

# **The optimal LTV-ratio, mortgage market variability and monetary policy regimes: A demand side perspective**

Trond-Arne Borgersen

Østfold University College

Department of Economics, Social Sciences and Languages

Remmen

N- 1757 Halden

Norway

e-mail: [trond.a.borgersen@hiof.no](mailto:trond.a.borgersen@hiof.no)

Phone: +47 97756261

## **Abstract:\***

The purpose of this paper is twofold: First, it derives the optimal LTV-ratio for a mortgagor that maximizes the return to home equity when considering the capital structure of housing investment. Second, it analyses the demand side contribution to mortgage market variability across monetary policy regimes. The paper endogenises both the relation between the loan-to-value (LTV) ratio and the mortgage rate and the relation between LTV and the rate of appreciation. When analyzing LTV-variance and the demand side contribution to mortgage market variability we consider three stylized regimes. The paper finds an intuitive ranking of LTV-ratios across regimes, where the optimal LTV-ratio peaks during a housing boom. The demand side contribution to market variability is however at its highest during “normal” market conditions in housing and mortgage markets when monetary policy ignores asset inflation. Hence, there is a potentially humped shaped relation between the risk exposure of individual mortgagors and the demand side contribution to mortgage market variability.

**Keywords** LTV-ratio, housing appreciation, mortgage rates, mortgage market variability and monetary policy strategy.

\* The author appreciates the helpful comments of two anonymous referees and the journal editor.

## 1. Introduction

Empirical evidence shows variations in the Loan-to-Value (LTV) ratio across both markets and periods (see for instance Calza et al (2013) or Amior and Halket (2014)). Focusing the supply side of mortgage markets, a higher LTV-ratio is related to financial developments allowing for improved sorting- and pricing of credit risk (Duca et al, 2010). Others, analyzing profit-maximizing mortgagee behavior, find LTV-variations from differences in risk pricing, moral hazard, external funding, lending and collateral effects, producing context specific LTV-ratios (Borgersen, 2015).

The supply side is obviously important for both LTV-variations and mortgage market developments in general (see for instance Warnock and Warnock (2008 or Leece (2014))). But a fundamental question remains. What is the demand side contribution to variations in the LTV-ratio?

A number of factors impact the demand for LTV. Factors important for mortgage demand, such as demographics, household income, savings and risk aversion, are also important for LTV-ratios. In fact, owner-occupied housing serves a multiple of purposes providing housing consumption benefits, serving as an investment object and being used as collateral for mortgages (Sommervoll et al, 2010). The demand side contribution to variations in the LTV-ratio is thus easily argued as context-specific.

The majority of papers focusing the demand for LTV highlight contributions from the consumption motive (see for instance Berger et al (2011) or Agarwal et al (2014)). This paper highlights the contribution to variations in the LTV-ratio arising from the investment motive of housing demand. Often related to speculation and housing bubbles, the impact of the investment motive to the optimal LTV-ratio is also of interest when assessing policies to ensure financial stability.

Borgersen and Greibrokk (2012) separate the return to home equity (RHE) between a price gain and a leverage gain when considering the funding structure of housing investments. While standard when addressing real estate, the funding approach is not so common when analyzing housing. When the rate of appreciation exceeds the mortgage rate there is, compared to equity finance, an additional RHE for mortgage financed housing. The incentive

to increase leverage that the excess return to housing and the leverage gain creates is at the core of the reasoning that follows.

Analyzing different regimes in both mortgage- and in the housing markets the paper first considers the optimal LTV-ratio for a household that maximizes RHE. This paper endogenises the relations between the LTV-ratio and the factors that determine the excess return to housing, the mortgage rate and the rate of housing appreciation, respectively. The optimal LTV-ratio peaks in a housing boom, when the positive price effect of a higher LTV-ratio dominates. A housing bust, where the negative relation between the mortgage rate and the LTV-ratio dominates, produces the lowest LTV-ratio. When housing and mortgage markets are characterized by normal market conditions the optimal LTV-ratio is in between these two.

The paper continues by addressing the contribution to mortgage market variability from the investment motive in housing demand, framing it in a discussion of macro-prudential policy and whether a central bank should lean against the wind. Here more novel results emerge. Seeing the demand for LTV as an indicator of mortgage demand, variations in the LTV-ratio represent the demand side contribution to mortgage market variability.

