Referee Report "The Aggregate and Distributional Implications of Credit Shocks on Housing and Rental Markets" by Juan Castellanos, Andrew Hannon, and Gonzalo Paz-Pardo

1 SUMMARY

This paper examines how credit shocks affect housing and rental markets, focusing on the impact of macroprudential policies and interest rate changes. The authors develop a model featuring heterogeneous households who make decisions about renting, homeownership, and becoming landlords. The model incorporates various factors such as age, income, wealth, mortgage constraints, and the dynamics of both housing and rental markets.

Model Details: Key features of the model include:

- Heterogeneous households: Households in the model vary in age, income, wealth, and housing tenure choices. This heterogeneity allows the authors to analyze the distributional effects of credit shocks.
- Endogenous landlord choices: Households can choose to become landlords, buying additional properties to rent out, creating a more realistic and upward-sloping rental supply curve.
- Mortgage constraints: The model incorporates loan-to-value (LTV) and loan-to-income (LTI) constraints, reflecting real-world mortgage market conditions.
- Equilibrium in housing and rental markets: House prices and rental rates adjust to clear both markets, allowing for analysis of their interconnectedness.

Findings from macroprudential policies: The model is used to examine the impact of Ireland's 2015 macroprudential policy, which introduced LTV and LTI limits on mortgages. The model predicts that these restrictions reduce house prices while increasing rents. This occurs as tighter credit conditions push potential homebuyers into the rental market, increasing demand and driving up rents. The policy also reduces homeownership rates, particularly among young and middle-income households. The model suggests that this policy redistributes wealth from renters to landlords.

Findings from changes in the cost of borrowing: A permanent increase in real interest rates also reduces homeownership rates, increases rents, and decreases house prices. Higher interest rates make mortgages more expensive, discouraging homeownership, leading to a shift toward renting, and driving up rents. The higher cost of borrowing also encourages households to buy smaller houses. This interest rate shock has distributional consequences, benefiting wealthier households while negatively impacting lower-income households.

2 ASSESSMENT

This paper delves into a crucial topic in the macro-housing literature: the influence of downpayment requirements on housing markets (house price, rents, and homeownership). The conventional macro-housing model remains silent on this issue, assuming that whether homes are purchased with credit or cash does not impact house price expectations or future prices. However, this assumption is at odds with the concerns of central banks and financial stability agencies, who are more attentive to the potential impact of credit conditions on asset price volatility, particularly in the real estate market.

A critical question in the macro-housing literature revolves around the elasticity of house prices to changes in credit supply. This is a complex issue as credit supply can shift to the right either due to an increase in the collateralizable amount of credit or a reduction in credit costs, leading to increased demand for credit and consequently higher asset prices. Understanding the relationship between credit changes and asset valuation requires a comprehensive understanding of the key components of credit supply, demand, and the endogenous movement of asset prices. Complicating the matter further is the importance of considering the persistence of these changes. For example, a persistent reduction in loan-to-value requirements is likely to have a different impact on house prices than a temporary one. A temporary reduction could prompt a rush to purchase within the limited window, potentially leading to an overshooting effect in the short run. In contrast, a persistent reduction would generate a more gradual and delayed response.

The **primary contribution** of the paper is to analyze the distributional effects of changes in credit supply across different demographic groups. Using a quantitative model, the authors assess the impact of various credit supply changes on housing markets, including house prices, rents, and homeownership. They employ the model to validate some of the predictions implied by a policy change in Ireland. Through the lens of the model, the authors conclude that credit constraints have a substantial impact on both housing and rental markets, with varying effects on different household groups. Understanding the dynamics of the rental market is crucial for fully comprehending the extent of credit shocks. From the perspective of credit supply, the authors find that macroprudential policies can mitigate the impact of credit shocks but may have unintended distributional consequences. Additionally, permanent increases in borrowing costs have significant and uneven impacts on housing and rental affordability. These findings highlight the interconnectedness of housing and rental markets and the importance of considering credit constraints when analyzing the effects of economic shocks.

2.1 MAIN COMMENTS

One of the paper's main contributions is its analysis of the distributional effects across different age groups. However, a key challenge is to align these findings with existing literature. While I've already highlighted the paper's contributions, I want to focus on three core areas that connect its findings to a broader body of work: 1) rental supply elasticity, 2) the effect of relaxing LTV constraints, and 3) the impact of credit conditions on prices and rents.

2.1.1 Rental Market Supply Elasticity

I agree with the authors that the elasticity of rental supply is a frequently misunderstood area. Changes in credit conditions or tax treatment for owner- and tenant-occupied housing can significantly impact the incentives for buyers to purchase and supply rental property. The decision to invest in housing is closely linked to how the generated services are used. However, the paper does not explain how the literature has dealt with it?

- **Perfectly inelastic rental supply:** Early macro-housing models often assumed a perfectly inelastic rental supply, meaning the stock of rental housing was distinct from owner-occupied housing (e.g., Berkovic and Fullerton, JPE1992). This implied that house prices and rents were connected only through the equilibrium determination of the marginal buyer, with no direct arbitrage condition linking their prices.

- **Perfectly elastic rental supply:** Other models have assumed a perfectly elastic rental supply (e.g., Gervais, JME2002). In the absence of transaction costs for housing capital, the rate of return from buying and renting a house must equal that of holding capital. Investors are indifferent between these two asset classes. Therefore, with perfectly elastic supply, most policies primarily affect the equilibrium quantity, with minimal impact on rental prices.

