The aggregate and distributional implications of credit shocks on house and rental markets

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Motivation

- Housing has a **dual role** . . .
  * As a *consumption good* $\rightarrow$ if households don't buy a house, they must rent it
  * As an *asset/investment* $\rightarrow$ capital gains + cash flows for landlords

- Housing and rental markets are economically and politically very relevant and thus **subject to regulation**, e.g. tax advantages, subsidies, borrower-based macroprudential policies, etc.

- Understanding the effects of these policies on household's welfare as well as on the dynamics of house prices and rents requires a **joint study of both markets**.

▷ Small landlords

What we do

- Build an equilibrium model of the **rental and housing markets**
  - Heterogenous households (age, income and wealth)
  - Endogenous housing tenure choices (renters, homeowners or landlords)
  - Long-term mortgages with constraints that only bind at origination
- Use the model to study the effects of the **2015 macro-prudential intervention in Ireland** and its impact on:
  - House prices and rents
  - Homeownership rates
  - Welfare (distribution of losses)
- Model is also useful to understand other types of credit shocks such as a changes in the real interest rate

What we find: tighter LTV & LTI limits

- *Empirically*:
  - LTV & LTI limits $\Longrightarrow$ $\begin{cases} \downarrow \text{house price growth (Acharya et al., 2022)} \\ \uparrow \text{growth of rental prices} \end{cases}$
- *Model mechanisms*:
  - Increased rental demand by constrained households
  - More rental properties need to be supplied: higher rental rates (key: **landlord heterogeneity**)
  - Lower house prices over the transition, persistently if rental $\neq$ owner-occupied properties
- *Implications*:
  - Along the transition, the reform **benefits the old** and **hurts the young**
  - Largest welfare losses for middle of income distribution
  - Drivers of welfare loss: credit constraint + increase in rents
  - Increase in wealth concentration

The Irish Macroprudential Reform

Institutional framework

- First discussed in October 2014
- Officially announced and directly implemented in **February 2015**
- **Loan-to-Value (LTV) requirements**:
  * General limit: 80%
  * For *first time buyers* (FTB): 90% if property value is below €220,000
  * For *buy-to-let* (BTL): 70%
  * 15% of new lending can be above limit
- **Loan-to-Income (LTI) requirements**:
  * 3.5 times household income (only for FTB)
  * 20% of bank lending can be above limit

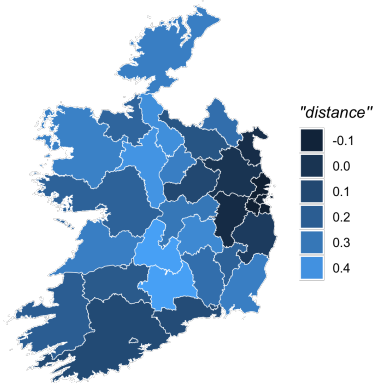
▷ Relaxation of the rules announced in October 2022

Empirical evidence

Intended effect on house prices

- Acharya, Bergant, Crosignani, Eisert, McCann (2022) study the effect of the reform on house prices

- What do they do?
  * Use data on newly originated mortgages before the reform
  * Construct a `Distance` measure that captures the exposure to lending limits (LTI & LTV) across counties and the income distribution
  * Regress house price changes on the `Distance` measure
  * Main finding: house prices increased more in more distant counties



What about rents?

- We replicate Acharya et al. (2020) empirical strategy using also **data on rents**:

