{ij}^* < 0$; lastly D_{ij} is the long-term savings reduction which is computed as $D_{ij} = \tau_j^s C_{ij} (T / (1 - d_0) P_i^0)$ with τ_j^s the average tax rate, C_{ij} the mortgage capital payment and T the first share of 50.000€ of the principal $(1 - d_j^0) P_i^0$ at the time of the purchase of the rental unit.

2.2 Transaction costs

Belgium has one of the highest levels of transaction costs of the entire OECD ([Andrews et al., 2011](#)). The largest cost an investor faces when he wants to purchase a dwelling in Belgium, are stamp duties. Every transaction of immovable property is taxed at a minimum rate of 10 percent.⁹ Aside from stamp duties, the investor will also have to pay notary and other fees when buying a property. Finally, if he wants to use a broker to sell his house, he will have to pay a brokerage fee of about 3 percent next to the capital gains tax under the conditions we discussed earlier. The transactions costs can become quite large, the question is how they affect the equilibrium relationship between rents and user costs?

In order to analyse the impact of transactions costs, it is essential to distinguish the annual user cost from the net present value (NPV) of a rental property. The latter equals the present value of the stream of rents net of expenses over the entire expected holding period of the property. Like any other type of investment, an agent will only acquire a property if its present value is larger or equal to its market value. Changes in transactions costs alter the NPV of a property and thereby influence the decision to invest or not; but after the property is acquired, the investor will no longer take the costs into account because they

⁹Owner-occupiers can enjoy abatements and lower tariffs under certain conditions.

are essentially a sunk cost.¹⁰ This is why they do not enter the specification of the annual user cost. It does not mean, however, that transactions costs do not affect the equilibrium relationship of rents and user costs.

Lets take the example of an increase in the costs of acquiring a property from zero to a certain percentage of its sales price. Given that prospective investors cannot expect to earn more than the market rent, they will forego to acquire new units as long as the NPV remains beneath the market value. There are two important channels through which the NPV-value ratio can increase. First of all, to the extent that transaction costs apply to the acquisition of properties regardless of their future use, they will not only alter the decisions of investors but also affect those of consumers (Diaz and Luengo-Prado, 2011). When costs increase, consumers will want to substitute the acquisition of a dwelling by renting one. Both investors and consumers will thus reduce their demand for houses which will lead to a decrease in house prices. Secondly, the consumer's decision to switch from buying a house to renting one will increase the demand for rental housing to which landlords will respond by raising the rent. On top of that, the drop in the demand for properties by investors leads to a lower supply of rental housing which on its turn increases market rents even further.

The decline in house prices not only affects the NPV-value ratio but also the annual user cost of 'incumbent' rental properties albeit in an indirect manner. Equation 1 shows that several of the cost components depend on the market value (P_i). The direction of this effect depends on the difference between the value-based cost components and the expected capital gain. Lower market values imply lower annual user costs whenever this difference is positive. However, a decline in house prices can lead to negative expected appreciation rates which will increase the annual user cost. The net effect is therefore ambiguous. Prices, rents and user costs will adjust until it becomes profitable again for investors to buy additional rental properties and for consumers to reconsider purchasing a home. However, in the new steady state rents will be larger than the annual user cost. This difference reflects the additional return that is required by investors to compensate for the transaction costs. Its present value needs to equal the transaction cost in equilibrium. This is captured by the following condition:

$$c_t P_{it} = \sum_{t=1}^N \frac{(R_{it} - U_{it})}{(1 - i^m)^t} \quad (2)$$

With c the transaction costs rate and N the expected holding period. From this equation,

¹⁰The costs of selling a property will of course still influence the decision whether to exit the market or not.

we can derive a simple formula for the size of the wedge between equilibrium rents and user costs as a share of the property's value:

$$\left[\frac{(1 - i^m)(1 - (1 - i^m)^{-N})}{i^m} \right]^{-1} c_t \frac{(R_{it} - U_{it})}{P_{it}} r_t^c \quad (3)$$

Equation 3 shows that the additional return depends on the transaction costs rate, the discount rate and, as [Díaz and Luengo-Prado \(2008\)](#) already pointed out, the investor's expected holding period. Indeed, its size decreases with the duration of the landlord's holding period. Investors with longer expected holding periods will have a lower level of r_t^c and will therefore buy an additional property sooner than those with shorter horizons all else equal.

We will add r_t^c to our measure of the annual user costs in order to account for the wedge between equilibrium rents and user costs. The decision to adjust the user cost measure instead of the rental earnings is arbitrary. The additional return can be the result of an increase in rents, a decrease in the user cost or both. The size and speed at which rents rise and house prices drop will depend on the short- and long-run price-elasticities of supply and demand for housing assets and housing services. Our choice to increase user costs instead of reducing rents is based on a couple of studies in the empirical literature of which the results suggest that prices are more responsive than rents.¹¹ Note that we are not the first to adjust the user cost for the presence of transaction taxes. Both [Díaz and Luengo-Prado \(2008\)](#) and [Hill and Syed \(2016\)](#) add an additional component to capture transactions costs.

Lastly, we need to point out that there is no variation in the data which we can use to test whether the actual differences between the rental earnings and unadjusted user costs from the portfolios in our sample correlate with the additional return from Equation 3. Increasing the user cost of all observations with a fixed percentage of their market value can alter the results and model fit, but it is impossible to verify whether the increase itself is due to transactions costs or some other, possible omitted, variable.

2.3 Rent control

Rental prices in Belgium are subject to within tenancy rent control or what is called a vacancy decontrol-recontrol system. Landlords are free to set the price of their units and can negotiate with prospective tenants, but the rent will remain fixed during the entire term of the contract. Once the contract expires, the landlord can adjust the rental price whether

¹¹ [Genesove \(2003\)](#) finds substantial rigidity in apartment rents while [Gallin \(2008\)](#), in his analysis of the long-run relationship of house prices and rents, cannot reject the hypothesis that prices do all the correcting.

or not the tenancy changes. Every rental agreement regarding a property that serves as the primary residence of the tenant, falls under the scope of this legislation. So overall, the majority of rental contracts are affected. Given that the rent remains fixed during the entire duration of a renter's tenancy, the regulations with regard to the term of rental contracts are quite important. Since 1991 it is not allowed to close a rental contract of which the duration is undetermined. There are four different possibilities: it can either have a duration of i) three years or less which is called a short-term rental contract; ii) exactly nine years which is considered as the standard rule from a legal perspective; iii) more than nine years or iv) a contract for life. Each rental agreement of which the duration is between three and nine years or left unspecified, is automatically considered to be a contract of nine years. A landlord and tenant are thus perfectly capable of closing an agreement for a period shorter than three years or longer than nine, but every contract within this interval is in principle one of nine years.

There is not a lot of data available with regard to the average duration of tenancy in Belgium. Landlords are required to register their rental contracts since 2007, but they only have to indicate whether it is a short- or long-term agreement. Short-term agreements are shorter or equal to three years whereas long-term agreements are those longer than three.¹² A data set of registered contracts from 1990 to 2009 shows that 57% are short rental contracts and 43% long ones.¹³ The average period between the registration of two contracts is 2.97 years. However, the latter number certainly underestimates the average duration of a tenancy given the large share of short-term contracts (75%) in the pool of properties for which there are at least two registered contracts. Data from the Flemish Housing Survey shows that 32.4 percent of the private tenants has a rental contract of three years or less, 38.9 percent has contract with a duration longer than three years and 28.7 percent has a contract in which the duration is not specified.

Tenancy rent control can affect rental price dynamics since landlords will not always be able to adjust rents immediately to unexpected changes in the user cost.¹⁴ Unfortunately, the Flemish Housing Survey (FHS) does not provide us any information on the period when the rental prices were set nor on the duration of the tenancies. Because of the tenancy rent control, the reported rental earnings could be based on rents which were set a couple of years ago. The portfolio earnings from the FHS are probably a crude proxy for the market

¹²Tenancy rent control in Belgium deviates from the rent control regime addressed in [Basu and Emerson \(2000\)](#) and [Basu and Emerson \(2003\)](#) in which landlords do not have the option to close short-term contracts nor are they allowed to evict the sitting tenant.

¹³See [Vastmans and de Vries \(2013\)](#) for a description of the data on registered rental contracts and some summary statistics.

¹⁴[McFarlane \(2003\)](#) shows that second generation rent regulation does not affect the long-run supply of housing. So it does not make the equivalence hypothesis improbable due to supply frictions.

rent, whereas the annual user cost measures reflect the situation in 2012.

However, there are some forces that can counteract the effect of the rent control. First of all, landlords are assumed to be forward-looking. When they list their price or negotiate a new price with a sitting tenant, they will take the cost over the entire duration of the tenancy into account. The rent will thus reflect the annualized expected total user cost. To the extent that landlords are able to make an accurate prediction of the evolution in their costs, and they have a strong incentive to do so, rental earnings will be closely related to the current user cost at each moment in time during the tenancy. Admittedly, this relationship will be less strong than in case one would compare the current price of one-year rental contracts with the current annual user cost. Secondly, the landlord and tenant can stipulate that the rent will be adjusted for overall inflation on an annual basis using the health index.¹⁵

3 Data

The primary goal of this paper is straightforward. We want to test whether the rental price reflects the user cost of the property that is based on reasonable values for the different cost components. Our main empirical analysis is based on a set of landlords from the Flemish Housing Survey (FHS), an extensive survey on behalf of the Flemish government which questioned over 10,000 households concerning their housing conditions. The novelty of this data set is that landlords report the gross annual earnings of their portfolio along with several important components of the user cost: the market value, expenditures on maintenance and repairs, annual fees for fire insurance, and the property tax. Because of this rich information set, we are able to test whether rental earnings and user costs are strongly correlated at the micro-level. This will be the first time, to our knowledge, that the equilibrium relationship is examined using concurrent rents and costs of the same rental portfolios.

