Flip or Flop?
Tobin Taxes in the Real Estate Market

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AFA Meeting: Real Estate & Housing Finance

New Orleans, Louisiana

January 6th, 2023

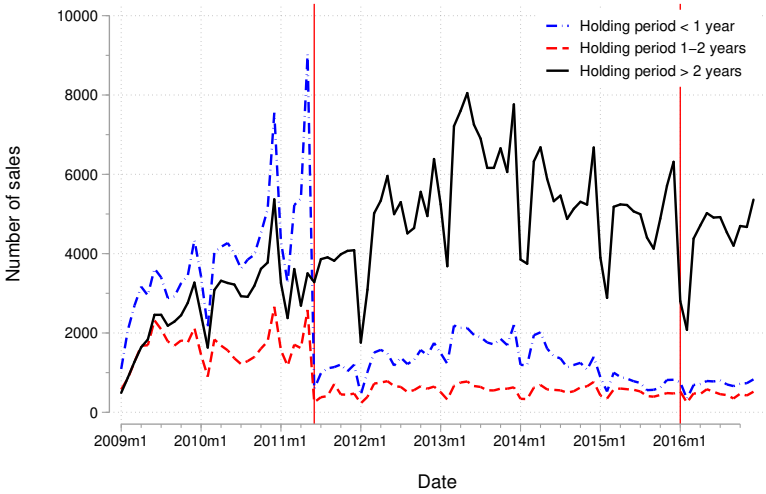
Motivation: taxes and housing affordability

- Rising housing unaffordability in major global RE markets has led to proposals to tax transactions of investment properties
- How to target **speculators** while minimizing efficiency losses?
  - Non-residents/second homes: based on where tax bill gets sent
  - Vacancies: higher rate if vacant $>$ 6 months of tax year
  - Flippers: higher tax rate for short-term sales **(Tobin tax)**
- What are the potential efficiency losses?
  - Policymakers emphasize demand instead of inventory or capital "lock-in" effects
  - Theoretically ambiguous whether prices/volatility go up or down!
- **Price-rent ratio targeting** through transfer taxes $\implies$ **redistribution**

What we do

- **First paper to quantify "optimal" flip tax in the RE market**
  - Extend sufficient statistics formulas derived for financial transaction taxes (FTTs)
  - Add in investors' housing tenure choices, rental risk, search costs, horizon
- Empirical setting: tax surcharge on short-term sales of second homes in Taiwan
  - Flippers pay 15% on sales within 1 year, 10% if within 2 years
- This tax did not work as policymakers intended
  - Overall muted, but $(+)$ effects on quality-adjusted prices (segmentation)
  - Trades prevented at horizons $>$ 2 years, but quantitatively small search costs
- Tobin tax rate $\uparrow \implies P \uparrow$, but $P/r \downarrow$, $\implies$ buying relatively cheaper for marginal renter
  - To achieve a "normal" PR ratio of 20, required flip tax rate is $\approx 4\%$

Our empirical application in one picture



- 90% drop from pre-reform peak in sales within two-year HP
  - **Efficiency costs** of tax
- Second homeowners delay transactions beyond 2 years to avoid tax
  - Sales less likely to be due to **noise traders**

Our contributions

1. **Optimality of transfer taxes targeting speculators**
   - Sufficient statistics: drop in sales volume and *ex ante* noise trading share
   - Administrative data $\implies$ can estimate model-implied regressions to recover optimal taxes on **specific groups** of investors (renters, owner-occupiers, flippers/landlords)

2. **Produce new measures of noise trading**
   - Spatial/time variation in storm severity ($-$) predicts speculative sales volume
   - Idea: persistently bad weather raises fixed cost of selling

3. **Clean setting and comprehensive data to quantify...** Literature
   - Price/quantity effects of targeted tax on property flips
     - ⋆ Tax stays in place for 4 years rather than being constantly tweaked
   - Heterogeneity in **tax-adjusted** holding period returns (net cap gains + net income)

Optimal Real Estate Tobin Tax Framework

Optimal (uniform) Tobin taxes: executive summary

- Policymaker has some notion of which prices are "correct"
- Two ways to think about how to set optimal round-trip transfer tax w/biased beliefs
  1. Beliefs approach: set τ^* to eliminate gap in avg. expected returns between buyers/sellers
  2. Volume **("Pigouvian")** approach: set τ^* to tax away non-fundamental trading
- Under the volume approach optimal tax is non-fundamental share s_{NF} over volume semi-elasticity $\epsilon = d \log V / d\tau$

$$\tau^* \approx \frac{s_{NF}\{\tau = 0\}}{-d \log V / d\tau|_{\tau=0}} \tag{1}$$

- In our case semi-elasticity $= -75\%/15$ p.p. $= -5$ for one-year flips, or $-50\%/10$ p.p $= -5$ for two-year flips
- Hence, a 20% noise trading share $\implies \tau^* = 4\%$ tax on short-term second home flips

Our framework: extend intuition to housing market

- Basic building blocks from Dávila (2022) on financial Tobin taxes:
  - Equilibrium model of heterogeneous investors who differ in risk aversion and beliefs
  - One risk-free asset and one asset in fixed supply w/risky dividend (e.g. equities)
  - Planner cares about pricing efficiency and can only use linear taxes

- **We add the following features to mimic microstructure of housing market:**
  1. Risky asset (housing) carries both price (capital gain) and rental (dividend) risk
  2. Cost H to consuming housing embeds rents/imputed dividends (Sinai & Souleles 2005)
  3. Asset demands X divide investors into renters ($X < 1$), owner-occupiers ($X = 1$), and landlords ($X > 1$)

- Similar math when buyers pay a search cost...we'll come back to this later Jump to

Housing investor's problem

- Investors i start with housing endowment $X_{i,0}$, pay tax τ on trades in period 1, receive stochastic income $Y_{i,2}$, pay housing costs, and consume everything in period 2
- Lifetime consumption budget:

$$C_{i,2} = Y_{i,2} + P_2 \cdot X_{i,1} + \underbrace{P_1 \cdot (X_{i,0} - X_{i,1})}_{\text{realized cap gain}} \underbrace{-\tau \cdot P_1 |\Delta X_{i,1}| + T_{i,1}}_{\text{net tax bill}} - H_{i,2} \tag{2}$$

- Housing costs enter negatively for renters, but positively for landlords with $X_{i,1} > 1$ who earn rental income

$$H_{i,2} = (1 - X_{i,1}) \cdot r_2 \quad \text{with} \quad r_2 \sim_i N(\mu_i^r, (\sigma^r)^2) \tag{3}$$

- We assume $P_1 > 0$ is always positive, and $P_2 \sim_i N(\mu_i^p, (\sigma^p)^2)$

Housing demands by tenure choice

- Assume CARA utility with absolute risk aversion A_i for investor i
- Choose a housing scale $X_{i,1}$ to max exp. utility, which yields a demand system:

$$\Delta X_{i,1}(P_1) = \begin{cases} \Delta X_{i,1}^{+}(P_1) = \frac{(\mu_i^p + \mu_i^r) - A_i\Omega_i - P_1(1+\tau)}{A_i\Omega} - X_{i,0} & \text{if } \Delta X_{i,1}^{+}(P_1) > 0 \text{ (buyers)} \\ 0 \text{ (no trade)} & \text{if } \Delta X_{i,1}^{+}(P_1) \leq 0, \Delta X_{i,1}^{-}(P_1) \geq 0 \\ \Delta X_{i,1}^{-}(P_1) = \frac{(\mu_i^p + \mu_i^r) - A_i\Omega_i - P_1(1-\tau)}{A_i\Omega} - X_{i,0} & \text{if } \Delta X_{i,1}^{-}(P_1) < 0 \text{ (sellers)} \end{cases}$$

- Ω_i and Ω are variance-covariance terms which capture hedging needs

$$\Omega_i = \underbrace{Cov(Y_{i,2}, P_2) + Cov(Y_{i,2}, r_2)}_{\text{fundamental risk}} + \underbrace{Cov(P_2, r_2)}_{\text{affordability risk}} - (\sigma^r)^2 \tag{4}$$

$$\Omega = (\sigma^p)^2 + (\sigma^r)^2 - 2Cov(P_2, r_2) \tag{5}$$

Planner's problem with uniform tax rate τ

- Govt. runs balanced budget (no revenue constraint) $\implies$ lump-sum transfers $T_{i,1}$
- Investor's certainty equivalent from the planner's perspective is given by:

$$\text{CE}_i^p(\tau) = \left[(\mu_p^p + \mu_p^r) - P_1 - \Omega_i\right] \cdot X_{i,1}(\tau) + P_1(\tau) \cdot X_{i,0} - \tfrac{A_i}{2}\Omega \cdot (X_{i,1}(\tau))^2 + \widetilde{T}_{i,1}(\tau) - \mu_p^r \quad (6)$$

Lemma (sufficient statistics for uniform tax)

The optimal tax satisfies: $\tau^* = \text{argmax}_\tau \int CE_i^p(\tau) dF(i)$, which recovers the formula

$$\tau^* \approx \frac{s_{NF}\{\tau = 0\}}{-d \log V\{\tau = 0\}/d\tau}$$

Importantly, this expression does not depend on what the planner considers to be the "correct" set of beliefs $\mu_p^p + \mu_p^r$.

Allowing for group or investor-specific taxes

- Investors self-select into 4 groups based on their housing positions ΔX:

$$\begin{cases} X_{i,1}^{-}(\tau_i') < X_{i,0} \leq 1 & \text{renter-seller (RS) [reference group]} \\ \max\{1, X_{i,1}^{-}(\tau_i')\} < X_{i,0} & \text{landlord-seller (LS) [flippers]} \\ X_{i,0} \leq \max\{1, X_{i,1}^{+}(\tau_i')\} & \text{renter-buyer (RB)} \\ 1 < X_{i,0} < X_{i,1}^{+}(\tau_i') & \text{landlord-buyer (LB)} \end{cases}$$

- Taxes targeting individual investors are increasing in optimism ($\mu_i^p + \mu_i^r$):

$$\tau_i^* = \frac{sgn(\Delta X_{i,1}) \cdot (\mu_i^p + \mu_i^r - \Upsilon)}{P^*} \tag{7}$$

- Market-clearing price P^* satisfies $\int \Delta X_{i,1}(P^*) dF(i) = 0$ Pricing effects
- To calibrate we set $\Upsilon = \mu_p^p + \mu_p^r \implies$ investors own developers who supply housing

Summary of model extensions

1. **Housing search costs: buyers pay a fixed cost c to trade** Jump
   - Penalty term on optimal uniform tax formula $\propto c/P$
   - Intuition: annualized search cost higher for flippers, so lower τ^* needed to tax away noise
2. **Model weather shocks as discrete jump in search costs** Jump
   - Severe weather is a persistent $(-)$ shock to buyer-seller matching
   - Parameterize using TOM and weather station data $\implies$ τ^* is $\approx$ 0.22 p.p. lower
3. **Heterogeneity in investment horizon** Jump
   - Model via heterogeneity in beliefs about *discounted* utility $\mathbb{E}[\beta_i \cdot U_i(C_{i,2})]$
   - Wedge forms between "correct" and incorrect investment horizon
   - Compared to our benchmark model, wedge increases τ^* by 0.6 p.p. (a 15% inc.) Details

Empirical Application: Flip Taxes in Taiwan

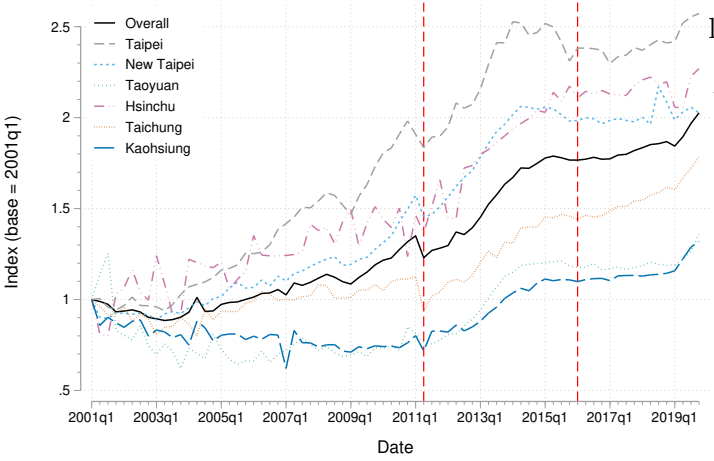
Taiwan's transfer tax experiment

- Govt. worried about rapid price gains in Taipei area in 2008-11 HPI PR ratio Global
  - Announce surcharge on short-term second home flips in January 2011
  - Reasoning: PR ratio in capital area rapidly increased from 20 to 30 in 2 years
  - Implemented June 1, 2011 to December 31, 2015
- Sellers pay tax surcharge rate τ as function of holding period T:

$$\tau = \begin{cases} 15\% & \text{if} \quad T < 1 \\ 10\% & \text{if} \quad 1 \leq T < 2 \\ 0\% & \text{if} \quad T \geq 2 \end{cases} \tag{8}$$

- Only applies to arms-length transactions (housing or commercial)

Small drop ($\approx 7\%$) in HPI around reform date



$$\log P_{i,t}^c = \delta_t^c + \gamma_{\tilde{i}}^c + \beta^{c\prime} \cdot \mathbf{X_{i,t}^c} + \epsilon_{i,t}^c$$

with $P_t^c = \exp(\delta_t^c)$

- Unlike official indexes, ours include short-term, non-realty home sales
- Prices increase faster after reform, as also predicted by our structural model

Details Compare Translog RD

Tax data and transaction records

- Four main datasets from Ministry of Finance (2006-16)
  1. Building property tax records → owner-occupied status, property use, number of houses owned by taxpayer
  2. Deed tax records → buyer/seller identifiers, transaction dates, appraised values
  3. Personal income tax returns → buyer/seller address, rental income, gifts/inheritances
  4. Personal wealth estimates → vehicles, equities, bonds, deposits
- Merge with a newly compiled database of market prices and rents from public records
- Listings data from an anonymous (large) realty firm ⟶ time on market

Transfer process | Other taxes | Example | Wealth details

Bunching: defining a counterfactual

- Goal: compute number of sales prevented by the tax $\longrightarrow \varepsilon$ (denominator)
- Two common approaches in the literature inappropriate here:
  1. Use the distribution by holding period in the pre-reform period Pre-reform dist.
  2. Estimate local polynomial using data in the post-reform period in an "unaffected region" away from the notches
- Problem: tax changes sales composition even far from the notches
  - Delaying a sale today affects sales volume tomorrow, and the next day, etc.
- Solution: compute what the distribution would have looked like, conditional on property amenities in available housing stock
  - Similar to the individual-level covariate correction proposed in Collier, Ellis, Keys (2021)

