Asset pricing and the housing market

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House prices have risen rapidly in recent years. While there is little doubt that the rates of increase observed are unsustainable, there is uncertainty as to the sustainability of the level of house prices. This article applies asset-pricing theory to the housing market to gain additional insights into some of the factors accounting for this rise in house prices. It presents estimates of the ratio of house prices to net rentals (a concept close to an equity market's price to earnings ratio). This ratio is currently well above its long-term average, a situation that in the past has often been followed by periods in which real house prices have fallen. However, a simple 'dividend' discount model of the housing market suggests that lower real interest rates can account for part of the increase in the ratio of house prices to net rentals since 1996. Nevertheless, to account fully for this increase, the housing risk premium would need to have fallen too. Comparing the implied housing risk premium now with that in the late 1980s may suggest that house prices are closer to sustainable levels now than was the case in the late 1980s. However, because of data and model limitations no firm conclusions can be drawn.

Introduction

House prices have risen rapidly in recent years. Precise rates of increase depend on the house price index chosen, but using the average of the Nationwide and Halifax indices as an example, the annual inflation rate in February 2004 was about 17%. There is little doubt that such rates of increase are unsustainable. But there is uncertainty as to the sustainability of the current level of house prices, or the likelihood of price falls. A reversal of a house price misalignment would be likely to have strong repercussions on the economy. Reflecting its importance, the housing market has been a recurring theme in Bank research.(1)

This article extends this work by applying asset-pricing theory to the UK housing market.(2) It is organised as follows. The next section briefly outlines the basic model and how it relates to the literature on housing in an asset-pricing framework. The following section uses two approaches to analyse housing market valuations. It first compares the ratio of house prices to net rentals (a concept close to an equity market's price to earnings ratio) with its historic average. It then uses a model akin to the dividend discount model familiar from the literature on equity valuation, to account for recent house price movements. The penultimate section investigates to what extent special features such as the indivisibility of housing may alter the results. The final section concludes.

The basic asset-pricing framework

Theoretical models of housing have been developed both in and outside the Bank. The model used in this article is a simple version where households either rent or own the housing stock. It is most closely related to the models in Aoki, Proudman and Vlieghe (2002) and Piazzesi, Schneider and Tuzel (2003), which treat housing as a durable asset that provides utility via the flow of housing services.

In this framework the price P of an asset is the present value of its expected future pay-offs D discounted at a rate R that accounts for the risk associated with holding that asset. Assuming that the risk premium k and the real risk-free rate r^f that make up R are both constant, this can be written as:

$$P_t = \sum_{j=1}^{\infty} \frac{D_{t+j}}{\left(1+R\right)^j} \qquad \textbf{(1)}$$

(1) Wood (2003) and Thwaites and Wood (2003) are some recent examples.
(2) See also Bank of England (2003).

If pay-offs grow at a constant real rate g, equation **(1)** can be rearranged into **(2)**:

$$P_t = \frac{D_t(1+g)}{(R-g)} = \frac{D_t(1+g)}{(r^f + k - g)} \qquad \textbf{(2)}$$

In equity valuation, the pay-off D is usually proxied by dividends. As will be discussed in more detail later, a similar pay-off proxy can be constructed for housing. However, while the equity risk premium is a familiar concept, the notion of a housing risk premium is less so. But like equities, property does not guarantee payment of a known income and return of a known principal at maturity. It is therefore a risky asset.

As with other risky assets, the housing risk premium depends on whether housing provides returns at times when they are most needed.(1) The reason is that consumers are primarily concerned about smoothing out consumption volatility, not asset return volatility. In other words, it is the covariance between expected returns and expected consumption growth that matters.(2) Risk-averse consumers would require a positive risk premium if housing provided high returns at a time when consumption growth was already expected to be high, ie if expected housing returns and expected consumption growth were positively correlated. But they would be prepared to *pay* a premium if housing provided them with high returns when consumption growth was expected to be low, ie if they were negatively correlated and housing provided insurance.

The next section applies this framework to UK data.