- **Elastic rental supply:** The first general equilibrium macro-model with an elastic rental supply was introduced by Chambers, Garriga, and Schlagenhauf (JME2009). Their model includes individual and corporate landlords with fixed operating costs, endogenous construction, and house prices determined by the construction sector. Rental markets are determined in equilibrium based on the supply of housing units from different types of landlords and the demand from young and old households. They show that the rental housing supply has an asymmetric response to changes in rental prices, marginal tax rates, and maintenance costs, while the corporate response is symmetric. They show that the introduction of a corporate sector can affect the household rental supply in two ways. First, a more elastic corporate sector response to rent price changes can dampen the noncorporate sector response. Second, a larger corporate rental sector can also dampen rental price responses.

Recommendation: I would encourage the authors to familiarize themselves with the early developments in the literature to ensure they have a thorough understanding of how rental prices respond to shifts in the supply and demand of rental units. The references in the paper only address very stylized cases (e.g., Guren and Greenwald, 2024), and their focus is solely on whether rental units are perfect substitutes for owner-occupied units. This is a direct response to the paper by Kaplan, Mitman, and Violante (2020), which presents a narrow and incomplete theory of house prices. I argue that their work is a distraction, as other research has demonstrated that house prices can be aligned with data in response to changes in credit conditions. These movements can occur with or without segmentation (see below for a pencil-and-paper specification). For example, Garriga and Hedlund (AER 2020, 2019) have shown this to be the case.

2.1.2 House prices and Regime Changes/Duration of Credit Conditions

Another important aspect of changes in credit conditions, especially those related to regulatory or monetary policy, is their degree of persistence (e.g., transitory or permanent changes). This applies to the supply of credit (LTV and PTI/DTI/cash-flow constraints), the cost of credit (mortgage rates), the level of path dependence (from which level policy adjusts credit conditions), and, in monetary economies, the persistence of inflation/deflation as it affects the nominal value of mortgage payments. Given this constellation of possible changes (considering the variable, degree of persistence, and path dependence), the authors focus on a persistent tightening of credit availability and an increase in the cost of borrowing. In this context, I want to emphasize the importance of the underlying assumptions, which are well-established in the literature, by highlighting how the elasticity of house prices to credit supply critically depends on changes in interest rates, loan-to-value ratios, and the duration of changes in credit conditions (regime).

I will make this point by using a simple model based on Garriga, Manuelli, and Peralta-Alva (AER 2019) as it provides a stylized pencil-and-paper asset pricing model that highlights two key dimensions: the role of credit frictions and the expected duration of periods of changing financial conditions. The pencil solution reveals flat areas with zero elasticity to credit conditions, while also highlighting areas in the state space where nonlinearities appear. This is important because it demonstrates that, at a conceptual level, the elasticity of house prices to changes in credit conditions can be zero, positive, or even negative. Their model considers an economy with two regimes for credit conditions.

Short-run: I would start with a short-run—which I view as the period of loose financial conditions—when interest rates on mortgages are low and loan-to-value ratios are high.

Long-run: The long-run—which I view as the permanent steady state—has interest rates and loan-to-value ratios return to their normal values.

Each regime is characterized by a vector (r_j^*, ϕ_j) for $j \in \{S, L\}$ corresponding to the effective cost of mortgages in that regime, r_j^*, and the maximal loan-to-value ratio, ϕ_j. An important parameter is the expected duration of the phase in which financial conditions are lax relative to the long-run. I would model the transition from the short-run to the long-run—a permanent transition—as governed by a Poisson process with parameter $1/T$. The expected duration of the low interest rate period is then T. I assume that the rate at which cash-flows are discounted for asset valuations is given by the rate of return, r^d, and ignoring for now general equilibrium effects, I will assume that changes in the mortgage rate, r_j^*, have no impact on r^d. To maintain a stylized model, I will assume that the output of housing and non-housing goods are given. I will relax these assumptions in the next especification. Since I view a switch to the long-run (L) as permanent, the price of a unit of housing in the long-run, P_L, satisfies the standard asset pricing equation

$$r^d P_L = R_L + \phi_L (r^d - r_L^*) P_L.$$

The first term, R_L, is the implicit rent associated with a unit of housing. I assume that the utility function is of the form $u(c, h) = \alpha_c \ln(c) + (1 - \alpha_c) \ln(h)$, which implies that $R_j = \left(y - \upsilon \phi_j r_j^*\right)(1 - \alpha_c)/\alpha_c$, where y is the ratio of income to housing stock and υ is the fraction of all mortgages held by

foreigners (or by individuals with inelastic demand for housing so that their consumption does not influence housing prices). The second term, $\phi_L(r^d - r_L^*)P_L$, is the profit associated with borrowing at the rate r_L^* and lending at the rate r^d. The borrowing limit is proportional to the value of the house maximal amount $\phi_L P_L$, and it is always optimal to borrow at the low rate as much as possible when $r_L^* \leq r^d$. The price of a unit of housing in the short-run (S) satisfies

$$r^d P_S = R_S + \phi_S(r^d - r_S^*)P_S + \frac{1}{T}(P_L - P_S).$$

The first two terms parallel those in the long-run pricing equation while the third term captures the appreciation change (e.g. loss) associated with a regime change.

