Spatially Targeted LTV Policies and Collateral Values

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Motivation: regulating leverage to cool housing demand

- Housing increasingly unaffordable in major cities around the world
- Many types of policy experiments conducted to bring prices down
  - Taxes: transaction, capital gains, vacancy, foreign homebuyer surcharges, etc.
  - Most recent studies show transfer taxes distortionary and $P \uparrow$ through lock-in effects
  - **Mortgage regulation:** downpayment requirements, insurance, bank quotas/risk weights
- U.S. has **conforming loan limits (CLL)** which positively co-move with house prices
  - Uniform cutoffs for whether Fannie/Freddie can buy mortgage on secondary market
  - Exceptions for certain high cost areas set by 2008 law (e.g. D.C., NYC)

U.S. CLL formula imperfectly targets based on local ΔP

$$CLL_{i,t} = \alpha \cdot \mathbb{1}\{HighCoL\}_{i,t-1} + (1 + \%\Delta HPI_{t-1,t}) \times \overline{CLL}_{t-1}$$

- Movements in leverage limits anchored to *national* housing cycle
- What would happen if we replaced with $\%\Delta HPI_{i,t-1,t}$?

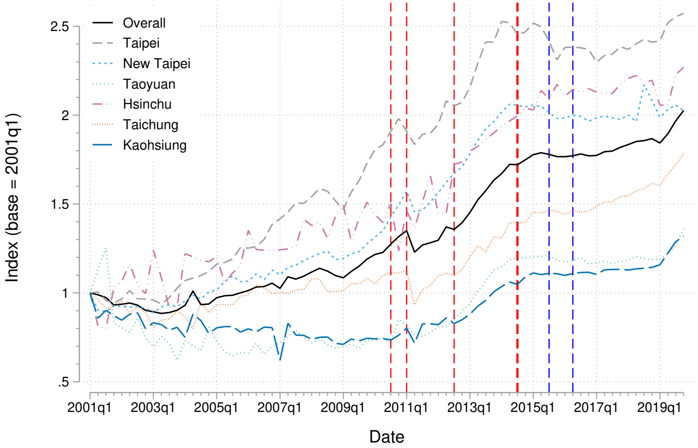
What we do

Research question

Are **spatially targeted** leverage limits preferred from an *efficiency* perspective as a way to "cool" housing markets? And how to quantify the **general equilibrium** costs?

- Study this question using a novel series of changes to strict LTV limits in Taiwan
  - Leverage policy part of Central Bank regulatory mandate (common outside U.S.)
  - **Select specific districts** to impose credit limits based on *ex ante* ΔP
- Loan-level data tracking origination and performance of **all** mortgages
  - Merge with info from administrative tax returns, public database of geocoded home sales, and bank balance sheets Details
  - Larger set of outcomes than other macropru studies $\rightarrow$ financial (mispricing) + real costs

Setting: sequence of LTV policy experiments in Taiwan



Notes: Nominal price indices from our companion paper (Chi, LaPoint, Lin 2022). Vertical dashed lines indicate LTV policy reforms, with red lines indicating tightening episodes, and the blue line indicating the 2016 temporary removal of LTV limits on second mortgages.

- Govt. concerned about $\Delta P >> 0$ in Taipei area
- Setting features regimes lasting multiple years Details
  - Uncommon in literature
  - Govts. frequently tweak leverage limits post-GFC
  - Symmetric windows around reform remove seasonality in RE sales
- Test for asymmetry: several tightening events followed by loosening in 2016

Results: in what sense are these policies "successful"?

- Focus on 2014 reform: LTV drops from standard 80% to 60% for investment properties
  - Headline result: **house prices decline by 6%** in policy areas relative to nearby unregulated neighborhoods $\Longrightarrow$ price-leverage ratio elasticity ≈ 1
  - No average effect on loan delinquency outcomes or borrower creditworthiness
- **$\downarrow$ in origination amounts, sale prices, quoted rates for loans in treated areas**
- **But also $\downarrow$ in sales volume across price distribution relative to untreated areas**
  - Small distortions in HH location choice, commuting cost $\uparrow$ for non-vacation homes
  - Spatial pricing spillovers limited to 4 km distance to policy border
- **Evidence of avoidance through collateral misreporting**
  - Gap between bank and govt. appraisal widens by 5% $\Longrightarrow$ observed LTV $<$ true LTV

Related work on housing market regulation

Lit review

- **Macroprudential regulation of housing**
- **Evidence of relationship between credit supply and house price growth**
- **Adverse outcomes of lender-borrower collusion**

What's new here...

1. **Spatially targeted nature of a national leverage policy $\longrightarrow$ spillovers**
2. Measure collateral revaluation by comparing loans to *administrative* appraisals
3. Setting features tightening and loosening of LTV limits, multiple years without successive reforms $\longrightarrow$ remove seasonality + GE effects
4. Ability to identify banks $\longrightarrow$ trace out what happens to profits + portfolio shifts

Background & Data

Mortgage market in Taiwan: a quick primer

- **Private bank lending market is $\approx$ 100% floating rate mortgage contracts**
  - Standard contract type resets rate each year ("tracker mortgage")
  - Small # of adjustable rate mortgages (ARMs) w/initial period where rate fixed
  - Indexed to bank-specific 1 or 2-year CD rate = weighted avg. of Treasury rates

- Fixed rate mortgages (FRMs) only offered on special govt. loans issued by public banks

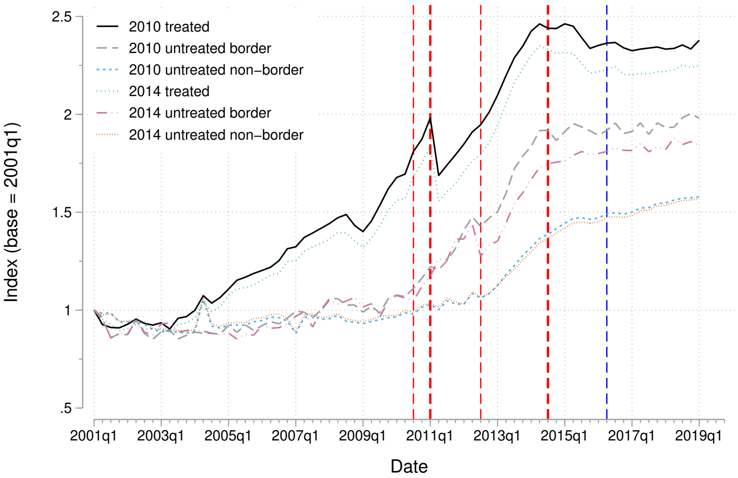
- **Like U.S., standard pre-reform LTV is 80%, for similar reasons**
  - Banks explicitly set a maximum LTV they are willing to originate (private insurance)
  - Prepayment penalties, and no points rolled into closing costs

- LTV policies we study apply uniformly to traditional banks (90%) and shadow banking sector (10%) $\Longrightarrow$ no avoidance through shopping across lender types

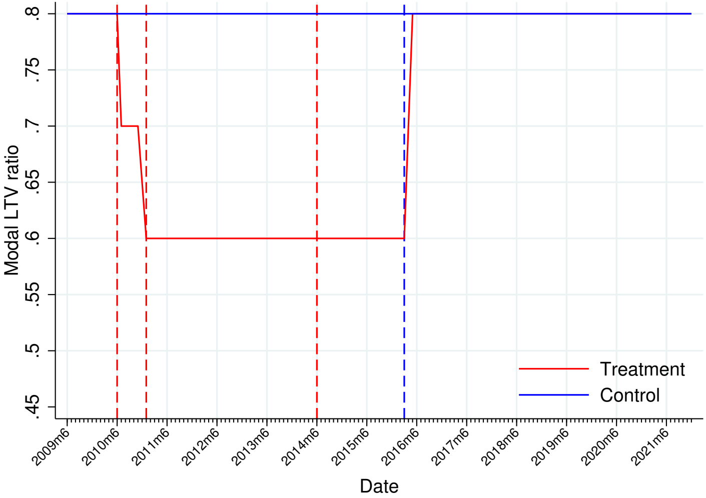
Spatial targeting clearly based on *ex ante* ΔP

Full table　Map

$$\log p_{i\in g,q} = \delta_q^g + \gamma_b^g + \beta^{g\prime} \cdot \mathbf{X_{i\in g,t}} + \varepsilon_{i\in g,q} \longrightarrow \widetilde{P}_q^g = \exp(\widehat{\delta}_q^g)$$



Clear first stage: LTV ratios bunch around limits



- Treatment group varies over time according to:
  - First vs. **second** mortgages
  - **Neighborhoods** selected by central govt.
  - Very high-end properties ($>$ 1.3 mil. USD)
- All restrictions lifted in March 2016 except for high-end homes $\longrightarrow$ test for symmetry
- We will show that due to changes in LTV limit formula, 2014 had biggest effects

Empirical research designs to identify policy effects

1. **Matched DiD** (à la Abadie & Imbens 2011)
   - Match on observables to identify second mortgagors which would have asked for higher LTV but could not due to policy limits
   - Identifies very localized treatment on treated effect Details
2. **Border discontinuity designs** (Dell & Olken 2020; Méndez & Van Patten 2022)
   - Examine how outcomes vary around borders formed by spatial LTV policy
   - One of few applications of border diff-in-disc design in financial intermediation literature
3. **Bank-level DiD using exposure based on existing branch locations**
   - Parent banks and their branches face differential exposure to reform depending on where they concentrate their loan originations
   - No laws against inter-regional banking to finance home purchases

Matched diff-in-diff approach

Matched diff-in-diff implementation

Balance table

Fill in "missing" homebuyers who would have taken out (second) mortgage w/LTV above the limit according to following steps...