An hedonic-logit model of flips

- Use pre-reform property characteristics to estimate a logit model for sale probability $f_{i,t}$:

$$f_{i,t} = \text{Pr}\Big(y_{i,t} = 1 | \mathbf{X_{i,t}}, \delta_t, \beta\Big) = \frac{1}{1 + \exp(-\delta_t - \beta' \cdot \mathbf{X_{i,t}})} \tag{9}$$

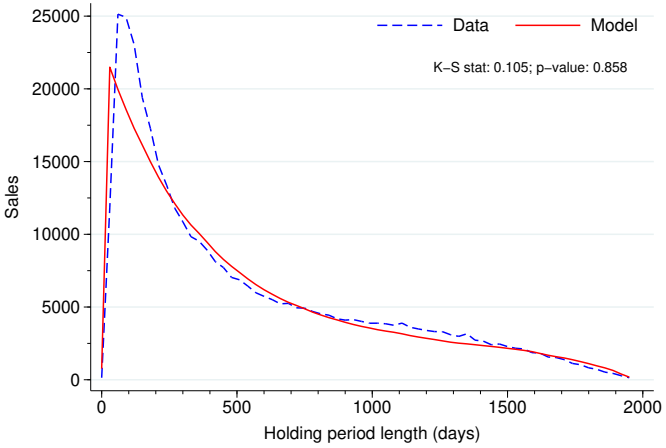
$$y_{i,t} = \mathbb{1}\{\delta_t + \beta' \cdot \mathbf{X_{i,t}} + \epsilon_{i,t} > 0\} \tag{10}$$

- Compute predicted prob. $\widehat{f}$ in post-reform period with $\widehat{\beta}'$ and integrate over properties within holding period bin j

$$\widehat{q}_j = \sum_{i=1}^{N_j} \widehat{f}\Big(\mathbf{X_{i,t}};\ \widehat{\delta}_\mathbf{t}, \widehat{\beta}\Big) \tag{11}$$

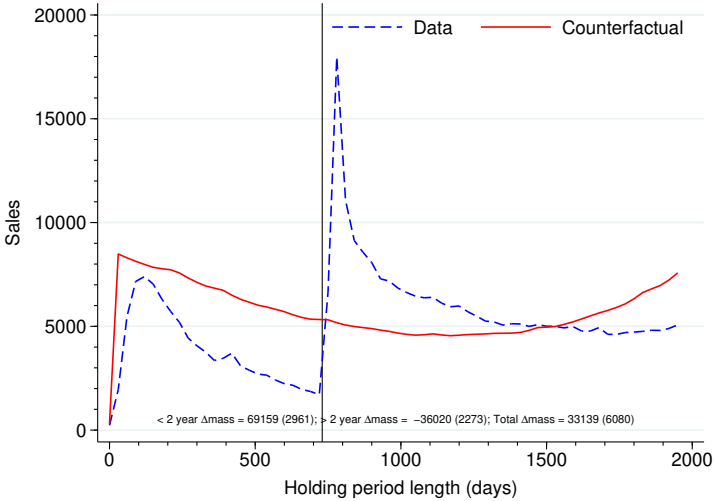
- Identifying assumption: w/o tax reform market would have priced amenities in $\mathbf{X_{i,t}}$ in the same way as in pre-reform period Pre-trends Salience

Check: hedonic-logit fit to pre-reform data



- Underestimate the missing mass at < 1 yr. $\Longrightarrow$ overestimate the optimal tax (upper bound) Cond. prob.
- K-S tests fail to reject the null of no difference between the empirical and model distributions K-S tests
- All models include full set of time FEs, quadratic in property age, structural material dummies, floor space, land area, use type, holding period length, building floor

Market unraveling: ≈ 33,000 total missing sales



- 40% drop in overall second home sales volume but 75% drop in one-year flips
- Missing mass for long holding periods ($> 1{,}500$ days)
- Owners seeking to offload depreciated properties no longer can $\rightarrow$ unraveling

By wealth | OOT | Old properties | TOM

Estimated semi-elasticity of 5 stable across models

	(1)	(2)	(3)	**(4)**	(5)	(6)	(7)
	Full sample	Full sample	Full sample	**Full sample**	Full sample	Age ≥ 5	Age ≥ 10
ϵ_{1-year}	4.8	4.7	4.7	**5.1**	6.3	7.7	6.8
ϵ_{2-year}	4.8	4.7	4.7	**3.7**	6.8	9.2	7.5
$\Delta mass_{<720}$	71411^{***}	70977^{***}	70961^{***}	69159^{***}	85762^{***}	69407^{***}	57087^{***}
	(3196)	(2870)	(2880)	(2962)	(2892)	(2369)	(2111)
$\Delta mass_{\geq 720}$	-28488^{***}	-28568^{***}	-28592^{***}	-36020^{***}	-25888^{***}	-12946^{***}	-16091^{***}
	(5714)	(5314)	(5317)	(5403)	(4240)	(4201)	(3140)
$\Delta mass_{<365}$	31156^{***}	30855^{***}	30827^{***}	33546^{***}	41455^{***}	35966^{***}	29088^{***}
	(2384)	(2134)	(2136)	(2273)	(1754)	(1626)	(1469)
Property controls	✓	✓	✓	✓	✓	✓	✓
NW^B, NW^S		✓					
HNW^B, HNW^S			✓				
Material, Use, Time FEs				✓	✓	✓	✓
Realty dummy					✓		
N	12,163,977	12,163,977	12,163,977	12,163,977	11,939,191	8,281,861	7,171,456

- Source of unraveling > 2 years: volume of older properties more sensitive to the tax

Who are the noise traders here?

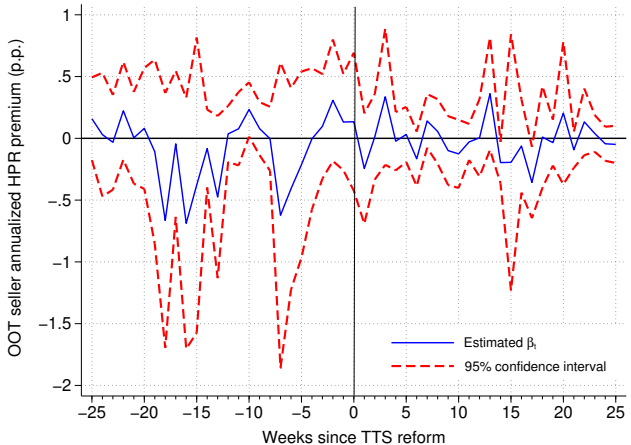
- Literature: non-residents earn lower (gross) capital gains
  - Non-residents often used as a synonym for "misinformed" speculators (Chinco & Mayer 2016) or bad bargainers (Cvijanović & Spaenjers 2021)
- *But are speculators always noise traders?*
- We compute total tax-adjusted holding period returns and show... Details
  1. No evidence of pre-reform local premium when selling to OOT buyers
  2. Annualized HPRs decline linearly with wealth
  3. Sellers of mortgaged properties earn similar capital gains
  4. Stock market participants earn lower returns
  5. Term structure of realized returns is downward sloping, and tax flattens the curve

Fact #1 Fact #2 Fact #3 Fact #4 Fact #5

No local seller premium in realized cap gains

DDD Robust

$$r_{i,j,t} = \sum^{T} \beta_t \cdot OOT\_seller_{i,j,t} + \eta_i + \delta_t + \gamma' \cdot \mathbf{X_{j,t}} + \epsilon_{i,j,t}$$



- Repeat investor (η_i) event study $\implies$ OOT sellers do not have more/less biased beliefs

Our measure of noise trading $\longrightarrow$ severe rain shocks

- **Idea: severe storm season raises cost of listing and selling properties**
  - Fundamental traders: people who persist with sale due to family/work commitments even when weather limits outdoor activity
  - Inspired by literature on weather effects on economic activity (Dell, Jones, Olken 2014)

- Season runs from July to September, but severe storms also possible in June and October
  - On average, Taiwan experiences 5 typhoons per year, with 2 making direct landfall
  - Classification relies on wind speed $\geq$ 118 km/h (74 mph) $\implies$ typhoon Classification
  - Accompanied by low air pressure and significant rainfall Tracking Cyclicality

- We find volume declines by 15-20% during severe storm seasons, with little evidence of pent-up demand in the following months

Heavy rain reduces aggregate sales volume

$$Volume_t = \beta \cdot (Weather_t \times Summer_t) + \delta_t + \gamma' \cdot \mathbf{X_t} + \varepsilon_t$$

	(1)	(2)	(3)	(4)	(5)	(6)
Max WS $\times Summer$	-2.27^{**}		-1.16			
Rainfall $\times Summer$		-0.32^{***}	-0.26^{***}	-0.31^{***}		-0.24^{***}
$\mathbb{1}\{T > 32°C\}$				5.14		
$\mathbb{1}\{27 < T \leq 32°C\}$				1.51		
$\mathbb{1}\{\text{Max WS} \geq 74\text{mph}\}$					-65.98^{***}	-27.49^{**}
$\mathbb{1}\{55 \leq \text{Max WS} < 74\text{mph}\}$					-10.88^{**}	-9.18
7-day FEs	✓	✓	✓	✓	✓	✓
Day-of-week FEs	✓	✓	✓	✓	✓	✓
Damages controls	✓	✓	✓	✓	✓	✓
N	1,973	1,973	1,973	1,973	1,973	1,973

- Tropical storm-level rainfall shock $\implies$ 20% drop in sales volume Data County DDD
- Consistent with other papers: people don't like to do things in the rain! Factor analysis

Volume does not bounce back after rain subsides

$$Volume_t = \beta_1 \cdot (Rain_t \times Summer_t) + \beta_2 \cdot (\overline{Rain}_{t-L,t-1} \times Summer_t) + \delta_t + \gamma' \cdot \mathbf{X_t} + \varepsilon_t$$

	(1)	(2)	(3)	(4)
$Rain_t \times Summer_t$	-0.33^{***}	-0.33^{***}	-0.32^{***}	-0.32^{***}
$\overline{Rain}_{t-1w,t-1} \times Summer_t$	-0.57			
$\overline{Rain}_{t-2w,t-1} \times Summer_t$		-0.30		
$\overline{Rain}_{t-4w,t-1} \times Summer_t$			0.47	
$\overline{Rain}_{t-8w,t-1} \times Summer_t$				0.83
7-day FEs	✓	✓	✓	✓
Day-of-week FEs	✓	✓	✓	✓
Damages controls	✓	✓	✓	✓
N	1,973	1,973	1,973	1973

- Also, no pent-up demand even if very long and severe typhoon season

Event studies Severe

Sanity check: storms lower share of other noise tags

Rain Shocks and Noise Trading Shares

	M1	M2	M3	All
Overall	0.91	0.79	0.42	0.33
$<$ 1 s.d. rain	0.91	0.79	0.42	0.33
$\geq$ 1 s.d. rain	0.95	0.78	0.38	0.30
Difference	0.04^{***}	-0.01	$\mathbf{-0.04}^{***}$	$\mathbf{-0.03}^{***}$
$<$ 2 s.d. rain	0.91	0.79	0.42	0.33
$\geq$ 2 s.d. rain	0.99	0.76	0.23	0.18
Difference	0.08^{***}	-0.03^{**}	$\mathbf{-0.19}^{***}$	$\mathbf{-0.15}^{***}$

Note: 1 s.d. above avg. rainfall = 12 mm (0.47 in); 2 s.d. above avg. rainfall = 15 mm (0.59 in). A 2 s.d. rain shock corresponds to avg. rainfall during a tropical storm event.

- Problem: severe weather frictions also reduce non-noisy trading
  - Formally model this bias to τ^* via search costs and find that it is small
- Other common tags for noise:
  1. M1: sales involving OOT investors (buyer or seller)
  2. M2: sales where no employment or marital status change within one-year window
  3. M3: flips with holding period $<$ 1 year (as targeted by tax)
  4. All: M1 + M2 + M3 == 1

Optimal Tax Calibration Exercises

Sufficient statistics $\Longrightarrow$ uniform tax rate of 4%-5%

- Recall our sufficient statistics formula of $\tau^* = -s_{NF}\{\tau = 0\}/\epsilon$
  - Semi-elasticity (ϵ) estimates from bunching design range from 4.8 – 5.1 for one-year flips, or 3.7 – 4.8 including two-year flips Robustness
  - Noise trading estimates fall between 15% – 20% from the weather design

- **Putting these two pieces together yields** $4\% \leq \tau^* \leq 5\%$
  - Upper bound: logit model under-fits the pre-reform data, and weather shocks related to both non-fundamental trading and search costs
  - Using the revised sufficient statistics formula with c/P search costs leads to at most a 0.22 p.p. reduction in τ^* Details
  - This range of τ is at high-end of flat transfer rates in place in global markets

Calibrating investor-specific taxes

- In practice, govt. sets different tax rates for homeowners vs. renters and buyers vs. sellers
- Model admits regression relating housing demand and hedging needs to movements in the tax bill $P_t \cdot \tau_{i,t}$:

$$\widehat{\Omega} \cdot X_{i,t} + \widehat{\Omega}_i = \alpha_i \cdot P_t \times (1 + \mathcal{D}_{i,t} \cdot \tau_{i,t}) + e_{i,t} \tag{12}$$

$$\text{where} \quad \mathcal{D}_{i,t} = \begin{cases} -1 & \text{if } X_{i,t} < X_{i,t-1} \quad \text{(sellers)} \\ 1 & \text{if } X_{i,t} > X_{i,t-1} \quad \text{(buyers)} \end{cases}$$

- $\widehat{\Omega}$ and $\widehat{\Omega}_i$ are the empirical variance-covariance terms from our administrative tax data covering histories of incomes, prices, and rents
- Use time-variation in $\tau_{g,t}$ to estimate the regression for each of the 4 groups $g \in \{RS, LS, RB, LB\}$ to obtain vector of fixed effects $\widehat{\alpha}_i$ Step-by-step

Policy rule: price-rent ratio targeting

- For optimal uniform tax, sufficient statistics formula applies regardless of planner's belief
  - Intuition: conditional on a belief, choose tax which sets non-fundamental component of volume equal to tax-induced volume reduction
- Does not apply to investor-specific taxes, so need to take stance on planner's beliefs on "correct" prices μ_p^p and rental rates μ_p^r
  - Types differ by how much they deviate from "correct" beliefs, so can't use avg. cost pricing
- Calibration: planner targets a particular **price-rent ratio** to achieve affordability
  - Baseline: consider $\mathbb{E}[P/r] = 20$ rule, or roughly where Taipei market was before boom
  - To target lower P/r need higher τ_{LS}^* which creates larger liquidity crunch $\implies P \uparrow$
  - Marginal renter better off when $\tau_{LS} \uparrow$, owning becomes relatively cheaper $\implies$ wealth $\uparrow$

