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# Buying Versus Renting – Determinants of the Net Present Value of Home Ownership for Individual Households.

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## Abstract

The tenure decision upon whether to buy or to rent accommodation has long-term consequences for households' financial wellbeing that influence macroeconomic development and stability when the cumulative effects of individual decisions are aggregated across populations. The author explains how the net present value (NPV) of ownership versus renting can be used as a framework for informing housing tenure decisions. Increases in holding periods, inflation and the spread between imputed rent and the opportunity cost of household

savings shifts the balance in favour of ownership. With plausible assumptions the model demonstrates that households typically need a holding period of between five and ten years to

achieve a breakeven NPV. The findings support the conjecture that inflation transfers wealth from renters and mortgage providers to owners, whereas deflation reverses the flow until rising

default levels establish a new equilibrium.

**Keywords:** House Prices; Real Estate; Valuation; Household Finance; Tenure Choice; Buying versus Renting.

**JEL Codes:** D1, D84, G10, G12, G14, L85, P36, P46, R21, R31

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# 1 Introduction

One of the most important financial decisions that households encounter is the decision upon whether to own or to rent housing for personal consumption (tenure choice). It is a decision fraught with emotional, value expressive and ideological aspirations that often results in culture and policy biases that favour ownership. For example, in countries such as the UK, there is social pressure for young people to 'get a foot on the housing ladder', while homeownership confers status and housing tenure is a standard question in credit applications. Social status and the behavioural desire to engage in value expressive activity are examples of the consumption benefits of ownership. One manifestation of the behavioural bias towards ownership is the difficulty that consumers have in differentiating between investment, speculation, insurance and consumption when arranging housing needs. Whereas some forms of consumption are easily recognisable, for example purchases of luxury goods; other forms, such as expenditure on fashionable home styling, are often confused with investment when in reality the recoverable value of such expenditure is close to zero. Furthermore, preoccupations with supply restrictions distract purchasers from the investment risk to which housing is exposed, both at the macro level and the individual plot level. This risk is not readily diversifiable for households due to the immovability, indivisibility and illiquidity of owner occupied housing. In fact, supply restrictions are associated with greater volatility in house prices rather than greater stability (Glaeser, Gyourko and Saiz 2008; Mizuno and Tabner 2011).

It has been shown that leverage and the concentration of assets that ownership implies, results in allocations of savings between risky and risk-free investment that are inconsistent with households' risk tolerance (Becker and Shabani 2010). It is arguable that for most households, housing wealth is undiversifiable due to transaction costs, unavailability of hedging instruments and financial constraints. These characteristics coupled with government interventions result in market imperfections that allow prices to diverge from theoretical equilibrium levels for many years (Shiller 2007; Mizuno and Tabner 2011; Shiller 2014). The micro and macro implications for financial stability resulting from individual household tenure decisions together with the cumulative effects of decisions across many households respectively are amplified as prices diverge, or converge, over individuals' holding periods.

Prior research provides insights into the mechanisms by which wealth is transferred between agents in the housing market by examining tenure choices theoretically, using equilibrium models, and empirically, using aggregate data. The author argues that

heterogeneity between households enables these insights to be applied for the purpose of improving individual tenure decisions. Heterogeneity between households, with regards to variables such as marginal tax rates, financing constraints and risk preferences are important if market imperfections drive a wedge between theoretical equilibrium prices at the aggregate level and optimal choices at the individual household level. The aim of this study is to allow for the possibility that divergence from equilibrium can exist and demonstrate how households can evaluate the financial consequences of the tenure choices available to them.

There are many powerful behavioural, emotional and social forces that influence tenure choice and these are typically biased towards ownership. Guiding clients' tenure choices and alerting them to the risks that they face if they succumb to such biases without objective consideration of the consequences is a service that finance professionals can and should perform. To further this aim, the author presents an algorithm for examining the costs and benefits of ownership versus renting. For example, if a client's, cultural, social, political and behavioural considerations result in a very high utility value of ownership, wealthy clients will accept a negative NPV as the consumption cost of ownership. On the other hand, a financially constrained client would be counselled to the effect that although the consumption benefits of ownership are very desirable, affordability constraints necessitate compromise upon the level of consumption that can be enjoyed. Conversely, if the predicted NPV is positive, then ownership offers a margin of safety to mitigate the costs and uncertainty. Finally, if the housing consumer is confident enough to bet that conditions will be more favourable than the most likely base case, the NPV arising if their forecasts are realised can be categorised as the return to speculation. The algorithm is flexible enough to be adapted to most individual circumstances and demonstrates that increases in holding periods typically increase the NPV arising from ownership, so long as inflation costs combined with the spread of imputed rent over the discount rate are not negative. Homeowners with holding periods shorter than five years, or holding periods characterised by deflation, or by an adverse spread between imputed rents and financing cost, are the most likely to experience a negative NPV. With modest inflation, the NPV of ownership is likely to breakeven and turn positive when holding periods are somewhere between five and ten years. However, following the Global Financial Crisis of 2008 there has been much concern about deflation. If these concerns are realised, many home purchases will never breakeven unless they are preceded by increasing rental yields caused by prices deflating faster than rents. Wealth transfers resulting from a rapid reset of this kind have

the potential to dislocate the economic and social fabric of society creating positive feedback exacerbating instability of the financial system.

## 1.1 The net present value approach

The NPV of the buy versus rent decision is determined by calculating the present value (PV) of all cash savings arising from homeownership, all cash inflows and all cash outflows which are then netted off as in exhibit 1. A key principle illustrated in note B of exhibit 1 is that other things being equal: (a) higher cash flows, whether from rental savings or received from the proceeds of a home sale, always result in a higher present value and; (b) higher discount rates always result in a lower present value. This is because cash flows affect the numerator and discount rates affect the denominator of the present value calculation.

[Exhibit 1 about here]

The illustration presented here is restricted to a single tenure choice decision at time zero. In line with good financial planning practice, that decision should be periodically re-evaluated using the same model but with updated inputs as individual circumstances and macroeconomic conditions evolve. For tractability, at each evaluation point, model inputs are assumed to remain unchanged throughout the holding period. Substantial realised violations of that assumption should trigger new evaluations that are incorporated into households' revised financial plans. For households that are financially constrained, or whose human capital is vulnerable to exogenous shocks, the model is useful for determining the margin of safety required to withstand adverse shocks, for example to interest rates or to income during the anticipated holding period.

The intuition summarised in exhibit 1 allows inputs that are clearly defined and ascertainable today to assist in the formation of objective estimates of the range and location of possible financial outcomes in the future. The aim is to remove as much guesswork and subjectivity as is possible from the housing tenure choice[1].

The NPV analysis can be used to evaluate tenure choices both at the micro level for the benefit of individual households and at the macro level to inform economic analysis and policymaking. The method is flexible enough to incorporate differences in individuals'

[1] A theoretically appealing but challenging alternative would be to consider a multi-period setting with stochastic discount rates but determination of an appropriate probability distribution to characterise the path of future interest rates is beyond the scope of this article. Demonstrating that such a method is more effective than simpler alternatives and communicating the benefits to financially unsophisticated households is a further challenge.

required return on housing equity and tax rates. For example, an individual might ask a financial planner whether they should buy or rent their accommodation; a portfolio manager might be concerned about the assumptions needed to justify prevailing mortgage market characteristics in the context of current house prices; or, a policy advisor might be concerned about the winners and losers arising from a change in housing related tax or interest rates. The author demonstrates how such questions can be answered by focussing on the combined effect of the spread between the imputed rental yield and the discount rate; inflation; the real growth rate of rents and capital appreciation during the holding period. When these combinations are positive the NPV of ownership increases with the length of the holding period and vice versa.

## 1.2 Factors influencing tenure choice and policy

It is argued that rents avoided by ownership (imputed rents) often exceed mortgage interest while the requirement to save for down-payments provides a powerful savings motive that facilitates wealth accumulation. Ownership also confers a hedge against future increases in housing costs (Sinai and Souleles 2005; Han 2010; Han 2013) and increases the collective value of neighbourhoods because owners are incentivised to invest more in their community than renters (Coulson Hwang and Imai 2003; Haurin, Deitz and Weinberg 2003). In addition, educational attainment is greater in the children of owners (Aaronson 2000). Conversely, both evidence that homeownership constrains economic growth by restricting labour mobility (Munch, Rosholm and Svarer 2008; Coulson and Fisher 2009) and, evidence supporting the financial benefits of ownership are mixed (for example, Smith and Smith 2006). Other studies find that transaction costs and liquidity risk render buying riskier and costlier than renting for the majority of the time, although capturing the financial benefit of renting requires individuals to be fiscally disciplined and invest all gains from renting into a risk free asset, or a risk equivalent portfolio (Hennessey 2003; Lin and Vandell 2007; Beracha and Johnson 2012) [2]. A possible rationalisation of empirical results in favour of renting is that expected capital gains allow landlords to subsidise their tenants housing costs through low rents while allowing tenants to diversify their investment portfolios (Linneman 1985). The rise in US house prices leading up to 2005 can largely be explained as a correction of previous under valuations and as a result of declining real interest rates (Himmelberg, Mayer and Sinai 2005). Furthermore, tax subsidies for ownership lead to inefficient capital allocation (Hendershott 1983; Mills 1987;

[2] In order to reach their conclusion Beracha and Johnson assume an average 8 year holding period; a constant 20% loan to value (LTV) ratio and funding via a 30 year non-recourse repayment mortgage.

Poterba, 1992; Taylor 1998). In a paper published nearly half a century ago Shelton provides multiple citations warning of the financial risks of ownership and says that *"economic aspects of the [tenure] decision hinge primarily on the family's prospective duration in the dwelling"* (Shelton 1968, p. 62). More recently, Haurin and Gill (2002) demonstrate empirically that ownership is positively associated with expected holding periods, arguing that this is due to greater amortization of transaction costs over longer holding periods. Although, most housing consumers seem to believe that ownership benefits are worth paying a premium for (Sekkat and Szafarz 2011), the message from all of these studies is that the relative costs and benefits of ownership vary considerably over time and between households.

Advice regarding the tenure decision must take into account economic and market conditions, together with behavioural biases associated with the prevailing social and political environment, in addition to the individual household's circumstances. Social, political and individual behavioural biases frequently lean towards ownership. Therefore, the present study provides a mechanism by which households can objectively gauge the financial implications of such biases. The algorithm and analysis presented here explicitly recognises and addresses the fact that prices, liquidity and, to a lesser extent, financing costs are market determined (exogenous) variables, whereas affordability is primarily driven by individual circumstances that are endogenous to the consumer in question. For example, individual components of financing costs, marginal tax rates and holding periods. This has the result that the weight of the consumption component relative to the investment component of a home purchase varies between individuals and over time in such a way that the same opportunity may be a good prospect for one individual but a dead loss for another. While the majority of studies examine tenure choice at the macro level using aggregate data, the author examines the mechanism by which individual household characteristics interact with macro variables to influence the financial outcomes of tenure choices, thus contributing to discussions about wealth redistribution arising from policies favouring ownership.