1. Exclude individuals with an LTV ratio far from cap
2. Match borrower who chose loan slightly below the cap post-reform to nearest pre-reform borrower in same district according to $\mathbf{X_{i,t}}$ (age, income, educ.)
3. **Control group** chooses LTV ratio slightly below cap before and after policy
4. **Treatment group** chooses to be above the LTV cutoff before the policy

$$ATT = \left(\overline{After} - \overline{Before}\right)_{treated} - \left(\overline{After} - \overline{Before}\right)_{control} \qquad (1)$$

5. Run regression on matched sample to account for other sources of observed heterogeneity

Borrower characteristics before vs. after matching

GO BACK

A. December 2010 reform

	Unmatched			Matched		
	Pre-reform	Post-reform	t-stat	Pre-reform	Post-reform	t-stat
Annual income	607.66	743.97	5.766	655.80	699.88	1.43
Year of education	15.00	15.11	2.046	14.74	14.98	0.87
Birth year	1966.92	1968.81	9.224	1969.92	1970.09	0.79

B. June 2014 reform

	Unmatched			Matched		
	Pre-reform	Post-reform	t-stat	Pre-reform	Post-reform	t-stat
Annual income	504.99	650.43	4.308	588.51	625.44	1.82
Year of education	14.59	14.73	1.941	14.37	14.28	-0.73
Birth year	1970.30	1971.95	5.646	1973.27	1973.67	0.89

2014 MATCHED DIFF-IN-DIFF $\Longrightarrow$ SMALLER LOANS, $P\downarrow$, $r\downarrow$ 2010

	log(loan \$)		log(psm)		interest rate (%)	
ATT	-0.110^{**}	-0.096^{*}	-0.230^{***}	-0.195^{**}	-0.148^{***}	-0.190^{***}
	(0.049)	(0.058)	(0.087)	(0.089)	(0.050)	(0.057)
Matched variables:						
District & bank	✓	✓	✓	✓	✓	✓
Salary income	✓	✓	✓	✓	✓	✓
Age	✓	✓	✓	✓	✓	✓
Education	✓	✓	✓	✓	✓	✓
LTV bandwidth	±4%	±4%	±4%	±4%	±4%	±4%
Property controls		✓		✓		✓
N	966	920	952	906	966	920

- Compare 61-65% LTV to 55-59% LTV in symmetric window around 2014 reform
- Similar point estimates if use tighter range, but wide CIs

No effect on loan delinquency outcomes in either reform

$$Delinquent_{i,t} = \alpha + \beta_1 \cdot Post_t + \beta_2 \cdot Post_t \times \mathbb{1}\{LTV > 60\%\}_j + \beta_3 \cdot Income_i \times Post_t$$

$$+\beta_4 \cdot Income_i \times \mathbb{1}\{LTV > 60\%\}_j + \beta_5 \cdot Income_i \times Post_t \times \mathbb{1}\{LTV > 60\%\}_j + \psi_{(i,j)} + \varepsilon_{(i,j),t}$$

- Estimate regression on matched sample with matched borrower pair FEs $\psi_{(i,j)}$
- Take matched sample of loans around each reform and track performance over the full time sample ($\approx$ 5 years on average), **controlling for maturity**
- For both reforms we find...
  - **No evidence of change in delinquency** (30-day, 30-60 day, 90+ day) or frequency of lenders writing off the loan (charge-offs)
  - No heterogeneity in delinquency within an income bin or by mortgage DTI

2010 2014

Robustness checks for matched DiD strategy

1. **Alternative LTV bandwidths:** results robust for main outcomes, although standard errors blow up for $\leq \pm 3\%$ windows around 60% LTV Jump

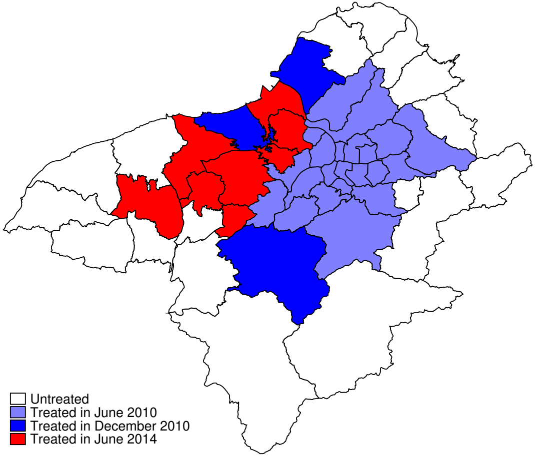
2. **Similar results for prices and loan quantity within a standard loan maturity** Jump
   - 51.9% of mortgages have 20-year amortization period, and 34.5% are 30-year loans
   - Due to power issues check with more expansive bandwidth $> \pm 4\%$

3. **Delinquency results at different horizons and by ex ante bank risk** Jump
   - No average effect on loan delinquency or charge-off rates
   - Use parent bank ROE as a proxy for ex ante riskiness measure (Meiselman, Nagel, Purnanandam 2023)
   - Banks with high *ex ante* ROE have higher systematic tail risk exposure during the crisis
   - Post-reform reduction in ever-delinquent probability if higher bank ROE
   - $\Longrightarrow$ some gains on the systemic risk side to spatial targeting

Border Diff-in-Disc Approach

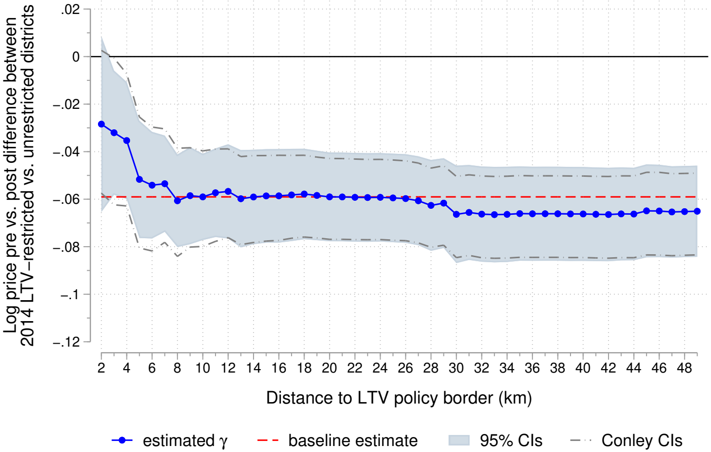
Border "diff-in-disc" design to capture direct effects

$$Y_{i,d,t} = \gamma \cdot \left(LTVCap_{i,d} \times Post_{d,t} \right) + f(lat_i, lon_i) + g(DTrain_i) + \beta' \cdot \mathbf{X}_{i,d,t} + \xi_d + \delta_t + \sum_{s=1}^{N} \phi_i^s + \varepsilon_{i,d,t}$$



- Compare two properties with same distance + characteristics and compare outcomes pre vs. post LTV tightening
- Extend to border "diff-in-diff-in-disc" comparing the newly treated region to the previously treated one (blue) $\longrightarrow Post_{d,t}$
- Reduced demand from investors for houses in treated regions $\Longrightarrow \gamma < 0$ on prices

Prices ↓ for properties in leverage-restricted areas

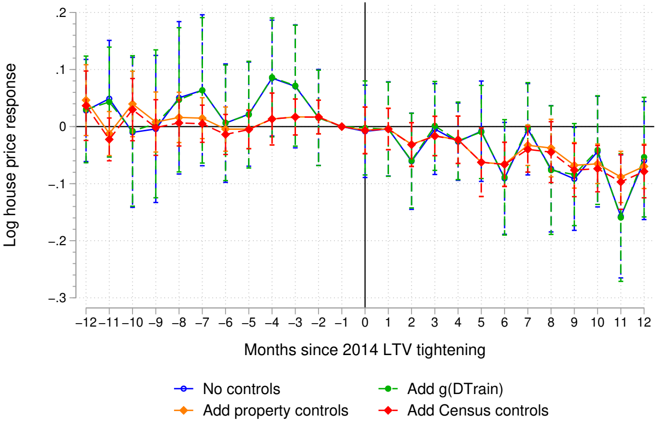


Notes: Shaded confidence intervals obtained by clustering standard errors at the district level. Conley standard error bands in green dashed lines obtained with spatial cutoff of 50 km. Baseline point estimate indicated by red dashed line obtained with a bandwidth of $x = 20$ km.