While the optimal LTV-ratio peaks in a housing boom, is the demand side contribution to mortgage market variability shown to be contingent on how the central bank targets asset inflation. When the central bank ignores asset inflation mortgage market variability peaks when conditions in housing and mortgage markets are “normal”, and both mortgage rates and house prices are affected by LTV-ratios. Thus, the paper argues for a potentially a humped-shaped relation between the optimal LTV-ratio for a mortgagor maximizing RHE and mortgage market variability. The demand side contribution to mortgage market variability is of particular interest in relation to macro-prudential policy in general, and LTV-caps more specifically (Claessens et al (2013). Some argue LTV-caps as efficient tools to constrain mortgage supply and support banking stability, but leaving the demand side of mortgage markets rather unaffected (Wong et al, 2014). Others focus on whether monetary policy and macro-prudential policy are supplementary or complementary measures for ensuring financial stability (see for instance IMF (2013)). This paper is relevant to both discussions.

The paper is structured as follows: The next section relates our approach to the literature on optimal LTV-ratios. The third section illustrates rather conventionally both the leverage gain

and the risk associated with different funding structures for housing investments. The fourth section endogenizes both the relation between the LTV-ratio and the mortgage rate and the relation between house prices and the LTV-ratio. The fifth section derives the optimal LTV-ratio across three different regimes. The sixth section analyses mortgage market variability. The last section concludes.

## **2. Relations to the LTV-literature**

When focusing the supply side of the mortgage market Duca et al (2010) relates higher LTV-ratios to two types of financial innovations, credit scoring technology and the pricing of non-prime mortgages. Borgersen (2015) relates the optimal LTV-ratio for a profit maximizing mortgagee to moral hazard, risk pricing, funding, lending volumes and collateral values. Goodhart and Hoffman (2008) see higher LTV-ratios as a response to nominal return targets in a low interest rate environment. Borgersen and Robertsen (2012) show how weak regulations might allow for higher LTV-ratios during appreciations as higher collateral values reduce loss given default.

Instead of highlighting supply side factors, both Aherne et al (2005) and Campbell and Hercowitz (2006) see variations in the LTV-ratio as a result of changes in the regulatory and legal framework, treating the LTV-ratio as an exogenous variable. Taking mortgage supply and mortgage demand into account, Allen and Carletti (2011) and Lin (2014) endogenises the LTV-ratio. Lin (2014) applies a (monetary) general equilibrium model to show how the welfare of the debtor is not monotonically increasing in the LTV-ratio and that the optimal LTV-ratio both for the debtor and the creditor allows for the possibility of ex post default. Separating between two regimes, Allen and Carletti (2011) show how a reduction in the interest rate might be unstable if the LTV-ratio is too high and how macro-prudential policies, such as an LTV-cap, will reduce house price growth when markets are booming.

When abstracting away from the supply side and highlighting the demand side of mortgage markets the LTV-ratio can be argued to vary between young adults and the elderly, due to differences in savings and income (See for instance Attanasio et al (2012), Fischer and Gervais (2011) or Iacoviello and Pavan (2013)). However, modelling mortgage demand is complex due to that demand is derived from a mix between the motives for housing consumption and housing investments (Bruckner, 1997). Models often lack closed form solutions (Alm and Follain, 1987). Standard references for mortgage demand models are

Brueckner (1994), Dunsky and Follain (1997, 2000), and Alm and Follain (1987). The degree of risk aversion will obviously matter for the optimal LTV-ratio, and Amior and Halket (2014) for instance argue for negative correlation between house price volatility and the LTV-ratio.

Most of the analysis on housing demand highlights the consumption motives. Poterba (1984) introduced housing as an asset, and the investment motive, when analyzing housing demand. Guiso et al (2002) as well as Campbell and Cocco (2003) discuss different aspects of household portfolios, highlighting the role of risk aversion. Brueckner (1997) extended Henderson and Ioannides (1983) analyzing the interaction between consumption and investment motives in household portfolios. The paper shows how portfolios often are inefficient in a mean-variance sense, when housing is included. Highlighting the investment aspect of housing Borgersen and Greibrokk (2012) analysed the demand for LTV focusing on the optimal funding structure. The funding structure approach is commonly used when analyzing commercial real estate investments (see for instance Harris and Raviv (1991)), but not when addressing housing. A number of papers analyses different aspects of optimal funding structures, such as the tax policy on interest and dividends, stock prices and interest rates, the level of business activity, risk attitude, optimal operational control and future flexibility (see for instance Groth et al (1997), Flannery et al (2006) or Delcours (2007) for different aspects of optimal capital structure). An optimal capital structure minimizes the cost of capital and, hence, maximizes the return, or firm value, is analogue to a household maximizing RHE.