One compelling explanation for the bias towards ownership in the face of empirical evidence demonstrating financial gains to renting is that purchases are a hedge against future increases in housing costs (Sinai and Souleles 2005; Han 2010; Han 2013). These authors argue that housing price risk affects demand through two channels. The first channel is conventional financial risk that is positively associated with required return and negatively associated with demand. Financial risk is particularly important for home owners because of the illiquidity and difficulty in diversifying the risk of housing assets. The second channel works in the opposite

direction to the first and arises because housing consumers face the risk of future real increases in housing costs. For households in which the second channel dominates, the expected return of housing is negatively related to the price risk of housing consumption. Thus, households are sometimes prepared to accept low or even negative expected returns as the price for insuring against unexpected increases in housing costs. The price of insurance, or the magnitude of the negative expected returns, is greatest when population and hence demand are expected to grow faster than supply, thus increasing the risk of upward price volatility (Han 2013). In this setting, prices appear expensive relative to rents because they reflect the premium for insurance against real house price inflation paid by consumers who purchase. If subsequent real price growth does not materialise, or is negative, the premium costs are partially offset by reductions in the cost of future consumption. For example, in the event of a 10% market wide price fall, a young couple selling their first $200,000 home at $180,000 would typically move to a larger property, e.g. $400,000. If they retained sufficient equity from their first home, the $20,000 loss realised is more than compensated for by the $40,000 discount when they buy the second $400,000 property at $360,000.

The author's analysis can inform households of the costs and benefits of using ownership as a means of insuring against price rises by taking into account their specific funding arrangements and the nature of their expected housing transitions. For example, the Sinai Souleles and Han (SSH) model of insurance, argues that house price falls are hedged for homeowners because lower future housing costs offset capital losses realised when the current home is sold. However, this mechanism is ineffective for households who are unable to relocate to a 'cheaper' home because their equity has been wiped out due to price falls occurring when their loan to value (LTV) ratio is high. Likewise, someone who for lifecycle or other reasons needs to downsize to a smaller property, or relocate to where prices have not suffered an equivalent negative adjustment may find that cost savings arising from the reduction in future housing costs either, do not materialise, or are insufficient to compensate for capital losses realised when the first home is sold. Reversing the above example of the young couple to an elderly couple selling their family home previously valued at $400,000 for just $360,000. The $20,000 discount they obtain off their $200,000 retirement accommodation falls short of the $40,000 loss realised on the sale of their previous home. Thus, the insurance derived from ownership during the first tenure becomes costly to the point of being ineffective during transition to the new tenure. Examining the NPV of ownership allows households to quantify the margin of safety according to their personal circumstances.

The legal environment is also an important determinant of the economic implications of tenure choice. In jurisdictions such as Germany, where tenant protection is high relative to landlord protection, security of tenant tenure and limitations on rent increases mitigate the risks of renting and tilt the economic analysis further in favour of renting, if other variables remain constant. Debtor and creditor protection also varies between jurisdictions; so for example, in the UK mortgages are issued on a recourse basis allowing the lender to pursue the borrower for additional compensation if a home-owner defaults with negative equity. In contrast, US mortgages are typically issued on a non-recourse basis providing borrowers with an option to put their homes back to the lender and walk away from further liabilities if the value of the home falls below the value of the mortgage. Personal bankruptcy conditions are also less onerous in the US compared to the UK. Both of these characteristics make home ownership a less risky proposition for US borrowers when compared to their UK counterparts.

The next section provides guidance on how to determine the model inputs while Section 3 provides a step by step explanation of how the model can be applied to a hypothetical tenure decision. Section 4 examines how sensitive the model outputs are to changes in the underlying assumptions and the relationship between the inputs. The final section concludes.

## 2 Determining model inputs

[Table 1 about here]

A full list of inputs and their definitions is provided in table 1 together with some assumed values that are used to demonstrate the model in section 3. Some of the inputs in table 1 are market derived and require little adjustment. For example, market prices of available houses at time of purchase, $P_0$, are relatively easy to verify. Likewise reliable estimates can be formed of purchase and resale transaction costs; including taxes, contemporary mortgage interest rates and arrangement fees. Usually it is easy to determine imputed rent by comparing rental yields of properties similar to ones that the prospective owner would rent if they decided against buying, but adjusted downwards to account for the maintenance and insurance costs included in the rental payments. Other inputs, such as the discount rate, inflation forecast and real growth rates, require judgement and are harder to determine precisely.

For individuals, the expected holding period is important because it determines the period over which round trip transaction costs can be amortised so that the longer the period the lower the cost. In addition, during periods of rising prices longer holding periods allow the value of

the inflation hedge tied to ownership to be realised. Risk managers and policymakers working at the aggregate level, can use known averages for holding periods as a working assumption, whereas individuals may form estimates about their likely holding period based upon personal circumstances such as their employment and financial security, age and life aspirations. Life aspirations often include social pressure from friends and family members, and a desire to transfer wealth to succeeding generations.

It is more challenging to determine appropriate assumptions for the capital appreciation rate, the imputed rental growth rate, average borrowing costs (when not fixed) and the discount rate adjusted for individual circumstances including risk preferences. Suggestions for these are detailed in turn below.

*Risk and capital appreciation rates*

Ungeared housing assets display less variability in returns than equity markets but for many households the variability of housing equity is magnified considerably by gearing. For example, if the volatility of ungeared housing is one third that of equity markets, then a loan to value (LTV) ratio of 67% increases the volatility of homeowners' equity to a comparable level to that of an ungeared equity portfolio. In addition, Lin and Vandell (2007) demonstrate that traditional real estate valuation methods understate risk and overstate returns compared to more liquid assets by failing to account for the marketing period, and the need for liquidity experienced by some investors. Their analysis suggests that for US investors in the residential market, with a holding period of less than one year, accounting for marketing period risk increases the risk faced by 3.4 times that estimated using traditional methods. For longer term investors, actual risk is around 40% higher than the risk estimated using traditional methods (Lin and Vandell 2007 p. 321). Various other studies document the variability of housing markets in relation to macroeconomic variables such as consumer price inflation, GDP and household disposable incomes. While prices tend to rise broadly in line with these variables over the long term, considerable deviations from these relationships can persist for periods exceeding ten years (for example, Mizuno and Tabner 2011; Ambrose, Eichholtz and Lindenthal 2013). Therefore, for a long holding period it may be reasonable to use the working assumption that prices will broadly track economic growth rates. However, for shorter periods of less than ten years one could argue that a high risk premium is required around an expected real appreciation rate of zero, to compensate for the potentially wide and unpredictable deviations from trend values and liquidity risk. Arguably the inflation hedging characteristics

of ownership are more likely to be outweighed by transaction costs, liquidity and price risk over shorter periods.

*Rental yields*

At the basic level, the imputed rent *IR* is the annual rent, *R*, of a furnished property that is equally desirable to the one that is available for purchase after deducting both the annual maintenance costs, *m*, required to sustain the value of *R* in *real* terms and the building insurance costs, *i*. Both of these items would normally be included in the rental cost of a furnished let. For housing consumers, the tax rate on *IR* is typically zero enhancing the competitiveness of owned housing relative to many other assets, although exceptions exist such as in Switzerland (Bourassa and Hoesli 2008). A more nuanced approach has been argued on the basis that many households are happy to rent an inferior home to that which they would buy, perhaps because features of rental properties that conflict with their style and values are more easily externalised as being due to the landlord's bad taste and neglect than the same features in an owned property, or: alternatively, because rental properties are seen as a short term solution, with the result that consumers focus more on their primary needs, such as type and distance to work. Hence the wedge between an acceptable owned property and an acceptable rented property reflects some of the consumption component of housing. This can be addressed by deriving the yield from the rental value of a property that the household would be prepared to occupy if they chose to rent, rather than buy.[3] Likewise, some properties are let unfurnished, often at a lower rent and for longer periods, necessitating a corresponding adjustment to the model inputs.

*Risk premiums and discount rates*

The discount rate is the return required by home purchasers to compensate them for the opportunity cost incurred by not investing their home equity capital including down-payments elsewhere (see, for example, Himmelberg, Mayer and Sinai 2005). In the Gordon Growth Model, present value is defined as the cash flow at time *t*, divided by the discount rate less expected growth rates. Hence to calculate the present value of home ownership imputed rents are the numerator, and the discount rate less the expected growth rate is the denominator. Hence, other things being equal one or both of a higher imputed rent or, a lower discount rate, increases the present value of ownership. In this setting, the denominator is often referred to as

[3] In countries where 'do it yourself' (DIY) home improvement is fashionable, it could be argued that the reverse also occurs, whereby households purchase homes in a worse state of repair than they would be prepared to rent with the view to carrying out home improvements in their spare time.

the capitalisation rate (Hendershott and MacGregor 2005). Given the substantial risks to capital arising from homeownership, the discount rate $r_n$ should compensate for the opportunity costs of risk free investments forgone, plus a premium for the risk and illiquidity of housing assets.

Given the fixed physical location of housing assets within specific legal jurisdictions, it is also appropriate to adjust the discount rate to reflect differences in relative legal risks between homeownership and renting. For example, in jurisdictions where tenant protection is high, the insurance premium against rental increases defined in the SSH model is arguably lower because tenants have less fear of rent increases. The SSH insurance premium is a negative component of the discount rate, hence the overall discount rate applied to ownership cash-flows increases when the value of the insurance premium declines. Increasing discount rates lower the present value of the financial benefits to ownership as demonstrated by exhibit 1, note B. Similarly, in the US where mortgage creditor protection is lower than in the UK, as typified by non-recourse mortgages and less onerous personal bankruptcy conditions, the risks of ownership financed by mortgages are lower than for UK consumers. In this setting, the discount rate applied to the financial benefits of ownership should be lower in the US than in the UK. However, such effects might be offset in an efficient capital market if creditors demand higher borrowing costs as compensation for the lower creditor protection.

Regardless of the scaling method used to determine the risk premium, or the assumptions concerning investors' levels of diversification, $r_n$ also varies between individuals depending upon their tax status and funding requirements. Well-funded individuals who expect to hold for the medium or long term may sacrifice expected returns in exchange for the hedge against future increases in housing costs (Han, 2010; 2013). In most jurisdictions where imputed rent is not taxed, it is important to discount using an after tax required return. In addition, when holding periods are finite, a higher risk premium is required to compensate for fluctuations in the resale value of the property encountered when the consumer relocates. In summary, shorter holding periods, or higher LTV ratios warrant a higher discount rate to reflect the greater risk to owners' equity.