Application to UK housing market data

The ratio of house prices to net rentals

The price to earnings ratio (or its inverse, the earnings yield) is a popular valuation measure when analysing equity markets. But such data are not readily available for the housing market. First, because no two dwellings are identical and repeat sales of dwellings are infrequent, house prices(3) are more difficult to measure than equity prices, which are the outcome of frequent trades in identical shares. Second, in the context of the housing market, rent payments received by the landlord do not correspond to the earnings measures used in company accounts. The reason is that rent represents only a gross income to the landlord, who incurs operating costs, eg for maintenance, management and utilities. These costs need to be deducted from the rent payments received. The resulting 'net rentals', denoted E^h, broadly correspond to earnings.

Data on both *gross* and *net* rental yields published by some estate agencies and research institutes show that the difference between *gross* and *net* rentals can be large. For example, Investment Property Databank (IPD) estimates that the average gross yield on UK residential property in 2002 was 7.0%, while the net yield, which takes voids and irrecoverable operating costs into account, was 4.4%.

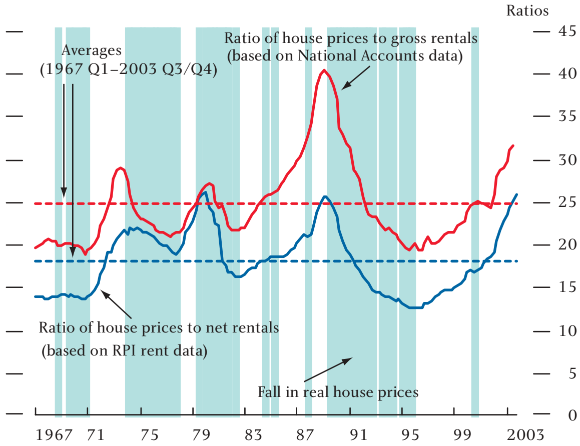
The inverse of such net rental yields, henceforth the ratio of house prices to net rentals P/E^h, probably corresponds most closely to the price to earnings ratio used in equity analysis. Under the assumption that consumers are indifferent between obtaining housing services via renting or owning property, these data may provide a benchmark for the housing market as a whole.(4) But they are only available for recent years and time-series data need to be estimated by combining data from different sources.

Chart 1 shows an estimate of the UK ratio of house prices to net rentals. This estimate uses the inverse of the IPD estimate of the net rental yield as a benchmark for the ratio of house prices to net rentals. The data are then extrapolated by using the historical ratio of house prices to rentals. The data are described in more detail in the data appendix. But it needs to be stressed from the outset that, because of the data limitations described above, the estimates presented are subject to a large error margin of unknown quantity and are therefore only illustrative of broad trends. For comparison, Chart 1 also shows an alternative ratio of house prices to *gross* rentals, based on National Accounts data.(5)

Despite the levels differences, the two measures show a broadly similar profile over time, with the ratio of house

(1) These returns could reflect capital growth or rental income.
(2) More formally, the risk premium depends on the covariance between expected returns and the 'stochastic discount factor'. Under the assumption of 'power utility', this translates into consumption growth. For details see Cochrane (2001).
(3) Thwaites and Wood (2003) provide details about the measurement of house prices.
(4) In other words, for two identical properties, one rented, the other owner-occupied, 'net rentals' of the former equal imputed 'net rentals' of the latter.
(5) It is calculated as the ratio of personal sector residential housing wealth to actual and imputed rents for housing.

Chart 1
The ratio of house prices to rentals and falls in real house prices



prices to rentals having risen in recent years to well above its historical average. This result is similar to those obtained by Broadbent (2003) for the United Kingdom, by Krainer (2003) and Leamer (2002) for the United States and Ayuso and Restoy (2003) for the United Kingdom, the United States and Spain.(1) The shaded areas in Chart 1 show that periods of deviations from the average have in the past often been followed by periods in which real house prices (ie house prices deflated by the RPI) have fallen for prolonged periods.(2)