$$\Delta HP_i = \beta_0 + \beta_1 \texttt{Distance}_i + \epsilon_i \quad (1)$$

$$\Delta HR_i = \gamma_0 + \gamma_1 \texttt{Distance}_i + \nu_i \quad (2)$$

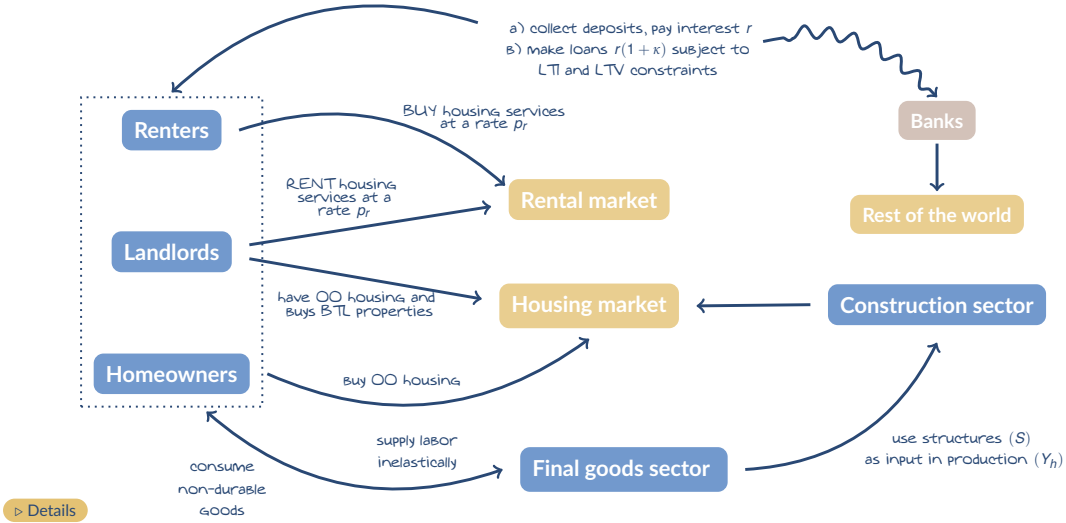
where i is county, Δ is change between 2014Q3 and 2016Q4

	Δ House prices	Δ Rents
Distance	0.289	-0.171
	(0.068)	(0.039)
Obs.	54	54
R^2	0.34	0.31