*Growth rates of imputed rent and capital*

The nominal imputed rental growth rate, $GR_n$, should not generally exceed the overall level of economic growth in the region in which household occupants are likely to be employed. In a mature economy it is often appropriate to make the simplifying assumption that the $GR_n$ is equal to the rate of inflation so that the real growth rate $GR_r$ is zero. A similar principle

applies to nominal and real house price appreciation rates $GP_n$ and $GP_r$ respectively. However, positive real rental growth and capital appreciation rates are known to persist for long periods in many markets including the US, Japan and the UK (Mizuno and Tabner 2011). Sustained positive growth rates are arguably a result of supply constraints that cause housing costs to take a larger proportion of household income and GDP. Forecasting where the upper bounds of housing's share of GDP lie is challenging. The risk of abnormal positive growth makes the inflation hedging characteristics of ownership more attractive. Indicators of such risks could include situations where the current price level is either far below historical levels relative to GDP, incomes or rents, or far below levels already attained in other regions that have realised similar growth. In these situations, households with a speculative disposition can reasonably incorporate modest positive real growth rates into their assumptions for short/medium term holding periods. Likewise, if they are well-funded and expect their next move will be an upgrade to a more valuable home in the same neighbourhood, a low or even negative discount rate may be accepted in exchange for the inflation hedge conferred by ownership.

# 3 Implementing the model step by step

The first stage is to determine the model inputs. Assumptions used in the worked example are summarised in table 1. The author assumes a repayment mortgage with a 25 year term, a discount rate of 6%, a purchase price of $200,000 and an initial LTV of 50%, so the initial mortgage is $100,000. These parameters are easily varied for sensitivity analysis as in section 4.

## 3.1 Calculate the total purchase cost

From table 1, the total purchase cost, $TP_0$, of the property is,

$$TP_0 = P_0 + F + PC = \$200{,}000 + \$10{,}000 + \$10{,}000 = \$220{,}000 \quad (1).$$

Where $F$ and $PC$ are furnishing – renovation and purchase costs respectively each comprising 5% of the initial $200,000 price.

## 3.2 Determine the initial mortgage principal, $MP_0$, to be borrowed,

The initial mortgage principal is the purchase price less the value of the down-payment provided.

$$MP_0 = P_0 - DP = \$100{,}000 \quad (2).$$

## 3.3 Determine the mortgage payments in arrears and total holding period mortgage payments.

Annual mortgage payments in arrears, *PMP*, for a repayment mortgage equal the cash flows from a level payment annuity with the same number of cash flows and discount rate as the mortgage.[4] So for example, a hypothetical 25 year mortgage with a fixed rate of 6% and a balance of $100,000 would have annual payments of,

$$PMP = MP_0 \div \left[ \frac{1 - \frac{1}{(1+r_m)^T}}{r_m} \right] = \$100{,}000 \div \left[ \frac{1 - \frac{1}{(1.06)^{25}}}{0.06} \right] = \$7{,}823 \qquad (3).$$

The first mortgage payment of $7,823 is comprised of $6,000 of interest and $1,823 of principal repayment. If the expected holding period is, for example, eight years and we assume that the homeowner expects to sell up and repay the outstanding balance at the end of this, then the total mortgage payments during the holding period are $7,823 × 8 = $62,581, excluding sale transaction costs captured by *SC*.

## 3.4 Calculate the future and present value of mortgage interest and principal payments

*Determine the present value of mortgage payments over the holding period*

The present value of mortgage payments made over the holding period can also be calculated using the formula for the present value of an annuity, bearing in mind that the appropriate discount rate for the individual consumer may not be the same as the mortgage financing rate. Using the above example, if the appropriate discount rate is the same as the mortgage rate 6%, we calculate the present value as,

$$PVMP = \$7{,}823 \times \left[ \frac{1 - \frac{1}{(1.06)^8}}{0.06} \right] = \$48{,}577 \qquad (4).$$

[4] Annual payments are used in this example to simplify the illustration, but converting from annual to monthly payments for a real life case is a trivial exercise. The use of monthly, continuous or annual intervals does not change the conclusions reported here. However, when applying the model in practice, the compounding period should be the same as the respective household's financing arrangements, otherwise, the difference could be material enough to alter the recommended tenure choice. An example spreadsheet is available from the author.

*Determine present value of the principal payments over the holding period*

The principal payments in a mortgage increase each period at the rate of mortgage interest, so for example, the principal payment for the first period of $1,823, will have increased by 6% to $1,932 by the second payment and so on. This means that we can calculate the present value of principal payments over the holding period using the formula for a growing annuity as in eq. (2), but substituting the mortgage interest rate for the growth rate as follows:

$$PVMPP = MPP_1 \times \left[ \frac{1 - \left( \frac{1 + r_m}{1 + r_n} \right)^T}{r_n - r_m} \right],$$

which in our above example is,

$$PVMPP = \$1{,}823 \times \left[ \frac{1 - \left( \frac{1.06}{1.0600001} \right)^8}{0.0600001 - 0.06} \right] = \$13{,}756 \qquad (5).$$

Note that, this method only works when the discount rate does not exactly equal the mortgage rate. In our example, the discount rate is the same as the mortgage rate causing the denominator, $r_n - r_m$, in the growing annuity factor to be zero. Therefore, we adjust the discount rate by a tiny amount, in fact an amount as small as $1 \times 10^{-9}$ works to within $0.01 in the above example. Given that estimation of discount rates is always imprecise, it is trivial to ensure that it never exactly equals the mortgage rate.

*Determine the interest component over the holding period*

Continuing the above example, we know that the present value of the mortgage payments made over the holding period is $48,577 and that the present value of principal payments is $13,756, hence the present value of the interest payments made over the holding period is $48,577 – $13,756 = $34,821.

## 3.5 Determine the principal outstanding at the end of the holding period

The total principal paid during the holding period can be calculated as the future value of an annuity in which the first principal payment is the cash flow and the discount rate is the

mortgage interest rate. Hence the principal outstanding, $MP_T$, is the original loan amount less the principal paid as in,

$$MP_T = MP_0 - PP_1 \times \left[ \frac{(1+r_m)^T - 1}{r_m} \right] =$$

$$\$100{,}000 - \$1{,}823 \times \left[ \frac{(1.06)^8 - 1}{0.06_m} \right] =$$

$$\$100{,}000 - \$18{,}040 = \$81{,}960 \qquad (6).$$

## 3.6 Forecast the net future resale value and calculate the present value

Using the inputs assumed in table 1, net future resale value is calculated using the formula,

$$NP_T = P_0 \times (1 + GP_n)^T - SC - MP_T = \$195{,}801$$

$P_T = 1.05^8 \times 200{,}000 = \$295{,}491$, $SC = 0.06 \times \$295{,}491 = \$17{,}729$ and $MP_T = \$81{,}960$ (7).

The present value of $NP_T$ is,

$$PVNP_T = NP_T / (1 + r_n)^T = \$122{,}848 \qquad (8).$$

## 3.7 Determine the imputed rent and its present value

The net rental saving (imputed rent) from ownership is,

$$IR = R - i - m - TIR \qquad (9).$$

So from our example in table 1, the gross rent, *R*, is \$12,000, *i* and *m* are each \$2,000 and tax on imputed rent, *TIR*, is zero, so *IR* is \$8,000. If we make the simplifying assumption that *i*, *m* and *TIR* remain a fixed portion of *R*, we can calculate the present value of imputed rent, *PVIR*, using the formula for calculating the present value of a growing annuity as in,

$$PVIR = IR_t \times \left[ \frac{1 - \left( \frac{1+GR_n}{1+r_n} \right)^T}{r_n - GR_n} \right]$$

Again, from table 1, $\left[\frac{1-\left(\frac{1+0.05}{1+0.06}\right)^{8}}{0.06-0.05}\right] \times \$8{,}000 = 7.3 \times \$8{,}000 = \$58{,}421$ (10).

### 3.8 Calculate the net present value of all cash flows over the holding period

Present value of total cash inflows are: \$122,848 + \$58,421 = \$181,269

The present value of total cash outflows excluding selling costs are:

*DP* + *F* + *PC* + *PVMIP* + *PVMPP* = \$100,000 + \$10,000 + \$10,000 + \$13,756 + \$34,821 = \$168,577.

Hence the NPV is \$12,692 = \$181,269 – \$168,577.

The breakeven discount rate (internal rate of return) generating an NPV of zero is 7.37%.

[Exhibit 2 about here]

### 3.9 Synopsis

Application of the above process for the guidance of individual households can be distilled into the 11 steps identified in Exhibit 3. Exhibit 4 provides a five step distillation of the process for policymakers and professional investors who may wish to apply the process to determine whether to cap LTV ratios, require financial institutions to hold more capital, or to evaluate the cost of subsidies to homeownership such as mortgage guarantees, right to buy and shared equity schemes. Investors may apply the same analysis to guide judgements about whether or not to invest in mortgages, bank equity or other housing related assets. Likewise, bank risk managers may use the analysis to guide lending decisions.

[Exhibit 3 about here]

[Exhibit 4 about here]

## 4 Analysis of model outputs

Figures 1 through 5 plot NPVs calculated as in section 3 for the purchase of a hypothetical home at a market price of \$200,000 through different holding periods. Assumed purchase costs including legal fees, transaction taxes, furnishing and refurbishment amount to \$20,000 and resale transaction costs are assumed to be \$12,000 at current prices. The different charts represent variations in the relationship between key inputs and demonstrate how these

relationships interact with the NPV for different holding periods. The five charts demonstrate that NPV usually increases in a non-linear fashion with holding period. The form of this relationship depends upon the financing arrangement, inflation and the spread between imputed rental yields and discount rates. So for example, if the imputed rent yield is 5% and the discount rate is 4%, the spread is 1%. Conversely, if the yields are 4% and discount rates 5%, then the spread is minus 1%. [5]Overall, both: (a) the rate at which NPV rises with holding periods and; (b) the total NPV achievable, increase as spreads and inflation increase, thus enabling the breakeven NPV of zero to be realised over shorter holding periods.

## 4.1 Analysis of financing variations when real rental growth is zero

[Figure 1 about here]

Figure 1 demonstrates how the NPV breakeven holding period and NPV range varies according to changes in the discount rate for a fully funded housing consumer when the imputed rental yield is constant at 4.5%; inflation and the real growth in imputed rental yields and house prices are all held at zero. Purchase and resale transaction costs are as assumed in table 1 giving round trip costs of $32,000 for a hypothetical holding period of zero. When the discount rate is 3% so that the spread (imputed rent less the discount rate) is 150 basis points, a breakeven NPV of zero after transaction costs is achieved within a holding period of 12 years. In this setting the NPV continues to increase to reach $60,990 by the end of the 60 year evaluation period. When the spread is compressed to 50 basis points by increasing the discount rate to 4%, the holding period required for NPV to breakeven is extended to 51 years. Breakeven NPV is never achieved when the required return matches the imputed rental yield (zero spread), while a negative spread of 50 basis points results in an NPV that gradually declines towards a negative $40,000 as the holding period is extended to 60 years. In the last setting, a housing consumer may determine that a 50 basis point negative spread is a reasonable price to pay for the consumption benefits of ownership. Alternatively, household who is indifferent about the consumption benefits of owning versus renting, may still find the 50 basis point negative spread from ownership to be good value as an insurance premium against increases in future housing costs, as in the SSH model.