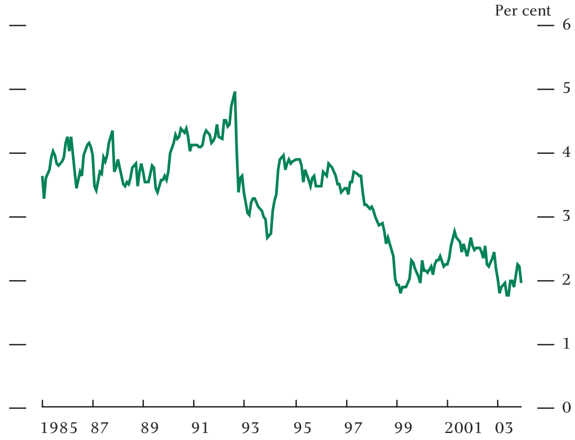
Real interest rates and the housing market risk premium

Vila Wetherilt and Weeken (2002) show that simply focusing on deviations of valuation measures from their historical averages ignores possible effects from other variables. This is illustrated by rearranging equation **(2)** to obtain the ratio of house prices to net rentals on the left-hand side where $\theta = D^h/E^h$ is the payout ratio. The long-run growth rate of 'housing dividends' D^h (ie the part of 'net rentals' (E^h) not spent on new housing investment)(3) is given by $g = (r^f + k^h)(1\text{-}\theta)$.(4)

$$\frac{P_t}{E_t^h} = \frac{(1+g)\theta}{r^f + k^h - g} \qquad \textbf{(3)}$$

For example, other things being equal, a lower real risk-free rate r^f could sustain a higher house price to rentals ratio than in the past. Chart 2 shows that real interest rates, as measured by the yields on index-linked gilts, fell markedly during the 1990s.(5)

Chart 2
UK ten-year spot real interest rates



By the same token, a lower housing risk premium k^h, or a higher long-term 'net rentals' growth rate g, could also sustain a higher price to rentals ratio.

Decomposing house price changes

Decomposing changes in house prices to account for the relative contribution of these variables may provide further insights into house price movements.

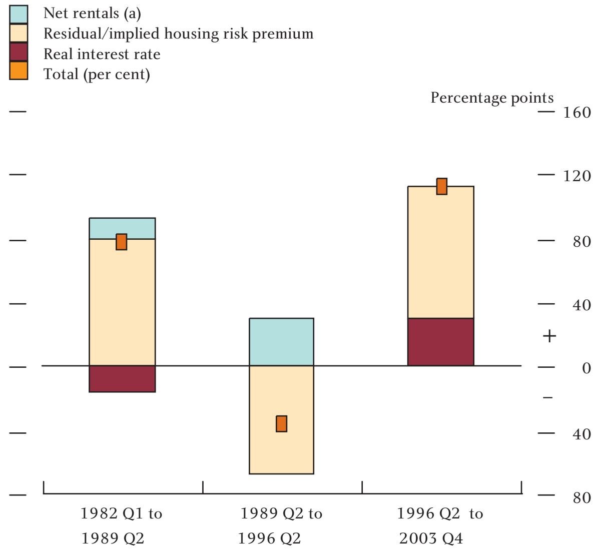
Chart 3 illustrates such a decomposition of changes in the real Nationwide mix-adjusted house price index, based on the proxies for r^f, P/E^h and θ defined above.

Again, it needs to be stressed that estimates of many of the variables entering equation **(3)** are subject to a margin of error. For example, to calculate the payout ratio θ, data on 'housing dividends' D^h are required. In addition to the data limitations already described above, these 'housing dividends' are difficult to estimate.

Moreover, expectations of near and medium-term growth in 'housing dividends' are not available and cannot be incorporated in the model. This may be important as planning restrictions on new housing may result in the