- **6% drop in house prices** as cross into LTV regulation area
- Complements matched DiD results by controlling for prop. + neighborhood characteristics
  - Age, size, building material, commuting costs, high-rise
  - Census demographics + slope/elevation/temperature
- Robust to choice of bandwidth (x-axis) and conservative standard error bands (Conley)

Details | 2012 placebo | Table | 2016 lifting

No pre-trends on dynamic diff-in-disc effects

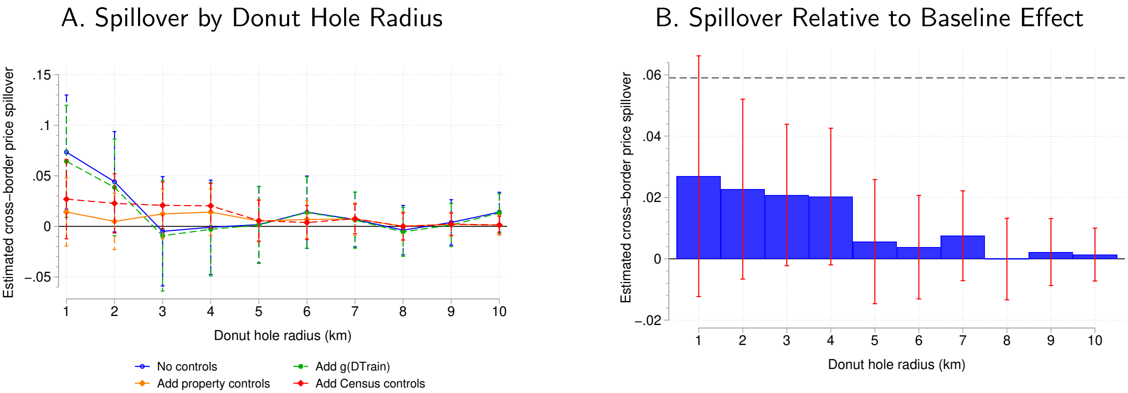


- Select symmetric windows around reform to avoid policy overlap + seasonality effects
- Robust to quadratic lat/lon function [2010 reform]

Separating cross-border spillover effects

- In our baseline specification $\widehat{\gamma}$ captures the sum of two effects:
  1. Direct effect on treated properties in districts subject to LTV policy
  2. Spillover effect due to increased demand for properties in neighboring untreated areas
- Solution: exclude i in the "donut hole" $\mathcal{C}(r) := \{i| - r \leq x(i) \leq r\}$ and compare $\widehat{\gamma}$

Small cross-border spillover effects of LTV tightening



- Spillover effects limited to within $\leq$ 4 km of policy border $\longrightarrow$ commuting costs
- Reject null that entire DiD pricing effect in treated areas is due to spillovers

Collateral Misreporting Channel

Isolating collateral misreporting

- **Appraisal gap** = (log) difference between bank's appraised collateral value and most recent local property tax appraisal value for house i

$$Gap_{i,b,d,t} = \log(A_{i,b,d,t} - A^*_{i,d,t^*}) \quad (2)$$

  - For land transactions, A^* publicly observable
  - For buildings, compute A^* based on AVM (hedonic) fitted value Details
  - Houses appraised every 3 years for building property tax

- Include appraisal drift function $\mathcal{D}(t, t^*)$: bank may simply move their collateral appraisal in lockstep with reval announced by tax authority

- Using change in loan-to-price (LTP) ratios would overestimate amount of misreporting
  - Since $\Delta P < 0$ due to regulation, then even if no misreporting $\Delta LTP > 0$

Triple diff shows large inc. in collateral misreporting

$$Gap_{i,b,d,t} = \alpha + \gamma_1 \cdot Post_t + \gamma_2 \cdot LTV\_District_{i,d} + \gamma_3 \cdot \Big(Post_t \times LTV\_District_{i,d}\Big)$$
$$+\gamma_4 \cdot 2nd\_Mrtg_i + \gamma_5 \cdot \Big(Post_t \times 2nd\_Mrtg_i\Big) + \gamma_6 \cdot \Big(LTV\_District_{i,d} \times 2nd\_Mrtg_i\Big) \quad (3)$$
$$+\gamma_7 \cdot \Big(Post_t \times LTV\_District_{i,d} \times 2nd\_Mrtg_i\Big) + \mathcal{D}(t, t^*) + \beta' \cdot \mathbf{X}_{i,t} + \eta_b + \xi_d + \delta_t + \varepsilon_{i,d,b,t}$$

Transaction types	All transactions		Apartment units	
α	14.19***	14.23***	13.43***	13.11***
	(5.62)	(5.56)	(6.93)	(6.74)
Triple interaction (γ_7)	0.09**	0.13***	0.09*	0.14***
	(2.46)	(5.75)	(1.81)	(3.46)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank/property/borrower controls	✓	✓	✓	✓
N	41,015	40,123	29,648	29,283
Adj. R^2	0.56	0.55	0.62	0.61

Note: Full set of interaction terms suppressed for space.

Full table

- ATT: $Gap \uparrow$ by $\approx$ 15% ($2.3k) relative to average of $15.5k gap for 2nd+ mortgages under the 2010 regime with the loophole
- Since market prices depend on lagged appraisals, collateral inflation creates **persistent mispricing** in regulated neighborhoods

Additional results for appraisal gap analysis

1. **Baseline DiD:** average appraisal gap for entire mortgage market ↑ 6% Jump
2. **Winsorizing:** drop if Gap outside $\pm 5 \times IQR$, or drop loans with bank appraisals $A < 33\% \times A^*$ or $A > 300\% \times A^*$ (Demiroglu & James 2018) Jump
3. **Controls:** lagged bank balance sheet variables, branch vs. bank fixed effects, and winsorized property controls Jump
4. **Dropping older properties** to account for increased difficulty in valuing properties with historical amenity value Jump
5. **Alternative scaling** of Gap Jump
   - Baseline definition is $Gap = \log(A - A^*)$
   - Check using $Gap = (A - A^*)/.5(A + A^*)$ (Kruger & Maturana 2021)

Conclusion: price vs. quantity controls on housing

- We provide new evidence on how conditioning mortgage credit provision to investors on *ex ante* local ΔP can cool housing markets
  - Contrast to local transaction taxes which often result in $P \uparrow$ due to capital lock-in
  - Lower rate on mortgages since banks no longer charge insurance premia
  - No impact on delinquency outcomes $\implies$ not mitigating systemic risks

- **Policy implications** for current system in U.S. of local restrictions based on national rules (FHA, Conforming Loan Limit)
  - Potential macroprudential gains to moving to rule indexed to local ΔP
  - But financial costs of mispricing collateral if incentives to collude are high $\rightarrow$ persistence
  - Small inc. in real commuting costs from moving further out from CBD

- **Future work:** impacts on bank profitability and credit rationing, reduced-form welfare analysis using PV surplus of owners + renters + banks

THANK YOU!

Appendix

Discussion: How do we choose between macroprudential policy instruments?

Comparing macroprudential policy elasticities

- Our results yield an elasticity of local house prices w.r.t. local leverage ratios of $\varepsilon \approx 1$
  - This number takes into account spillovers across the border to the unregulated control housing markets in the 2014 reform

$$\varepsilon = \frac{\%\Delta P}{\%\Delta LTV} = \frac{\overbrace{-(6\% - 2\%)}^{\text{Border DiD estimate of } \Delta P \text{ net of spatial spillover}}}{\underbrace{(55\% - 60\%)/60\% - (67\% - 70\%)/70\%}_{\text{1st stage effect comparing regulated vs. unregulated areas}}} = 0.99$$

  - Lower bound due to avoidance through collateral appraisal inflation
- Appears consistent with ε estimates from other broad-based LTV policies
  - Local semi-elasticity estimates for strict LTV policies (Armstrong, Sklling, Yao 2019 [NZ] ; de Araujo et al. 2020 [Brazil]) $\implies 0.3 \leq \varepsilon \leq 1$
  - Caveat: estimates not reported in comparable ways across studies

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Place-based policy welfare decomposition

- Anchoring min. downpayments to local HP growth is a type of **place-based policy**
- We can decompose the losses generated for each market actor between borrowers, lenders, incumbent homeowners, and policymakers (property tax revenues)
  - Ignore banking sector risk since no avg. effects on delinquency outcomes
  - Analog to decompositions in Busso, Gregory, Kline (2013); Lu, Wang, Zhu (2019)
- Borrowers don't lose much because higher downpayment accompanied by lower rates
  - Housing supply shifts inward only slightly since mortgage lock-in channel is weak
  - Reform also targeted investors, who are more mobile in terms of housing choice
- Most losses driven by lenders who originate **lower IRR loans** and incumbent homeowners who see property values ↓

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Our companion paper: PR ratio targeting via taxes

- Common alternative to leverage-based MPPs is to tax housing transactions
- **Idea:** sellers pass along costs of the tax to buyers, which acts like an increased downpayment requirement
- **Reality:** taxes create an **inventory crunch**, as investors hold onto properties for longer to subdivide the fixed cost over a longer holding period
- In our companion paper, we show in a structural model that such flip taxes...
  1. Increase house prices for most tax rates, but help achieve price-rent (PR) ratio targets by pushing more people into rentership
  2. Renters on margin of homeownership gain, but aggregate welfare losses are large and equal to $\approx 55\%$ of housing consumption Details
- Targeting buyers directly using spatially targeted LTV limits helps improve affordability *in price levels* without large welfare losses

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Data infrastructure

Go back

- **Complete set of mortgage originations from ROC Central Bank (2009-21)**
  - Contract characteristics at origination + track loan performance over time
  - Info on borrowers: occupation, income, age, permanent address
- **Merge with database of market prices and rents from public records**
  - Compiled + geocoded in our other paper on Tobin taxes (Chi, LaPoint, Lin 2023)
- **Universe of personal tax records from Ministry of Finance (2006-16)**
  - Already linked with wealth estimates, property and deed tax assessments
  - Cannot merge directly with loan registry, but can merge with public property records
- **Bank balance sheet data from TEJ+ and DealScan**
  - Link branch information to scraped addresses $\longrightarrow$ track (re)allocation of loans within bank