Empirical PR Buy-to-rent

Optimal tax/subsidy rates and redistribution

Complete plots

P/r **target** $=$	10	15	20	25	30	35	40
τ^*_{LS} (flip tax)	7.20%	5.73%	**4.97%**	4.52%	4.21%	3.99%	3.82%
τ^*_{LB}	-3.63%	-2.10%	-1.32%	-0.84%	-0.52%	-0.29%	-0.12%
τ^*_{RB}	0.69%	2.29%	3.10%	3.60%	3.94%	4.17%	4.36%
$\sum_g s_g \cdot \tau^*_g$	6.06%	4.93%	4.35%	4.00%	3.76%	3.59%	3.46%
$\%(\mathcal{W}^*_{LS} - \mathcal{W}_{LS})/W_{LS}$	-64.61%	-64.61%	-64.61%	-64.61%	-64.61%	-64.61%	-64.61%
$\%(\mathcal{W}^*_{LB} - \mathcal{W}_{LB})/W_{LB}$	-11.45%	-11.45%	-11.45%	-11.45%	-11.45%	-11.45%	-11.45%
$\%(\mathcal{W}^*_{RB} - \mathcal{W}_{RB})/W_{RB}$	66.43%	66.43%	66.43%	66.43%	66.43%	66.43%	66.43%
$\sum_g s_g \cdot \%\Delta\mathcal{W}_g$	-55.58%	-55.58%	-55.58%	-55.58%	-55.58%	-55.58%	-55.58%
$\%(\widehat{P} - P)/P$	13.12%	11.35%	**10.47%**	9.94%	9.59%	9.33%	9.14%

- Optimal taxation $\Longrightarrow$ large redistribution from flippers to marginal renters
- $\%\Delta\mathcal{W}$ (almost) constant b/c prices and tax rates have offsetting effects
- Optimal taxation $\Longrightarrow$ higher prices $\widehat{P}$ relative to pre-reform actual level P

Conclusion

- **We introduce new framework to estimate optimal Tobin taxes on housing**
  - Derive sufficient statistics formula w/tenure choice, rental risk, search costs, horizon
  - Estimate investor-specific corrective tax rates $\implies$ big $\Delta\mathcal{W} > 0$ for marginal renter
- **We apply the model to the Taiwan RE market and show...**
  - Targeting flips reduces volume, but no overall drop in quality-adjusted prices/volatility
  - Model-predicted $dP/d\tau_{LS} > 0$, but $\mathbb{E}[P/r] \downarrow \implies$ substitution effects
  - Tax makes RE even less liquid via TOM $\uparrow$ (unraveling)
  - Govt. taxed too much! ($\tau^*_{LS} =$ 4%-7% vs. $\tau_{LS} =$ 10%-15%)
- **Related work in progress**
  - Macroprudential considerations: can we tax away leverage?
  - Alternative policy instruments such as loan-to-value (LTV) limits

THANK YOU!

Appendix

Related work

Main deck

- Speculators in the housing market
  - OOT shock: Chinco & Mayer (2016); Badarinza & Ramadorai (2018); Cvijanović & Spaenjers (2021); Bayer et al. (2020); Favilukis & Van Nieuwerburgh (2021)
  - Tax policy: Dachis, Duranton, Turner (2012); Besley, Meads, Surico (2014); Kopczuk & Munroe (2015); Suher (2016); Slemrod et al. (2017); Best & Kleven (2018); Deng, Tu, Zhang (2019); Gorback & Keys (2020); Agarwal et al. (2021); Han, Ngai, Sheedy (2022)
- Financial transaction taxes (FTTs) and excess volatility
  - Empirics: Umlauf (1993); Jones & Seguin (1997), Hau (2006); Foucault, Sraer, Thesmar (2011); Colliard & Hoffmann (2017); Deng, Liu, Wei (2018); Cai et al. (2021)
  - Theory: Tobin (1978); Kupiec (1996); Scheinkman & Xiong (2003); Vives (2017); Dávila (2022); DeFusco, Nathanson, Zwick (2022); Biais & Rochet (2022)
- Weather shocks to economic activity
  - Hirshleifer & Shumway (2003); Goetzmann & Zhu (2005); Goetzmann et al. (2014); Dell, Jones, Olken (2014); Cortés, Duchin, Sosyura (2016); Cho (2021)

Pricing effects in the model

Main deck

- Sign of $dP/d\tau$ is *ex ante* ambiguous in the model
- Implicit equilibrium pricing function:

$$P_1 = \frac{\int_{i \in \mathcal{T}(P_1)} \left(\frac{(\mu_i^p + \mu_i^r)}{a_i} - A\left(\Omega_i + \Omega X_{0i}\right) \right) dF(i)}{1 + \tau \cdot \left(\int_{i \in \mathcal{B}(P_1)} \frac{1}{a_i} dF(i) - \int_{i \in \mathcal{S}(P_1)} \frac{1}{a_i} dF(i) \right)} \tag{13}$$

$$\text{where } A \equiv \left(\int_{i \in \mathcal{T}(P_1)} A_i^{-1} dF(i) \right)^{-1} \quad \text{and } a_i = A_i / A \tag{14}$$

- Prices are inc. in expected payoff $\mu_i^p + \mu_i^r$ and dec. in rental risk premium
- $dP_1/d\tau > 0$ if $\int_{i \in B(P_1^*)} \frac{1}{a_i} dF(i) \leq \int_{i \in S(P_1^*)} \frac{1}{a_i} dF(i)$, or tax hike reduces owners' willingness to sell to such an extent that inventory goes down

Details: sufficient statistics formula w/search costs (1)

- Keep the basic setup the same except now impose a proportional search cost c_1 paid by buyers in period 1, so lifetime consumption is:

$$C_{i,2} = Y_{i,2} + P_2 \cdot X_{i,1} + P_1 \cdot (X_{i,0} - X_{i,1}) - \tau \cdot P_1 |\Delta X_{i,1}| + T_{i,1}$$
$$- c_1 \cdot (X_{i,1} - X_{i,0}) \times \mathbb{1}\{X_{i,1} > X_{i,0}\} - H_{i,2} \tag{15}$$

- Make **symmetry** assumption: traders have identical risk preferences $A_i = A$ and symmetric distribution of beliefs, hedging needs, and initial endowments

- Then the new equilibrium price $P = P^* - c_1/2$, with P^* the price without search frictions

- Introduce persistent shock to housing search costs (e.g. storms, or iBuyers):

$$c_t = z_t \cdot w_t \quad \text{and} \quad z_t \sim_i N(\mu_i^z, (\sigma^z)^2) \tag{16}$$

$$w_t = \phi \cdot w_{t-1} + \varepsilon_t^w \tag{17}$$

Go back Weather

Details: sufficient statistics formula w/search costs (2)

- Decomposition of trading volume into four components:

$$P_1 V(\tau) = \underbrace{\Theta_F(\tau)}_{\text{fundamental}} + \underbrace{\Theta_{NF}(\tau)}_{\text{non-fundamental}} - \underbrace{\Theta_\tau(\tau)}_{\text{reduction due to tax}} - \underbrace{\Theta_{WS}(\tau)}_{\text{reduction due to weather}} \tag{18}$$

- Symmetry + Gaussian trading motives $\implies$ changes to V due to ε_1^w do not operate through changes in fundamental volume $\Theta_F(\tau)$, which leads to the lemma:

Lemma (sufficient statistics with search costs)

The optimal tax satisfies: $\tau^* = \text{argmax}_\tau \int CE_i^p(\tau) dF(i)$, which recovers the formula

$$\tau^* \approx \frac{s_{NF}\{\tau = 0\}}{-d \log V\{\tau = 0\}/d\tau} - \frac{1}{2}\frac{c_1}{P_1}$$

This does not depend on what the planner considers to be the "correct" set of beliefs.

Go back Weather

Details: optimal tax estimates w/weather shocks

- We estimate regressions of the form: $Volume_t = \beta \cdot Weather_t + \delta_t + \varepsilon_t^w \rightarrow \widehat{\beta}$, where $Weather_t$ is a typhoon shock
- We can show that $\frac{\partial V}{\partial \varepsilon_1^w} = s_{NF}(\varepsilon_1^w) - \underbrace{s_{WS}(\varepsilon_1^w = 1)}_{\propto c_1/p_1}$
- We estimate the cost c in days by running: $TOM_t = \gamma \cdot Weather_t + \delta_t + \varepsilon_t^w$, where TOM is time on market from listings data in pre-reform period
  - The highest $\widehat{\gamma}$ we estimate is 21 days (3 week delay)
  - Translates to an opportunity cost in lost wages of roughly 0.36% of median home sale price
- Therefore, using the revised sufficient statistics formula, the optimal uniform τ^* is only $(0.36/2)/\epsilon + 0.36/2 = \mathbf{0.216}$ **p.p. lower** for $\epsilon = 5$

Go back Weather

Details: adding in discount rate heterogeneity (1)

Main deck

- Same model primitives except now discounting in expected utility: $\mathbb{E}[\beta_i \cdot U_i(C_{i,2})]$
  - Assume $\ln(\beta_i) \sim \mathcal{N}\left(\mu_i^\beta, (\sigma_i^\beta)^2\right) \implies$ discounted utility also log-normal
  - In practice, discount rate uncertainty is pervasive (Bessembinder & Décaire 2021)

- Assume discount rates and expected consumption are correlated according to

$$\rho_i^{\beta,C} = \frac{\phi_i}{2} \cdot \frac{\sigma_i^C}{\sigma_i^\beta} \qquad \text{where } A_i \cdot C_{i,2} \sim \mathcal{N}\left(\mu_i^C, (\sigma_i^C)^2\right) \tag{19}$$

- Can then rewrite original demand functions replacing A_i with $\widetilde{A}_i = \phi_i \cdot A_i$
  - Intuition: $\phi_i \uparrow \implies$ lower discounted MU in future period $\implies$ lower demand for properties today to eat more future profits
  - In standard dynamic model, property demand governed by the SDF $\mathbb{E}[\beta_i \cdot U_i'(C_{i,2})]/U_i'(C_{i,1})$

Details: adding in discount rate heterogeneity (2)

Main deck

- Optimal tax rate τ^* maximizes the aggregate certainty equivalent $\int_{i \in T(\tau)} \frac{dCE_i^p}{d\tau} dF(i) = 0$

- We can decompose the certainty equivalent into the standard biased-beliefs term, plus a new wedge due to discount rate uncertainty

$$\frac{dCE_i^p}{d\tau} = \Bigg[\underbrace{\left(\mu_p^p + \mu_p^r\right) - \left(\mu_i^p + \mu_i^r\right)}_{\text{Wedge of beliefs on returns}} + sgn\left(\Delta X_{1i}(\tau)\right) \cdot P_1(\tau) \cdot \tau$$

$$- \underbrace{\left(1 - \frac{\phi_p}{\phi_i}\right) P_1(\tau)}_{\text{Wedge of beliefs on discount rates}} \Bigg] \cdot \frac{dX_{1i}(\tau)}{d\tau} - \underbrace{\Delta X_{1i}(\tau) \frac{dP_1(\tau)}{d\tau} + \frac{d\tilde{T}_{1i}(\tau)}{d\tau}}_{\text{Distributive externality}}$$

- Sufficient statistics formula now does not apply b/c planner's belief on correlation between β and C matters for optimal tax rate

Details: adding in discount rate heterogeneity (3)

Main deck

Lemma (optimal uniform tax with discount heterogeneity)

1. The optimal tax equals the gap between weighted average buyer and seller returns:

$$\tau^* = \frac{\mathcal{R}_{\mathcal{B}(\tau^*)} - \mathcal{R}_{\mathcal{S}(\tau^*)}}{2}$$

with $\mathrm{R}_{\mathcal{B}(\tau)} = \int_{i\in\mathcal{B}(\tau)} \omega_i^{\mathcal{B}}(\tau) \left(\frac{\mu_i^p + \mu_i^r}{P_1} + \frac{\phi_i - \phi_p}{\phi_p} \right) dF(i)$ and $\omega_i^{\mathcal{B}}(\tau) \equiv \frac{\frac{dX_{1i}(\tau)}{d\tau}}{\int_{i\in\mathcal{B}(\tau)} \frac{dX_{1i}(\tau)}{d\tau} dF(i)}$

with an analogous definition for sellers $i \in \mathcal{S}(\tau)$

2. In the special case where biased beliefs on prices/rents are identical across agents and $\sigma^\beta \to 0$ (i.e. little discount rate uncertainty), the optimal tax reduces to:

$$\tau^* = \frac{\int_{i\in\mathcal{B}(\tau^*)} w_i^{\mathcal{B}} \frac{\phi_i}{\phi_p} dF(i) - \int_{i\in\mathcal{S}(\tau^*)} w_i^{\mathcal{S}} \frac{\phi_i}{\phi_p} dF(i)}{2}$$

Step-by-step group-specific tax calibration (1)

Main deck

i. Compute the variance-covariance terms $\widehat{\Omega}$ and $\widehat{\Omega}_i$ using gross taxable income (from the tax returns), and index levels of home prices and rents

ii. Determine actual tax rates faced by each investor on sales before the transfer tax reform – this includes stamp duty, land value increment, and local house transfer income taxes

iii. Estimate the model-implied regression using the investor-specific rates τ_i from the previous step and the index levels P_t:

$$\widehat{\Omega} \cdot X_{i,t} + \widehat{\Omega}_i = \alpha_i \cdot P_t \times (1 + \mathcal{D}_{i,t} \cdot \tau_{i,t}) + e_{i,t}$$

iv. Recover the investor fixed effects $\widehat{\alpha}_i$ from the above regression and set the free parameter $\Upsilon = \mu_p^p + \mu_p^r$, where μ_p^r is set to retain a price-rent ratio target

Step-by-step group-specific tax calibration (2)

Main deck

- (V) Back out an estimate for the market-clearing price $\widehat{P}$ under the optimal tax regime by rearranging the expression:

$$\sum_i \Delta \widehat{X}_i = \sum_i \Delta \left\{ \frac{-\widehat{A}_i \cdot \widehat{\Omega}_i - \widehat{P} + \Upsilon}{\widehat{A}_i \cdot \widehat{\Omega}} \right\} = 0$$

- (VI) We plug $\widehat{P}, \widehat{A}_i, \widehat{\Omega}, \widehat{\Omega}_i$ into the demand system to retrieve counterfactual housing demand $X_i(\tau_i^*)$ under the optimal tax rates τ_i^* for each investor:

$$X_{i,1}(\tau_i^*) = \frac{-A_i \cdot \Omega_i - P^* + \Upsilon}{A_i \cdot \Omega}$$

- (VII) Sort investors into groups $g \in \{RS, LS, RB, LB\}$ based on their housing positions $X_i(\tau_i^*) - X_{i,0}$, where $X_{i,0}$ is housing held at the beginning of the sample

- (VIII) Separately run the model-implied regression for each group g, recover group-specific fixed effects $\widehat{\alpha}_g$, and then plug back into optimal tax formula to obtain τ_g^*

How important is discount rate heterogeneity?

