

The Aggregate Demand Channel of Loan-to-Value Shocks

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- Many advocated for the use of macroprudential measures, such as Loan-to-Value (LtV) limits
- Challenges to assess impact of LtV changes:
 - Direct effects are highly heterogeneous
 - strongly concentrated at the lower end of the housing market
 - Indirect effects through house prices and the macroeconomy
 - suggests a role for general equilibrium channels

This Paper

Research Question(s) : LTV changes...

- How do **direct** and **indirect** transmission channels interact?
- And how they shape the **aggregate** and **distributional** effects ?
- How does monetary policy affect the **transmission** of LTV changes?

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- How does monetary policy affect the **transmission** of LTV changes?

Methodology: quantitative HANK model with housing

- Role for heterogeneity
 - Idiosyncratic income risk + Tenure decision + Mortgage choice
- Aggregate demand channel
 - nominal frictions
- Calibrated to Spain

Results

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⇒ drop in consumption largely due to indirect channels

2. Indirect (GE) channels exacerbate the unequal burden across households

⇒ highly leveraged home-owners suffer the most

3. Monetary policy response is a key factor for the transmission of LtV changes

⇒ dampens aggregate demand effects & reduces the unequal burden across households

Literature

① Redistributive effects of policies in HANK models

(see e.g. Gornemann, et al. 2016; McKay, 2016; Kaplan et al., 2018; Auclert, 2019; Auclert et. al., 2023; Hedlund et al. 2017)

⇒ **explicit focus on the transmission of shocks to LTV limits**

② Household credit conditions in HA models

(see e.g. Garriga and Hedlund, 2020; Guerrieri and Lorenzoni, 2017; Greenwald and Guren, 2021; Kaplan et al., 2020; Castellanos et al., 2024; Favilukis et al., 2017)

⇒ **highlight the importance of aggregate demand channel**

③ Interactions between monetary and macro-prudential policy

(see e.g. Mendicino et. al. 2020; Van der Gote, 2021; Carrillo et. al., 2021; Ferrero, 2024; Lambertini et.al. 2013; Angelini et. al., 2021; Chen et. al., 2023)

⇒ **zoom into the distributional effects of LTV changes**

Model

Model Overview

① Households

- heterogeneous income, housing wealth, liquid savings & long-term mortgage debt
- derive utility from consuming final goods c_t and housing services s_t

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③ Goods market

- final good: $y_t = n_t$
- nominal wage rigidities

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④ Policy Authority

- monetary policy: $i_{t+1} = \bar{i} + \phi^\pi (\pi_{t+1} - \bar{\pi})$
- macro-prudential policy: λ_t

Households - Overview

Infinitely lived households, facing idiosyncratic income risk $(z_{i,t})$, making choices a_t to maximize

$$\max_{a_t \in \mathcal{A}_t} \mathbb{E} \sum_{t=0}^{\infty} \beta^t u(x_t) \quad \text{where} \quad x_t = (c_t)^\gamma (s_t)^{1-\gamma}$$

- Endogenous state:
 - b_t : liquid bonds
 - borrowing limit $b_t \geq 0$
 - h_t : housing wealth
 - $h_t = 0$ if renter
 - m_t : mortgage debt
 - LTV constraint at origination/refinance
 - constant amortization & variable rate
- Tenure choice: $V_t(z_t, b_t, h_t, m_t) = \max \left[\underbrace{V_t^r(z_t, b_t, h_t, m_t)}_{\text{renter}}, \underbrace{V_t^o(z_t, b_t, h_t, m_t)}_{\text{owner}} \right]$

Household Problem: Renter

1. \implies **Renter:**

$$\begin{aligned} \circ \quad & b_{t+1} + c_t + \underbrace{fs_t}_{\text{rent cost}} = \underbrace{(1 + r_t)b_t + (1 - \tau_t)w_t n_t z_t}_{\text{cash in hand} \equiv W_t} \\ \circ \quad & b_{t+1} \geq 0 \end{aligned}$$

