Credit standards and the bubble in US house prices: new econometric evidence

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1. Introduction

Many commentators link the US house price boom and bust of the past decade to an unsustainable easing of mortgage credit standards. However, few existing empirical house price models take account of changes in credit standards, since they are hard to measure. As a consequence, most models perform poorly during the recent boom and bust in US house prices (see Duca et al. (2011a, 2011b), Gallin (2006) and Geanakoplos (2010), inter alia). We circumvent this problem by incorporating a plausible measure of mortgage credit standards – the average loan-to-value ratio for first-time homebuyers – into an inverted housing demand model explaining US house prices. We show that this measure of mortgage credit standards is weakly exogenous and is not simply a proxy for expected future house price capital gains or losses.

During the subprime boom, mortgage loans were extended to riskier borrowers, who would previously have been denied loans. Many of these loans were for adjustable rate mortgages which particularly benefited from the then lowest interest rates for decades. The rise in house prices, set in train by these credit-supply and interest-rate changes, fooled many people into thinking that such rises would be sustained. Fundamentals began changing in 2003, as interest rates began to return to more "normal" levels and high rates of building expanded the housing stock, while house prices became increasingly overvalued. As the extent of bad loans became clear, the fundamentals changed again as the supply of credit for all types of mortgages contracted, inducing an unwinding of earlier rises in house prices (Duca et al., (2010)).

Glaeser et al. (2010) found no convincing evidence that movements in the average loan-to-value (LTV) ratio, which only changed modestly between 2001 and 2005, explained the recent house price boom. Unfortunately, the average LTV ratio is highly endogenous. It also masks different trends in the LTV ratios of former owner-occupiers and first-time buyers. Former owners benefited from the house price boom, so their average LTV ratio fell as they rolled over their capital gains into a new property. By contrast, the average first-time buyer LTV ratio rose sharply from about 88 per cent in the mid- to late 1990s to a peak of 94 per cent in 2005. This is the reason we measure shifts in mortgage credit standards using the LTV ratio for first-time homebuyers, rather than all buyers. Mian and Sufi (2009) address the link between credit and house prices using micro data and conclude that the expansion in mortgage credit was more likely to be a driver of house price growth than a response to it.

We find that shifts in credit standards help account for the boom and bust in US house prices, consistent with previous inverted demand results for the United Kingdom (Cameron et al. (2006), Meen (2001), Muellbauer and Murphy (1997)) and with our house price-to-rent

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results for the United States (Duca et al. (2011a)).[4] In contrast to standard models, our model yields stable long-run relationships and speeds of adjustment, plausible income and price elasticities, better model fits, and sensible estimates of tax credit effects and a possible upturn in real house prices in the next few years.

2. The inverted demand model of house prices

The simplest theory of what determines house prices is to treat supply – the stock of houses – as given in the short run, with prices driven by the inverted demand for housing services (*h*) that are proportional to the housing stock (*hs*). Let housing demand be given by:

$$\ln hs = -\alpha \ln hp + \beta \ln y - \ \ln hs - \ \gamma \ln uc - \ \delta \ln cc + z \tag{1}$$

where *hp* is real house price, *y* is real income, *uc* is real user cost of housing, *cc* is credit standards, and *z is* other demand shifters. The own price elasticity of demand is $-\alpha$ and the income elasticity is *β*. Inverting Equation (1) implies that equilibrium house prices are a function of income, the housing stock, user costs and credit standards:

$$\ln hp = {}^{1}\!/_{\alpha}\left(\beta \ln y - \ \ln hs - \ \gamma \ln uc - \ \delta \ln cc + z\right) \tag{2}$$

Our house price model is a dynamic version of Equation (2).