[Figure 2 about here]

[5] If tax relief on mortgage interest is greater than zero, the net mortgage financing rate is correspondingly reduced by the amount of relief available.

A somewhat different approach to analysing the spread of imputed rent over the discount rate is adopted in figure 2. Here, imputed rent, inflation, capital appreciation and rental growth rates are all assumed to be zero. In this hypothetical scenario, a positive spread is achieved by allowing the discount rate to be negative. In the context of Han (2010) such a scenario could occur when households perceive the investment risk of ownership to be low, but the risk of housing cost inflation to be high with the result that the inflation insurance conferred by ownership is valuable enough to warrant a negative discount rate. In this setting, a positive spread of 2% gives a breakeven holding period of around 8 years if the other assumptions are held constant. Furthermore, the NPV increases at an increasing rate as the holding period is extended. When the spread is zero, transaction costs are never recovered but the NPV never declines below transaction costs. However, when the imputed rental yield is less than the discount rate so that the spread is negative, NPV declines as holding period increases. Unlike in figure 1, the positive spread resulting from a negative discount rate results in a convex relationship between NPV and holding period cash-flows, with the result that, the present value of cash flows increase as they move further into the future, i.e. inverse compounding.

## 4.2 The role of inflation for a fully funded purchaser

[Figure 3 about here]

The previous section demonstrates how breakeven NPV holding periods vary according to the spread between imputed rental yields and the required return on the capital invested when inflation is held constant at zero. Holding, inflation, capital appreciation and imputed rent constant at zero, figure 2 allows us to focus directly upon the spread between imputed rent and the discount rate. In figure 3, the discount rate is also held constant at zero together with real prices and rents but inflation varies for each line plot. Presenting figures 2 and 3 in this way allows a near direct comparison of the relationships between the spread of imputed rent over discount rates and holding periods in determining NPV and between inflation and holding periods in determining NPV. This comparison reveals that inflation and spreads are nearly identical in their effect on NPV for a given holding period. Thus, as with the 2% spread plotted in figure 2, two percent inflation results in NPV breaking even after eight years and rising towards $400,000 as the holding period is extended to 60 years. Hence the inflation hedging characteristics of housing documented by (Sinai and Souleles 2005) mean that even when imputed rent, the discount rate and capital appreciation are all zero, ownership confers a benefit provided that inflation is positive. Conversely, when inflation is zero or negative, nominal rents

are constant or declining so that breakeven NPV is never reached unless the yield spread of imputed rent over the required return is sufficiently positive to cancel out the negative effects of deflation.

### 4.3 The role of inflation for a mortgage financed purchase with a LTV of 90%

[Figure 4 about here]

In figure 4 we extend the analysis of figures 1 - 3 to examine how NPV is determined when the purchase is made using a mortgage with an initial LTV of 90% and an interest cost of 3% pa. Imputed rent and the discount rate are both 4.5% resulting in a spread of zero. We can see immediately that with inflation at zero breakeven NPV occurs when holding periods exceed 16 years. NPV slowly rises to a maximum of $9,500 for holding periods of 60 years. Breakeven is only reached because the financing cost (3%) is lower than the discount rate and imputed rental yield. When inflation is 1%, the NPV breaks even after a holding period of 8 years and gradually rises to around $60,000 as holding periods are increased. With inflation at 2% NPV turns positive within six years gradually rising to $130,000 by the end of the evaluation period. Clearly inflation is very helpful to homeowners. One might argue that the discount rate should decline as the holding period increases, due to deleveraging as the mortgage principal is repaid. This might be justifiable if the housing consumer was confident that their holding period would be longer than the mortgage repayment period. The model could accommodate this scenario by using a discount rate that reflected the average cost of capital over the anticipated holding period. This could justifiably be less than the initial mortgage rate due to savings likely to arise from refinancing. As in figure 3, when inflation is positive the rise in NPV observed as holding period increases reflects the return from the inflation hedge.

### 4.4 Returns to ownership under a range of plausible scenarios

[Figure 5 about here]

Central banks in developed markets typically target CPI inflation within the 1 to 3% range. It is therefore reasonable to forecast that inflation will mean revert around target levels unless policy objectives are changed. In addition, in many areas rising population density, fragmentation of families and economic growth that outstrips the supply of available dwellings result in both rents and capital values increasing ahead of inflation for periods in excess of the expected tenure period. Such arguments are often used to justify purchases, even when imputed rental yields appear to make ownership costly compared to renting. Indeed the risk of rapid

price appreciation arguably makes owning more attractive as the value of the hedge against housing cost inflation is greater (Han 2010). Although it is implausible to assume that property prices will increase ahead of aggregate economic growth rates indefinitely, such economic imbalances can and do persist over periods long enough to encompass the average holding periods of many households (Himmelberg et al., 2005; Mizuno and Tabner 2011). Historical excess real returns to ownership provide motivation for housing consumers to seek excess returns via speculation, or to hedge against the risk of abnormal price increases. The assumptions required to make such a position financially attractive are examined in figure 5. NPV is plotted against holding periods for five scenarios in which CPI inflation is assumed to be 2% but real capital and rental appreciation rates are allowed to differ modestly from zero. The illustration is for a housing purchaser financed by a 25 year repayment mortgage with an initial LTV ratio of 90%, a mortgage financing cost of 3%, a discount rate of 6% and an initial imputed rental yield of 4.5%.

If both prices and rents are allowed to increase at a real rate of 1% pa over the entire holding period, NPV breakeven is reached within 5 years. If the holding period is extended NPV reaches $113,588 after 60 years. If only rents increase by 1% pa in real terms breakeven NPV is reached within 6 years and increases to around $100,000 after 60 years. In the scenario where both real imputed rent and real capital appreciation are both zero, breakeven NPV is still reached within six years and continues to rise thereafter to $55,000 after 60 years. Even when both real rent and real capital values depreciate at 1% pa, breakeven NPV is reached within 10 years when the other assumptions remain unchanged.

## 4.5 Critical considerations for the financial evaluation of tenure choices

Five critical issues for evaluating the financial consequences of tenure choice emerge from the above analysis. These are: (1) length of tenure or holding period; (2) relative risk of inflation versus deflation; (3) the imputed rental yield; (4) the risk of real changes in housing costs and; (5) the discount rate applicable to the individual household. In fact, more crudely, if the sum of 2, 3 and 4 minus 5 are positive, then breakeven NPV will be achieved if the holding period is sufficiently long.

*One – Length of tenure or holding period*

Transaction costs are substantially higher when purchasing rather than renting a home and are augmented by transaction taxes[6]. Under reasonable assumptions holding periods of five or more years are required to cover the financial transaction costs of home purchases but longer holding periods are required if economic conditions and tax rates are less favourable. In the UK the average holding period has increased, from 10 years in the 1980s to 14 years during the period, 2002 – 2003, and 21 years by 2015, but with big variations between cities such as Liverpool, 28 years, and Belfast, 12.6 years (Hometrack, 2015). In the US, estimates vary from 11.5 years for first time buyers and 15 years for repeat buyers (Emrath, 2013). Therefore the average UK or US home buyer would achieve a positive NPV under the majority of scenarios examined in this study.

*Two – Inflation versus deflation*

The cumulative effects of inflation or deflation become more apparent as holding periods increase. Inflation favours ownership while deflation favours renting; however, their effect on individual households differs. Furthermore, households' perceptions of the relative threats may be biased by their recent experiences or that of their parents (representativeness) to the extent that they may not adequately update their risk assessments to take into account contemporary economic conditions. It is arguable that the inflation hedging characteristics of ownership are of greater benefit to younger households that are likely to trade up to a more valuable house in the same locale. However, if younger households need a higher loan to value ratio, the risk of deflation wiping out their equity and thus making it difficult for them to move at all is greater. Typically, younger households are more likely to have shorter holding periods and to relocate to a different region where the inflation hedge of the first purchase may not be effective. Therefore ownership is likely to be most effective as an inflation hedge for younger households who are unlikely to move in the next 10 years and when they do move are likely to stay within the same region and be able to accumulate substantial equity during their first period of ownership tenure. The risk of deflation renders the inflation hedging characteristics of ownership less valuable for households who are likely to relocate to a region with different housing market characteristics, households who are unable to accumulate substantial equity,

[6] For example, in the UK prior to the 5th April 2015 Stamp Duty Land Tax (stamp duty) was chargeable against the value of the entire transaction at a rate that varies with the transaction value. The rate was zero on transactions up to £125,000, 1% for transactions from £125,000 – £250,000 and the top rate was 7% on transactions of £2,000,000 or above (Her Majesty's Revenue and Customs 2014).

households whose tenure period is likely to be short and households whose next move is likely to be into less valuable accommodation.

*Three – Imputed rental yield*

The imputed rental yield is determined by current market conditions affecting the relevant housing type, by individual households' marginal tax rates and also by the local tax treatment of housing costs. For example, reliefs on mortgage interest, rents, or imputed rents.

*Four – Risk of positive or negative real growth rates in rent and capital values*

The long run relationships between housing costs, GDP, inflation and incomes are mean reverting but phases of misalignment sometimes extend for ten or more years providing opportunities for households to realise abnormal gains or losses (Mizuno and Tabner 2011). Balancing these risks requires the provision of objective information regarding sustainability of real growth rates in the context of historical boundaries of the share of GDP accounted for by housing; the demographic and macroeconomic conditions in the region concerned and individual household characteristics. These factors should allow reasonable confidence intervals for real growth rates to be established. The net present values from the established range of reasonable assumptions can then generated.

*Five – discount rate specific to the individual household*

In jurisdictions where imputed rents are free of tax the discount rate applied should reflect the opportunity cost of household capital appropriately adjusted for the marginal tax rate on investment income.

## 4.6 Adapting the model to individual cases

Every effort has been made to illustrate the generalisability of the model to different financial circumstances. However, in recognition that it is not always possible to foresee every eventuality, it is helpful, when presented with a novel prospect to undertake the process illustrated in exhibit 5 and consider whether the novelty effects net imputed rent, the financing cost or an individual cash flow.

[Exhibit 5 about here]

For example, an opportunity to purchase below the market value, perhaps from a distressed seller or a generous family member, will reduce the cash outlay on purchase but is unlikely to reduce the resale value. If the alternative rent is the market rent, the net rental yield will be

correspondingly higher than if the purchase had been for market value. The real expected capital appreciation rate over the holding period will also be higher if the property is sold at the market price. Alternatively, if a client is concerned about job insecurity and a risk that their labour income may decline in real terms, a higher discount rate would be appropriate. Finally, it is important to stress that the focus of this approach is purely on the financial implications of tenure choice. Therefore, if a client has sufficient financial resources and believes that the consumption benefits of ownership are sufficiently great, then the emotional, social or other rewards of consumption may justify a choice that is financially costly according to the analysis presented here. The analysis simply provides a means by which the client can quantify the financial implications of her/his consumption preferences.