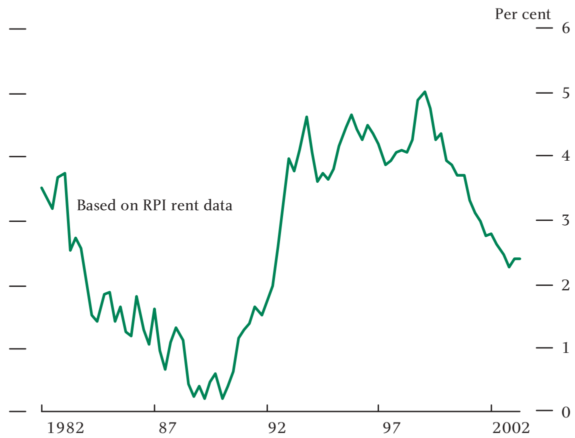
(1) The RICS letting survey provides corroborative evidence. It shows that UK gross rental yields (the inverse of the ratio of house prices to gross rentals) have mostly been falling for the past few years.
(2) The shaded areas represent periods in which real house prices have fallen compared with the previous quarter. This could reflect a fall in the money value of houses or the money value of houses increasing by less than retail prices.
(3) In accounting terminology, the difference between 'net rentals' and 'housing dividends' corresponds to 'retained earnings'. The net investment could reflect property improvements which should enable the landlord to receive higher rental income in the future. In practice, new housing investment has been low relative to net rentals, with the payout ratio close to one. See the data appendix for more details.
(4) See Panigirtzoglou and Scammell (2002) for a derivation of the long-term growth rate g.
(5) Constant-maturity ten-year spot real interest rates were derived from index-linked gilts using the variable roughness penalty (VRP) method described in Anderson and Sleath (1999). Scholtes (2002) discusses why these rates are an imperfect measure of the risk-free rate.

Chart 3
Contributions to changes in the real Nationwide house price index



(a) Using the net rentals estimate based on RPI rent data.

Chart 4
The UK housing residual/risk premium



returns on housing investment exceeding the cost of finance for a considerable period of time.

The residual contribution in Chart 3 is thus a mixture of the effects of these data limitations and omissions, inappropriate valuations of housing assets and the unobservable housing risk premium k^h.

Interpreting the results

Chart 3 shows that, although growth in net rentals made a positive contribution, changes in the residual are needed to account for the increase in real house prices between 1982 and 1989 and the subsequent falls during 1989–96. For the most recent period the model attributes part of the rise in real house prices to a fall in the ten-year real spot interest rate (a proxy for the real risk-free rate). But the residual component also makes a large positive contribution.

The extent to which this residual reflects changes in the unobservable housing risk premium, rather than distortions resulting from poor data, may influence the interpretation of house price movements. Chart 4 shows a time series of the residual backed out from equation **(3)** consistent with Chart 3 and the estimate of the ratio of house prices to net rentals based on RPI rent data shown in Chart 1. It shows large movements in the residual over time. Are such movements plausible for the housing market risk premium?

Vila Wetherilt and Weeken (2002) discuss changes to risk premia in the context of equities. The analysis carries through to other risky assets such as housing. In particular, changes in the expected variability of consumption, the variability of housing returns, the correlation between housing returns and consumption growth or changes in investors' risk preferences could each explain changes in the housing risk premium.

It is conceivable that past economic stability reduces expectations about the number and/or strength of future shocks to the economy, and/or that it increases confidence in policymakers' ability to deal with such shocks. This may lower the expected variability of consumption growth and asset returns and the risk premium required. Risk preferences may also be affected by the economic cycle. For example, the literature on habit formation implies that in booms consumption rises and risk aversion and risk premia fall, whereas the opposite happens in recessions.(1)

All these factors may have affected the risk premium, thus contributing to changes in the residual shown in Chart 4. But the rapid rise in house prices and their subsequent fall during the late 1980s/early 1990s suggest that the low level of the residual during this period may also have reflected an overvaluation of housing assets, for example caused by mistaken perceptions of underlying fundamentals.(2) It is not

(1) Cochrane (2001) discusses such models.
(2) An additional explanation is that house price increases over that period may have been fuelled by fiscal changes affecting mortgage holders, not captured in our simple empirical model. For example, Baddeley (2003) suggests that the announcement of forthcoming restrictions to Mortgage Interest Relief at Source (MIRAS) contributed to the rapid rise in house prices of Summer 1988.

possible to say whether the fall in the residual over recent years reflects genuine changes in the housing risk premium or an overvaluation of housing assets. But comparing the residual now with that in the late 1980s may suggest that house prices are closer to sustainable levels than was the case in the late 1980s.

