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ABSTRACT

The often used housing price-to-income and housing price-to-rent ratios are problematic in housing market analysis and may result in misleading conclusions. Instead, the no-arbitrage condition of housing market is a theoretically sound basis to evaluate if housing prices are misaligned. Unfortunately, empirical application of the no-arbitrage condition has notable complications. This article reviews these complications and suggests some solutions to them. The use of implied expected appreciation derived from the no-arbitrage condition is recommended. It is also claimed that the real appreciation is better to use than the nominal one in the no-arbitrage computations. Furthermore, the paper shows that the maintenance costs as a fraction of housing price vary substantially in time and location, which may significantly affect the equilibrium housing price level relative to rental prices. An empirical application of the no-arbitrage relation using data from ten Finnish cities shows that housing price level in 2007 was not based on high expected appreciation. This lowers the fears for a price bubble.

JEL Classification: R21

Keywords: Housing, no-arbitrage condition, overpricing, user cost

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1 Introduction

Housing prices have soared in most of the industrialized countries during the last decade. The rapid housing price increase has raised questions about the sustainability of the prevailing housing price levels. Given the important role that housing wealth seems to play on aggregate demand through its impact on construction activity, on household consumption and on the credit market, it is worthwhile to reliably assess the prevailing housing price level in order to better assess the prospects of the economy. Consequently, different institutions and researchers have put a lot of effort to evaluate if housing prices are at an unsustainably high level in a number of countries and cities. Various methodologies from econometric analyses to simple ratios between housing prices and some fundamentals have been employed in the sustainability analyses. Unfortunately, the evaluation of housing price level is anything but an easy task and all of the assessment methodologies have their complications.

The econometric approach enables one to study the dynamics of housing prices, including the response of housing prices to various shocks to the fundamentals, and to conduct a formal statistical analysis. To make reliable conclusions regarding the relationship between housing prices and the fundamentals econometric analysis requires long sample periods. On the other hand, especially due to the significant institutional changes in most countries during the last two or three decades, it is often unrealistic to assume that the relations have remained the same over the long sample period. Furthermore, it is often unclear whether the selected econometric model properly represents the actual process behind housing prices. In particular, it has proven to be hard to take account of the supply side variables in an econometric analysis. Hence, it is complicated to base the evaluation of housing price level on econometric analysis.

Because of their simplicity and appealing intuition to the general public, housing price-to-rent ratio and housing price-to-income ratio have repeatedly been employed e.g. by credit institutions and by the media to justify views concerning the sustainability of existing housing price level. However, there is no reason to expect that the equilibrium price-to-rent and price-to-income ratios are constant over time. Therefore, the use of either of these simple ratios has got considerable problems and may lead to flawed conclusions.

A theoretically sound basis for evaluating if housing prices are misaligned is given by the so-called housing market no-arbitrage condition introduced by Poterba (1984). The no-arbitrage condition states that in equilibrium the user cost of housing should equal rental price level of a similar dwelling. The condition is basically equal to the discounted cash flow model. In addition to its appealing intuition to housing market, the advantage of the no-arbitrage condition is that it takes the future expectations into account by a single expected housing appreciation term. In general, it is easier to predict housing price movements in the relatively near future than to forecast changes in the rental price level far in to the future.

Recently, the no-arbitrage condition has been utilized in a number of studies (e.g. MacCarthy and Peach 2004, Himmelberg et al. 2005, Girouard et al. 2006, Finicelli 2007) to assess if housing prices are misaligned in one or more countries or cities. Unfortunately, the empirical application of the condition involves several complications and all of the above mentioned examinations have their problems. Nevertheless, careful analysis and data selection may enable a more reliable evaluation of housing price level based on the no-arbitrage relation than based on the alternative methods.

This article discusses the complications of utilizing the no-arbitrage condition in an empirical analysis. Moreover, a case study employing the no-arbitrage condition using data from a number of cities in Finland is conducted. In connection with the discussion and the case study some solutions to the presented problems are suggested.

It is proposed that the implied expected future appreciation should be reported when evaluating the prevailing housing price level through the no-arbitrage relation. The paper further suggests that it is more convenient to employ real instead of nominal appreciation rates in the analysis. Moreover, the paper claims that the fraction of maintenance costs of housing prices varies in time and region. To get reliable results, the variation in maintenance costs should be catered for. Furthermore, if the price-to-rent ratio is employed, due to simplicity reasons for instance, the rental price net of maintenance costs should be used instead of the traditionally employed "gross" price-to-rent ratio. In growing regions the gross price-to-rent ratio is likely to overstate current housing price level. It is also noted that the differences in maintenance costs weaken the comparability of the conventional (gross) price-to-rent figures across cities.

According to the empirical case study housing price level was not based on high expected appreciation in Finnish cities in 2007. This finding lowers the fears for a price bubble. In addition, empirical analysis suggests that either the Finnish households' risk premium on owner-occupied housing is substantially greater than the risk premium figures suggested in the previous literature or Finnish households have constantly underestimated the future housing appreciation since the early 1990s. A partial explanation for the constantly smaller user cost than rental cost may also be exhibited by the credit constraints.

Previously, Girouard et al. (2006) have applied the no-arbitrage relation to Finnish data. In line with the results in this paper, the analysis by Girouard et al. implies that in 2005 housing price level was somewhat lower than its fundamental level in Finland. Girouard et al., however, use national level data and the analysis has also got some other complications. Since there may be notable regional differences in the user cost-to-rental cost ratio within a country, it is reasonable to conduct the examination to distinct regional housing markets as in this article.

The outline of the paper is as follows. The next section delineates the price-to-rent and price-to-income ratios in the case areas and ponders the complications of relying on such ratios. In the third section the no-arbitrage condition is presented and complications with its empirical application are discussed. The empirical case study is conducted in section four. In the end, summary and conclusions are drawn.

2 Price-to-income and price-to-rent ratios

The potential misalignment in housing prices is often assessed by simple ratios between housing prices and fundamental variables, such as the price-to-income ratio and the price-to-rent ratio. Figure 1 exhibits the price-to-income ratio (P/Y), i.e. average housing price level per square meter divided by annual disposable income per capita, in ten Finnish cities.[1] Figure 2, in turn, pictures the price-to-rent ratio (P/E), which equals the average housing price level

[1] The income data for HMA are collected from the publications of the City of Helsinki Urban Facts. The income data for the other cities are reported by Statistics Finland. The data regarding housing prices and rents are described in section 3.6 and concerning maintenance costs in section 3.3.

per square meter divided by the average annual rent per square meter. The dotted lines in the Figures show the average level of the ratios during 1985-2007. Note that two different price-to-rent ratios are shown in Figure 2. "Gross P/E" corresponds to the ratio that is typically presented in various reports, i.e. ratio where maintenance costs are not deducted from the rental cash flow. A more justifiable ratio, however, is the ratio between housing prices and rental cash flows net of maintenance costs. This ratio is called "net P/E" here.

In each of the ten cities P/E values have declined from 1985 to 2007 despite the rapid increase in housing prices during the sample[2]. That is, rental prices have grown even faster than asset prices. This is partly due to changes in the rental market regulation in Finland. Lifting in rent ceilings started in the late 1980s and rent regulation was finally released in several stages during 1992-95. During the housing price overshot of the late 1980s, which followed the credit market liberalization, both P/Y and P/E were substantially above their average levels. Then, in the early 1990s, the ratios dropped below their long-run averages. Since then P/Y has climbed up suggesting overvalued housing in HMA and Tampere. In 2007 the average price of one square meter equalled approximately 17% of the average annual disposable income per capita in HMA. Corresponding value in Tampere was 13%.On the contrary, the net price-to-rent ratio was slightly below its long-term average in HMA and close to its average in Tampere. Thus, these two often used measures give different answers to the question on whether housing is overvalued in these two cities. In the other eight cities the price-to-income ratios in 2007, varying from 10% to 12%, closely corresponded to the estimated average, while in most cases the net price-to-rent ratios were below the averages.[3] Note that even though real housing prices have risen by at least 60% in all of the cities from the bottom in 1995 to 2007, in most cases P/Y has increased only slightly. That is, in many cities the income growth has almost equalled housing appreciation since the severe recession in the mid 1990s.

In 2007 the net P/E was at a lower level relative to its long-run average than the gross P/E in each of the cities. This is because the rental price level has increased notably faster than the maintenance costs. That is, the conventionally used gross P/E ratio is likely to overstate the current housing price level relative to fundamentals in growing areas, i.e. areas where rental price growth is relatively rapid. The impact of relative differences between rental prices and maintenance costs is discussed in more detail in section 3.3.

POINT 1: If P/E is used to evaluate housing price level, *net* P/E should be used instead of the conventionally used *gross* P/E, since the maintenance costs and rental prices do not, in general, grow at the same rate.

[2] Nominal price level rose between 105% (Rovaniemi) and 229% (Tampere) over 1985-2007. The real appreciation varied between 20% and 94%.
[3] In the case of Vaasa (1989-2007) and Rovaniemi (1991-2007) the average values of the price-to-rent ratios are based on even shorter sample periods than in the other cases.