# 5 Conclusion

Using a plausible range of assumptions, the author demonstrates how the net present value of homeownership varies with changes in the holding period. If there is modest inflation and a holding period greater than five years, but real rental growth rates are zero and the imputed rental yield is the same or slightly less than the homeowner's cost of capital, home purchases are likely to be financially beneficial. This is consistent with the argument that ownership provides an inflation hedge for future housing demand (Sinai and Souleles 2005). Even when inflation is zero, a modest positive spread between the imputed rent and the cost of capital tips the balance in favour of ownership if holding periods are long enough. Deflation tilts the balance in favour of renting unless it is offset by a sufficiently high spread of imputed rent over the cost of capital. At the margins, differences in risk preferences and marginal tax rates result in different costs of capital and hence, different answers to the question, is it better to buy or to rent across households. However, when macro-economic conditions result in positive/negative net present values for homeowners at the aggregate level it implies the existence of wealth transfers from renters and mortgage providers to homeowners and vice versa during periods of inflation/deflation.

While other studies have examined housing tenure decisions, to the author's knowledge, no other studies, examine the combined roles of holding period, inflation and spread of imputed rent over financing cost in the context of repayment mortgages. The present approach allows evaluation of individual household financing choices when tax rates, discount rates and holding periods vary. Financial planners should take expected holding periods into account when counselling clients about the financial implications of housing tenure decisions. Vulnerability

to housing cost inflation together with the nature of anticipated future housing transitions, leverage and risk preferences should be considered when determining an appropriate cost of capital. Economic analysts assessing the macro stability of housing and mortgage markets should also account for average holding periods, inflation expectations and the nature of housing transitions implied by the relevant population's demographic profile. Inflationary policies, mortgage tax relief and an absence of tax on imputed rent without offsetting reliefs on actual rent all favour ownership with disproportionate benefits accruing to those with higher marginal tax rates. Transaction taxes increase the attractiveness of renting but reduce labour mobility for those for whom the consumption benefits of ownership merit payment of the transaction tax.

# 6 References


Aaronson, Daniel. 2000. "Benefits of Home Ownership." *Journal of Urban Economics*, vol. 47, no. 3:356 – 369.

Ambrose, Brent W., Eichholtz, Piet A., and Thies Lindenthal. 2013. "House Prices and Fundamentals: 355 Years of Evidence." *Journal of Money Credit and Banking*, vol. 45, no. 2 – 3:477 – 491.

Becker, Thomas A., and Reza Shabani. 2010. "Outstanding Debt and the Household Portfolio." *Review of Financial Studies*, vol. 23, no. 7:2,900 – 2,934.

Beracha, Eli, and Ken, H. Johnson. 2012. "Lessons from Over 30 Years of Buy versus Rent decisions: Is the American Dream Always Wise?" *Real Estate Economics*, vol. 40, no. 2:217 – 247.

Coulson, N. Edward, Seok-Joon Hwang, and Susumu Imai. 2003. "The Value of Owner Occupation in Neighbourhoods." *Journal of Housing Research*, vol. 13, no. 2:153 – 174.

Coulson, N. Edward, and Lynn M. Fisher. 2009. "Housing Tenure and Labour Market Impacts: The Search Goes On." *Journal of Urban Economics*, vol. 65: 252 – 264.

Emrath, Paul. 2013. "Latest Study Shows Average Buyer Expected to Stay in Home 13 Years", National Association of Housebuilders, January 3rd 2013. Accessed 8th July 2016 at: http://nahbclassic.org/generic.aspx?genericContentID=194717

Glaeser, Edward L., Joseph Gyourko, and Albert Siaz. 2008. "Housing Supply and Housing Bubbles." *Journal of Urban Economics*, vol. 64, no. 2:198 – 217.

Han, Lu. 2010. "The Effects of Price Risk on Housing Demand: Empirical Evidence from U.S. Markets." *Review of Financial Studies*, vol. 23, no. 11, pp. 3889 – 3928.

Han, Lu. 2013. "Understanding the Puzzling Risk-return Relationship for Housing." *Review of Financial Studies*, vol. 26, no. 4:877 – 928.

Haurin, Donald R., and H. Leroy Gill. 2002. "The Impact of Transaction Costs and the Expected Length of Stay on Homeownership." *Journal of Urban Economics*, vol. 51, no 3:563 – 584.

Haurin, Donald R., Robert, D. Deitz, and Bruce A. Weinberg. 2003. "The Impact of Neighbourhood Homeownership Rates: A Review of the Theoretical and Empirical Literature." *Journal of Housing Research*, vol. 13, no. 2:119 – 151.

Hendershott, Patrick, H. 1983. "Government Policy and the Allocation of Capital between Residential and Industrial Uses." *Financial Analysts Journal*, vol. 39, no. 4:37 – 42.

Hendershott, Patrick, H. and Bryan, D. MacGregor. 2005. "Investor Rationality: Evidence from the UK Property Capitalization Rates." *Real Estate Economics*, vol. 33, no. 2:299 – 322.

Henderson, John, V., and Yannis, M. Ioannides. 1983. "A Model of Housing Tenure Choice." *American Economic Review*, vol. 73, no. 1:98 – 113.

Hennessey, Sean, M. 2003. "Housing Choice and Household Wealth." *Financial Services Review*, vol. 12, no. 1:143 – 164.

Her Majesty's Revenue and Customs. 2014. "Stamp Duty Land Tax Rates Tables - Quick Reference." accessed on 1st December 2014 at: http://www.hmrc.gov.uk/sdlt/rates-tables.htm

Himmelberg, Charles, Christopher Mayer and Todd Sinai. 2005. "House Price Fundamentals." *Journal of Economic Perspectives*, vol. 19, no. 4:67 -92.

Hometrack. 2015 "Hometrack UK Cities House Price Index", Hometrack, 22nd May 2015, https://www.hometrack.com/uk/about-us/press-room/april-2015-hometrack-uk-cities-house-price-index-figures-released/.

Jian, Zhou. 2010. "Testing for Cointegration between House Prices and Economic Fundamentals." *Real Estate Economics*, Vol. 38, No. 4, (Winter):599 – 632.

Lin, Zhenguo, and Kerry, D. Vandell. 2007. "Illiquidity and Pricing Biases in the Real Estate Market." *Real Estate Economics*, vol. 35, no. 3:291 – 330.

Linneman, Peter. 1985. "Tenure Choice." *Journal of Urban Economic*s, vol. 17, no. 2:230 – 246.

Munch, Jacob Roland, Michael Rosholm, and Michael Svarer. 2008. "Home Ownership, Job Duration and Wages." *Journal of Urban Economics*, vol. 63:130 – 145.

Mizuno, Mitsuru, and Isaac, T. Tabner. 2011. "The Margin of Safety and Turning Points in House Prices: Observations from Three Developed Markets." *Financial Analysts Journal*, vol. 67, no. 3:76 – 93.

Mills, Edwin, S. 1987. “Has the U.S. Overinvested in Housing?” *Real Estate Economics*, vol. 15, no. 1:601 – 616.

Poterba, James, M. 1992. “Taxation and Housing: Old Questions, New Answers.” *The American Economic Review*, vol. 82, no. 2:237 – 242.

Shelton, John, P. 1968. “The Cost of Renting Versus Owning a Home.” *Land Economics*, vol. 44, no. 1:59 – 72.

Shiller, Robert, J. 2007. “Understanding Recent Trends in House Prices and Homeownership, *NBER Working Paper (October) No. 13553*.

Shiller, Robert, J. 2014. “Speculative Asset Prices”, *American Economic Review,* Vol. 104, No. 6, pp. 1486 – 1517.

Sinai, Todd, and Nicholas, S. Souleles. 2005. “Owner-occupied Housing as Insurance Against Rent Risk.” *Quarterly Journal of Economics*, vol. 120, no. 2, (May):763-789.

Smith, Margaret, H. and Gary Smith. 2006. “Bubble, Bubble, Where’s the Housing Bubble?” *Brookings Papers on Economic Activity*, 2006, no. 1:1 – 67.

Sekkat, Khalid, and Ariane Szafarz. 2011. “Valuing home ownership.” *Journal of Real Estate Finance and Economics*, vol. 43, no. 4:491 – 504.

Taylor, Lorie, L. 1998. “Does the United States Still Overinvest in Housing?” *Federal Reserve Bank of Dallas, Economic and Financial Policy Review*, Second Quarter:10 – 18.

## Exhibit 1 – Model to Determine the Net Present Value of Ownership versus Renting

| |
|---|
| NPV of ownership equals: PV of the total benefits of ownership minus the PV of the total costs of ownership |
| PV of the total benefits of ownership equals:<br>PV of imputed rent during the holding period.<br>plus PV of the expected future resale value less sale transaction costs and the mortgage principal outstanding at time of resale. |
| PV of total costs of ownership equals:<br>Initial down-payment.<br>plus Initial purchase transaction costs.<br>plus Initial capital expenditure that would normally be avoided by renting, e.g. furnishing and refurbishment costs.*<br>plus The PV of future mortgage principal payments.<br>plus The PV of future mortgage interest payments. |
| *Note A:* Disaggregating mortgage interest from principal payments allows for the possibility that different tax reliefs and or charges may exist on mortgage interest, principal payments and imputed rents, while the discount rate may not equal the mortgage financing rate. In fact, appropriate discount rates vary between individuals due to differing tax rates, risk preferences, size of down-payments and credit ratings. *Often rental properties are furnished, thereby saving renters substantial upfront costs on furniture, although, this is not always the case as some properties are let unfurnished, typically for longer periods. For unfurnished lets, the rent is typically lower so if such a comparator is used, the present value of owners imputed rent will be lower to reflect the reduced cost saving from renting.<br><br>*Note B:* Present value and future value are standard concepts in financial mathematics relating to compound interest and discount rates. So for example, if the appropriate interest rate or discount rate, $r$, is 10%, the present value of £100 invested today would be worth a future value of £100 × $(1 + r)^5$ five years from today, when $r$ is expressed as the decimal (0.10). So the future value is £161.05 i.e. £100 × $1.1^5$. Using the same 10% discount rate, the future value (£161.05) can be converted back to its present value (£100) as follows: £100 = £161.05/$1.10^5$. A critical point to note is that in the present value calculation, the discount rate is always in the denominator, whereas the cash-flow is always in the numerator. This explains the standard principle of finance: that other things being equal, a higher discount rate always results in a lower present value and vice a versa. Likewise, a higher cash flow (numerator) other things being equal, always results in a higher present value. |