However, not every component of the annual user cost can be computed solely on the basis of the FHS. The term within brackets in Equation 1 exists of three components for which there is no information available in the FHS and we have to rely on different data sources. These are i) the cost of capital $((1 - d)i^m - d(1 - \tau^r)r)$, ii) the depreciation rate (δ) , and iii) the expected appreciation rate $(E(\pi^h))$.¹⁶ We discuss the computation of the value-based costs together with the adjustment factor for the transaction taxes after the overview of the FHS data.

¹⁵The health index is a different version of the commonly used CPI in which some products are left out, namely: alcoholic beverages, tobacco and fuels.

¹⁶Table 11 in the appendix gives an overview of the different components together with their respective data sources.

3.1 The Flemish Housing Survey

The main part of our empirical exercise is the analysis of concurrent rents and user costs of rental properties from the Flemish Housing Survey 2013. All of the figures which the landlords report, are aggregated numbers for their entire portfolio of rental units. The gross earnings are the sum of all the rents from the different properties that the landlord owns. The same holds for the market value and all other components of the user cost. Since we also observe the number of rental units in the portfolio, it is possible to compute average values whenever we need to. We use the reported annual expenses on maintenance and repairs as a proxy for the expected costs.¹⁷ The total property tax paid is reported. Households have to report their net taxable income, which makes it possible to impute marginal income tax rates.¹⁸ Together with the cadastral income, which we imputed using the property tax and the average tax rate in Flanders in 2012, we are able to get an estimate of the income tax on their rental earnings.

Landlords were not asked if they use the interest deduction or long-term savings reduction. However, we obtained aggregate data on tax returns from the Belgian Department of Finance, which are presented in Table 1. These data include every taxpayer who owns more than one dwelling whether they rent it out or not. The data indicate that on average 43,6% of these taxpayers used the interest deduction from 2005 to 2011. The value in the second column reflects the average cadastral income of the tax payer and the one in the fourth column is the average interest deduction. Both figures are nearly equal. It suggests that the landlords who made use of the interest deduction could deplete the entire tax base and thus avoid paying any rental income taxation. Less than a fifth of the tax payers uses the long-term savings reduction, but it is increasing over time. The fact that this number is much lower than the share who uses the interest deduction is not surprising. Landlords who are also paying of a mortgage for the house they live in themselves, can use the mortgage interest and capital deduction which is a more advantageous tax benefit restricted to owner-occupiers. However, you cannot enjoy both benefits at the same time. We use these aggregate figures to adjust the user costs. Specifically, we reduce the rental income taxation for all rental portfolios with 44% and only use 18% of the long-term savings reduction which we computed for each portfolio individually.¹⁹

¹⁷Landlords were asked the following question: "Can you give us an *estimate* of the annual expenses on maintenance and repairs of your rental units?". Given the way in which this question is phrased, one could argue that the reported figure will be based on a landlord's past experiences rather than exactly representing last year's expenses. In other words, it will arguably not differ much from the figure you would get if you asked them to predict their annual expenses for the next year.

¹⁸See the appendix for more information with regard to the imputation of the marginal income tax rates.

¹⁹For the calculation of the long-term savings reduction, we assume a loan-to-value ratio of 0.8.

Table 1. The cadastral income, interest deduction and long-term savings reduction.

Year	Average cadastral income (CI)	Interest deduction		Long term savings reduction	
		Fraction of tax-payers	Average deduction	Fraction of tax-payers	Average capital payment
2005	2.583,11	.42	2.689,62	.13	1.570,45
2006	2.649,38	.43	2.764,99	.14	1.591,59
2007	2.676,83	.43	2.877,39	.14	1.692,41
2008	2.747,46	.43	3.021,54	.16	1.703,42
2009	2.898,16	.43	3.084,22	.17	1.756,21
2010	2.918,05	.43	2.996,95	.17	1.792,50
2011	3.001,83	.44	3.056,57	.18	1.845,19

Notes: This table presents summary statistics of the cadastral income, the interest deduction and long term savings reduction. The averages are computed by dividing the total sum of the cadastral income (CI), interest deduction and eligible capital payments by the total number of tax returns for which the value of these variables is larger than zero. A taxpayer is defined on the basis of the tax return, it can represent a single individual or two partners. The cadastral income is the average reported income per tax return adjusted for inflation and increased with 40 percent. The *fraction of taxpayers* is the share of taxpayers that declare the cadastral income of one or more of their buildings that they own for which the interest deduction and the long term savings reduction is larger than one. Only the interest deduction itself is reported, the average interest payment could be a lot larger.

Source: Income tax data from the Federal Public Service (FPS) Finance, Belgium.

From the 10,013 interviews, 663 households indicated they owned one or more houses, flats or (student) rooms that they rented out. Of these 663 households, 80 observations were dropped because one or more of their rental units were rented through a social housing program, 7 because they did not report the number of rental properties in their portfolio and 27 because they rented one or more (student) rooms. Lastly, all observations for which one of the user cost components was missing, were dropped. The data cleaning reduced the final sample size to 190 portfolios existing of 342 rental units. Because of this large reduction in sample size, the question rises whether the restricted sample is still representative for the entire population of landlords. We therefore compared the summary statistics on the key variables in our analysis of the restricted sample with those of the excluded observations, and looked whether they are significantly different from each other. The summary statistics and the p-values from a standard t-test of the inequality of means are available in Table 2. The results from the t-test point out that none of the user cost components significantly differs between the regression sample and the excluded observations at the ten percent level.

Table 2. Summary statistics Flemish Housing Survey 2013.

		All landlords	Excluded	Regression sample		$\mu^r \neq \mu^0$	
	Obs.	Mean	Mean	Mean	Min	Max	P-value
A. Rental earnings							
Rental earnings	441	12,506.04	11,331.29	14,057.96	1,150	270,000	0.14
(R_i)		(18,612.25)	(11,848.71)	(24,829.67)			
	437	7,308.39	6968.74	7,749.94	360	72,000	0.13
		(6,916.86)	(6620.25)	(7,278.43)			
B. User cost components							
Market value	425	312,685	290,155	340,550	10,000	4,000,000	0.13
(P_i)		(345,627)	(280,143)	(411,597)			
	423	191,752	185,716	199,152	1,000	583,333	0.24
		(90,107)	(82,275)	(98,585)			
Maintenance	400	3,164.62	3,424.81	2,877.93	0	49,501	0.44
(M_i)		(7,050.73)	(8,090.10)	(5,693.43)			
	397	1,735.64	1,966.21	1,484.43	0	24,750.39	0.28
		(4,416.07)	(5,669.79)	(2,387.68)			
Fire insurance	310	536.08	507.27	554.28	0	5,000	0.51
(F_i)		(611.91)	(476.34)	(684.44)			
	308	307.86	285.85	321.52	0	1,666.67	0.16
		(216.80)	(169.91)	(240.81)			
Property tax	386	1,262.15	1,275.79	1,248.07	55	11,000	0.87
($\tau_m^p I_i$)		(1,612.94)	(1,654.36)	(1,573.31)			
	383	712.54	717.65	707.34	55	3,666.67	0.83
		(478.36)	(479.12)	(478.80)			
Rental income taxation*	386	1,766.86	1,761.97	1,771.90	69.37	15,608.2	0.97
($\tau_j^y I_i$)		(2,280.83)	(2,263.52)	(2,304.53)			
	383	995.13	998.19	992.01	69.37	5,205.73	0.93
		(656.75)	(639.74)	(675.28)			
Long-term savings	425	727.86	743.26	708.79	26.11	1,078.12	0.14
deduction*		(239.82)	(231.23)	(249.34)			
(D_i)	423	587.87	605.85	565.82	14.62	1,078.12	0.17
		(297.99)	(292.76)	(303.59)			

Note: This table presents summary statistics on the rental earnings and different cost components from the FHS. The first row contains the statistics at the portfolio-level and the third row the unweighted portfolio-average. All numbers are in euro except for the number of rental units. *Obs.* indicates the number of landlords for which a component is not missing. The regression sample consists of 190 portfolios with in total 342 rental properties. The P-value of a standard t-test on the inequality of means of the regression sample and excluded observations is given in the last column. Standard errors in parentheses. * indicates that these figures were not directly reported by the landlord but have been imputed based on other components.

Source: Flemish Housing Survey 2013.

3.2 The value-based components

3.2.1 The cost of capital

Landlords were not asked whether they got a mortgage to finance the acquisition of their rental units. We do not know the amount of outstanding debt they have nor the interest rate they currently need to pay. To compute the cost of capital, which is a weighted average of the cost of mortgage debt and the required return on equity, we took the average mortgage interest rate in 2012 from the Monetary financial institutions Interest Rate survey (MIR) from the National Bank of Belgium (NBB) equal to 3.743%. The latter is a survey in which financial institutions have to report the interest rates they charge on various kinds of credit. The NBB uses this to keep track of the evolution in interest rates. We assume that the mortgage interest rate is a good proxy for the landlords required return on equity. Income from financial assets is not taxed at the marginal income tax rate in Belgium, but at several fixed rates depending on the type of asset. For example, the tax rate on interests from a savings account is 15% whereas dividends were taxed at 25% in 2012. Given the low interest rates on saving accounts during that period, we will use the tax rate of 25% assuming that to earn a gross return of 3.743% they had to invest a large share of their money in stocks. The equity share in the property is set at 60%. This number is based on the fact that only 40% of the tax payers use the mortgage interest deduction.²⁰ Using these different components, the weighted cost of capital equals 3.18%. Annual depreciation is not directly measurable.