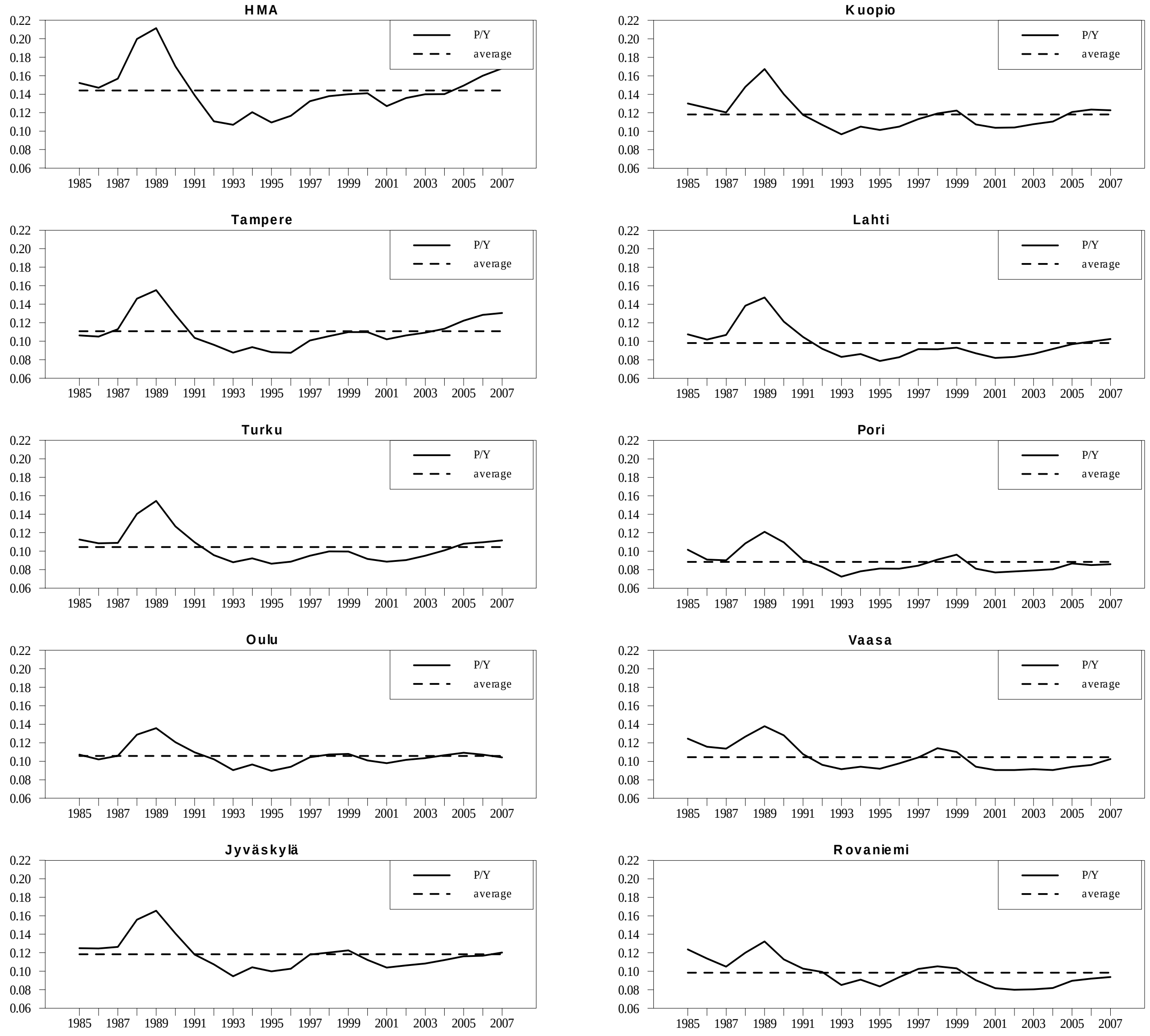

Figure 1 Price-to-income ratios

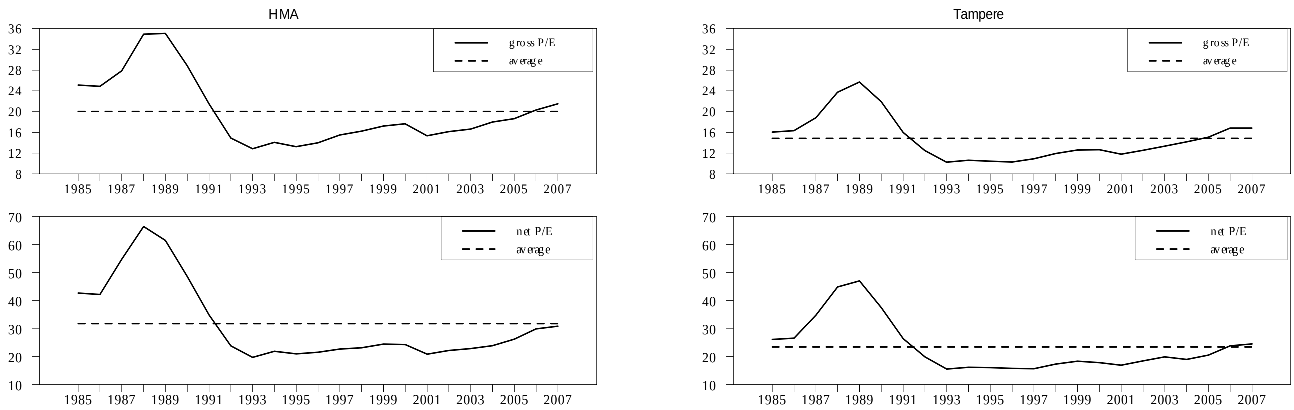

Figure 2 Price-to-rent ratios

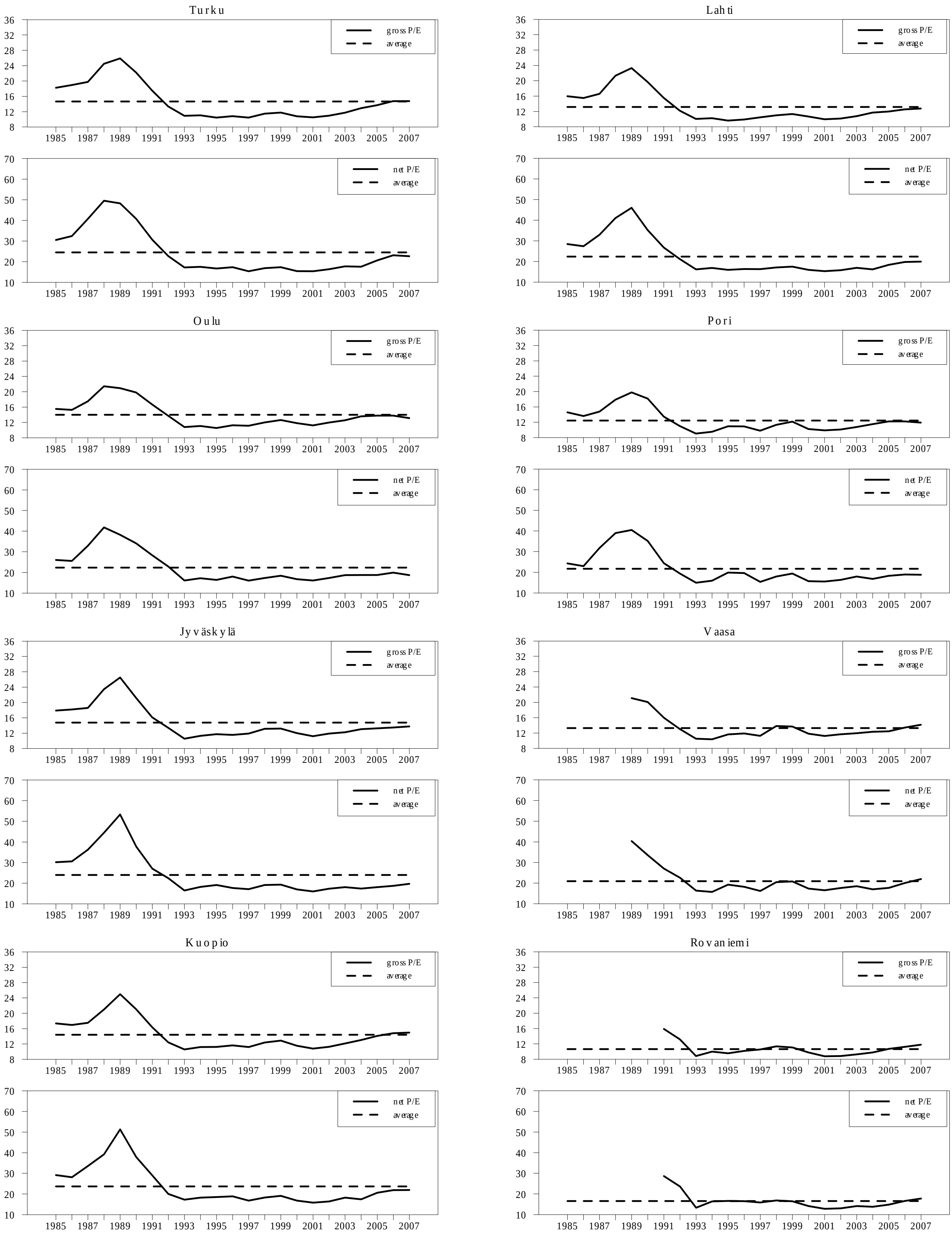

Figure 2 Price-to-rent ratios (continued)

P/Y works as a kind of "affordability index" of housing. However, there is no particular reason to assume that P/Y should be constant over time. In fact, depending on the elasticities of supply of labor and of supply of housing and on the driving forces behind metropolitan growth, P/Y can be decreasing, constant or growing in time (see DiPasquale and Wheaton 1996, 155-165). Furthermore, the institutional changes during the sample period, credit market liberalization in particular, may have influenced the ratio significantly. In addition, Meen (1996) shows that a range of policy shock, changes in the tax regime in particular, is capable of shifting the relationship between housing prices and income. Hence, it is highly problematic to use P/Y to evaluate the prevailing housing price level.