## Exhibit 2 – Summary of Model Output and Result

| | | |
|---|---|---|
| NPV of ownership equals: PV of the total benefits of ownership minus the PV of the total costs of ownership | | |
| PV of total benefits from ownership equals: | | |
| | PV of imputed rent during the holding period *(IR).* | $58,421 |
| plus | PV of the expected future resale value less sale transaction costs and mortgage principal at the time of sale. *($P_T - SC - MP_T$ ).* | $122,848 |
| | | $181,269 |
| PV of total costs of ownership equals: | | |
| | Initial down-payment *(DP).* | ($100,000) |
| | Initial purchase transaction costs *(PC).* | ($10,000) |
| | Initial capital expenditure that would not normally be required when renting, e.g. furnishing costs *(F).* | ($10,000) |
| | PV of mortgage interest payments *(PVNMI)* | ($34,821) |
| | PV of mortgage principal payments *(PVMPP).* | ($13,756) |
| | | ($168,577) |
| NPV of ownership versus renting equals: | $181,269 – $168,577 = | $12,692. |

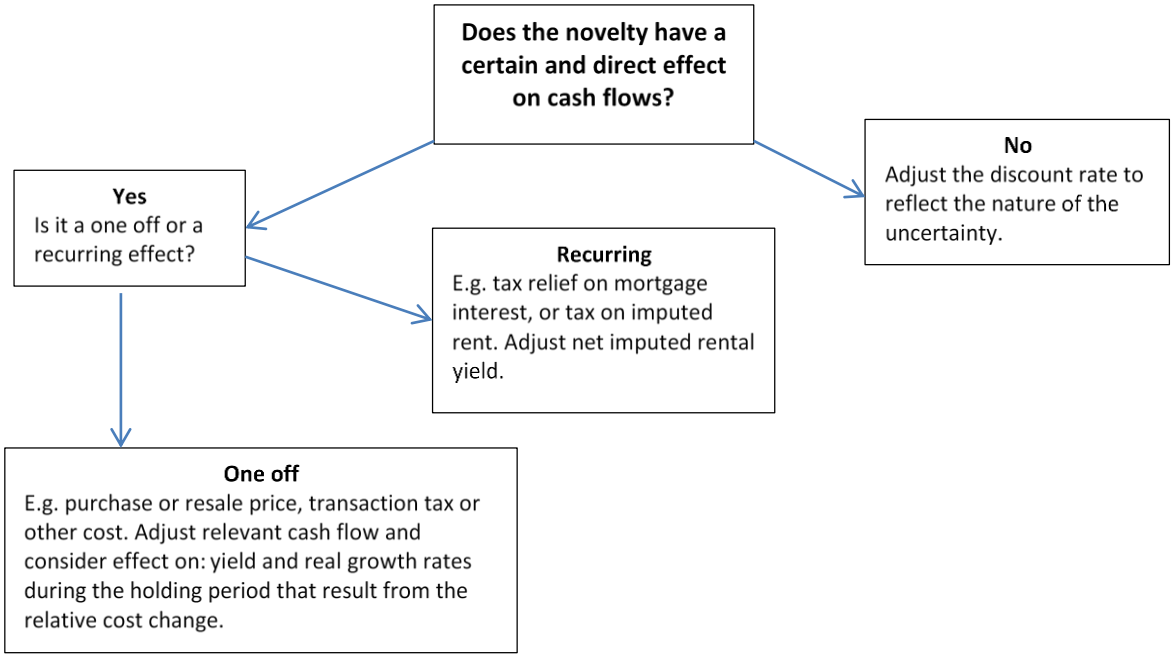
## Exhibit 3 Micro Analysis for Individual Households

| Step | Action |
|---|---|
| 1 | Determine the required housing characteristics. |
| 2 | Determine the expected duration of tenure and a reasonable error range. |
| 3 | Identify both the purchase and rental cost of housing, identified in step 1, and calculate the net imputed rent. |
| 4 | Identify affordability constraints (household solvency and income). |
| 5 | Determine attitude to risk and calibrate risk tolerance with affordability. |
| 6 | Evaluate the inflation hedging ability of human capital and market conditions. |
| 7 | Evaluate the risk of housing cost inflation versus deflation for the household. |
| 8 | Taking into account inflation/deflation risk and household leverage determine an appropriate discount rate. |
| 9 | Calculate the NPV of ownership versus renting following the process detailed in sections 3.1 – 3.8 above. |
| 10 | If the NPV of ownership from the above calculation is outside the range of acceptability or affordability renting is recommended. |
| 11 | If the NPV of ownership is within the acceptability and affordability range, redo the analysis but with assumptions that are at the plausible limit of adversity. For example, higher discount rate, shorter holding period, low inflation or deflation and low or negative real growth rates. In this less favourable scenario if household's financial solvency and risk tolerance render the outputs unacceptable then renting is still recommended. |

## Exhibit 4 Macro Analysis for Policymakers or Investors

| Step | Action |
|---|---|
| 1 | Determine the household population segment that is of concern. |
| 2 | Obtain best available data on average prices, rents, expected inflation, mortgage financing rates, loan to value ratios, holding periods and income. |
| 3 | Put the data into the model for each section of the market for which disaggregated data is available and calculate the breakeven net discount rate ($r - g$) implied from the contemporary market data. Is this plausible given the average LTV ratios and incomes of the respective segment? |
| 4 | Alternatively/additionally, determine an appropriate discount rate to reflect the risk exposure of the respective market segment. Then use this and the market data to derive the implied real growth rates. Are they plausible? |
| 5 | If the results of (3) and (4) above are plausible, redo the analysis but with adverse adjustments to the current market conditions that are at the plausible limit of their range. In this adverse scenario what proportion of households, banks or other relevant parties are insolvent or in financial difficulty? |

## Exhibit 5 Adapting the model to individual cases



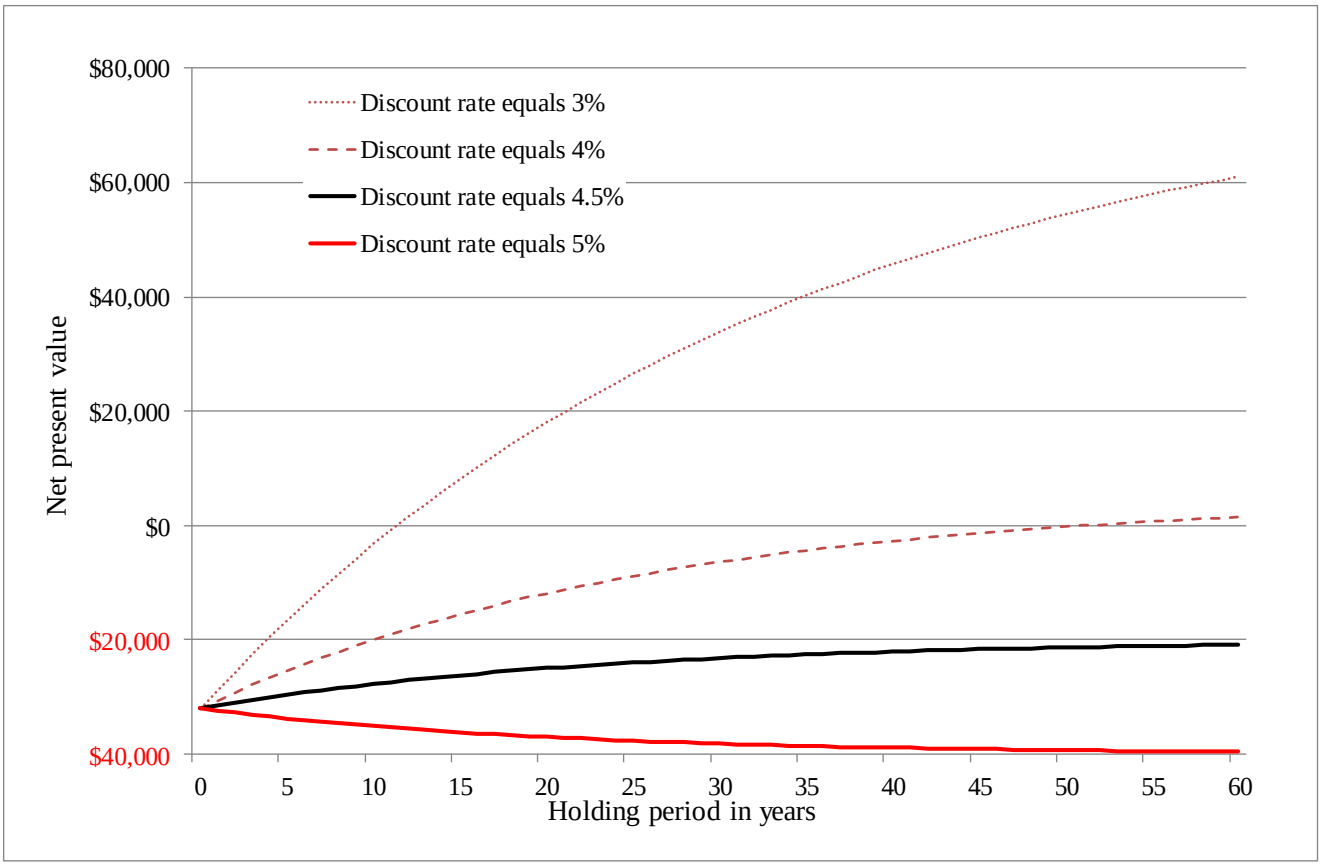
## Table 1 – Definitions, Abbreviations and Assumptions

