

Mark-to-Market and House Asset Valuation:

An Initial Attempt at Extending the Poterba Model using the Term Structure Of Real Forward Interest Rates

by

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Abstract

Purpose of this Paper: Downward movements in house prices can exacerbate bank crises if mark-to-market methods of asset valuation are used by lenders to assess their current balance sheet exposure. There is an imperative to find methods of house price index calculation that reflect equilibrium prices rather than temporary undershoots.

Approach: This paper proposes a method for house asset valuation that incorporates expected house price appreciation as an endogenous variable. This avoids the necessity to make conjectures about expected future house price appreciation when applying Poterba's (1984) user-cost method of house asset valuation. The methodological extension to Poterba's user-cost method of house asset valuation endogenises expected house price appreciation as the no-arbitrage expected price appreciation consistent with the term structure of real interest rates. A benchmark equilibrium house valuation can be calculated because the term structure of real forward interest rates is observable in financial markets. This enables market house prices to be compared with the benchmark equilibrium valuation in order to determine if house prices are overvalued or undervalued.

Findings: The paper presents the results of a worked example to illustrate how this approach could be applied in practice.

Research Limitations: There are a number of issues associated with the measurement of user cost which we do not address here and which we hope will provide fruitful avenues for future research. There are also issues regarding the impact of tax frameworks on the returns to housing, particularly the taxation of mortgage interest and imputed income. More work also needs to be done in comparing the performance of our extended Poterba model against alternative approaches, such as those that use expected inflation and/or long-run average house price appreciation, or the real interest rate spread to proxy for expected capital appreciation, and how these different approaches compare in different institutional and socio-economic contexts.

Practical Implications: Our results underscore the rationale for mortgage banks to use marking-to-model instead of marking to market, and this in turn should reduce unnecessary macroeconomic instability when the market prices of houses undershoot fundamental value.

Originality: The paper shows how the term structure of real forward interest rates, observable in financial markets, can be used to extend the Poterba model.

1. Introduction

This paper on house valuation considers two inter-related issues. First, existing house valuation rules may contribute to macroeconomic instability by calculating house asset values that systematically deviate from fundamental value. Second, the accepted benchmark user cost approach to house valuation proposed by Poterba (1984, 1991) may be extended to provide more accurate house valuations by incorporating expected house price appreciation as an endogenous variable.

Macroeconomic instability occurs when all banks are obliged to sell their assets at the same time in order to restore liquidity and maintain their solvency. Simultaneous action of this nature reduces the market price of assets, which in turn further destroys banks' equity. As a result, banks are forced to sell even more assets and restrict lending, causing a systemic downwards spiral in stock prices and house prices. Private investors, observing the trend, join in as they likewise seek to limit their losses. This downward spiral can lead to negative asset price bubbles in both the stock market and the house market. But stocks and mortgages hold real value that may be undervalued as market prices are driven below fundamental values in the general rush to liquidate assets during a period when no-one is willing "to catch a falling knife".

The 2008 bank credit crisis provides a good example of this problem. Figures 1 2 and 3 show how the pre-conditions were satisfied for a downwards systemic spiral in asset valuation. Figures 1 and 2 reveal that the western banking system became increasingly vulnerable to liquidity crises as liquidity ratios fell to unprecedented lows, while Figure 3

shows that real estate mortgages and mortgage-backed securities represent a high percentage of total bank assets.

<<<< Figures 1, 2, and 3 about here>>>>

The international banking system was an accident waiting to happen, and any major financial perturbation coming along post 2000 could have caused the financial system to crater. In the event it happened to be the concurrence of sub-prime mortgage lending, the availability of cheap inter-bank lending from far-eastern countries with large current account surpluses, and mortgage securitisation that triggered the collapse. However, it is important to note that that the 2008 crisis was exacerbated by the Basel II requirement that banks use “fair value” mark- to-market valuation.¹

Mark-to-market based valuation of banks’ assets declined in 2008 because the market was illiquid, and markets were illiquid because banks’ assets on marking-to-market valuation were falling. A vicious circle associated with marking-to-market exacerbated the asset valuation problem initially triggered by a downturn in the housing market caused by sub-prime lending and excessive leverage. The downward spiral of asset values based on marking-to-market transformed the 2008 banking liquidity crisis into a crisis of uncertainty as to how to distinguish between banks facing problems of insolvency rather than liquidity.