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2. \implies **Owner:**

$$\begin{aligned} \circ \quad & s_t = h_{t+1} \\ \circ \quad & b_{t+1} + c_t + \underbrace{(1 + \zeta)p_t h_{t+1}}_{\text{buying cost}} = W_t + \underbrace{m_{t+1}}_{\text{new mortgage}} \\ \circ \quad & m_{t+1} \leq \underbrace{\lambda_t}_{\text{LTV}} p_t h_{t+1} \end{aligned}$$

Household Problem: Owner

1. \implies **No Adjust:** $s_t = \underbrace{h_{t+1} = h_t}_{\text{stay in home}}$
- $b_{t+1} + c_t + \underbrace{\delta p_t h_t}_{\text{maintenance}} + \underbrace{m_t(\chi + r_t)}_{\text{mortgage payment}} = W_t$
- $m_{t+1} = \underbrace{(1 - \chi) \frac{m_t}{1 + \pi_t}}_{\text{mortgage LOM}}$

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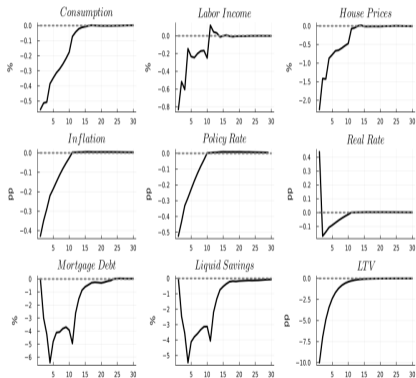
3. \implies **Renter:** $b_{t+1} + c_t + \delta p_t h_t + \underbrace{f s_t}_{\text{rent costs}} + \underbrace{m_t(1 + r_t)}_{\text{mortgage re-payment}} = W_t + \underbrace{p_t(1 - \zeta)h_t}_{\text{home sale}}$

Aggregate Effects

LTV tightening triggers substantial aggregate demand effects

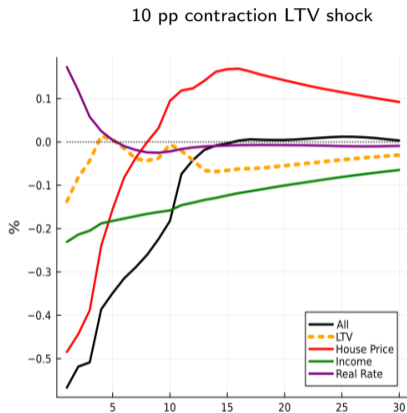
Aggregate Effects of LTV Shock

10 pp contraction LTV shock



- Temporary but persistent tightening in LTV cap ($0.8 \rightarrow 0.7$)
- Direct **LTV** effect \Rightarrow consume less:
 - delay house purchase
 - less incentive to refinance
- **Indirect** effects (aggregate demand)
 - \downarrow house prices
 - \downarrow inflation
 - \downarrow policy rate

Transmission Channels

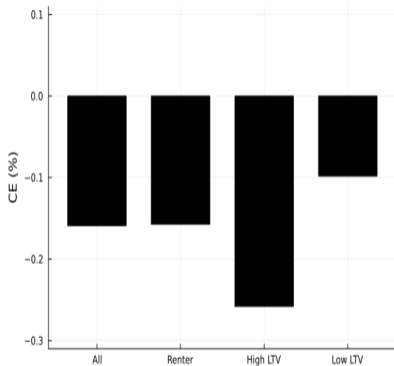


- **Direct LTV** effect is small
- **Indirect** effects through GE channels:
 - **Income** : consume less
 - **House price** : buy now
 - **Real rate** : consume more
- Indirect effects **reinforce** drop in consumption
 - 80% of decline on impact and 60 % in cumulative terms