Theoretically, the use of P/E is somewhat more justifiable. There are reasons to assume that housing price and rental price levels are tightly linked. For investors rent represents the incoming cash flow from the housing investment. For owner-occupants, in turn, the rental level exhibits the cost they would face if they did not own the dwelling. In other words, rental price is an implicit positive cash flow for the owner-occupants. However, there are factors, such as the interest rates and expectations concerning income and population growth in the area, which vary over time and across regions and may affect the ratio significantly. Changes in some of these factors are likely to be highly persistent. Therefore, the equilibrium P/E may well alter notably over time and is not likely to be stationary. Indeed, the non-stationarity of neither P/Y nor P/E can be rejected in any of the cities (except for Turku in the P/Y case) according the DF-GLS unit root test (see Table A1 in the Appendix). Naturally, shortness of the sample period may affect the unit root test results somewhat.

Finally, even if P/Y and P/E were constant over the long horizon and even if there had not been significant institutional alterations, it would be problematic to compare current ratios to the averages during 1985-2007. This is because it is unclear whether the sample represents a "normal" time period, i.e. whether the average ratios during the sample have equalled the long-term equilibrium ratios.

POINT 2: It may be highly misleading to base assessment of prevailing housing price level on the comparison of price-to-income and price-to-rent ratios with their long-term averages.

The price-to-rent ratio has also been utilized to compare the housing price level between different areas. While the net P/E was over 30 in HMA in 2007, the ratio was less than 20 in Pori. Does this necessarily mean that housing prices were higher relative to fundamentals in HMA than in Pori? No it does not. As will be explained in the next section, equilibrium P/E is influenced by factors such as risk premium, expected growth rate and the share of the physical structure of the total housing price level that may substantially differ between cities. Hence, comparison of P/E values between cities does necessarily not tell us anything about potential misalignments in regional housing prices. Some might claim though that the 3.2% net rental yield in HMA is all too low for housing to be correctly priced in the area. It is not that obvious, however: if real housing price level stays constant, the total return on housing in HMA is actually 3.2% in *real* terms. In fact, catering for the average real appreciation rate of 2.7% (which would lead to 6.9% real total return) in the HMA over 1985-2007 the relatively low rental yield does necessarily not sound all that bad.

POINT 3: Comparison of P/E values between different regions cannot, in general, be used to evaluate the "fairness" of housing price level in any of the areas.

3 No-arbitrage condition

A theoretically sound basis for the evaluation of prevailing housing price level is given by the housing market no-arbitrage condition (NAC). The theoretical foundation of NAC lies on the asset market approach of housing markets introduced by Poterba (1984).[4] The no-arbitrage condition states that the user cost of owner-occupied housing (U) should equal the rent (P^R) of a similar dwelling. More specifically:

$$U_t = P_t\,[\sigma_t\,(1 - T^m{}_t)r^m{}_t + (1 - \sigma_t)(1 - T^f{}_t)r^f{}_t + \lambda_t + M_t - i_t] = P^R{}_t, \qquad (1)$$

where M_t denotes the maintenance costs of housing as a fraction of house price and i_t stands for the expected nominal rate of future housing appreciation. M_t includes property taxes and depreciation. Here, depreciation refers to the maintenance and repair costs that are necessary to maintain constant quality of the structure. The rest of the term in the parenthesis expresses the opportunity cost of capital. In general, only a fraction σ of the value of a house is financed by mortgage. The cost of the mortgage capital equals the after-tax mortgage rate, $(1 - T^m)r^m$, where T^m is the tax deductibility of mortgage interest payments in taxation and r^m is the before-tax mortgage rate. The opportunity cost of housing capital is completed by the after-tax risk-free interest rate [$(1 - T^f{}_t)r^f{}_t$,where $T^f{}_t$ is the tax rate for capital income)] on the part of the dwelling financed by equity plus the additional risk premium (λ) to compensate homeowners for the higher risk of owning vs. renting.[5] Note that all the variables in (1) are in nominal terms. An inflation correction is carried out in the model by the inclusion of the expected *nominal* housing appreciation.

NAC can be used to illustrate the main problem with the price-to-rent ratio. From the equivalence condition in (1) we get:

$$P_t/P^R{}_t = 1/[\sigma_t\,(1 - T^m{}_t)r^m{}_t + (1\text{-}\sigma_t)(1 - T^f{}_t)r^f{}_t + \lambda_t + M_t - i_t] = P/E^{\mathrm{eq}}{}_t. \qquad (2)$$

It is evident that the "equilibrium" P/E, denoted by P/E^{eq}, is the larger the lower is the risk-free opportunity cost of capital and the greater is the expected future housing price growth. Furthermore, also the risk premium and maintenance costs of housing affect P/E^{eq}. The discount rate in the parenthesis in (2) cannot, in general, be assumed to be stable over time or stationary. Hence, one cannot make reliable conclusions on whether housing is fairly priced or not solely by comparing the P/E ratio with its long-term average value. Note also that it is clear from (1) and (2) that the sensitivity of housing prices to changes in fundamentals, i.e. in factors that affect the rental price level or variables in the discount factor, is higher when the discount factor is low.

POINT 4: The sensitivity of housing prices to changes in fundamentals is greater in regions where and periods when the discount factor is low.

[4] Poterba (1984) focuses on the price of housing structures only. Nevertheless, the same basic idea should apply (and has often been applied) to housing prices consisting of both the structure and the site.
[5] Englund et al. (1995) incorporate also a term catering for the effect of housing ownership on the wealth tax. In Finland, owner-occupied housing is not taxed in the wealth taxation. Hence, assuming that if the capital was not invested in housing, it would be invested in an investment form that is taxed in the wealth taxation, the wealth tax reduces the user cost of owner-occupied housing (there is an extra tax benefit). However, the rules regarding the wealth tax are complicated in Finland, and it would be highly problematic to try to include a wealth tax benefit term in (1) in an empirical application.

Although NAC is typically used to evaluate housing price level from the point of view of owner-occupied housing, the idea also applies for investment housing. From an owner-occupant's viewpoint the intuition behind NAC is that cost of the same good (housing service) should be equal whether one owns the dwelling or not. From an investor's point of view, in turn, NAC indicates that the expected return on housing equals the required return, i.e. there are no arbitrage opportunities. If expected return was higher than the required rate, investors would bid up prices back to the equilibrium.

Unlike in the owner-occupant case, the capital gains tax is imposed on the rental returns (net of maintenance costs and interest payments on the loan that is borrowed to buy the dwelling) in Finland. Moreover, housing appreciation is taxed when a rental dwelling is sold. Hence, because of the tax benefits of owner-occupied housing, housing is worth less for investors than for owner-occupiers if the other variables in (1) are the same for both groups. Therefore, if housing is of equal worth to owner-occupants and portfolio investors, the required return set by investors has to be lower or the future expectations more positive than those of the owner-occupants. The return required by a portfolio investor may be relatively small due to the greater diversification benefits gained by having multiple dwellings (and possibly also other assets) in a portfolio. In addition, investors may be less risk-averse than households and may have lower interest costs on debt. Furthermore, professional skills and scale economies of a large investor may lower the maintenance costs. On the other hand, turnover of tenants induces costs and vacancy of the rental dwellings. There are also other factors due to which the maintenance costs faced by landlords may deviate from those faced by owner-occupants (see Henderson and Ioannides 1983, Linneman 1985, Harding et al. 2000 and Englund 2003). Anyhow, as most of the privately financed dwellings are owner-occupied in Finland, the owner-occupants' view is taken in the forthcoming analysis.

Unfortunately, there are several complications with the empirical application of NAC. First of all, due to the high transaction costs and low liquidity of housing as well as due to households' liquidity constraints, in reality, there can be slight divergence from the presented relation even if the market participants are fully rational. In particular, if households are tightly credit constrained, user cost may be lower than the rental cost for sustainable periods.[6] If credit constraints are not significant, instead, the relation should hold in the long run. The transaction costs are far from straightforward to take account.[7] Therefore, transaction costs are usually ignored in the empirical analyses employing NAC as well as in the forthcoming analysis in this paper. A related problem is the measurement of an appropriate investment horizon. After all, due to the transaction costs and relatively low liquidity of housing it is reasonable to assume that, in general, the planned investment horizon of housing is relatively long. As DiPasquale and Wheaton (1994, p. 4) state, "*The expected price term refers to current or next period price inflation only if there are no transaction costs to altering housing consumption. When transaction costs impede mobility, the price term must consider planned holding periods*".

Secondly, the measurement of risk premium and of expected appreciation is difficult. Specifically, how should one estimate these two variables and are these variables constant through time? Also the measurement of the other variables may include some difficulties. The problems are similar to the other methods to assess housing prices and, as in any empirical

[6] Meen (1990) adds a shadow price of the rationing constraint in the user cost formula to cater for the credit constraints. Unfortunately such a shadow price measure is not available in most countries, including Finland.
[7] Transaction costs include brokerage fees, taxes, paperwork, information gathering as well as the financial and psychological costs of moving.

analysis, incorrect measurement of the variables may give rise to misleading conclusions. Nevertheless, careful analysis and data selection enables one to make relatively reliable evaluation based on NAC on whether housing is fairly priced.

