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House price developments and fundamentals in the United States

by Andrea Finicelli

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House price developments and fundamentals in the United States

Andrea Finicelli*

Abstract

This paper discusses the limitations of the price-income ratio, the price-rent ratio, and of affordability measures as indicators of housing market conditions. For the purpose of assessing whether house prices are misaligned, the most sensible approach is to calculate the user cost of ownership and the implied theoretical ratio of house prices to rents, and compare the latter with the observed ratio. On the basis of this methodology, US house prices appear to have departed from fundamentals since 2004, cumulating an overvaluation of between 25 and 30 per cent by the third quarter of 2006.

JEL classification: R21, R31, G10

Keywords: house prices, affordability, user cost, fundamentals, bubbles

Contents

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1 Introduction

During the last decade, house prices in the United States and in a number of other industrial countries have recorded unusually large increases, both in nominal and real terms. A recent OECD study notes that the duration of the current expansionary phase and its correlation across countries are both unprecedented and that recently, contrary to past experience, the behaviour of house prices appears to have disconnected from the business cycle.[1] Those facts pose a series of questions that are of interest for policy-making purposes. What are the factors underlying the observed acceleration of house prices? Are house prices in line with fundamentals, or have they moved apart somewhat from their economic determinants? How has the recent house price boom affected macroeconomic conditions, and how would the latter change in the event of a reduction — or even just a sharp deceleration — in house prices? How likely is such a correction? These questions are certainly related to each other. Assessing the likelihood of a downturn entails first establishing the fundamental determinants of house price dynamics and, thus, quantifying the extent of misalignment, if any. The macroeconomic implications of changes in house prices and housing wealth, especially with respect to aggregate consumption, could depend largely on whether those changes are perceived to be permanent or transitory. Therefore, any assessment of the sustainability of house prices must start from a recognition of their underlying determinants; the extent of misalignment can then be measured on the basis of some associated metrics. In addition to long-run demand and supply side determinants, such as trends in demographics and construction costs, and emerging restrictions on the use of land for the development of new properties, house prices are related to nominal and/or real interest rates, household incomes, and rents. The latter set of variables capture short as well as long-run house price dynamics and — since deviations from equilibrium are inherently a short-run concept — those fundamentals enter some commonly used measures of house price sustainability or affordability, including the price-income ratio, the price-rent ratio, the affordability index, and the user cost of ownership.

The aim of this paper is two-fold. The first is to discuss the information content of those measures, drawing on the existing literature. The most sensible approach is to calculate the user cost and the implied ratio of house prices to rents, and compare the latter with the observed ratio. Throughout the discussion, I elaborate on the meaning of commonly used affordability indexes, stressing how their interpretation as indicators of housing market conditions is not independent of one crucial feature of the economy, namely the presence of a sizeable fraction of households facing credit constraints.

[1] The rapid growth in house prices has occurred despite the slowdown in the OECD business cycle. See Girouard et al. (2006).

The second goal of the paper is to assess recent developments in the US housing market and infer whether they have moved in line with fundamentals. Calculations of the user cost, to be viewed with caution for reasons that are discussed in the paper, indicate that during the recent boom US house prices moved along an equilibrium path until the end of 2003, but diverged from fundamentals thereafter, accumulating an overvaluation of almost 30 per cent by the third quarter of 2006.

The paper is organized as follows: the next section briefly describes the evolution of house prices and its main determinants (incomes, interest rates, and rents) in the Unites States over the last 30 years; Section 3 reviews and calculates (for the US) the house price-income ratio (3.1) and price-rent ratio (3.2), the affordability index (3.3), and the user cost of capital (3.4). Section 4 concludes.

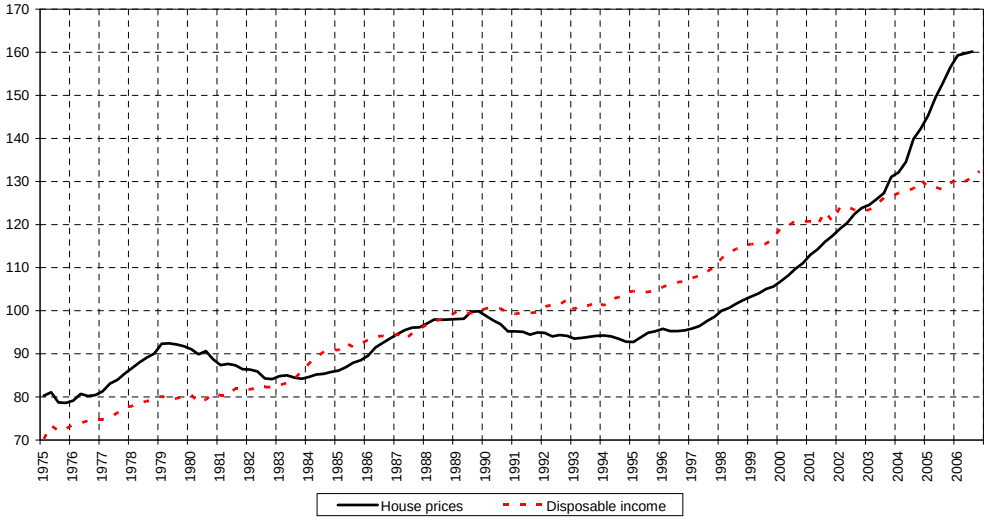
2 House prices and their determinants in the US

Between 1975 and the third quarter of 2006 real house prices in the United States doubled (Figure 1). Between 1975 and 1995 they rose by a cumulative 18 per cent, exhibiting two complete cycles: they rose by 15 per cent in 1975-79, fell by 9 per cent between 1979 and 1983, increased by 18 per cent between 1984 and 1989, and fell by 7 per cent in 1990-95. Since 1996, they have increased by almost 70 per cent, reaching a level almost 70 per cent above their previous (1989) historical peak.

The growth of real per capita personal disposable income between 1975 and 2006 has been much smoother. Real house prices have historically behaved procyclically, somewhat lagging business cycle developments (Figure 2); this empirical regularity, however, appears to have broken towards the end of the latest cycle, a fact highlighted for the US and other OECD countries by Girouard et al. (2006); since the 2001 recession, the deceleration of disposable income has been accompanied by a sharp acceleration of real house prices.

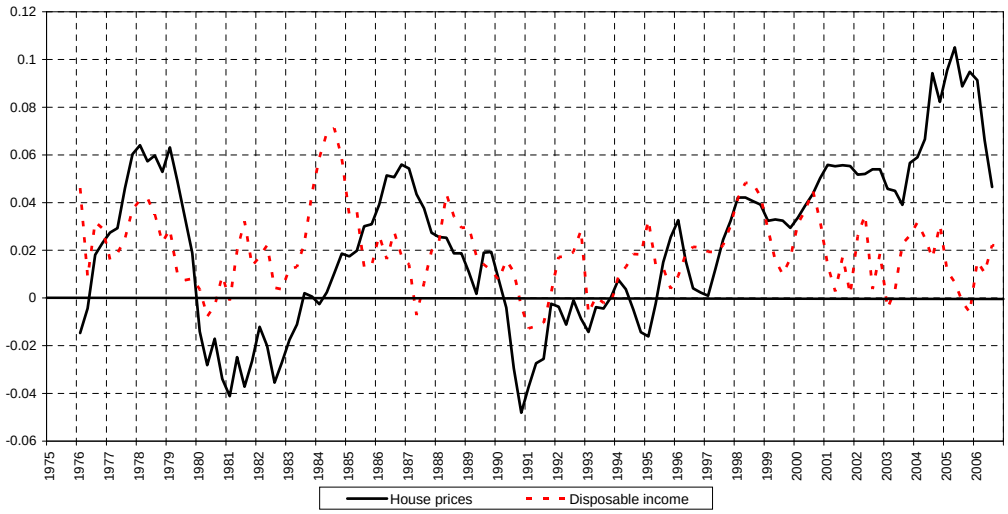
Among the potential determinants of house prices are also the levels of nominal and real interest rates (Figure 3). Nominal mortgage rates increased dramatically between the end of the 1970s and the beginning of the 1980s, from about 9 to 18 per cent, reflecting the increase in actual and expected inflation and the subsequent monetary restriction operated by the Federal Reserve. Since 1982 they have declined, to a historical low of 5.5 per cent at the beginning of 2003; thereafter, they have increased somewhat, but remained at historically low levels. The rise and subsequent fall in real