Heterogeneity

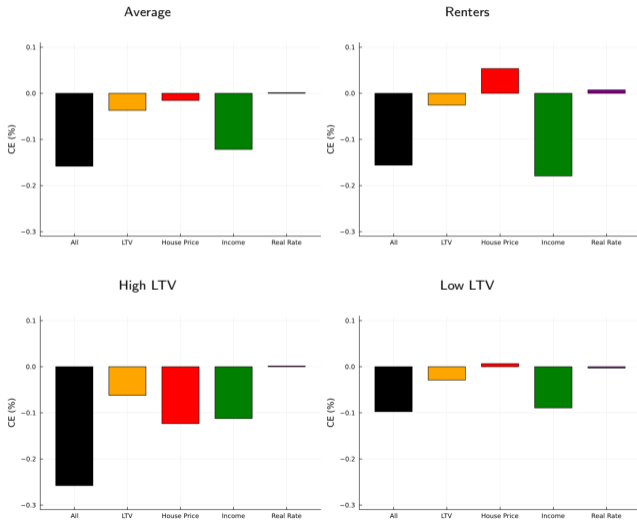
Indirect (GE) channels exacerbate the unequal burden across households

LTV Shock: Welfare Heterogeneity



- **Aggregate** welfare losses
- **Distributional** welfare effects
 - High LTV suffer the most

Welfare Heterogeneity by Channel

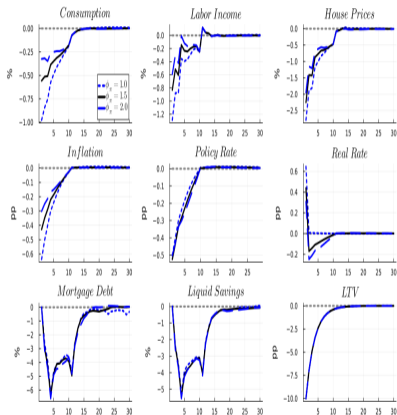


- Aggregate: Direct LTV + income channel
- House price \Rightarrow redistributive effects

Monetary Policy

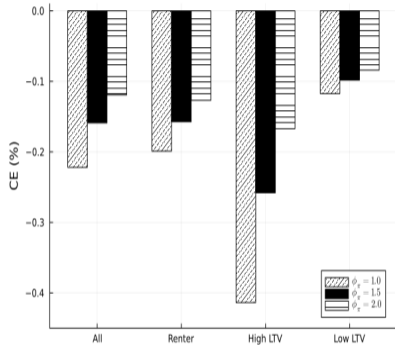
Key determinant of aggregate and distributive implications

The role of MP: Aggregate Effects of LtV shock



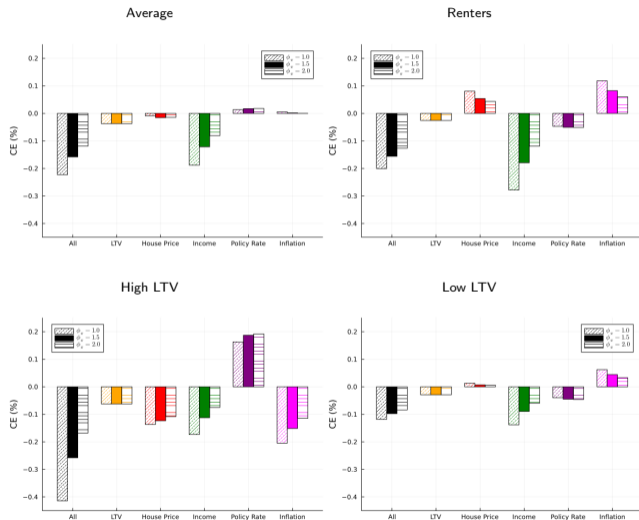
- $i_{t+1} = \bar{i} + \phi\pi(\pi_{t+1} - \bar{\pi})$
- **Stronger MP** response to π
 - mitigates consumption drop
 - dampen response of inflation, income and house prices

The role of MP : Welfare Heterogeneity



- **Aggregate** welfare effects
 - mitigates CE welfare losses
- **Distributional** welfare effects
 - stronger MP benefits high LTV the most