Limitations of the model

Data limitations have already been described above. In addition, the basic model described here rests on several assumptions that may not hold in practice. Most importantly:

Limited arbitrage opportunities

The model assumes that there are no arbitrage opportunities by which excess profits can be made without risk. Borrowing constraints or transaction costs could mean that this assumption is violated. For example, if people suspect that houses are too cheap, they are in practice limited in how many houses they can buy, and if they believed that they are too expensive they cannot in practice 'short sell' houses that they do not have.(1)

Moreover, compared with transaction costs for many financial assets, which are very low, transaction costs for housing are high. The latter include financial costs such as stamp duty, estate agent, surveyor and legal fees, as well as time spent searching for a property and the long time lag between making an offer for a property and the transaction being finalised.

Lumpiness of housing

It can be shown that if people can make small adjustments to their asset holdings they would all hold the same portfolio of risky assets (including housing), regardless of risk preferences. In this 'market portfolio' the specific risk associated with any particular asset would have been diversified away. In contrast to equities, where mutual funds enable agents to hold a small share of the overall stock market, housing is lumpy and investors cannot hold a small share of the overall housing market. This has two implications. First, a homeowner's property will typically account for a large share of his total wealth. This means that he is not well diversified across asset classes such as equities, bonds and property. Second, since the typical homeowner only owns a single house he is not even diversified across residential properties.(2) In other words, the lumpiness of housing reduces diversification benefits. This may lead to a higher housing risk premium than would be required otherwise.

Imperfect substitutability

Our simple model implies that people are indifferent between consuming the housing services through owning or renting a property. In this case volatility in rentals maps into volatility in imputed rents. A richer model could allow for a wedge between rentals and housing services. This distinction is implicit in Sinai and Souleles (2003), who argue that, while owner-occupiers are exposed to house price fluctuations, homeownership provides a hedge against fluctuations in future rent payments. To the degree that this hedging demand is capitalised into house prices this would lead to a lower housing risk premium in areas where rent variability was more important than house price variability.(3)

Distortionary taxes and regulation

Taxes and regulation—such as subsidised rental accommodation and rent controls (the latter were abolished in the late 1980s)—could cause two types of distortions. First, they could drive a wedge between market rents and imputed rents of owner-occupation. Second, taxes and regulation could drive a wedge between the post-tax return on property and other investments such as shares. For example, while capital gains tax is generally levied on financial investments, capital gains on the primary residence are not taxed. In addition, rental income is taxed differently from dividends or coupon payments. And owner-occupiers are not taxed on their imputed rents.

Moreover, because of changes to taxes and regulations these distortions have not been constant. For example, the value of Mortgage Interest Relief at Source (MIRAS), which gave tax breaks to mortgage holders, was reduced over time, before the scheme was fully abolished in 2000. Changes to local government taxes in the late

(1) Derivative products that allow betting on house prices are only a recent innovation in the United Kingdom.
(2) For example, Nationwide mix-adjusted regional house price data show that the average variability of annual house price changes across regions in the United Kingdom between 1975 and 2003 was 10.7%. This is higher than the variability of average UK house price increases (9.3%). That average variability is greater than the variability of the average reflects the fact that house prices in some regions rose while they fell in others.
(3) Nordvik (2001) is a related example. He develops a theoretical model in which households desire to trade up to larger properties. In this case investing in housing can insure against house price fluctuations affecting the consumption of future housing services, thereby generating a negative housing risk premium.

1980s/early 1990s will also have temporarily altered the relative attractiveness of property and financial investments.

Taken together, it is not clear into which direction the estimated housing risk premium should be adjusted to take account of these limitations. Although in aggregate and over time the effects of these limitations should be less severe, it is not completely straightforward to apply the simple asset-pricing framework to housing.