For convenience, I will assume that $r_S^* < r_L^* \leq r^d$ and $1 \geq \phi_S \geq \phi_L$ to capture a traditional boom with a period of temporary low cost mortgages (but with unchanged average return on other investments) and relatively relaxed lending standards. Simple calculations show that the price $P = P_S/P_L$—which we take as the model's prediction for the change in prices associated with the short-run switch to lower interest rates and higher loan-to-value ratios—is given by

$$P = \frac{r^d + \frac{1}{T} - \phi_L(r^d - r_L^*) + \frac{1-\alpha}{\alpha}\upsilon\phi_L r_L^*}{r^d + \frac{1}{T} - \phi_S(r^d - r_S^*) + \frac{1-\alpha}{\alpha}\upsilon\phi_S r_S^*}.$$

This expresson captures several important aspects of house price dynamics:

1. **The importance of interest rate segmentation:** Market segmentation in the form of a lower r_S^* increases housing prices even if the domestic rate, r^d, is unchanged. The implied equation is a generalization of the standard pricing equation that, in some parameterizations without segmentation (i.e., $r^d - r_j^* \approx 0$), cannot account for large changes in housing prices in response to credit conditions. The introduction of market segmentation and expectations about the duration of lax financial conditions in the housing market increases the sensitivity of house prices to credit conditions. This is an important and know result in the literature, and the authors should acknowledge their findings in the broader context where markets are incomplete.

2. **Effect of credit supply changes:** The effect of changing the LTV value ϕ_S is theoretically ambiguous and it depends on the sign of this expression

$$\frac{\partial P}{\partial \phi_S} = \frac{1-\alpha}{\alpha}\upsilon r_S^* - (r^d - r_S^*),$$

that trade-offs the cost of higher mortgage balances with the benefit of relaxing the borrowing constraint. In the simple parameterization that we use below, the sign is always negative and hence relaxation of lending standards increase housing prices. Nevertheless it is possible to show that the responsiveness of P to changes in r_S^* exceeds that of changes in ϕ_S.

3. **The role of duration:** The expected duration of the low interest rate and high loan-to-value phase is important. P is maximized when $T \to \infty$, and it is equal to 1 for $T = 0$. The responsiveness of the relative price P is low when the change is expected to be short term and high when the change is expected to be permanent. For reasonable values, changes in υ and α_c have a small impact on P.

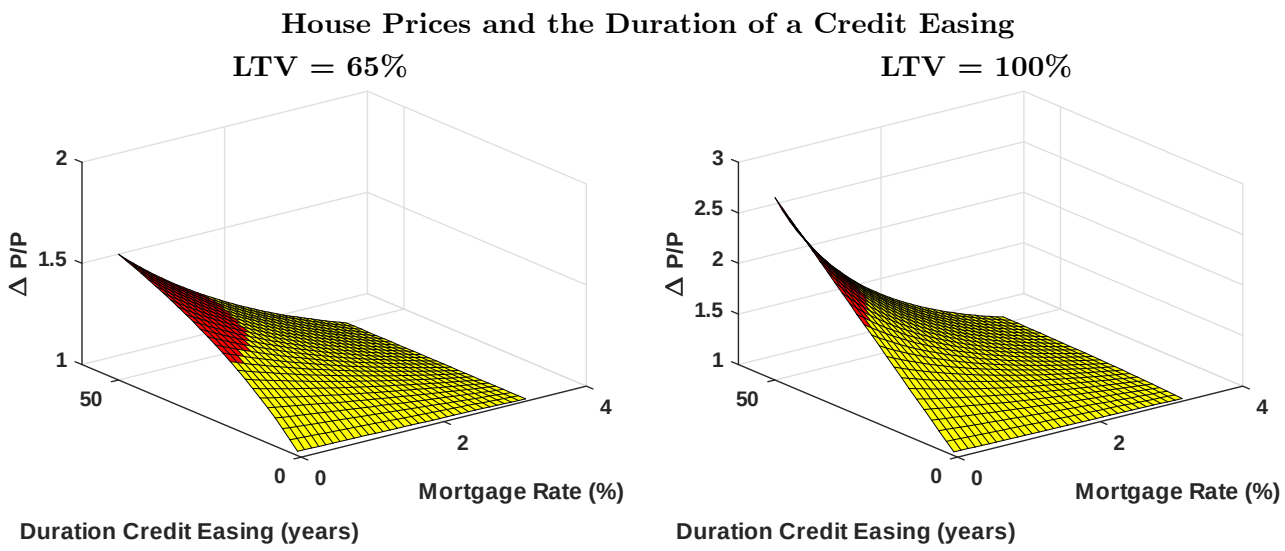
Can the change be quantitatively significant? To answer this question, I will report the impact on P of changing the financial conditions in the short-run using a base case that uses very standard parameters as summarized in the table below:

Parameters

r^d	r_L^*	ϕ_L	α_c	υ
0.042	0.031	0.6525	0.91	0.33

The real interest rate, real mortgage rate, and loan-to-value ratio can be viewed as conservative values, whereas the last two parameters are consistent with expenditure on housing being approximately 9-10 percent of income and a third of mortgages being held by foreigners. he figures below show the appreciation of house values P associated with changes in mortgage rates r_S^* and the expected duration of the phase in which financial conditions are lax for two different values of the loan-to-value ratio (ϕ_S): the baseline level of about 65 percent (i.e., $\phi_S = \phi_L$) , and 100 percent, which we take to be a very relaxed loan-to-value ratio, (i.e., $\phi_S > \phi_L$).

House Prices and the Duration of a Credit Easing



The response of house values to changes in housing finance highlight several important interactions between LTV, credit conditions, and house prices:

1. For some parameter values, the simple pricing formula can generate large increases in house prices. Even if the loan-to-value ratio is unchanged, large changes in interest rates (basically when r_S^* is close to zero) and expectations that the low interest rate period will last a long time (50 years at the extreme end) can generate increases in house values of about 60 percent. With more relaxed baseline for financial conditions (a loan-to-value ratio of 100 percent), the increase can be as high as 150 percent. For reasonable values, e.g., $r_S^* = 0.015$ and $\phi_S = 0.80$, the model predicts about a 35 percent increase in house prices.

