Mortgage borrowing limits and house prices

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Overview

Question: How do mortgage limits affect borrowing and house prices?

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This paper:

- **New empirical evidence:** Irish data and policy change in February 2015

Contribution

2015 policy change introduces loan-to-income and loan-to-value limits:

Individual portfolios:

- When a borrowing constraint binds, do borrowers:
  - get a mortgage, but
    - buy a cheaper house
    - reduce leverage
  - or not buy a house

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Individual portfolios:

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Equilibrium prices:

- If individuals buy a cheaper house, is this because
  - they buy a lower quality house
  - house prices fall in equilibrium

Contribution

2015 policy change introduces loan-to-income and loan-to-value limits:

Individual portfolios:

- When a borrowing constraint binds, do borrowers:
  - get a mortgage, but
    - buy a cheaper house (Poorer) borrowers above LTI threshold
    - reduce leverage (Richer) borrowers above LTV threshold
  - or not buy a house

Equilibrium prices:

- If individuals buy a cheaper house, is this because
  - they buy a lower quality house
  - house prices fall in equilibrium Regions with many above LTI threshold

Related Literature

Credit and housing

- Mian and Sufi (2011); Attanasio, Bottazzi, Low, Nesheim, Wakefield (2012); Corbae and Quintin (2015); Landvoigt, Piazzesi and Schneider (2015); Favilukis, Ludvigson, Van Neuwerburgh (2017); Greenwald (2018); Greenwald and Guren (2019); Justiniano, Primiceri and Tambalotti (2019); Kaplan, Mitman and Violante (2019); Boar, Gorea, Midrigan (2020).
  - Policy change tightened limits
  - LTI and LTV limits are different

Macroprudential policy and borrowing limits

- Lorenzoni (2007); Diamond and Kashyap (2016); Farhi and Werning (2016); Korinek and Simsek (2016); Acharya, Bergant, Crosignani, Eisert, and McCann (2020); Caballero and Simsek (2020).
  - Implementation of borrower based macro-pru policy

Key difference between LTV and LTI limits

Problem of an owner household:

$$
\begin{aligned}
\max_{c,b,m,h} \quad & \textstyle\sum_{t=0}^{T} \beta^t \mathbb{E} u(c_t, h_t) \\
s.t. \quad & c_t + \frac{b_{t+1}}{R_t} + \frac{m_{t+1}}{R_t^m} + p_t h_{t+1} = y_t + b_t + [m_t + p_t h_t]\mathbb{1}_h \\
& b_{t+1} \geq 0 \\
\text{LTV} \quad & 0 \geq m_{t+1} \geq -\psi^{ltv} p_t h_{t+1} \\
\text{LTI} \quad & 0 \geq m_{t+1} \geq -\psi^{lti} y_t
\end{aligned}
$$

- **Loan to value:** binds if cash on hand low relative to optimal house value
  - → More savings allows more borrowing
- **Loan to income:** binds if income low relative to optimal house value
  - → More savings **does not** allow more borrowing

1. Background to policy change

2. Impact of policy on borrowing

3. Impact on equilibrium prices

2015 policy change in Ireland

Context

- Ireland had large boom-bust in 2000s
- Policy introduced approx 18 months from bottom of cycle
- Unanticipated policy change ▸ Google Trends

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Loan to value

- First time buyers: 10% minimum downpayment ▸ Details 2015-17
- Second or later buyers: 20% minimum downpayment
- Investors (buy to rent): 30% minimum downpayment

Loan to income

- Non-investors 3.5 times income limit

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Loan to income

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Exemptions

- Each bank allowed exceed the limits for up to 20% of new lending (by value)
- Refinancing/restructuring mortgages exempt

1. Background to policy change

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Data

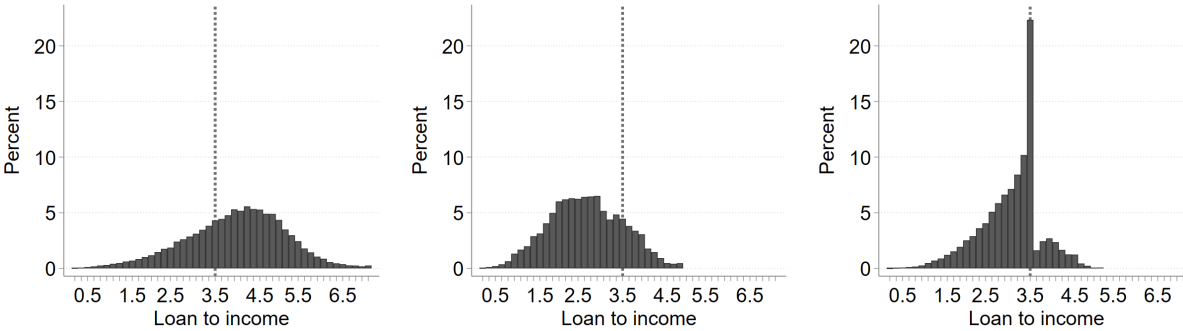
Individual mortgage dataset

- **Source:** Central Bank of Ireland
- Purchase price, mortgage, deposit, income at origination
- All mortgages except one large bank: no income reported before 2015

Question

- How do the 2015 limits compare to LTV, LTI ratios in previous years?

Density of new mortgages by LTI and year



(A) 2006 (B) 2014 (C) 2018

- Similar pattern for LTV: LTV

Comparing choices over time

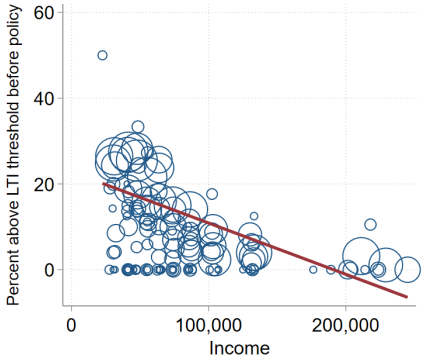
Data: Construct a panel of cells

- Cells: age (7) x income (10) x buyer type (2) = 140 x years (7) $\approx$ 927
- % above threshold in each cell in 2014
- Average purchase price, mortgage, deposit
- Weight results by cell size (Blundell et. al., 1998)

Questions:

1. What groups had the most people above the threshold in pre-period?
2. How did choices—purchase price and leverage— change?

Who was above threshold in pre-year (2014)



Each circle: is an age-income-type cell

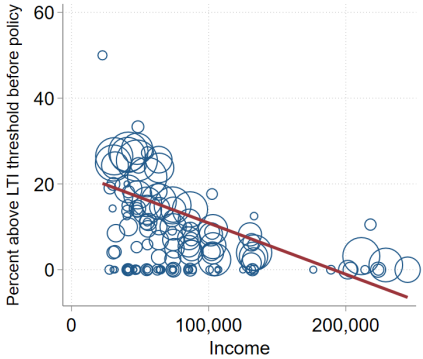
Size of circle: count of cell

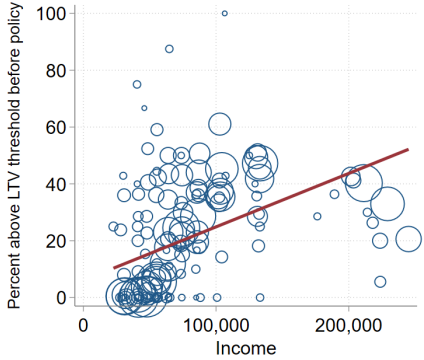
Line: weighted regression

Above LTI threshold:

- poorer
- younger ▸ by age
- less wealth ▸ HFCS

Who was above threshold in pre-year (2014)





Each circle: is an age-income-type cell

Size of circle: count of cell

Line: weighted regression

Above LTI threshold:

- poorer
- younger ▸ by age
- less wealth ▸ HFCS

Above LTV threshold:

- richer
- no age correlation
- more wealth

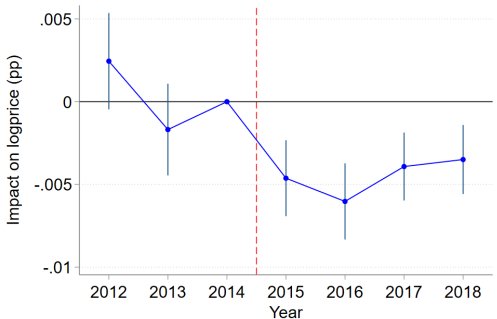
Empirical strategy

Difference-in-difference event study regressions

$$
\begin{aligned}
y_{it} &= \sum_{k \neq 2014} \delta_k^{LTI} [\text{\% above LTI threshold}_i^{2014} \times \mathbb{1}_{t=k}] \\
&+ \sum_{k \neq 2014} \delta_k^{LTV} [\text{\% above LTV threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \boldsymbol{\tau_t} + \boldsymbol{\gamma_i} + \epsilon_{it}
\end{aligned}
$$

- Outcome y_{it}
  - purchase price, loan-to-value
- Cell i, year t
- "Treatment intensity": % above threshold
- Weight regressions by cell size (in 2014)
- Standard errors clustered by cell

High LTI groups : δ_k^{LTI}



(A) Purchase price (log)

→ 15% lower price in 2015 for cells with 30% *above LTI threshold* versus those with 0%

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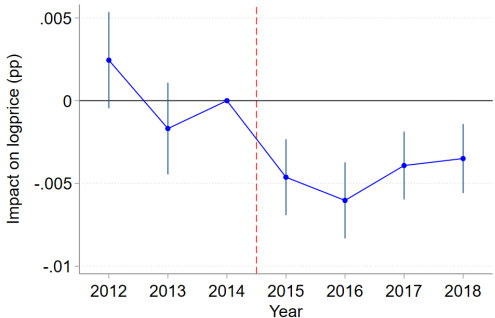

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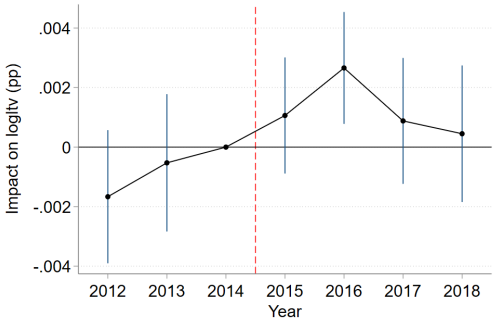
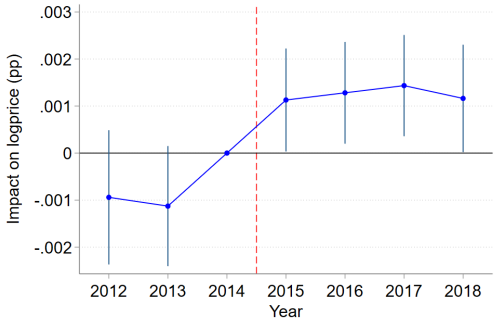