Main deck

- Quantitative result à la Atkinson-Stiglitz: if goal is to improve pricing efficiency, disagreement over discount rate *almost irrelevant*
  - i.e. investors with shorter holding period lengths do not create a large pricing externality beyond that generated by noise traders

- **Decompose** how much of optimal uniform τ^* is due to incorrect pricing vs. discounting:
  - Note: for both versions of model, optimal tax is always $\tau^* = \frac{\mathcal{R}_{B(\tau^*)} - \mathcal{R}_{S(\tau^*)}}{2}$
  - Empirically compute gap in exp. returns for buyers and sellers $\implies \tau^* = 4.50\%$
    - ★ For sellers, this is just the avg. realized post-tax annualized HPR $\longrightarrow$ 4.54%
    - ★ For buyers we take $\frac{1}{|\mathcal{B}|}\int_{i\in B(\tau)}\int_h \widetilde{r}_h^i dG(h)di$, where $G(h)$ is the empirical pdf of yield, and $\widetilde{r}_h^i$ is a residualized yield at holding period length h $\longrightarrow$ 13.53%
  - Compare to $\tau^* = 3.90\%$ from our calibrated baseline model without discount heterogeneity
  - $\implies$ incorrect pricing beliefs account for 3.90/4.50 $\approx$ 87% of optimal tax rate

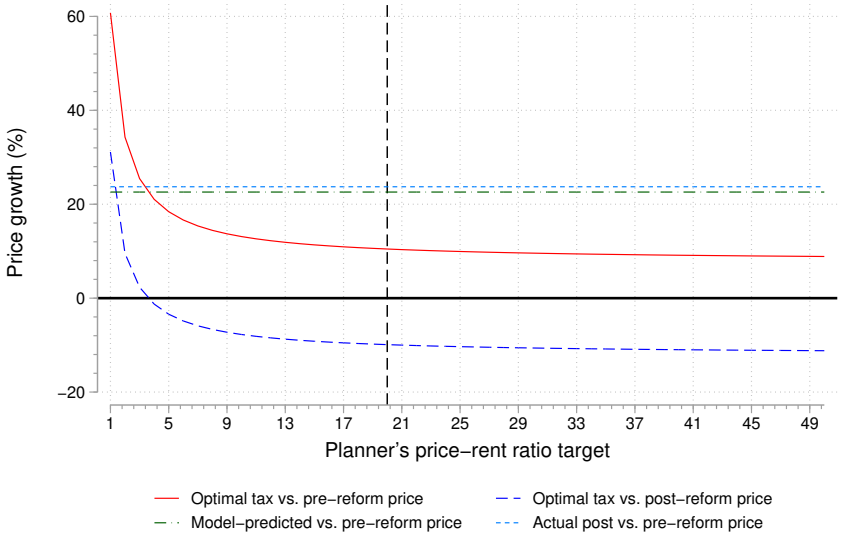
Sensitivity analysis: optimal uniform Tobin tax

Main deck

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Property sample:	Full	Full	Full	Full	Full	Age ≥ 5	Age ≥ 10
$\Delta mass_{<720}$	71411^{***}	70977^{***}	70961^{***}	69159^{***}	85762^{***}	69407^{***}	57087^{***}
$\Delta mass_{\geq 720}$	-28488^{***}	-28568^{***}	-28592^{***}	-36020^{***}	-25888^{***}	-12946^{***}	-16091^{***}
$\Delta mass_{<365}$	31156^{***}	30855^{***}	30827^{***}	33546^{***}	41455^{***}	35966^{***}	29088^{***}
ϵ_{1-year}	4.8	4.7	4.7	5.1	6.3	7.7	6.8
ϵ_{2-year}	4.8	4.7	4.7	3.7	6.8	9.2	7.5
τ^*_{1-year}	4.2%	4.3%	4.3%	3.9%	3.2%	2.6%	2.9%
τ^*_{2-year}	4.2%	4.3%	4.3%	5.4%	2.9%	2.2%	2.7%
Property controls	✓	✓	✓	✓	✓	✓	✓
Buyer/seller wealth		✓					
Buyer/seller housing wealth			✓				
Realty dummy					✓		
Material FEs				✓	✓	✓	✓
Property use FEs				✓	✓	✓	✓
Time FEs				✓	✓	✓	✓
N	12,163,977	12,163,977	12,163,977	12,163,977	11,939,191	8,281,861	7,171,456

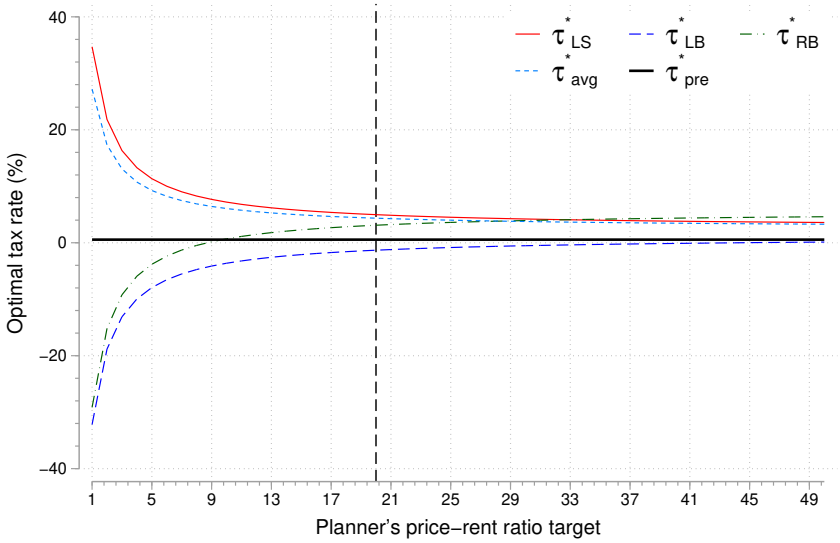
Price level convex + decreasing in PR ratio target

Main deck



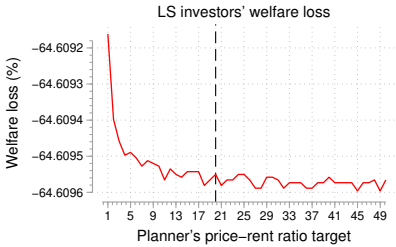
Optimal flip tax (τ^*_{LS}) decreasing in PR ratio target

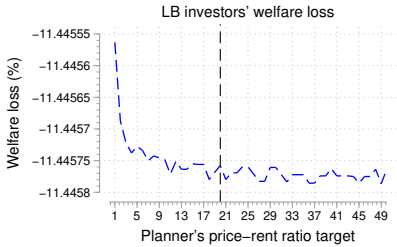
Main deck

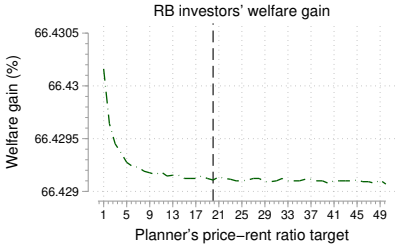


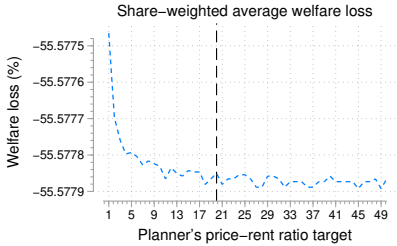
Welfare losses vary minimally with PR ratio target

Main deck









Property transfer taxes in global context

- We collect tax parameters for top markets by investable RE stock Main deck
- Patterns in transfer tax regimes:
  - High tax rates (>3%) and holding period notches fairly rare
  - 19 out of the top 25 impose a flat tax $\Longrightarrow$ rate does not rise progressively with sale price (only 3 have no tax)
  - Legal incidence: about half impose on buyer, other half on seller
  - Rarely have a separate capital gains tax for RE
- Typical exemptions: inheritances/gifts (separate tax), refinancing, collateral, divorce, court orders

Taxes in the top 10 RE cities + 4 Asian Tigers

	RE stock value	Transfer tax	Capital gains tax	Rate	Holding period notch	Incidence
Taiwan	**254**	✓	✓	**10-15% (flat)**	**✓(both)**	**Seller**
Hong Kong	197	✓	×	1.5-20% (progressive)	✓(buyer surcharge)	Seller & buyer surcharge
Singapore	217	✓	×	0.33-16% (progressive)	✓(seller stamp tax)	Buyer & seller (separate rates)
South Korea	758	✓	×	4.6% (flat)	×	Buyer
Tokyo	711	✓	✓	3% (flat)	✓(CGT)	Buyer
New York	657	✓	×	1-2.625% (flat)	×	Seller
Los Angeles	482	✓	×	0.45% (flat)	×	Seller
Paris	342	✓	×	0.71-6.41% (flat)	×	Seller
London	334	✓	✓	2-12% (progressive)	×	Buyer
San Francisco	307	✓	×	0.5-2.5% (flat)	×	Buyer
Chicago	300	✓	×	1.05% (flat)	×	70-30 buyer-seller
Seoul	291	✓	×	0.02-5% (flat)	×	Buyer
Osaka	288	✓	✓	3% (flat)	✓(CGT)	Buyer
Houston	255	×	×	–	–	–

Note: RE stock value in billions of USD. Progressive means rates rise with sale price.

Main deck

Estimating investable RE stock

- We use a rule of thumb applied in CRE investment firms to estimate and rank markets by the aggregate size of investable real estate: Main deck

$$\text{Investable RE stock} = 0.45 \cdot \text{GDP} \times \left[\left(\frac{\text{per capita GDP}}{27,800 \text{ USD}} \right)^{\alpha} \right]$$

- Based on observation that discontinuity in country-level RE investment flows occurs around 27,800 per capita GDP
  - Relationship is actually stronger at city-level for CBDs
  - Key assumption: long-run share of RE in aggregate physical capital stock is about 1/3

- Estimate for Taiwan: $0.45 * 586,104,000,000 \times (24,828/27,806)^{1/3} \approx$ \$253,973 million

- Compared to the investment flow of \$111,425 million of all properties transacted in 2017

Details: how to transfer property ownership

1. Buyer signs contract, pays 0.1% stamp duty tax, and a 5-10% contract fee (1 to 3 days)
2. Seller files transaction tax return and waits for bill (7 to 21 days)
3. Seller pays transaction and CG taxes, and any outstanding bills – must be paid within 30 days after signing the contract
4. Sellers files ownership transfer and pays stamp duty tax remitted to them by the buyer plus 0.1% flat fee (3 to 5 days)
5. Buyer pays remaining balance on property and completes transfer

- We estimate finalizing a transfer takes 38 days at maximum
- Realty companies estimate average time on market of 90-115 days in the top six cities

Main deck

Pre-existing property tax bases

- In addition to the surcharge on short-term flips, transfers subject to four other taxes:
  1. Deed tax: buyers pay 6% of triennial appraisal value
  2. Stamp duty tax: buyers pay 0.1% of appraised building value and annually assessed current land value
  3. Land value increment tax: second home sellers pay flat-rate tax on current land value which declines with holding period (20% to 40% rates)
  4. House transfer income tax: sellers pay a tax sale price which depends on a local scale factor (0.08 to 0.37) and personal income tax bracket
- In practice, for typical single-family home in Taipei, surcharge doubled the seller's total transfer tax bill

Main deck

Calculating tax bills: a simple example

- Mr. Lee sells his 125 m^2 second home in Taipei for 65 million NTD ($\approx$ 2.2 million USD) while the transfer tax surcharge is in effect
- 1.5 years ago Mr. Lee paid 170,000 NTD per m^2 and the current land value (CLV) is 200,000 NTD per m^2
- Land value increment tax: for holding period $<$ 20 years, 20% tax rate on CLV less deductions for inflation and renovations $\approx$ 700,000 NTD
- House transfer income tax: Mr. Lee is in the top income tax bracket, so (0.4 $\times$ 0.37) on 33.6 million NTD assessment $\approx$ 5 million NTD
- Transfer tax surcharge: 10% of 65 million NTD = 6.5 million NTD $\implies$ the total tax bill increases from 8.7% of the sale price to 18.7%

Main deck

Details: personal wealth estimates

- Wealth is the sum of all tangible (land + buildings + vehicles) and financial assets (cash + deposits + bonds + equities) Main deck

1. Real estate: separate procedure for land/building
   - ⋆ Building appraisal values from property tax base, inflated up to market value using our indices
   - ⋆ Declared land value inflated up to market value using ratio of announced land value to transaction price reported by Local Land Office
2. Vehicles: MSRP for vehicle make/model from DMV registration, less accumulated depreciation (linear)
3. Savings/deposits: personal interest income $r \cdot s$ where r is aggregate interest income divided by deposits with all banks from the CB
4. Bond holdings: personal interest income on ST bonds + public debt + corporate bonds + bank debentures divided by avg. nominal rate across all bonds in TEJ Database
5. Equities: OTC stocks at face value, and publicly-traded stocks at closing price of annual ex-right date (July 31st if no dividends)

Constructing the matching estimator index

- Index comes from a hybrid repeat-sales/hedonic valuation model

$$\log P_{i,t}^{c} = \delta_{t}^{c} + \gamma_{i}^{c} + \beta^{c\prime} \cdot \mathbf{X_{i,t}^{c}} + \epsilon_{i,t}^{c} \tag{20}$$

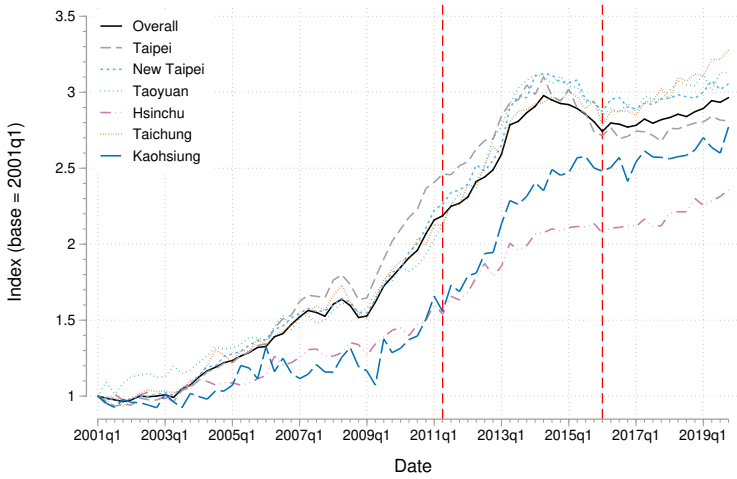
$$P_{t}^{c} = \exp(\delta_{t}^{c}) \tag{21}$$