3.2.2 The expected appreciation rate

One of the components of the user cost that we do not observe, and is probably the most tricky element to capture, is the expected appreciation rate. We use three different measures of the expected appreciation rate. The first measure can be considered as the conventional appreciation rate in the literature. It assumes that landlords are perfectly rational and adjust their expectations immediately to new developments in house price inflation. Our forecast of the expected capital gain is a simple average of three different models in which the dependent variable is the annual appreciation rate: a first order autoregressive model, a model in which we use three quarterly lags as independent variables and a three-year moving average. These models were re-estimated every quarter using the available information at that period. The 'Univariate' user cost is denoted $uc\{1\}$.

Our second measure of the user cost is motivated by the work of [Garner and Verbrugge \(2009\)](#) who use lagged annual overall inflation as the expected appreciation rate. This 'zero

²⁰Although we believe that this number would be higher if only landlords who rent on the private rental market were included in the aggregate data of Table 1.

real capital gains' user cost is defined as $uc\{pi\}$. The third measure accounts for the fact that a large share of the rental agreements in Belgium last three years. It is the average of the three-year moving average and an annualized three-year forecast from a first order auto-regressive model. It is defined as $uc\{3\}$. The fourth measure considers that the long-term evolution of house prices is driven by fundamentals. This measure is a forecast of the annual appreciation rate using a vector autoregressive model (VAR) with six lags of the annual growth rate of house prices, income and mortgage interest rates.²¹ The user cost is denoted $uc\{f\}$. The last measure of the expected appreciation rate is the average forecast of a panel of experts which is published in a popular newspaper which focuses on economic and financial news called 'The Time'. The latter is denoted $uc\{n\}$. Note that all of these rates are fixed across the rental portfolios. The variation that we will exploit comes from the portfolio-specific components like the market value.

In summary, three out of five appreciation rates are thus one-year ahead forecasts and can be considered as measures of short-term house price expectations ($uc\{1\}$, $uc\{f\}$ and $uc\{n\}$, $uc\{3\}$ is an annualized three-year forecast that should capture expectations in the medium run and lastly, $uc\{pi\}$ can be considered as a measure for long-term expectations.

The estimation of some of these measures requires a house price series of considerable length. We therefore constructed a house price index using data on property transactions from Statistics Belgium (SB). This series has to capture the evolution of the average market value of rental properties as close as possible. The transactions data consists of the sale price of every transaction in a given year. They are made publicly available in the form of a few descriptive statistics like the number of transactions and the average value. Furthermore, the transactions are divided in three groups: i) apartments, flats and studio's, ii) single family houses and iii) large mansions. Given that the majority of rental units belong to the first two categories, we computed a weighted average in which we retain these two housing types²²:

$$P_t = w_t^a * \bar{p}_t^a + w_t^h * \bar{p}_t^h \quad (4)$$

The weights w_t^k are the share of apartments and houses in the total number of transactions in both categories in a given year, whereas $\bar{p}_t^k$ is the average price within the category.

²¹We used common goodness of fit measures like Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (SBIC) to determine the number of lags.

²²Figures from the Flemish Housing Survey show that 55% of the tenants live in a flat and 38% in a single-family house. The average surface of the latter is only 465 square meters whereas the average surface of a mansion in the transactions data equals 1.562 square meters in 2013. The values of the rental portfolios from the FHS and the prices from the SB transactions data are quite comparable: the average self-reported value of rental units from the FHS was 191,751.5; while the average nominal sales price in the transactions data of Statistics Belgium equalled 197,060.04 in 2012 and 201,794.3 in 2013.

3.2.3 Depreciation and transaction costs

We rely on the estimates of [Harding et al. \(2007\)](#) to capture economic and physical depreciation of housing capital. Their results show that a typical single family home depreciates at an annual rate of 1.9% net of maintenance. The last component we will add is the additional return to adjust for transaction costs. The additional return is computed based on equation 3 which requires an expected holding period and transaction costs rate in addition to a discount rate for which we use the mortgage interest rate. Since we have no data on expected holding periods in the Belgian rental market, we had to make an assumption. We chose to follow [Blackley and Follain \(1996\)](#) and use a period of 12 years. The mortgage interest as the discount rate, a 12% transaction costs rate and a holding period of 12 years together lead to an additional return of 1.2%.

4 Research design and results

When it comes to information with regard to the user cost of rental properties, the Flemish Housing Survey is unique in its kind. To our knowledge, it is currently the only data set that includes information on rental earnings, market values and several user cost components of actual rental properties. This information enables us to compute the user cost for each individual portfolio of rental properties. The main question is how strongly gross rental earnings are related to our different measures of the annual user cost.

4.1 Descriptive results

In Table 3, we present summary statistics of the different user cost measures and the differences with the portfolio earnings. The average difference between earnings and costs ranges from -1,745.4€ (uc{n}) to 4,824.6€ (uc{3}) at the portfolio-level and from -969.6€ to 2,680.4€ for the portfolio-average. These differences correspond to an excess return of respectively -0.11% to 1.44% of the portfolio's value. Overall, the descriptive statistics reveal some interesting findings. First of all, two of five user cost measures are on average larger than rental earnings, while the three others are smaller. This tells us that, at first sight at least, rental earnings seem to be closely related to user cost measures that are based on reasonable assumptions with regard to the different components. There is no huge positive or negative gap between earnings and all user cost measures.

Secondly, based on the difference between the median and average values, the zero real capital gains user cost (uc{pi}) seems to be closest related to earnings. The differences in the median and mean values amount to 0.22% and 0.11%. The third finding is more data

oriented. The distribution of rental earnings is much more skewed than the distribution of the user cost measures. Note that the skewness of the user cost will be mainly driven by the skewness in the distribution of market values. The latter finding thus suggests that our sample may contain some severe outliers. In the next section, we will use regression analysis to formally test whether rental earnings are, on average, one-to-one related to user costs.

4.2 Regression results

Thanks to the level of detail in the Flemish Housing Survey, the formal test of our main research question is quite straightforward. We have to estimate the following regression equation using ordinary least squares (OLS):

$$R_{ij} = \alpha + \beta U_{ij} + \varepsilon_{ij} \quad (5)$$

After which we test whether the constant ($\hat{\alpha}$) is not significantly different from 0 and the user cost coefficient ($\hat{\beta}$) is not significantly different from 1. If these two hypotheses hold, it implies that rental earnings are on average equal to the annual user cost.

However, this interpretation only holds under the assumption that estimating Equation 5 using OLS will not be biased in any way. The upper left panel in Figure 1 plots the earnings against $uc\{1\}$ at the portfolio-level together with a 45 degree line. It clearly shows that our sample contains several outliers. Zaman et al. (2001) point out that the least squares estimator is very sensitive to outliers since they receive a large weight in the estimation procedure. The authors state that it has a breakdown point of 0%: a single outlier can have a large influence on the results. Fortunately, there exist estimation methods that are able to cope with the presence of outliers and produce robust estimates of the parameters. In addition to OLS, we estimate Equation 5 with two different robust regression techniques: the least median of squares (LMS) (Rousseeuw, 1984) and the MM-estimator (Yohai, 1987). The LMS-estimator has the lowest Gaussian efficiency but highest possible breakdown point of 50%, whereas the MM-estimator can have an efficiency level up to 95% but a lower breakdown point.²³

²³We use the STATA module `robreg` from Jann, B. (2010) which enables us to choose the desired efficiency level of the MM-estimator. We set the efficiency level at 70% since this gives the best trade off between efficiency and robustness.

Table 3. Summary statistics of the rental earnings and user cost measures.

		$E(\pi^h)$	Median	Mean	Std. Dev.	Min	Max
Rental earnings	R_i		7,800	14,058.0	24,829.7	1,150	270,000
			6,870	7,749.9	7,278.4	360	72,000
Rent-to-price ratio	$\frac{R_i}{P_i}$		.0379	.0446	.0501	.0023	.4909
Panel A. Levels							
Univariate forecast	uc{1}	0.0413	7,872.8	12,802.1	15,661.2	2,580.2	123,205.2
			5,988.2	7,112.3	4,475.2	287.7	29,524.4
Zero real capital gains	uc{pi}	0.0363	9,106.6	14,495.1	17,581.8	2,926.8	143,091.2
			6,846.8	8,052.8	4,910.8	292.7	32,010.2
3-year forecast	uc{3}	0.0518	5,351.1	9,233.3	11,752.4	1,608.1	81,287.6
			4,270.8	5,129.6	3,646.8	277.2	27,629.6
VAR forecast	uc{f}	0.0427	7,572.9	12,325.3	15,126.3	2,457.8	117,605.5
			5,725.7	6,847.4	4,356.6	286.3	28,824.5
Panel of experts	uc{n}	0.0325	9,990.1	15,803.3	19,083.7	2,965.2	158,456.8
			7,600.3	8,779.6	5,260.3	296.5	33,930.9
Panel B. Rent-user cost differences							
Univariate forecast	uc{1}	0.0413	519.8	1,255.9	19,736.2	-45,955.2	247,153.3
			247.8	697.7	8,261.7	-22,977.6	67,091.8
			0.0028	0.0039	0.0533	-0.3009	0.4494
Zero real capital gains	uc{pi}	0.0363	-710.9	-437.2	19,769.9	-46,949.5	244,419
			-380.5	-242.9	8,334.5	-23,474.7	66,196.9
			-0.0022	-0.0011	0.0533	-0.3059	0.4444
3-year contracts	uc{3}	0.0518	2,598.4	4,824.6	20,350.4	-43,859.3	252,917
			2,223.8	2,680.4	8,221.9	-21,929.6	68,978.1
			0.0133	0.0144	0.0533	-0.2905	0.4599
VAR forecast	uc{f}	0.0427	864.9	1,732.6	19,764.9	-45,675.2	247,923.3
			471.0	962.6	8,247.4	-22,837.6	67,343.78
			0.0042	0.0053	0.0533	-0.2996	0.4508
Panel of experts	uc{n}	0.0325	-1,494.1	-1,745.4	19,940.3	-47,717.8	242,306.2
			-1,184.1	-969.6	8,413.8	-23,858.9	65,505.5
			-0.0059	-0.0049	0.0533	-0.3098	0.44056

Note: the first row in Panel A presents the median, mean, standard deviation (Std. Dev.), minimum and maximum value of the variable at the portfolio-level (190 portfolios). The second row presents the same moments for the portfolio-average using the number of rental properties in each portfolio as frequency weights (342 properties). The first and second row in Panel B contain the same moments for the difference between earnings and costs ($\Delta_{ij} = R_{ij} - U_{ij}$), both at the portfolio-level and the portfolio-average. The third row presents the statistics on the difference-to-price ratio (Δ_{ij}/P_i). All numbers are in euro except for the ratios.