▷ Data ▷ Non-parameteric ▷ Pre-Trends

The Model Economy

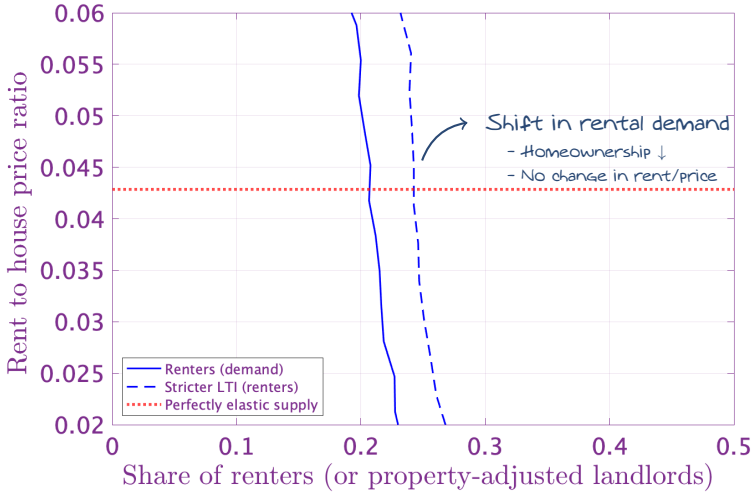
Model sketch



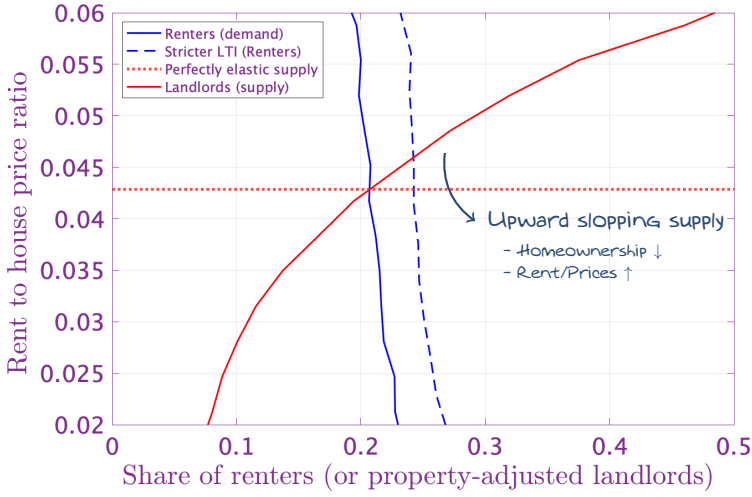
▷ Details

TIGHTER LTV & LTI LIMITS

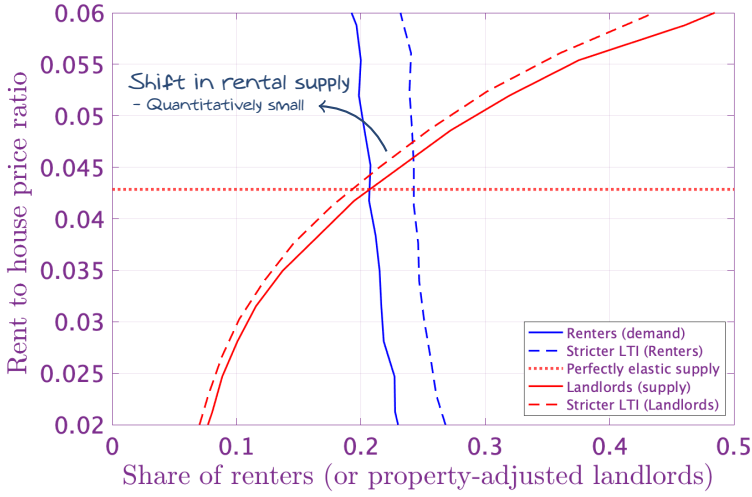
Model intuition: perfectly elastic supply



Model intuition: landlord heterogeneity



Model intuition: mostly unconstrained landlords



Aggregate effects

	Pre-Reform	Post-Reform
	LTV = 100%, LTI = 6	LTV = 80%, LTI = 3.5
Rent-to-Price	3.35 %	3.45 %
Average house price to income	4.70	4.65
Rent to Income	0.157	0.160
Homeownership rate	80.24 %	79.25 %
Share of HHs living in big house	64.74 %	61.27 %

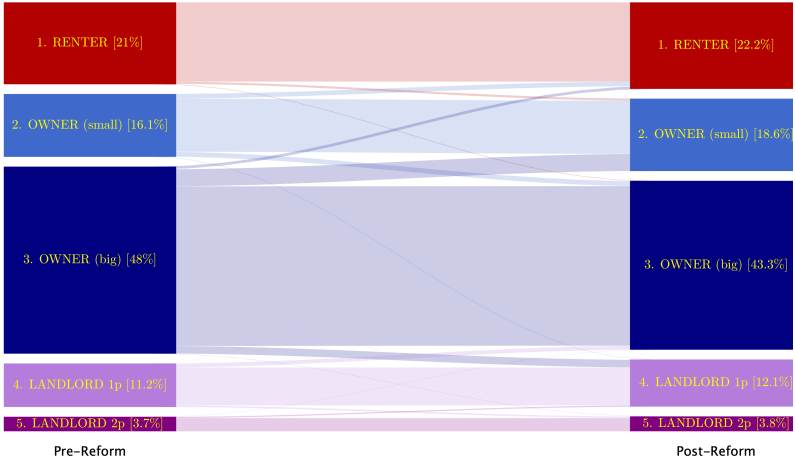
- Rent/Price $\rightarrow 3.1\% \uparrow =$ $\begin{cases} \text{Prices} \rightarrow 1.25\% \downarrow \\ \text{Rents} \rightarrow 1.81\% \uparrow \end{cases}$

- Homeownership rate $\rightarrow$ 1pp $\downarrow$
- Share of HHs living in big $\rightarrow$ 3.5pp $\downarrow$

- LTI more effective in controlling house prices without increasing rents or reducing homeownership

▷ LTV vs. LTI experiments

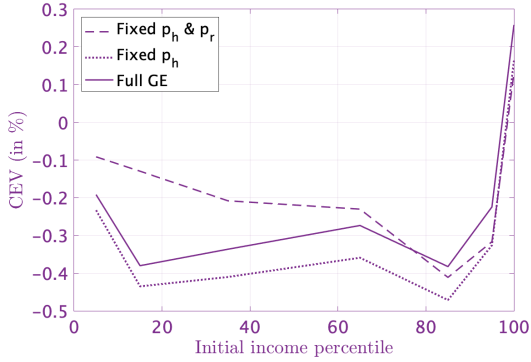
Housing tenure flows



▷ Homeownership rate

Welfare: Consumption Equivalent Variation

- Hypothetical question:
  - How much consumption needs to change in the pre-reform economy such that a newly born household is indifferent between pre and post-economies?
- Implications:
  - The **increase in rental prices** mostly **harms** low and middle income households
  - The **fall in house prices benefits** those in the middle of the income distribution



Other applications: Rising Real Interest Rates

A real rate shock

- $\uparrow r = \begin{cases} \uparrow r^s \rightarrow \text{substitution effect (financial assets)} + \text{positive income effect (downpayment)} \\ \uparrow r^b \rightarrow \text{negative income effect (mortgage payments)} \end{cases}$