Figure 1. Real house prices and per-capita disposable income (1)
(quarterly data; indexes: average 1975-2006Q3 = 100)



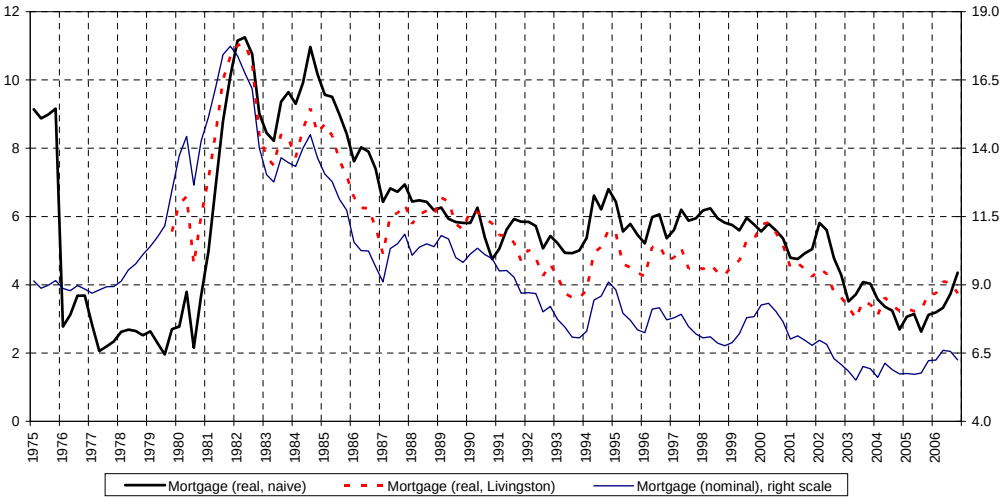
Source: Bureau of Economic Analysis, Federal Reserve, and Office of Federal Housing Enterprise Organization (OFHEO). (1) OFHEO house price index and nominal per capita personal disposable income deflated by the total consumption deflator.

Figure 2. Variations in real house prices and per-capita disposable income (1)
(quarterly data; log changes over 1 year earlier)



Source: Bureau of Economic Analysis, Federal Reserve, and Office of Federal Housing Enterprise Organization (OFHEO). (1) OFHEO house price index and nominal per capita personal disposable income deflated by the total consumption deflator.

Figure 3. Real mortgage interest rates (with naive and survey inflation expectations) (1)
(quarterly data; percentages)



Source: calculations on data from Bureau of Economic Analysis and Federal Reserve. (1) Naive inflation expectations are defined as the current quarter rate of inflation over 1 year earlier; survey 10-year inflation expectations are taken from the Livingston Survey (Federal Reserve Bank of Philadelphia).

interest rates have also been very pronounced, although less than in nominal terms. In particular, real rates calculated on the basis of survey inflation expectations declined from 10 per cent in 1982 to 3 per cent at the beginning of 2003.[2] The concurrent fall in actual and expected inflation accounts for the convergence of nominal to real interest rates. The recent boom in house prices could be partly explained by falling rates in recent years; analogously, the dramatic rise in interest rates could partly account for the housing market weakness in the first half of the 1980s.

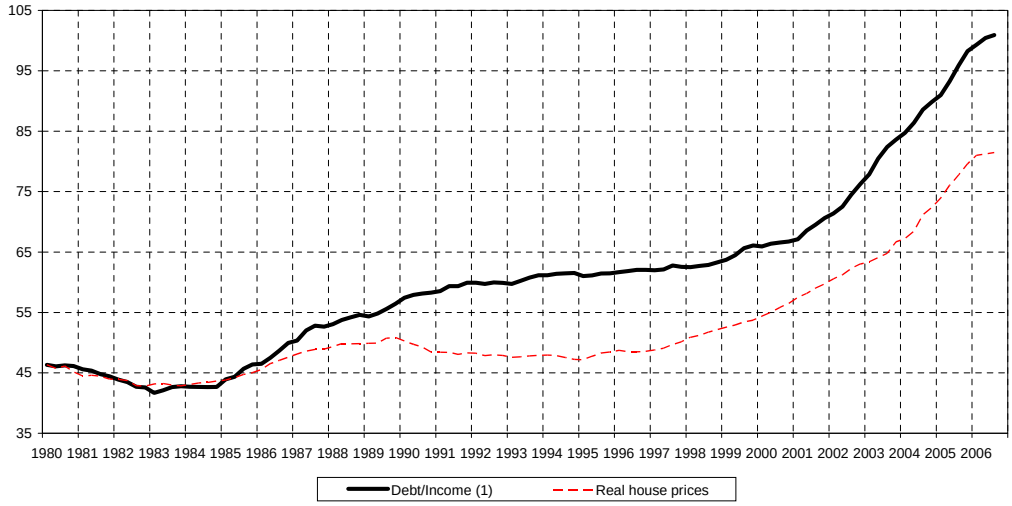
The trend increase in US real house prices over the last 30 years may to some extent reflect the structural changes that have occurred in the mortgage market, making it increasingly easy for households to access housing finance.[3] Since 1983 the ratio of mortgage debt to disposable income has more than doubled, from 42 per cent in to 96 per cent (Figure 4).[4] The view that the evolution of credit market conditions may have been an important determinant of housing market developments is reinforced by evidence of

[2] CPI inflation expectations 10 years ahead are obtained from the Livingston Survey of the Federal Reserve Bank of Philadelphia.

[3] For a thorough discussion of how institutional reforms have transformed the US mortgage market since the Great Depression, see Green and Wachter (2005).

[4] In a recent study, Campbell and Hercovitz (2006) argue that major institutional reforms at the beginning of the 1980s, by easing credit constraints for US households, account for much of the increase in household indebtedness over the last 25 years.

Figure 4. Household mortgage debt and real house prices
(quarterly data)



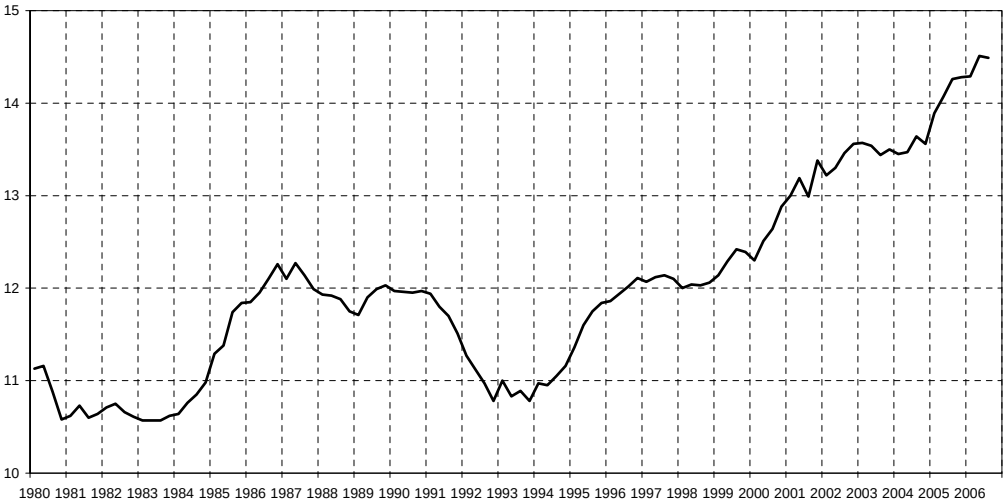
Source: Bureau of Economic Analysis and Federal Reserve. (1) Percentage values; the denominator is the value of disposable income for the year ending in the reference quarter. - (2) The house price index is normalized so that its value in 1980Q1 coincides with the debt-income ratio.

the correlation between real house prices and the debt-income ratio. It is worth noting that thanks to an equally rapid increase in households' financial and real assets, the rise in the ratio of debt to total assets, a measure of leverage, has been much less pronounced than that of the debt-income ratio; also, thanks to declining nominal interest rates, the ratio of debt service to disposable income has remained within a fairly limited range (Figure 5).