| no. | Abbrev. | Definition and discussion | Section 3 Assumptions and outputs |
|---|---|---|---|
| 1 | $P_0$ | Market price at the time of tenure decision. | $200,000 |
| 2 | $T$ | Evaluation (holding period) in years | 8 |
| 3 | $MT$ | Mortgage term in years | 25 |
| 4 | $F$ | Initial capital outlay not normally incurred when renting. E.g., cost of purchasing furniture equivalent to that included in a furnished let, and renovation costs typically incurred when acquiring a pre-owned home, percentage of $P_0$. | 5% |
| 5 | $PC$ | Purchase costs, including transaction tax, legal fees, surveyors' fees and mortgage arrangers' fees, percentage of $P_0$. | 5% |
| 6 | $TP_0$ | Total purchase costs, i.e. $TP_0 = P_0 + F + PC$ | $220,000 |
| 7 | $P_T$ | Expected nominal market price of property at the end of the evaluation period. | $295,491 |
| 8 | $SC$ | Selling costs, including transaction tax, legal and agents fees, percentage of $P_T$. | 6% |
| 9 | $NP_T$ | Net sale proceeds, i.e. $NP_T = P_T – SC - MP_T$. Where $MP_T$ is outstanding mortgage principal at the end of the holding period. | $195,801 |
| 10 | $PVCOF$ | Present value of total cash outflows | $168,577 |
| 11 | $PVNP_T$ | Present value of net future resale value | $122,848 |
| 12 | $PVCIF$ | Present value of total cash inflows | $181,269 |
| 13 | $NPV$ | Net present value of buying versus renting | $12,692 |
| 14 | $DP$ | Deposit (down payment). | $100,000 |
| 15 | $i$ | Annual building insurance costs, percentage of $P_t$. | 1% |
| 16 | $m$ | Average annual maintenance cost required to eliminate depreciation, as a percentage of $P_t$. It is assumed that property taxes are paid by both owners and renters and can thus be ignored. However, in countries where property tax is paid exclusively by owners, $m$ may also include property taxes, unless these are accounted for separately, as in Hennessey (2003) or Beracha and Johnson (2012). | 1% |
| 17 | $R$ | Gross rent required to occupy an equivalent fully furnished property percentage of $P_t$. | 6% |
| 18 | $TIR$ | Tax rate on imputed rent. This is zero in most countries but not all, e.g. Switzerland. | 0% |
| 19 | $IR_1$ | Imputed rent saved by owning in the first year of the holding period, $R = R – i – m – TIR$. Note, unlike some studies, the present study does not included financing costs in the definition of imputed rent as these are examined separately. | $8,000 |
| 20 | $PVIR$ | Present value of $IR$ over the holding period equal to the present value of a growing annuity. | $58,421 |
| 21 | $GR_n$ | Assumed nominal annual growth rate in imputed rental cash-flows. | 5% |
| 22 | $GR_r$ | Assumed real annual growth rate in imputed rental cash-flows. | 3% |
| 23 | $GP_n$ | Assumed nominal annual growth rate in house prices. | 5% |
| 24 | $GP_r$ | Assumed real annual growth rate in house prices. | 3% |
| 25 | $CPI$ | Consumer price inflation for converting nominal growth to real growth. | 2% |
| 26 | $NMI$ | Mortgage interest paid during the holding period less tax relief received. This is zero for fully funded purchasers. | 6% |
| 27 | $MTR$ | Marginal tax rate on income from non-housing investments. | 0% |
| 28 | $TRMI$ | Rate of tax relief on mortgage interest. This is zero in some countries. | 0% |
| 29 | $PTR$ | Property tax rate, this is paid by both buyers and renters in some countries | 0% |
| 30 | $CGT$ | Capital gains tax rate, not payable on primary residence in some countries, e.g. UK. | 0% |
| 31 | $r_f$ | Risk free rate of interest for a depositor | 3% |
| 32 | $r_p$ | Percentage risk premium return required by the home owner on top of the contemporaneous risk free deposit rate scaled according to leverage determined by the loan to value ratio. This incorporates the component of opportunity cost that a homeowner forfeits by not renting and investing her/his capital in a portfolio of risky assets such as equities. | 3% |
| 33 | $r_n$ | Nominal discount (capitalisation) rate comprising the risk free return plus the risk premium returns on capital required by a consumer to compensate for risk to the home equity including the down payment and the opportunity cost reflecting the returns that could have been achieved had the consumer rented and invested their funds in the capital markets at a similar level of risk. | 6% |

| no. | Abbrev. | Definition and discussion | Assumption |
|---|---|---|---|
| 34 | $r_m$ | Mortgage interest rate per period | 6% |
| 35 | $r_r$ | Net breakeven real yield implied by the $TP_0$, the $NIR$ and $NP_T$. | 7.37% |
| 36 | $MP_0$ | Amount borrowed, i.e. present value of mortgage principal | $100,000 |
| 37 | $MP_T$ | Mortgage principal outstanding at the end of the holding period, $T$. | $81,960 |
| 38 | $PMP$ | Periodic mortgage payments (i.e. annual or monthly) including interest and principal | $7,823 |
| 39 | $PP_{t=1}$ | Principal payment at period $t$ | $1,823 |
| 40 | $LTV$ | Loan to value ratio, i.e. $MP/P_0$. | 50% |
| 41 | $PVMP$ | Present value of mortgage repayments during the holding period, principal and interest. | $48,577 |
| 42 | $PVMPP$ | Present value of mortgage principal repayments during the holding period. | $13,756 |
| 43 | $PVMIP$ | Present value of mortgage interest repayments during the holding period. | $34,821 |

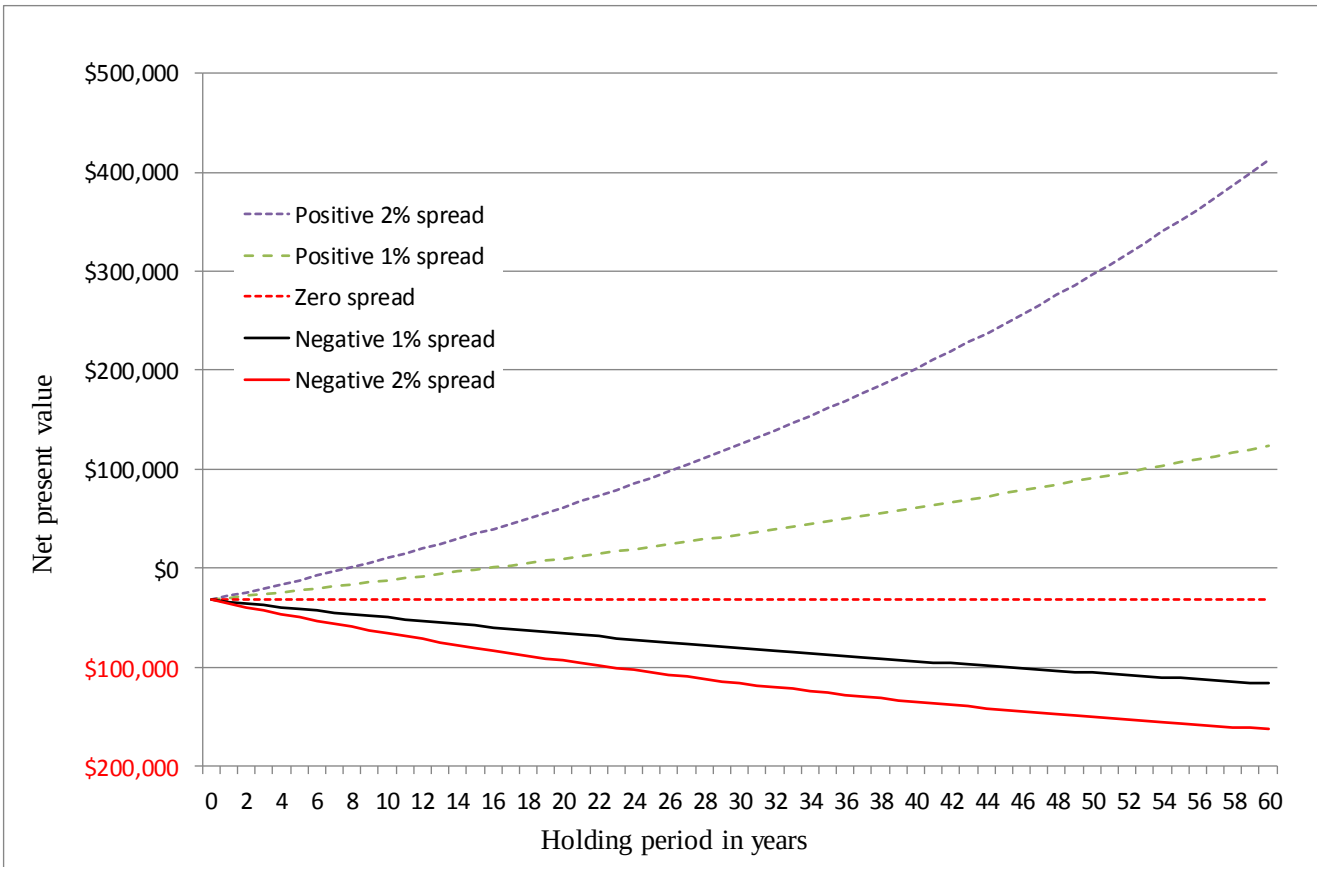
Table 1 lists the name and definitions of inputs to our model and their abbreviated acronyms. In addition, the right hand column reports the assumptions used in the calculation demonstrated in section 3. Some of these fixed assumptions are also used in the analysis in figures 1 through 4. Percentage figures reflect a proportion of the market price. Where these figures are annual, the assumption is made that these costs remain a constant proportion of the market value of the respective house throughout the holding period evaluated.

**Figure 1 – Fully Funded purchase with constant NIR but varying discount rate**



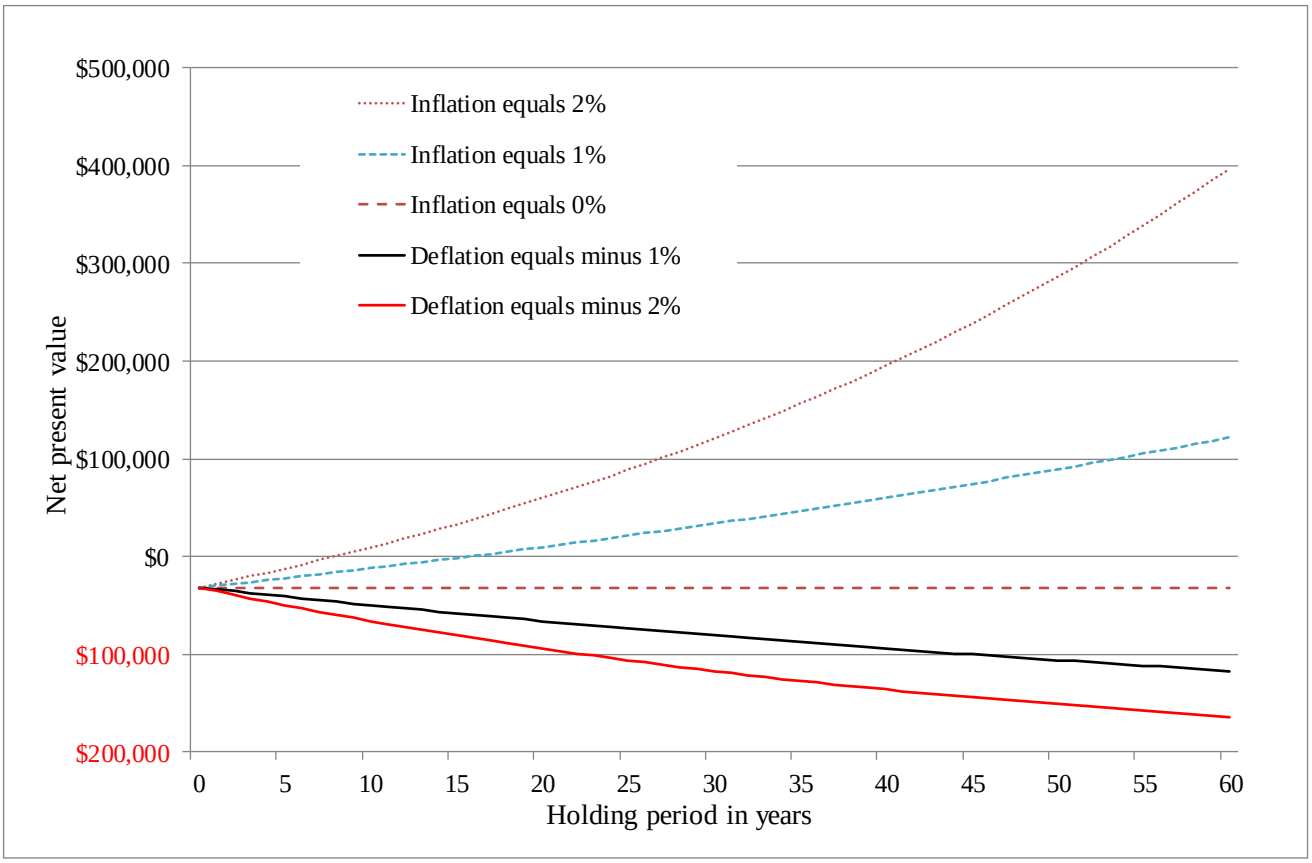

Note: the figure evaluates the NPV over different holding periods for a fully funded housing consumer (no mortgage) when inflation is held at zero; net imputed rent is held constant at 4.5% and the real growth rate of net imputed rent and house price appreciation are both zero. The purchase price ($P_0$) is $200,000. The four plotted lines represent the relationship between holding period and the NPV of purchase when different discount rates are applied. Other assumptions are as in table 1, so that total round trip transaction costs assumed for a purchase followed by an immediate resale are $32,000.