### 3. The capital structure of housing investments

We start by repeating the approach of Borgersen and Greibrokk (2012) where a dwelling  $V$  is financed by equity  $E$  and a mortgage  $D$ . House price growth  $p$  gives the total (expected) return to housing investments which must compensate creditors and provide a return to home equity (RHE)  $e$ , where the mortgage rate  $r$  determines the former. Applying the loan-to-value (LTV)  $\frac{D}{V}$  and equity-ratio  $\frac{E}{V}$  gives the standard investment theory-relation before taxes as

$$1) \quad p = e \frac{E}{V} + \frac{D}{V} r$$

By rearranging, this is expressed as

$$2) \quad e = p + \frac{D}{E}(p - r),$$

Expression 2) shows how RHE is divided between a *price gain*  $p$  and a *leverage gain*

$\frac{D}{E}(p - r_B)$ . The *leverage gain* is positively related to the mortgage-to-equity ratio (D/E) and the difference between the rate of appreciation and the mortgage rate - hereafter referred to as the excess return to mortgage financed housing.

A numerical example illustrates both the incentive for increasing leverage in the presence of excess return to housing, as well as the risk increase associated with higher leverage. Let us consider two situations where the rate of appreciation is fixed at 8 percent, but where the mortgage rate is either 4 or 10 percent respectively. We consider three different funding structures, one where the LTV-ratio is 80 percent and another where the LTV-ratio is 90 percent and, finally, a case with 100 percent equity financing. When housing is 100 percent equity financed (D=0 in expression 2) RHE is always equal to the rate of appreciation. For the two other funding structures RHE is:

	$p = 8\%$ and $r = 4\%$	$p = 8\%$ and $r = 10\%$
$e_{LTV=80}$	24%	0%
$e_{LTV=90}$	40%	-10%

When the rate of appreciation exceeds the mortgage rate there are incentives to increase leverage as  $e_{LTV=90} > e_{LTV=80}$ . When the mortgage rate exceeds the rate of appreciation there are no incentives to increase leverage as  $e_{LTV=90} < e_{LTV=80}$ .

Figure 1 pictures the range of variation in RHE for the two situations described above across the three funding structures. The variation in RHE can here be seen as an indicator of the risk exposure the different funding structures entail. A housing investment completely funded by equity produces a RHE equal to the rate of appreciation, which we have fixed at 8 percent abstracting away from price risk. Figure 1 also shows a positive relation between leverage and the range of variation in RHE. When LTV is 80 percent the RHE varies from 0 percent to 20 percent, while RHE varies between -10 percent and 40 percent when LTV is 90 percent.







We consider three stylized regimes characterized by the different relations between housing and mortgage markets sketched by Borgersen (2016). In a **housing boom** appreciations might be due to both market fundamentals and the prevailing mortgage policy. The latter argument introduces, as argued by Pavlow and Wachter (2011) a positive relation between house prices and the LTV-ratio. Highlighting mortgage markets we, as in the financial accelerator regime of Borgersen (2016) assume appreciations during a boom to be dominated by the positive relation between house prices and the LTV-ratio. A **housing bust** on the other hand, is characterized by negative market sentiment and housing depreciations. The lending policy of mortgagees is now more restrictive and it is the repayment ability of mortgagors, which in the terminology of Borgersen (2016) is the first-line of defense in the credit-risk assessments of a mortgagee that governs mortgage policy. This puts the relation between house prices and the LTV-ratio out of play, while the negative relation between the mortgage rate and the LTV-ratio as given by the mortgage demand function dominates this regime. Finally, we refer to the regime where both the negative demand effect and the positive price effect are included a “**normal housing-mortgage market relation**”.

### Regime I: A housing boom

Let us start by considering a housing boom where we abstract away from risk pricing and assume  $r'(\lambda) = 0$ . This reduces expression 3) to

$$4) \quad \frac{de}{d\lambda} = p'(\cdot) + (p-r) \frac{1}{(1-\lambda)^2} + p'(\cdot) \frac{\lambda}{1-\lambda}.$$

The optimal LTV-ratio can, after rearranging, be expressed as

$$5) \quad \lambda' = \frac{p'(\cdot) + (p-r)}{p'(\cdot)} = 1 + \frac{(p-r)}{p'(\cdot)}.$$

As  $p'(\lambda) > 0$  by assumption, we have  $\lambda' < 1$  when  $p < r$ ,  $\lambda' = 1$  when  $p = r$  and  $\lambda' > 1$  when  $p > r$ . In a booming housing market the optimal LTV-ratio is below 100 percent only when the excess return to mortgage financed housing is negative.<sup>4</sup> When the excess return to

---

<sup>4</sup> The condition for  $\lambda' > 0$  is  $(p-r) > -p'(\lambda)$ . We assume this inequality to hold. As  $p'(\lambda) > 0$  we see that  $\lambda'$  is positive, even for small negative values on the excess return to housing.

mortgage financed housing is positive  $p > r$ , and we allow for the positive impact from higher LTV-ratios to house prices, the optimal LTV-ratio is above 100 percent.