- Idea: limit the selection problem in repeat sales by defining γ_{i}^{c} as an "almost" repeat sale and use $\mathbf{X_{i,t}^{c}}$ to control for small differences

- Matching estimator à la McMillen (2012) and Fang et al. (2015)
  - Assign unique panel id to half-block level (range of 30 house #'s)
  - $\mathbf{X_{i,t}^{c}}$ includes polynomial of age, land and floor area – accounts for rounding errors and differences in unit floor plans
  - Check bias as we move closer to defining γ_{i}^{c} as unique property

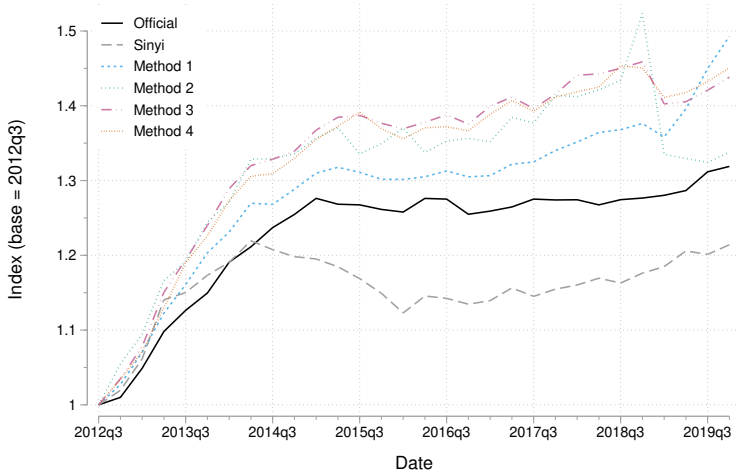
Main deck

"Official" HPIs: steep growth but no reform effect



- Hedonic index which shows 116% gain (94% real) in 10 years before reform
- Created from realty data and excludes flips within a year Main deck

Comparison of quarterly housing price indices



- Selection bias problem: prices become more inflated as we adopt more stringent definition of repeat sales (Method 1 $\rightarrow$ Method 4) Main deck

Alternative: estimate translog production function

- Estimate annual depreciation rate using hedonic model with translog function of land and structure size To index

$$\log P_{i,j,t} = \alpha_0 + f(A,S,L,D) + \beta_1 \log S_i + \beta_2 (\log S_i)^2$$

$$+ \beta_3 \log L_i + \beta_4 (\log L_i)^2 + \beta_5 D_i + \beta_6 D_i^2 + \beta_7 D_i^3$$

$$+ \beta_8 \log S_i \times \log L_i + \beta_9 \log S_i \times D_i + \beta_{10} \log L_i \times D_i$$

$$+ \psi' \cdot \mathbf{X_{i,j,t}} + \gamma_j + \delta_t + \epsilon_{i,j,t}$$

$$f(A,S,L,D) = \alpha_1 A_i + \alpha_2 A_i \times \log S_i + \alpha_3 A_i \times \log L_i + \alpha_4 A_i \times \log D_i$$

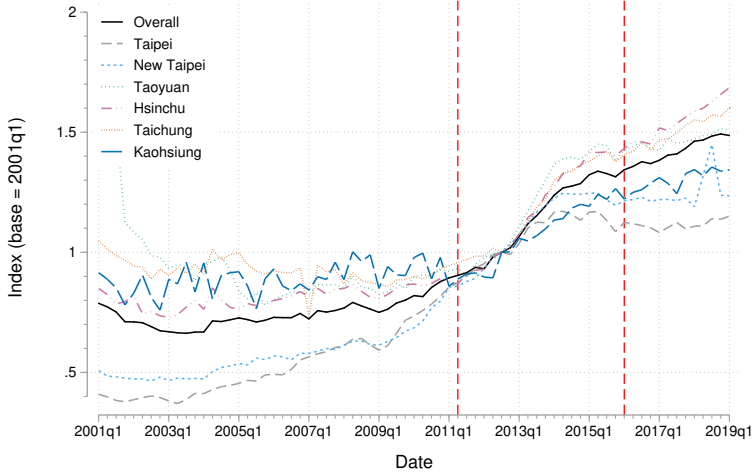
- Alternatively, use piecewise linear function to see how marginal effects evolve with building age

$$f(A,S,L,D) = \sum_g \left[\alpha_{1,g} \mathbb{1}_g + \alpha_{2,g} \mathbb{1}_g \times \log S_i + \alpha_{3,g} \mathbb{1}_g \times \log L_i + \alpha_{4,g} \mathbb{1}_g \times D_i \right]$$

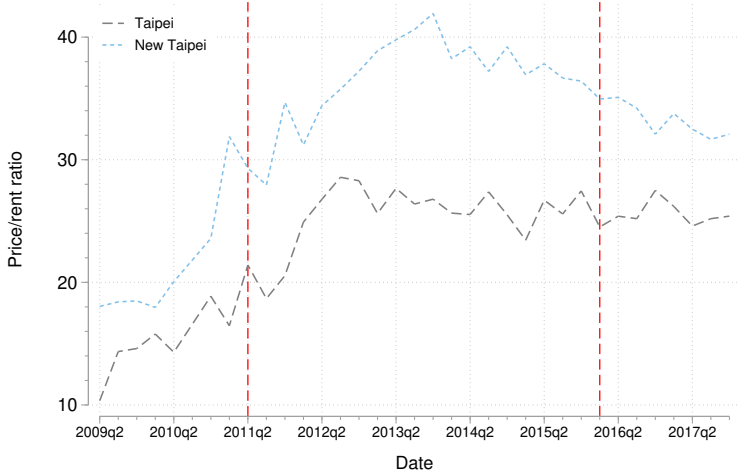
Translog index shows higher post-reform growth

Main deck

$$\log P^c_{i,j,t} = \alpha_0 + f(A, S, L, D) + \psi' \cdot \mathbf{X_{i,j,t}} + \gamma^c_j + \delta^c_t + \epsilon^c_{i,j,t} \quad \text{with } P^c_t = \exp(\delta^c_t)$$



Price-rent ratios were approaching "bubble" territory

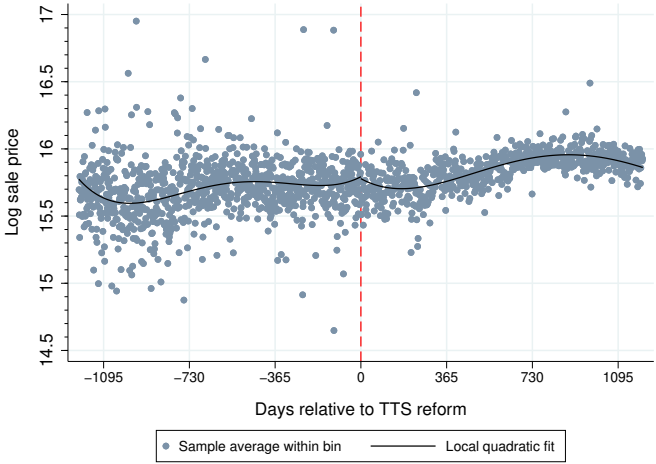


- Greater Taipei area had similar trajectory to HK: PR ratio went from 18 to 30 (2009-11)

Main deck Calibration

No clear discontinuity in raw sale prices

Main deck

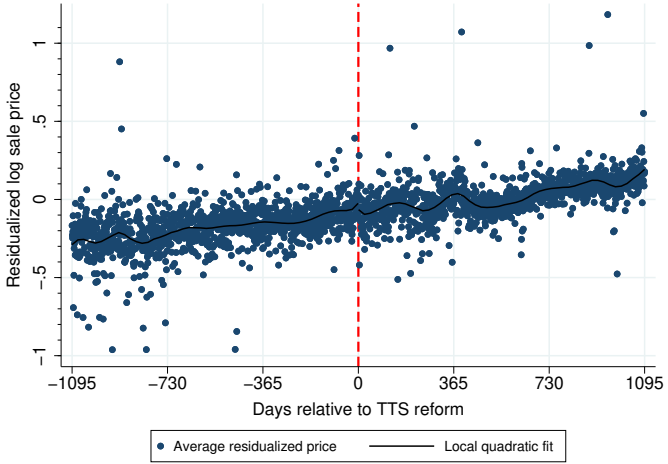


- Notably much lower variance in sales prices after the reform
- No break in unit prices either, but $\Delta P > 0$ for home quality-adjusted prices

  Grandfathered | Unit price | Salience
- Segmentation: price drop concentrated in low end of the market where cap gain $<<$ $\Delta\tau$, but price hike at high end

  Low end | High end | Residualized | Spillover

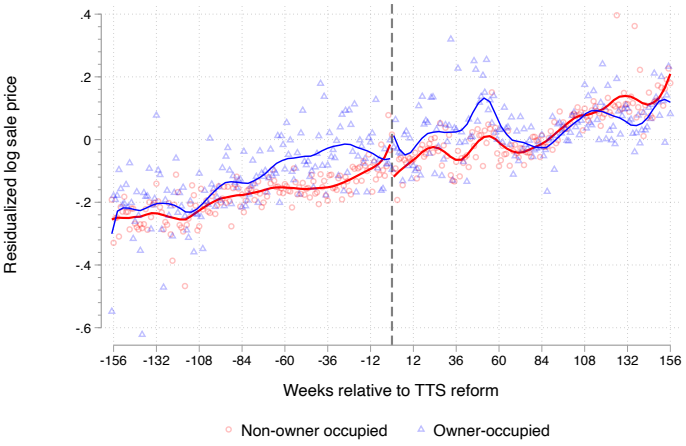
Evolution of quality-adjusted prices around reform



- Residualize log prices on block FEs, day of week FEs, floor number (for apartments), # of floors (SFHs), quadratics in age, floor space, land area
- Clear upward pricing trend with no break around reform date
- No jumps in prices elsewhere in distribution when we look at assessed value quantiles $\Longrightarrow$ strong selection effects

Go back

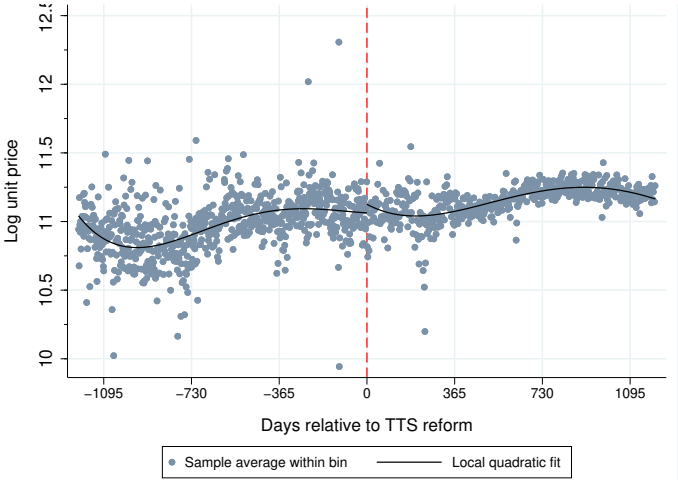
Almost complete pass through to owner-occupied segment



- Compare residualized prices for non-owner-occupied (taxed) vs. owner-occupied (not taxed) property sales
- Similar price rise across two segments $\Longrightarrow$ pass through from taxed to untaxed units (liquidity crunch)
- Same pattern when we look at prices by segment $\times$ value quantiles

Go back

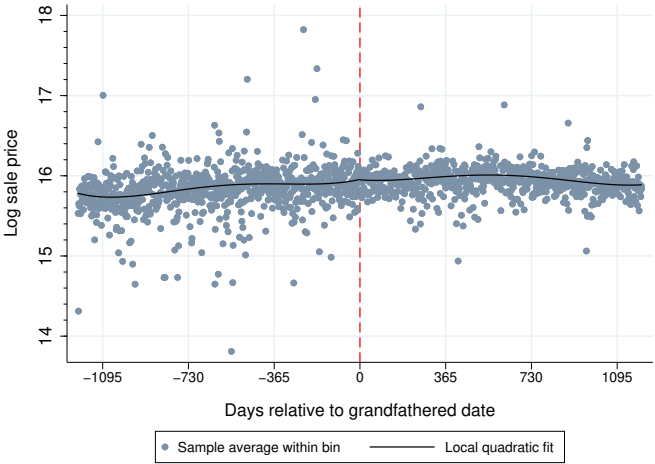
No clear discontinuity in unit prices



- Clear reduction in unit price variance after the reform

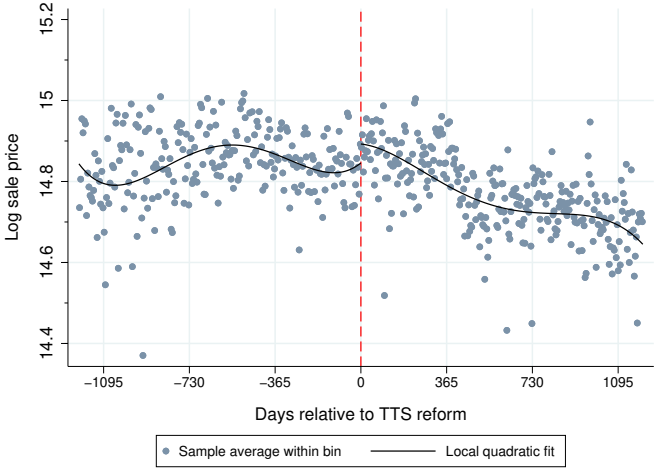
Go back

No discontinuity around the grandfathered date



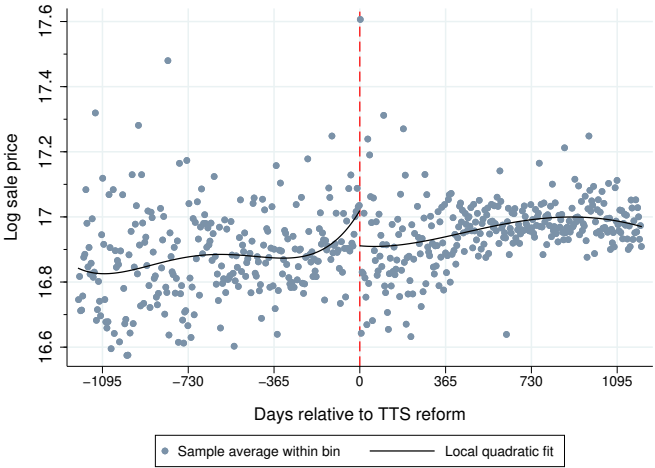
- Grandfathering: if flipped after implementation, tax still applies to anything bought after June 1, 2009 Go back