Market rents are an important theoretical determinant of tenure choice, and should therefore concur to determine, in general equilibrium, the level of house prices. This is true especially in the long run, when one should expect market forces to prevent house prices diverging from market rents. In the short run, however, persistent deviations are possible due to the illiquid and segmented nature of the housing market. Figure 6 shows the evolution of the rent component of the CPI, "deflated" with the consumption expenditure price index;[5] average rents have tended to increase faster than overall consumer prices, but slower than per capita disposable income. The latter does not imply that the aggregate value of housing consumption (the services provided by housing) has declined relative to income, since the service flow of housing depends on both mean rents and the quantity of housing; rather, the ratio of housing consumption to disposable income has

[5] The series for the rent index, available from the Bureau of Labor Statistics, starts in 1983.

Figure 5. Debt service ratio (1)
(quarterly data; percentages)



Source: Federal Reserve. (1) Ratio of interest and minimum contracted principal payments and disposable income.

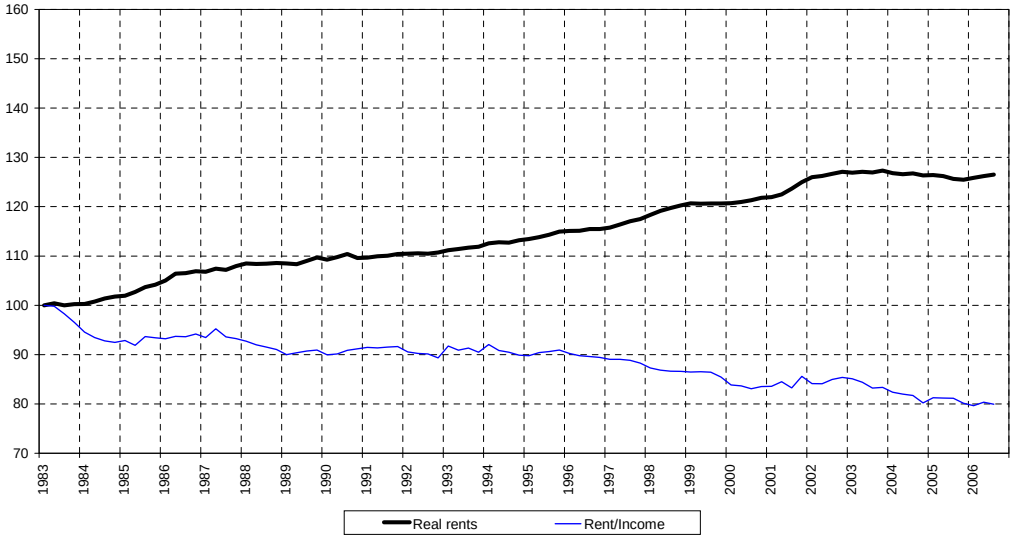
fluctuated within a fairly narrow range, exhibiting a trend — if any — that over has been positive the last 30 years (Figure 7). It should be noted, however, that total consumption has also increased as a fraction of income; the ratio of housing to total consumption, instead, has been rather stable (possibly with the exception of the 1950s) with no evidence of a trend in the last few decades.

3 Measuring house price misalignment

In this section I review and discuss some commonly used metrics for the assessment of house price misalignments, i.e. the price-income ratio, the price-rent ratio, the affordability index, and the user cost of capital, showing for each of them calculations for the United States over the longest available sample. Note that in all cases I only provide an index of the ratio, since the dollar levels of house prices and rents are not available. This implies that house prices can only be assessed by comparing any measure with its own historical average. Results should therefore be viewed with caution, especially considering that the indicators are available for relatively short periods of time, starting in 1975 at the earliest. The core message of this section is that the price-income and price-rent ratios, as well as the affordability index, are not appropriate metrics to infer misalignments. Economically,

Figure 6. Real rents and rent-income ratio

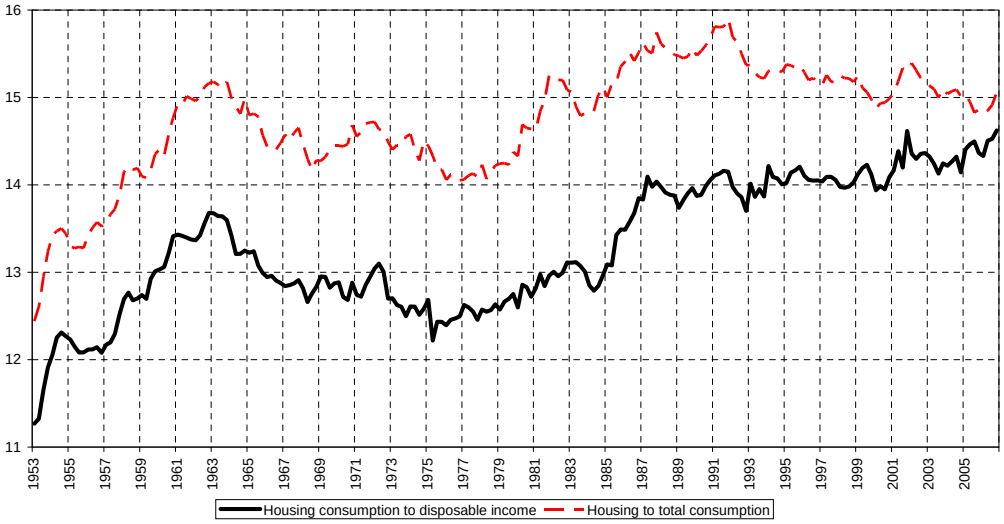
(quarterly data; indexes: 1st quarter 1983 = 100)



Source: Bureau of Economic Analysis, Bureau of Labor Statistics, and Federal Reserve

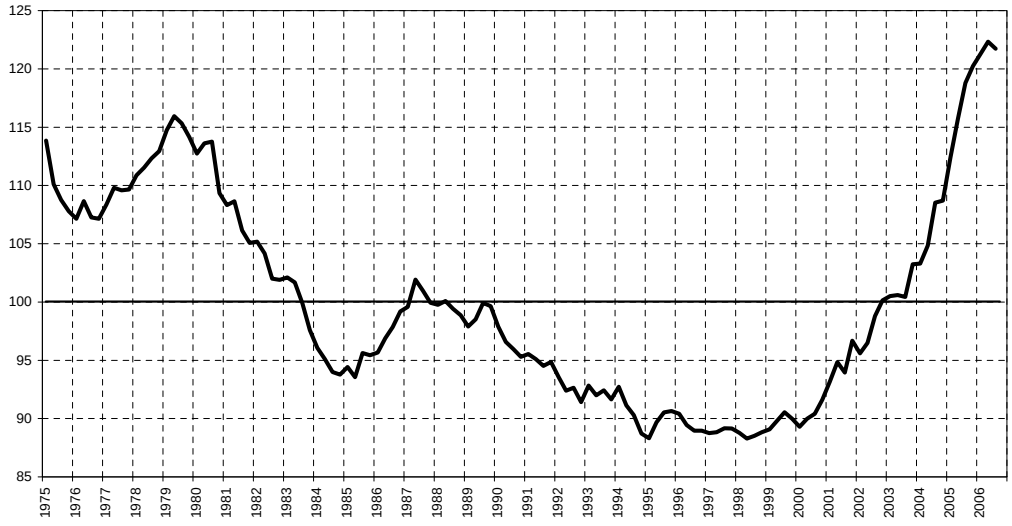
Figure 7. Ratio of housing consumption expenditure to disposable income and to total consumption expenditure

(quarterly data; percentages)



Source: Bureau of Economic Analysis and Federal Reserve.