Figure 1. Rent-user cost relationship: portfolios and outliers.

Note: The upper left plot shows the portfolio-level earnings and $uc\{1\}$ with a 45° line. The upper right panel shows the exact same plot, but the size of the circles indicating the number of properties of the portfolios. The two panels in the bottom are the exact same plots as those above, except we used portfolio-average earnings and user costs.

Applying the robust estimators to our sample will still lead to biased results if we do not account for the fact that several of the observations represent a portfolio of more than one rental property. Theoretically speaking, aggregating earnings and costs of different properties should not give rise to any problem as long as both are measured without error and the equivalence theorem holds, meaning market rents equal user costs one-to-one. OLS regressions at the portfolio-level will then return the estimates of $\hat{\beta} = 1$ and $\hat{\alpha} = 0$ even if we use portfolios of different sizes. The larger portfolios will appear as outliers in the distribution, but they will lie on the regression line and not bias the results. Yet this result breaks down if one of these two conditions does not apply. Whenever the data contains observations with measurement error or observations that are part of a different population, the use of portfolios instead of individual properties can bias the results because the robust regression method will have a hard time identifying all of these observations.²⁴

²⁴The term 'different population' refers to the hypothesis that not all the observations are driven by the exact same data generating process, but that there are observations which are the result of a different underlying

There could be single properties in our sample that are large outliers relative to all other properties, but are now not recognized as such because the larger portfolios mask their presence.

The upper right panel in Figure 1 is exactly the same plot as the one on the left, but the size of the circles indicates the number of rental properties in that portfolio. The two panels at the bottom are similar to the two above them except for the fact that we used the portfolio-average earnings and costs. Some observations are clearly outliers because they are large portfolios containing multiple rental properties. Despite their size, most of these portfolios lie quite close to the theoretical regression line. When we use the average earnings and costs, we see that several of them shift to the center of the observations cloud. These large portfolios would not bias the estimation results, but there are also observations that seem to be an outlier when using portfolio-averages, only were they not recognised as such in the portfolio-level plots. Take for example the very large vertical outlier in the upper left panel. It has very high earnings in comparison to the majority of our sample and to its own user cost, but it drops under another observation that represents a single rental property when we use its average earnings.

Using the portfolio-average earnings and costs can help identify single property outliers by making the observations more comparable to each other. However, if we just use the average without making any further adjustments, the results might still end up being biased since we would treat all portfolios as single rental units thereby ignoring their true size. This will influence the estimates from both the least squares estimation as well as those from the robust regression methods. Both of them are, to some extent, sensitive to this transformation. The objective of the least median of squares estimator is to find the coefficient vector which minimizes the median residual. The median residual can shift when we take the number of properties in the portfolios into account by using them as frequency weights in the estimation. The same holds for the MM-estimator. In the first step of the algorithm of [Salibian-Barrera and Yohai \(2006\)](#), N subsamples of p observations are randomly chosen to estimate a trial solution of the parameter vector β which minimizes a scale parameter σ of the residuals $r(\beta)$:

$$\bar{\beta} = \arg \min_{\beta} \hat{\sigma} \{r_1(\beta), \dots, r_n(\beta)\} \quad (6)$$

The number of subsamples is chosen to increase the probability that there will be at least one subset which does not contain an outlier. This probability changes if we account for the number of units in the portfolios. The share of outliers in the sample will drop if the large

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model.

portfolios are less contaminated by measurement error. Given the experience of landlords with large portfolios, it is possible that the information on their earnings and costs is more accurate.

The first row of Table 4 presents the results from regressions of portfolio-average rental earnings on portfolio-average user costs using ordinary least squares. The coefficient estimates of the user cost measures are all significantly different from zero but at the same time also significantly different from one. Furthermore, the intercepts are all significantly different from zero and quite large with an average value of 3,912.8. Notice also that the model t is very low for two variables for which theory predicts a one-to-one relationship.

These results stand in sharp contrast with those from the robust regression methods. The user costs coefficients are all much closer to one and most of the intercepts are not significantly different from zero.²⁵ However, there are also important differences between the results of both estimators. First of all, both the user cost coefficients and intercepts are less precisely estimated with LMS meaning that they have larger standard errors. This has important implications for statistical inference. While all user cost coefficients in the LMS estimates are not significantly different from 1, the same does not hold for all MM-estimates. For both $uc\{n\}$ and $uc\{3\}$ we can reject the null hypothesis at the 1% level. Secondly, the coefficient size of the LMS estimates seems to be more in line with the size of the user cost measures: the largest user cost $uc\{n\}$ has the smallest coefficient estimate and visa versa. We do not see a similar pattern in the MM-estimates where the coefficient size of the smallest and largest user costs are almost identical. Note that the robust regression methods are able to cope with erroneously measured outliers but not with measurement error as such. Observations that are affected by measurement error but are not identified as an outlier in the sample, will still bias the coefficient estimates towards zero.²⁶

Rousseeuw and van Zomeren (1990) propose to use the results from a robust estimator to compute two measures that together can identify outliers in the sample.²⁷ The first measure is the Mahalanobis distance: $MD_i = \sqrt{(X_i - \mu)\Sigma^{-1}(X_i - \mu)'} in which X_i is the vector of explanatory variables of observation i , μ is the multivariate location vector and Σ the covariance matrix of the explanatory variables.²⁸ The Mahalanobis distance tells us how far an observation lies from the center of the observations' cloud. The second measure$

²⁵See the online appendix for the results of the regressions with unadjusted user costs.

²⁶See Bound et al. (2001) for a thorough overview of the effects of measurement error in survey data.

²⁷In a previous version of the paper, we used OLS after trimming the sample in order to remove outliers. Specifically, we dropped the one percent smallest and largest observations of several user cost components: the value of the portfolio, the rent-to-price, property tax-to-price and maintenance-to-price ratios. However, the results were quite sensitive to the choice of this threshold.

²⁸The standard version of the Mahalanobis distance is based on the arithmetic mean and sample covariance matrix. However, Rousseeuw and Van Zomeren point out that it can suffer from the so called masking effect due to which several outliers will not have a large MD_i .

is the robust standardized residual ($r_i/\hat{\sigma}$) and represents the distance of the observation with respect to the fitted regression plane.

We drop all observations for which the robust standardized residual from the MM-estimator is larger (smaller) than 2.25 (-2.25) and for which the Mahalanobis distance is larger than two times $\sqrt{\chi^2_{p,0.975}}$.²⁹ Figure 2 plots the earnings and $uc\{1\}$ for the full sample and the outlier-trimmed sample. Using this outlier-trimmed sample we re-estimate Equation 5 using OLS. The user cost coefficients and intercepts are reported in Panel C of Table 4. They are all nearly identical to the MM-estimates. Due to the decrease in the standard errors, $uc\{pi\}$ is now also significantly different from one.

Figure 2. Rental earnings and the user cost: cross-sectional variation in costs.

Note: this figure plots the portfolio-average rental earnings and user costs based on the univariate forecast. The left plot is the full sample of portfolios after dropping the portfolios with earnings larger than 30,000€ and costs larger than 20,000€. The right plot is the sample trimmed for outliers using the procedure described by [Rousseeuw and van Zomeren \(1990\)](#).

As expected, the fit of the model has significantly improved in comparison to the full sample. The user cost can explain a large part of the variation in rental earnings but it is far from perfect. There are several things that can explain this finding. First of all, there may still be measurement error in the user costs even after removing outliers from the sample. Secondly, as discussed in the theory section, rent control might blur the relationship between the reported rental earnings and user costs. The latter are computed using the current value for the different cost components, whereas the former should be based on the expected cost over the entire duration of the tenancy at the time the rental agreement was closed. Unexpected shocks during the tenancy might have affected some of the cost components thereby creating variation in the former without affecting

²⁹The latter threshold is motivated by the fact that the squared distances are chi-squared distributed under normality ([Verardi and Croux, 2009](#)).

the latter.