Notice also that the discount factor may differ between households. In the empirical analysis below the attractiveness of owner-occupation is assessed from the viewpoint of both existing owner-occupants and of potential first-time home-buyers that are living in rental housing. In practice, the separation is of importance only concerning the values of σ and T^m. The debt-to-value ratio is, in general, substantially greater for the first-time buyers than for the households that already are owner-occupants. T^m, in turn, has been slightly higher for first-time buyers who buy a home for their own use than for the other owner-occupants since 1993. A great number of the existing owner-occupants can utilize the higher T, however, because they have taken their outstanding mortgages to buy their first home. In any case, it is worthwhile to analyse the potential first-time buyers' view separately, since Ortalo-Magné and Rady (2006) show that the importance of first-time buyers on housing market dynamics is likely to be particularly important, at least in the relatively short horizon.

Despite the complications, the relation between the user cost and rental prices has been utilized in a number of papers studying housing price dynamics or examining the fairness of housing prices. Below, complications regarding the empirical application of NAC are discussed and past empirical studies are reviewed. Furthermore, some potential solutions to the exhibited problems are suggested. At the same time the data employed in the empirical case study are delineated. The empirical analysis is presented in section 4. First, however, the relationship between NAC and the conventional Gordon growth model is discussed.

3.1 Relationship between no-arbitrage condition and Gordon growth model

The no-arbitrage condition is tightly related to the present value condition, i.e. to the fact that in an efficient market the price of a house must equal the present discounted value of its future net service (cash) flows. The two relations just present the same idea somewhat differently. There is a clear equivalence between the conventional Gordon growth model and NAC. The Gordon growth model is presented as

$$P = C/(r\text{-}g), \quad (3)$$

where C is the first period cash flow from the asset, r is the required rate of return and g is the expected growth rate of the cash flows. From (2) it is easy to see that in the no-arbitrage relation C equals P^R, r is $\sigma_t (1 - T_t)r^m_t + (1\text{-}\sigma_t)(1 - T^f_t)r^f_t + \lambda_t + M_t$ and i stands for g. Alternatively, M can be excluded from r and deducted straight from P^R. While in the conventional Gordon model it is the rental growth rate that matters, in NAC the growth expectations are catered for by the expected next period housing appreciation. In the long-run, of course, housing price growth and rental price growth are expected to be tightly related.

The Gordon model assumes r and g to be constant over time. Since maintenance costs do not generally grow at the same rate as the rental prices do, the assumption of constant g is problematic. As already stated, in a growing metro area rental prices are expected to grow faster than maintenance costs (this is further discussed in section 3.3). It is easy to show that this would induce the growth rate of net rental cash flow to decrease over time. This might weaken the applicability of the Gordon model to the housing market. Nevertheless, with reasonable rental price and maintenance cost growth rates and with realistic cost-to-rent ratios the change in the growth rate of net cash flows is negligible.

In the end, it is a matter of taste whether a researcher likes to approach the problem of assessing housing price level by applying NAC or the conventional present value relation. Both approaches have the same kind of complications and both are likely to yield relatively reliable conclusions if the analysis is conducted carefully. The advantage of NAC is in its intuitive appeal to housing market questions.

3.2 Expected appreciation

Typically, simple, often somewhat arbitrary assumption concerning the expected appreciation is used in the literature. Poterba (1992) and Girouard et al. (2006) assume that expected housing price increase equals the expected rate of overall inflation. Poterba approximates the expected inflation as the arithmetic average and Girouard et al. as the moving average of the inflation rate in the five preceding years. Englund et al. (1995), in turn, employ the average annual housing appreciation during the 1980s, while Finicelli (2007) proxies the expected capital gain as the sum of long-term inflation expectations and historical growth in real rents. Himmelberg et al. (2005), who include also a forward-looking component by adding the spread between long- and short-term interest rates in the user cost formula, use the average real growth rate of housing prices from 1940 to 2000 as a proxy for expected real appreciation. Furthermore, Smith and Smith (2006) use the same arbitrary expected appreciation values (in the base case 3%) for a number of different areas in the US, even though the actual expectations are likely to substantially differ between different regions.[8] DiPasquale and Wheaton (1994), instead, calculate, what they call, rational expectations. Even these "rational" expectations are based solely on historic values of the fundamental variables.

The measurement of the expected appreciation is of major importance, since different methodologies can lead to different conclusion about the extent of misalignment in housing prices. Obviously, the use of the purely backward-looking expectations utilized in several papers may induce misleading conclusions. Past housing appreciation or overall inflation do necessarily not represent well the rational expectations. For example, if housing prices have risen rapidly during the past few years and are currently notably above the fundamental level, backward-looking expectations based on relatively short history imply fast housing inflation also in the future. On the contrary, rational agents should take the prevailing overpricing into account. That is, rational agents would cater for the adjustment of housing prices towards the fundamental level and, therefore, the forward-looking expectations would predict a substantially lower appreciation figure.

Nevertheless, because it is extremely difficult to correctly evaluate the rational expectations at a given point of time and because based on the empirical literature expectations appear to be, to some extent, backward-looking in the housing market, it is understandable that mainly backward-looking expectations have been employed in the user cost literature. In particular, the longer the horizon is, the harder it is to predict the development of the price level. The expected appreciation figure caters for the expectations concerning income and population growth (and thereby rental growth) in the area as well as for expected interest rate

[8] Smith and Smith use the present value approach in their analysis.

movements. Therefore, assuming that the expectations are not notably different from the historical population and (real) income growth and that nothing radical is expected to happen in the real interest rate level, it is reasonable to employ the average appreciation during a long period in the past.[9] If historical averages are utilized, i should be based on the average *real, not nominal*, appreciation. This is because inflation figures typically were substantially higher in the past than today. Nevertheless, a number of studies employ the average nominal appreciation figure.

POINT 5: If a historical average housing price growth rate is used to estimate the expected appreciation, the real, instead of nominal, growth rate should be used.

In the analysis below, three different appreciation assumptions are employed: the first two assume a constant expected real appreciation at zero and at the average rate during 1987-2007[10], whereas the third model presumes "perfect foresight" The perfect foresight model assumes that households have perfectly foreseen the changes in the housing prices at a one year horizon.

Another option is not to set any more or less arbitrary expected appreciation value but to calculate the "implied" expected appreciation, i.e. the magnitude of i at which the user cost equals rental price level. If the implied growth rate is very high, there are concerns about overly optimistic expectations and thereby about overpricing of housing. On the contrary, low implied appreciation would suggest that the housing price level is not based on high expectations and, therefore, the risk of notable overpricing is relatively small. By using the implied expected appreciation it is also easy to see what happens if one of the variables in the discount factor is altered. For instance, if an agent thinks that the risk premium for housing should be one percentage point higher than used in the calculations, the agent can just add one percentage point to the presented implied appreciation figure to find the situation based on his own views. Similarly, one can easily get answers to questions such as "what if interest rate was higher" by employing the implied appreciation rate. The fact that the ratio between user cost and rental cost is quite sensitive to variation in factors such as the level of maintenance costs, risk premium and interest rate makes the use of implied expected appreciation worthwhile. Finally, one can compare housing price predictions with the reported implied appreciation to evaluate the prevailing housing price level.

POINT 6: It is reasonable to report the "implied" expected appreciation when assessing housing prices by the no-arbitrage condition.

3.3 Maintenance costs

The maintenance costs are typically assumed to be a constant fraction of housing prices. In Poterba (1991), Englund et al. (1995) and Finicelli (2007) M equals 4%, 5.5% and 4%, respectively, whereas Girouard et al. (2006) set $M+\lambda$ to a constant 4%. Furthermore, even though M is likely to vary substantially between different areas, Himmelberg et al. (2005) assume that M equals 2.5% in all the cities included in their analysis.

[9] "Long" period refers to a time span of preferably several decades, or at least a period which includes several economic cycles. The use of an average appreciation that is based on a couple of preceding years only may cause significant problems, as discussed above.

[10] The average growth rates are calculated based on the hedonic price indices provided by statistics Finland.

Generally it is not reasonable to assume that the maintenance costs are a constant share of the value of housing. Typically, in a growing metropolitan area the appreciation of land accounts for a significant part of the housing price growth. As it is, in general, only the structure that depreciates, it is likely that *M* decreases in the long run in a growing metro area. That is, the evolution of *M* alone can cause the gross P/E to trend upwards in to long run. Furthermore, it is expected that in cities with higher housing prices, i.e. higher value of land, *M* is smaller than in the regions with lower housing price level. In other words, other things being equal, the gross P/E is expected to be larger in bigger cities. Malpezzi (1999) finds this to be true in the US market.

In this study, proxy for *M* is calculated as the average per square meter maintenance costs[11] of privately financed flats reported by Statistics Finland divided by the average sales price of privately financed flats in the same year. Except for the HMA, there are no statistics at the city level. Hence, the reported values for the corresponding greater geographical area are used for the other nine cities. Major part of flats in each of the greater regions is located in the case cities, which limits this data problem. The maintenance costs are reported annually. Hence, departing from the previous literature, *M* is allowed to vary in time.

Expectedly, *M* varies substantially over time and between the cities in Finland. The smallest figure is 1.2% in HMA in the peak of the price overshot in 1989, while the largest *M* is 4.4% in Rovaniemi in 1995. In 2007 *M* was smaller in all the cities than the average during 1989-2007, varying from 1.4% in HMA to 2.9% in Rovaniemi. This is not surprising, since housing prices have grown fast during the last decade while construction costs have increased only slightly, i.e. the share of land value of the total price of housing has notably increased (see Oikarinen and Peltola 2006 for the HMA case). In general, *M* is smaller in larger cities, i.e. cities with higher housing prices, as expected.