Trend break for low-value properties



- Avg. sale prices in first quintile decline by $\approx$ 28% over 3 yrs.
- Inaction region: less likely to pay tax bill to flip an apartment w/low cap gain Go back

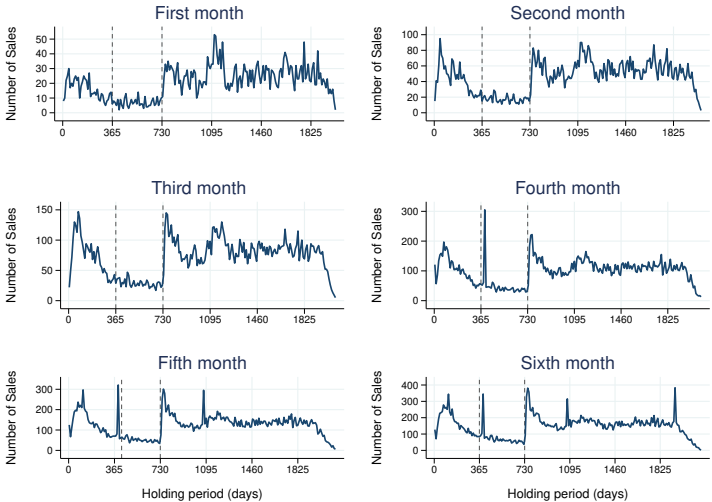
Prime property investors sell at premium to expedite



- Within the top quintile of assessed values, prices jump by 10% (full pass through) around reform, then revert to trend Go back

Tax reform highly salient for flippers

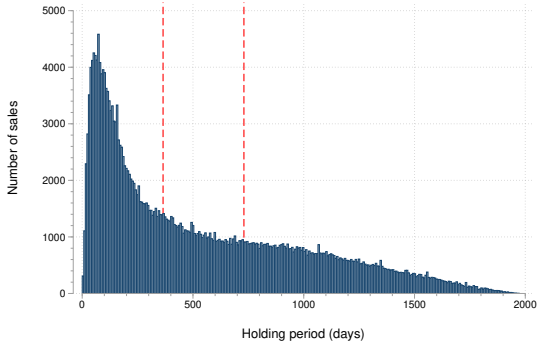
Main deck



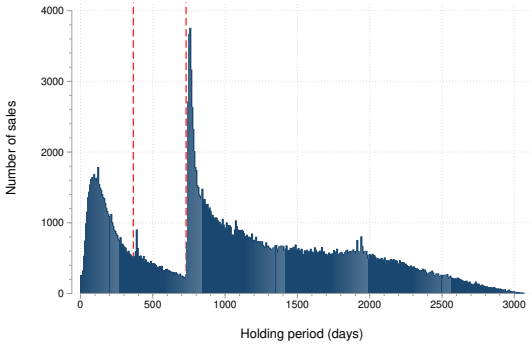
- Optimization frictions unlikely here – convergence to a new steady state within 6 months

Taxpayers buy and hold for two years to avoid tax

Pre-reform

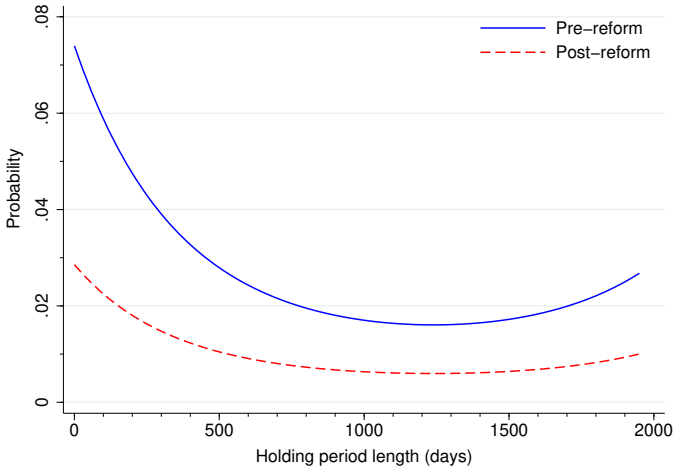


Post-reform



Main deck

Predicted sales function flattens after tax



- Level shift: lower post-reform sale probability at each holding period Main deck
- Slope shift: weaker post-reform relationship between holding period and sale probability

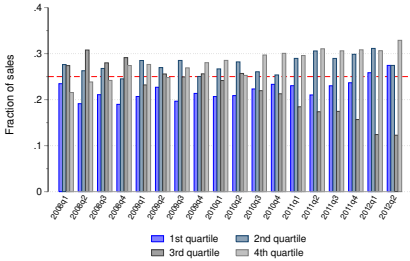
K-S tests of model fit to pre-reform data

	Baseline	Age < 5	Age 5-10	Age > 10	OOT	non-OOT	$Q_1(NW_s)$	$Q_3(NW_s)$	$Q_5(NW_s)$
K-S stat	0.105	0.149	0.090	0.149	0.105	0.119	0.149	0.119	0.075
p-value	0.858	0.444	0.951	0.444	0.858	0.726	0.444	0.726	0.992

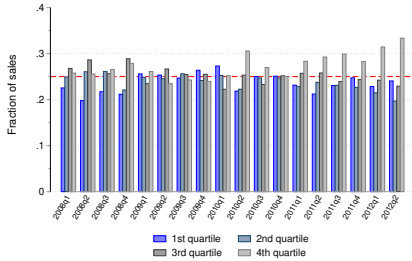
- Fail to reject the null of no difference in the distribution of sales by holding period for the CF model vs. data along several cuts:
  - Young vs. middle-aged vs. old properties $\implies$ unobserved renovations and tax avoidance in new builds not playing a role in model fit
  - OOT vs. non-OOT sellers
  - By quantiles of seller net worth

Main deck

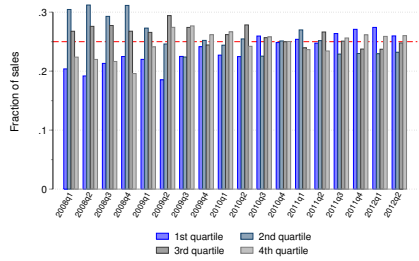
Building age



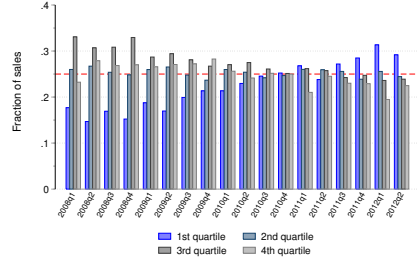
Distance to train station



Floor space

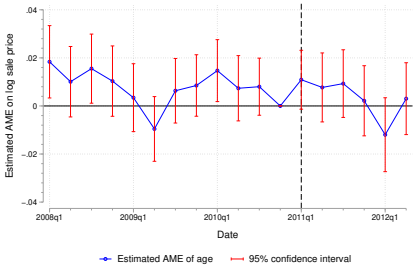


Land plot size

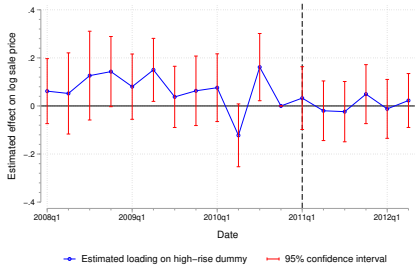


Main deck

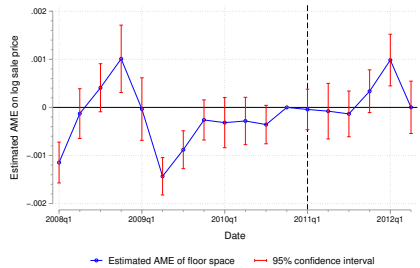
Building age



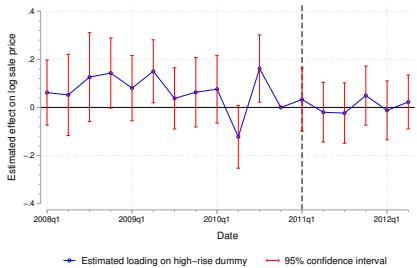
Distance to train station



Floor space



High-rise apartment dummy



Main deck

Half of missing sales from low-wealth sellers

Main deck

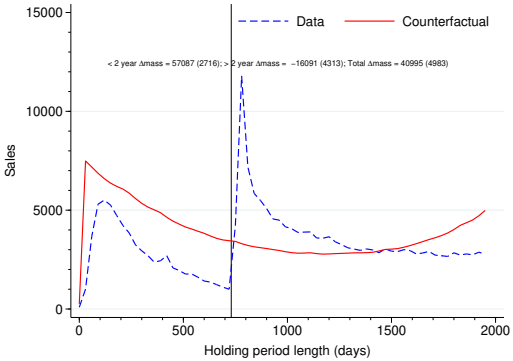
	HP $\leq$ 2 yrs.	HP $>$ 2 yrs.	Net missing	% of total
First quintile	32669***	−17999***	14670***	44%
	(549)	(993)	(1153)	
Second quintile	520	137	657	2%
	(540)	(1029)	(1158)	
Third quintile	4958***	−65	4893***	15%
	(593)	(1125)	(1342)	
Fourth quintile	11999***	−6693***	5306***	16%
	(613)	(1117)	(1315)	
Fifth quintile	19013***	−11400***	7613***	23%
	(605)	(1099)	(1296)	
Total	69159***	−36020***	33139***	100%
	(2962)	(2273)	(6080)	

Note: Transactions split by the seller's wealth quintile as of the last tax year before the flip tax reform. Standard errors in parentheses à la Chetty et al. (2011) from bootstrapping residuals with replacement from the logit model.

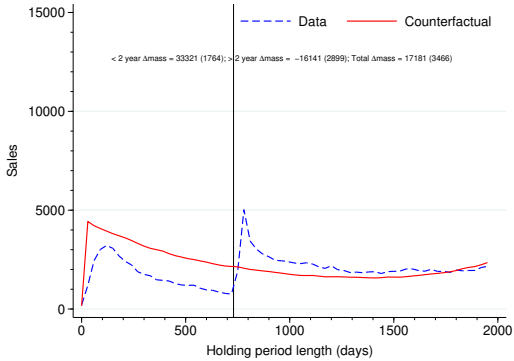
Missing sales driven by OOT sellers

Main deck

OOT sellers



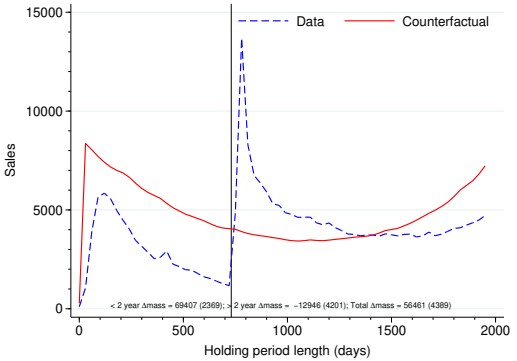
Local sellers



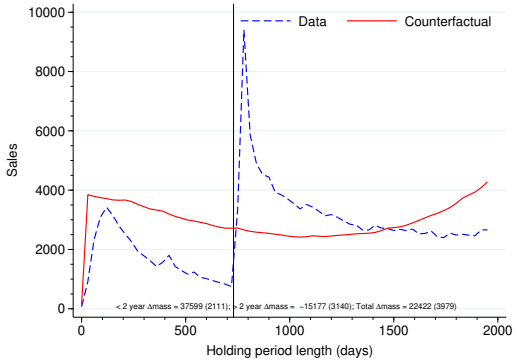
Missing sales volume larger for older properties

Main deck

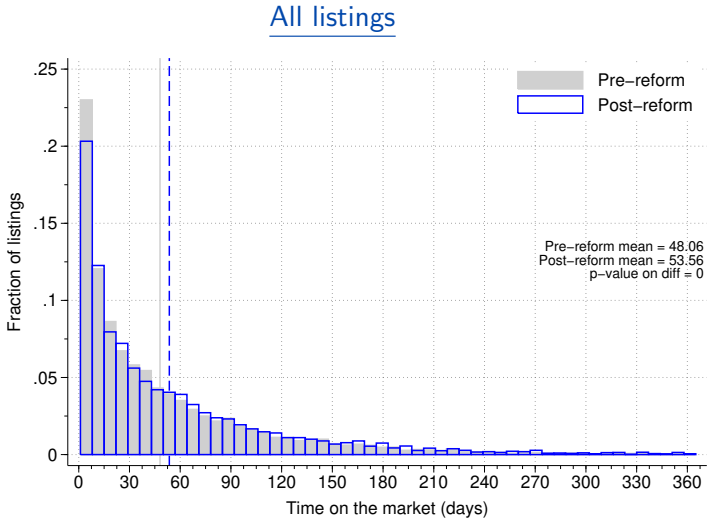
Age $\geq$ 5 years



Age $\geq$ 10 years



Time on market (TOM) ↑ by a week after the tax

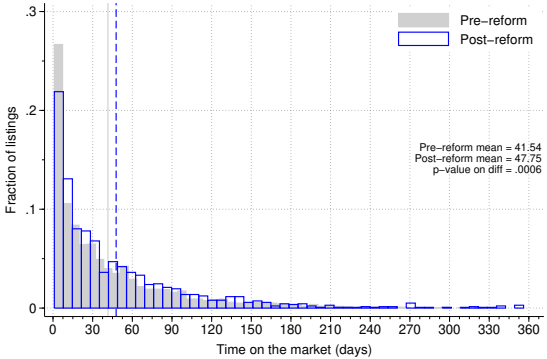


- Data: listings which close within 1-year window around the reform
- Definition: days between initial listing date and removal date
- $\approx$ 3 p.p. drop in fraction of listings closing within a week driven by bottom of price distribution
- Increase in properties with very long TOM driven by top of price distribution

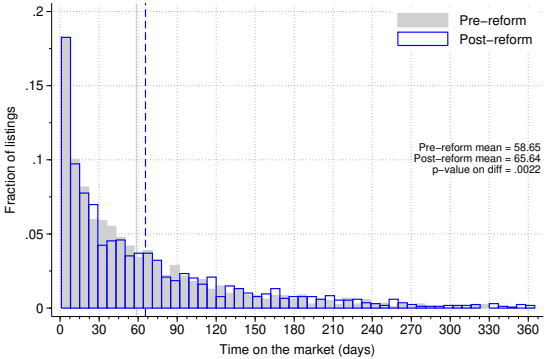
Main deck

Heterogeneous effects on TOM mirror those for prices

First quintile



Top quintile



- Avg. TOM grew by 7 days (Q1), 9 days (Q5), but by a statistically insignificant 3-4 days in the middle of the distribution Main deck
- Liquidity crunch worse for unique properties (Q5) and low cap gain apartments (Q1)

Time on Market and Occupancy Status: DiD Results

Main deck

	(1)	(2)	(3)	(4)	(5)	(6)
$Post$	7.59^{***}	7.39^{***}	7.52^{***}	7.71^{**}	6.88^{*}	6.92^{*}
	(1.87)	(1.89)	(1.90)	(3.51)	(3.54)	(3.57)
$SelfOcc$	1.14	2.21	2.31			
	(3.60)	(3.82)	(3.82)			
$Post \times SelfOcc$	-15.01^{***}	-14.62^{***}	-14.82^{***}			
	(5.52)	(5.62)	(5.62)			
$Second$				2.88	2.76	2.70
				(2.39)	(2.38)	(2.38)
$Post \times Second$				-2.31	-1.44	-1.36
				(4.06)	(4.10)	(4.11)
District × month-year FEs	✓	✓	✓	✓	✓	✓
Property controls		✓	✓		✓	✓
Day-of-week FEs			✓			✓
N	4,605	4,553	4,553	4,605	4,553	4,553
Adj. R^2	0.021	0.033	0.033	0.019	0.031	0.031

Notes: $SelfOcc$ is a dummy for whether the listing is for an (untaxed) owner-occupied property, while $Second$ is a dummy for whether the listing is for the seller's second (or later) home. We define a "second home" here as one that was acquired after the seller's original home purchase in our panel.