The third reason is more theoretical in nature. In the perfect market framework, landlords are expected to earn a 'normal' return on their properties in equilibrium. This implies that properties with similar rental prices should have similar user costs. In reality, the user cost of properties with similar rental prices may vary because of landlord heterogeneity. For example, some landlords might have higher user costs than others because they are less efficient in managing their portfolios and visa versa. However, in a competitive rental market with price-elastic demand, similar properties will be rented at similar prices.³⁰ The law of one price should prevent inefficient landlords from increasing their rental prices above the prevailing market rent in order to compensate for their larger costs. They will need to settle for a lower return or sell their property and leave the market. This argument holds in both directions. Landlords that have been able to cut back on expenses for maintenance or enjoy a larger tax benefit because of their higher marginal income tax rate, are not expected to cut rents. They might be earning an above-normal return for some time before new investors enter the market putting pressure on their mark-up. It seems reasonable to assume that the market is more effective in restricting the dispersion in rental prices than it is in driving out landlords with lower than normal returns or putting pressure on landlords earning above-normal returns.

We conclude this section with the following key takeaways. Contrary to previous empirical studies, we find convincing evidence that market rents reflect user costs. More specifically, portfolio-average rental earnings are strongly related to portfolio-average user costs that are based on what have been considered as reasonable values for the different cost components. In some cases we cannot reject the null hypotheses that the user cost coefficient is equal to one and the intercept estimate is equal to zero. These findings thus suggest that the use of data with rents and cost components for the same properties might indeed be superior in comparison to different kind of aggregated series. In the next section, we take a closer look at the relationship between rental earnings and the individual cost components.

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³⁰This is of course assuming a similar landlord and similar rental contract with regard to all the characteristics that might affect pricing like length of tenancy.

Table 4. The rent-user cost relationship.

		(1)	(2)	(3)	(4)	(5)
		uc{1}	uc{pi}	uc{3}	uc{f}	uc{n}
Expected appreciation rate		(0.041)	(0.036)	(0.052)	(0.043)	(0.033)
A. Full sample						
OLS	User cost ($\hat{\beta}$)	0.56	0.52	0.61	0.57	0.49
		(0.10)	(0.09)	(0.12)	(0.10)	(0.08)
	Intercept ($\hat{\alpha}$)	3,857	3,612	4,688	3,940	3,468
		(816.27)	(832.58)	(757.50)	(810.61)	(842.01)
	R ²	0.088	0.093	0.070	0.086	0.096
	Observations	342	342	342	342	342
B. Robust regression methods						
LMS	User cost ($\hat{\beta}$)	1.06	1.01	1.18	1.11	0.93
		(0.10)	(0.15)	(0.40)	(0.20)	(0.12)
	Intercept ($\hat{\alpha}$)	54.99	-436.3	677.6	41.54	-464.4
		(943.7)	(970.1)	(1,291)	(986.7)	(949.5)
MM	User cost ($\hat{\beta}$)	0.95	0.85	0.79	0.97	0.78
		(0.09)	(0.08)	(0.03)	(0.10)	(0.08)
	Intercept ($\hat{\alpha}$)	777.3	644.9	2,975	836.4	621.6
		(522.2)	(514.3)	(216.2)	(526.8)	(539.6)
	Observations	342	342	342	342	342
C. Outlier-trimmed sample						
OLS	User cost ($\hat{\beta}$)	0.94	0.84	0.79	0.96	0.77
		(0.04)	(0.03)	(0.06)	(0.04)	(0.03)
	Intercept ($\hat{\alpha}$)	907.53	833.44	3,036.95	974.81	813.05
		(244.78)	(240.46)	(276.83)	(250.38)	(240.79)
	R ²	0.755	0.773	0.468	0.747	0.784
	Observations	299	297	308	300	295

Note: this table presents the results from linear regressions of portfolio-average rental earnings on a constant and the portfolio-average user cost. The number of properties in the portfolios is used as frequency weight. Robust standard errors in parentheses. We used a bootstrap procedure of 1,000 replications for the standard errors of the least median of squares estimates.

4.3 Earnings and cost components

In the previous section, we focused on the question whether market rents reflect the user cost of rental properties. The results showed that portfolio-average rental earnings are strongly correlated with portfolio-average user costs. We argued that this finding might be due to superior data quality. In this section, we take a closer look at the relationship between earnings and the individual cost components to see which of these components drive the strong relationship. Recall that the FHS contains the market value, the expenses on maintenance and repairs, the property tax and the fire insurance for each rental portfolio.³¹ We want to stress that the goal of this empirical exercise is not to estimate the pass-through of the different components in rents, but merely to look how much of the variation in earnings can be explained by the different cost components.

Table 5 reports the results of linear regressions of portfolio-average rental earnings on the different user cost components after removing outliers using the procedure described in the previous section. We added the components sequentially in order to see how the estimates and model R^2 change. The most important finding is that the market value explains almost all of the cross-sectional variation in earnings. Only the sum of the rental income taxation and property tax further improves the model R^2 .³² This result might explain the large difference in the model R^2 between $uc\{3\}$ and the other measures in Table 4. The former has the largest expected appreciation rate. Since all other value-based components do not vary across the user cost measures, the weight of the total value-based cost will be much smaller for $uc\{3\}$ than the other measures.³³ The variation in $uc\{3\}$ might therefore be dominated by the sum of the other cost components which, as the results in Table 5 show, can explain a much smaller fraction of the variation in earnings.

The latter finding might also explain one of the main differences between our results and those of [Garner and Verbrugge \(2009\)](#) who only find a strong relationship between owner equivalent rents and the user cost measure based on inflation. Garner and Verbrugge use the annual inflation rate at the national level for their inflation based user cost and city-by-city house price forecasts for the other measures. This implies that the latter appreciation rates vary across the properties in their sample, while the former does not. If the city-by-city forecasts do not accurately capture the true expectations of the homeowners, they may only induce measurement error in one of the key value-based components and could thus

³¹We used the reported property tax to impute the rental income taxation and the reported market value to impute the long-term savings deduction.

³²We took the sum of both taxes in order to avoid multicollinearity problems. Their correlation coefficient was 0.98.

³³The sum of the other value-based components, i.e. the cost of capital (3.18%), depreciation (1.9%) and the transactions costs (1.2%), is 6.28%.

bias the estimate of the user cost coefficient towards zero.³⁴ From a theoretical viewpoint, it is reasonable to expect that homeowners look at the recent evolution in local house prices when they form their beliefs on the price of their own house. However, recent research on price expectations shows that households do not behave as perfect forward-looking rational agents.³⁵ When we use district-level data to estimate the expected appreciation rate for $uc\{1\}$ and $uc\{3\}$, the coefficient estimates almost drop by half and the t decreases significantly.³⁶

The same reasons as to why the user cost measures do not explain a larger share of the variation in rental earnings might also explain why some of the property-specific costs are not significantly correlated with earnings. Expenses on maintenance and repairs might be more prone to unexpected shocks or measurement error. Though errors-in-variables will not only bias the estimate of the former but also of the regressors that are correlated with this variable, because it will fail to accurately capture the confounding effect.³⁷ Most importantly, it might be theoretically implausible for some of the components to be significantly correlated with the rental earnings. First of all, the law of one price should prevent inefficient landlords to pass on expenses on maintenance and repairs to tenants. Secondly, a part of the variation in some cost components will be captured by others. For example, newly constructed properties might need lower expenses on maintenance and repairs, but have a higher market value.

³⁴Other results that support this hypothesis are the differences in the t of the different models in Table 1 of [Garner and Verbrugge \(2009\)](#).

³⁵For example, [Bailey et al. \(2017\)](#) show that expectations are influenced by house price experiences of friends living in a different commuting zone; [Kuchler and Zafar \(2018\)](#) point out that individuals extrapolate recent changes in local house prices when they form expectations with regard to the evolution in national house prices; and [Armona et al. \(2018\)](#) find that people tend to underpredict the strength of the short-term momentum in prices.

³⁶Results are available upon request.

³⁷Contrary to the bivariate regressions in the previous section, the size of the attenuation bias will now also depend on the correlation between the erroneously measured cost component and the other, possibly correctly measured, costs ([Levi, 1973](#); [Garber and Klepper, 1980](#)).

Table 5. Rental earnings and cost components.

	(1)	(2)	(3)	(4)	(5)
Market value	0.028*** (0.001)	0.025*** (0.001)	0.025*** (0.001)	0.025*** (0.001)	0.024*** (0.001)
Taxes		0.627*** (0.146)	0.632*** (0.155)	0.581*** (0.177)	0.654*** (0.183)
Maintenance & repairs			0.180* (0.093)	0.144 (0.093)	0.082 (0.093)
Long-term savings deduction				1.669 (1.355)	1.894 (1.375)
Fire insurance					0.026 (0.551)
Constant	1,624.971*** (195.316)	1,527.771*** (181.172)	1,282.656*** (214.482)	1,307.101*** (218.978)	1,328.169*** (233.030)
Observations	294	279	267	265	255
Adjusted R-squared	0.713	0.751	0.739	0.749	0.750

Note: this table presents the results of regressions of portfolio-average rental earnings on portfolio-average cost components. All specifications were estimated with ordinary least squares after removing outliers using the procedure described by [Rousseeuw and van Zomeren \(1990\)](#). The number of properties in each portfolio is used as a frequency weight. Robust standard errors in parentheses.

4.4 Landlord heterogeneity

We already mentioned a couple of times how landlord behavior might affect user costs. Up to now, we assumed that their behavior affects costs without having an impact on earnings and would therefore not bias the estimates of the user cost coefficients. The reasoning was that in a competitive rental market, landlords are price takers. However, the law of one price might limit the variation in listed rental prices, there is an important channel through which landlords are still able to influence their earnings: the bargaining process. [Røed Larsen and Sommervoll \(2009\)](#) argue that the process of negotiating the terms of a rental agreement differs in several respects from the bargaining process with regard to the sales price of a property. A landlord and prospective tenant decide on the basic terms of what could end in a long-term relationship, whereas the purchase of a property is a transaction at one particular moment in time. Bargaining will not only play a role at the start of a new rental agreement, but it may be even more important when the tenancy ends and parties want to renegotiate the contract terms.