Our real house price (*hp*) series is the Freddie Mac repeat sales index, deflated by the personal consumption expenditure price index. For income (*y*), we use a measure of real per capita permanent income, generated from the discounted path of forecast non-property (labour plus transfer) income, adjusted for temporary tax effects. The real user cost of housing (*uc*) reflects the fact that a house is a durable investment good. We let $uc = r + \delta + t + \rho - \pi_{hp}^{e}$, where *r* is the real after-tax mortgage rate, δ is the depreciation rate, *t* is the property tax rate, ρ is an allowance for transaction costs and a risk premium, and π_{hp}^{e} is the expected real rate of house price appreciation. Studies suggest that many homebuyers have extrapolative expectations, so lagged appreciation is a good proxy for expected house price gains or losses, π_{hp}^{e}. We use the lagged annual rate of change in real house prices over the prior four years, adjusted for the cost of selling a home. We also adjust *uc* for the first-time homebuyer tax credit in 2009 and 2010.[5]

3. Measuring shifts in mortgage credit standards

We measure credit standards using data updated through mid-2009 on average LTV ratios for first-time homebuyers – the marginal group most affected by credit constraints – from Duca et al. (2011b). The raw LTV series, which comes from the biennial American Housing

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4 Standard house price-to rent models are reduced form models, with no explicit role for housing supply or income. The approach assumes that rental and owner-occupied housing are close substitutes and is not applicable in many countries where the government regulates the rental market.

5 We subtract the 4.1 per cent effective value of the tax credit for first-time homebuyers from *uc* from 2009 Q1 to 2010 Q3. Our *uc* variable is always positive.

Survey, is adjusted for several factors, such as the change in the unemployment rate.[6] We find that it captures mostly exogenous shifts in credit standards, and not borrower or lender expectations of future house price capital gains or losses.

Consistent with a weakening of credit standards during the subprime boom, the LTV series in Figure 1 is positively correlated with the share of mortgages outstanding that were securitised into private label mortgage-backed securities (MBS's). Because our adjusted LTV series reflects credit standards on new mortgages, it leads the private MBS share of the stock of home mortgages by about two years. The rise of LTVs through the mid-2000s also coincided with a large rise in the home ownership rate of younger households (Bardhan et al. (2009)). Since many of these households had limited savings, the timing is consistent with the view that the rise of LTVs for first-time homebuyers in the early 2000s eased credit constraints for the marginal homebuyer, bolstering the effective demand for housing.

The two large shifts in our LTV-based measure of mortgage credit standards coincide with major changes in government mortgage policy and financial innovations. The upshift of the early to mid-1990s coincides with the Congress directing Fannie Mae and Freddie Mac to increase home ownership by funding low down-payment mortgages (Gabriel and Rosenthal (2010)), either by easing underwriting credit standards or by purchasing private label MBS's.

The second large shift in our measure occurs between 2000 and 2005 during the subprime boom. Innovations in structural finance, the rise of hedge funds and SIVs, as well as changes in the origination, pricing and funding of nonprime mortgages, led to a rise in the issuance of private label MBS's, especially subprime MBS's.[7] Regulatory changes included adopting Basel II capital requirements, which induced banks to hold more MBS's, and the Congress raising the GSEs' home ownership goals, so they started buying nonprime MBS's.[8]

4. Some empirical results

We estimated various dynamic – vector error correction (VEC) and autoregressive distributed lag (ARDL) – models with and without our adjusted loan-to-value measure of mortgage credit standards. For example, our ARDL model is:

$$\begin{aligned}\Delta \ln hp_t = {} & \alpha_1\left(\ln hp_{t-1} - \beta_0 - \beta_1 \ln y_{t-1} - \beta_2 \ln hs_{t-1} - \beta_3 \ln uc_{t-1} - \beta_4 \ln ltv_{t-2}\right) \\ & + \sum\nolimits_s \gamma_s \Delta \ln hp_{t-s} + \sum\nolimits_j \gamma_{1s} \Delta \ln y_{t-s} + \sum\nolimits_s \gamma_{2s} \Delta \ln hs_{t-s} + \sum\nolimits_s \gamma_{3s} \Delta \ln uc_{t-s} \\ & + \sum\nolimits_s \gamma_{4s} \Delta \ln ltv_{t-s} + \gamma_0 + \sum\nolimits_k \delta_k z_{k,t} + u_t\end{aligned} \tag{3}$$

where u is a random error term, $\ln ltv$ replaces cc, and z is a vector of tax, monetary policy and regulatory factors which proved significant in previous research.