### **Regime II: A housing bust**

In a housing bust house prices are driven by market fundamentals and not mortgage policy, and we abstract away from the price effect by assuming  $p'(\lambda) = 0$ . The negative demand effect and the relation between the mortgage rate and the LTV-ratio is now included, reducing expression 3) to

$$6) \quad \frac{de}{d\lambda} = (p-r) \frac{1}{(1-\lambda)^2} - r'(\cdot) \frac{\lambda}{1-\lambda}.$$

Rearranging the condition for  $\frac{de}{d\lambda} = 0$  gives

$$7) \quad r'(\cdot)\lambda^2 - \lambda r'(\cdot) + (p-r) = 0$$

The optimal LTV-ratio is now independent of all model variables and equal to

$$8) \quad \lambda'' = \frac{1}{2}.$$

When we compare Regime I and Regime II we have  $\lambda' > \lambda''$  as long as  $(p-r) > -p'(\cdot)/2$ .

Even for some negative values on the excess return to housing the investment motive lifts the optimal LTV-ratio in a boom above the optimal LTV-ratio during a bust.

### **Regime III: A normal housing-mortgage market relation**

Finally, considering more normal market conditions where both the negative demand effect and the positive price effect of higher LTV-ratios are taken into account the derivative is as given by expression 3) and the first-order condition equals

$$9) \quad \frac{de}{d\lambda} = 0 \Leftrightarrow r'(\cdot)\lambda^2 - \lambda(p'(\cdot) + r'(\cdot)) + (p-r) + p'(\cdot) = 0.$$

Solving for the optimal LTV-ratio gives

$$10) \quad \lambda^{III} = \frac{r'(\cdot) + p'(\cdot)}{2r'(\cdot)} = \frac{1}{2} + \frac{p'(\cdot)}{2r'(\cdot)}$$

As  $r'(\lambda) < 0$  the condition for  $\lambda^{III} > 0$  is  $1 > \frac{-p'(\cdot)}{r'(\cdot)}$  or alternatively,  $-r'(\cdot) < p'(\cdot)$ , which we assume is the case. A positive LTV-ratio is contingent on the positive house price effect exceeding the negative demand effect.

Comparing the optimal LTV-ratio across the three regimes we see directly how  $\lambda^{III} > \lambda^{II}$  as long as  $p'(\lambda) > 0$ , which holds by assumption. When comparing a housing bust to a situation with normal market conditions, the optimal LTV-ratio is higher in the latter regime. This is intuitive as this regime also incorporates the positive price effect, while the housing bust only takes the negative demand side effect of a higher LTV-ratio into account.

When comparing a housing boom to the normal market situation we find  $\lambda^I > \lambda^{III}$  when

$$(p - r) > \frac{-p'(\cdot)}{2} + \frac{p'(\cdot)^2}{2r'(\cdot)}. \text{ When this condition holds the optimal LTV-ratio during a housing boom is higher than the LTV-ratio optimal during normal market conditions.}^5$$

If we compare the three optimal LTV-ratios we find the intuitive ranking  $\lambda^I > \lambda^{III} > \lambda^{II}$ . The optimal LTV-ratio is lowest during a housing bust, where the mortgage rate responds to higher LTV-ratios but house prices do not. In this regime a higher LTV-ratio impacts negatively on the excess return to mortgage financed housing, pulling the optimal LTV-ratio towards lower levels. During a housing boom, where only the positive price effect is included and a higher LTV-ratio impact positively on the excess return, the optimal LTV-ratio peaks. When both the negative demand effect and the positive price effect is included the total impact on the excess return is a combination of the two, and the optimal LTV-ratio is in between.

## 6. LTV-variation, leaning against the wind and mortgage market variability

---

<sup>5</sup> As both components on the left hand side of the inequality are negative, this intuitive result is valid for some negative values on the excess return to housing.