¹ It is beyond the scope of this paper to present a comprehensive analysis of the various reasons why this crisis emerged. Tim Congdon (2009) states that one of the reasons why the decline in house and stock prices resulted in financial instability is due to a historical decline in the cash/deposit ratio and equity capital to total assets.

A question mark arose over just how far house prices would have to fall before reaching fundamental value, and whether house prices might undershoot to levels below fundamental value causing unnecessary magnification of the financial crisis. Concern about the collateral value of property while house prices were falling and repossessions were rising increased uncertainty as to the insolvency-illiquidity status of banks during the 2008 banking crisis. This uncertainty about insolvency vis-à-vis illiquidity paralysed the initial policy response to the crisis. Like doctors reluctant to administer medicine before they have a clear diagnosis as to which disease needs to be cured, central banks were initially uncertain about the appropriate action. The correct central bank response for a purely liquidity problem is to flood the market with liquidity (i.e. exchange cash for government bonds) because this represents no threat to the taxpayer.² However, simply flooding the market with liquidity is both costly to the taxpayer and ineffective if there is an underlying solvency problem. In this case the worthless assets have to be identified as such and written off as worthless and the banks recapitalised before confidence can be restored.

The analysis in this paper responds with a proposal to improve the accuracy of house asset valuation. Section 2 of this paper extends the conventional application of Poterba's (1984) user-cost method of house asset valuation by proposing an amended formulation of this methodology that incorporates the no-arbitrage expected price appreciation consistent with the term structure of real interest rates. Section 3 discusses the empirical results of this analysis in the context of problems associated with historic valuation and

² This point is quite important if we consider that illiquid and insolvent banks require different rescue strategies. In the first case the central bank can act as lender of last resort in accordance with the *Bagshot principles*, and this carries no cost for the tax payers. In the second case the only possible solution is nationalization.

marking-to-market valuation rules. The analysis suggests that English house prices were over-priced relative to their asset valuation based on mark-to-market rules between 2003 and 2006, and that the extended Poterba user cost technique would have provided a superior basis for banks to value the mortgage collateral value of house assets.

2. The Asset Valuation of Houses

Poterba (1984, 1992) provides the standard asset market model for owner-occupied house market. The user cost of housing U may be calculated as

$$U = P \cdot (i + \tau + \delta - \pi) \quad (1)$$

where P is the house price index, i is the foregone interest rate that the home owner could have earned in the money market, incremented by the property tax rate on owner-occupied houses τ and the rate of depreciation and maintenance δ , less the rate of expected capital appreciation π . In equilibrium the expected user cost of owning a house should equal the cost of renting R . This implies that the user cost may be expressed as:

$$R = P \cdot (i + \tau + \delta - \pi) \quad (2)$$

and by re-arranging (2)

$$P = \frac{R}{i + \tau + \delta - \pi} \quad (3)$$

Equation (3) expresses the asset value of a house given the market rent, interest rate, depreciation and maintenance costs and expected future house price appreciation.

Asset-market equilibrium requires the price of a house to equal the discounted value of its net future service flow. Accordingly, a more general expression of (3) is given by

$$P_t = E \left[\sum_{j=1}^{\infty} \frac{R_{t+j}}{\prod_{k=1}^j (1 + i_k + \tau_k + \delta_k)} \right] \quad (4)$$

where $E[\bullet]$ denotes the expectation operator, and i_k is the forward real interest rate for period k . The above formulation can be interpreted as the expected discounted returns required by a potential investor in order to undertake the investment. He/she should buy the dwelling if the price P_t is higher than the present value; on the other hand an owner can sell a house without a loss if he/she can recover at least the present value.