The role of MP : Welfare Heterogeneity by Channel



- **Aggregate** welfare effects: mostly driven by income channel

- **Distributive** effects: mostly driven by house prices and inflation

Conclusion

Conclusion

- Build **HANK** model with **housing** to study effects of **LTV** shocks
 - Aggregate demand channel
 - Costs mostly due to **indirect** GE effects
 - Highly heterogeneous effects
 - Degree of **monetary policy** accommodation
 - Affects aggregate and distributional effects of LTVs
 - Limited monetary policy accommodation: costs of tighter LTV regulation can be substantial and more unevenly spread across households
- ⇒ Crucial for monetary and macroprudential authorities to take these interactions into account

Thanks for your attention !

Appendix

Work in Progress

Limitations

- So far: **single house size** + **fixed supply** of rental/owner-occupied housing
 - ⇒ fixed housing at individual level ⇒ rich (low-LTV) can't increase housing
 - ⇒ fixed home-ownership ⇒ extreme segmentation
 - ⇒ fixed rents ⇒ renters more affected if rents ↑ (and weaker house price ↓) ?

How we address them:

- ① Add more **house size choices** to the HH problem (four sizes)
- ② Competitive rental market gives **rental equation**

$$f_t = \underbrace{\phi + p_t - \frac{(1 - \delta)}{(1 + r_{t+1})} p_{t+1}}_{\text{standard}} + \underbrace{\psi \left(\frac{h_{t+1}^r}{h_t} - 1 \right)}_{\text{adj. costs}}$$

⇒ Nests full/no segmentation ($\psi = \infty / \psi = 0$)

- ③ Make rental sector owned by HH through **competitive mutual fund**

⇒ Allows for adjustments in ownership, rents, rental supply, and house size distribution

Segmentation in Domestic Rental Market

Aggregate Effects: Domestic Rental market by Segmentation



- More segmentation \implies more adjustment in prices and less in home-ownership
- More segmentation \implies weaker drop in consumption and labor income.

Supply

- Fixed supply of OOH housing $\implies h_{ooh,t}^s = \bar{h}_{ooh}$
- Output is linear in aggregate labour $\implies y_t = n_t$
- Sticky wages & flexible prices $\implies \pi_t^w = \pi_t$
- n_t decisions made by union \implies NKPC

$$\pi_t^w (1 + \pi_t^w) = \kappa \left[v'(n_t) - \frac{\epsilon - 1}{\epsilon} (1 - \tau_t) u'(x_t) \right] n_t + \beta \pi_{t+1}^w (1 + \pi_{t+1}^w)$$

- Fisher equation determines real rate $\implies (1 + i_t) = (1 + \pi_t)(1 + r_t)$
- Central-Bank follows a Taylor Rule $\implies i_{t+1} = \bar{i} + \phi^\pi (\pi_{t+1} - \bar{\pi})$
- Fiscal Authority stabilizes debt $\implies \tau n_t = r_t \bar{d} + g_t$

Calibration Overview

- Calibrate to Spanish Economy
 - Large fraction of variable rate mortgages (60-65% of new originations up to 2019)
 - Most household wealth in housing
 - (Soft) LTV limit at 80% through Basel III requirements (risk-weighting)
 - Central Bank reserves right to impose strict LTV limit
- Internally calibrate $\{\beta, \gamma, \zeta\}$ targeting Financial Wealth, Housing Wealth, Ownership, LTV

Model Moments

Model Moments

Description	Model	Data (ES 2017)	Internal
Financial Wealth	0.18	0.17	Y
Housing Wealth	3.56	3.53	Y
Ownership	0.72	0.72	Y
LTV (mean)	0.31	0.23	Y
Net-Wealth	3.74	3.71	N
LTV (90p)	0.67	0.77	N
Y^{owner}/Y^{renter}	1.5	1.45	N
Gov't Spending	0.22	0.41	N

Notes: Aggregates & Distribution model moments. Normalized by output where applicable. Data comes from the LWS household survey data for Spain in 2017. *Y* stands for internally calibrated parameters and *N* stands for non-targeted moments.