In this section we consider the demand side contribution to mortgage market variability. When applying the optimal LTV-ratio as an indicator for mortgage demand variations in the LTV-ratio represent the demand side contribution to mortgage market variability.

Obviously, in Regime II, where  $\lambda''$  is a fixed number  $Var(\lambda'') = 0$ .

Moving on to consider a housing boom (Regime I), we find the variance of  $\lambda'$  as

$$11) \quad Var(\lambda') = Var\left(1 + \frac{p-r}{p'(\cdot)}\right) = Var\left(\frac{p-r}{p'(\cdot)}\right) = \frac{Var p(\cdot) + Var r(\cdot) - 2 Kovar(p, r)}{Var p'(\cdot)}.$$

The negative relation between the mortgage rate and the rate of appreciation (see Figure 2), makes  $Kovar(p, r) < 0$ . From expression 11) we have  $Var(\lambda') > 0$ .

When market conditions are normal and both the price effect and the demand side effect are included, we find the variance of  $\lambda'''$  as

$$12) \quad Var(\lambda''') = Var\left(\frac{r'(\cdot) + p'(\cdot)}{2r'(\cdot)}\right) = \frac{Var r'(\cdot) + Var p'(\cdot) + 2 Kovar(p', r')}{4Var r'(\cdot)}.$$

The assumed shape of the two curves in Figure 2 equates the sign on the covariance between the mortgage rate and the rate appreciation to the sign on the covariance between the two first-derivatives  $Kovar(p', r') < 0$ . While  $Var(\lambda')$  is unambiguously positive, we have to assume  $Var(r') + Var(p') > 2Kovar(p', r')$  for the same to be true for  $Var(\lambda''')$ .

When we compare the variance of  $\lambda'$  and  $\lambda'''$  we find two scenarios: One where the higher LTV-ratio derived from a housing boom also carries with it higher mortgage market variability in terms of  $Var(\lambda''') < Var(\lambda')$ , The other scenario is one where  $Var(\lambda''') > Var(\lambda')$ . Focusing on the latter where the higher LTV-ratio  $\lambda'$  derived from a housing boom contributes less to mortgage market variability than the lower LTV-ratio  $\lambda'''$  derived from a situation with normal market conditions, this scenario comes about as

$$13) \quad \Omega > \Pi.$$

where  $\Pi = -8Kovar(p, r)Var(r') - 2Kovar(p', r')Var(p')$



Figure 3 pictures the relation between the optimal LTV-ratio and mortgage market variability, and, when considering normal market conditions, the effect of two different monetary policy regimes. One regime where monetary policy targets asset inflation (represented by  $\Omega > \Pi$ ), and a regime where asset prices are ignored ( $\Omega < \Pi$ ).

The model produces an intuitive ranking of LTV-ratios across three stylized regimes. The optimal LTV-ratio bottoms out in a housing bust where the LTV-ratio impacts the excess return negatively through the mortgage rate and peaks in a housing boom where the LTV-ratio impacts the excess return positively through a capital gain. In a more normal situation where mortgage markets are characterized by a downward sloping demand curve and housing markets see positive feed-back effects on prices from the optimal LTV-ratio is somewhere in between. However, while the optimal LTV-ratio is between that of a bust and that of a boom respectively, is the strength of the mortgage market variability during normal market conditions contingent on how monetary policy responds to asset inflation. When monetary policy ignores asset inflation it allows the demand side contribution to mortgage market variability to exceed that of a housing boom. A monetary policy that, on the other hand, takes asset inflation into account will counteract the effect of a higher LTV-ratio on the rate of appreciation by simultaneously lifting the mortgage rate, thereby reduce the demand side contribution to market variability compared to in a the housing boom. There is thus a potentially humped shaped relation between the optimal LTV-ratio and the individual risk exposure of a mortgagor and mortgage market variability across our three regimes.

Figure 3 provides several lessons for monetary policy and financial stability. The first is that macro-prudential policy and monetary policy are complements and not substitutes in the battle to ensure financial stability. A cap on the LTV-ratio is by itself not sufficient to constrain mortgage market variability. The cap should be accompanied by a monetary policy targeting asset inflation. Second, when asset inflation is not a target for monetary policy a cap on the LTV-ratio might not be sufficient for reducing the demand side contribution to mortgage market variability as the excess return to mortgage financed housing still stimulates the investment motive in housing demand. Third, and again related to the two former, a pro-cyclic macro-prudential policy should be aware of the mortgage market variability that develops in the period preceding a housing boom (See Gelati and Moessner (2011) for macro prudential policy in general). When monetary policy ignores asset inflation it allows for speculative behavior which might create bubbles and instability later on.