It is easy to think of landlord characteristics that may be important in the light of the

bargaining process and can also influence costs. More experienced or better educated landlords might be more efficient in minimizing costs or identify properties that are priced below market value, but at the same time also have higher bargaining power and thus able to negotiate a better rental price. Retired landlords might be less efficient in managing maintenance expenses and at the same time require lower rents in order to avoid long vacancy spells and safeguard their income flow. In order to test whether landlord heterogeneity affects the results, we include several characteristics in our specification with the outlier-trimmed samples:

$$R_{ij} = \alpha + \beta U_{ij} + \theta' X_j + \varepsilon_{ij} \quad (7)$$

In which X_j is the vector of characteristics including the number of rental properties, age, education and employment status. Summary statistics of these characteristics for both the regression sample as the excluded observations are presented in Table 6.

The coefficient estimates for $uc\{1\}$ and the landlord characteristics are reported in the first column of Table 7. The estimates for the other measures are available in Table 12 in the Appendix. A first key result is that the user cost coefficient is somewhat smaller when we control for landlord characteristics. However, the decrease is not significantly different from zero. The results from the baseline analysis are thus robust for the inclusion of these characteristics. The second key result is that almost none of the characteristics are significantly correlated with rental earnings. Only retired landlords earn significantly less than employed landlords for a property with a similar user cost.

Table 6. Summary statistics of landlord characteristics.

	Full sample of landlords		Regression sample		Excluded observations	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Rental units (#)	1.85	1.88	1.87	1.88	1.9	1.89
Age	54.94	14.06	54.64	14.13	55.41	14.70
	Freq.	(%)	Freq.	(%)	Freq.	(%)
<i>Schooling</i>						
None, primary						
or high school	316	47.66	81	42.63	235	49.68
Higher education	340	51.28	107	56.32	233	49.26
Other	7	1.06	2	1.05	5	1.06
<i>Employment</i>						
Employed	357	54.17	106	56.68	251	53.18
Retired	224	33.99	65	34.76	159	33.69
Unemployed	15	2.28	4	2.14	11	2.33
Other	63	9.56	12	6.42	51	10.81

Note: This table presents summary statistics on the different landlord's characteristics.

Source: Flemish Housing Survey, 2013.

The results in the second column show that this is not the case when we leave the portfolio-average user cost out of the specification. Now, almost all coefficient estimates turn out to be statistically significant. As expected, using the user cost as dependent variable renders a similar set of results in column three. Older landlords and those with a college degree or higher own rental portfolios with on average higher earnings and costs, while landlords who own a greater number of rental properties or are unemployed have portfolios with on average lower costs and earnings. One of the reasons why landlord characteristics are correlated with the user cost is that rental properties are not randomly distributed across landlords but are the outcome of a decision process in which landlord heterogeneity matters. The characteristics of the landlord might thus be correlated with the market value:

$$R_{ij} = \alpha + \beta[P(X_j)](1-d)^m + \dots + \tau_m^p I_i - D_{ij} + \theta'X_i + \varepsilon_{ij}$$

The results in columns four and five of Table 7 suggest that a large part of the variation in

costs that is attributed to some of the characteristics is due to variation in the average value of the rental properties in the portfolio. While owning more units naturally increases the total value of their portfolio, landlords with a larger number of properties seem to invest in cheaper properties which explains the lower average earnings and costs. College educated landlords own on average more expensive rental properties than lower educated landlords, whereas retired landlords own on average cheaper units than employed ones.

Table 7. The rent-user cost relationship and landlord heterogeneity.

	(1)	(2)	(3)	(4)	(5)
	$\bar{R}_i$	$\bar{R}_i$	$\bar{U}_i$	P_i	$\bar{P}_i$
uc{1}	0.90*** (0.04)				
Age	-3.24 (11.11)	33.75* (17.87)	40.94** (19.04)	9.05*** (2.58)	0.79 (0.54)
Number of rental units	-19.01 (18.01)	-109.64*** (38.00)	-100.33*** (33.00)	168.39*** (12.45)	-3.15*** (1.14)
<i>Schooling</i>					
Higher education	198.71 (201.32)	1,637.56*** (342.07)	1,592.72*** (322.19)	434.42*** (60.78)	53.36*** (9.54)
Other	33.44 (355.93)	206.66 (415.13)	191.74 (739.25)	67.17 (70.24)	-41.86*** (13.20)
<i>Employment</i>					
Retired	-758.51** (323.33)	-2,398.18*** (573.94)	-1,815.02*** (533.65)	-487.32*** (102.95)	-50.18*** (15.15)
Unemployed	-150.91 (348.51)	-1,716.58*** (336.45)	-1,733.11*** (584.23)	-58.70 (107.83)	-63.47*** (15.19)
Other	-527.71 (405.96)	-354.44 (720.43)	191.80 (1,058.75)	12.87 (72.69)	37.52 (26.24)
Constant	1,500.94*** (544.34)	5,304.21*** (839.92)	4,210.00*** (907.91)	-589.58*** (140.82)	133.07*** (27.55)
Observations	296	296	296	296	296
Adj. R ²	0.762	0.145	0.127	0.688	0.169

Note: all specifications were estimated with ordinary least squares using the outlier-trimmed sample from the baseline analysis. The market values P_i and $\bar{P}_i$ are converted in 1000's €. The number of rental properties is used as a frequency weight. Robust standard errors in parentheses.

4.5 Placebo test

Even when we control for landlord heterogeneity, rental earnings and annual user costs are strongly related. This finding stands in stark contrast with previous results in the literature. One of the possible explanations is that the use of high quality data at the micro-level really makes a difference in studying this equilibrium relationship. In order to test whether an aggregate user cost measure can easily cloud the relationship at the micro-level, we performed a placebo test in which we replace the portfolio-specific annual user cost by a measure of the average user cost at the district-level. The placebo test mimics the possible failures that are possible when we use an aggregate measure.³⁸ In order to compute this aggregate measure of the user cost, we will replace the different portfolio-specific components by the district-level average using information from the Flemish Housing Survey and the transactions data from Statistics Belgium.

The cost of capital, economic depreciation rate and the expected appreciation did not need to be replaced since these are assumed to be homogeneous across landlords, but the remaining components are adjusted. First of all, the value of the portfolio is replaced by the weighted average transaction price of apartments and common houses at the district-level.³⁹ Secondly, we substituted the expenses on maintenance and repair, and the fees for fire insurance by the average over all portfolios.⁴⁰ Thirdly, we took the district-level average of the cadastral incomes of owner-occupiers in the FHS.⁴¹ The same was done for the marginal tax rate. Based on these numbers we calculated the district-level average immovable withholding tax and rental income taxation.

The results from the regression of portfolio-specific rental earnings on district-level average user costs provide absolutely no evidence of a strong relationship.⁴² On the contrary, almost all user cost coefficients are negative and statistically insignificant. As a result, the intercept estimates are all positive, significantly different from zero and larger than 4,214.74. The results from the placebo test suggest that our findings using the concurrent earnings and costs are not replicable with an aggregate measure.

³⁸ Admittedly, the set-up of the placebo test does not fully reflect the normal process of aggregation. In order to do this we should also have computed a district average of the portfolio-average rental earnings, but this would leave us with a too small number of data points to perform a credible regression analysis.

³⁹ We have also computed average user costs using the value reported by owner-occupiers in the FHS. However, the average value of an owner-occupied property in the FHS data differs from the average value of the landlord's portfolio, whereas the average value-based on the transaction data from Statistics Belgium comes quite close.

⁴⁰ For clarity, we took the average of the ratio of the expenses on maintenance and repairs over the property's market value and multiplied this with the weighted average house price. The ratio is thus not a district-level average.

⁴¹ The sample of landlords in the FHS is too small to get a reliable estimate of the mean cadastral income at the district-level and tenants did not have to report the cadastral income of the dwelling they rented.

⁴² The results are available in Table 14 together with summary statistics in Table 13 in the online appendix.

5 Time series analysis

The results from the micro-level analysis show that rental earnings and user costs are closely related. This finding stands in stark contrast with previous work. The difference is especially large with studies based on aggregated rent and house price indices like those of [Blackley and Follain \(1996\)](#) and [Verbrugge \(2008\)](#). They found that user costs are much more volatile than rents and that both variables diverge from each other over extended periods of time. There are several issues that could explain the difference between the results of these studies and ours. An obvious candidate is data quality, but it could also be due to institutional differences. User costs and market rents may have always been closer related in Belgium than in the U.S., although there is no reason to believe that this is the case given the rent control system. In order to get a hint of what could be the in our results, we need to make our study in some way more comparable to those in the literature. Given that we do not possess a similar data set of American rental properties, we went for the second option which is to replicate their time series analysis for Belgium. In the final part of this paper, we are going to study the long-run relationship of market rents and user costs. We start by constructing a proper series of the user cost, after which we will examine its relationship with the rent index from the CPI.

5.1 Data

To capture the market value of the rental property, we take the weighted house price index that we computed for the estimation of our expected appreciation rates. The required return is the mortgage interest rate. For 1970 to 2003 we use an interest series from the ASLK⁴³, a major financial intermediary in Belgium at the time, and for the period of 2003 to 2013 a series from the Monetary Financial Institutions Interest Rate (MIR) survey of the National Bank of Belgium (NBB). Just like in our micro-analysis, we compute the after-tax cost of capital using a tax rate of 25% and an equity share of 60%. Both are assumed to be constant over time. The rate of depreciation comes from [Harding et al. \(2007\)](#) but we add the average annual expenses on maintenance, repairs and fire insurance from the FHS. The mean ratio of these expenses over the value of the portfolio equals 1.2% and is, together with the rate of depreciation, also assumed to be constant over time. Obviously, we use the same estimates from the micro-level analysis for the expected appreciation rates except

⁴³The 'Algemene Spaar- en Lijfrentekas' (ASLK).

for the forecast from the newspaper since they only started publishing these forecasts from 2011 onwards. The four other measures together with the actual annual nominal growth rate are plotted in Figure 3.