History of targeted LTV restrictions

Go back | Recent

Effective date	Type	Property target	Region	Buyers	Maximum LTV
March 1, 1989	T	Land, residential and non-residential properties	All regions	Individuals and institutions	140% of the current appraisal value
June 25, 2010	T	Second (mortgaged) homes	Taipei and New Taipei (22 districts)	Individuals	70% of the collateral value
December 31, 2010	T	Second (mortgaged) homes	Taipei and New Taipei (+3 districts)	Individuals and institutions	60% of the collateral value
		Land	All regions	Individuals and institutions	65% of $min(price, collateral\ value)$
June 22, 2012	T	High-end properties	All regions	Individuals and institutions	60% of $min(price, collateral\ value)$
June 27, 2014	T	Second (mortgaged) homes	Taipei, New Taipei, Taoyuan (+ 8 districts)	Individuals	60% of $min(price, collateral\ value)$
		Third (mortgaged) homes	All regions	Individuals	50% of $min(price, collateral\ value)$
		High-end properties	All regions	Individuals	50% of $min(price, collateral\ value)$
		Residential properties	All regions	Institutions	50% of $min(price, collateral\ value)$
August 14, 2015	L	Third (mortgaged) homes	All regions	Individuals	60% of $min(price, collateral\ value)$
		Second (mortgaged) homes	New Taipei and Taoyuan (– 6 districts)	Individuals	No LTV limit
		High-end properties	All regions	Individuals and institutions	60% of $min(price, collateral\ value)$
		Residential properties	All regions	Institutions	60% of $min(price, collateral\ value)$
March 25, 2016	L	High-end properties	All regions	Individuals and institutions	60% of $min(price, collateral\ value)$
		All other mortgages	All regions	Individuals and institutions	No LTV limit

- We focus on the June 2014 reform which tied LTV limits to **market prices**
- Use 2012 reform as a placebo since it only applied to very expensive homes

Related work on housing market regulation Go back

- **Macroprudential regulation of housing**
  - LTV limits: Igan & Kang (2011); Campbell, Ramadorai, Ranish (2015); Chen et al. (2016); Armstrong, Skilling, Yao (2019); Aastveit et al. (2020); de Araujo et al. (2020); Han et al. (2021); Higgins (2021); Acharya et al. (2022); Eerola et al. (2022); Van Bekkum et al. (2022); Tzur-Ilan (2023), and many more...
  - Other constraints [D(P)TI, quotas, risk weights, taxes, etc.]: Kuttner & Shim (2016); Cerutti, Claessens, Laeven (2017); DeFusco & Paciorek (2017); DeFusco, Johnson, Mondragon (2020); Benetton (2021); Deng et al. (2021); Hu (2022); Chi, LaPoint, Lin (2023)
- **Evidence of relationship between credit supply and house price growth**
  - Mian & Sufi (2011,22); Favara & Imbs (2015); Loutskina & Strahan (2015); Cerutti, Dagher, Dell'Ariccia (2017); Fuster & Zafar (2021); Greenwald & Guren (2021); Blickle (2022)
- **Adverse outcomes of lender-borrower collusion**
  - Collateral misreporting: Ben-David (2011); Agarwal, Ben-David, Yao (2015); Garmaise (2015); Piskorski, Seru, Witkin (2015); Griffin (2021); Kruger & Maturana (2021)
  - Credit screening standards: Keys et al. (2010); Purnanandam (2011); Ambrose, Conklin, Yoshida (2016); Griffin & Maturana (2016a,b); Mian & Sufi (2017)

COVID-era LTV restrictions in Taiwan

Go back

Effective date	Type	Property target	Region	Buyers	Maximum LTV
December 8, 2020	T	Third (mortgaged) homes	All regions	Individuals	60% of $min(price, collateral\ value)$
		First (mortgaged) homes	All regions	Institutions	60% of $min(price, collateral\ value)$
		Second (mortgaged) homes	All regions	Institutions	50% of $min(price, collateral\ value)$
		High-end properties	All regions	Individuals and institutions	60% of $min(price, collateral\ value)$
		Land	All regions	Individuals and institutions	65% of $min(price, collateral\ value)$
March 19, 2021	T	Third (mortgaged) homes	All regions	Individuals	55% of $min(price, collateral\ value)$
		Fourth (mortgaged) homes	All regions	Individuals	50% of $min(price, collateral\ value)$
		First and second high-end properties	All regions	Individuals	55% of $min(price, collateral\ value)$
		Third high-end properties	All regions	Individuals	40% of $min(price, collateral\ value)$
		Residential properties	All regions	Institutions	40% of $min(price, collateral\ value)$
September 24, 2021	T	Second (mortgaged) homes	All regions	Individuals	Interest-Only mortgages not available
		Land	All regions	Individuals and institutions	60% of $min(price, collateral\ value)$
December 17, 2021	T	Second (mortgaged) homes	8 major cities	Individuals	40% of $min(price, collateral\ value)$
		Third (mortgaged) homes	All regions	Individuals	40% of $min(price, collateral\ value)$
		High-end properties	All regions	Individuals	40% of $min(price, collateral\ value)$
		Land	All regions	Individuals and institutions	50% of $min(price, collateral\ value)$

Govt. picked high (resid.) price growth districts

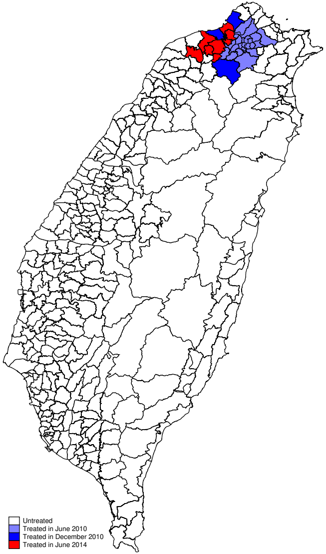
Go back

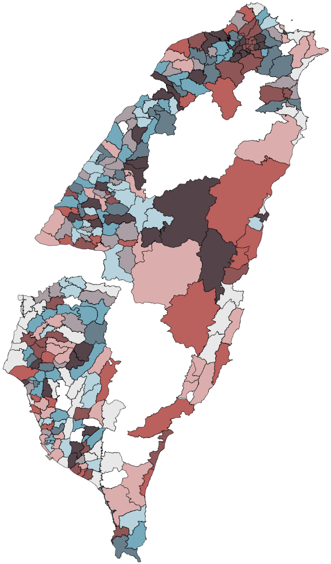
$$\log p_{i\in g,q} = \delta_q^g + \gamma_b^g + \beta^{g\prime} \cdot \mathbf{X_{i\in g,t}} + \varepsilon_{i\in g,q} \implies \Delta\widetilde{P}^g_{q,q+1} = \exp(\widehat{\delta}^g_{q+1}) / \exp(\widehat{\delta}^g_q) - 1$$

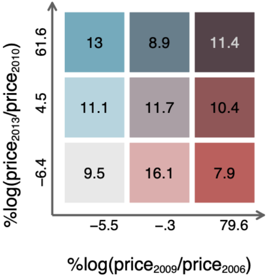
	$\%\Delta\widetilde{P}_{08Q1-10Q1}$		$\%\Delta\widetilde{P}_{10Q2-12Q2}$		$\%\Delta\widetilde{P}_{12Q2-14Q2}$		$\%\Delta\widetilde{P}_{14Q3-16Q3}$		$\%\Delta\widetilde{P}_{16Q4-18Q4}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Dec. 2010 Treated Borders										
Treated districts	27.2%	16.4%	34.2%	12.6%	18.6%	28.9%	−5.8%	−3.0%	21.8%	−0.2%
Untreated border districts	3.7%	2.0%	37.5%	37.9%	35.2%	29.9%	0.7%	2.0%	3.4%	5.3%
Untreated non-border districts	1.5%	1.1%	12.9%	10.0%	29.1%	25.9%	6.2%	8.0%	7.0%	5.6%
B. June 2014 Treated Borders										
Treated districts	17.2%	14.7%	30.3%	12.2%	25.5%	33.5%	−4.5%	−3.8%	1.8%	1.5%
Untreated border districts	5.5%	3.1%	21.1%	35.2%	16.2%	19.9%	3.8%	4.6%	4.9%	2.5%
Untreated non-border districts	1.4%	0.7%	12.3%	9.6%	27.9%	22.9%	7.0%	8.1%	7.2%	6.0%
Property controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City block FEs		✓		✓		✓		✓		✓