(B) Leverage (log ltv)

High LTV groups: δ_k^{LTV}



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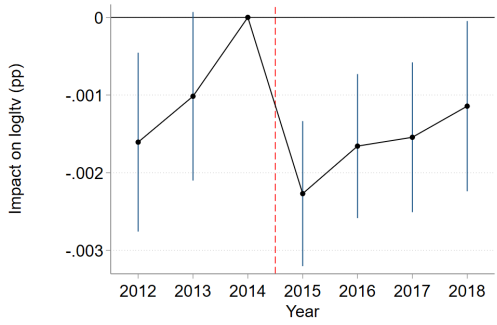


(B) Leverage (log ltv)

→ 25% lower LTV in 2015 for cells with 50% *above LTV threshold* versus those with 0%

1. Background to policy change

2. Impact of policy on borrowing

3. Impact on equilibrium prices

Data description

Regional dataset

- Postcode level: 25 counties and 23 postcodes within Dublin
- Average price and rent indicies *daft website*
- Mortgage: % above threshold in each postcode in 2014 Central Bank
- Within Dublin data limited to 2 banks

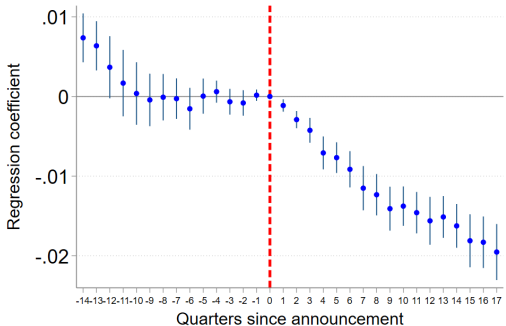
Question:

1. How did equilibrium prices change?

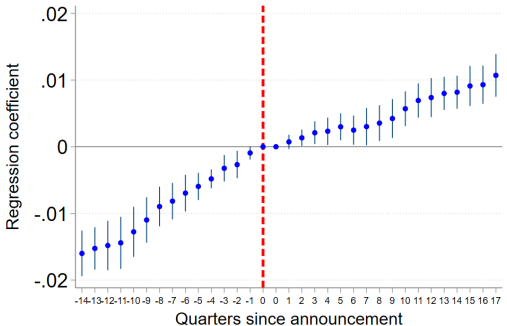
Same empirical specification as before: link

1. Outcome: log price-to-rent ratio

Impact on log price-to-rent



Loan to income δ_k^{LTI}



Loan to value δ_k^{LTV}

▸ LTV and LTI separately

Conclusion

Lessons from Irish micro data around 2015 policy change

1. Impact of policy on borrowing:
   - High LTI groups: Decrease purchase price (and increase leverage)
     → 15% lower purchase price in group with 30% above LTI threshold
   - High LTV groups: Decrease leverage (and increase price)
     → 25% lower loan-to-value in group with 50% above LTV threshold
   - High LTV and LTI groups differ in **net worth** and **income**

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2. Impact of policy on house prices:
   - Price-rent ratio fell in areas where many people above LTI threshold

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   - High LTV and LTI groups differ in **net worth** and **income**
2. Impact of policy on house prices:
   - Price-rent ratio fell in areas where many people above LTI threshold

On-going work: Explain these results in a quantitative lifecycle model

THANK YOU

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APPENDIX

2015 policy change in Ireland

Context

- Ireland had large boom-bust in 2000s
- Policy introduced approx 18 months from bottom of cycle
- Unanticipated policy change ▸ Google Trends

Loan to value

- First time buyers: 10% minimum downpayment ▸ LTV
  - 2015-2017: 10% on first €220,000; 20% on borrowing above €220,000
  - Post 2017: 10% on all borrowing
- Second or later buyers: 20% minimum downpayment
- Investors (buy to rent): 30% minimum downpayment

Loan to income

- Non-investors 3.5 times income limit

Exemptions

- All banks allowed exceed the cap in 10-20% of new lending
- Refinancing/restructuring mortgages exempt

Was the 2015 policy change expected?

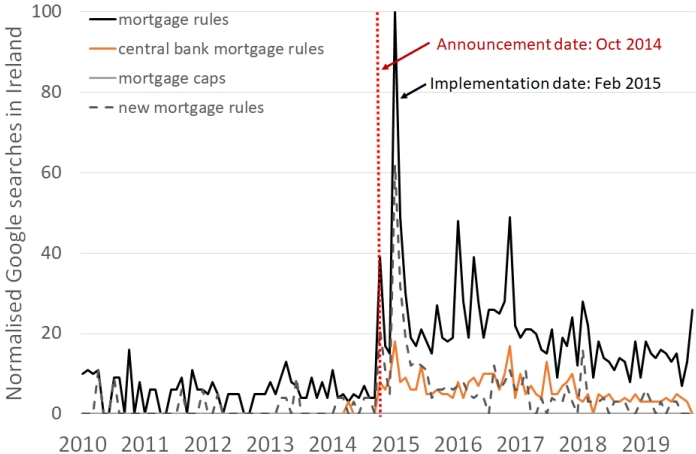
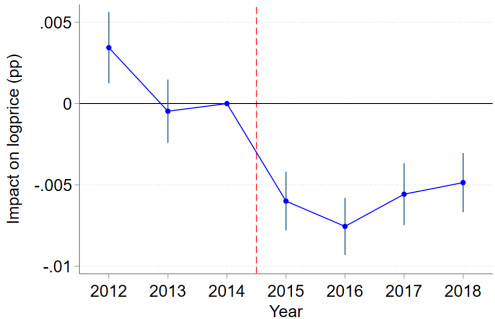


Figure: Google searches for mortgage related terms in Ireland

Highly income-levered groups: δ_k^{LTI}



(A) Price paid (log)

- 1pp increase in *% above LTI threshold* is associated with 0.005 relative decline in log price paid in year after policy
- Comparing cells with 0 to 30 *% above LTI threshold*: 0.15 log price difference

Note: Regressions are weighted by cell size in the pre-treatment year (2014). Standard errors are clustered at the cell level.

$$y_{it} = \sum_{k \neq 2014} \delta_k^{LTI} [\text{\% above LTI threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \boldsymbol{\tau_t} + \boldsymbol{\gamma_i} + \epsilon_{it}$$

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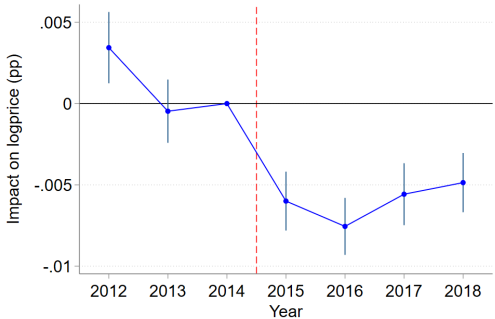

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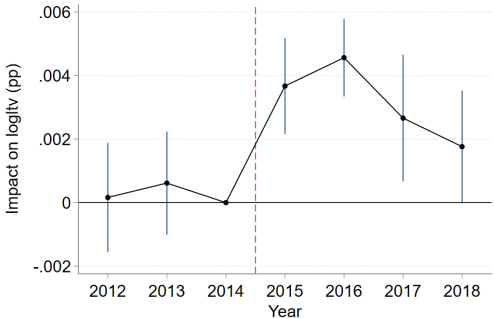

(B) Leverage (log ltv)

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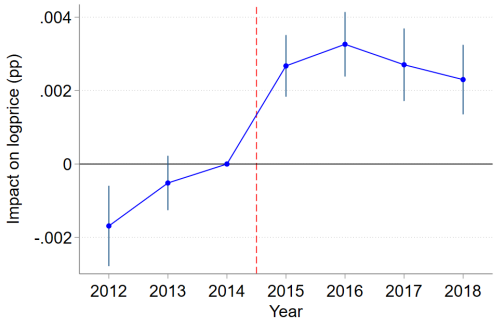
Highly downpayment-levered groups: δ_k^{LTV}



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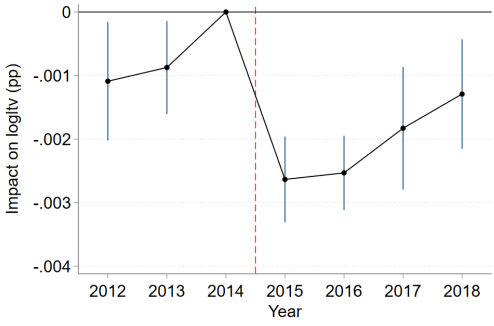

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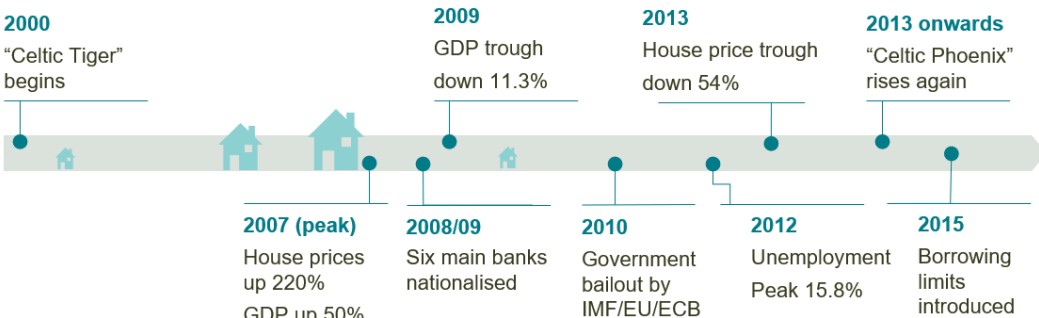
$$y_{it} = \sum_{k \neq 2014} \delta_k^{LTV} [\text{\% above LTV threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \boldsymbol{\tau_t} + \boldsymbol{\gamma_i} + \epsilon_{it}$$