There is an important advantage of reformulating (3) as (4). In (3) it is impossible to calculate P without some conjecture about expected future house price appreciation because π is an exogenous variable.³ However, in (4) the impact of expected house price appreciation on the house price is endogenously determined by the term structure of

³ Existing approaches proxy for expected capital appreciation component of the formula using expected inflation and/or long-run average house price appreciation, or the real interest rate spread (see Himmelberg, Mayer, Sinai (2005)).

forward interest rates. Consequently the equilibrium price P can be calculated because interest rates are observable in financial markets.

3. Empirical Analysis

In this section we calculate the fundamental price as given in (4) for the UK house market. The forward user cost real rates for each of the twenty-five years along the term are calculated by subtracting forward expected inflation rates from the forward nominal interest rates⁴, adding τ and δ , assuming property taxes τ at a constant 1% per annum, maintenance and depreciation rates δ at a constant 2% per annum⁵. The redemption user cost yield r_t corresponding to the twenty-five forward user cost rates was then calculated at 30 June for each year 1990 to 2008. Assuming a real growth rate in rentals g of 1% per year, and using the Gordon growth model, the equilibrium house price P^* can be calculated for each year by the equation

$$P_t^* = \frac{R_t}{r_t + \tau + \delta - g} \quad (5)$$

⁴ Forward nominal interest rate data and forward expected inflation rate data for one to twenty-five years maturity at close of trading on 30 June for each year 1990 to 2008 is available from the Bank of England database at <http://www.bankofengland.co.uk/statistics/yieldcurve/index.htm>.

⁵ Average second quarter prices for houses in England for each year 1990 to 2008 were obtained from Table 506 Housing Market: Simple Average House Prices at <http://www.communities.gov.uk/documents/housing/xls/140960.xls>. Private rent data was obtained from Table 72 Rents and earnings in England, The UK Housing Review 2006/2007, ed. Steve Wilcox, Centre for Housing Policy, University of York.

The equilibrium price P_t^* can then be compared with the actual price P_t in order to determine if house prices are overvalued or undervalued. Figure 3 shows the comparison between actual house prices and fundamental value between 1990 and 2007 using The UK Housing Review (2008) private rent data for each year between 1990 and 2005, and assuming that real private rents grew at 0.8% between 2006 and 2008⁶.

<<<< Figure 4 about here >>>>

Figure 4 reveals that English house prices were over-priced relative to their fundamental asset value between 2003 and 2007, but that the house price decline between 2007 and 2008 was sufficient to bring the market price of houses back to fundamental value.

4. Discussion

Allen and Carletti (2008) show how the use of market prices to value assets in banks and insurance companies may create distortions and contagion that causes banks to be liquidated unnecessarily when financial markets are illiquid. During periods of financial crisis, prices in illiquid markets do not reflect future payoffs but rather the amount of cash available to buyers in the market. The level of liquidity in financial markets is endogenously determined and so therefore is liquidity pricing. Banks can become

⁶ This 0.8% estimate is conservative because real private rent grew at 2.2% per annum between 1990 and 2005. The 0.8% growth rate, based on the real private rent growth between 2006 to 2008 from Table 731 www.communities.gov, is lower than the UK Housing Review 1990 to 2005 real average, lower than the Paragon 2005 to 2008 real average, and lower than the DCLG quarterly experimental index 2005 to 2007 real average growth in private rents

insolvent even though they would be fully able to cover their commitments if they were allowed to continue until the assets mature. Hence the debate between marking-to-market (which is biased) versus historic cost accounting (which is irrelevant).