Conclusion

This article applied asset-pricing theory to the housing market to gain additional insights into some of the factors accounting for the recent rise in house prices. It showed that estimates of the ratio of house prices to rentals are currently well above their long-term average, as rapidly rising house prices have outpaced growth in rentals. Such a situation has in the past often been followed by periods in which real house prices have fallen. However, a simple 'dividend' discount model of the housing market suggests that lower real interest rates and a fall in the residual (which could reflect a fall in the housing risk premium) can account for the increase in the ratio of house prices to net rentals since 1996. The fact that the residual has fallen by less than in the late 1980s may suggest that house prices are closer to sustainable levels now than was the case in the late 1980s. However, because of data and model limitations no firm conclusions can be drawn.

Data appendix

House prices and house price indices

Unless stated otherwise, data for the money value of house prices and the house price index used throughout this article refer to the Nationwide quarterly mix-adjusted house price data. Thwaites and Wood (2003) provide an overview of UK house price indices.

The house price to rentals ratio

Two estimates of this ratio are provided, one using net rentals, the other using gross rentals.

The first estimate uses a measure of net rentals. End-2002, net rental yield data were obtained from Investment Property Databank (IPD). IPD defines the net rental yield as income received over the year net of property management and irrecoverable costs divided by year-end capital value. The data were inverted to provide an end-2002 estimate for the ratio of house prices to net rentals. The time series for the ratio of house prices to net rentals was obtained by applying the ratio of the Nationwide house price index to the RPI rent index to the end-2002 estimate (both series were seasonally adjusted). The resulting estimate is only indicative, as the approach described above is subject to a number of caveats.

First, it assumes that the development over time of the RPI rent index is a good proxy for the development over time of 'net rentals'. Second, while the Nationwide house price index is mix adjusted, the rent data are not. Furthermore, the mix of dwellings in the Nationwide data is likely to differ from the mix of dwellings in the IPD data and the RPI rent data. The latter are likely to contain more smaller properties, flats and maisonettes.

The second estimate uses a National Accounts based measure of gross rentals. It is calculated as the ratio of personal sector residential housing wealth to actual and imputed rents. Similar to the first measure described above, the National Accounts based estimate is subject to caveats, as many of these rent data are estimated.

'Housing dividends'

To apply the dividend discount model to the housing market, a measure of 'housing dividends' is needed. These 'housing dividends' are that part of 'net rentals' not spent on new housing investment.

First, an estimate of total economy net rentals is needed. 'Average' net rentals can be constructed from the ratio of house prices to net rentals and data on the money value of house prices described above. The estimate of economy-wide net rentals was constructed by multiplying this estimate of 'average' net rentals by the ODPM data of the number of households.

Second, data on new housing investment (ie net investment) need to be estimated. This is proxied by the difference between current-price private sector gross dwellings investment and dwellings capital consumption.

The difference between total-economy net rentals and housing investment broadly corresponds to 'housing dividends'. Because housing investment is small relative to net rentals, the ratio of 'housing dividends' to net rentals (ie the payout ratio) has been around 97% over the sample period.

Technical appendix

This appendix sets out a model in which housing is both an asset and a durable consumption good. It is a much-simplified version of the kind of models set out in Aoki, Proudman and Vlieghe (2002) and Piazzesi, Schneider and Tuzel (2003).

Consumer's optimisation problem

The representative landlord-consumer derives utility from consumption (of goods and services other than housing) c, and also from housing services ('living in a house') h. Furthermore, the consumer is always required to need somewhere to live each period. There is a finite housing stock H, and the representative landlord-consumer can choose to rent part of this stock, f, out for a rental price η, and to live in the rest of the stock. (Rented houses are assumed to be rented out to another class of agents, not described here, who rent whatever stock is allocated to them.)[1] The price of housing is denoted q. This 'housing in the utility function' is not dissimilar to the familiar 'money in the utility function'.