## 7. Summary and discussion

A rate of appreciation that exceeds the mortgage rate introduces a leverage gain to mortgage financed housing. This provides incentives to increase leverage for households entering owner-occupation. The incentives might be particularly strong when the investment motive is important for housing demand. Conventionally, higher leverage increases the risk exposure of homeowners. While standard when analyzing commercial investments the arguments regarding leverage are less common when analyzing housing investments.

Owner-occupied housing serves a multiple of purposes, including as a source for housing consumption and as an object for investments. For a household entering owner-occupied housing in need of mortgage finance the optimal LTV-ratio is therefore related to a number of factors. Thinking in terms of housing consumption, the level of savings and household income are important, often separating the optimal LTV-ratio for young adults from the optimal LTV-ratio of households with a history of savings and built-up equity.

Highlighting the investment motive of owner-occupied housing this paper derives the optimal LTV-ratio for a household maximizing RHE. Relating the investment motive of housing demand to speculative behavior and housing bubbles (see for instance Malpezzi and Wachter (2005)), this reasoning should be equally important as consumption motives when considering demand side contributions to variations in the LTV-ratio. Being at the heart of housing bubbles and financial instability, the arguments is also relevant for monetary policy strategies and macro-prudential policy.

When considering the capital structure of housing investments we derive the optimal LTV-ratio for a household maximizing RHE across three stylized regimes. In a housing boom, where the positive effect on house prices from higher LTV-ratios dominates, the optimal LTV-ratio peaks. The optimal LTV-ratio bottoms out in a housing bust where the negative relation between the LTV-ratio and the mortgage rate dominates. When market conditions are normal, and both the negative demand effect and the positive price effect of higher LTV-ratios are taken into account, the optimal LTV-ratio is somewhere in between. As the excess return to housing determines the incentives to increase leverage, a ranking of LTV-ratios where the regime that includes the positive (negative) effect of higher LTV-ratios on the excess return provides the peak (the bottom) is intuitive.

This intuitive ranking of optimal LTV-ratios across regimes implies however a potentially less intuitive ranking when it comes to the demand side contribution to mortgage market variability.

Mortgage market variability is assessed considering variations in the LTV-ratio, our indicator for mortgage demand. In a housing bust the demand side of mortgage markets does not contribute to mortgage market variability when the investment motive dominates housing demand. Despite that the optimal LTV-ratio peaks in housing boom, is the demand side contribution to mortgage market variability at its highest during normal conditions in housing and mortgage markets when monetary policy does not respond to asset inflation. Thus, the paper finds a potentially humped-shaped relation between the LTV-ratio and the demand side contribution to mortgage market variability.

While the optimal LTV-ratio and, hence, the individual risk taking in mortgage markets is at its highest when we abstract away from the negative relation between the LTV-ratio and the mortgage rate, the demand side contribution to mortgage market variability is contingent on how monetary policy responds to asset inflation. When monetary policy takes asset inflation into account is there, as shown by Figure 3, a positive relation between the LTV-ratio and mortgage market variability. When, on the other hand, monetary policy does not consider asset inflation the LTV-variation and the demand side contribution to mortgage market variability, peaks as housing and mortgage markets are characterized by normal market conditions.

The link between the investment motive of housing demand, speculative behavior and housing bubbles provides a context for policy considerations when thinking in terms of financial stability. The first comment in this regard is that macro-prudential policy such as LTV-caps is not an alternative to leaning against the wind. Macro-prudential and monetary policy are, as seen by Figure 3, complementary in effort to ensure financial stability. An LTV cap, for instance set as  $\lambda^{CAP} = \lambda^{III}$  will allow mortgage demand to produce the highest level of market variability when the cap is not accompanied by a monetary policy leaning against the wind. A combination of a macro-prudential policy intervention such as an LTV-cap and a monetary policy targeting asset inflation is reducing the demand side contribution to mortgage market variability.