Figure 8. Ratio between house prices and per capita disposable income
(quarterly data; index: sample average = 100)



Source: calculations on data from Federal Reserve and Office of Federal Housing Enterprise Organization.

the most sensible way to pursue this goal is to calculate the annual cost of ownership, and to compare it to market rents. Measures of the user cost for the United States suggest that in the second half of 2006 house prices were overvalued by about 30 per cent.

3.1 Price-income ratio

One of the measures commonly used to assess whether house prices are "too high" is the ratio of average prices to average per capita income. A high ratio should be taken as indication that the cost of buying a house is high relative to households' ability to pay or, alternatively, that purchasing a house entails devoting a higher share of income. The assumption underlying this approach is that in the long run, house prices and incomes share some common trend.

Figure 8 shows the ratio of average house prices to per capita disposable income for the United States, normalized by its 30-year average. During the 1980s and most of the 1990s the price-income ratio declined. The recent acceleration of house prices has inverted the trend: in 2002 the price-income ratio was back to its historical average, and by the second half of 2006 it had increased to an historical high of 123. Proxying the equilibrium ratio with the sample average would lead to the conclusion that in the third quarter of 2006 house prices were between 20 and 25 per cent "too high".

With respect to the purpose of measuring house price misalignments, the price-income ratio has the merit of linking house prices to an indicator of the ability of households to issue and service debt. However, two major drawbacks are that it in no way accounts for market rents, which measure the value of housing services, and that it does not control for the level of either nominal or real interest rates. A high ratio need not necessarily imply a misalignment, but could be explained by relatively high market rents or low interest rates. In particular, as will be shown in Section 3.3, a measure of the burden of a house purchase — i.e. the share of available resources a household has to give up over its lifetime to purchase a house — is given by the price-income ratio multiplied by the ratio between current and average expected future nominal mortgage interest rates.

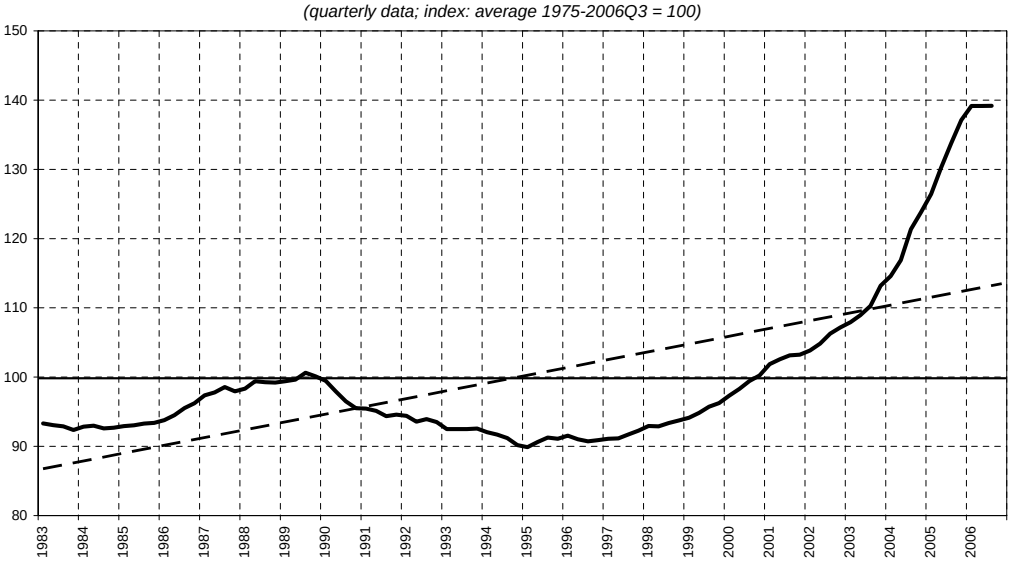
3.2 Price-rent ratio

The easiest way to account for rents is to take the ratio of house prices to an index of rents, which is akin to calculating the price-earnings ratio for stocks. In a frictionless market, any price misalignment relative to rents should be arbitraged away by households optimizing over their tenure choice. An increase in the price-rent ratio could therefore be an indication that owning has become less convenient compared with renting and should be followed by a decrease.

Figure 9 reports the price-rent ratio for the United States over the 1983-2006 period. Contrary to the price-income ratio, there was no declining trend in the price-rent ratio over the 1980s and 1990s; rather, the latter exhibited large swings, mostly reflecting real house price movements, increasing throughout the 1980s, reaching a peak in 1989, and subsequently declining, smoothly, to a low in 1995 that was just 11 per cent below the previous peak. Since the second half of the last decade, the ratio has increased at an accelerating pace; the new peak reached in the third quarter of 2006 was 55 per cent higher than the level in 1995, 40 per cent above the historical average, and almost 30 per cent above a linear trend, which could suggest a large misalignment.

While controlling for the value of housing services, the price-rent ratio, taken at face value, still misses two important elements, namely the opportunity cost of the housing investment (which for simplicity could be proxied by the risk-free long-term interest rate), and the expected capital gain (house appreciation). As in the standard Gordon formula for stocks, the equilibrium ratio of house prices to rents should be derived by equating the return

Figure 9. Ratio of house prices to rents
(quarterly data; index: average 1975-2006Q3 = 100)



Source: calculations on data from Bureau of Labor Statistics and Office of Federal Housing Enterprise Organization.

on the housing investment to that on an alternative risk-free asset:[6]

$$\frac{R_{t+1} + E_t\left(P_{t+1}\right) - P_t}{P_t} = rr_{t+1} + \gamma \tag{1}$$

where R_t is the real level of rents, P_t the real price of the house, rr_{t+1} the real interest rate between t and $t+1$, γ is a constant compensation for the risk of holding real estate assets, and E_t is the expectation operator conditional on information available at time t. Solving (1) forward with respect to P_t yields the following expression:

$$P_t = E_t \sum_{j=1}^{\infty} \frac{R_{t+j}}{(1 + rr_{t+j} + \gamma)^j} \tag{2}$$

which says that P_t should equal the expected present discounted value of future rents. If the real interest rate was constant at rr and real rents grew at the constant rate g, (2) would become:

$$\frac{P_t}{R_t} = \frac{1+g}{rr + \gamma - g} \ . \tag{3}$$

If real interest rates and the growth of real rents are not constant but are at least stationary and not too erratic, then equation (3) provides a good approximation of equation (2). In this case one may expect the price-rent

[6] See Weeken (2004).

ratio to be stationary, and justify an assessment of house price misalignments based on the comparison of the actual and the average ratio. If instead the real interest rate is not stationary, or exhibits sizeable and persistent deviations from its mean, as suggested by the experience of the last thirty years, one should not expect the price-rent ratio to be approximately constant. A correct procedure would therefore be to compare the price-rent ratio not with its historical average, but with the value implied by (2), which is explicitly accomplished by the user cost approach (Section 3.4).