Timeline leading to mortgage limits



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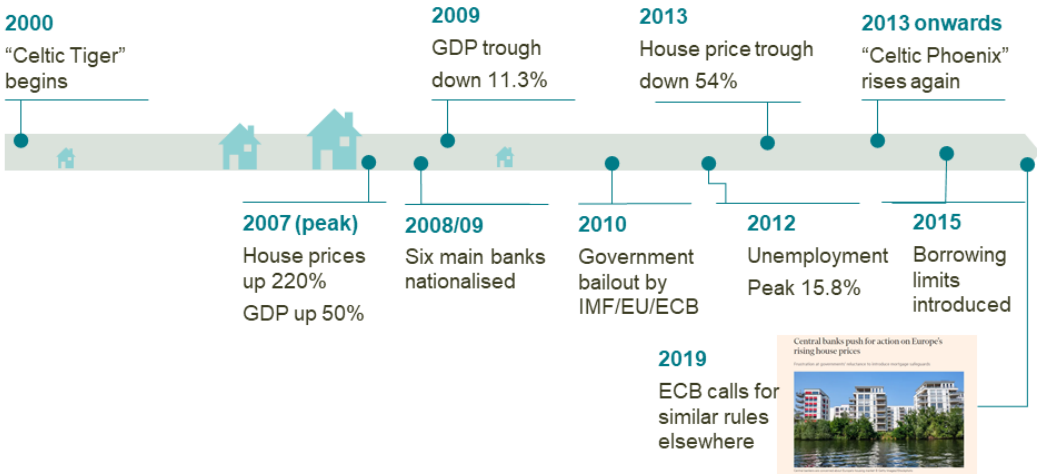
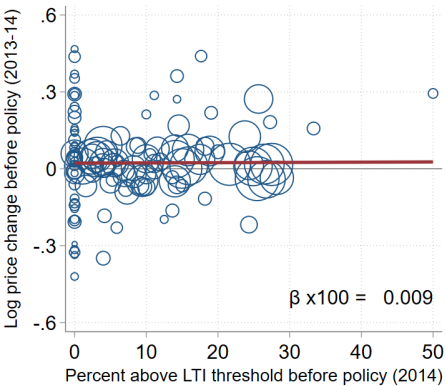


High LTI groups - changes 2013-14



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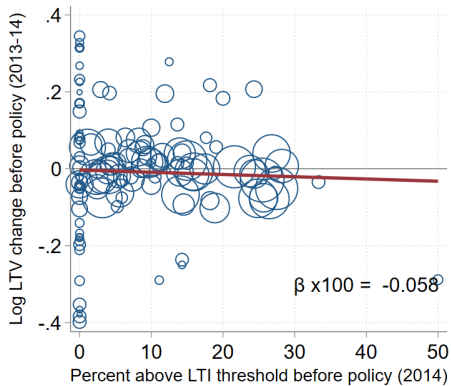

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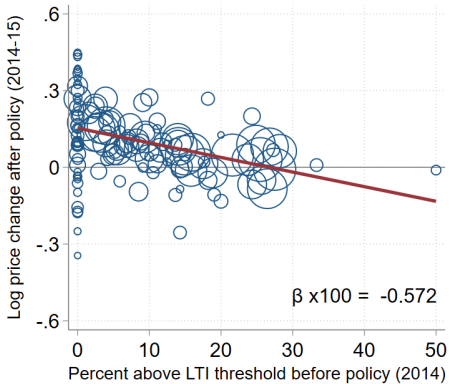
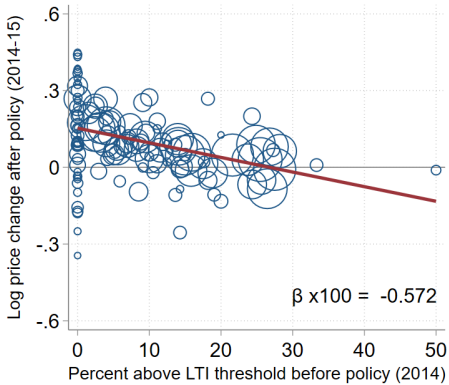
High LTI groups - change 2014-15



(A) Purchase price

Remaining questions: Is change in slope statistically significant? Did it change in other years? Does is persist at different horizons?

High LTI groups - change 2014-15



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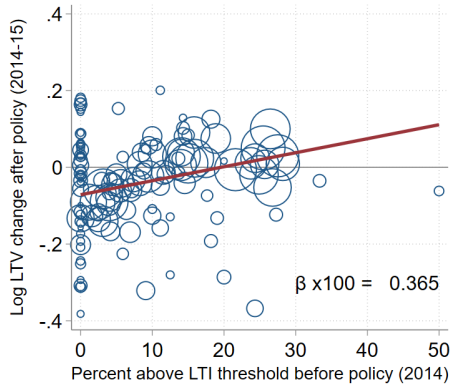
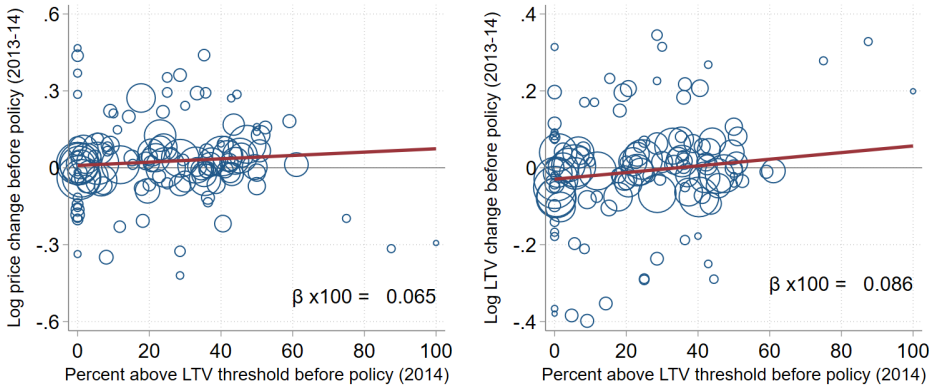


(B) Leverage (log LTV)

Remaining questions: Is change in slope statistically significant? Did it change in other years? Does is persist at different horizons?

Downpayment-levered groups - year before

Figure: Log changes in year **before** policy

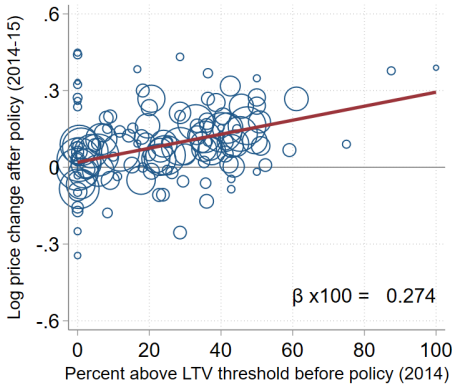


(A) Price paid

(B) Leverage (LTV)

Notes: Each circle is a cell, e.g. Age 30-34, €25k. The size of circle indicates the size (count) of the cell. The line is the fit from a weighted regression.

Downpayment-levered groups - year after



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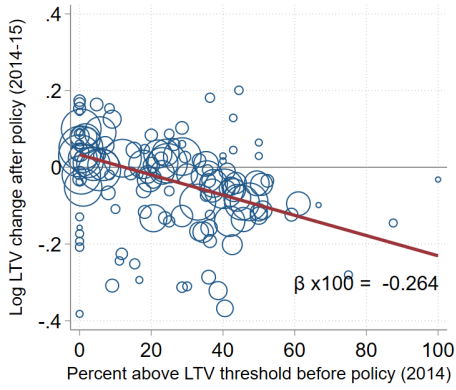


(B) LTV

Remaining questions: Is change in slope statistically significant? Did it change in other years? Does is persist at different horizons?

Empirical strategy

Difference in difference event study regressions

$$
\begin{aligned}
y_{it} \quad = \quad & \sum_{k \neq 2014Q3} \delta_k^{LTI} [\text{\% above LTI threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \\
& \sum_{k \neq 2014Q3} \delta_k^{LTV} [\text{\% above LTV threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \boldsymbol{\tau_t} + \boldsymbol{\gamma_i} + \boldsymbol{\mu_i} t + \epsilon_{it}
\end{aligned}
$$

Notes:

- Outcome y_{it}
  - log price-to-rent,
- Postcode i, year t
- Time trend $\boldsymbol{\mu_i} t$
- "Treatment intensity": % above threshold
- Standard errors clustered at the postcode level

▸ Where above threshold ▸ back to data

Recap so far

- Individual portfolio choice:
  1. Income-levered groups: Decrease price paid (and increase leverage)
  2. Downpayment-levered groups: Decrease leverage (and increase price)

Recap so far

- Individual portfolio choice:
  1. Income-levered groups: Decrease price paid (and increase leverage)
  2. Downpayment-levered groups: Decrease leverage (and increase price)

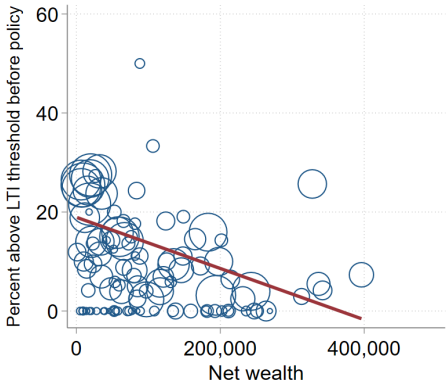
- What might explain the differences: unclear so far!
  1. Different groups affected
     - and each have different resources to react with
  2. Different effects of the constraints
     - LTV constraint easier to save out of

Further evidence

1. Fall in aggregate price-rent ▸ Time series: Ireland, price-to-rent
2. Fall in Price expectations ▸ Time series: price expectations
3. Fall in Price-rent relative to UK ▸ Time series: international
4. Prices still growing ▸ Time series: Ireland, prices and rents in levels

Differences in cash may reconcile responses

- Different responses could be due to differences: (1) assets/cash; (2) reaction to limits
- To check (1): Merge mean assets by age-income-type group from HFCS



Above LTI threshold:

- **low net wealth**
- poorer, younger ▸ by age

Above LTV threshold:

- **high net wealth**
- richer, no age correlation

APPENDIX: DESCRIPTIVE EVIDENCE

Macroprudential tools are widely used

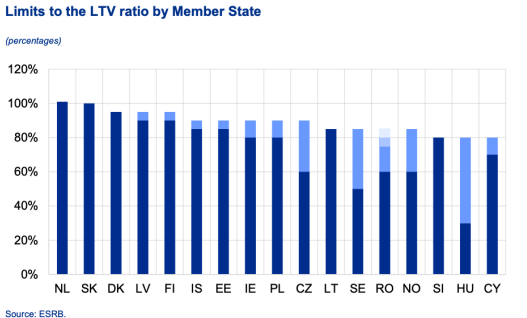


Figure: Loan-to-value caps in the European Union

Notes: European Stability and rick Board, 2018. Shaded area indicates different policy for certain groups. E.g. Ireland has 90% LTV cap for first time buyers and 80% LTV cap for second time buyers.

back

Rules introduced in Ireland in 2015

Minimum downpayment (i.e. loan to value (LTV))

- First time buyers:
  - 10% up to €220,000;
  - 20% on *additional* house price above €220,000 (kink, removed in 2017)
- Second or later buyers: 20%
- Investors (buy to rent): 30%

Loan to income (LTI)

- Non-investors 3.5 times income

Exemptions

- Banks allowed exceed the cap in 10-20% of new lending
- Restructured/refinanced mortgages
- Negative equity borrowers

back

Summary statistics

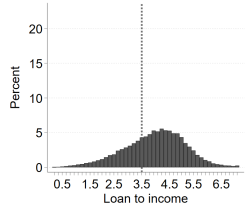
Figure: Top and bottom five areas, by LTI

Area	Mean LTI	Mean LTV
DUBLIN 16	3.01	72.2
DUBLIN 5	2.93	78.1
DUBLIN 13	2.89	76.3
DUBLIN 9	2.83	72
DUBLIN 24	2.83	77.7
CARLOW	2.02	72.3
MAYO	2.01	70.6
LONGFORD	1.97	77.9
ROSCOMMON	1.96	73.7
DONEGAL	1.94	69.6

back

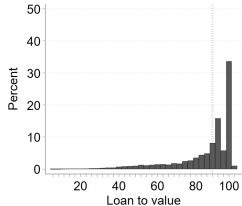
Was the policy binding

Loan to income →
(First and second+ time buyers)



Loan to value →
(First time buyers)

▸ LTV: Second time and investors



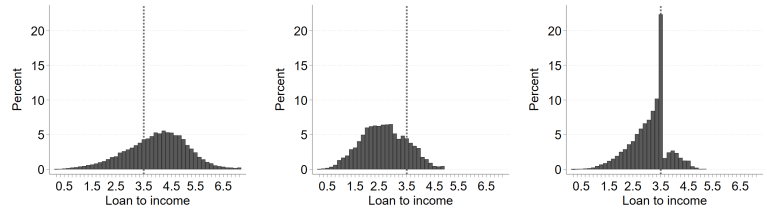
(A) 2006

Notes: Density plots for new mortgages originated in a particular year. Histograms are weighted by the euro value of the loan at origination.

▸ back to histograms ▸ Volume conforming ▸ Volume conforming: LTI and LTV separately ▸ LTI: 2000-18 ▸ LTV: 2000-18

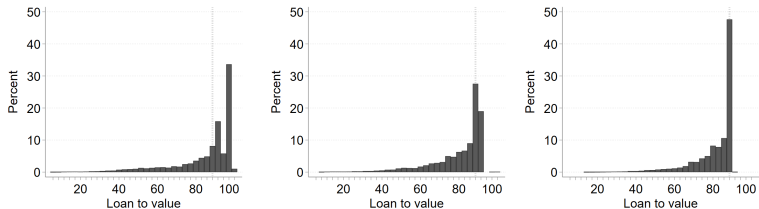
Was the policy binding

Loan to income →
(First and second+ time buyers)



Loan to value →
(First time buyers)

▸ LTV: Second time and investors



(A) 2006 (B) 2014 (C) 2018

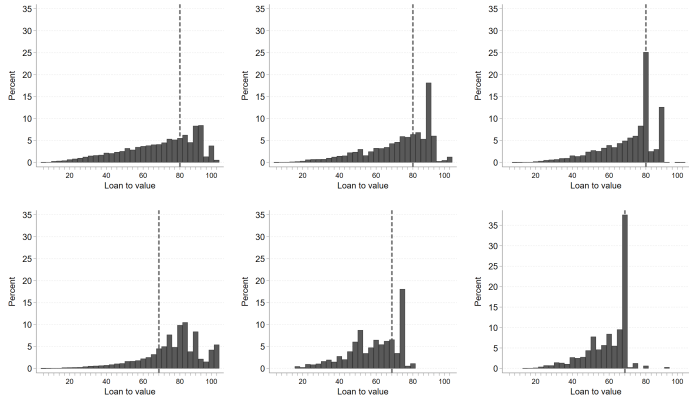
Notes: Density plots for new mortgages originated in a particular year. Histograms are weighted by the euro value of the loan at origination.

▸ back to histograms ▸ Volume conforming ▸ Volume conforming: LTI and LTV separately ▸ LTI: 2000-18 ▸ LTV: 2000-18

Was the policy binding

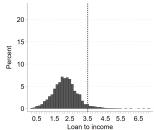
Loan to value →
(Second+ time buyers)

Loan to value →
(Investors)



(A) 2006 (B) 2014 (C) 2018

back to histograms



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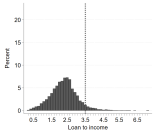

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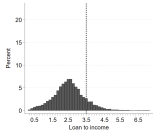

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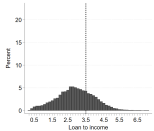

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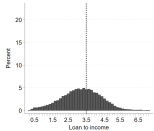

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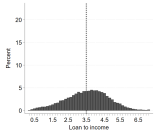

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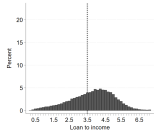

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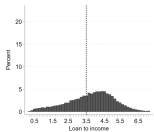

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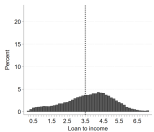

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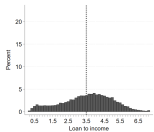

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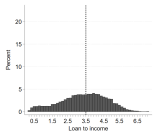

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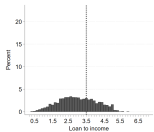

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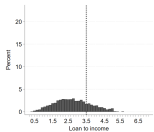

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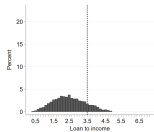

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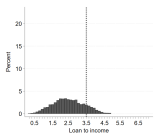

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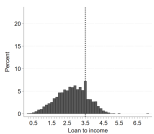

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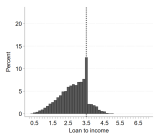

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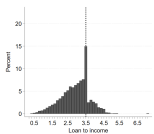

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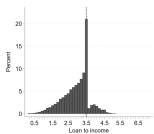
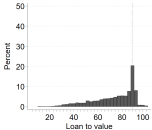


2018

▸ back to histograms



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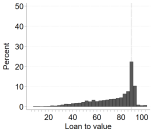

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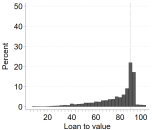

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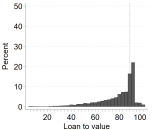

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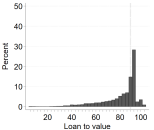

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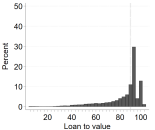

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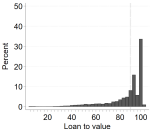

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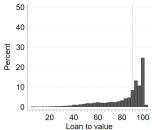

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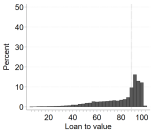

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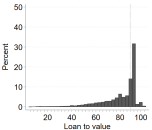

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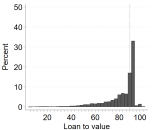

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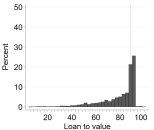

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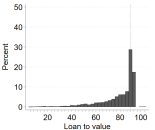

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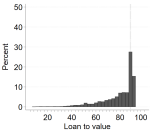

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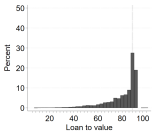

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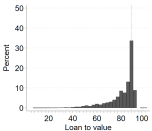

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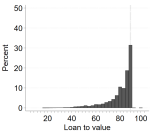

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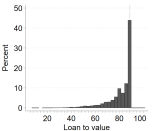

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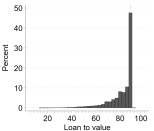


2018

▸ back to histograms

Was the policy binding?

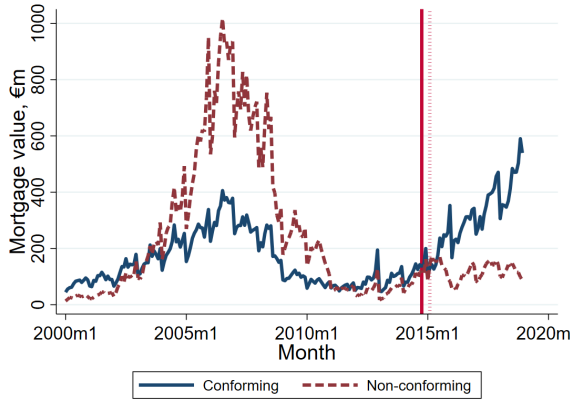
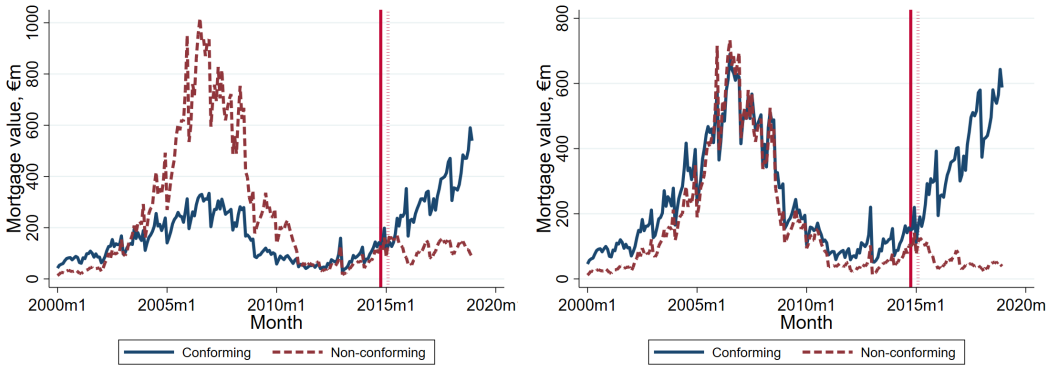


Figure: Mortgages conforming to 2015 policy ▸ LTI and LTV separately

Notes: Figure shows the value of loans conforming to the 2015 mortgage rules before and after the introduction of the rules. Vertical dashed lines show the announcement and implementation dates respectively.