Asset values based on recent prices, marking-to-market, should provide a more accurate picture of a bank's financial health compared with the historical value of the assets at the arbitrary dates when they were acquired. The problem is that the application of fair-value accounting may cause prices to diverge from fundamental asset value, and distorted prices do not provide accurate indicators of asset values. Plantin, Shapra and Shin (2008) provide a framework that compares the circumstances under which the damage is greater under mark-to-market valuation compared with historic cost valuation, and explains the opposition of the banking and insurance industries to mark-to-market valuation. Hemmer (2008), Sapra (2008), Shin (2008) have also explored different ways that mark-to-market valuation can contribute to financial contagion.

We do not enter the debate as to whether the assets of financial institutions should be valued at current market prices or historic cost except to suggest that perhaps the valuation of assets should not be restricted to a choice between historic cost and mark-to-market. The valuation of mortgage loans may be valued using the extended Poterba user cost method proposed in this paper. In this context the Basel Committee on Banking Supervision (2008) para. 695 states that "only where marking-to-market is not possible may banks mark-to-model". We suggest that there may be a case for marking-to-model even where marking-to-market is possible.

5. Conclusion

In this paper we propose a new methodology in order to evaluate whether market house prices are different from their fundamental asset prices. We use the term structure of real forward interest rates to extend Poterba's user-cost method of house asset valuation. This enables market house prices to be compared with the benchmark equilibrium valuation in order to determine if house prices are overvalued or undervalued. This in turn provides a rationale for mortgage banks to use marking-to-model instead of marking to market in order to prevent unnecessary macroeconomic instability when the market prices of houses undershoot fundamental value.

Finally, in April 2009 the Financial Accounting Standards Board (FASB) allowed banks to ignore market prices for assets if they judge the market is illiquid with sales transactions at fire sale prices by distressed sellers⁷. There will also be changes to allow banks to book smaller losses on impaired assets that are available for sale. These changes will allow banks and other financial companies to use *significant* judgment when gauging the price of mortgage-backed securities on their books. After being handcuffed by the FASB 157 rule, US banks may now be free to make it up as it suits them. The analysis in our paper proposes an arms length method of valuing housing collateral.

We acknowledge that the work presented is only a first step towards a complete characterization of a term-structure of interest rates approach to extending the Poterba model. For example, there are a number of issues associated with the measurement of

⁷ http://www.fasb.org/pdf/fsp_fas157-4.pdf

user cost (particularly the risk-adjustment of the cost of funds, risk of owning vs. renting, rental market dynamics) which we do not address here and which we hope will provide fruitful avenues for future research. There are also issues regarding the impact of tax frameworks on the returns to housing, particularly the taxation of mortgage interest and imputed income (see Poterba and Sinai 2008 and Hendershott and Pryce 2006). More work also needs to be done in comparing the performance of our extended Poterba model against alternative approaches, such as those that use expected inflation and/or long-run average house price appreciation, or the real interest rate spread (see Himmelberg, Mayer, Sinai (2005)) to proxy for expected capital appreciation component of the formula, and how these different approaches compare in different institutional and socio-economic contexts—all of which imply an imperative for cross-county, inter-method comparative work to place the current work in a broader methodological context.