2. For the range of high-price increases, the model displays significant nonlinearities for the relevant dimensions (i.e., low mortgage rates, a high loan-to-value ratio, and a long duration for the expectations of the credit easing). This highlight the potential differences between hot and less hot markets in the state space.

Recommendation: The take away from this exercise is that—in this setting—the critical factors such as where are current rates before the change in policy (low rates or high rates, as this determines the distribution of credit). I think the authors could do more connecting the levels, and the persistence of the policy changes with the work already done in the literature.

2.1.3 Endogenous House Prices and Rents in Response to a Change in Credit Conditions

The previous formulation analyzed the impact of changes in credit conditions on house prices but neglected to consider the impact on rents. To address this, I'll use a simplified version of Garriga, Manuelli, and Peralta-Alva (AER2019) to highlight the connection between these three variables in a model with a representative agent. This means there's no segmentation, as the same agent is pricing both the housing stock and the cash-flow services from housing. While this is a very simple model, it effectively explains the negative co-movement of prices and rents in response to shocks to credit conditions.

A common perception in the literature is that house prices should be more sensitive to credit conditions in an environment where the supply of housing is relatively inelastic (i.e., Sáez 2004, Martin 2009). To address this issue, I consider a special case of their model where housing is completely fix and represented by the land component, $L = \overline{L}$. The technology that maps housing stocks into flows is given by

$$H = G(L) = z_h L,$$

Like the general specification, the steady state interest rate is given by

$$r^d = 1/\beta - 1,$$

and it is independent of the factors that determine housing variables and mortgage financing. Since housing is land, the equation that determines its value is given by a standard asser pricing equation

$$p^\ell = (1 + r^d)\frac{u_h}{u_c} G_L(L) \frac{1}{r^d - \phi(r^d - r^*)},$$

where $G_L(L) = z_h$. The house value, $V = p^\ell \overline{L}$, is entirely determined by the price of land

$$V = p^\ell \overline{L} = (1 + r^d)\frac{u_h}{u_c} H \frac{1}{r^d - \phi(r^d - r^*)}.$$

To relate with the traditional housing literature that often uses the "user cost" as the fundamental value of housing, it is convenient to rewrite the equation as follows

$$\frac{V}{H} = \frac{(1 + r^d)R}{r^d} \frac{r^d}{r^d - \phi(r^d - r^*)}.$$

The term $R = (u_h/u_c)$ captures the implicit value of owner-occupied housing. In the absence of frictions, this value should be equal to the market rental price of one unit of housing (no segmentation between owner-occupied and rental housing). Since this is a general equilibrium model, the value of rents is tight to the level of consumption and the size of mortgage payments that feeds into the determination of the above expression

$$C = Y^* - \phi r^* V,$$

where $Y^* = zN$. In short, changes on housing finance (ϕ and r^*) have a direct effect on the pricing equation, but also an indirect effect through consumption. This second effect captures the impact of housing finance on disposable income.

When $\phi = 0$, the individuals purchase the housing without borrowing, the house values are entirely determined by the "user cost" or fundamental value of housing.

$$V^f = \frac{(1 + r^d)}{r^d} R \cdot H,$$

where the marginal utility of consumption is evaluated at $C = Y^*$ and housing consumption is given by $H = z_h \overline{L}$. Formally, rents satisfy $R = u_h(Y^*, H)/u_c(Y^*, H)$ and house values are entirely determined by the present discounted value of future rents in the economy. Using the fundamental value, it is useful to define the component of the house value derived from the ability to collateralize the house.

$$\widetilde{V}(r^d, r^*, \phi) = \frac{V}{V^f} = \frac{r^d}{r^d - \phi(r^d - r^*)}.$$

This expression is often referred as the price-to-rent ratio. There are some interesting cases that illustrate the relationship between mortgage rates, r^*, and LTV constraints, ϕ, with the price-to-rent ratio:

- **No borrowing** ($\phi = 0$) : In this case the price-to-rent ratio is one and independent of the cost of borrowing, r^*,

  $$\widetilde{V}(r^d, r^*, 0) = 1$$

- **Fully collateralized loan** ($\phi = 1$) : In this case the price-to-rent ratio is determined by the excess return between the deposit rate (i.e., marginal product of capital) and the borrowing rate.

  $$\widetilde{V}(r^d, r^*, 1) = r^d/r^*$$

- **Zero spread between rates of return** ($r^d = r^*$) : In this case the price-to-rent ratio is independent of the LTV value, ϕ,

  $$\widetilde{V}(r^d, r^d, \phi) = 1.$$

  Therefore, the relaxation of collateral constraints has no effect on house values.