▸ back to histograms

Was the policy binding?



(A) Loan-to-income

(B) Loan-to-value

Figure: Mortgages conforming to 2015 policy

Notes: Figure shows the value of loans conforming to the 2015 LTI and LTV mortgage rules before and after the introduction of the rules. Vertical dashed lines show the announcement and implementation dates respectively.

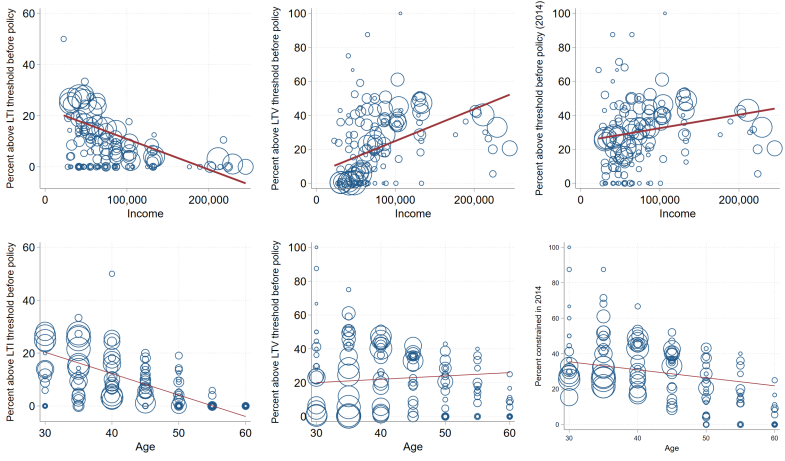
back

APPENDIX: INDIVIDUAL EMPIRICAL EVIDENCE

Who was above threshold in year pre

Income

Age

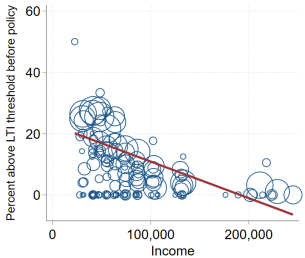


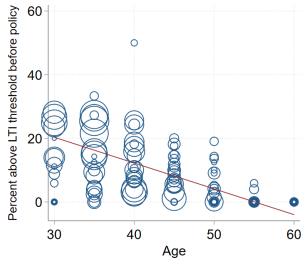
(A) Loan to income (B) Loan to value (C) LTV or LTI

back

Who was above threshold in pre-year (2014)

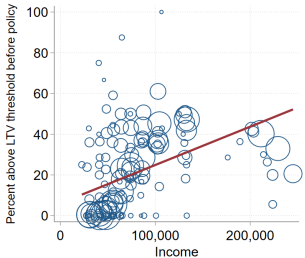
LTI →

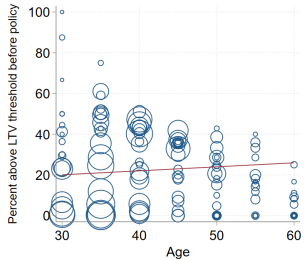




- **Each circle:** is a cell e.g. Age 30-34, €25k
- **Size of circle** = size (count) of cell
- **Line:** weighted regression
- **% above threshold** is calculated in year prior to policy change (2014)

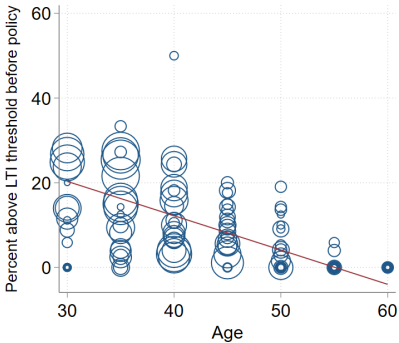
LTV →

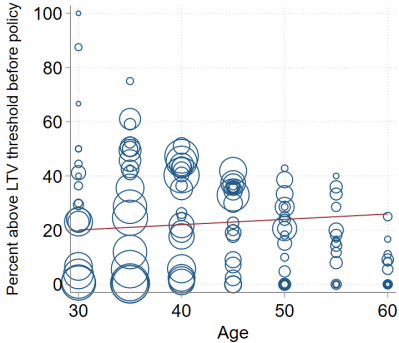




- ▸ LTV and LTI
- ▸ back to income

Who was above threshold in pre-year (2014)

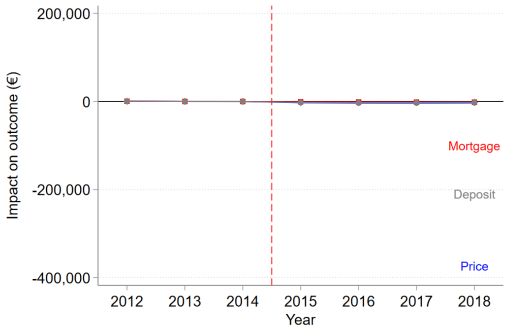


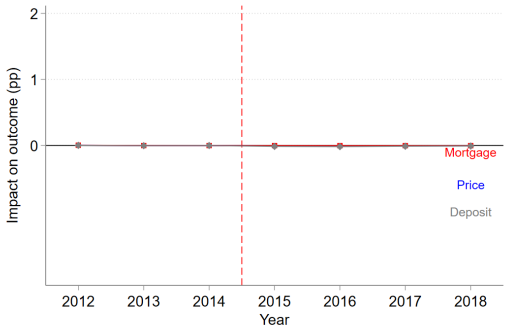


- **Each circle:** is a cell e.g. Age 30-34, €25k
- **Size of circle** = size (count) of cell
- **Line:** weighted regression
- **% above threshold** is calculated in year prior to policy change (2014)

back to income

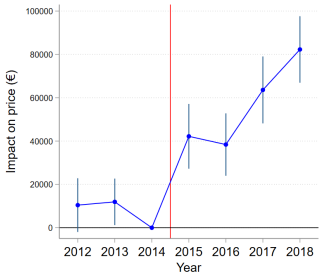
Robust to using logs or levels

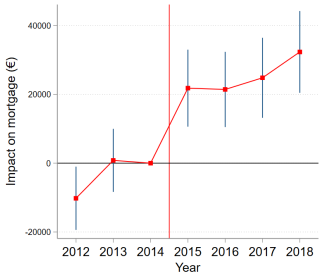


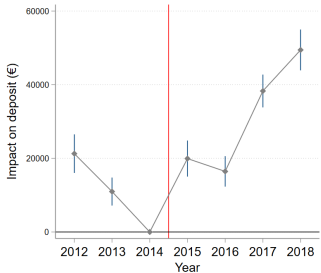


back

Impact of LTV on mortgages, price and deposits

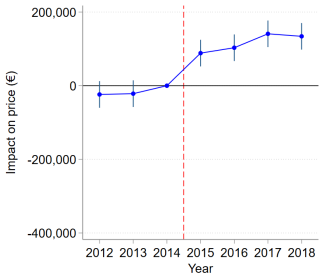


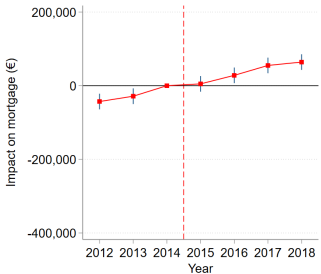


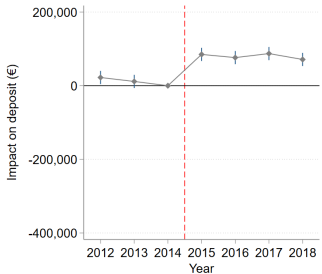


back

Comparing mortgages, price and deposits







back

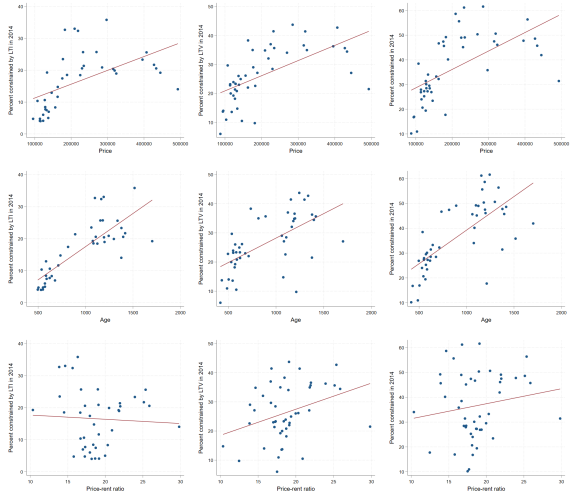
APPENDIX: AGGREGATE EMPIRICAL EVIDENCE

Where was above threshold in pre-year

Price

Rent

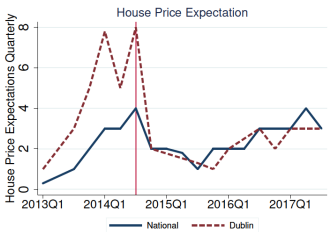
Price-to-rent



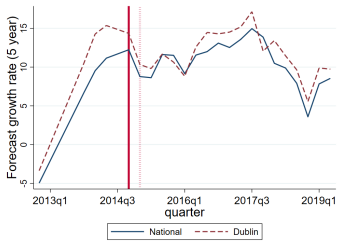
(A) LTI (B) LTV (C) LTV or LTI

▸ back to empirical strategy

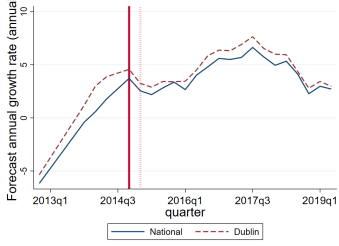
House price expectations



(A) *CBI*



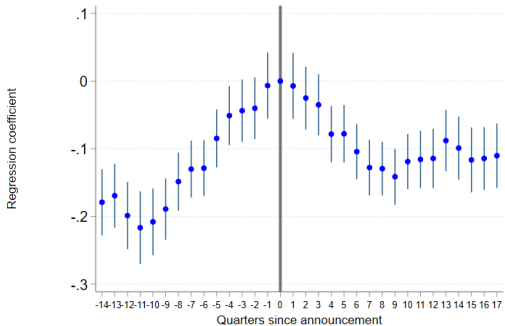
(B) *daft*: Five year forecast



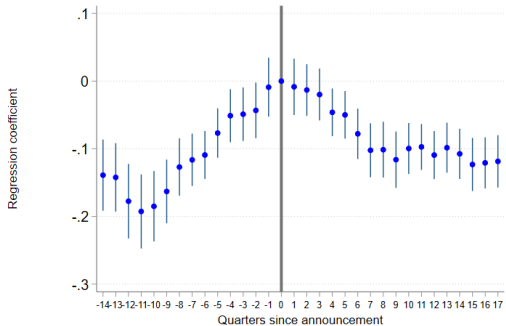
(C) *daft:* One year forecast

Notes: Left figure is from Acharya Et.Al. (2018) using Central Bank of Ireland Expectations Survey. Vertical lines indicates the announcement date. Other figure shows the mean house price growth forecast from the *daft* expectations survey. Vertical lines indicates the announcement and implementation dates respectively. The left panel plots five year forecasts while the right panel plots one year forecasts.