POINT 7: The fraction of maintenance costs of housing prices varies over time and between regions. This should be taken account of in the calculations to get reliable results. Furthermore, the differences in maintenance costs weaken the comparability of the conventional (gross) P/E figures between cities.

3.4 Risk-free opportunity cost of capital

In the literature, usually the after-tax mortgage interest rate is assumed to equal the risk-free opportunity cost of capital tied in owner-occupied housing (see e.g. Poterba 1991, Englund et al. 1995, McCarthy and Peach 2004, Girouard et al. 2006). At the same time the ratio of the mortgage debt to the value of the owner-occupied house is assumed to be 100%. An exception is the analysis by Himmelberg et al (2005), where the risk-free opportunity cost of capital is measured as the ten-year US Treasury rate. Himmelberg et al. use the mortgage rate only to calculate the tax benefit. Also they employ a 100% debt-to-value ratio, however.

In reality, the debt-to-value ratio of most owner-occupiers is substantially below one. Even the first-time home-buyers usually need a down-payment. If the risk-free interest rate equals the mortgage rate and is taxed at a rate equal to the deduction rate of mortgage interest payments, the assumption regarding the debt-to-value ratio does not matter. However, if $r^m \neq r^f$ or $T^m \neq T^f$ the assumed debt-to-value ratio is of significance. In general, banks include a risk

[11] The figures include the repairs needed to maintain constant quality.

premium to their lending rates. Hence, it is reasonable to assume that in most periods $r^m > r^f$ at least in Finland, where the interest rate of most housing loans is fixed only for 12 months at a time. Therefore, in the Finnish case the use of a 100% ratio is likely to exaggerate the user cost somewhat, since after 1992 T^f has equaled or been close to T^m. The distortion is emphasized if the housing price level is evaluated from the viewpoint of the households that already are owner-occupants. In Finland, for instance, the average mortgage-to-value ratio was approximately 24% in 2007.[12] In the first-time home-buyer case, in turn, a 90% ratio is employed in this study.

Another problem is whether to use the average interest rate on the new mortgage withdrawals or on the whole outstanding mortgage stock. Evidently, in the calculations concerning potential first-time buyers it is sensible to use the rate on new withdrawals. Concerning the owner-occupants, on the contrary, the average rate is a more prominent stand point. Anyhow, the spread between the two rates is, in general, only slight. The spread (new contracts minus old stock) was quite large, from .71% to 1.71% during 1989-1992, however. In 2007 the spread was only .01%. Due to a change in tax rules in 1993, T^m is set to equal the average marginal income tax rate prior to 1993 and the capital income tax rate or 30% (first-time buyers) from 1993 onwards. Furthermore, it is assumed that the deduction ceiling is not binding in either of the groups. In the Finnish case T^f equals T^m with the exception of the 30% rate for the first-time buyers. Finally, the 12 month euribor is used as the risk-free interest rate.

3.5 Risk premium

Also the risk premium is assumed to be constant in the empirical applications. Flamin and Yamashita (2002), Himmelberg et al. (2005) and Finicelli (2007) assume a risk premium of 2%. Poterba (1991), instead, uses a 4% risk premium, while Englund et al. (1995), McCarthy and Peach (2004) and Quigley and Raphael (2004) do not include a separate risk premium at all. Himmelberg et al. claim that even the 2% risk premium may be overly high. Indeed, there are some factors that may decrease λ. Firstly, households might derive extra utility from owning a house (e.g. ability to customize the interior or pride of ownership). Secondly, also renters confront uncertainty. Typically, tenants can expect to have to move more frequently than owner-occupants, and the future development of rental prices is uncertain. In fact, owner-occupation may work as a hedge against the risk of unanticipated future rental price movements (see Sinai and Souleles 2005). On the other hand, for a typical household renting enables better diversification of investment portfolio. Note also that the risk premium should be the greater the higher the debt-to-value ratio is, since the use of leverage increases the volatility of return on equity.

The assumption of constant risk premium may involve similar problem to the constant M. Himmelberg et al. (2005) note that the risk premium is likely to be larger in cities with high housing prices. The rationale behind this is that in cities with high housing prices the value of developed land is generally high relative to the construction costs. As the value of land is, in general, substantially more volatile than the construction costs (see e.g. Somerville 1999, Davis and Heathcote 2005, Oikarinen and Peltola 2006), housing prices are likely to be more volatile in cities with high housing (i.e. land) prices.

[12] Unfortunately, there is no sufficient data to estimate the loan-to-value ratio for the cities separately. Hence, the national annual time series is employed in the calculations. The housing loan stock statistics are reported by the Bank of Finland.

The higher volatility in larger cities can be rationalized also through the NAC framework. Other things being equal, smaller M leads to smaller discount factor and thereby to a greater sensitivity of housing price to changes in fundamentals. Therefore, since in a growing metro area the sensitivity of housing prices with respect to fundamentals is likely to increase over time, the risk premium may trend upwards in time. On the other hand, in many cases the riskiness of larger cities is diminished by the typically wider economic base compared to smaller cities: risk related to growth of different industries is likely to be better diversified in larger cities. Hence, the increasing trend in the risk premium may be offset if the industrial mix of the city widens as the city grows.

Anyhow, a perfect model would allow the risk premium to vary over time. Because it is extremely difficult to estimate time-varying risk premium reliably, a constant risk premium is assumed also in this study. However, due to the rental market liberalization, λ is assumed to be greater prior to 1993 than currently. Following Flamin and Yamashita (2002), in the owner-occupant case the post 1992 λ is set to 2%, whereas the pre 1993 λ equals 3%. As the risk premium is likely to be the larger the greater the debt-to-value ratio is, the corresponding risk premiums for the potential buyers are 2.5% and 3.5%, respectively.

Obviously, the risk premiums employed in this study as well as in the previous literature are somewhat arbitrary. During 1987-2007 the return on Finnish housing over the 12 month euribor was on average 1.9% per annum. This is in line with the suggestion of 2% risk premium by Flamin and Yamashita (2002) and implies that the risk premiums employed in this study are of reasonable magnitude.

Anyhow, as the implied expected appreciation rates are reported in the empirical analysis below, it is easy to adjust the results for different risk premium assumptions. One only needs to add the increase or decrease in λ to the reported implied appreciation value. The same, naturally, applies if one thinks that the risk premium should vary between the cities. This is one of the advantages of calculating and reporting the implied expected appreciation rate.

3.6 Comparing user cost with rental cost

Due to the high transaction costs and low liquidity of housing as well as because of the liquidity constraints faced by households, user costs may diverge somewhat from rental prices even if the market participants are fully rational. A large divergence, however, would imply an existence of housing price misalignment, assuming that the employed data is sufficiently reliable and the presumptions are realistic. In other words, the no-arbitrage relation implies that if the user cost-to-rent ratio, i.e. the annual user cost divided by the annual rental payments, is substantially above (below) one, housing is overvalued (undervalued). In reality, the exact actual ratio cannot be observed and the analysis has to be based on best possible approximations.

In some cases a direct comparison between user cost and rental cost is not possible. For instance, Himmelberg et al. (2005) compare the user cost-to-rent ratio with its long-term (25 years) average, since their data does not allow for direct comparison. Given that in the long run U should equal P^R, it may be reasonable to assume that the long-run average, indeed, shows the equilibrium. However, if there are price bubbles or institutional changes during the sample period, the estimated long-run average may be distorted. In particular, changes in credit availability in the form of credit market deregulation and other innovations in the credit market affect credit constraints and thereby may cause a structural change in the user cost-to-rent ratio. Thus, if possible, user cost should be directly compared to rental cost to make reliable conclusions.

POINT 8: Comparison of the estimated user cost-to-rental cost ratio to its historical average may result in misleading conclusions. Hence, direct comparison between the costs should be made if possible.

In the literature, the considered investment horizon usually is one year. A year is a considerably shorter period than the typical holding period of housing. However, the one-year horizon does not mean that the house will necessarily be sold after a year. It is merely the planning horizon employed in the calculations. The relatively short horizon makes the calculations simple.

One potential shortcoming with an analysis employing NAC is the comparability of the housing price and rental price series. In general, the sales price data are based on different dwellings from the rental price data. In this study, the rental price series represent the average rent per square meter in privately financed rental dwellings.[13] For consistency, also the housing price data utilized is non-quality adjusted. The price data does not separate between owner-occupied and rental units. The problem is that the general quality of rental housing may be lower than the average quality of housing transacted in the market. Because of this, the perceived user cost-to-rent ratio may exceed the actual one and housing may appear to be more expensive than it actually is. Moreover, the rental price series represent the whole privately financed stock of rental dwellings, not only flats in multi-storey buildings as the price data does. This should not matter significantly, however, since most of the privately financed rental dwellings are flats in multi-storey buildings in all the cities included in the examination. This differs from the US case, where owner-occupied units are mostly of the single-family, detached unit type, whereas most of the rental units are in multiple-unit buildings as noted by Glaeser and Gyourko (2007). Also the other differences between owner-occupied and rental housing, such as the quality of the neighborhood, are substantially smaller in Finland than in the US, which makes the use of NAC more reliable. Furthermore, the use of price data on only flats, together with the use of per square meter prices, dampens the potential variation in the quality, size and other characteristics between rental and owner-occupied dwellings.