Figure 3. Expected and actual annual house price growth rate (%), 1984(1)-2013(4).

Note: 'eg' stands for expected gain.

Source: Author's calculation using transaction data from Statistics Belgium.

In order to compute the rental earnings taxation and the immovable withholding tax, we need an estimate of the average cadastral income in the CPI rent index sample. However, data with regard to cadastral incomes are not publicly available. We rely on the study of [Mahieu et al. \(2012\)](#) who looked at the relationship between the house prices and cadastral incomes in the 13 biggest Flemish cities using a matched set of transactions of single-family houses and cadastral incomes from 2010.⁴⁴ The authors use the same transactions data from Statistics Belgium as we do to compute the house price index. Contrary to the FHS, these consist of individual transactions of both owner-occupied and rental properties. The average house price in our series equalled 184,227 euro in 2010 and corresponds to

⁴⁴Only available in Dutch.

a cadastral income of about 650 euro. Marginal tax rates are taken from the CEP-OECD institutions dataset for the period of 1984-1999 and the OECD Taxing Wage Statistics from 2000 onwards.⁴⁵ To account for the fact that 43% of the taxpayers who report the cadastral income of their properties make use of the interest deduction, we will restrict the taxable cadastral income to 57% of its original value. The immovable withholding tax rate was computed using the basic regional tariff in Flanders of 2,5% and the average surcharges of the Flemish municipalities and provinces. Lastly, we computed the mortgage capital payment for the long-term savings tax reduction assuming a loan-to-value ratio of 0.8 and we reduced its size to 15% of the original value to account for the low usage of this tax benefit.⁴⁶

To test for cointegration between user cost and rents, we use the rent index from the Belgian CPI which captures the evolution of private market rental prices over time. It started measuring rent in 1984 on a monthly basis from 1984 using a sample of approximately 1.800 properties.⁴⁷ Since Statistics Belgium follows the same sample of rental units over time, the index can be considered as a repeat rent index. However, they sometimes lose observations when the landlord or tenant no longer wants to share the necessary information and occasionally replace old properties with newly constructed dwellings in order to control for improvements in construction quality.⁴⁸ The index equals the average rent of the sample which consists of both new and existing rental contracts and thus reflects the same situation as in the micro data in which we used portfolio rental earnings.

5.2 Results

The main question we want to address in this section, is whether there exists a long-term equilibrium relationship between the rent index and one of the user cost series we constructed. For the formal assessment of the long-run relationship between user costs and rents, we will rely on the concept of cointegration. An $(n \times 1)$ vector series Y_t is cointegrated if each of the series taken individually is nonstationary with a unit root, while some linear combination of the series αY_t is stationary, or $I(0)$, for a nonzero $(n \times 1)$ vector α . If two series are cointegrated in this sense, they are said to share a common trend. The user cost series are plotted in Figure 4 together with the rent index from the CPI. The plot shows that quarterly user costs are all quite volatile in comparison to the steady upward-sloping

⁴⁵See Nickell (2006) for a description of the CEP-OECD dataset. These are annual tax rates which are linearly interpolated to construct quarterly series.

⁴⁶The limits and legislation with regard to the eligible amount have changed a couple times over the sample period, for more details you can contact the authors.

⁴⁷The rental prices are net of utility costs and we converted these series to quarterly averages.

⁴⁸Unfortunately, we do not have specific information on the number of drop-outs from the sample due to non-replies nor regarding the share of replacements to control for quality improvements.

market rent. There is a large difference between $uc\{pi\}$, which fluctuates around the rent index, and the other three measures that are strongly influenced by the steep increase in house prices during the second half of the 2000's.

Figure 4. Rent and user cost indices (base = 1994): Belgium, 1989Q4-2013Q4.

Note: The graph shows the indexes of the unadjusted quarterly user cost measures together with the private rental price index of the CPI.

Source: Author's calculation and Statistics Belgium.

Before we test for a cointegrating relationship, we check whether the different series are integrated of order one. The unit root tests render ambiguous results for the rent index.⁴⁹ Because of the uncertainty with regard to the order of integration of the rent index, we are not able to use the CPI rent in the cointegration analysis. However, the annual user cost is just as often presented relative to the market value of the property.⁵⁰ This adjustment enables us to work with a different metric that reflects the dynamics of market rents,

⁴⁹The Augmented Dickey-Fuller test accepts the null of a unit root in both levels and differences, whereas the Philips-Perron tests rejects the null in both cases. The results from the Kwiatkowski, Philips, Schmidt and Shin stationarity test rejects the null hypothesis for the rent index both in levels and difference. The results from these unit root tests are available upon request.

⁵⁰See for example ? and Poterba and Sinai (2008).

namely the rent-to-price ratio. We transform the rent index following a similar approach as Blackley and Follain (1996) in which the rent-to-price ratio is computed as follows: $r_t = \frac{(CPI_t^r/100)\bar{R}^{FHS}}{P_t^h}$ with CPI_t^r the rent index from the CPI with base year 2013, $\bar{R}^{FHS}$ the average annual nominal rental price reported by the tenants in the FHS and P_t^h the average house price.

Figure 5. Rent-to-price and user cost ratios (%): Belgium, 1989Q4-2013Q4.

Note: The figure plots the series of the rent- and cost-to-price ratios.
Source: Author's calculation and Statistics Belgium.

Figure 5 plots the rent-to-price ratio and our five measures of the user cost relative to the market value. The former has been decreasing steadily over time, from 10% in the mid 80's to about 3% at the last quarter of 2013. The user costs seem to follow a similar trend, but remain more volatile. Again, $uc\{pi\}$ appears to be most closely related to the rent index both in terms of its level and the variation over time. However, note that we did not adjust the series to incorporate the effect of transaction costs. These could shift the user cost series upwards albeit not enough to reach the level of the rent-to-price ratio. Table 8 presents the results from Augmented Dickey-Fuller and Philips-Perron tests. Both accept the null of a

unit root in levels for both the rent-to-price ratio and all user costs except uc{1} and uc{f}. These two user costs are thus excluded from the cointegration analysis.

Table 8. Rent-to-price and user cost ratios: unit root tests.

	x_t			Δx_t		
	ADF	# lags	PP	ADF	# lags	PP
Rent-to-price	0.78	4	0.99	0.01	3	0.00
uc{1}	***		***	***		***
uc{pi}	0.06	2	0.07	0.00	1	0.00
uc{3}	0.31	1	0.33	0.00	3	0.00
uc{f}	0.46	12	0.48	0.01	3	0.00
	***		***	***		***
	0.01	2	0.02	0.00	9	0.00

Note: The results in this table are Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in levels and differences. The null hypothesis states that the variable has a unit root according to the specific test. Reported numbers are MacKinnon (1994) approximate p-values. The *, ** and *** denote a rejection of the null at the 10%, 5% and 1% level respectively.

The results from the Engle and Granger (1987) procedure and the Johansen (1995) trace test in Table 9 show that the hypothesis of a cointegrating relationship is rejected for most user costs measures. The Johansen trace test rejects the hypothesis of zero cointegrating equations in two cases. However, in both occasions this result is not confirmed by the Engle and Granger procedure. We do not find any evidence of an equilibrium relationship between the rent-to-price ratio and one of the the user cost series. Overall, the results are in line with those from previous empirical studies based on aggregate index data.

Table 9. Cointegration tests of the rent-to-price and user cost ratio.

	EG (AIC)	EG (SBIC)	JH Trace (AIC)		JH Trace (SBIC)	
			rank 0	rank 1	rank 0	rank 1
uc{pi}	-2.295	-	12.4364	1.0710	16.6036	0.6897
uc{3}	-1.402	-0.352	18.0173	0.0148	11.9517	1.8912

Note: This table shows the results from cointegration tests following the procedure of Engle and Granger (1987) (EG) and the Johansen (1995) trace test (JH). The null hypothesis is that of no cointegration between rental earnings and the specific user cost measure.

Before we conclude this section, we need to point out that a casual observation of the times series casts some doubt on the external validity of our results using the micro data:

the user cost ratios in Figure 5 lie very close to the rent-to-price over the period of 2010 to 2013, the time when the Flemish Housing Survey was executed.⁵¹ It raises the question whether the strong relationship between rental earnings and the user cost at the portfolio-level reflects a general result that holds over time. We leave this for future work as only an analysis of panel data over a considerable long time period will be able to provide an answer.

6 Conclusion

The research concerning the fundamentals of rental prices has been very limited in comparison to the attention for the fundamentals of house prices. This is surprising given the fact that in many developed countries more than twenty percent of all households rely on the private rental market for the provision of their housing services. Standard capital investment theory states that, in a frictionless market, the per period rental price will equal the user cost of capital in equilibrium. However, the validity of this theorem rests on the assumption of a perfect competitive rental market which may be unreasonable given the existence of various frictions in the housing market. This could be one of the reasons why there does not exist empirical evidence of a strong one-to-one relationship between rents and user costs. Previous studies presented mixed results whether they were based on aggregate indices or micro data. We make a contribution to the empirical literature by exploiting a brand new data set from the Flemish government in which landlords report detailed information with regard to the earnings and costs of their rental units. These data provide us enough information to analyse the relationship at the micro-level using earnings based on rents at arm's length, the market value of the rental properties and several other user cost components.