Adding the adjusted LTV/mortgage credit standards variable improves our house price models by yielding more stable long-run relationships, more sensible estimated income and price elasticities, better and more stable speeds of adjustment, and better model fits. The VEC and ARDL models yield similar estimated long-run relationships that imply higher LTVs

6 Our average LTV series comes from small samples, so, in our empirical models, we smooth the LTV series using a three-quarter moving average.

7 For example, credit scoring technology, earlier used in consumer credit, was increasingly used by loan originators to sort and price riskier nonprime mortgages.

8 The estimates in Frame (2008) suggest that that the GSEs funded one quarter of nonprime mortgages.

drove up house prices. For example, the full sample (1981 Q2 to 2009 Q3) long-run cointegrating relationship in the VEC model is:

$$\ln hp = 4.71 + \underset{(7.9)}{2.80} \ln y^{p} - \underset{(6.7)}{2.07} \ln hs - \underset{(23.4)}{0.24} \ln uc + \underset{(5.5)}{0.97} \ln ltv \quad (4)$$

with *t*-statistics shown in parentheses. Our measure of credit standards is positive and highly significant. The implied price and income elasticities of housing demand are 1.35 and –0.48 respectively, close to the average estimates obtained in earlier studies. We obtained similar results using other house price indices, such as the Freddie Mac house prices adjusted for home improvements or the CoreLogic house price index.

The estimated coefficient on our adjusted LTV/mortgage credit standards variable and the long-run cointegrating relationship are stable over time. We verified this by estimating our models over shorter samples that ended in mid-2002, before the steep rise in the LTV series and the start of the subprime boom.[9] In our "short" sample, variations in mortgage lending standards in the early 1990s allow us to identify the LTV effect. Ignoring feedback effects from looser mortgage credit to higher incomes, etc., the model suggests that the loosening of mortgage credit standards from 2001 onwards generated over half of the 29 per cent rise in real house prices between 2001 Q4 and 2005 Q4.[10] If the LTV ratio were endogenous, the interpretation of Equation (4) would be very problematic. However, our evidence is that the LTV ratio is weakly exogenous in our model and, contrary to the claims of some commentators, is not picking up expectations of *future* house price gains or losses. There is, however, a non-linear feedback effect from *past* house price changes. Higher foreclosures, which depend on past house price falls, generate tighter mortgage credit standards and a higher down-payment ratio/lower LTV ratio.

5. Where are house prices heading?

To shed some light on where US house prices might be heading, we simulated house prices out of sample (post-2009 Q3), using the full sample coefficient estimates from cointegration models with and without our LTV-based measure of mortgage credit standards. We carried out the simulations in autumn 2010. We assumed that the adjusted LTV ratio would remain at its 2009 Q2 value (close to its 2002 value). Actual non-LTV data are used through 2010 Q2. We used published data to specify reasonable values for future income, interest rates and the housing stock, etc.[11] Because an error-correction model is used, with lagged house price change and real user cost terms, the model captures the "bubble builder" and "bubble burster" dynamics stressed by Abraham and Hendershott (1996), inter alia. In Figure 2, house prices undershoot during the bust and then gradually revert back to their long-run "fundamental" level.

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[9] The estimated speeds of adjustment are stable at 12 and 11 per cent per quarter in the shorter, pre-subprime boom (1981 Q2 to 2002 Q2) and full (1981 Q2 to 2009 Q3) samples, respectively. By contrast, the estimated speeds of adjustment in models omitting the LTV ratio plunge from 16 to 5 per cent, respectively, reflecting a breakdown in the underlying long-run relationships.