Details: holding period return formulas

Main deck

$$r^i_{t-1,t} = \frac{\sum_{j=1}^{n}(1-\tau_{j,t})\cdot \widetilde{V}^i_{j,t} + (1-c^i_{j,t})\cdot Y^i_{j,t} - T^i_{t-1,t}}{\sum_{j=1}^{n}\widetilde{V}_{j,t-1}} - 1$$

$$\widetilde{V}_{j,t} = (1-\delta)\cdot V_{j,t-1} \times \frac{\widehat{P_{j,t}}}{\widehat{P_{j,t-1}}}$$

- $\widetilde{V} \rightarrow$ current market value, defined as either the sale price within filing year t, or the last observed sale price inflated up using our MSA-level index $\widehat{P}$
- $\tau \rightarrow$ taxes triggered by property sale ($\tau = 0$ if no sale occurs at t)
- $T \rightarrow$ property holding taxes, usually proportional to assessed values
- $\delta \rightarrow$ linear rate of depreciation between $t-1$ and t (2% for SFH or 3% for apt.) Estimates
- $c_{i,t} \rightarrow$ tax rate on rental income Y less any mortgage interest deductions

Fact #1: local premium only as a result of the tax

Main deck

Pre-reform

	Local buyer	*OOT buyer*	**Difference**
OOT seller	25.06%	25.17%	$\mathbf{0.11}^{***}$
Local seller	23.16%	24.09%	$\mathbf{0.93}^{***}$
Difference	$\mathbf{-1.90}$	$\mathbf{-1.08}$	$\mathbf{0.82}$

Post-reform

	Local buyer	*OOT buyer*	**Difference**
OOT seller	7.96%	9.37%	$\mathbf{1.41}^{***}$
Local seller	13.42%	15.69%	$\mathbf{2.27}^{***}$
Difference	$\mathbf{5.46}^{***}$	$\mathbf{6.32}^{***}$	$\mathbf{0.86}^{***}$

- ΔDDD estimate $= 0.86 - 0.82 = 0.04$ (p-value $= 0.98$)

No local premium conditional on FEs

Main deck

$$r_{i,j,t} = OOT\_seller_{i,j,t} \times Post_t + \eta_i + \theta_{c,t} + \gamma' \cdot \mathbf{X_{j,t}} + \epsilon_{i,j,t}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$OOT\_seller \times Post$	-0.03^{***}	-0.02^{*}	-0.02	-0.04				
	(0.01)	(0.01)	(0.02)	(0.05)				
$OOT\_seller \times OOT\_buyer \times Post$					-0.03^{***}	-0.02	-0.02	-0.03
					(0.01)	(0.02)	(0.02)	(0.05)
$OOT\_seller \times Local\_buyer \times Post$					-0.03^{**}	-0.02	-0.01	-0.02
					(0.01)	(0.01)	(0.02)	(0.07)
$Local\_seller \times OOT\_buyer \times Post$					0.01	0.00	0.01	0.06
					(0.01)	(0.01)	(0.02)	(0.08)
City × year FEs	✓	✓	✓	✓	✓	✓	✓	✓
# of houses	✓		✓		✓		✓	
Wealth quintile dummies	✓		✓		✓		✓	
Taxpayer id FEs		✓		✓		✓		✓
Property id FEs			✓	✓				✓

Note: Standard errors clustered at the taxpayer id level, which determines OOT status.

Fact #2: HPRs decline with wealth quintile

Main deck

Annualized holding period return (%): by wealth quintile

	μ_{HPR}	P^{50}_{HPR}	σ_{HPR}	N
First quintile	28.01	4.83	108.04	9,881
Second quintile	25.06	3.55	104.84	9,819
Third quintile	21.28	3.48	92.25	9,850
Fourth quintile	19.47	2.68	93.15	9,850
Fifth quintile	18.33	1.60	89.66	9,849

- Goes against idea in literature that novices with less housing wealth perform worse in flipping properties

Fact #3: mortgaged sellers earn similar capital gains

Main deck

Year	Investor type	μ_{HPR}	$\mu_{capital}$	μ_{rental}	$\mu_{interest}$
2008	Mortgaged	2.06	2.61	0.23	0.65
	Owned	3.41	3.07	0.71	0.00
2009	Mortgaged	−0.24	−0.31	0.78	0.60
	Owned	−0.22	−0.48	0.61	0.00
2010	Mortgaged	9.14	8.92	1.28	0.87
	Owned	6.47	6.22	0.64	0.00
2011	Mortgaged	6.94	9.46	0.61	2.97
	Owned	8.56	8.00	1.04	0.00
2012	Mortgaged	6.52	6.88	0.78	0.98
	Owned	6.35	5.87	0.91	0.00
2013	Mortgaged	10.59	10.70	1.30	1.18
	Owned	11.39	10.92	0.89	0.00
2014	Mortgaged	8.30	8.18	1.15	0.87
	Owned	8.59	8.17	0.69	0.00

- Caveat: proxy mortgage with itemized deduction for interest expense

Fact #4: stock market participants earn lower returns

Main deck

Annualized holding period return (%): by stock market participation

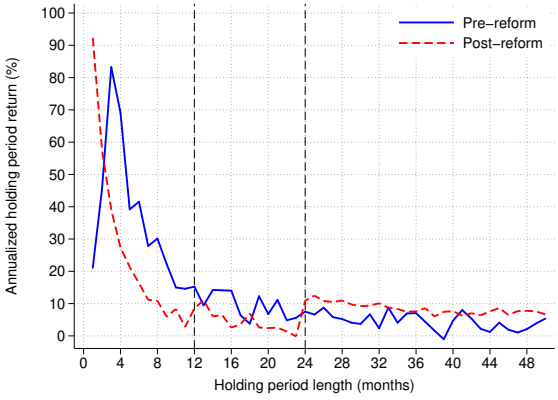
	μ_{HPR}	P^{50}_{HPR}	σ_{HPR}	N
Non-stock holders	24.80	3.21	107.17	17,657
Stock holders	12.67	2.05	74.54	79,649

- 83% of homeowners with wealth estimates in our sample hold stocks (p-value < 0.001 on difference in means)
- Returns declining in equities as share of wealth

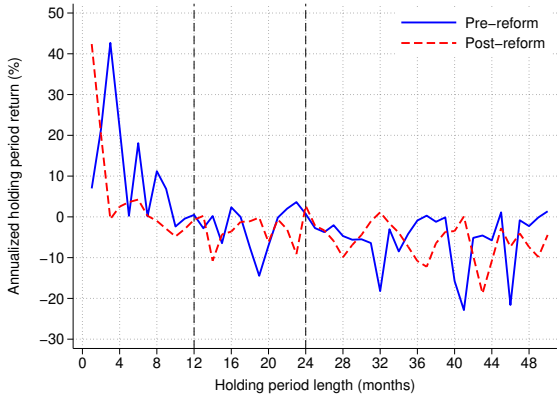
Fact #5: downward-sloping HPR term structure

Main deck

Raw returns



Residualized returns



- Mirrors results for other asset classes (van Binsbergen & Koijen 2017)
- Reform flattens short end but shifts profits to HP $>$ 24 mos.

Estimating economic depreciation of properties

- Model real estate production function as generalized CES of structure and land quantities
- Property owner maximizes profits subject to paying shadow prices for structure and land inputs (Epple, Gordon, Sieg 2010)
- Under these assumptions can show property depreciation rate is the structure depreciation rate times the structure input share $s_{t,a}$

$$-\frac{\partial \log P_{t,a}}{\partial a} = \delta_a \cdot s_{t,a} \equiv \delta \tag{22}$$

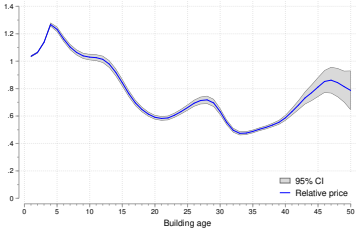
- Compute average marginal effect (AME) implied by estimated translog production function to get $\delta \approx 2\%$ for SFH (3% for apartments)

Go back Translog

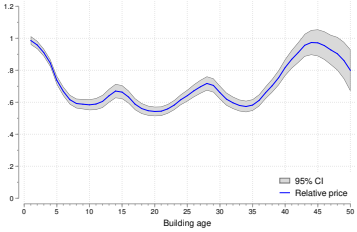
Smoothed relationship between prices and age

Go back

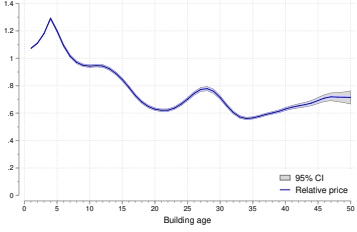
Residential, Non-Top Six



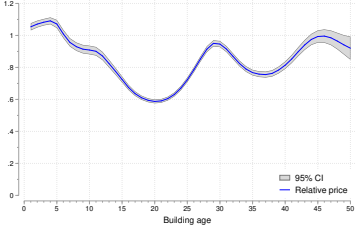
Commercial, Non-Top Six



Residential, Top Six



Commercial, Top Six



Depreciation rate estimates: regression results

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	Top Six Metros				Outside Top Six Metros			
	Single family		Apartment		Single family		Apartment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Building age	0.013***		0.017***		0.010***		0.016***	
	(0.000)		(0.000)		(0.000)		(0.000)	
𝟙(1-5 years)		0.000		−0.002**		−0.012***		−0.009***
		(0.000)		(0.001)		(0.001)		(0.001)
𝟙(6-10 years)		0.025***		0.022***		0.010***		0.025***
		(0.001)		(0.001)		(0.002)		(0.001)
𝟙(11-15 years)		0.036***		0.042***		0.025***		0.060***
		(0.001)		(0.001)		(0.001)		(0.001)
𝟙(16-20 years)		0.062***		0.067***		0.059***		0.078***
		(0.001)		(0.000)		(0.001)		(0.001)
𝟙(21-25 years)		0.068***		0.072***		0.062***		0.077***
		(0.001)		(0.000)		(0.001)		(0.000)
𝟙(26-30 years)		0.057***		0.077***		0.040***		0.076***
		(0.001)		(0.000)		(0.002)		(0.001)
𝟙(31-35 years)		0.060***		0.085***		0.049***		0.087***
		(0.001)		(0.000)		(0.002)		(0.001)
𝟙(36-40 years)		0.055***		0.087***		0.038***		0.086***
		(0.001)		(0.001)		(0.002)		(0.001)
𝟙(41-45 years)		0.041***		0.092***		0.023***		0.078***
		(0.003)		(0.001)		(0.005)		(0.002)
𝟙(46-50 years)		0.045***		0.095***		−0.006		0.083***
		(0.005)		(0.002)		(0.010)		(0.003)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Location FEs	✓	✓	✓	✓	✓	✓	✓	✓
N	81,434	81,434	356,386	356,386	47,126	47,126	141,617	141,617
Adj. R^2	0.761	0.773	0.846	0.852	0.759	0.775	0.788	0.801

- Average rate of $\delta = 1.7\%$ annual depreciation for urban apartments
- Similar rate if take average over properties < 10 years old, which is the majority of flips and $\approx 40\%$ of our entire sample
- Convex, U-shaped curve matches patterns in other residential markets

Mapping severe weather to property sales

Main deck

- We scraped daily weather reports from 832 Taiwanese stations (2005-2019)
  - Variables: wind speed, max gust, precipitation, sea surface pressure, humidity, dew point, temperature, UVI, sun/rain duration, cloud coverage, visibility Stats
  - Focus on stations which record precipitation and wind speed (N = 516) Main stations Rain map
  - Property level: compute distance of property to nearest weather station

- Time series regression run at different aggregation levels:

$$Volume_t = \beta_1 \cdot (WS_t \times Summer_t) + \beta_2 \cdot (Rain_t \times Summer_t) + \delta_t + \gamma' \cdot \mathbf{X_t} + \varepsilon_t \tag{23}$$

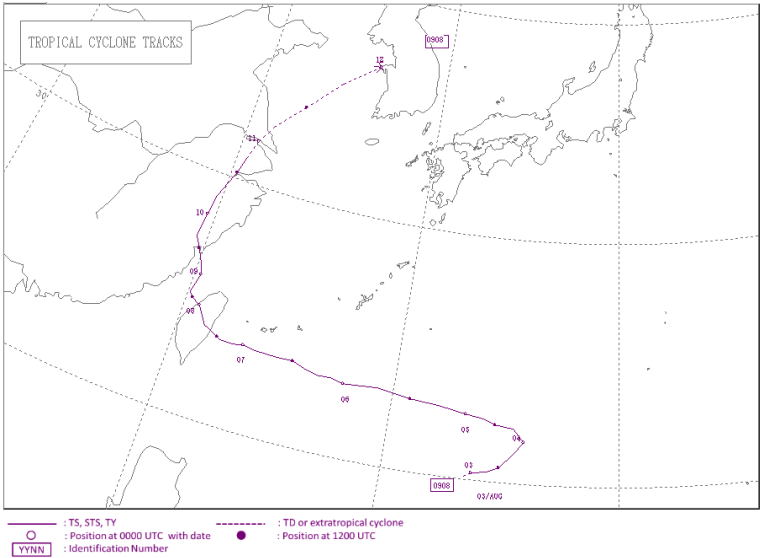
- Purge from $Volume$ transactions "fundamental trades" involving buyer/sellers who recently changed marital or employment status

Spatial distribution of main weather stations

Go back

Example: tracking for typhoon Morakot (8/2009)