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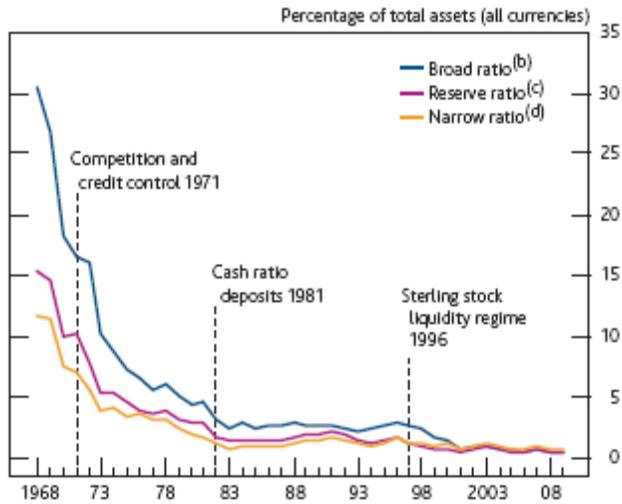
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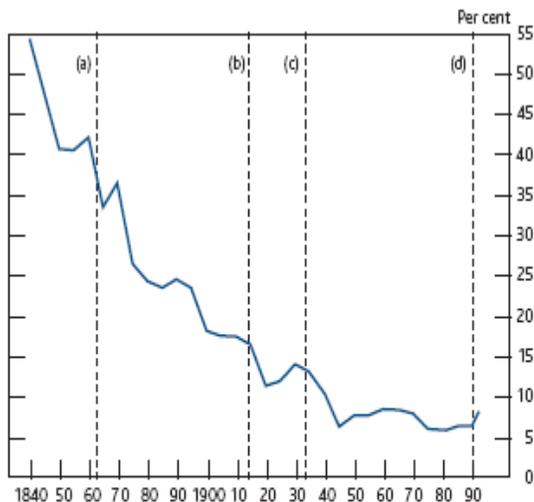
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Figure 1 Sterling Liquid Assets relative to total asset holdings of UK Banking Sector^(a)



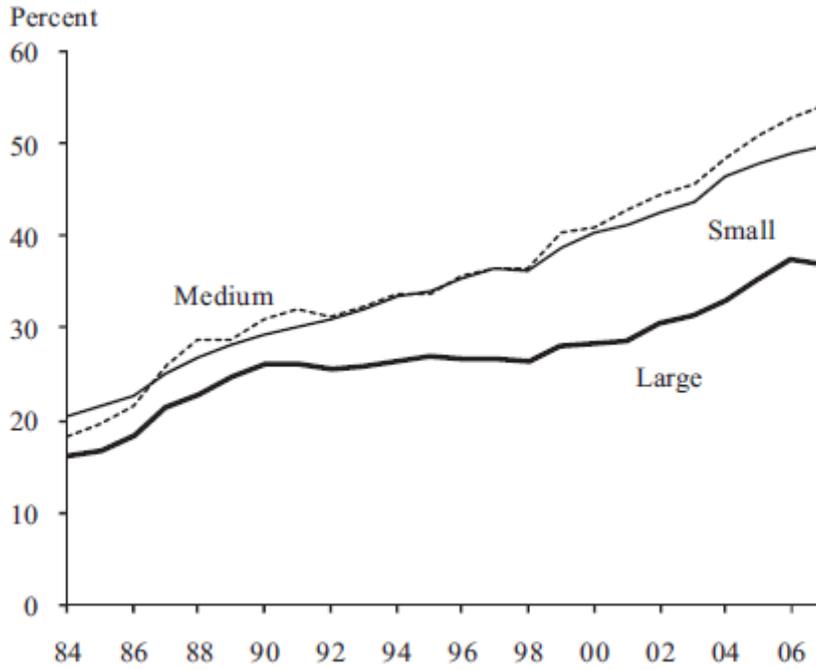
Source: Bank calculations.
 (a) 2008 data are as of end-August 2008.
 (b) Cash + Bank of England balances + money at call + eligible bills + UK gilts.
 (c) Proxied by: Bank of England balances + money at call + eligible bills.
 (d) Cash + Bank of England balances + eligible bills.

Figure 2 Long run capital levels for US commercial banks



Source: Berger, A, Herring, R and Szegö, G (1995), 'The role of capital in financial institutions', *Journal of Banking and Finance*, pages 399–430.
 (a) National Banking Act 1863.
 (b) Creation of Federal Reserve 1914.
 (c) Creation of Federal Deposit Insurance Corporation 1933.
 (d) Implementation of Basel risk-based capital requirements 1990.
 See FSR Chart 6.1 for details.

Figure 3 US Real Estate Loans and Mortgage-Backed Securities as a Percent of Total Assets, by Bank Size



Source: Federal Reserve Bank of San Francisco Economic Letter, Number 2009-06, February 6, 2009

Figure 4 Actual and Equilibrium House Prices for England 1988 to 2007