- **Zero interest payment on mortgage loans** ($r^* = 0$) : In this extreme case the negative income effect associated to the size of interest payments disappears. As a result, a change in house values is entirely determined by the ability to collateralize the house.

  $$\widetilde{V}(r^d, r^*, \phi) = \frac{1}{(1 - \phi)}.$$

All these extreme specifications are useful to understand limiting cases, but do not allow a sharp characterization of the underlying drivers in the intermediate cases and this is where the curvature of the utility function becomes critical. To study the general case, it is useful to use a CES specification for preferences.

$$u(c,h) = [\alpha_c C^{-\rho} + (1-\alpha_c)H^{-\rho}]^{-\frac{1}{\rho}},$$

where the elasticity of substitution between consumption and housing is given by $\Sigma_{c,h} = 1/(1+\rho)$ where $\rho \in [1,\infty)$. In this case, house values solve a nonlinear equation characterized by

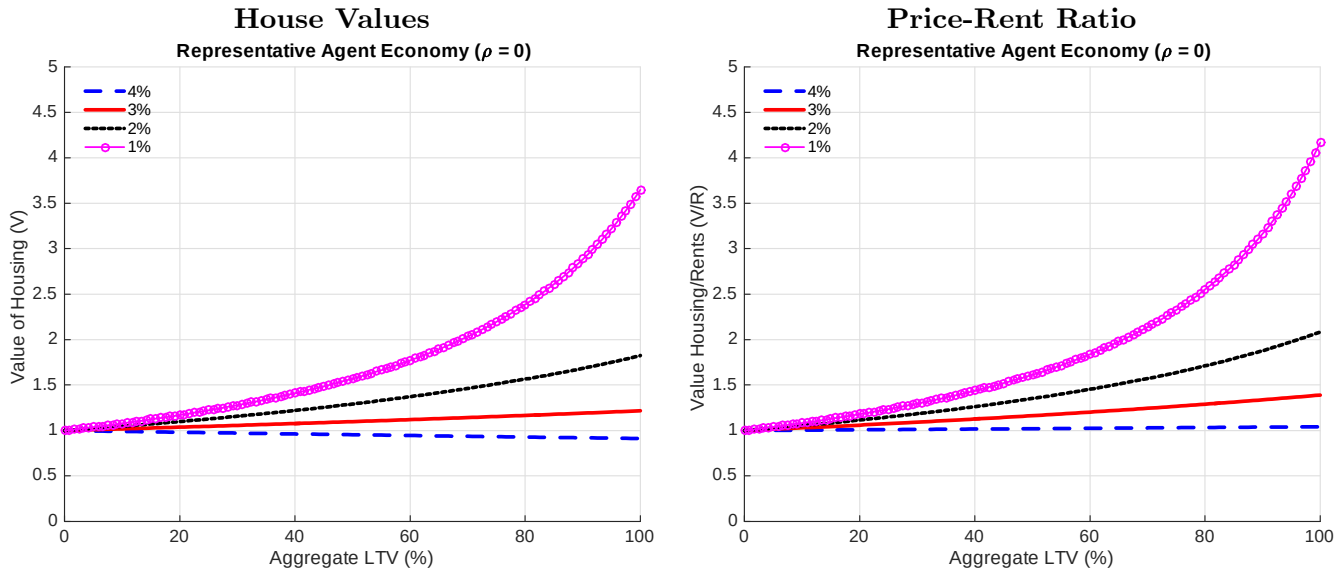
$$V = (1+r^d)\left(\frac{1-\alpha_c}{\alpha_c}\right)\left(\frac{Y^* - \phi r^* V}{H}\right)^{1+\rho} H \frac{1}{r^d - \phi(r^d - r^*)}.$$

In general, this functional equation $V(r^*, \phi, r^d, ...)$ depends on parameters, the return on deposits, the cost of borrowing, and the LTV. Changes in the last two have nonlinear effects on house values, V. Before delving in the general cases calculating the appropriate values and the response to changes in housing finance, it is useful to analyze a special case ($\rho = 0$) that has a closed form solution.

$$V = \frac{(1+r^d)\left(\frac{1-\alpha_c}{\alpha_c}\right)Y^*}{r^d - \phi(r^d - r^*) + \phi r^*(1+r^d)\left(\frac{1-\alpha_c}{\alpha_c}\right)}.$$

Plugging some standard parameters in this equation, it is possible to characterize how house values change with changes of the LTV value (ϕ) for a given mortgage rate. The results in the Figure have normalized the value of the house by a baseline level where $\phi = 1$, so one can interpret any change as the marginal contribution of relaxing the LTV constraint for a given r^*. The left panel depicts house values and the right panel the price-rent ratio, as both house prices and rents are endogenous..

House Prices Baseline with Unitary Elasticity ($\rho = 0$)



The figure highlights how changes in credit conditions (moving LTV up or down move house prices and rents), for a given level of interest rates. For a change in the interest rate, r^*, one has to jump from one curve to the next one. The experiments in the figure consider 4 curves based on different levels of the mortgage rate $r^* \in (1\%, 2\%, 3\%, 4\%)$. The steady state internal rate of return, r^d, equals 4.2%.

MAIN FINDING: *The relaxation of collateral constraint has an ambiguous effect on the appreciation of house values that depend on the relative spread between the internal rate of return and the mortgage rate* (r^d/r^*).

INTUITION: The figures show some interesting implications associated to changing the LTV. When the cost of borrowing is relatively high or the spread of rates relatively low (i.e., $r^* = 4\%$ or $r^d - r^* = 0.2\%$), the relaxation of the LTV constraint increases the "collateral value" of the house, but reduces rents via a negative "income effect". This second effect is driven by the reduction in consumption associated to higher interest rate bill that results from a larger loan. When the "income effect" dominates, house values decrease as LTV constraints are relaxed as can be seen in the blue dashed line. To mitigate the consequences of the "income effect" it is sufficient to reduce the baseline cost of borrowing to a point where house prices increase as the LTV increases. In this economy, the effects from a relaxation of collateral constraints has an indeterminate effect on house values that depends of the relative strength of these two opposing effects. The model shows that when the spread between the mortgage rates and the internal rate of return is high, house values are very sensitive to relaxing LTV constraints. However, this relationship is highly nonlinear as a change in ϕ from 0 to 20 percent has a different effect on house values than from 50 to 70 percent. A way to capture this non-linearity is to calculate the elasticity of house values to mortgage rates for different LTV levels

$$\Sigma_{V,r^*} = -\frac{\partial V}{\partial r^*}\frac{r^*}{V}.$$

This elasticity captures how fast house values increase as a result of reducing the cost of borrowing. In the case of $\rho = 0$, the expression for the elasticity can be solved analytically.