Govt. picked high (resid.) price growth districts

Go back

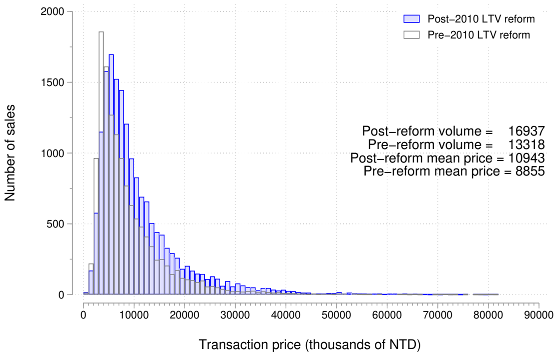




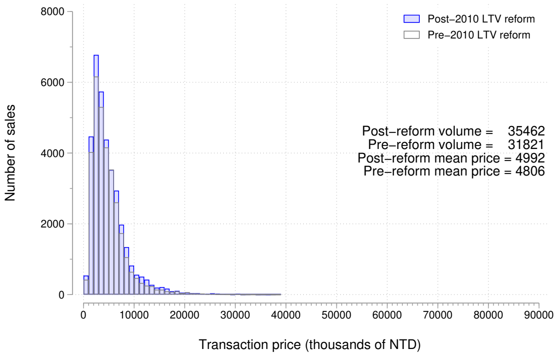


Due to avoidance, 2010 reform had no impact on volume

A. Treated districts [Go back]



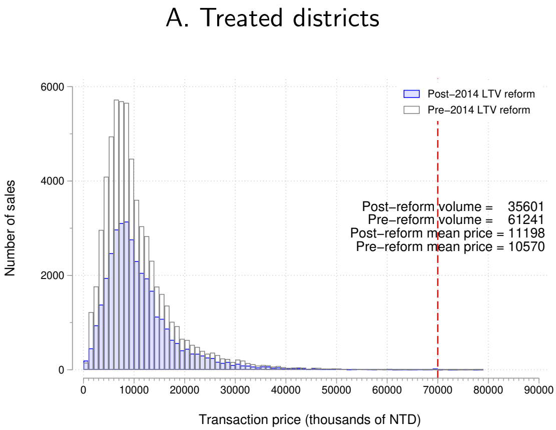
B. Untreated (non-border) districts

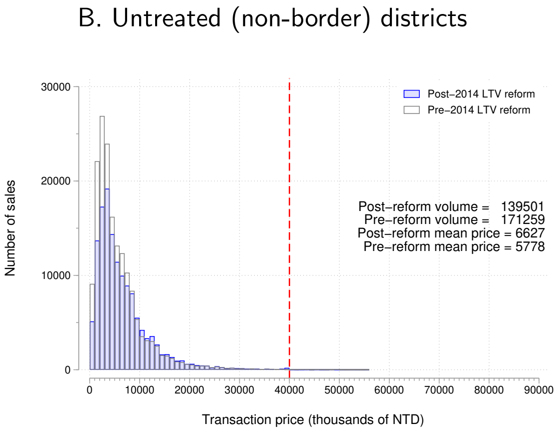


- Naive DiD in means: $(16,937/13,318) - (35,462/31,821) = 15.73\% \uparrow$ in volume suggests no deterrence of investment buying due to collateral loophole

Clear drop in sales volume after 2014 LTV limits

Go back





2010 MATCHED DIFF-IN-DIFF $\implies$ SMALLER, SHORTER LOANS, $P \downarrow$

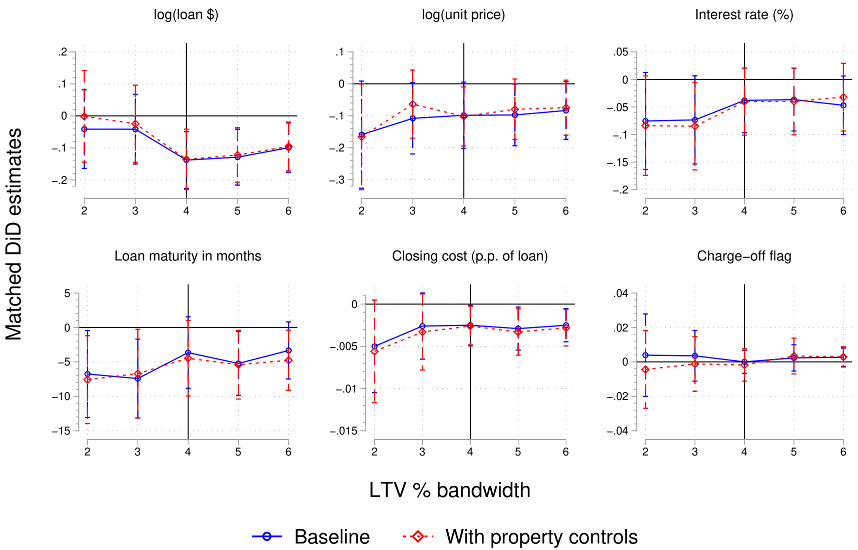
	log(loan $)		log(psm)		interest rate (%)	
ATT	-0.130^{***}	-0.128^{***}	-0.092^{*}	-0.104^{**}	-0.029	-0.033
	(0.044)	(0.048)	(0.049)	(0.045)	(0.031)	(0.033)
Matched variables:						
District & bank	✓	✓	✓	✓	✓	✓
Salary income	✓	✓	✓	✓	✓	✓
Age	✓	✓	✓	✓	✓	✓
Education	✓	✓	✓	✓	✓	✓
LTV bandwidth	±4%	±4%	±4%	±4%	±4%	±4%
Property controls		✓		✓		✓
N	4,052	3,742	3,962	3,656	4,052	3,742

- Compare 61-65% LTV to 55-59% LTV in symmetric window around each reform
- Similar point estimates if use tighter range, but wide CIs
- Some neg. effect on maturity: substitution to shorter loans to lock in teaser rates

Go back

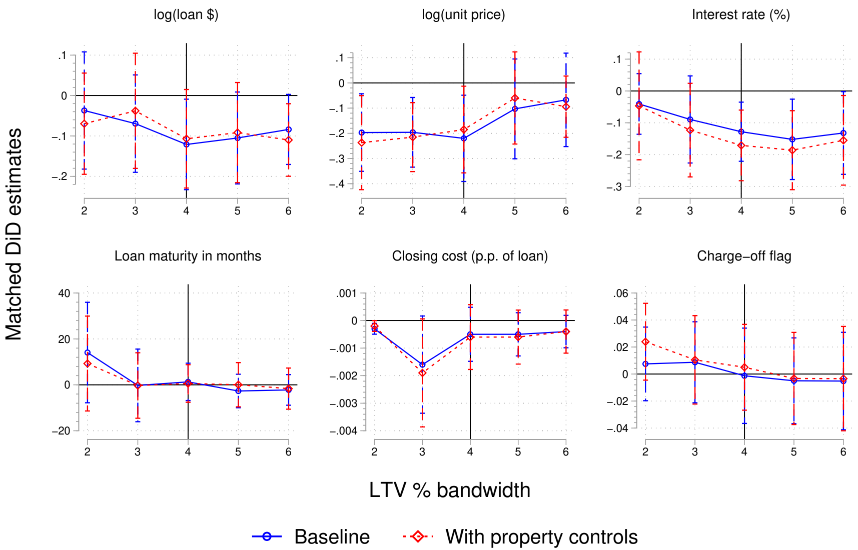
2010 reform matched DiD estimates by bandwidth

Go back



2014 reform matched DiD estimates by bandwidth

Go back



No effect on loan delinquency outcomes (2010)

Go back

	Ever-delinquent flag			Charge-off flag		
$Post_t$	0.0007	0.0008	0.0011	0.0037	0.0056	0.0014
	(0.0004)	(0.0005)	(0.0007)	(0.0041)	(0.0042)	(0.0053)
$Post_t \times \mathbb{1}\{LTV > 60\%\}_j$	-0.0007	-0.0007	-0.0010	-0.0003	-0.0021	0.0039
	(0.0004)	(0.0005)	(0.0006)	(0.0048)	(0.0052)	(0.0072)
$Income_i \times Post_t$			-0.0004			0.0064
			(0.0003)			(0.0066)
$Income_i \times \mathbb{1}\{LTV > 60\%\}_j$			-0.0001			0.0001
			(0.0001)			(0.0012)
$Income_i \times Post_t \times \mathbb{1}\{LTV > 60\%\}_j$			0.0004			-0.0090
			(0.0003)			(0.0082)
LTV bandwidth	$\pm 4\%$	$\pm 4\%$	$\pm 4\%$	$\pm 4\%$	$\pm 4\%$	$\pm 4\%$
Property controls		✓	✓		✓	✓
N	4,052	3,742	3,742	4,052	3,742	3,742

No effect on loan delinquency outcomes (2014)

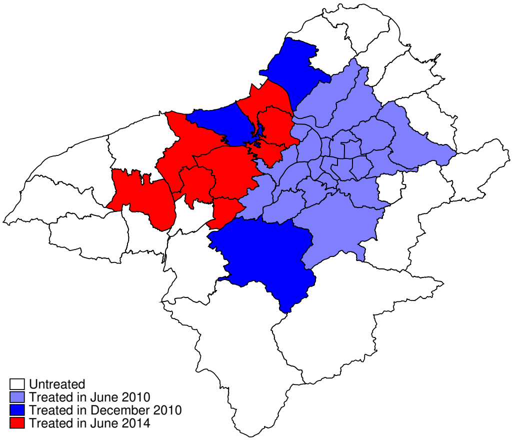
Go back

	Ever-delinquent flag			Charge-off flag		
$Post_t$	−0.0058	−0.0076	−0.0089	−0.0017	−0.0010	−0.0025
	(0.0059)	(0.0071)	(0.0082)	(0.0125)	(0.0108)	(0.0128)
$Post_t \times \mathbb{1}\{LTV > 60\%\}_j$	0.0031	0.0039	0.0045	−0.0011	0.0048	0.0102
	(0.0040)	(0.0046)	(0.0058)	(0.0167)	(0.0162)	(0.0193)
$Income_i \times Post_t$			0.0019			0.0030
			(0.0023)			(0.0130)
$Income_i \times \mathbb{1}\{LTV > 60\%\}_j$			0.0001			0.0136
			(0.0020)			(0.0178)
$Income_i \times Post_t \times \mathbb{1}\{LTV > 60\%\}_j$			−0.0010			−0.0087
			(0.0028)			(0.0166)
LTV bandwidth	±4%	±4%	±4%	±4%	±4%	±4%
Property controls		✓	✓		✓	✓
N	960	922	922	960	922	922