	Low Int. Rate	Decomposition	High Int. Rate
	$r^s = 0.02, r^b = 0.04$	$r^s = 0.03, r^b = 0.04$	$r^s = 0.03, r^b = 0.05$
Rent-to-Price	3.45 %	3.88 %	3.96 %
Average house price to income	4.65	4.61	4.59
Rent to Income	0.160	0.179	0.182
Homeownership rate	79.25 %	78.85 %	77.52 %
Share of HHs living in big house	61.27 %	59.08 %	57.89 %

- $\uparrow r^s$ (SE $>$ IE) $\rightarrow$ homowership $\downarrow 0.39 p.p.$, $p_r \uparrow 11.38\%$, $p_h^{avg} \downarrow 0.80\%$
- $\uparrow r^b \rightarrow$ homowership $\downarrow 1.33 p.p.$, $p_r \uparrow 1.59\%$, $p_h^{avg} \downarrow 0.43\%$
- $\uparrow r \rightarrow$ homowership $\downarrow 1.73 p.p.$, $p_r \uparrow 13.16\%$, $p_h^{avg} \downarrow 1.23\%$

▷ Looser credit constraints ▷ SS CEV

Concluding remarks

Main Takeaways

- We have **empirically** shown that the Irish macroprudential reform had **opposite effects on house prices and rents**

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- We build an **equilibrium model with landlord heterogeneity** and use it to evaluate the *aggregate* and *distributional* effects of the reform:
  * across steady states: homeownership $\downarrow$ 1 pp, rents $\uparrow$ 1.81%, house prices $\downarrow$ 1.25%
  * ☹ poor and middle income $\rightarrow$ higher rents + postpone/cancel buying
  * ☺ top-earners $\rightarrow$ not constrained, higher returns at lower costs

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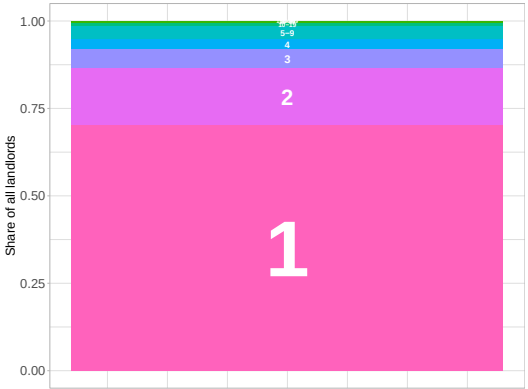
THANK YOU!

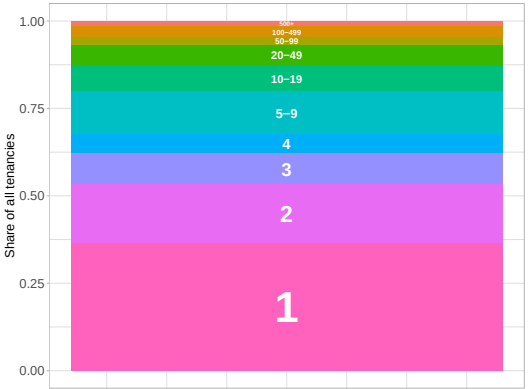
Appendix

Why we only model small landlords?

Share of landlords by number of registered tenancies (RTB)



Share of tenancies by number of registered tenancies (RTB)



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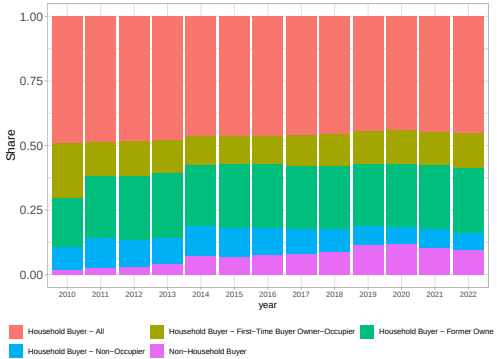
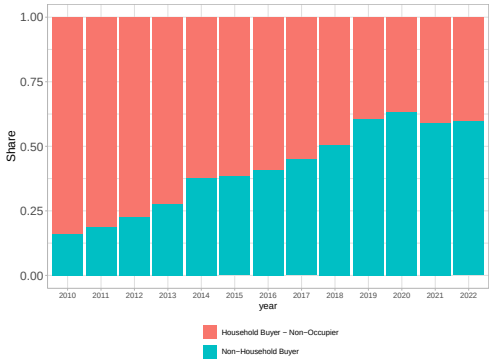
Who is the marginal investor?