3.3 Affordability index

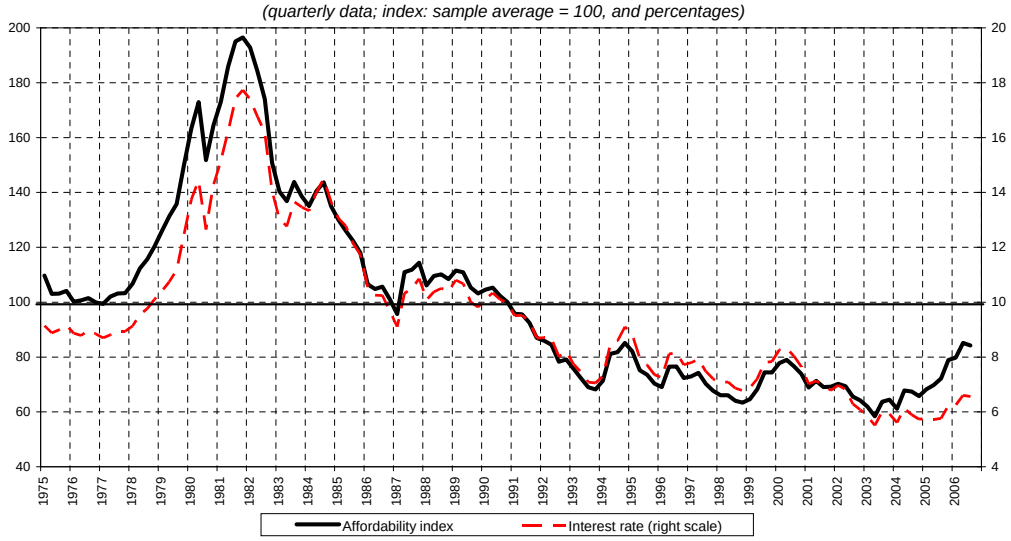
Broadly speaking, housing affordability refers to the "terms on which dwellings can be purchased and loans to purchase can be amortized", and the relationship between those terms and households' incomes.[7] Rough-and-ready indicators of affordability are obtained from some measure of the ability to service the debt that is necessary to purchase it. Here, I consider the ratio between a proxy for the interest service corresponding to the loan that is necessary to purchase an average-priced house and average income.[8] The numerator, obtained by multiplying the fixed interest rate on conventional mortgages (r_t^m) by the average house price (index, P_t), is thus divided by the level of per capita disposable income (Y_t). An increase in the index indicates a fall in affordability, since the burden of payments required to amortize the fixed-rate long-term mortgage needed to buy the representative (average-priced) house has increased relative to average income.[9] In the United States, affordability fell sharply towards the end of the 1970s following the dramatic increase in nominal interest rates not being compensated by higher incomes or lower house prices (Figure 10). Since the beginning of the 1980s, falling nominal interest rates have driven affordability first back

[7] Quigley and Raphael (2004). The authors also note that for low-income and poor households, who are priced out by the market for home-ownership, affordability should instead be defined as the terms for rental contracts, and the relation between those terms and their incomes.

[8] The definition of affordability adopted in this paper is slightly different, somewhat more simplistic than those adopted by US organizations such as the National Association of Realtors (NAR) or the US Department for Housing and Urban Development (HUD), which define affordability as the ratio between the median household income and the income that qualifies for a conventional mortgage on the average house sold; this takes into account the constraints posed by the existence of requirements such as a maximum loan-to-value ratio or a maximum ratio between amortization payments and income.

[9] One should bear in mind that the interest rate is not the only variable defining the terms of mortgage contracts. The latter usually also include a minimum required prepayment and a term by which principal must be repaid, usually associated with a repayment schedule. These conditions also affect affordability: higher prepayment requirements imply that more equity must be built up in order to purchase a house. Longer mortgage durations lower average per-period payments, and make ownership easier to access by households for given income and house prices. Commonly used affordability indexes, including the one discussed in this section, do not account for the features mentioned.

Figure 10. Index of housing affordability and nominal mortgage interest rate
(quarterly data; index: sample average = 100, and percentages)



Source: calculations on data from Federal Reserve and Office of Federal Housing Enterprise Organization. (1) The index is defined as the product of the house price index and mortgage interest rate divided by per capita disposable income; an increase in the index means that housing is less affordable.

to its initial level, then up to an historical high in 2003.

Note that the affordability index correlates at both the low- and the high-frequency with the nominal interest rate, and that most of the latter's decline — and the associated increase in affordability — over the last 25 years took place in 1980-93 (Figure 10). During the recent house price boom, the index floated around an already low level, although between 2000 and end-2002 the interest rate declined from 8.3 to an historical low of 5.5 per cent, broadly compensating higher house prices. Since the beginning of 2003 affordability has declined by about 25 per cent, following the continuing rapid increase in house prices and the stability of nominal interest rates.

It is natural to ask what implications for house prices one should expect from changes in affordability. The reciprocal of the affordability index corresponds to the (normalized) share of the average income that should be devoted to service the interest bill on the mortgage necessary to buy the average-priced house. I stress the conditionality of this claim since, without credit constraints, nothing should prevent households from borrowing in order to meet part or all of their current debt payments. Indeed, a household possibly facing an upward sloping income path, after taking debt would optimally choose to devote more of its current income to consumption, and postpone the amortization of debt to draw on future income flows. In general, in such a world an increase in affordability stemming solely from a fall

in nominal interest rates, for unchanged real rates, should not be expected to affect housing demand and prices. In fact, an increase in nominal interest rates that is exactly matched by inflation results only in a tilting of the debt service burden towards early periods of a lifetime, while releasing resources in the more distant future. However, the share of the present value of lifetime income flows that must be devoted to service debt remains unchanged. To see this, assume for example that the reference contract is an interest-only infinite time horizon mortgage, which is consistent with the adopted measure of affordability, whose numerator considers interest payments only.[10] For simplicity, also assume that the house purchase is fully debt-financed, i.e. one has to raise funds for an amount equal to the current value of the house (P_t), and that the mortgage contract features a fixed nominal interest rate. These assumptions imply that over his/her lifetime, the prospective debtor will incur a fixed annual nominal payment equal to the product between P_t and the mortgage interest rate at the time of the purchase. Using the risk-free interest rate to discount future payments, their present value is given by:

$$\sum_{j=1}^{\infty} \frac{r_t^m P_t}{(1+r_{t+j})^j} \sim \frac{r_t^m P_t}{r} \tag{4}$$

where r_t is the risk-free nominal interest rate, r_t^m is the fixed mortgage interest rate. Assuming that the nominal interest rate (r_t) can be expressed as the sum of the real growth rate of the economy (g_t), inflation (π_t), and a risk premium (φ_t), i.e. $(1+r_t) = (1+g_t)(1+\pi_t)(1+\varphi_t)$, the approximation in (4) holds if g_t, π_t, and φ_t are approximately constant. Similarly, the present value of future incomes is:

$$\sum_{j=1}^{\infty} \frac{Y_{t+j}}{(1+r_{t+j})^j} \sim \frac{Y_t}{\varphi} \tag{5}$$

where Y_t is income, φ the inflation risk premium, and the approximation rests on the assumption made above about the nominal interest rate plus the additional assumption that nominal income growth is given approximately by $(1+g)(1+\pi)$.

Thus, the ratio between present value debt payments and present value income is approximately equal to:

$$\left(\frac{payments}{income}\right)_{PV} \sim \frac{r_t^m}{r}\frac{P_t}{Y_t}\varphi \sim \frac{r_t^m}{(r^m-s)}\frac{P_t}{Y_t}\varphi \tag{6}$$

[10] Note that since mortgage contracts typically specify a term by which principal has to be fully repaid, debt related payments are typically not limited to servicing the interest bill. In principle, affordability should therefore account for the existence of repayment schedules. On the other hand, since affordability is measured by an index, then one is interested in changes, not levels. Because the typical duration of mortgages does not change abruptly over time, accounting for repayment schedules is a minor issue.

where the second approximation rests on the assumption that the nominal mortgage rate is an approximately constant spread above the risk-free rate, i.e. $r^m = r + s$. From (6), it is clear that the lifetime burden of a debt-financed house purchase depends not only on the current price-income ratio, but also on the current mortgage interest rate relative to its long-run level. On average r_t^m must be equal to r^m, which implies that a permanent reduction of inflation and nominal interest rates should not affect the ratio in (6).