## References

- Adelino, M., A. Schoar and F. Severino (2012), "Credit Supply and House prices: Evidence from Mortgage Market Segmentation", NBER Working Paper No. 17832  
<http://www.nber.org/papers/w17832>
- Agarwal, S., R. K. Green, E. Rosenblatt and V. Yao (2014), "Collateral Pledge, Sunk-Cost fallacy and Mortgage Default", *Journal of Financial Intermediation*, Available online 27.october. Corrected proof.
- Aherne, A., G. J. Ammer, B. M. Doyle, L. S. Krole and F. M. Martin (2005), "House prices and monetary policy: A cross-country study", Board of Governors of the Federal Reserve System. International Financial Discussion papers nr. 841.  
<http://www.federalreserve.gov/pubs/ifdp/2005/841/ifdp841.pdf>
- Allen F., and E. Carletti (2014), "Systemic Risk from Real Estate and Macro-Prudential Regulation", *International Journal of Banking, Accounting and Finance*, Vol 5 No.1/2, pp. 28-48.
- Alm, J. and J. R. Follain (1987), "Consumer demand for adjustable rate mortgages", *Housing Finance Review* Vol. 6, pp. 11-17.
- Amior, M. and J. Halket (2014), "Do households use homeownership to insure themselves? Evidence across US cities", *Quantitative Economics* Vol. 5 (3), pp.631-674.
- Anundsen, A. K. and E. S. Jansen (2013), "Self-reinforcing effects between housing prices and credit", *Journal of Housing Economics*, Vol. 22, pp. 192-212.
- Attanasio, O., R. Bottazzi, H.Low, L.Neisham and M. Wakefield (2012), "Modelling the demand for housing over the life-cycle", *Review of Economic Dynamics*, Vol.15 (1), pp.10-53.
- Berger, A., M.N. Espinosa-Vega, W. Scott Frame and N.H. Miller (2011), "Why do borrowers pledge collateral? New empirical evidence on the role of asymmetric information", *Journal of Financial Intermediation*, Vol. 20, pp.55-70.
- Borgersen, T. A (2016), "Housing appreciation and the (in)stable relation between housing and mortgage markets", *International Journal of Housing Policy*, Vol. 16 No. 1, pp. 91-110.
- Borgersen, T. A (2015), "Mortgage Supply, LTV and Risk Pricing", Available at SSRN:/<http://ssrn.com/abstracts>.

Borgersen, T. A and J. Greibrokk (2012), “Reflections on LTV, risk and incentives in mortgage markets”, *Journal of European Real Estate Research*, Vol. 5 No. 3, pp. 199-210.

Borgersen, T.A. and D. E. Sommervoll (2012), “Housing Careers, Price-Rent Ratios and Rental Equivalence”, *Housing, Theory and Society*, Vol. 29 No.3, pp. 276-288.

Borio, C. and P. Lowe (2002), “Asset prices, financial and monetary stability: exploring the nexus”, BIS Working Paper No.114, Bank for International Settlements.

Brueckner, J. K. (1994), “The demand for mortgage debt: some basic results”, *Journal of Housing Economics* Vol. 3, pp. 251-62.

Brueckner, J. K. (1997), “Consumption and investments motives and the portfolio choices of home-owners”, *Journal of Real Estate Finance and Economics*, Vol. 15, pp. 159-80.

Calza, A., T. Monacelli, and L. Stracca (2013), “Housing finance and monetary policy”, *Journal of the European Economic Association*, Vol. 11, pp. 101–122.

Campbell, J. Y. and J. F. Cocco (2003), “Household risk management and optimal mortgage choice”, *The Quarterly Journal of Economics*, Vol. 118 No. 4, pp. 1449-1494.

Campbell, J. R. and Z. Hercowitz (2009). “Welfare implications of the transition to high household debt”, *Journal of Monetary Economics*, 56, 1-16.

Claessens, S., S.R. Gosh and R. Mihet (2013), “Macro-prudential policies to mitigate financial system vulnerabilities”, *Journal of International Money and Finance*, Vol. 39, pp. 153-185.

Delcours, N. (2007), “The Determinants of Capital Structure in Transitional Economies”, *International Review of Economics and Finance*, Vol. 16, pp. 400-415.

Demirguc-Kunt, A., and E. Detragiache (2002), “Does deposit insurance increase banking system stability? An empirical investigation”, *Journal of Monetary Economics*, Vol. 49, pp. 1373-1406.

Diewert, W. E. (2001), “The consumer price index and index number purposes”, *Journal of Economic and Social Measurement*, Vol. 27, pp.167-208.

Duca, J. V., J. Muellbauer and A. Murphy (2010), “Housing Markets and the Financial Crisis of 2007–2009: Lessons for the Future”, *Journal of Financial Stability*, Vol. 6, pp. 203–17.

Duca, J. V., J. Muellbauer and A. Murphy (2011), “House prices and credit constraints: making sense of the US experience”, *The Economic Journal*, Vol. 121 (May), pp. 533-551.