Share of all property transactions, by type of buyer and year (CSO data)



Share of all property transactions, by type of buyer and year (CSO data), **excluding owner-occupiers**.



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The Irish Macro-Prudential Framework

Mortgage Measures Framework Review

- Relaxation of the rules were announced in October 2022
- These measures will come into effect in **January 2023**
- *First-Time-Buyers (FTB)*
  * The **LTI limit** increases from 3.5 to **4 times household's income**
  * No changes in the LTV limit
- *Second and Subsequent Buyers (SSB)*
  * The **LTV limit** increases from 80% to **90%**
  * No changes in the LTI limit
- The proportion of lending above limits applies at the level of borrower type
  * 15% of FTB and SSB can be above limit
  * 10% of BTL lending can be above limit

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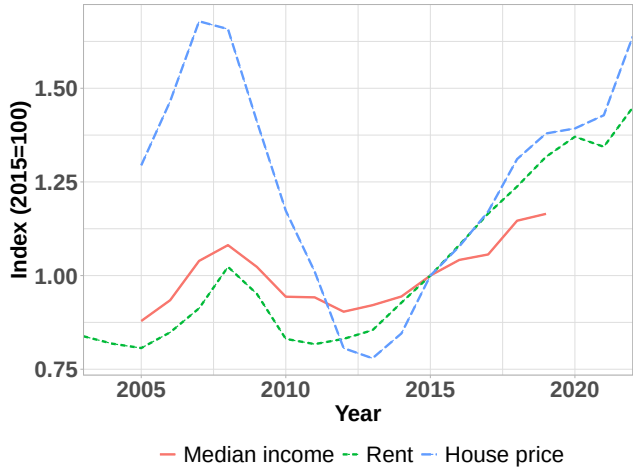
Cyclical evolution of house prices and rents in Ireland



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Data Sources

- Data on **house prices and rents** obtained from **daft.ie** property website (Lyons, 2022)
  * 54 housing markets (26 counties + cities + all postcodes in Dublin)

- **Distance measure** computed at borrower level (Acharya et al., 2022)
  * Look at households who obtain a mortgage in year 2014
  * Compute the distance of their mortgage from the new limits
  * Group over 26 counties and over the income distribution
  * Take averages

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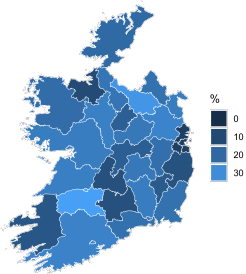
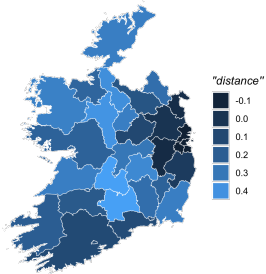
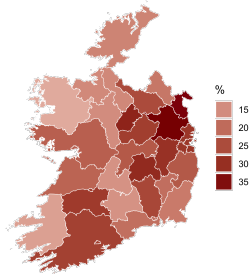
Non-parametric evidence



(a) House price growth



(b) Distance measure



(c) Rental price growth

- Counties where borrowers are close to the borrowing limits (low distance), e.g. around Dublin, experience *lower house price growth* (positive correlation) and *higher rental growth* (negative correlation).

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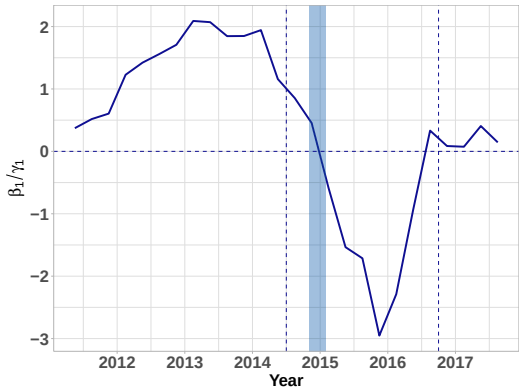
Robustness: Pre-Trends?