Impact on price to rent (no time trend)



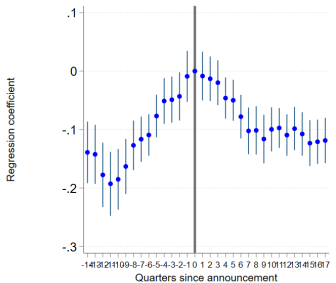
(A) Loan to income

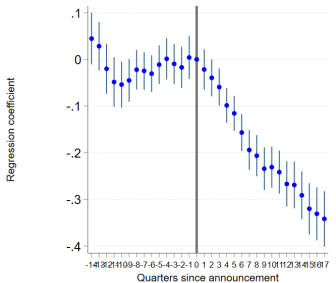


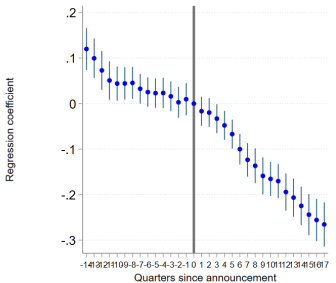
(B) Loan to value

back

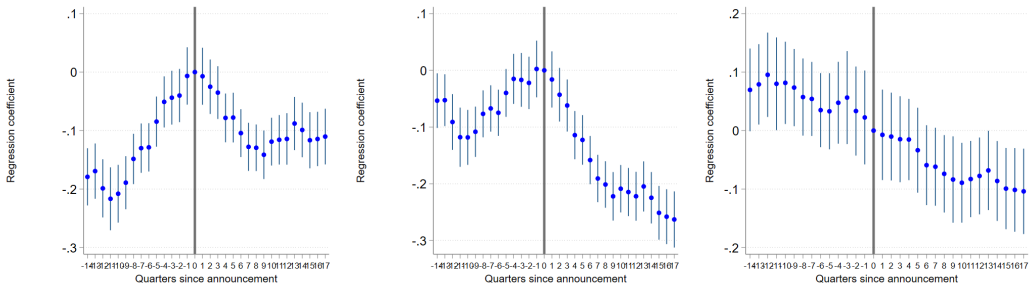
Impact on price-to-rent - LTV





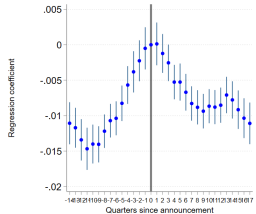


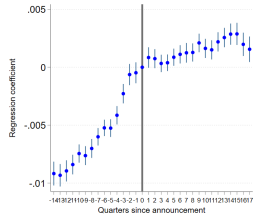
Impact on price-to-rent- LTI



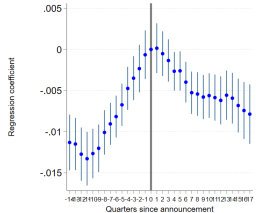
Impact on log prices and log rents

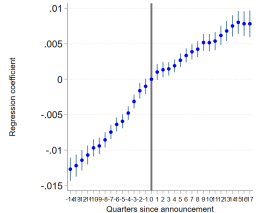
Loan to income:





Loan to value:



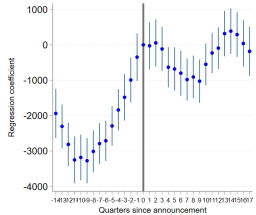


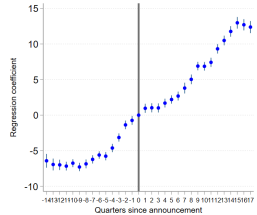
log price log rent

▸ back ▸ levels ▸ Conditional (logs) ▸ Conditional (levels)

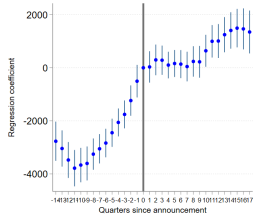
Impact on prices and rents (levels)

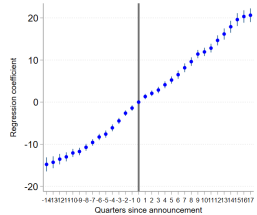
Loan to income:





Loan to value:

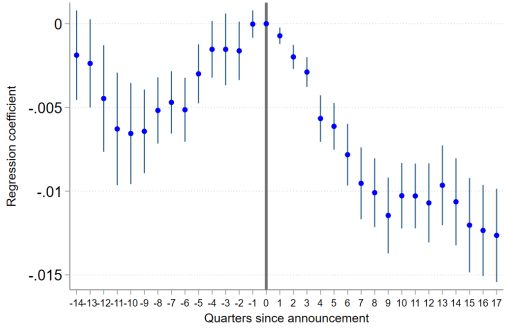




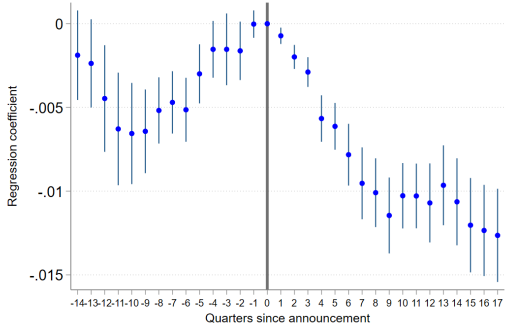
price rent

back

Impact on log price-to-rent



(A) Loan to income δ_k^{LTI}



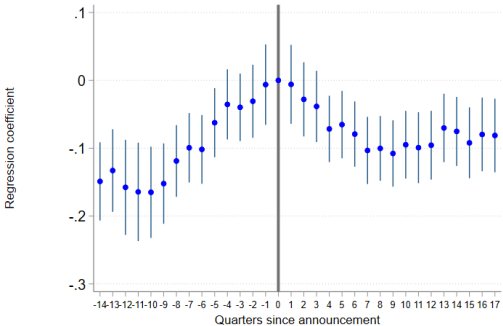
(B) Loan to value δ_k^{LTV}

Note: Standard errors are clustered at the postcode level.

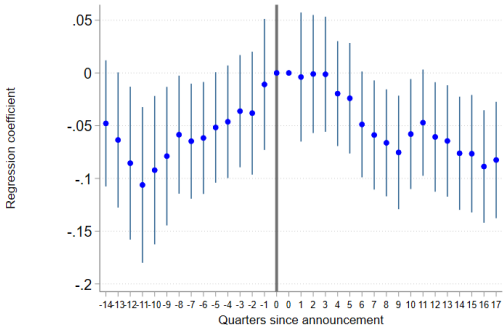
$$y_{it} = \sum_{k \neq 2014Q3} \delta_k [\%\text{ above threshold}_i^{2014} \times \mathbb{1}_{t=k}] + \boldsymbol{\tau_t} + \boldsymbol{\gamma_i} + \boldsymbol{\mu_i} t + \epsilon_{it} \quad (1)$$

▸ back to conditional ▸ Prices and rents separately

Impact on price-to-rent conditionally - no trends



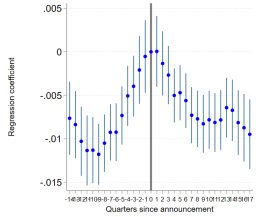
Loan to income

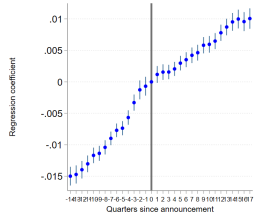


Loan to value

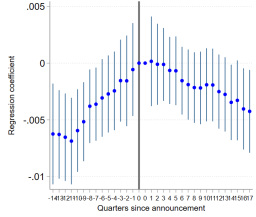
Impact on rents and prices (log) - conditional

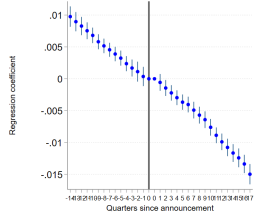
Loan to income:





Loan to value:





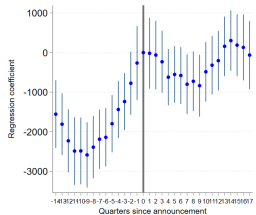
back

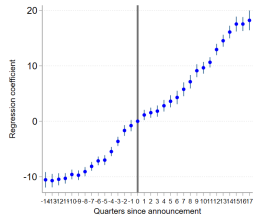
log price

log rent

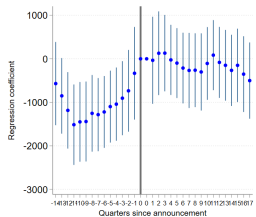
Impact on rents and prices (levels) - conditional

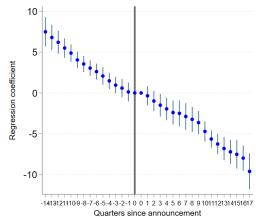
Loan to income:





Loan to value:





price

rent

back

Price-rent ratio declined after policy

Figure: Price-to-rent ratio 2006-18

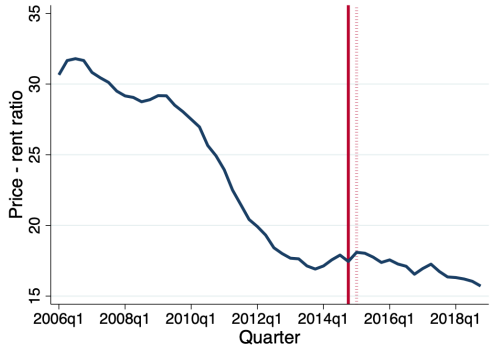
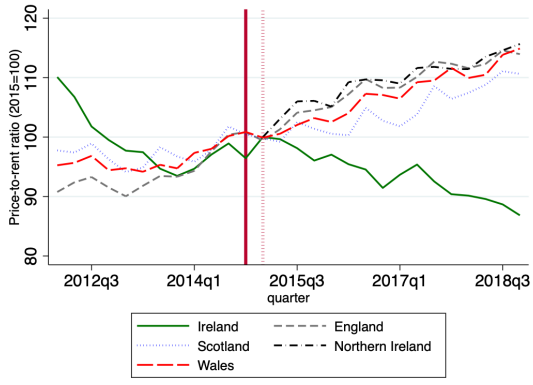