The representative landlord-consumer maximises utility

$$\max_{\{c_t, h_{t+1}, f_{t+1}\}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, h_t) \quad \textbf{(1)}$$

subject to a budget constraint which holds each period

$$c_t + q_t H_{t+1} \leq y_t + q_t H_t + \eta_t f_t \quad \textbf{(2)}$$

where E_t is the conditional expectations operator, β is the subjective discount factor measuring the consumer's impatience to consume, c is non-housing consumption and y is endowment income.[2] Moreover, rental housing f and lived-in housing h sum to the total housing stock H.

$$f_t + h_t = H_t \quad \textbf{(3)}$$

We assume standard conditions on the shape of the utility function, in particular that marginal utility is decreasing in both housing and non-housing consumption, and that both non-housing consumption and the stock of lived-in housing must be strictly positive.

First-order conditions and derivation of the risk premium

The landlord's first-order conditions imply the following intra and intertemporal relationships between marginal utilities u_h and u_c:

$$\beta E[u_h(c_{t+1}, h_{t+1})] - u_c(c_t, h_t)q_t + \beta E_t[u_c(c_{t+1}, h_{t+1})q_{t+1}] = 0 \quad \textbf{(4)}$$

$$\beta E[u_h(c_{t+1}, h_{t+1})] - \beta E_t[u_c(c_{t+1}, h_{t+1})\eta_{t+1}] = 0 \quad \textbf{(5)}$$

Combining equations **(4)** and **(5)** and dividing through by $u_c(c_t, h_t)q_t$ gives:

(1) Renters need to be included in the problem so that landlords have someone to occupy their rented property. But because house purchase does not enter their utility maximisation problem, focusing on the landlords is sufficient to derive an asset-pricing equation for houses.
(2) Adding financial assets to the budget constraint would not alter the relationships derived below.

$$E_t\left[\frac{\eta_{t+1}}{q_t}\frac{\beta u_c\left(c_{t+1},h_{t+1}\right)}{u_c\left(c_t,h_t\right)}\right]+E_t\left[\frac{q_{t+1}}{q_t}\frac{\beta u_c\left(c_{t+1},h_{t+1}\right)}{u_c\left(c_t,h_t\right)}\right]=1 \qquad \textbf{(6)}$$

With $\dfrac{\beta u_c\left(c_{t+1},h_{t+1}\right)}{u_c\left(c_t,h_t\right)} \equiv m_{t+1}$ and rearranging:

$$E_t\left[\frac{q_{t+1}+\eta_{t+1}}{q_t}m_{t+1}\right]=E_t\left[\left(1+\frac{q_{t+1}-q_t+\eta_{t+1}}{q_t}\right)m_{t+1}\right]=1 \qquad \textbf{(7)}$$

Defining the total gross return on housing, ie price appreciation and rental income as:

$$1+R_{t+1}^h \equiv \left(1+\frac{q_{t+1}-q_t+\eta_{t+1}}{q_t}\right) \quad \text{where } R^h = k^h + r^f \qquad \textbf{(8)}$$

equation **(7)** becomes:

$$E_t\left[\left(1+R_{t+1}^h\right)m_{t+1}\right]=1 \qquad \textbf{(9)}$$

Equation **(9)** is the equivalent to the standard asset-pricing equation (see Cochrane (2001)). Expanding this expression gives:

$$E_t\left[\left(1+R_{t+1}^h\right)\right]E_t\left[m_{t+1}\right]+\text{cov}_t\left[\left(1+R_{t+1}^h\right),m_{t+1}\right]=1 \qquad \textbf{(10)}$$

The gross return on a risk-free asset satisfies:

$$\left(1+r_{t+1}^f\right)E_t\left[m_{t+1}\right]=1 \qquad \textbf{(11)}$$

Combining equations **(10)** and **(11)**, the housing market risk premium k^h can be written as:

$$k_{t+1}^h=E_t\left[R_{t+1}^h\right]-r_{t+1}^f=-\frac{\text{cov}_t\left[\left(1+R_{t+1}^h\right),m_{t+1}\right]}{E_t\left[m_{t+1}\right]} \qquad \textbf{(12)}$$

This expression shows that the basic asset-pricing framework for financial assets also holds for housing. The risk premium on any risky asset (including housing) will depend on the expected covariance of the returns from that asset with the stochastic discount factor *m*. This is true even if housing is treated as a durable consumption good and features as an argument in the utility function.

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