Model Parameters

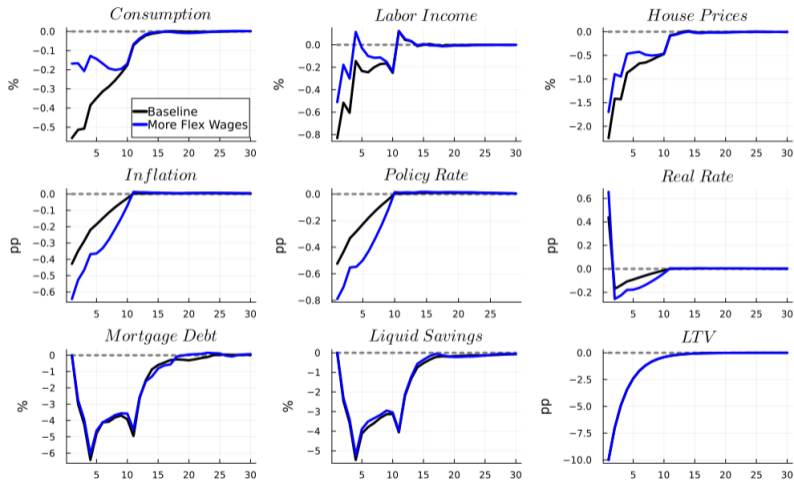
Model Parameters (I)

Parameter	Description	Value	Comment
<i>Preferences</i>			
β	Discount	0.956	Internal
σ	CRRA	2.0	Standard
γ	Housing pref.	0.80	Internal
ψ	Inv. Frisch	1.0	Standard
η	Disutility labor	0.66	Internal
<i>Income</i>			
ρ	Persistence z	0.9	Standard
σ^z	Std. z	0.2	Data
<i>Housing</i>			
ζ	Transaction cost	0.017	Internal
δ	Maint./Deprec.	1.5%	Standard
$\{\underline{h}^r, \dots, \bar{h}^r\}$	Rental sizes	{5.0}	Internal
$\{\underline{h}^o, \dots, \bar{h}^o\}$	House sizes	{5.0}	Internal
λ	LTV	0.8	Indus. Standard

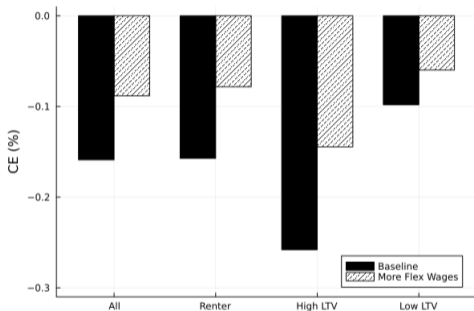
Model Parameters (II)

Parameter	Description	Value	Comment
<i>Union</i>			
ϵ	Elast.	5	Standard
κ	Wage stick.	0.08	Standard
<i>Gov't</i>			
\bar{d}	Debt	0.99	Data
\bar{d}^f	Foreign held debt	0.82	Data
\bar{g}	Govt Spending	0.22	Data
τ	Tax	0.23	Data
<i>Mon. Pol.</i>			
ϕ^π	Stance on inflation	1.5	Standard
ϕ^n	Stance on output	0.00	Standard
<i>Prices</i>			
$\frac{p}{f}$	Price-rent	25	Data
\bar{r}	Real rate	1.5%	Internal
$\bar{\pi}$	Inflation	0.0%	Standard
\bar{i}	Nominal rate	1.5%	Standard

The role of Nominal Frictions: Aggregate Effects



The Role of Nominal Frictions : Welfare Heterogeneity



- **Aggregate** welfare effects ($\phi_\pi = 1.5 \Rightarrow \phi_\pi = 2.0$)
 - mitigates CE welfare losses
 - mostly driven by income channel
- **Distributional** welfare effects
 - stronger MP benefits high LTV the most
 - mostly driven by real rates

Role of Nominal Frictions : Welfare Heterogeneity