**Figure 2 – Fully funded purchase with different spreads of NIR over the discount rate**



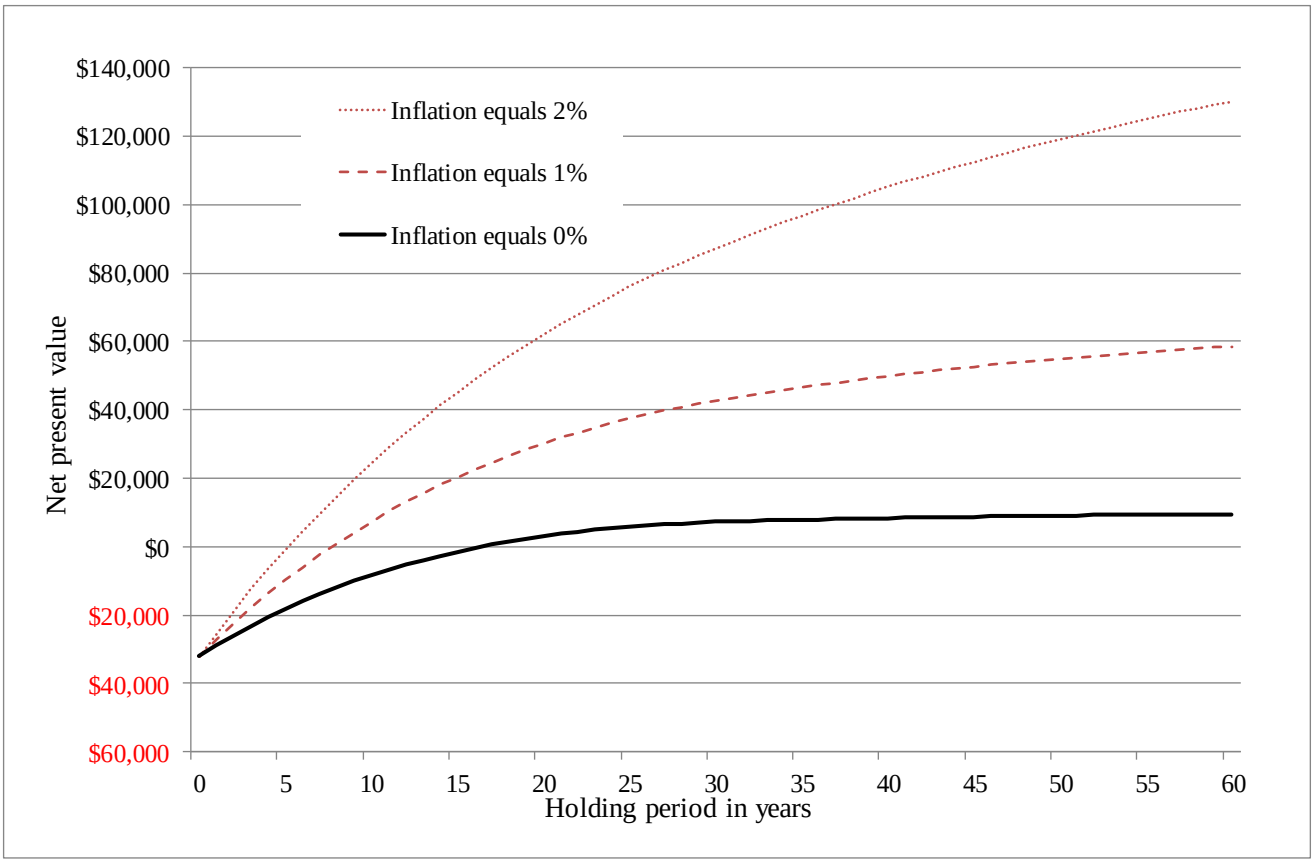

Note: the figure evaluates the NPV over different holding periods for a fully funded housing consumer (no mortgage) when inflation, net imputed rents, the real growth rate of net imputed rent and house price appreciation are all held constant at zero. The purchase price ($P_0$) is $200,000. The four plotted lines represent the relationship between NPV and holding period for different spreads of net imputed rent over the discount rate, allowing for the possibility that discount rates can be negative if the inflation hedging motivation is high. Other assumptions are as in table 1 so that total round trip transaction costs assumed for a hypothetical purchase followed by an immediate resale are $32,000.

**Figure 3 – Fully funded purchase with different levels of inflation or deflation**



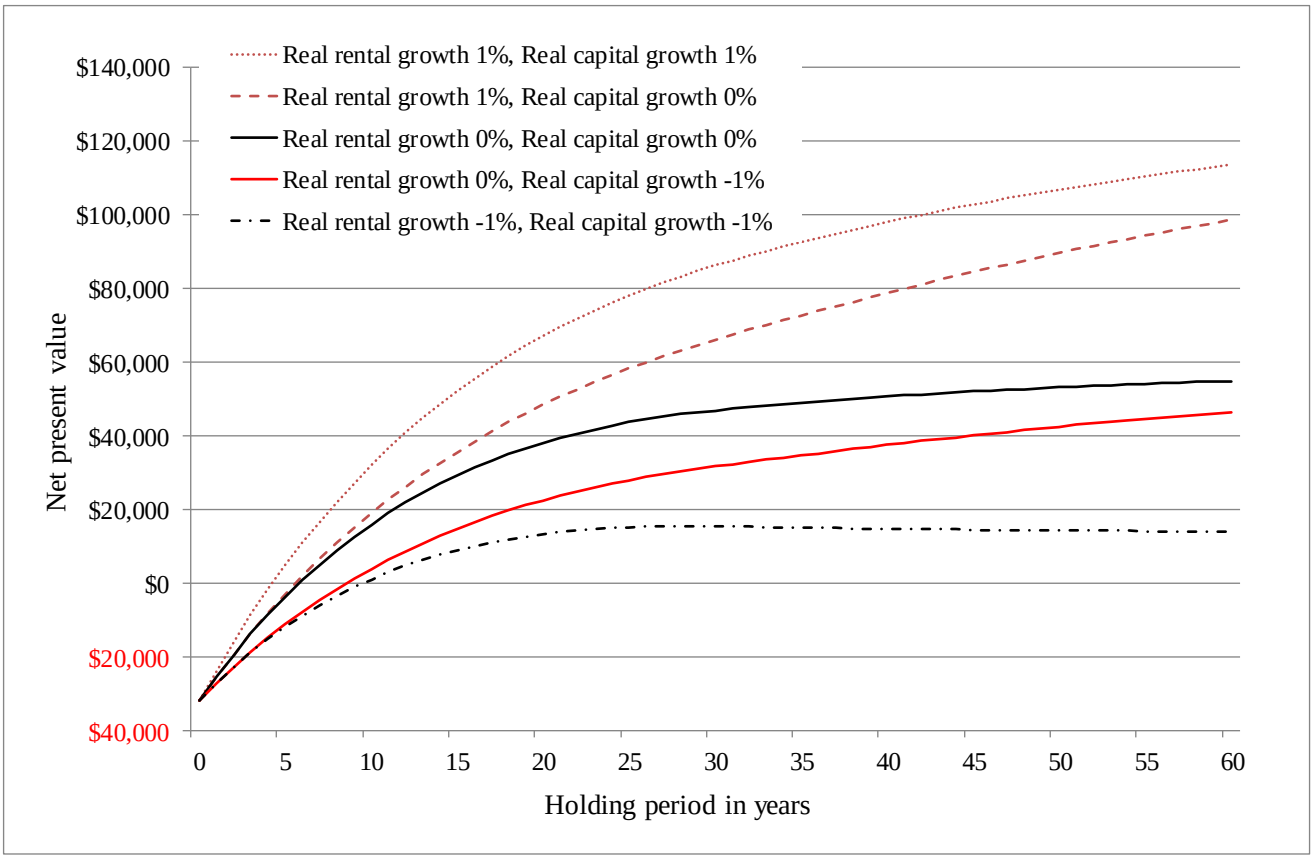

Note: the figure evaluates the NPV over different holding periods for a fully funded housing consumer (no mortgage) when the net imputed rents, the discount rate, the real growth rate of net imputed rent and house price appreciation are all held constant at zero. The purchase price ($P_0$) is $200,000. The four plotted lines represent the relationship between holding period and NPV with different levels of inflation. Other assumptions are as in table 1 so that total round trip transaction costs assumed for a hypothetical purchase followed by an immediate resale are $32,000.

**Figure 4 – Different inflation for a mortgage financed purchase and a LTV of 90%**




Note: the figure evaluates the NPV over different holding periods for a housing consumer financing a purchase with a 25 year repayment mortgage with an initial loan to value of 90%. The average annual interest rate over the mortgage term (or holding period if shorter) is 3% and net imputed rent is held constant at 4.5%; the discount rate is also 4.5%. The real growth rate of net imputed rent and house price appreciation are held constant at zero. The purchase price ($P_0$) is $200,000. The four plotted lines represent the relationship between holding period and NPV with different levels of inflation over the holding periods. Other assumptions are as in table 1 so that total round trip transaction costs assumed for a hypothetical purchase followed by an immediate resale are $32,000.

**Figure 5 –Different real growth rates with a 90% LTV mortgage financed purchase**




Note: the figure evaluates the NPV over different holding periods for a housing consumer financing a purchase with a 25 year repayment mortgage with an initial loan to value of 90%. The average annual interest rate over the mortgage term (or holding period if shorter) is 3% net imputed rent is held constant at 4.5%; the discount (capitalisation) rate is 6% and inflation is held at 2%. The purchase price ($P_0$) is $200,000. The three plotted lines represent the relationship between holding period and NPV with different real growth rates. Other assumptions are as in table 1 so that total round trip transaction costs assumed for a hypothetical purchase followed by an immediate resale are $32,000.