Implementation of border "diff-in-disc" design

Go back

$$Y_{i,d,t} = \gamma \cdot \left(LTVCap_{i,d} \times Post_{d,t} \right) + f(lat_i, lon_i) + g(DTrain_i) + \beta' \cdot \mathbf{X}_{i,d,t} + \xi_d + \delta_t + \sum_{s=1}^{N} \phi_i^s + \varepsilon_{i,d,t}$$



- Bandwidth x: restrict to obs. within distance $\leq x$ to border
- $f(\cdot)$ local linear function in lat/lon
- $g(\cdot)$ linear spline in distance to nearest commuter rail
- Border segment ϕ^s or neighborhood FEs
- Standard errors either (i) clustered by district, or (ii) Conley correction
  - Use Conley distance cutoff which maximizes standard errors
  - Search over range from 2 km to max district distance to border (49 km)

Pooled border diff-in-disc (2014 reform)

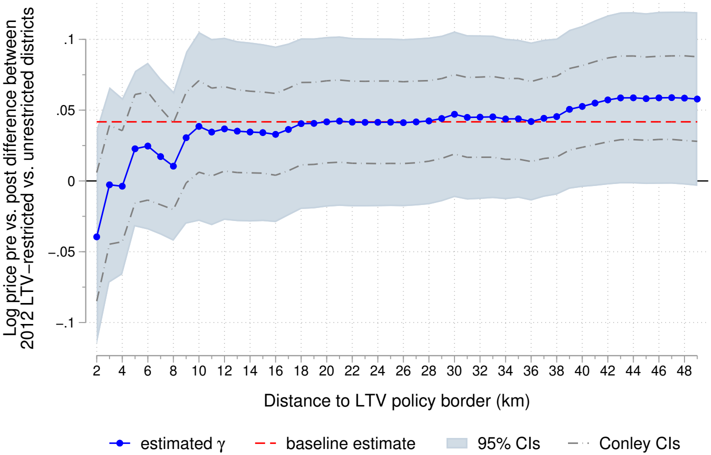
Go back

	(1)	(2)	(3)	(4)	(5)	(6)
$LTVCap \times Post$	-0.078^{***}	-0.078^{***}	-0.065^{***}	-0.059^{***}	-0.058^{***}	-0.077^{***}
	(0.019)	(0.018)	(0.010)	(0.009)	(0.010)	(0.013)
	[0.012]	[0.012]	[0.007]	[0.006]	[0.006]	[0.010]
Sample	Buildings	Buildings	Buildings	Buildings	Buildings	Buildings + land
Bandwidth (km)	20	20	20	20	20	20
$f(lat, lon)$	Linear	Linear	Linear	Linear	Quadratic	Linear
Time FEs	✓	✓	✓	✓	✓	✓
Border segment FEs	✓	✓	✓	✓	✓	✓
$g(DTrain)$		✓	✓	✓	✓	✓
Property controls			✓	✓	✓	✓
Census controls				✓	✓	✓
N	131,169	131,169	131,169	131,169	131,169	166,137
# districts	79	79	79	79	79	79
Adj. R^2	0.354	0.359	0.821	0.822	0.825	0.603

Notes: Conley standard errors estimated with a maximal spatial correlation distance cutoff parameter of 2 km appear in brackets.

Placebo: 2012 LTV reform to very high-end homes

Go back

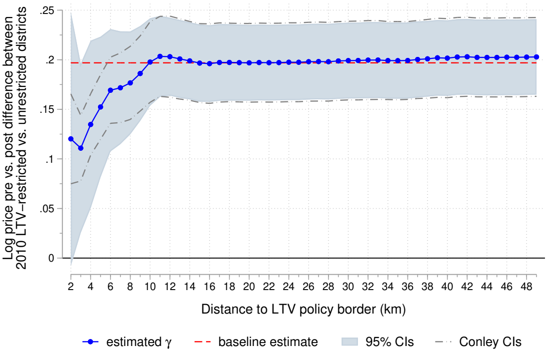


- 2012 reform left 2010 regime intact but added new restriction on loans for properties with $P >$ 80 mil. NTD ($\approx$ 2.5 mil. USD)
- We drop obs. below 1st or above 99th pct., so such sales are not included
- No significant effect on prices for all bandwidth choices
- $\implies$ border discontinuity not simply picking up differential neighborhood price trends

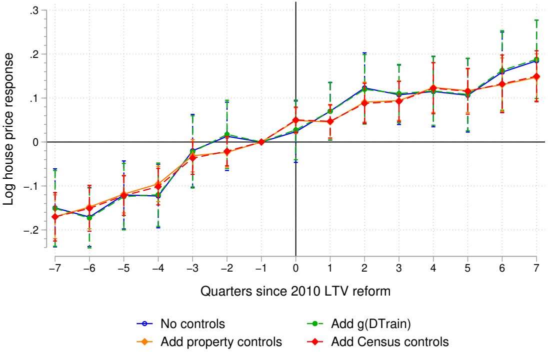
Notes: Shaded confidence intervals obtained by clustering standard errors at the district level. Conley standard error bands in green dashed lines obtained with spatial cutoff of 49 km. Baseline point estimate indicated by red dashed line obtained with a bandwidth of $x = 20$ km.

Due to loophole, no impact of 2010 reform local prices

A. Robustness to bandwidth



B. Dynamic border diff-in-disc effects



- House prices in treated border neighborhoods continue to grow on trend
  - 2010 treated group of districts also more positively selected based on ΔP path
- Contrast to ATT (matched DiD) estimates which restrict to regulated 2nd mortgages

Steps to compute the appraisal gap

Go back

$$Gap_{i,b,d,t} = \log(A_{i,b,d,t} - A^*_{i,d,t^*})$$

- A^* is the official appraisal for tax purposes
- A is the collateral value reported by the lender at origination
- To obtain A^* we distinguish between land only, building + land, and building transactions
  - Land portion of appraised value observed directly in year t^*, inflate using our index $\Delta\widetilde{P}^d_{t*,t}$
  - For buildings appraised every 3 years in t^*, we use **known local valuation formula:**

$$A^*_{i,d,t^*} = standard\_value_{i,d,t^*} \times size_i \times (1 - \delta_{i,d,t^*} \times age_{i,t^*}) \times \zeta_{i,d,t^*}$$

- $standard\_value$, depreciation factor (δ) and road adjustment factor (ζ) depends on property type, updated by district in each year
- $A > A^*$ in 99.2% of cases, so log transform does not censor the data

DiD evidence of collusion after 2014

Go back

	All transactions		Apartment units	
α	15.37***	15.05***	14.08***	13.33***
	(5.52)	(5.40)	(7.24)	(7.18)
$Post_t$	0.01	0.00	−0.01	−0.02
	(0.50)	(0.10)	(0.53)	(1.04)
$LTVCap_{i,d}$	−0.05	−0.06*	−0.06**	−0.07***
	(1.31)	(1.85)	(1.96)	(3.12)
$LTVCap_{i,d} \times Post_t$	0.03	0.04**	0.05**	**0.06*** **
	(1.42)	(2.03)	(2.05)	(3.10)
$\mathcal{D}(t, t^*)$	−0.06***	−0.00***	−0.08***	−0.00***
	(2.69)	(4.65)	(3.40)	(4.45)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank controls	✓	✓	✓	✓
Property controls	✓	✓	✓	✓
Borrower controls	✓	✓	✓	✓
N	41,015	40,123	29,648	29,283
Adj. R^2	0.54	0.54	0.60	0.60

- *Gap* ↑ by ≈ 6% ($1k) relative to average of $20k gap under the 2010 regime with the loophole
  - Estimation sample: all mortgages (ITT effect)
  - Extend to triple diff to get ATT
- Recall that 2010 reform defined limit as 60% of collateral value
  - Loophole: not a function of the price until 2014!
- Lenders not required to use official appraisers plus no restrictions on valuation model

2010 reform

DiD evidence of collusion after 2014

Go back

	All transactions		Apartment units	
α	15.37***	15.05***	14.08***	13.33***
	(5.52)	(5.40)	(7.24)	(7.18)
$Post_t$	0.01	0.00	−0.01	−0.02
	(0.50)	(0.10)	(0.53)	(1.04)
$LTVCap_{i,d}$	−0.05	−0.06*	−0.06**	−0.07***
	(1.31)	(1.85)	(1.96)	(3.12)
$LTVCap_{i,d} \times Post_t$	0.03	0.04**	0.05**	**0.06*** **
	(1.42)	(2.03)	(2.05)	(3.10)
$\mathcal{D}(t, t^*)$	−0.06***	−0.00***	−0.08***	−0.00***
	(2.69)	(4.65)	(3.40)	(4.45)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank controls	✓	✓	✓	✓
Property controls	✓	✓	✓	✓
Borrower controls	✓	✓	✓	✓
N	41,015	40,123	29,648	29,283
Adj. R^2	0.54	0.54	0.60	0.60