In this paper, another potential source of slight divergence of the estimated user cost from the actual one comes from the maintenance costs. Since the employed maintenance cost figures represent larger areas around the cities (except in the case of HMA), they may not perfectly correspond to the actual values. Anyhow, the employed figures are the best approximations available and it is not likely that the possible inaccuracies in the estimation of M notably affect the reported results.

One problem in some of the papers presented here (e.g. in DiPasquale and Wheaton 1994, McCarthy and Peach 2004 and Girouard et al. 2006) is the use of national level data. It is highly likely that at least some of the variables in the discount factor substantially vary between different regions and cities within a country. This is why this study conducts the analysis at a city level.

[13] Both rental price and housing price data are published by Statistics Finland.

4 User cost vs. rental cost in Finnish cities

In the basic form, the no-arbitrage relation includes only nominal variables. To be able to utilize the constant real appreciation assumptions, the following formula, which includes the expected inflation rate and expected real housing price growth separately is employed to estimate the user costs:

$$U_t = P_t\,[\sigma_t\,(1 - T^m{}_t)r^m{}_t + (1 - \sigma_t)(1 - T^f{}_t)r^f{}_t + \lambda_t + M_t - \pi_t - I_t] = P^R{}_t. \quad (4)$$

In (4), π refers to inflation rate and I denotes for expected real housing appreciation. It is assumed that the households expect the overall inflation rate, measured by the change in the cost of living index, to equal the inflation rate during the preceding year. In the perfect foresight case, however, the households are assumed to have a perfect foresight also regarding future inflation. Following the previous literature, the considered investment horizon is one year in the forthcoming analysis. In the Finnish case this makes sense also because the interest rate on housing loans is typically fixed only for one year at a time. Hence the assumption of constant mortgage rate at a one year horizon is reasonable.

Keeping in mind the complications and assumptions discussed above, the user cost-to-rental cost ratios are pictured in Figures 3 and 4. The curves cover 1989-2007, since the data on the mortgage rates are not available prior to June 1989. In equilibrium the ratio should equal one, which is indicated by the straight dash line in the graphs.

Even at the zero real appreciation expectation there appear to be notable overvaluation in none of the cities. On the contrary, if real housing price level is expected to stay constant, owner-occupation seems highly attractive compared to living in a rental dwelling in all the cities except in HMA. At the average appreciation rate of the past 20 years owner-occupation seems attractive even in HMA.

In practice, the perfect foresight assumption (Figure 4) is highly unrealistic, but its role is to show the user cost-to-rental cost ratios that have actually materialized. The message told by this model is that since 1993 the user cost of owner-occupied flats has been extremely low, in HMA and Tampere even negative on average. This implies that, on average, households have highly underestimated the future housing price growth rate after 1993. Another explanation would be that the risk premium for housing is substantially greater in Finland than suggested in the literature. This explanation, however, would require unreasonably large risk premiums implying that the divergence between materialized user cost and rental cost has been, to a significant extent, due to higher than expected appreciation rates. One further factor affecting the divergence may be the credit constraints faced by households. The credit constraints have eased during the last decade which may have contributed to the convergence of the ratio towards one.

Even since 1989, a period when housing prices were at an exceptionally high level due to the price overshot that followed the financial market liberalization, owner-occupation has been profitable on average in each of the cities. Even if the time value of money is taken into account using a 9% discount rate[14], i.e. even if the influence of the low user costs in the later periods is diminished notably, one would have been better of being an owner-occupant

[14] Approximately equal to the average risk-free interest rate during the sample plus the risk premium of 2%.

compared to living in a rental dwelling, with the exception of HMA. This is, of course, assuming that the underlying assumptions and employed data are adequate.

Notice that the non-stationarity of the user-cost-to-rent ratios over 1989-2007 cannot be rejected when employing the constant expected appreciation assumption (see Table A2 in the Appendix). With only 18 usable observations and a housing price overshot as well as a deep recession during the sample period, it is not surprising that the unit root tests cannot reject. With longer sample period the existence of unit root in the ratios might be rejected. It has to be noted, however, that due to the loosening in credit constraints there may have been a gradual structural change in the user cost-to-rent ratios. Anyhow, all the unit root test statistics concerning the user-cost-to-rent ratios are closer to the critical values than the statistics regarding P/E or P/Y series if the same sample period is employed. The values reported in Table A2 cannot be compared to those reported in Table A1 because the sample periods differ.

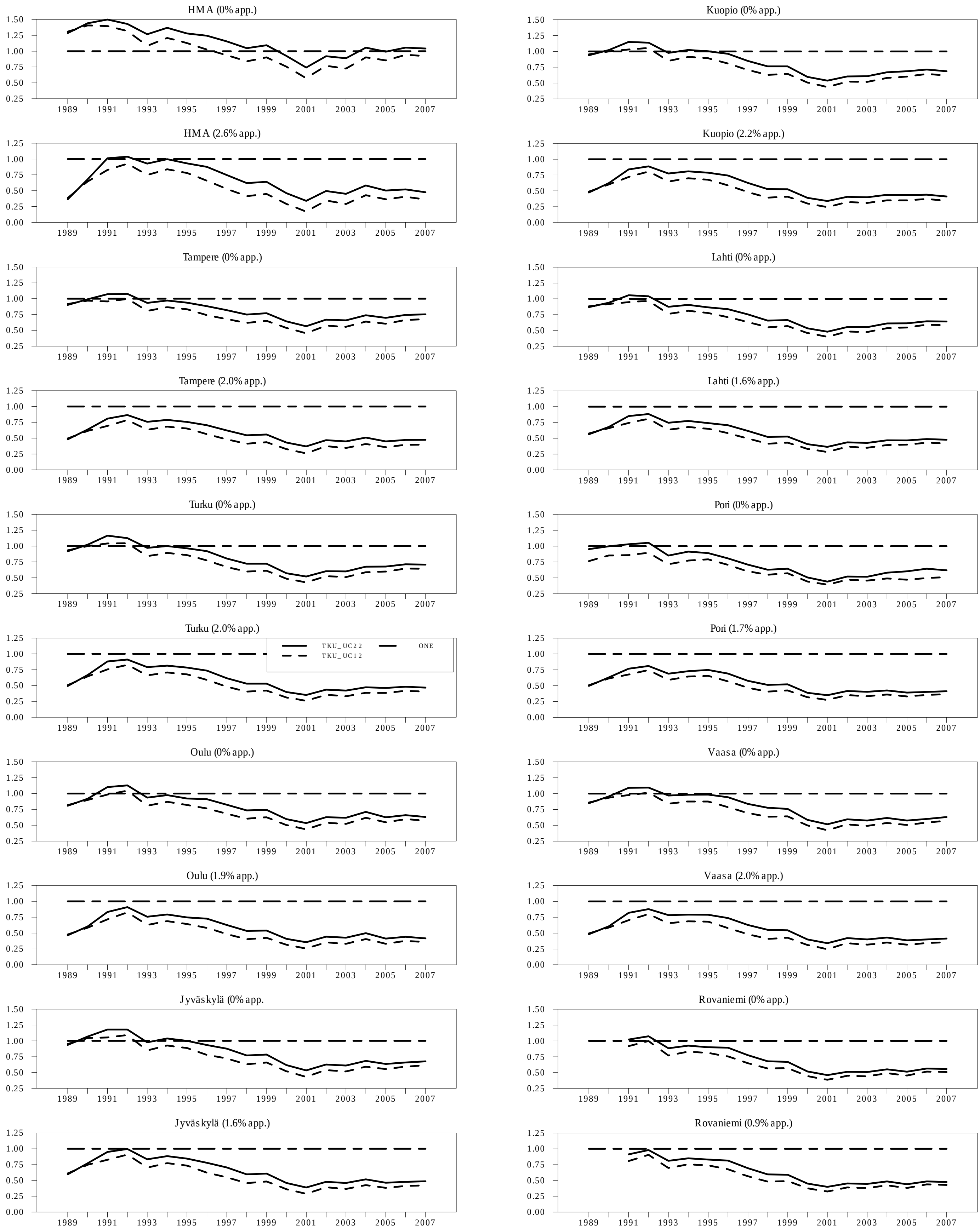

Figure 3 User cost-to-rent ratios in 1989-2007 in the first-time buyer (continuous curve) and owner-occupant (dashed curve) case based on the constant real appreciation assumptions