[10] The long relationship in Equation (4) suggests that the loosening of mortgage credit standards would have raised real house prices by about 7 per cent. The rest of the effect is a short-run "bubble builder" or feedback effect from higher prices to larger expected capital gains, which, in turn, induced further increases in house prices.

[11] We used the average Blue Chip Economic Indicators forecasts of incomes and interest rates and assumed that housing starts would gradually rise from 0.6 million units in 2010 to 1.4 million units in early 2015.

The dynamic simulations from the model with our LTV-based measure of mortgage credit standards (the “LTV-model”) imply that real house prices may fall 10 per cent further from their actual 2010 Q2 levels before hitting bottom in early 2012, with nominal prices falling 8 per cent by 2012 Q1. The declines are less dramatic in the misspecified “non-LTV model”, where real house prices bottom out 3 per cent below their actual 2010 Q2 levels. In the five quarters following 2009 Q3 for which we have actual house price data, the LTV and non-LTV model simulations straddle actual real prices, with the LTV model tracking notably better. In the simulations, the nominal level of the Freddie Mac house price series only recovers its 2007 Q2 subprime boom peak in early 2015.

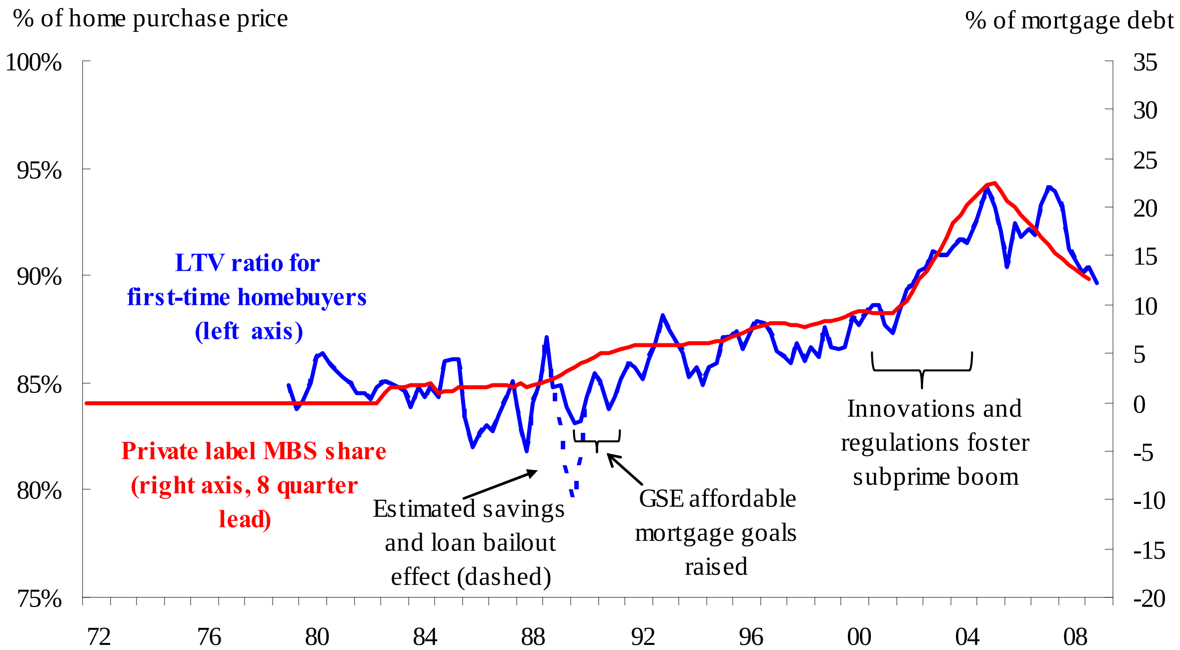
The simulations, of course, are based on projections of house price determinants which are hard to predict. For example, our permanent income path is based on a 2010 Blue Chip Survey forecast of a modest economic recovery. Another source of uncertainty is changes in public policy affecting the foreclosure process or the availability of mortgages from federal programs. We believe that the simulation results are reasonably robust to alternative definitions of house prices and to endogenising housing supply, but we have not yet completed our analysis of these issues. For these reasons, the simulation results should be treated with caution.