- *Gap* $\uparrow$ by $\approx$ 6% ($1k) relative to average of $20k gap under the 2010 regime with the loophole
  - Estimation sample: all mortgages (ITT effect)
  - Extend to triple diff to get ATT
- Recall that 2010 reform defined limit as 60% of collateral value
  - Loophole: not a function of the price until 2014!
- Lenders not required to use official appraisers plus no restrictions on valuation model 2010 reform

DiD evidence of collusion after 2014

Go back

	All transactions		Apartment units	
α	15.37***	15.05***	14.08***	13.33***
	(5.52)	(5.40)	(7.24)	(7.18)
$Post_t$	0.01	0.00	−0.01	−0.02
	(0.50)	(0.10)	(0.53)	(1.04)
$LTVCap_{i,d}$	−0.05	−0.06*	−0.06**	−0.07***
	(1.31)	(1.85)	(1.96)	(3.12)
$LTVCap_{i,d} \times Post_t$	0.03	0.04**	0.05**	**0.06*** **
	(1.42)	(2.03)	(2.05)	(3.10)
$\mathcal{D}(t, t^*)$	−0.06***	−0.00***	−0.08***	−0.00***
	(2.69)	(4.65)	(3.40)	(4.45)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank controls	✓	✓	✓	✓
Property controls	✓	✓	✓	✓
Borrower controls	✓	✓	✓	✓
N	41,015	40,123	29,648	29,283
Adj. R^2	0.54	0.54	0.60	0.60

- *Gap* ↑ by ≈ 6% ($1k) relative to average of $20k gap under the 2010 regime with the loophole
  - Estimation sample: all mortgages (ITT effect)
  - Extend to triple diff to get ATT
- Recall that 2010 reform defined limit as 60% of collateral value
  - Loophole: not a function of the price until 2014!
- Lenders not required to use official appraisers plus no restrictions on valuation model

2010 reform

Appraisal gap triple diff: full results table

Go back

Transaction types	All transactions		Apartment units	
α	14.19***	14.23***	13.43***	13.11***
	(5.62)	(5.56)	(6.93)	(6.74)
$Post_t$	0.08***	0.08***	0.08	0.06
	(3.62)	(3.19)	(1.70)	(1.52)
$LTV\_District_{i,d}$	0.82***	0.79***	0.90***	0.83***
	(4.86)	(4.68)	(4.55)	(4.44)
$Post_t \times LTV\_District_{i,d}$	−0.10***	−0.11***	−0.12**	−0.11**
	(3.83)	(3.61)	(2.58)	(2.37)
$2nd\_Mrtg_i$	0.09**	0.13***	0.07	0.12**
	(2.53)	(5.82)	(1.32)	(3.01)
$Post_t \times 2nd\_Mrtg_i$	−0.07*	−0.10***	−0.05	−0.10**
	(1.91)	(4.77)	(0.99)	(2.46)
$LTV\_District_{i,d} \times 2nd\_Mrtg_i$	−0.15***	−0.19***	−0.13**	−0.18***
	(3.06)	(4.94)	(2.18)	(3.42)
$Post_t \times LTV\_District_{i,d} \times 2nd\_Mrtg_i$	0.09**	0.13***	0.09*	0.14***
	(2.46)	(5.75)	(1.81)	(3.46)
$\mathcal{D}(t, t^*)$	−0.05**	−0.00	−0.06**	−0.00***
	(2.45)	(1.38)	(2.85)	(3.14)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank/property/borrower controls	✓	✓	✓	✓
N	41,015	40,123	29,648	29,283
Adj. R^2	0.56	0.55	0.62	0.61

- Reference group: first mortgages in untreated districts in the pre-reform period $\longrightarrow \alpha$
- Add the coefficients on $2nd\_Mrtg_i$ and $LTV\_District_{i,d}$ to α to get the pre-existing average appraisal gap in the treatment group
- Drift function $\mathcal{D}(t, t^*)$ loads negatively on the gap in all specifications, reflecting benign gap from delays between official appraisals

Appraisal gap triple diff: $Gap = (A - A^*)/.5(A + A^*)$

Go back

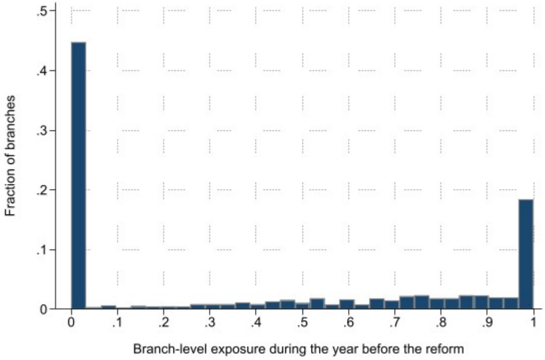
Transaction types	All transactions		Apartment units	
α	2.37***	2.18***	0.80	1.37**
	(3.19)	(2.84)	(1.36)	(2.20)
$Post_t$	−0.01	0.02**	−0.01	0.03**
	(0.49)	(2.29)	(0.36)	(2.92)
$LTV\_District_{i,d}$	0.24***	0.24***	0.27***	0.26***
	(9.11)	(6.44)	(8.95)	(7.13)
$Post_t \times LTV\_District_{i,d}$	−0.05**	−0.09***	−0.07*	−0.12***
	(1.96)	(5.83)	(1.81)	(6.19)
$2nd\_Mrtg_i$	0.03***	0.03***	0.02***	0.03**
	(4.22)	(5.56)	(3.18)	(3.14)
$Post_t \times 2nd\_Mrtg_i$	−0.02**	−0.02***	−0.01	−0.01
	(2.45)	(3.33)	(1.21)	(1.79)
$LTV\_District_{i,d} \times 2nd\_Mrtg_i$	−0.03***	−0.03***	−0.03**	−0.03***
	(3.39)	(5.91)	(3.02)	(3.63)
$Post_t \times LTV\_District_{i,d} \times 2nd\_Mrtg_i$	0.02***	0.03***	0.02*	0.03***
	(2.83)	(4.52)	(1.81)	(3.21)
$\mathcal{D}(t, t^*)$	−0.03*	0.00	−0.03**	0.00
	(1.93)	(1.32)	(2.28)	(1.49)
Drift function	dummy	linear	dummy	linear
Time FEs	✓	✓	✓	✓
District & bank FEs	✓	✓	✓	✓
Bank/property/borrower controls	✓	✓	✓	✓
N	41,178	40,112	29,797	29,268
Adj. R^2	0.66	0.73	0.70	0.77

- Alternative measure proposed by Kruger & Maturana (2021)
- Gap centered at zero if A and A^* symmetrically distributed around same mean (not true here)
  - Here, there is a large existing pre-existing gap (α), since typically $A^* << A$
- 2-3 p.p. increase in gap for 2nd+ mortgages relative to average valuation $\overline{A} = .5(A + A^*)$
- Similar result for $Gap = (A - A^*)/A^*$

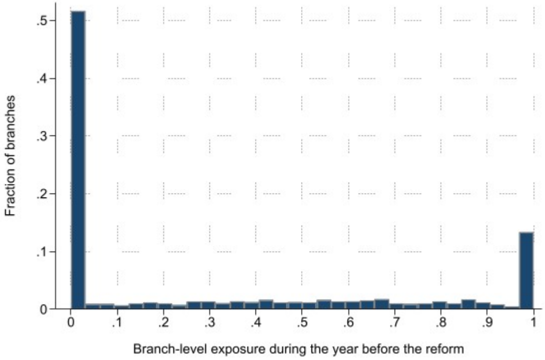
Distribution of branch exposure measure

Go back

Exposure before 2010 LTV reform



Exposure before 2014 LTV reform



Note: $Exposure_j$ defined in terms of 2nd+ mortgage loan amounts.

- Share of unexposed branches rises by 6 p.p. after initial 2010 reform
- Use balanced panel of branches b/c some stop originating 2nd+ mortgages altogether

Separating Credit Demand vs. Credit Supply Responses

How do spatially targeted LTV limits operate?