The preceding discussion leads to the conclusion that the affordability index can in no way be taken as a measure of the burden of house ownership, defined as the amount of resources that a household must sacrifice over its lifetime in order to purchase a house: permanent disinflation and the associated fall in nominal interest rates, while making housing more affordable, do not result in more lifetime resources being available for other types of consumption, but only in a tilting of the debt service burden from early to late in the lifetime. In the absence of credit constraints, the allocation of lifetime income to housing versus non-housing consumption should not be affected by changing nominal interest rates, so long as real rates are unchanged.

However, it is widely recognized that at least a fraction of households face credit constraints; for them, borrowing against future incomes may not be an available option. In this context, household borrowing is below the desired level.[11] Suppose for simplicity that households have access to infinite horizon interest-only mortgages, and that they would optimally choose to devote a given fraction of their lifetime resources to debt servicing in a smoothed way. In a high-inflation high-nominal interest rates environment, the real burden of debt payments would be tilted towards earlier periods, since on average the rate of increase of nominal income is proportional to the rate of inflation. Without the possibility of achieving the desired smoothing of consumption over time, households wishing to issue a given amount of debt may be discouraged by the need to give up a disproportionately large share of current and near future consumption. Permanent disinflation would have the effect of making that constraint less stringent, inducing households to issue more debt and raising house prices, at least in the short term when the supply of housing is fixed.[12] As documented above, disinflation and

[11] The literature typically models credit constraints by imposing that a representative agents' debt cannot exceed a fraction of his/her housing wealth (e.g. Iacoviello, 2005). Campbell and Hercovitz (2006) address the issue of constraints deriving from repayment schedules; they incorporate repayment schedules in an otherwise standard saver-borrower model by assuming that a declining share of the accumulated housing stock can serve as collateral, implying that collateralized debt must be repaid according to a predetermined schedule. Note however that Campbell and Hercovitz's model has no nominal rigidities, thus it cannot account for the tilt effect of inflation.

[12] Nickell (2005) mentions the tilt effect as a possible cause for the sharp increase in UK

falling nominal interest rates have characterized the US economy over the last two decades, possibly allowing credit constrained households to increase their debt closer to the desired level and pushing up overall housing demand.

What information therefore can be extracted from the affordability index? In the presence of credit constrained households, whereby actual debt is below the unconstrained optimum, an increase in affordability should be expected to raise the demand for housing; the associated increase in house prices should thus be regarded as structural; however, by the same token, an unexpected increase in actual and expected inflation and in nominal interest rates would inevitably have a depressive effect on house prices. How much of the recent boom in house prices can actually be explained by increased affordability is hard to say. On one hand, the answer depends on whether credit constraints in the US are sufficiently pervasive to drive the scenario depicted above; on the other hand, in recent years interest rates have fallen both in nominal and real terms, and house prices may have been driven at least in part by changing real costs of ownership, rather than by the presumed tilt effect. The affordability index therefore provides information that is difficult to interpret.

3.4 The user cost approach

The literature regards the user cost approach as economically the most sensible to assess the consistency of house prices with fundamentals. The user cost of ownership, i.e. the sum of the costs that house owners incur every year net of any offsetting benefits, should be equal, on average, to the corresponding market rents.[13] Denoting by P_t the average house price, by R_t the associated market rent, and by UC_t the average user cost expressed as a fraction of P_t, the equilibrium condition is:

$$R_t = P_t \cdot UC_t \tag{7}$$

The inverse of UC_t is thus the ratio of house prices to rents consistent with equilibrium, i.e. $1/UC_t = (P/R)_t^{eq}$. By comparing this theoretical ratio with the actual one it is possible to say whether and to what extent house prices are misaligned.[14] The user cost is computed by combining the

house prices over recent years (see also Debelle, 2004); Brunnermeier and Julliard (2006) argue that such effects of changing inflation and nominal interest rates on house prices are better explained by inflation illusion.

[13] See Hendershott and Slemrod (1983) and Poterba (1984, 1992); more recently, Himmelberg et al. (2005).

[14] Note that house prices and rents, and therefore the ratio between them, are available as indexes, not values; a meaningful comparison between the actual and theoretical ratios is possible only if the two (index) ratios can be normalized in a way that informs about the relationship between the two. A sensible solution is to assume that on average deviations of the actual price-rent ratio from $(P/R)_t^{eq}$, however persistent, are eliminated by market

costs and the offsetting benefits of ownership:

$$UC_t = r_t^m (1-\tau) + w(1-\tau) + d - (E_t g_{t+1} + E_t \pi_{t+1}) + \psi \qquad (8)$$

where r_t^m is the long-term nominal mortgage interest rate; τ the marginal tax rate; w the property tax rate; d the rate of depreciation of the property; $(E_t g_{t+1} + E_t \pi_{t+1})$ is the expected capital gain between t and $t+1$, expressed as the sum of house real appreciation $(E_t g_{t+1})$ and inflation $(E_t \pi_{t+1})$; ψ a compensation for the risk of holding real estate assets. The first term on the right hand side of (8) is the interest bill on the mortgage necessary to finance the house purchase, which is implicitly assumed to be fully debt-financed; if on the other hand it were equity financed, then one should replace the mortgage interest rate by a measure of the opportunity cost of money, such as the long-term Treasury interest rate.[15] To the extent that the Treasury and mortgage interest rates have correlated dynamics, either's choice affects the levels of, but not changes in, the user cost. The offsetting benefits of ownership are given by the tax deductibility of mortgage interest costs $(-r_t^m \tau)$ and of property taxes $(-w\tau)$, and by the expected capital gain, which is not observed and must therefore be estimated. The last component of the user cost (ψ) is also unobservable, but the assumption that it is constant implies that it affects the level of UC_t but not its changes;[16] if this assumption did not hold, which is admittedly possible, variations of the price-rent ratio induced by changes in the risk premium would be wrongly regarded as non-fundamental movements.[17] As far as τ is concerned, its level, even if constant, multiplies the mortgage rate and is therefore not irrelevant for the dynamics of the user cost. If interest payments were not tax-deductible, (8) could be rewritten as $UC_t = rr_t^m + w(1-\tau) + d - E_t g_{t+1} + \psi$, where rr_t^m is the real mortgage interest rate (i.e. the difference between the nominal rate and expected inflation); in this case, a change in inflation that is exactly matched by a change in the nominal interest rate would have no effect on the user cost, and thus on the equilibrium price-rent ratio. With tax deductibility, instead, an increase (fall) in inflation lowers (raises) the user cost, which is the converse of the effect expected from the implied change in affordability, assuming households are credit constrained.

forces that tend to restore the indifference between renting and owning. Equivalently, the averages of $(P/R)_t$ and $(P/R)_t^{eq}$ are approximately equal if taken over a sufficiently long period, implying the following normalization: $\sum_{t=1}^{T}(P/R)_t = \sum_{t=1}^{T}(P/R)_t^{eq} = 100$, where T is the number of available observations.

[15] Himmelberg et al. (2005) specify the interest costs in terms of the risk-free rate, but retain the mortgage rate when subtracting the implicit tax benefit.

[16] This also applies to w and d.

[17] The problem would be more serious if the changes in the risk premium were correlated with other housing market determinants, rather than being structural breaks determined by institutional factors.