Main deck



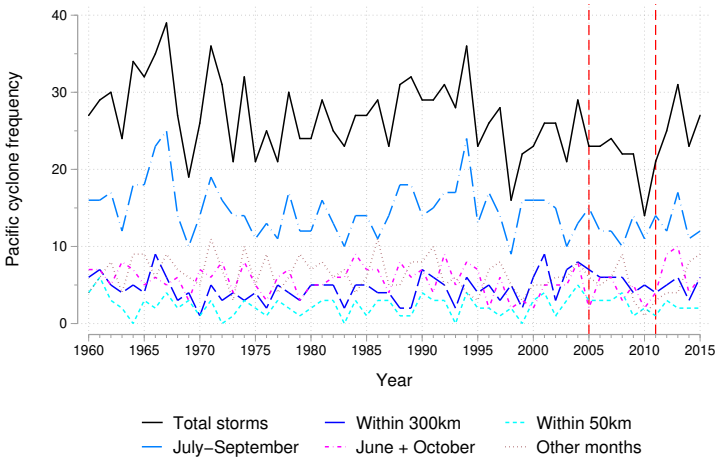
Classification system for Tropical Cyclones

Main deck

Category	Sustained wind speed
Violent typhoon	$\geq$ 105 knots (121 mph)
Very strong typhoon	85-104 knots (98-120 mph)
Typhoon	64-84 knots (74-97 mph)
Severe tropical storm	48-63 knots (55-73 mph)
Tropical storm	34-47 knots (39-54 mph)
Tropical depression	$\leq$ 33 knots (38 mph)

Source: World Meteorological Organization Technical Document, Typhoon Committee Operational Manual

Cyclicality in typhoon season length and storm incidence



- Cyclonic Niño effects explain why uptick in incidence every 10 years Main deck
- But average severity (wind speed and rainfall) on the rise due to climate change

Taiwan weather summary statistics

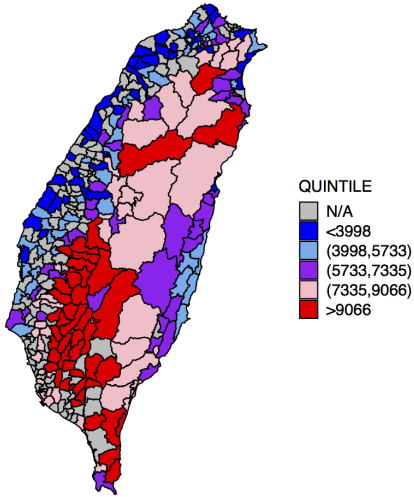
Go back

	Taipei/New Taipei		Other Metros	
	Peak season	Non-peak	Peak season	Non-peak
Avg. # typhoon warning days	15.8	3.9	15.8	3.9
Max daily precipitation (in)	17.5	16.7	37.8	26.7
Cumulative precipitation (in)	38.9	82.4	47.0	48.9
Avg. wind speed (mph)	3.9	4.0	3.8	4.3
Max wind gust (mph)	101.4	88.3	153.9	126.6
Avg. station pressure (hPa)	989.7	997.4	965.4	973.1
Min. station pressure (hPa)	896.5	907.4	627.8	634.0
Avg. daily high temperature (°F)	89.5	73.6	86.3	74.6
Max daily high temperature (°F)	116.6	115.8	112.7	111.5
N	19,944	64,440	74,790	241,650
# Stations	36	36	135	135

Note: Includes observations from a balanced panel of stations (N = 171) reporting key typhoon forecasting variables.

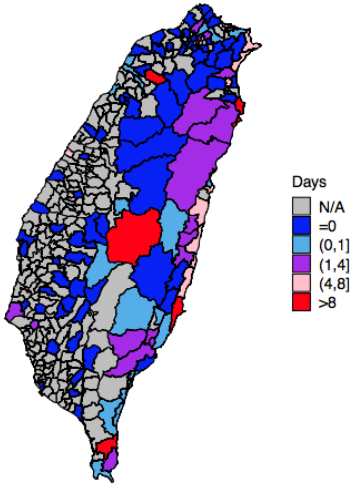
Map of cumulative rainfall intensity (2005-11)

Go back



- Rains during typhoon season concentrated in the south/middle of island

Map of typhoon force wind days (2005-11) Go back



- While warnings set for entire island, majority of districts do not experience $\geq$ 74 mph winds in the average typhoon season (imperfect coverage)

Neg. effects on volume in county cross-section

Main deck

$$Volume_{j,t} = \beta \cdot (Weather_{j,t} \times Summer_t) + \delta_t + \psi_j + \gamma' \cdot \mathbf{X_t} + \varepsilon_{j,t}$$

	(1)	(2)	(3)	(4)	(5)
Max WS $\times Summer$	0.04			0.12	
Avg. WS $\times Summer$		-0.14			-0.01
Rainfall $\times Summer$			-0.04^{**}	-0.03^{**}	-0.04^{***}
7-day FEs	✓	✓	✓	✓	✓
Day-of-week FEs	✓	✓	✓	✓	✓
County FEs	✓	✓	✓	✓	✓
Damages controls	✓	✓	✓	✓	✓
N	88,466	98,666	101,141	88,441	98,627

- 1 mm increase in rainfall $\implies$ 0.03% lower sales volume in the county-level cross-section
- DDD differences out common factors across locations which might be correlated with storm events (e.g. business shutdown responses) Main deck

Factor loadings on key weather variables

	Factor 1 *"Fair weather"*	Factor 2 *"Low pressure"*	Factor 3 *"High wind"*	Factor 4 *"Heavy rainfall"*
Avg. station pressure	0.37	−0.38	0.01	0.21
Max station pressure	0.37	−0.38	0.02	0.21
Min station pressure	0.37	−0.37	0.01	0.21
Avg. temperature	0.33	0.43	−0.01	0.19
Max temperature	0.33	0.44	−0.04	0.08
Min temperature	0.31	0.42	0.00	0.28
Avg. relative humidity	−0.34	0.04	−0.32	0.38
Min relative humidity	−0.33	−0.07	−0.19	0.46
Avg. wind speed	−0.13	−0.01	0.65	0.14
Max wind gust	−0.13	0.06	0.66	0.17
Cumulative precipitation	−0.14	0.02	0.00	0.58

- Identify four factors with eigenvalues > 1 (88% of variation) Main deck
- Includes data from all main + automated stations (N = 517)

Principal weather factors and real estate sales

Main deck

	(1)	(2)	(3)	(4)	(5)	(6)
$Factor1 \times Summer$	17.54^{***}					6.35
"Fair weather"	(3.34)					(6.69)
$Factor2 \times Summer$		-4.46				5.63
"Low pressure"		(6.90)				(7.27)
$Factor3 \times Summer$			-17.67^{***}		-13.66^{***}	-14.29^{***}
"High wind"			(2.89)		(2.74)	(2.93)
$Factor4 \times Summer$				-13.24^{***}	-8.02^{***}	-3.42
"Heavy rainfall"				(2.60)	(2.32)	(5.00)
7-day FEs	✓	✓	✓	✓	✓	✓
Day-of-week FEs	✓	✓	✓	✓	✓	✓
Damage Controls	✓	✓	✓	✓	✓	✓
N	4,681	4,681	4,681	4,681	4,681	4,681

No pent-up demand for severe rain shocks

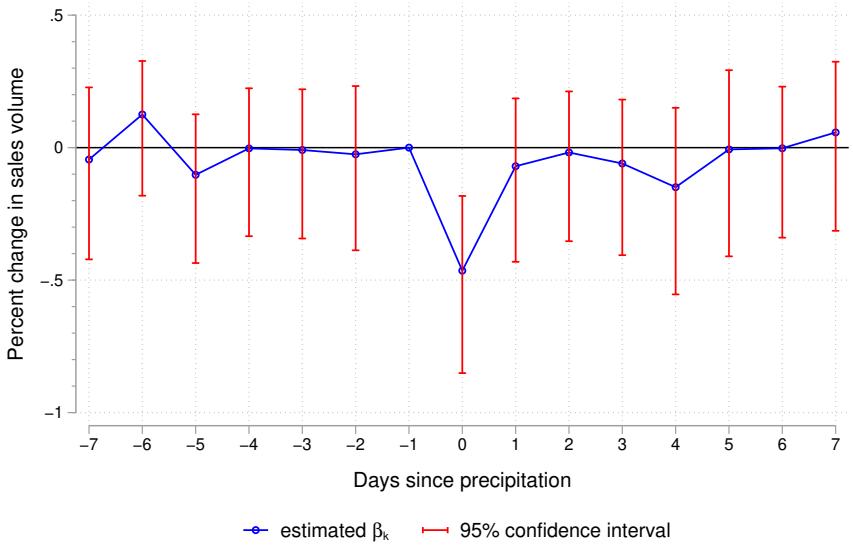
Main deck

$$\text{Volume}_t = \beta_1 \cdot (Rain_t \times Summer_t) + \delta_t + \beta_2 \cdot \mathbb{1}_{t-L,t-1}\{\overline{Rain} \geq 0.5\text{in.}\} + \gamma' \cdot \mathbf{X_t} + \varepsilon_t$$

	(1)	(2)	(3)	(4)
$Rain_t \times Summer_t$	-0.33^{***}	-0.33^{***}	-0.32^{***}	-0.31^{***}
$\mathbb{1}_{t-1w,t-1}\{\overline{Rain} \geq 0.5\text{in.}\}$	-10.33^{*}			
$\mathbb{1}_{t-2w,t-1}\{\overline{Rain} \geq 0.5\text{in.}\}$		-7.34		
$\mathbb{1}_{t-4w,t-1}\{\overline{Rain} \geq 0.5\text{in.}\}$			-3.03	
$\mathbb{1}_{t-8w,t-1}\{\overline{Rain} \geq 0.5\text{in.}\}$				18.85
7-day FEs	✓	✓	✓	✓
Day-of-week FEs	✓	✓	✓	✓
Damages controls	✓	✓	✓	✓
N	1,973	1,973	1,973	1,973

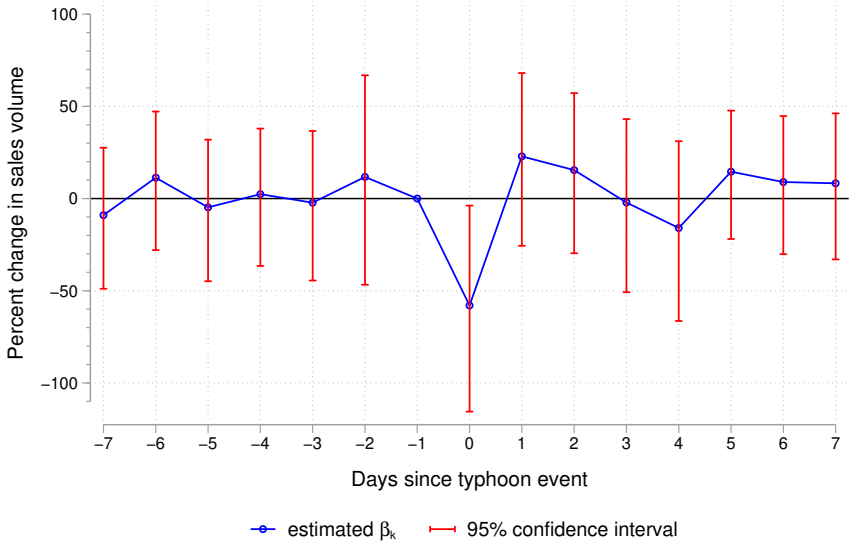
No pre-trend in sales volume w.r.t. rainfall shocks

Main deck



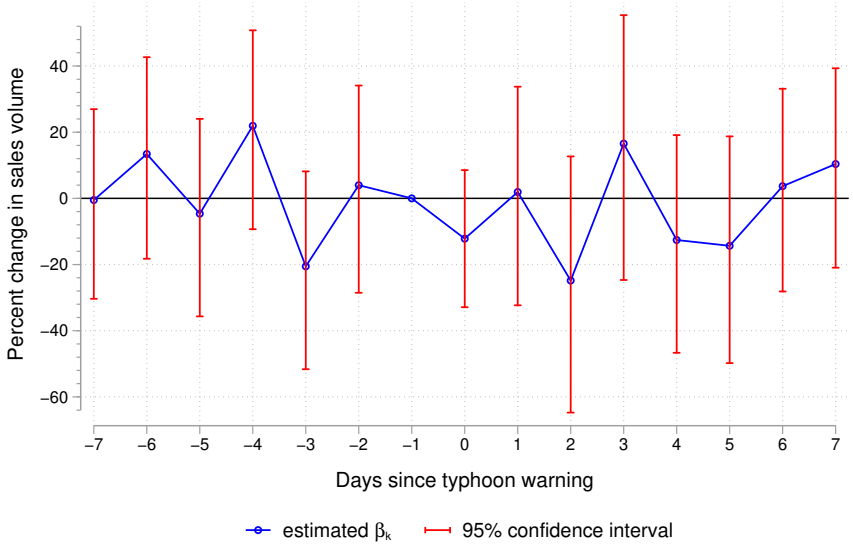
Also no pre-trend in volume confirmed typhoons

Main deck



Volume remains flat around typhoon warnings

Main deck



No substitution towards buy-to-rent behavior

Main deck

Dependent variable:	(1) Prob(rent)	(2) Prob(rent)	(3) Prob(rent)	(4) Prob(rent)	(5) Rental income	(6) Rental income
$Treated_{i,t} \times Post_t$	0.0056	0.0052	0.0671	0.0731	−0.384	−0.392*
	(0.75)	(0.72)	(1.50)	(1.62)	(−1.63)	(−1.66)
$Treated_{i,t}$	0.187***	0.186***	1.416***	1.413***	0.735**	0.733**
	(26.80)	(26.28)	(28.59)	(28.57)	(3.18)	(3.16)
$Post_t$	−0.0239***	−0.0127	−0.231***	−0.453***	−0.053***	0.122
	(−6.17)	(−1.64)	(−4.78)	(−6.92)	(−4.76)	(1.55)
Estimation	LPM	LPM	Logit	Logit	OLS	OLS
Property controls	✓	✓	✓	✓	✓	✓
District FEs		✓		✓		✓
Adj R^2	0.070	0.078	0.080	0.080	0.015	0.021
N	879,040	879,037	879,040	879,037	879,040	879,037

Notes: This table estimates difference-in-differences models of the effect of the Tobin tax policy on the probability of renting property and individuals' total rental income (millions NTD). Property controls include bins for averages of properties age, unit floor number (for apartments), and number of floors (for single-family homes) of individuals' properties portfolio. Columns (1), (2), (5), and (6) report the results of linear regressions. Columns (3) and (4) report the results of logistic regressions. T-statistics in parentheses obtained from robust standard errors clustered at the property district level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$