Dunsky, R.M. and J. R. Follain (2000), “Tax-induced portfolio reshuffling: the case of mortgage insurance deduction”, *Real Estate Economics* Vol. 28, pp. 549-80.

Fischer, J.D.M. and M.Gervais (2011), “Why has home ownership fallen among the young?”, *International Economic Review*, Vol. 52 83), pp. 883-912.

Flannery, M. J. and K.P. Rangan (2006), “Partial adjustment toward target capital structure”. *Journal of Financial Economics*, Vol. 67, pp. 469-506.

Follain, J. R. and R. M. Dunsky (1997), “The demand for mortgage debt and the income tax”, *Journal of Housing Research* , Vol. 8 No.2, pp. 155-200.

Gelati, G. and R. Moessner (2011), “Macro prudential policy - A Literature Review”. *BIS Working Paper* No.337. <http://www.bis.org/publ/work337.htm>

Goodhart, C. and B. Hoffman (2008), “House Prices, Money, Credit, and the Macroeconomy”, *Oxford Review of Economic Policy*, Vol 24 No.1, pp. 180–205.

Groth, J. C and R. C. Anderson (1997), “Capital Structure: perspectives for managers”, *Management Decision* ,Vol. 35 No.7, pp. 552-561.

Guiso, L., M. Haliassos and T. Japanelli (2002), *Household Portfolios*. The MIT Press, Cambridge Massachusetts, London, England.

Harris, M. and Raviv, A. (1991), “The theory of capital structure”, *The Journal of Finance*, Vol. XLVI No. 1, pp. 297-355.

Henderson, P. H. and Y.M. Ioannides (1983), “A Model of Housing Tenure Choice”, *American Economic Review*, Vol. 73 (March), pp. 98-113.

Holmstrøm, B. and J. Tirole (1997), “Financial Intermediation, Loanable Funds and the Real Sector”, *Quarterly Journal of Economics* Vol. 112 No.3, pp. 663-691.

Iacoviello, M. and M.Pavan (2013), “ Housing and Debt over the life-cycle and over the business cycle”, *Journal of Monetary Economics*, Vol. 60 (2), pp. 221-238.

IMF (2009), “Lessons for monetary policy from asset price inflation”, *World Economic Outlook*, Ch. 3, International Monetary Fund, Washington DC, September.

IMF (2013), “The interaction of monetary and macroprudential policy”, IMF Staff Paper, January 29, 2013. <https://www.imf.org/external/np/pp/eng/2013/012913.pdf>

Kiyotaki, N. and J. Moore (1997), “Credit Cycles”, *Journal of Political Economy*, Vol 105, pp. 211–248.

Leece, D. (2004), *The Economics of the Mortgage Market*. Perspectives on Household Decision Making. Blackwell Publishing.

Lin, L. (2014), “Optimal- loan-to-value ratio and the efficiency gains of default”, *Annals of Finance* Vol. 10, pp. 47-69.

Malpezzi, S. and S. Wachter (2005), “The Role of Speculation in Real Estate Cycles”, *Journal of Real Estate Literature*, 2005, Vol. 13, No. 2, pp. 141-164.

Pavlov, A. and S. M. Wachter (2011), “Subprime lending and real estate prices”, *Real Estate Economics* Vol. 39, pp. 1-17.

Poterba, J. M. (1984), “Tax subsidies to owner-occupied housing: an asset market approach”, *Quarterly Journal of Economics*, Vol. XCIX, pp. 729-52.

Sommervoll, D.E., T. A. Borgersen and T. Wennemo (2010). “Endogenous Housing Markets Cycles”, *Journal of Banking and Finance*, 2010, Vol. 34, pp.. 557-567.

Sophocles, B. and T. Vlassopoulos (2009), “The interaction between mortgage financing and house prices in Greece”, *Journal of Real Estate Finance and Economics* Vol. 39 No.9, pp 146-164.

Warnock, V.C. and F. E. Warnock (2008), “Markets and housing finance”, *Journal of Housing Economics*, Vol. 171 83), 239-251.

Woodford, M. (2012), “Inflation targeting and financial stability”, *Sveriges Riksbank Economic Review*, Vol. 1, pp. 7-33.

Wong, E., A. Tsang and S. Kong (2014), “How does loan-to-value policy strengthen banks’ resilience to property price shocks-Evidence from Hong Kong”, *HKIMR Working Paper* No.03/2014.