An essential ingredient of the user cost approach is the measurement of expected capital gains. In the literature, different methodologies have been adopted. For example, the expected increase in house prices is proxied by a moving average of recent past inflation in Poterba (1992) and Girouard et al. (2006); in a similar fashion, Quigley and Raphael (2004) and the ECB (2006) use a moving average of recent house price changes. Using a different approach, Himmelberg et al. (2005) measure expected capital gains by long-term inflation expectations. Since different methodologies can lead to quite different dynamics of the user cost, and thus to equally starkly different conclusions about the extent of misalignment of house prices, choosing either methodology is a critical point that deserves some inspection. An important drawback with proxies based on moving averages of CPI or house price inflation is that they are backward looking: there is no reason why high or low rates of appreciation in the recent past should be expected to persist far into the future. One may object that it is the expected capital gain between the current and next period which matters for the user cost, and that a backward looking proxy works well as a predictor of next period house appreciation given the high persistence of both CPI and house price inflation. However, this point does not account for the iterative nature of expectations, which implies that — in order to be consistent with equilibrium — the expected capital gain from t to $t+1$ cannot be disjointed from what house prices are expected to do in subsequent periods. Solving (8) forward with respect to P_t yields:

$$P_t = E_t \sum_{j=1}^{\infty} \frac{R_{t+j}}{\left(1 + uc'_{t+j}\right)^j} \tag{9}$$

where $uc'_{t+j} = r^m_{t+j}(1-\tau) + w(1-\tau) + d + \psi$. Expression (9), just like (2), resembles the dividend discount formula for stocks, and implies that the expected change in house prices from t to $t+1$ reflects all the future expected changes in market rents. For example, assuming uc'_{t+j} is constant (u'):

$$\frac{E_t(P_{t+1}) - P_t}{P_t} = E_t \frac{\sum_{j=1}^{\infty} \frac{R_{t+j}}{(1+u')^j} q_{t+j+1}}{\sum_{j=1}^{\infty} \frac{R_{t+j}}{(1+u')^j}} \tag{10}$$

where $q_{t+j+1} = \frac{R_{t+j+1} - R_{t+j}}{R_{t+j}}$. In (10), the rate of growth of house prices in the next period is a weighted average of the expected percentage changes in market rents.[18] This can conveniently be implemented by setting the expected capital gain in (8) equal to the sum of the historical average growth of real

[18] If, in particular, $q_{t+j+1} = q$, then $\frac{E_t(P_{t+1}) - P_t}{P_t} = q$, i.e. house prices grow at the same constant rate as market rents.

rents ($E_t g_{t+1}$) and the long-term expected rate of CPI inflation ($E_t \pi_{t+1}$). Note that the growth of real rents has been a fairly stable process over the available sample, although recently real rents appear to have stabilized, interrupting (perhaps only temporarily) a long-run positive trend (see Figure 6); thus, proxying expected house appreciation with the growth of rents in the recent past would affect the results in the direction of finding a higher overvaluation (or lower undervaluation) in recent years.

In addition to the inherent difficulties of measuring expectations, another potentially important caveat of the analysis is the fact that the OFHEO repeat sales house price index does not control for quality improvements of the units sold, implying that a significant portion of the measured long-term increase in house prices could result from quality additions;[19] on the other hand, quality changes are accounted for by the BLS index of market rents. A constant quality house price index is available from the US Bureau of Census, but is calculated for new homes; to the extent that the development of new property typically occurs at the fringe where the supply of land is relatively more elastic, the Census house price index has the diametrically opposite drawback of not properly accounting for the increasing value of land; in addition, the hedonic methods used to calculate such index have their own limitations.[20]

User cost calculations for the US assume the following parameter configuration: $\tau = 27.5\%$, $w = d = \psi = 2\%$.[21] In the preferred measure of the user cost (Model 1), capital gains are proxied, as indicated above, as the sum of the growth of real rents and long-term inflation expectations.[22] For the sake of comparison with a more naive measure of expectations, Model 2 proxies expected capital gains with the realized CPI inflation over one-year earlier. Model 3 averages the expectations measured as in Models 1 and 2. The observed price-rent ratios and their theoretical equivalents obtained from the user cost formula are normalized by the respective 1983-2006Q3 averages (Figure 11).[23] An actual price-rent above (below) the equilibrium ratio can be taken as indication of overvaluation (undervaluation).

[19] See the discussion in McCarthy and Peach (2004).

[20] See Hulten (2003).

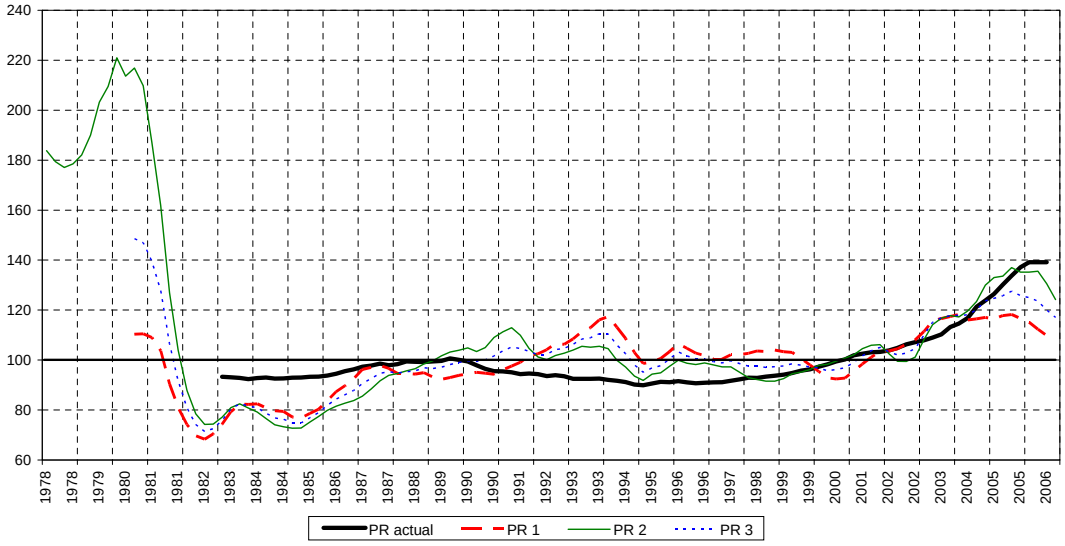
[21] Quigley and Raphael (2004) assume $\tau = 30\%$, $w = d = 2\%$, but include no risk premium. Himmelberg et al. (2005) assume $\tau = 25\%$, $w = \psi = 2\%$, and $d = 2.5\%$. For the marginal tax rate, I average between their numbers.

[22] Himmelberg et al. (2005) use this approach to measure the user cost for the US metropolitan areas (they do not report calculations for the US as a whole). As in their paper, I use the 10-year ahead CPI inflation expectation series from the Livingston Survey of the Federal Reserve Bank of Philadelphia.

[23] This is the period of availability of the rent index series.