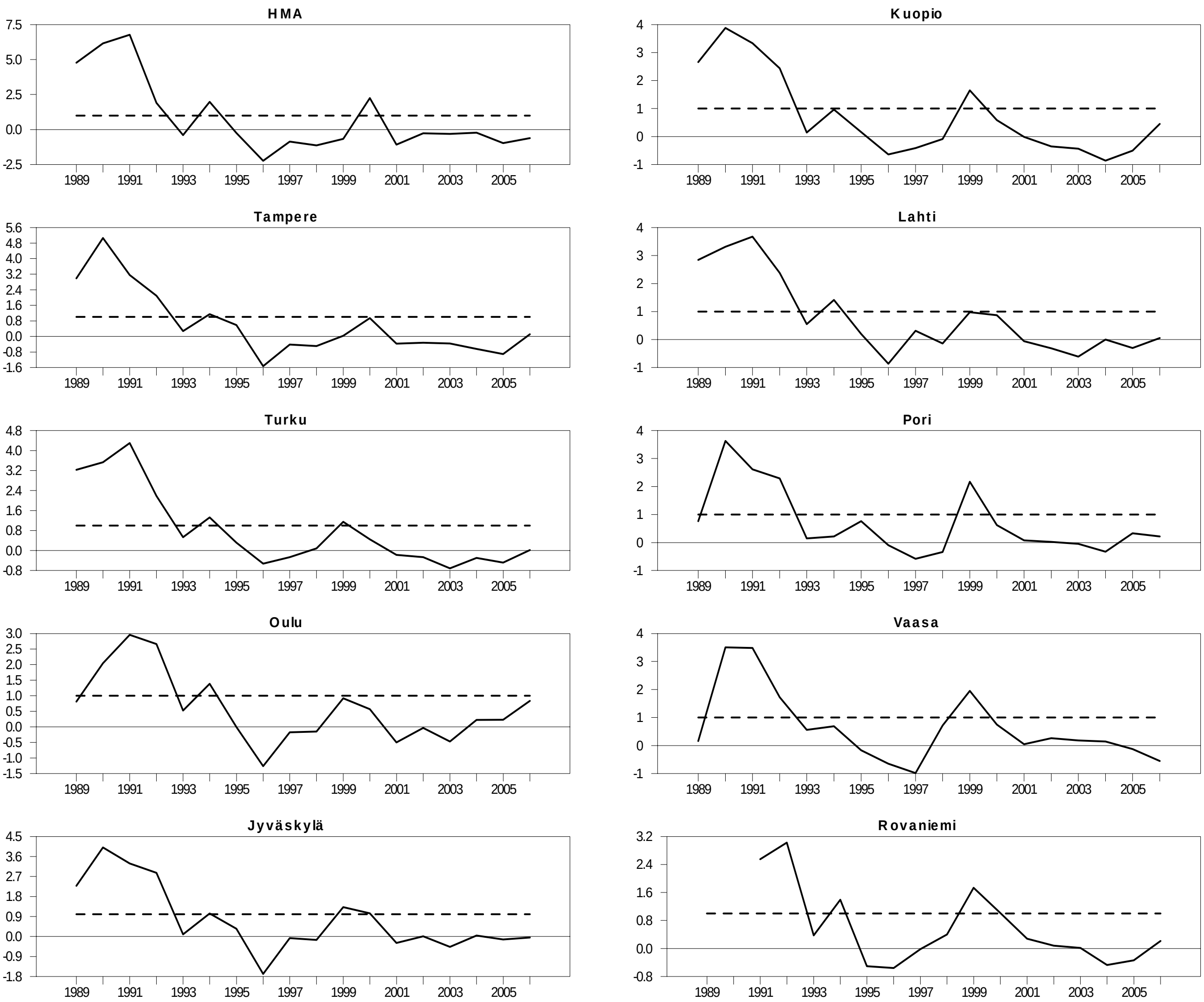

Figure 4 User cost-to-rent ratios in 1989-2006 based on the perfect foresight assumption

As discussed above it is often unrealistic to assume that the expected housing appreciation is constant through time. Therefore, the constant expected appreciation assumption may lead to somewhat misleading conclusions. The perfect foresight assumption in turn, cannot be used to assess current housing prices since future appreciation is not yet known. Furthermore, while the perfect foresight model is clearly forward-looking, it is unrealistic and may lead to false views concerning past housing prices.

Therefore, Figure 5 pictures the expected real annual appreciation implied by the model (i.e. the value of I_t with which U_t=$P^R{}_t$). The calculations indicate that the price level in 2007 was not based on expectations of rapid future appreciation. As already indicated by Figure 3, in all the cities except for HMA the real appreciation expectation implied by the model is negative. Even in HMA constant real prices are enough to justify the price level in 2007. In other words, without changes in the real housing price level owner-occupation appears to be attractive relative to living in rental housing, in general.

The fact that housing price level is not based on high expected appreciation attenuates fears for a notable overpricing of housing. Obviously, the implied appreciation curves do not support the existence of a bubble in the market. One sign for a housing price bubble would be if prevailing housing prices were founded on overly optimistic expectations regarding future price growth. It has to be noted, however, that potential changes in the supply side might put downwards pressure on housing prices even though NAC implies that downwards correction is not needed. Other variables being constant, greater housing supply would lead to lower prices and rents in the housing market.

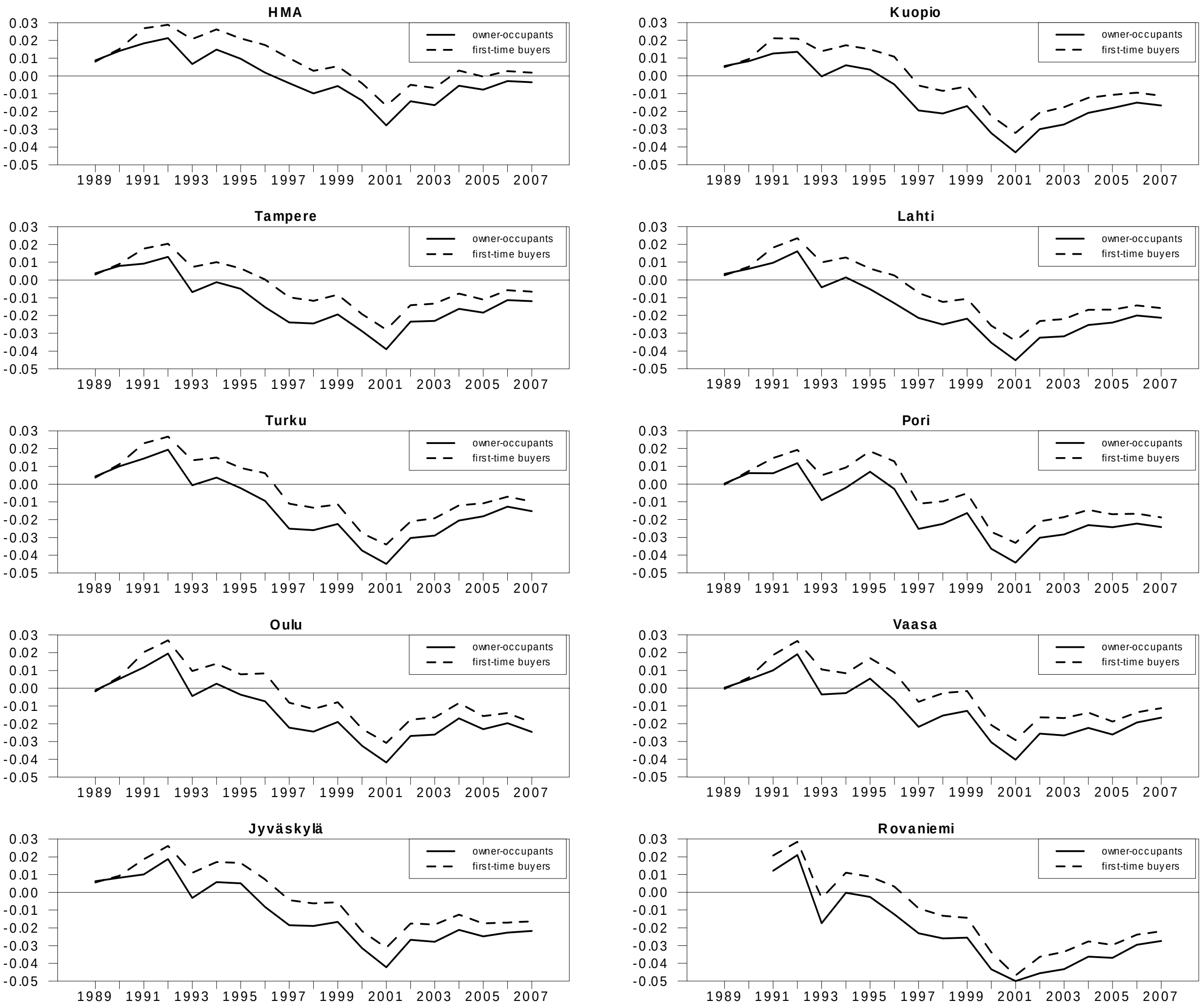

Figure 5 Expected appreciation implied by the no-arbitrage relation in 1989-2007

Surprisingly, the computations suggest that even during the peak of the price overshot in 1989 the price level did not necessitate huge real appreciation expectations. This may imply that the risk premium is actually somewhat larger in the Finnish case than assumed in the analysis. As explained above, one can easily see the implied appreciation expectation assuming higher risk premiums by just adding the extra premium to the implied appreciation rates. Note, however, that a significant factor contributing to the relatively low implied appreciation figures in the turn of the decade was the high value of T^m and T^f. The average marginal income tax rate was almost 53% in 1989. In 1993 the tax rules were altered and T^m and T^f dropped to 25%. It is likely that the high deductibility rates prior to 1993, together with relatively high inflation and nominal interest rates, fortified the housing price overshot in the late 1980s as the availability of credit increased remarkably.

Note also that, due to the tax benefit, in the current environment a percentage point increase in the nominal interest rate and inflation leads to a .28 or .30 %-point decline in the implied expected appreciation in the owner occupants' and first-time buyers' case, respectively.[15] On the contrary, one %-point rise in the real interest rate causes a .72 or .70 increase in the implied appreciation rate.

The first-time buyers' curves have been at a higher level than the owner-occupants' curves after 1991, since the mortgage rate on new contracts became permanently greater than the risk-free interest rate in 1991. In most cases the implied appreciation was relatively high still after housing prices had dropped substantially in the early 1990s. The figures started to notably decline in the mid 1990s. This was due to the rapid growth of rental prices, decline in *M* and decreasing interest rates. Owing to the considerably faster growth of housing prices than rental prices, there has been an upward trend in the curves since 2001.