- LTV limits are enforced through banks but target household leverage
  - **Demand channel:** investors lower WTP for properties in regulated areas due to higher downpayment requirements
  - All else equal, higher leverage loans generate higher internal rates of return (IRR) for lenders
  - **Supply channel:** lenders might ration credit in regulated areas, or steer borrowers towards loan contracts which are unregulated or which carry higher IRR
    - ⋆ Matched DiD: within treated areas no steering towards higher yield contracts
- Standard technique to separate supply vs. demand in loan origination is the Amiti & Weinstein (2018) decomposition for corporate loans
  - Problem: relies on identification of bank and borrower fixed effects
  - Very limited number, and very selected sample, of repeat borrowers within time window around each reform

Isolating supply-side responses using regulation exposure

- Idea: tease out credit rationing using measures of how *ex ante* exposed lenders' loan portfolios are to LTV regulation

- Define **exposure** as the dollar share of loans each lender j originated in treated areas within a year before the reform:

$$Exposure_j = \frac{\sum_{i=1}^{N_j} \left(Loan\_amt_{i,j} \times Treated_{i \in d} \right)}{\sum_{i=1}^{N_j} Loan\_amt_{i,j}} \quad (4)$$

- Further decompose into exposure by 1st (unregulated) vs. 2nd+ mortgages (regulated) or parent bank b level vs. branch j level Distribution

- Collateral internalization: $Exposure_j$ also picks up the fact that collateral values may fall due to change in broader housing market demand (Favara & Giannetti 2017)
  - Measure based directly on collateral values would require book-to-market conversion

Within-bank branch network exposure measure

Go back

- We define the indirect branch network exposure of a branch j of parent bank b as:

$$\sum_{k \neq j}^{N_b} Exposure_{k,t-1} = \sum_{k \neq j}^{N_b} \left(\frac{\sum_{i=1}^{N_k} \left(Loan\_amt_{i,k} \times Treated_{i \in d} \right)}{\sum_{i=1}^{N(b)} Loan\_amt_{i,b}} \right) \tag{5}$$

  - N_b is the # of branches within bank b
  - N_k is the # of loans originated within branch k
  - $N(b)$ is the # of loans originated within bank b

- **Interpretation:** this measure captures how much the branch peers contribute to the overall regulation exposure of the parent bank's mortgage portfolio

Drop in loans concentrated among most exposed branches

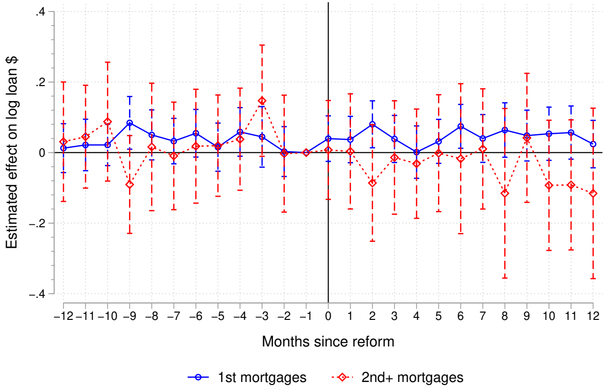
$$L_{j,b,d,t} = \gamma_1 \cdot Post_t \times Treated_{j\in d} + \gamma_2 \cdot Post_t \times Exposure_j + \gamma_3 \cdot Post_t \times Treated_{j\in d} \times Exposure_j + \eta_j + \theta_{d,t} + \varepsilon_{j,b,d,t} \quad (6)$$

	1st mortgages		2nd+ mortgages	
Outcome:	Δ log(loan \$)	Δ log(# of loans)	Δ log(loan \$)	Δ log(# of loans)
$Post_t \times Treated_{j\in d}$	-0.02	-0.02	0.28^{**}	0.05
	(0.22)	(0.34)	(2.08)	(0.61)
	[0.16]	[0.24]	[1.80]	[0.42]
$Post_t \times Exposure_j$	-0.20^{***}	-0.13^{**}	-0.28^{***}	-0.06
	(2.79)	(2.54)	(2.31)	(1.01)
	[2.23]	[1.86]	[1.99]	[0.85]
$Post_t \times Treated_{j\in d} \times Exposure_j$	0.22^{**}	0.13^{**}	-0.38^{**}	-0.17^{**}
	(2.37)	(2.12)	(2.35)	(1.98)
	[2.01]	[1.53]	[1.90]	[1.39]
Branch FEs	✓	✓	✓	✓
District × time FEs	✓	✓	✓	✓
N	28,280	28,280	10,013	10,013
Adj. R^2	0.52	0.61	0.41	0.49

Note: t-stats from standard errors clustered by bank-time in parentheses. t-stats clustered by branch in brackets. $Exposure_j$ measured using 2nd+ mortgages originated on properties located in regulated areas but in the year prior to the 2014 reform.

- Collapse data to branch-month level
- More exposed branches within the same district reduce their 2nd+ mortgage lending by more
- Suggestive of substitution towards unregulated first mortgage borrowers
- Extensive margin is important: stronger results for untransformed 2nd+ mortgage outcomes

Effects driven by anticipation among exposed branches



Note: We plot the dynamic coefficients on $Post_t \times Treated_{j \in d} \times Exposure_j$, with 95% confidence intervals obtained from clustering standard errors by bank-time.

- Spike in loans comes around time public banks started enacting their own internal LTV policies
  - Public mortgages are not in our sample
  - Market interpreted this as a signal of future LTV tightening
- Points to **brokers acting strategically** to expedite loans under the preceding regime (higher commission), but no real change in screening standards after the reform

No evidence of branch network contagion effects

$$\Delta L_{j,b,d,t,t+1} = \alpha + \gamma_1 \cdot Exposure_{j,t-1} + \gamma_2 \cdot Exposure_{j,t-1} \times Treated_{j \in d}$$
$$+\gamma_3 \cdot \sum_{k \neq j}^{N_b} Exposure_{k,t-1} + \gamma_4 \cdot \sum_{k \neq j}^{N_b} Exposure_{k,t-1} \times Treated_{j \in d} + \xi_d + \varepsilon_{j,b,d,t,t+1} \quad (7)$$

- Direct exposure $Exposure_{j,t-1}$ vs. exposure of N_b peer branches within same bank chain $\sum_{k \neq j}^{N_b} Exposure_{k,t-1}$ Definition
- **Hypothesis:** banks more exposed to regulatory risk through LTV limits might smooth out the shock across branches in their network $\implies \gamma_4 \neq 0$
  - Lower screening standards in unregulated areas or loan segments to make up lost profits
  - If so, spatial limits may have simply exported risk to unregulated areas
- **Our result:** no network effects on either 1st or 2nd+ mortgage issuance Full table

Null results from branch network regressions

Go back

$$\Delta L_{j,b,d,t,t+1} = \alpha + \gamma_1 \cdot Exposure_{j,t-1} + \gamma_2 \cdot Exposure_{j,t-1} \times Treated_{j\in d}$$

$$+\gamma_3 \cdot \sum_{k\neq j}^{N_b} Exposure_{k,t-1} + \gamma_4 \cdot \sum_{k\neq j}^{N_b} Exposure_{k,t-1} \times Treated_{j\in d} + \xi_d + \varepsilon_{j,b,d,t,t+1}$$

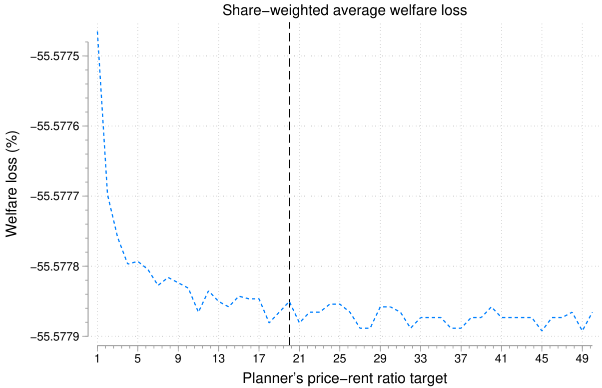
	1st mortgages		2nd+ mortgages	
Outcome:	Δ log(loan \$)	Δ log(# of loans)	Δ log(loan \$)	Δ log(# of loans)
$Exposure_{j,t-1}$	0.043	0.017	−0.052	0.050
	(1.04)	(0.70)	(0.47)	(0.10)
$Exposure_{j,t-1} \times Treated_{j\in d}$	−0.041	−0.017	−0.018	−0.006
	(0.93)	(0.65)	(0.15)	(0.12)
$\sum_{k\neq j}^{N_b} Exposure_{k,t-1}$	0.062	0.074	−0.252	−0.068
	(0.22)	(0.37)	(0.35)	(0.20)
$\sum_{k\neq j}^{N_b} Exposure_{k,t-1} \times Treated_{j\in d}$	−0.015	−0.019	1.000	0.269
	(0.05)	(0.09)	(1.12)	(0.61)
District FEs	✓	✓	✓	✓
N	20,815	20.815	4,272	4,272
R^2	0.003	0.002	0.015	0.014

Note: Column headings indicate which subsample (first mortgages vs. mortgages on a second property) of loans are included in the lending growth outcome measure. $Exposure$ measured using 2nd+ mortgages originated on properties located in regulated areas but in the year prior to the 2014 reform. $Exposure$ rescaled in terms of a 10 p.p. increments. t-stats from standard errors clustered at the branch level in parentheses.

- Collapse data to branch-year level
- Results here use 2nd+ mortgages to construct exposure measures, but also null if use all loans
- ξ_d compare two branches located within same district but which have differential network exposure through peer branches of same parent bank
- Still null effects without the district FEs

Transfer taxes generate large welfare losses

Go back



- Model from Chi, LaPoint, Lin (2023)
  - Investors with heterogeneous beliefs about house prices and rents
  - Government taxes housing sales to bring PR ratio down
  - Idea is that investors are noise traders, so tax moves their beliefs more in line with fundamental value
- **Result: aggregate welfare loss is almost invariant to PR ratio target**
  - Calibrate to 2014-16 transfer tax
  - Loss is roughly 55% of aggregate housing-based consumption