Robust regression estimates of portfolio-average rental earnings on portfolio-average user costs reveal a strong relationship between user costs and rents. In some cases, we even find a user cost coefficient which is not significantly different from one together with an intercept estimate which is not significantly different from zero. These estimates can be considered as evidence of the equivalence theorem since they suggest that average rental earnings equal average user costs. Controlling for landlord characteristics does not alter this conclusion. The results from a placebo test in which we replace the portfolio-average user costs by a district-level average suggest that data quality might be an important issue.

⁵¹The difference between the rent-to-price ratio and the smoothed cost ratios is larger than that with the unadjusted ratios, but remember that neither of the series include the additional term to account for transaction costs.

Regressing the portfolio-average rental earnings on the individual user cost components reveals that having both the rental price and the market value of the same property seems to be key in studying this relationship. However, this hypothesis is still questionable since an analysis of the long-run relationship between user costs and rents reveals that they were closely related when the FHS was executed, whereas they deviate from each other during different time periods thereby confirming the findings of some of the previous studies.

We think that there are several interesting avenues for future research. Given that we are still in the stage of settling on the strength of the relationship between user costs and rents over time, the literature would certainly benefit from panel data with similar information as the FHS. Furthermore, variation over time in the different cost components can then be used to estimate the size and speed of the pass-through in rents. The pass-through rate determines different outcomes in housing markets. For example, the degree to which landlords adjust their rental prices to changes in (expected) house price appreciation has at least two important consequences. First of all, the rate at which increases in the expected appreciation of the property's value lead to decreases in its rental price will determine the size of a welfare transfer from landlords to tenants which ultimately depends on the actual realization of these expected gains. Given the appreciation in house prices we experienced during the first half of the 2000's, this welfare transfer can be sizeable. Secondly, a low pass-through rate of expected appreciation rates can fuel or at least support a housing bubble since it renders large and increasing returns to housing investment in expectation. Finally, as we have pointed out in this paper, several specific frictions like transactions costs can prevent the housing market from working efficiently. Further research on how these frictions affect the rent-user cost relationship can help solving important policy questions.

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A Appendix paper

A.1 Imputation of the marginal income tax rates

Landlords were asked to report their net taxable income (NTI). This is the income on the basis of which the tax authorities calculate the income tax a person has to pay. There are two issues we have to deal with before we can use these figures to compute the marginal income tax rates. First of all, the respondents are asked which year this NTI corresponds to. The majority of our sample of landlords that we use in the regression analysis, indicated that this is the NTI from 2012. However, it is very unlikely that the figure is actually the NTI from 2012 because the respondents were also asked to show their notice of assessment or tax bill in order to verify that the actual NTI was reported. Individual taxpayers receive their notice of assessment after they filed their tax form. In Belgium, the deadline for individual taxpayers to file their tax form or tax return is normally the 30th of June in the year following the year in which they earned the income. Given that the Flemish Housing Survey was conducted during the first months of 2013, most respondents will not have filed their tax return let alone received their notice of assessment. So there are two options for those who said the NTI was from 2012: or they did not show the notice of assessment to the interviewer, or they both made the mistake of switching the income year with the tax year. The practice of declaring your income to the tax authorities after the year you earned it, is probably confusing for many of the respondents. That is why many will think they gave their NTI of 2012 whereas in most cases it corresponds to the income they earned in 2011. Therefore we use the tariff-scheme of income year 2011 even if the respondents indicated they gave their income of 2012.

The second issue is that the figure they report is *household* net taxable income. They had to tell whether it is solely the respondent's income or if it is the sum of both the respondent's and his partner's income. In the former case we just use the NTI and directly compute the marginal income tax rate. But when the reported NTI is the total of both partners' income, they did not have to break it down in two which makes it of course difficult to compute the marginal income tax rate of an individual landlord. We had to make some assumptions. First of all, we assumed that the households will minimize their tax bill and thus allocate the tax advantages to the partner with the highest income. Secondly, in order to divide the NTI over both partners we relied on the information with regard to their current work situation to come with some allocation key. We thus computed the marginal income tax rates of all landlords for which net taxable income was reported and we had this work-related information to make an informed guess. However, it was not possible to

do this for the entire sample. Our assumptions with regard to the share of earnings of each partner in the household are available in table 10.

Table 10. Allocation of net taxable income for both partners.

	FT	PT	2 x FT & PT	2 x PT	N
Both partners work.			1/2	2/3	1/2
One partner works and the other:					
A) Stays at home, volunteers or does something else	1	1			
B) Retired or in sick/pregnancy leave	2/3	1/2			
C) Incapacitated or unemployed	2/3	1/2			
None of the partners work:					
One is retired, unemployed or incapacitated and the other stays at home					1
Both are retired, incapacitated, volunteering or something else					1/2
One retired and the other unemployed or incapacitated					2/3

A.2 Data overview

Table 11. Data overview annual user cost.

Variable	Data	Variation	Source
Panel A. Micro-analysis			
R_i	Rental earnings	Cross-sectional	Flemish Housing Survey
P_i	Market value	Cross-sectional	Flemish Housing Survey
d	Share of equity	Fixed	FPS Finance
$i^m \& r$	Mortgage interest rate	Fixed	MFI Interest Rate Survey
δ	Depreciation rate	Fixed	Harding et al. (2007)
$E(\pi^h)$	Expected appreciation	Fixed	Statistics Belgium
M_i	Maintenance	Cross-sectional	Flemish Housing Survey
F_i	Fire insurance	Cross-sectional	Flemish Housing Survey
I_{ij}	Cadastral income	Cross-sectional	Flemish Housing Survey
τ_j^y	Marginal tax rate	Cross-sectional	Flemish Housing Survey
τ_j^p	Property tax rate	Cross-sectional	Flemish Housing Survey
D_j	Long term savings deduction	Cross-sectional	Market value (FHS)
Panel B. Placebo test			
R_i	Rental earnings	Cross-sectional	Flemish Housing Survey
P_i	Average house price	District-level	Statistics Belgium
$i^m \& r$	Mortgage interest rate	Fixed	MFI Interest Rate Survey
δ	Depreciation rate	Fixed	Harding et al. (2007)
$E(\pi^h)$	Expected appreciation	Fixed	Statistics Belgium
M_i	Maintenance	District-level	Flemish Housing Survey
F_i	Fire insurance	District-level	Flemish Housing Survey
I_{ij}	Cadastral income	District-level	Flemish Housing Survey
τ_j^y	Marginal tax rate	District-level	Flemish Housing Survey
τ_j^p	Property tax rate	District-level	Flemish Housing Survey
D_j	Long term savings deduction	District-level	Average house price (SB)
Panel C. Time-series			
R_i	CPI Private rent index	Time	Statistics Belgium
P_i	Average house price index	Time	Statistics Belgium
$i^m \& r$	Mortgage interest rate	Time	ALSK & MFI Survey
d	Share of equity	Fixed	FPS Finance
δ	Depreciation rate	Fixed	Harding et al. (2007)
$E(\pi^h)$	Expected appreciation	Time	Statistics Belgium
M_i	Maintenance	Fixed	Flemish Housing Survey
F_i	Fire insurance	Fixed	Flemish Housing Survey
I_{ij}	Cadastral income	Fixed*	Mahieu et al. (2012)
τ_j^y	Marginal tax rate	Time	OECD
τ_j^p	Property tax rate	Time	Statutory tax rates
D_j	Long term savings deduction	Time	Average house price (SB)

This table gives an overview of the data sources for each individual component of the annual user cost as specified in equation 1. Note that all the components from the Flemish Housing Survey vary across portfolios, whereas the three components from the other data sources are constant across portfolios.

Table 12. The rent-user cost relationship: landlord characteristics.

	(1)	(2)	(3)	(4)	(5)
	uc{1}	uc{pi}	uc{3}	uc{f}	uc{n}
User cost	0.90*** (0.03)	0.81*** (0.03)	0.74*** (0.05)	0.93*** (0.03)	0.74*** (0.03)
Age	-3.24 (11.29)	-3.34 (10.92)	-12.48 (12.13)	-5.15 (11.42)	-4.48 (10.60)
Number of rental units	-19.01 (24.74)	-19.86 (23.95)	-38.46 (28.23)	-17.31 (25.05)	-18.56 (23.28)
Schooling					
Higher education	198.71 (198.24)	179.97 (192.41)	539.04** (221.21)	212.43 (200.79)	145.94 (187.44)
Other	33.44 (1,170.35)	223.45 (1,131.36)	-137.64 (1,340.17)	-11.37 (1,186.49)	333.03 (1,095.80)
Employment					
Retired	-758.51** (326.33)	-699.99** (317.17)	-784.93** (354.16)	-718.73** (330.01)	-732.64** (307.41)
Unemployed	-150.91 (679.08)	-74.10 (656.78)	-650.90 (776.72)	-171.04 (688.35)	-50.91 (636.46)
Other	-527.71 (491.72)	-678.76 (475.52)	344.00 (558.26)	-439.70 (498.06)	-765.28* (460.95)
Constant	1,500.94*** (554.43)	1,418.04*** (536.92)	4,029.13*** (582.54)	1,645.28*** (559.88)	1,472.51*** (521.16)
Observations	294	279	267	265	255
Adjusted R-squared	0.713	0.751	0.739	0.749	0.750

Note: this table presents the results of linear regressions of portfolio-average rental earnings on portfolio-average user cost and landlord characteristics. All specifications were estimated with ordinary least squares using the outlier-trimmed sample from the baseline analysis. The number of rental properties is used as a frequency weight. Robust standard errors in parentheses.