- Run placebo regressions (6) - (7) using 9-quarter rolling windows to compute growth rates

- Plot ratio of regression coefficients
  - $\beta_1/\gamma_1 > 0 \implies cov(\Delta HP, \Delta HR) > 0$
  - $\beta_1/\gamma_1 < 0 \implies cov(\Delta HP, \Delta HR) < 0$

- Sign changes around the reform . . .
  - Rents do not longer co-move with house prices as a result of the credit shock



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The Model Economy

Production

- **Final Good Producer**
  - Linear technology: $Y_c = A_c N$, where A_c is a parameter and N is labor
  - Profit maximization: wage $= A_c$
- **Housing Good Producer**
  - Cobb-Douglas technology: $Y_h = A_h \bar{L}^{\alpha_L} S^{1-\alpha_L}$ where $\{A_h, \alpha_L\}$ are parameters, $\bar{L}$ land permits and S structures
  - Profit maximization: $Y_h = A_h^{1/\alpha_L} \left((1-\alpha_L)\, p_h \right)^{(1-\alpha_L)/\alpha_L} \bar{L}$ (housing investment function)
  - *Housing stock* is composed by houses of *two different qualities*: $H = \tilde{h}_1 H_1^{sh} + \tilde{h}_2 H_2^{sh}$ where $\tilde{h}_i$ denotes quality and H_i^{sh} is its share in the aggregate stock
    - Final transaction price depends on type: $p(\tilde{h}_i)$
    - Conversion between types and aggregation is costless for the firm
    - Households will need to buy and sell to adjust their stock

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Households: environment

- **Life cycle model**
  - Working age from $j = 1, \cdots, J^{ret} \rightarrow$ supply labor inelastically and receive idiosyncratic income
  - Retirement age from $j = J^{ret} + 1, \cdots, J \rightarrow$ receive fix fraction of their last period income
  - After age $J \rightarrow$ they die with certainty
- **Preferences**

$$u(c, \tilde{h}) = \frac{\left(c\, f(\tilde{h}_i)\right)^{1-\gamma}}{1-\gamma} \quad \text{where} \quad f'(\cdot) > 0, f''(\cdot) < 0$$

- **Assets and liabilities**
  - Financial assets $\rightarrow r$
  - Real estate $\rightarrow p_r \,/\, p(\tilde{h})$
  - Mortgages $\rightarrow r(1+\kappa)$

▷ Back

Households: housing & mortgages

- **Housing state**: quantity and quality of housing $s := \{h, \tilde{h}\} \in \mathcal{H}, \dim(\mathcal{H}) = 5$
  - *Renter*: doesn't own $(h = 0)$, lives in a small rented house $\{\tilde{h}_1\}$, and pays rent p_r
  - *Homeowner*: owns $(h = 1)$ and lives in a house of either quality $\{\tilde{h}_1, \tilde{h}_2\}$
  - *Landlord*: owns multiple houses $(1 < h \leq 3)$, lives in the best quality $\{\tilde{h}_2\}$ and rents the remaining low quality $\{\tilde{h}_1\}$ at a rate p_r each
- Houses are **illiquid** (proportional transaction costs, τ_h) and **costly to maintain**, δ_h
- Mortgages ($a < 0$) are limited by two **financial constraints** that can only *bind at origination*:

$$a' \geq -\lambda_{LTV}\, p_h(\tilde{h}')h'$$
$$a' \geq -\lambda_{LTI}\, y$$

- Households must at least **pay interests** and **amortize** a minimum amount per period for the remaining life of the mortgage

▷ Back

Household's problem

$$V(a, \underbrace{\{h, \tilde{h}\}}_{=s}, y, j) = \max_{c,a',s} \left\{ \frac{(c\, f\,(\tilde{h}))^{1-\gamma}}{1-\gamma} + \sigma_\varepsilon \varepsilon(s) + \beta \mathbb{E} V\,(a', s', y', j+1) \right\} \tag{3}$$

s.t.

$$c + a' + p(\tilde{h}')h' + \mathbb{1}_{sell}\tau^h p(\tilde{h})h + \mathbb{1}_{buy}\tau^h p(\tilde{h}')h' + \delta^h p(\tilde{h})h \leq y + (1 + r\,(1 + \mathbb{1}_{a'<0}\kappa))\,a + p(\tilde{h})h + p_r(h-1) \tag{4}$$

$$a' \geq \begin{cases} \max\left\{-\lambda_{LTV}\, p(\tilde{h}')\, h', -\lambda_{LTI}\, y\right\} & \text{if } h' > h \\ a(1 + r(1+\kappa) - m(j)) & \text{if } h > 0 \text{ and } a < 0 \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

$$\varepsilon(s) \sim F, \text{ extreme value type I dtb} \tag{6}$$

$$m(j) = \frac{r(1+\kappa)(1+r(1+\kappa))^{J-j}}{(1+r(1+\kappa))^{J-j} - 1} \tag{7}$$