Figure shows the price-to-rent ratio nationally, 2007q1 to 2018q4. The monthly rent is annualised before calculating the ratio. The two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

▸ Price and rents in levels ▸ back

Comparing across countries

Figure: Price-to-rent ratio 2012-18

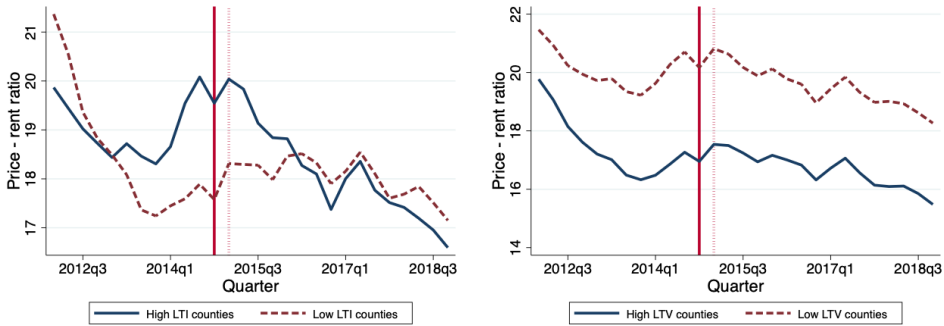


Notes: Figure shows the price-to-rent nationally in Ireland and the four countries of the United Kingdom year-on-year growth rate in average price and rent nationally, 2012q1 to 2018q2. The ONS started some of the series after the 2006 and these are presented from their first available date. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT (Ireland), ONS (UK).

▸ Longer timeseries ▸ back

Comparing across segments

Figure: Price-to-rent ratio in high and low constrained segments

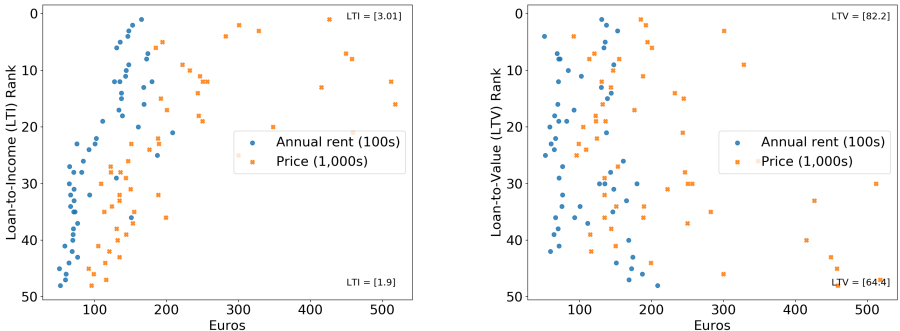


Notes: Figure shows the price-to-rent ratio in high and low counties for both the LTV and LTI constraints. High (and low) counties are defined as the top (and bottom) half of counties on the respective metric. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

▸ Longer timeseries ▸ LTI LTV scatter ▸ back

Price and loan-to-income (LTI) positively correlated

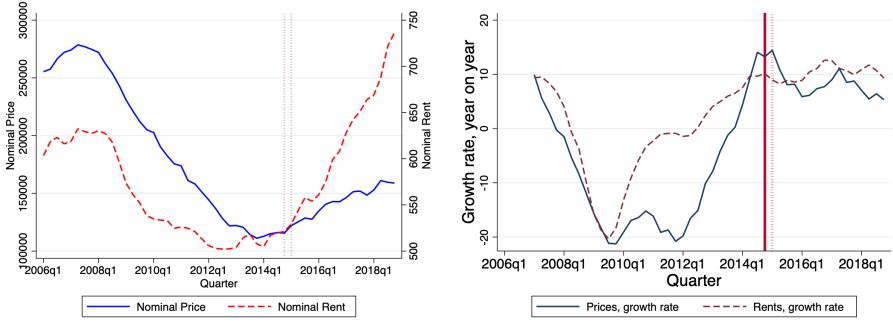
Figure: Average prices and rents by LTI and LTV rank in 2014



Notes: Figure shows average price and rent by LTI and LTV ranks. Data is from 2014 and at the county level. Source: DAFT, Central Bank of Ireland.

Prices did not rise as much as rents

Figure: House prices and rents 2006-18



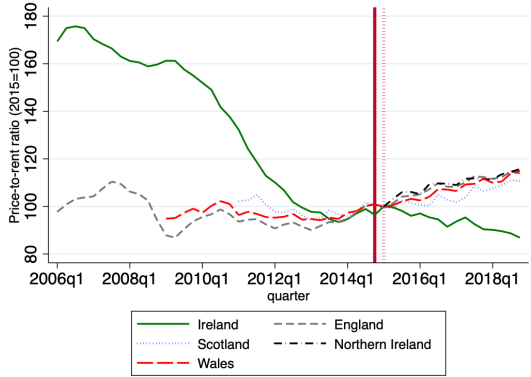
(a) Levels (b) Growth rates

Notes: Right figure shows the price and rent indices nationally, 2007q1 to 2018q4. Left figure shoews the growth rate (log change) in the same indices. The two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

▸ back to further evidence ▸ back to price-rent ratio

Comparing across countries 2006-18

Figure: Price-to-rent ratio 2006-18

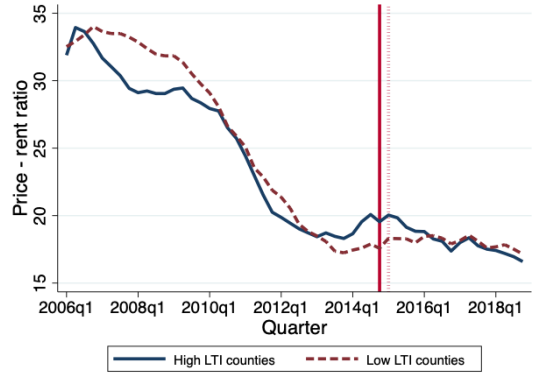


Notes: Figure shows the price-to-rent nationally in Ireland and the four countries of the United Kingdom year-on-year growth rate in average price and rent nationally, 2006q1 to 2018q2. The ONS started some of the series after the 2006 and these are presented from their first available date. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT (Ireland), ONS (UK).

▸ shorter timeseries ▸ back

Comparing across segments 2006-18

Figure: Price-to-rent ratio in high and low constrained segments



Notes: Figure shows the year-on-year growth rate in average price and rent nationally, 2007q1 to 2018q4. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

Difference across segments - regression

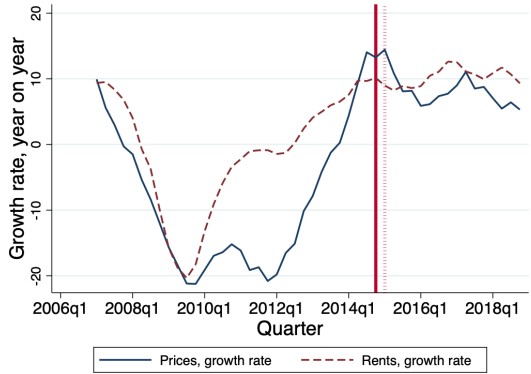
	(1)	(2)	(3)	(4)	(5)	(6)
	Price change (t+2) - (t)			Rent change (t+2) - (t)		
Loan-to-value (t)	0.007		0.008*	0.004*		0.004*
	(1.84)		(2.53)	(2.16)		(2.03)
Loan-to-income (t)		-0.127**	-0.134**		0.010	0.007
		(-3.18)	(-3.45)		(0.38)	(0.25)
Constant	-0.350	0.437***	-0.099	-0.115	0.149*	-0.128
	(-1.32)	(4.34)	(-0.44)	(-0.86)	(2.10)	(-0.96)
Observations	47	47	47	47	47	47

Notes: Table shows the two year change in price and rents after the policy change , $\Delta p_{t+2,t}$ and $\Delta r_{t+2,t}$, regressed on the mean loan-to-value and loan-to-income in the county in the year prior to the policy change, LTV_t and LTI_t. Unit of observation is a county. Robust standard errors are in parenthesis. Stars indicate $p < 0.05$, $p < 0.01$, and $p < 0.001$.

back

Time series evidence - growth rates

Figure: Growth rate of prices and rents before and after announcement



Notes: Figure shows the year-on-year growth rate in average price and rent nationally, 2007q1 to 2018q4. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

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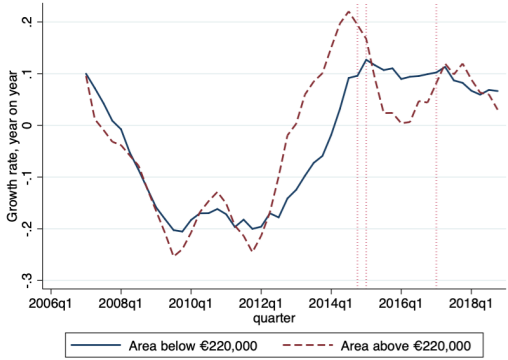
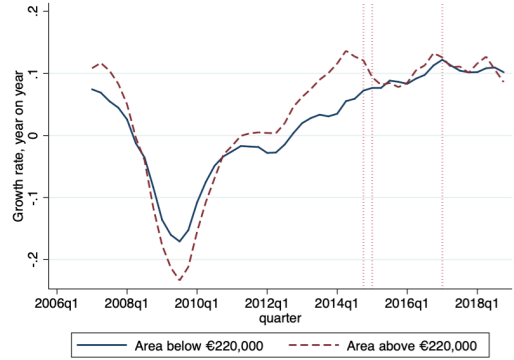
Comparing across segments - growth rates



(A) Prices



(B) Rents

Figure: Growth rate of prices and rents by market segment

Notes: Figure shows the year-on-year growth rate in average price and rent nationally, 2007q1 to 2018q4. Vertical dashed lines show the announcement and implementation dates respectively. The third vertical line denotes the date when the kink in the LTV requirement was removed. Source: DAFT.