There does not appear to be notable correlation between the implied expected appreciation values and the next period actual housing price growth. In fact, correlation between the implied and actual rates is negative over the whole sample. This, however, is due to the boom-bust period during the first few years.

Table 1 presents information regarding the computed user costs and rental costs.

Table 1 Details of annual user costs and rental costs over 1989-2007 (% of housing price level)

	Avg. actual user cost (owner-occupants)	Avg. user cost (0% exp. real app., first-time buyers)	User cost in 2007 (0% exp. real app.)	Average rental cost	Rental cost in 2007
HMA	2.7%	6.6%	4.8%	5.8%	4.6%
Tampere	3.2%	7.3%	5.3%	7.6%	5.9%
Turku	4.5%	7.6%	5.8%	7.9%	6.8%
Oulu	3.8%	7.4%	5.7%	7.8%	7.6%
Lahti	5.1%	8.0%	6.2%	8.6%	7.8%
Kuopio	4.1%	7.5%	5.6%	7.7%	6.7%
Jyväskylä	4.3%	7.3%	5.6%	7.6%	7.3%
Pori	5.1%	8.2%	6.5%	8.8%	8.4%
Vaasa	4.2%	7.5%	5.8%	7.8%	7.0%
Rovaniemi	4.1%	8.3%	6.3%	9.6%	8.5%

With constant expected appreciation across cities the user cost (as a percentage of housing prices) in 2007 is the lowest in HMA. This follows from the fact that in HMA, where housing price level is by far the highest of the cities, *M* is the smallest whereas the other factors determining user cost-% are the same in all the cities. Despite the lowest user cost-%, the user cost-to-rental price ratio was the greatest in HMA in 2007 assuming zero real appreciation. This is because of the substantially higher price-to-rent ratio in HMA than in the other Finnish cities.

The average actual user costs (perfect foresight model) over 1989-2007 vary between 2.7% (in HMA) and 5.1% (in Lahti and Pori) while the average rental costs are notably larger, from 5.8% (HMA) to 9.6% (Rovaniemi). Since the user cost is just the inverse of the perceived P/E value, zero real appreciation expectation justifies gross P/E value of 21 in HMA. In Pori the

[15] In 2007 the capital income tax rate was 28%, while the deduction rate for first-time buyers was 30%.

corresponding figure is 15. If the average long-run appreciation rates were employed as expected price growth rates, the model would rationalize as high gross P/E value as 43 in HMA. Even the lowest P/E figure would be 20 (in Rovaniemi). In general, the larger and faster growing the city is, the smaller the user cost and rental cost percentages are. This is in line with the prior expectations and with empirical result by Himmelberg et al. (2005) from the US.

Correlation between the materialized user cost-% and rental cost-% over time is negative and highly significant in all the cities. This is unsurprising, since in the beginning of the sample price level dropped from the overly high level resulting high user costs while the high price level compared to rental prices, naturally, caused low rent-to-price ratios. Similarly, when prices started to gradually rise in the late 1990s after the recession, user costs became small whereas rental cost-% was high due to the housing price overreaction downwards during the early 1990s.

5 Summary and conclusions

The often used housing price-to-income and housing price-to-rent ratios are problematic in housing market analysis and may result in misleading conclusions. Instead, a theoretically sound basis for evaluating if housing prices are misaligned is given by the housing market no-arbitrage condition. Unfortunately, the empirical application of the no-arbitrage condition has notable complications. This article reviews these complications and previous empirical literature that has employed the condition. Furthermore, some solutions to the complications are suggested.

The paper recommends the calculation of implied expected appreciation derived from the no-arbitrage condition. By reporting the implied expected housing price growth, i.e. the appreciation rate at which user cost equals rental cost, a researcher makes it easy for a reader to adjust the results to diverging assumptions from those employed in the analysis. In the computations the real appreciation rate is better to use than the nominal one. During times of high inflation large implied expected nominal appreciation does not necessarily mean high current price level but high implied real appreciation does at a much greater probability.

The paper also claims that the maintenance costs as a fraction of housing price level vary substantially in time and location. The maintenance cost fraction is expected to be greater in larger cities and, most importantly, downward trending in a growing metro area. Hence, to make reliable conclusions the constant maintenance cost assumption should not be used when comparing the user cost between regions or when studying the evolution of user costs over time.

Moreover, if the price-to-rent ratio is used, for instance for simplicity reasons, to assess housing price level, the rental cash flow net of maintenance costs should be employed. This is because, in general, maintenance costs do not grow at the same rate as rental prices do. In particular, in a growing metro area rental prices are expected to grow faster than maintenance costs and thereby the equilibrium price-to-rent (gross) ratio is likely to trend upwards. It is also clear that, in general, the price-to-rent ratio cannot be utilized to compare housing price “fairness” across cities.

The empirical application of the no-arbitrage relation using data from ten Finnish cities shows that housing price level was not based on high expected appreciation in 2007. In fact, in most of the cities even a 1%-3% negative real appreciation at one year horizon can justify the price level in 2007. The findings are in line with the calculations of Girouard et al. (2006) concerning the whole of Finland during 1995-2004.

The fact that housing price level is not based on high expected appreciation attenuates fears for notable overpricing of housing. One sign for a housing price bubble would be if prevailing housing prices were founded on overly optimistic expectations regarding future price growth. Nevertheless, potential changes in the supply side might put downward pressure on housing prices even though the no-arbitrage condition implies that downward correction is not needed. Other variables being constant, greater housing supply would lead to lower prices and rents in the housing market.

Anyhow, it appears that the rapid housing price growth since the mid 1990s has been, at least to a large extent, adjustment of housing prices towards the no-arbitrage relation. Housing prices dropped to an overly low level compared with rental prices during the deep recession in the mid 1990s. The notable loosening in the credit constraints during the last ten years has facilitated the ability of housing price level to move towards the no-arbitrage condition.

The analysis proposes that the high deductibility rates of mortgage interest payments in taxation prior to 1993, together with relatively high inflation and nominal interest rates, fortified the housing price overshot in the late 1980s as the availability of credit increased remarkably. After 1992, in turn, the user cost of owner-occupied housing has been extremely low on average. This suggests that households have highly underestimated the future housing price growth rate since the early 1990s. Another explanation would be that the risk premium for housing is substantially greater in Finland than suggested in the literature. This explanation, however, would require unreasonably large risk premiums. One further factor affecting the divergence between user costs and rental cost may have been the credit constraints faced by households.

Finally, there have been some demands for the exclusion of deductibility of interest payments on housing loans in taxation in Finland. If the deductibility would have been abolished in 2007, the estimated equilibrium housing prices would have decreased by some 20% (assuming zero real appreciation expectation and not taking account of any supply response and thereby rental price response to the price decline). That is, the consequences of such tax rule alteration might be tremendous.

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Appendix

Table A1 DF-GLS unit root test statistics on the P/Y and net P/E series over 1985-2007

City	P/Y	P/E
HMA	-.34 (2)	-1.44 (2)
Tampere	.02 (2)	-1.67* (2)
Turku	-.21 (2)	-2.01* (2)
Oulu	-.25 (0)	-.79 (1)
Lahti	-.-.41 (2)	-1.34 (2)
Kuopio	-.20 (2)	-.87 (2)
Jyväskylä	-.34 (1)	-.95 (1)
Pori	-.42 (2)	-1.51 (2)
Vaasa	-.67 (2)	-1.07 (1)
Rovaniemi	-.97 (0)	-1.64* (0)

Critical value at the 5% and 10% level of significance is 1.95 and 1.60, respectively. The tests do not include any deterministic variables. The number of lags included in the test is reported in the parenthesis. The lag length is based on the general-to-specific method. ** denotes statistical significance at the 5% level and * at the 10% level.

Table A2 DF-GLS unit root test statistics on the user cost-to-rent ratios employing the constant expected appreciation and perfect foresight assumptions over 1989-2007

City	Constant app.	Perfect foresight
HMA	-1.52 (1)	-2.21** (0)
Tampere	-1.43 (1)	-1.99** (0)
Turku	-1.14 (0)	-2.04** (0)
Oulu	-.88 (0)	-1.70* (0)
Lahti	-1.26 (0)	-1.98** (0)
Kuopio	-1.27 (0)	-1.88* (0)
Jyväskylä	-1.15 (0)	-1.92* (0)
Pori	-1.04 (0)	-2.00** (0)
Vaasa	-1.11 (0)	-4.15** (1)
Rovaniemi	1.66* (0)	-2.70** (0)

Critical value at the 5% and 10% level of significance is 1.95 and 1.60, respectively. The tests do not include any deterministic variables. The number of lags included in the test is reported in the parenthesis. The lag length is based on the general-to-specific method. ** denotes statistical significance at the 5% level and * at the 10% level.

Aboa Centre for Economics (ACE) was founded in 1998 by the departments of economics at the Turku School of Economics, Åbo Akademi University and University of Turku. The aim of the Centre is to coordinate research and education related to economics in the three universities.

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Aboa Centre for Economics (ACE) on Turun kolmen yliopiston vuonna 1998 perustama yhteistyöelin. Sen osapuolet ovat Turun kauppakorkeakoulun kansantaloustieteen oppiaine, Åbo Akademin nationalekonomi-oppiaine ja Turun yliopiston taloustieteen laitos. ACEn toiminta-ajatuksena on koordinoida kansantaloustieteen tutkimusta ja opetusta Turun kolmessa yliopistossa.

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