$$\Sigma_{V,r^*} = \frac{\phi r^*[1 + (1 + r^d)\frac{1-\alpha_c}{\alpha_c}]}{r^d - \phi(r^d - r^*) + \phi r^*(1 + r^d)\frac{1-\alpha_c}{\alpha_c}}.$$

From the expression one can characterize some bounds on the elasticity, for a range of $\phi \in [0, 1]$. In particular, when $\phi = 0$, the elasticity is equal to

$$\Sigma_{V,r^*} = 0$$

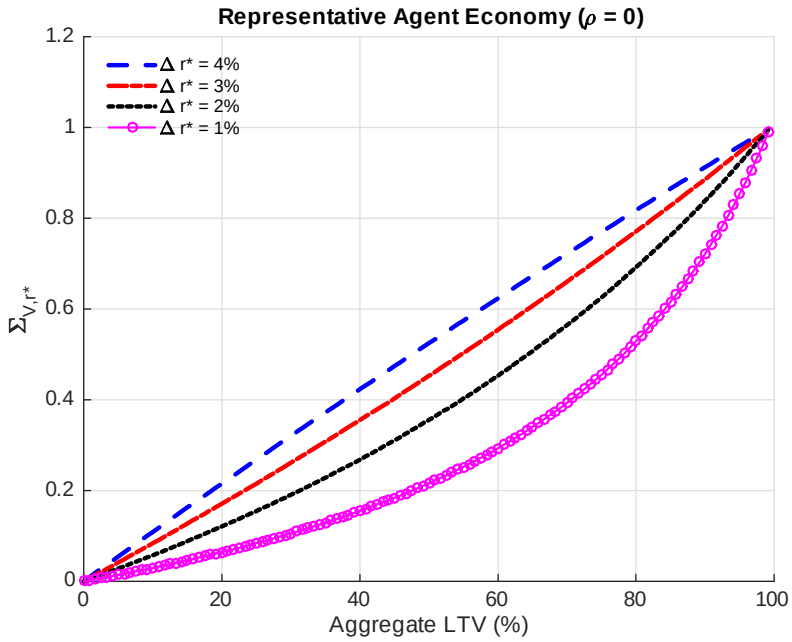
and when $\phi = 1$, the elasticity is equal to

$$\Sigma_{V,r^*} = 1$$

for any positive spread, $r^d - r^* > 0$. For intermediate values of the LTV, $\phi \in (0, 1)$, it is direct to show that $\Sigma_{V,r_1} > \Sigma_{V,r2}$ when $r_1 > r_2$. That is the elasticity of house values is always higher for higher interest rates. These theoretical findings are represented in Figure below that displays the

shape of the elasticity for the different baseline levels of r^*.

Elasticity of House Values to Mortgage Rates ($\rho = 0$)



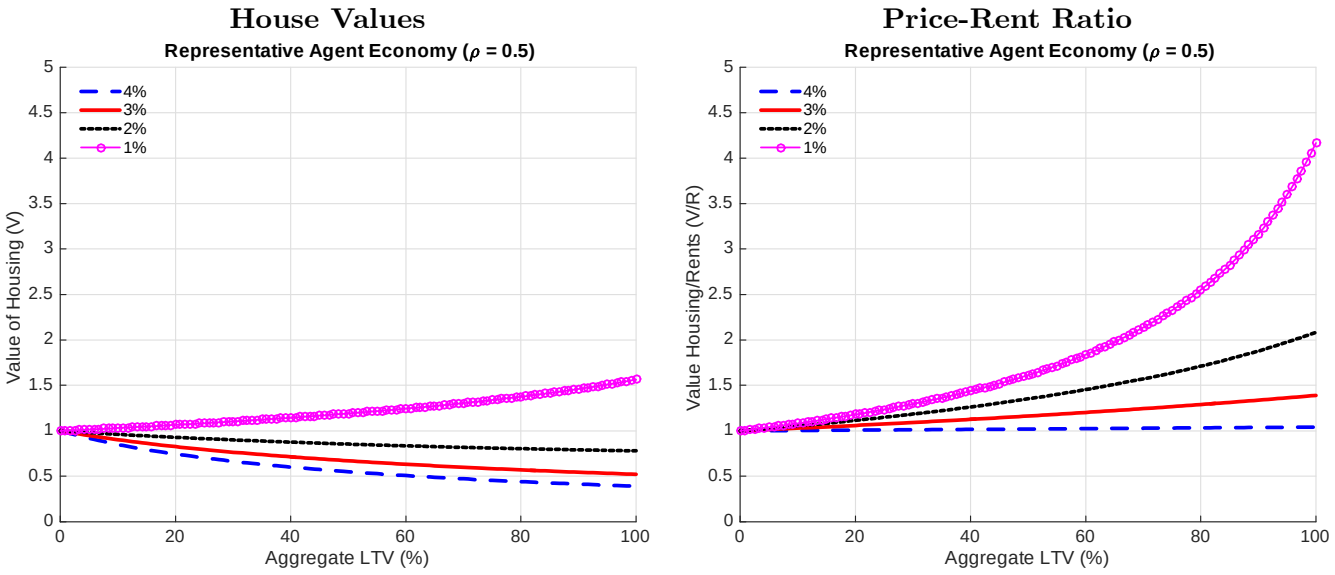
This measure is interesting because for $\phi = 0$ house values are independent of mortgage rates r^*. Relaxing collateral constraints increases the value of the elasticity. For very high mortgage rates (low spread), the change in the elasticity is concave and over the 45-degree line meaning that relaxing the constraint decreases house values but at a decreasing rate. There exists a value for the mortgage rate that exhibits a linear relationship between house values and interest rates, below this value the relationship is convex meaning that house prices increase at an increasing rate. The intuition is related to the two opposing effects. When ϕ is low, house prices are low (as can be see in Figure 1) and relaxing the LTV constraints has small effects on disposable income. However, when ϕ is high housing provides a sizeable collateral value and the value increases. For a high house value, a low interest rate reduces the burden of interest payment. As shown above, the limiting case when $r^* \to 0$ makes the elasticity to be extremely nonlinear.