▷ Back

Market clearing & equilibrium

- r is fixed $\rightarrow$ small open economy
- **Housing market**
  * houses bought = houses produced + houses sold - depreciation
- **Rental market**
  * Competitive: renters meet landlords
  * p_r is determined using household's equilibrium distribution, $\mathcal{D}(a, s, y, j)$

$$\underbrace{\sum_{j=1}^{J} \int \int \mathcal{D}(a, s_1, y, j) da\, dy}_{\text{renters}} = \underbrace{\sum_{j=1}^{J} \int \int \mathcal{D}(a, s_4, y, j) da\, dy}_{\text{landlords w/ 1 btl property}} + 2 \underbrace{\sum_{j=1}^{J} \int \int \mathcal{D}(a, s_5, y, j) da\, dy}_{\text{landlords w/ 2 btl properties}}$$

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Equilibrium Definition

Definition 1: Competitive Equilibrium

For a given risk free rate r, a competitive equilibrium in this economy consists of: *(i)* a value function, a housing choice probability, and a consumption and asset policy function for the **households**: $\{V, \mathbb{P}(s), c, a'\}$, *(ii)* a **stationary distribution** over households' state: $\{\mathcal{D}\}$, *(iii)* policy functions for the **firms**: $\{N, L, S\}$, and *(iv)* **prices**: $\{w, p_L, p_h, p_r\}$ such that they jointly solve the household, final-good firm and construction firm problems, as well as satisfy the following **market clearing** conditions:

$$\sum_{j=1}^{J} \int \int \mathcal{D}(a, s_1, y, j) da\, dy = \sum_{j=1}^{J} \int \int \mathcal{D}(a, s_4, y, j) da\, dy + 2 \sum_{j=1}^{J} \int \int \mathcal{D}(a, s_5, y, j) da\, dy \tag{8}$$

$$Y_h = \left(\delta_h + \frac{1}{J}\right) H \tag{9}$$

$$Y_c = C + S \tag{10}$$

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TIGHTER LTV & LTI LIMITS

Isolating the effects of each limit

	Full-Reform	Only LTI	Only LTV
Δ% Rent-to-Price	**+3.10 %**	+1.76 %	+1.72 %
Δ% Average house price to income	-1.25 %	**-1.11 %**	- 0.78 %
Δ% Rent to Income	+1.81 %	**+0.63 %**	+0.93 %
Δ Homeownership rate	-0.99 p.p	**-0.57 p.p.**	-0.63 p.p.
Δ Share of HHs living in big houses	-3.47 p.p.	-3.07 p.p.	**-2.15 p.p.**

- Non-linear interactions between the two constraints amplify the response of prices
  - Similar to the constraint switching effect of Greenwald (2018)
- LTI limit seems more effective in controlling house prices without: *(i)* distorting as much the homeownership rate, and *(ii)* pushing rental prices upwards

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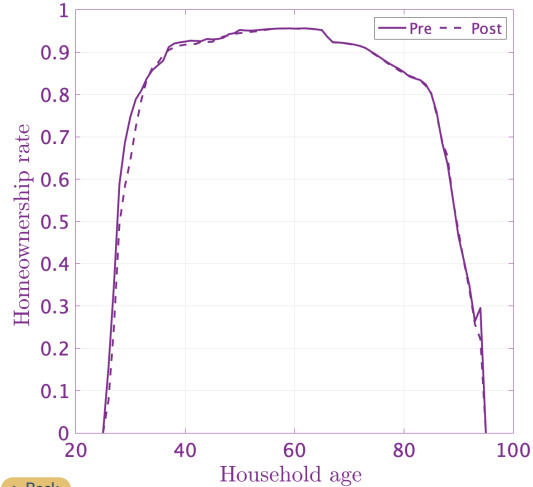
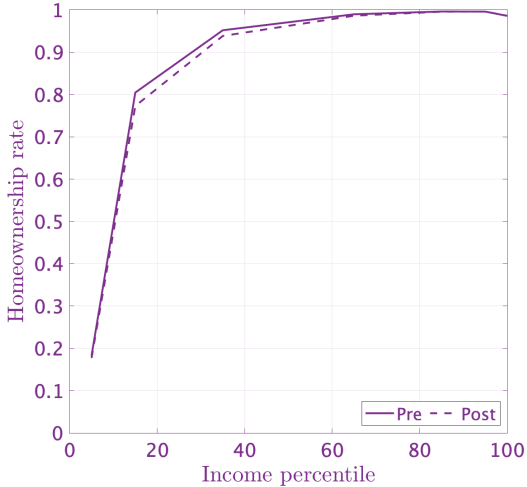
Homeownership rate by age and income