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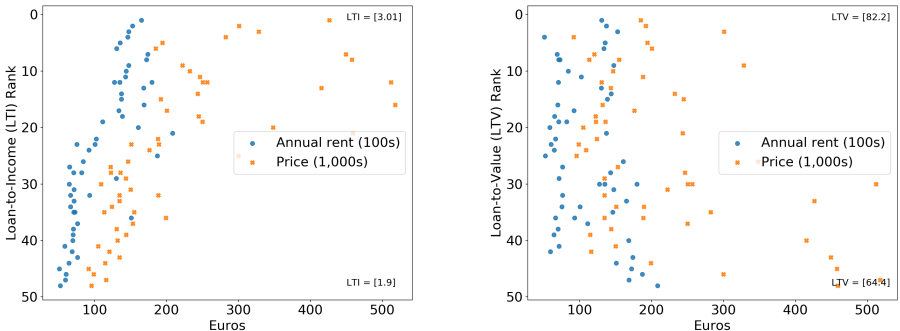
Comparing across segments

Figure: Price-to-rent ratio in high and low constrained segments



Notes: Figure shows the price-to-rent ratio in high and low counties for both the LTV and LTI constraints. High (and low) counties are defined as the top (and bottom) half of counties on the respective metric. The first two vertical dashed lines show the announcement and implementation dates respectively.
Source: DAFT.

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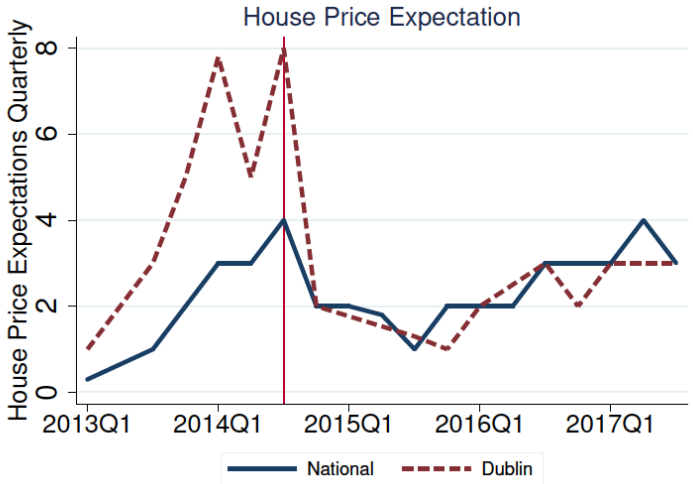
House price expectations



Source: Acharya Et.Al. (2018) and Central Bank of Ireland Expectations Survey. Notes: Vertical lines indicates the announcement date.

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Bellman equation

Each consumer chooses to rent or buy:

$$V[b, m, h, a, y] = \max \{V^{rent}, V^{buy}\}$$

Where the value of buying is:

$$\begin{aligned} V^{buy}[b, m, h, a, y] = & \max_{b', m', h'} u(c, s) + \beta \mathbb{E}_{y'} V_{a+1}[b', m', h', a', y'] \\ s.t. \quad & c + \frac{b'}{R} + \frac{m'}{R^m} + ph' = y + b + [m + ph]\mathbb{1}_h \\ & b' \geq 0 \qquad s = \phi h' \\ & 0 \geq m' \geq -\psi^{ltv} ph' \\ & 0 \geq m' \geq -y\psi^{lti} \end{aligned}$$

back

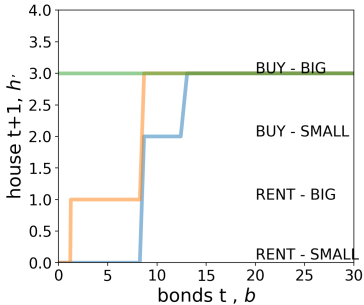
Bellman equation

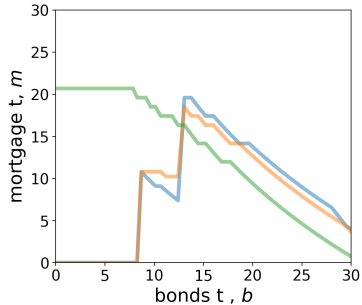
And the value of renting is:

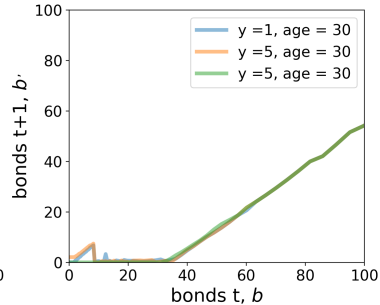
$$
\begin{aligned}
V^{rent}[b, m, h, a, y] = \quad & \max_{b', h'} u(c, s) + \beta \mathbb{E}_{y'} V_{a+1}[b', 0, 0, a', y'] \\
s.t. \quad & c + \frac{b'}{R} + r h' = y + b + [m + p \cdot h)] \mathbb{1}_h \\
& b' \geq 0 \qquad\qquad s = h'
\end{aligned}
$$

Policy functions: renter with three income states

Figure: Policy function for renter at beginning of period







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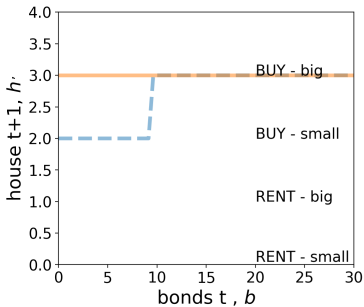
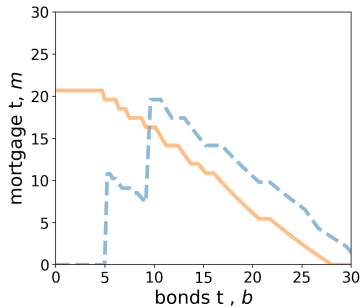
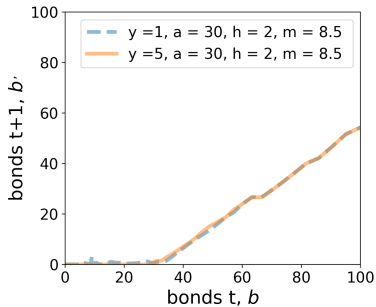
Policy functions: owner

Figure: Policy function for owner at beginning of period







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Income shock estimates

Guvenen, Karahan, Ozkan and Song 2016
Model 5 - Table A 2: AR(1)

$$\rho = 0.993 \tag{2}$$
$$\sigma_\epsilon = 0.303 \tag{3}$$

Kaplan, Mitman and Violante (2019)

$$\rho = 0.97 \tag{4}$$
$$\sigma_\epsilon = 0.20 \tag{5}$$

Comparing DAFT and OECD datasets

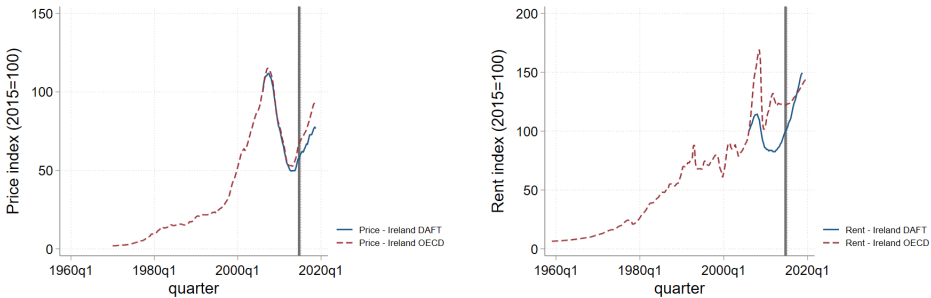
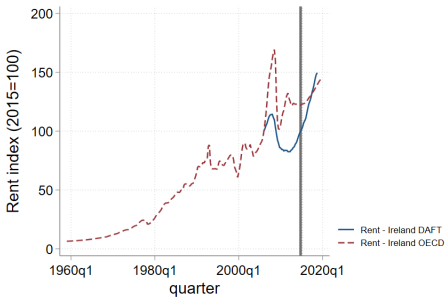


Figure: Growth rate of prices and rents before and after announcement

Notes: Figure shows the year-on-year growth rate in average price and rent nationally, 2007q1 to 2018q4. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

Comparing Rents: DAFT, OECD and CSO datasets



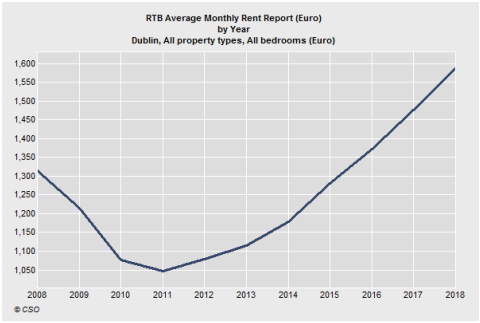


Figure: Growth rate of prices and rents before and after announcement

Notes: Figure shows the year-on-year growth rate in average price and rent nationally, 2007q1 to 2018q4. The first two vertical dashed lines show the announcement and implementation dates respectively. Source: DAFT.

Purpose of a model

Calibrate: partial equilibrium life-cycle model w/housing

- Aim to match cross sectional facts in pre-period (2014)
- Impose policy change in post-period (2015-)

Shed light on

- Mechanisms: expectations, constraints
- Tradeoffs: excessive savings, rental markets
- Modelling assumptions: indivisibility of housing; role of rental markets

Counterfactual policies

Clearing rental and sales markets

- **Initialise distribtuion** using HCFS
- Use **bisection method** to solve for linear prices, $\bar{p}, \bar{r}$ s.t. $\sum_i h_r^i = \hat{h}_r$, $\sum_i h_s^i = \hat{h}_s$
- **Intuition:** Rents pin down total demand; prices pin down ownership share.

1. $\bar{p} = \infty$
2. Find $\bar{r}$ s.t. $\underbrace{\sum_i h_r^i + \sum_i h_s^i}_{\text{Total demand}} = \underbrace{\hat{h}_r + \hat{h}_s}_{\text{Total supply}}$
3. Fix $\bar{r}$, find $\bar{p}$ s.t. $\underbrace{\sum_i h_s^i}_{\text{Sale demand}} = \underbrace{\hat{h}_s}_{\text{Sale supply}}$
4. Check $\bar{r}$ still satisfies 2, otherwise iterate 2 and 3.

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Market clearing with linear prices

Figure: Excess demand under divisible and indivisible housing