Non-Unitary Elasticity: The next set of simulations explore how the complementarity between consumption and housing affects the relative strength of the collateral and income effect as mortgage rates and LTV constraints change.

- *More complementarity*: The figure below explores the implications of making consumption and housing more complements by reducing the elasticity of substitution to 2/3 setting $\rho =$

0.5.

Less Than Unitarity Elasticity ($\Sigma_{c,h} = 2/3$)

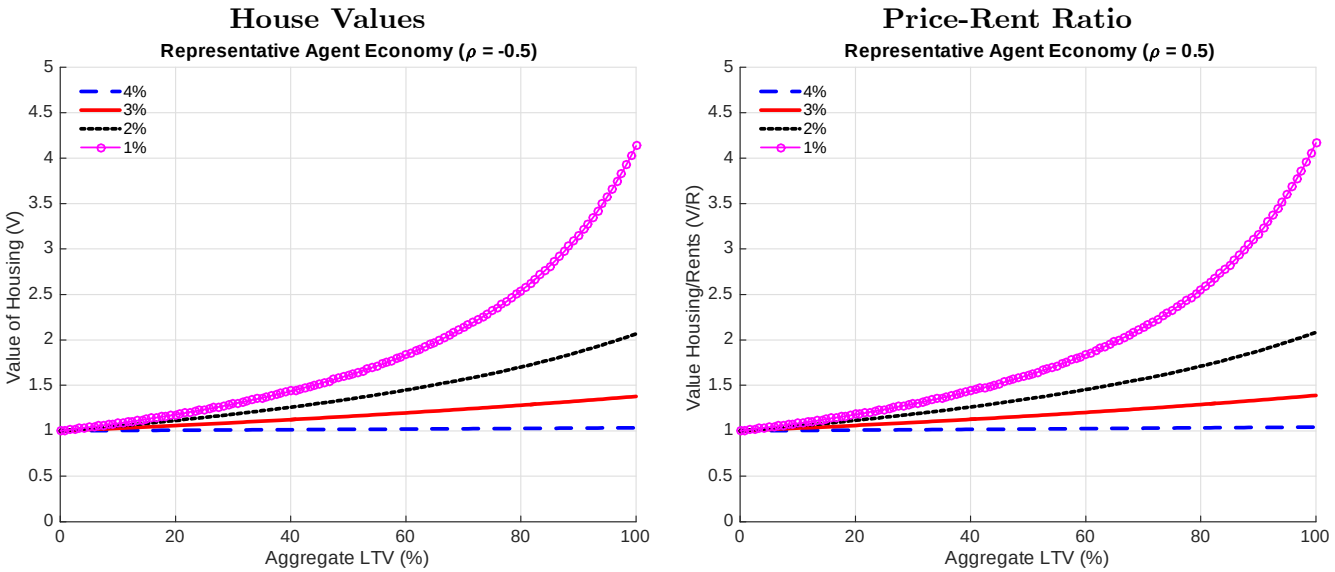


In the economy with a fixed housing supply, making consumption and housing more complements significantly reduces the response of house prices to collateral values. As the complementarity increases, the individual is force to buy c and h and has less freedom to substitute one good for the other. As the LTV $\phi \to 1$, the housing collateral values increase making houses more valuable. From an individual perspective, that requires a higher fraction of income, Y^*, to be devoted to meet interest obligations. As this fraction increases, the disposable income for c consumption declines and house values need to fall in order to clear the market. This mechanism can be seen by comparing the left chart (house values) in Figure 3 with the right chart (price-rent ratio). The price-to-rent ratio increase for all interest rates, meaning the collateral effect is always positive, but the decline in house values are driven by the negative income effect that make rents decline for all the mortgage rates over 1 percent. The responses of house values to the relaxation of collateral constraints are very different than in the case of unitary elasticity.

- *Less complementarity*: Increasing the elasticity of substitution between consumption and housing weakens the negative effects of relaxing the LTV constraints on house prices. The

figure below considers the case where the elasticity is increased to be 2 by setting$\rho = -0.5$.