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A Real Interest Rate Shock

A real rate shock with looser credit conditions

- The effect of the shock is amplified when looser LTV and LTI limits are in place

	Low Int. Rate	Decomposition	High Int. Rate
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Rent-to-Price	3.35 %	3.81 %	3.93 %
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Homeownership rate	80.24 %	79.75 %	77.77 %
Share of HHs living in big houses	64.74 %	61.76 %	58.39 %

- $\uparrow r^s$ (SE $>$ IE) $\rightarrow$ homowership $\downarrow 0.49 p.p.$, $p_r \uparrow 12.54\%$, $p_h^{avg} \downarrow 1.08\%$
- $\uparrow r^b \rightarrow$ homowership $\downarrow 1.98 p.p.$, $p_r \uparrow 1.82\%$, $p_h^{avg} \downarrow 1.23\%$
- $\uparrow r \rightarrow$ homowership $\downarrow 2.47 p.p.$, $p_r \uparrow 14.59\%$, $p_h^{avg} \downarrow 2.30\%$

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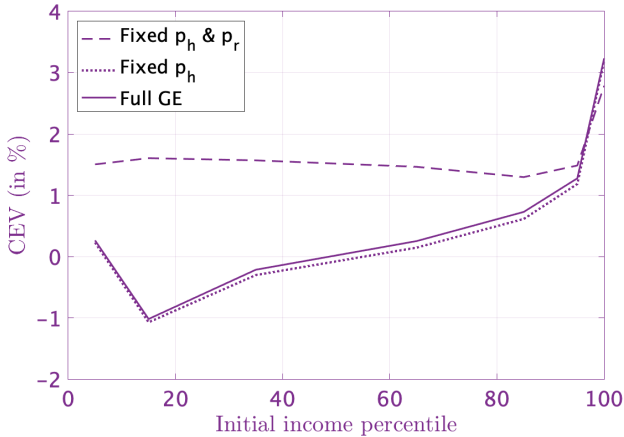
CEV (across SS) from a real rate shock



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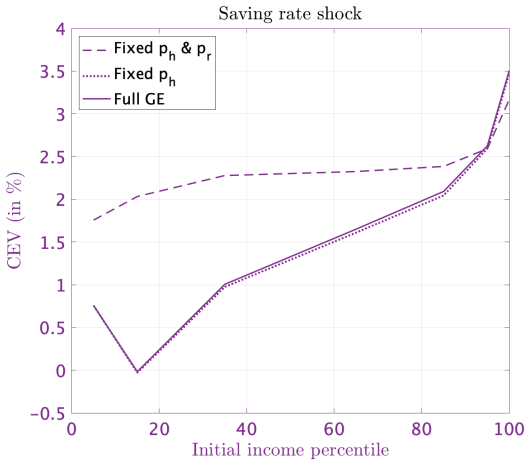
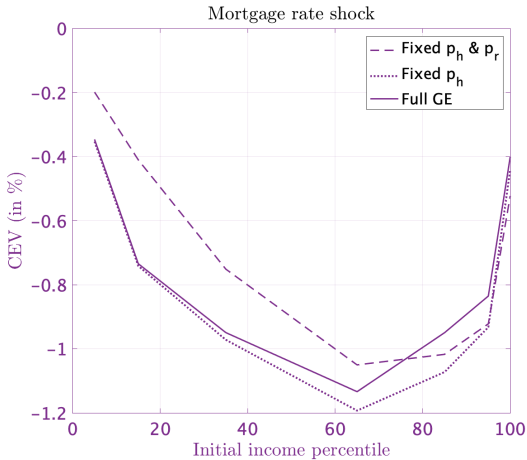
CEV (across SS) from savings and mortgage rate shocks





▷ Back