Figure 11. Actual *versus* theoretical house price-rent ratios (1)

(quarterly data; indexes: sample average = 100)

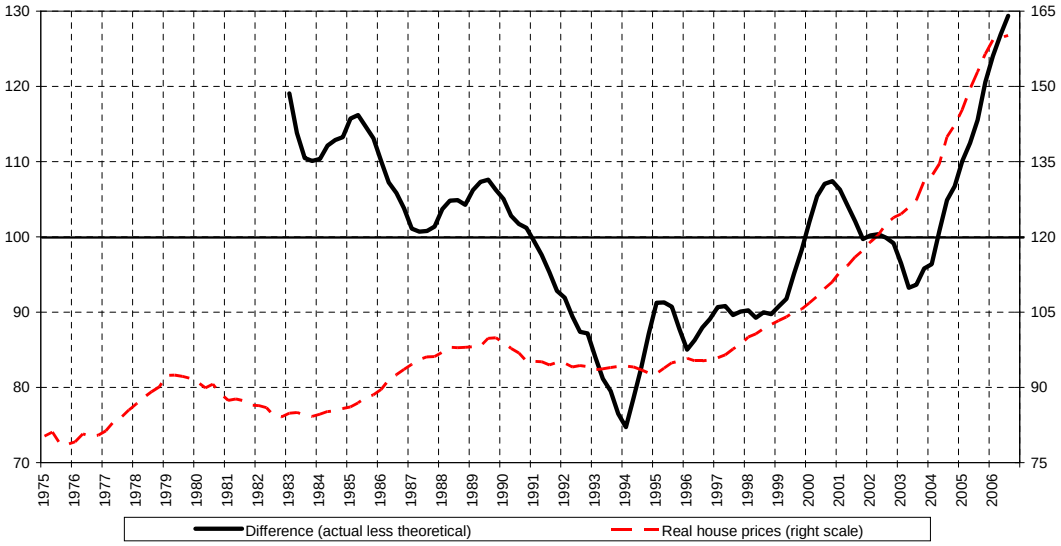


(1) Theoretical price-rent ratios PR 1, PR 2 and PR 5 (moving averages of four terms) are implied by the user cost approach, as explained in the text with reference to Models 1, 2, and 3, respectively.

The theoretical price-rent ratios exhibit similar dynamics across the three models, although there are periods during which they can diverge considerably. Between the end-1970s and the beginning of the 1980s, with high rates of inflation, the theoretical price-rent ratio calculated assuming naive expectations was much higher than the one calculated with the preferred methodology, reflecting the smoothness of expected relative to actual inflation. Focusing on Model 1, the theoretical price-rent ratio is much more erratic than the observed one, alternating periods of apparent overvaluation (the mid-1980s and the latest two years in the sample) to periods of undervaluation (most of the 1990s). As far as the latest house price boom is concerned, house prices appear to have been driven by fundamentals between 1997 and 2003, starting to depart from fundamentals thereafter (Figure 12);[24] by the third quarter of 2006, house prices were overvalued by almost 30 per cent. Note that the user cost calculated with naive expectations gives no indication of any misalignment throughout the recent boom; again, this reflects the fact that long-term inflation expectations have not increased by as much as current inflation in recent years.

[24] Figure 12 shows an index of the difference between the actual and the equilibrium (Model 1) price-rent ratio. When the two series are equal, i.e. there is equilibrium, the index is normalized to 100, so that the difference between the index and 100 gives the percentage overvaluation (if positive) or undervaluation (if negative) of house prices.

Fig 12. Difference between actual and theoretical price-rent ratios, and real house prices (1)
(quarterly data)



(1) The real house price series is an index with average 1975-2006Q3 = 100; the difference series is based on indexes (actual and equilibrium) with average 1975-2006Q3 = 100; the equilibrium price-rent ratio refers to Model 1, as explained in the text.

Figure 13 shows the theoretical price-rent ratios calculated by proxying the expected house appreciation with the three-year moving average of house price changes (Model 4), which is similar to Quigley and Raphael (2004). The results for Model 4 show that at times of rapid house appreciation (at the end of the 1970s and in most recent years) the equilibrium price-rent ratio increases to implausibly high levels: as a result of robust nominal house price growth and declining interest rates, the user cost falls to zero in the first half of 2005, sending the theoretical ratio up to infinity, and turns negative immediately after.[25] When the theoretical price-rent ratio is derived from the user cost calculated disregarding expected capital (Model 5), its dynamics essentially reflect the decline in nominal and real interest rates over the last 20-25 years, suggesting an overvaluation in 2006 similar to that given by the preferred measure (Model 1).

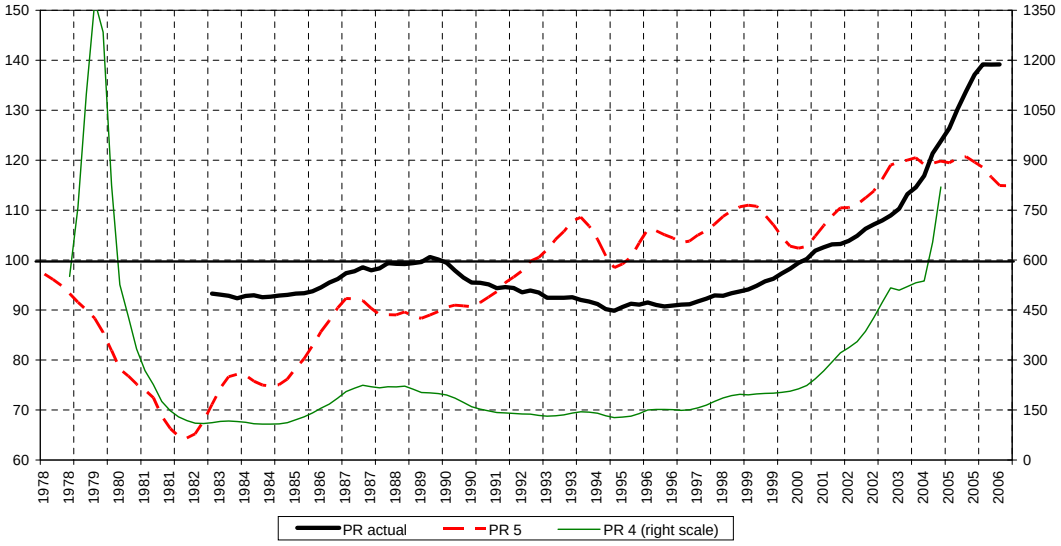
4 Conclusions

Price-income and price-rent ratios are sometimes used to look for evidence of house price misalignments. By comparing their current values to the respective historical averages, the price-income ratio suggests that in the third quarter of 2006 US house prices were 22 per cent too high, while the

[25] The values of the theoretical price-rent ratio after 2004 are not shown in Figure 13.

Figure 13. Actual *versus* theoretical house price-rent ratios (1)

(quarterly data; indexes: average 1975-2006Q3 = 100)



(1) Theoretical price-rent ratios PR 4 and PR 5 (moving averages of four terms) are implied by the user cost approach, as explained in the text with reference to Models 4 and 5, respectively.

price-rent ratio indicates an overvaluation of up to 40 per cent. However, as is well-known, those measures can be misleading, since none accounts for changes in the level of interest rates, and the price-income ratio does not account for the evolution of market rents.

Another commonly used measure of housing market conditions is the affordability index, here defined as the ratio between the interest payments for a loan necessary to purchase the average-priced house and average income. In this paper I argue that affordability indexes provide information that is difficult to interpret. If households do not face credit constraints, changes in nominal interest rates that are exactly matched by expected inflation should not affect housing demand and prices, while affecting affordability measures; for unchanged real interest rates, higher (lower) nominal interest rates raise (lower) the burden (in real terms) of purchasing a house early in a lifetime, but leave the present value of the overall burden unchanged. Therefore, affordability cannot be taken as an indication of how 'burdensome' it is to purchase a house in terms of the resources available to households over their entire lifetime. If, on the other hand, households face credit constraints, especially in the form of repayment schedules, then changes in nominal interest rates can result in a more or less stringent constraint, leading households to change their indebtedness with effects on housing demand and prices.

The most sensible approach to assess equilibrium house prices is to calcu-

late the user cost of ownership, which is equal to the equilibrium price-rent ratio. Then, by comparing the latter with the observed ratio, one obtains indications about whether house prices are close to equilibrium or misaligned. Calculations for the United States indicate that periods of overvaluation and undervaluation have alternated in the last 25-30 years. As far as the latest boom is concerned, US house price increases between 1997 and 2003 appear to be justified by fundamentals, while between 2004 and the third quarter of 2006 they suggest an accumulated overvaluation of almost 30 per cent.

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