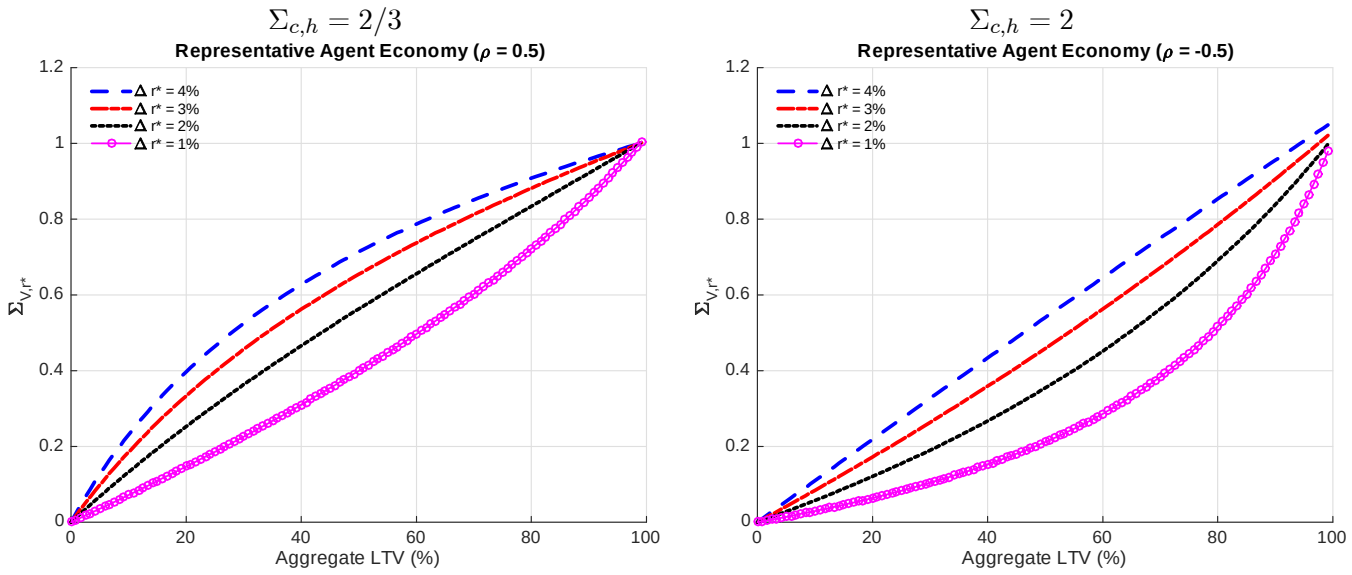
More Than Unitarity Elasticity ($\Sigma_{c,h} = 2$)



In this case, the negative income effect is almost eliminated and the increase in house values is entirely determined by the collateral component associated to relax ϕ.

The global soliution allows to compare the elasticity of house prices and rents for different elasticities across the LTV domain. The figure below compares the concavity and convexity of the price elasticities for the aforementioned values Σ_{V,r^*}:

Complementarity and Elasticities (Σ_{V,r^*})



Consistent with the baseline case ($\rho = 0$), the elasticity for the different values of ρ is equal to zero when $\phi = 0$, and equal to one when $\phi = 1$. The difference is how fast house values change

as $\phi \to 1$. The model suggests that the response is highly nonlinear, but it also affected by the elasticity of substitution between consumption and housing. One can show that endogenizing the housing supply can change qualitatively and quantitatively the response of house values to changes in housing finance.

Recommendation: The authors have the empirical discipline to conduct the experiment in Ireland and calibrate the model's response. However, it's important to be very clear and transparent about the indeterminate on house prices and rents from the basic theory.

2.2 Minor comments

Here are some minor comments about potential limitations of the analysis and findings in the paper that the authors should emphasize. It might be helpful to take a position and explain how the results could be biased due to the omission of some key margins. While I wouldn't recommend including these factors in the model, acknowledging them throughout the text, especially when explaining findings and connections to the literature, can enhance the paper's overall strength.

- **Limited consideration of supply-side factors**: The paper primarily focuses on the demand-side effects of credit shocks on housing and rental markets. While it acknowledges the role of housing supply, it assumes a fixed amount of buildable land (housing permits) each period. This simplification may not fully capture the complexities of housing supply responses to changes in demand and credit conditions. In reality, factors such as zoning regulations, construction costs, and developer incentives can significantly influence housing supply elasticity. A more comprehensive analysis would consider the dynamic interplay between supply and demand forces in response to credit shocks.

- **Assumption of a single, national housing market:** The model assumes a single, national housing market, which ignores regional variations in housing market conditions, demand, and supply dynamics. This simplification may not accurately reflect the localized nature of housing markets, where factors such as local economic conditions, amenities, and population growth can drive significant price and rent differentials across regions. A more nuanced analysis would consider the spatial heterogeneity of housing markets and the potential for spillover effects across regions in response to credit shocks.

- **Simplification of mortgage market features:** The model makes some simplifying assumptions regarding mortgage market features, such as treating mortgages as negative asset holdings and imposing a fixed minimum amortization payment. These simplifications may not fully capture the complexities of real-world mortgage contracts, which often involve various features like prepayment penalties, adjustable interest rates, and the possibility of default. A more realistic model would incorporate these features and their potential interactions with credit shocks. Other papers have address the role of long-term contracts that separate the stock of credit from its flow.

- **Absence of financial sector dynamics:** The model doesn't explicitly model the financial sector and its interactions with housing and rental markets. One the obvious one is mortgage

default in response to a negative credit supply shock that reduces prices. This omission limits the ability to assess the potential feedback loops between credit supply, housing demand, and financial stability. For example, a tightening of credit conditions could affect the availability of mortgage financing, leading to further reductions in housing demand and price declines. A more comprehensive model would incorporate financial sector dynamics and their role in amplifying or mitigating the effects of credit shocks.

Overall, while the paper provides valuable insights into the impacts of credit shocks on housing and rental markets, it's important to recognize the limitations of the analysis and the findings. Future research could address these limitations by incorporating more realistic features of housing supply, regional heterogeneity, long-term effects, mortgage market complexities, and financial sector dynamics.