6. Conclusion

Our findings indicate that swings in credit standards played a major, if not the major, role in driving the recent boom and bust in US house prices. Because standard time series models ignore changes in mortgage credit standards, they are misspecified and unstable over time. They also fail to track house prices well in contrast to models using our measure of mortgage credit standards – the cyclically adjusted LTV ratio for first-time homebuyers.

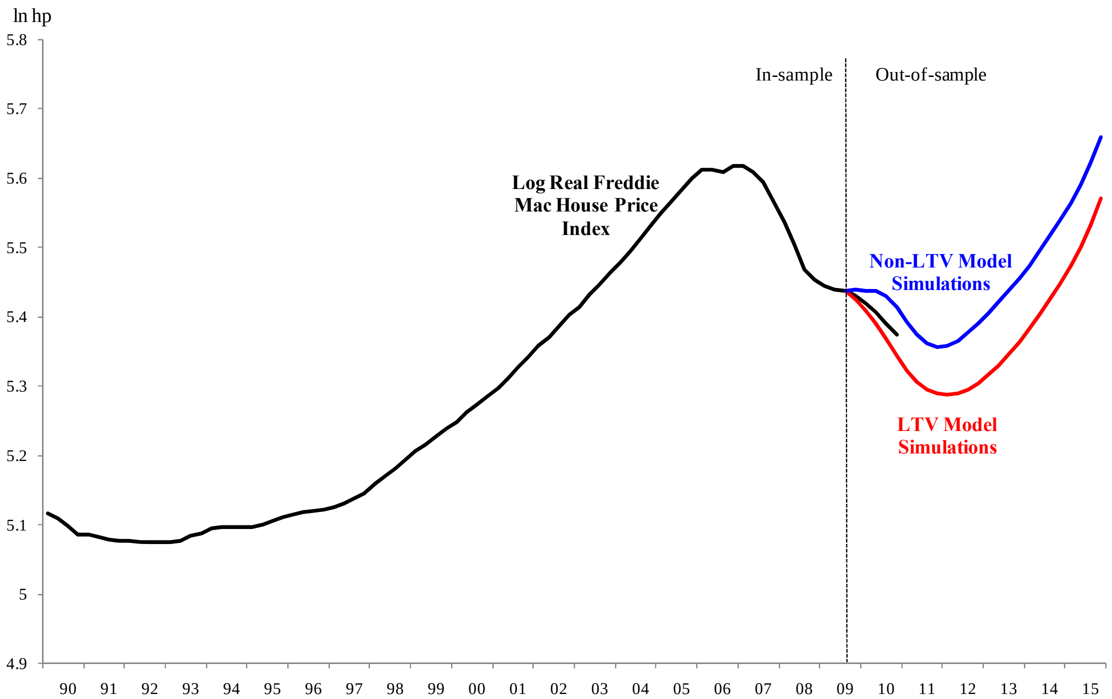
Overall, our findings support the view that many asset bubbles are fuelled by unsustainable increases in the availability of credit or use of non-robust financial practices. They also suggest a potential role for macroprudential policies that specify maximum LTV ratios or require lenders to fund high LTV mortgages with more regulatory bank capital, as suggested by the experience of Hong Kong (Wong et al. (2011)).

Figure 1: LTV Ratios for First-Time Homebuyers Trend with Share of Mortgages Packaged into Private Label Mortgage Backed Securities



Sources: Flow of Funds Accounts, American Housing Survey, authors' calculations, and Duca, Muellbauer, and Murphy (2011b).

Figure 2: Real House Prices Fall More In Line With Simulations From the LTV Than the Non-LTV Model



Sources: Freddie Mac and Duca, Muellbauer, and Murphy (2011b).

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