Global Capital and Local Assets: House Prices, Quantities, and Elasticities

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NBERSI
July 2020

Effect of foreign investment on domestic housing markets

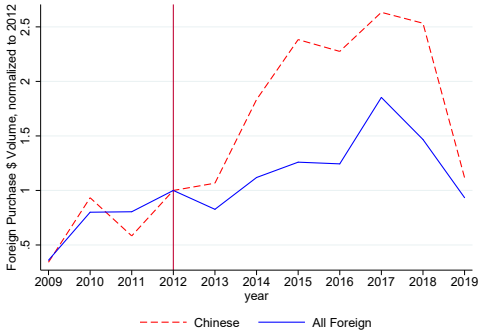
- International capital markets have the potential to influence domestic asset markets
- U.S. housing market has seen huge amounts of foreign investment since the housing crisis
  - 10% of home sales volume April 2016–March 2017 due to foreign buyers
  - Some submarkets attract more foreign investment than others
- We use this demand shock to estimate *local housing supply elasticities*

How do local housing markets respond to international capital flows?

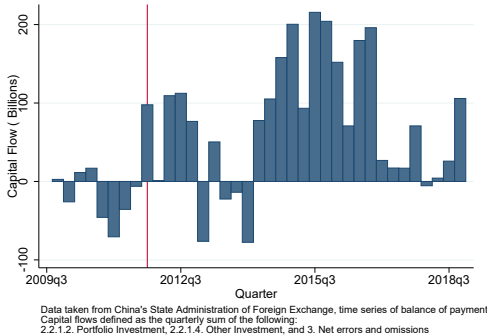
1. **Establish Foreign Demand Shock**
   - Impact of foreign buyer tax on local house prices in immigrant enclaves
   - DiD design with *Chinese enclaves*

2. **Use Foreign Demand Shock to Identify Local House Price Elasticities**
   - Instrument for capital flows using the natural experiment
   - Estimate impact of foreign capital on house prices and supply
   - Calculate local housing market supply elasticities
   - IV (1^{st} stage DiD) design with *all foreign capital*

International Investment in US Housing and Capital Flight



(a) Sales Volume, NAR



(b) Net Capital Flows from China

Source: Transaction volume from NAR's "2017 Profile of International Activity in U.S. Residential Real Estate." Capital outflows from SAFE, time series of balance of payments, and are defined as the quarterly sum of: 2.2.1.2. Portfolio Investment, 2.2.1.4. Other Investment, and 3. Net errors and omissions.

Preview of Results

Foreign capital impacts U.S. house prices, providing demand shock

1. Locations with high Chinese foreign-born populations realize an additional **8–17pp HPI** from 2012–2018

2. Results are robust to:
   - Placebo groups
   - Using matching estimators
   - Using synthetic controls
   - Variety of location and time fixed effects

3. The top 100 U.S. cities most exposed to foreign capital shock have **elasticities between 0.02 and 0.7** (mean $= 0.1$)

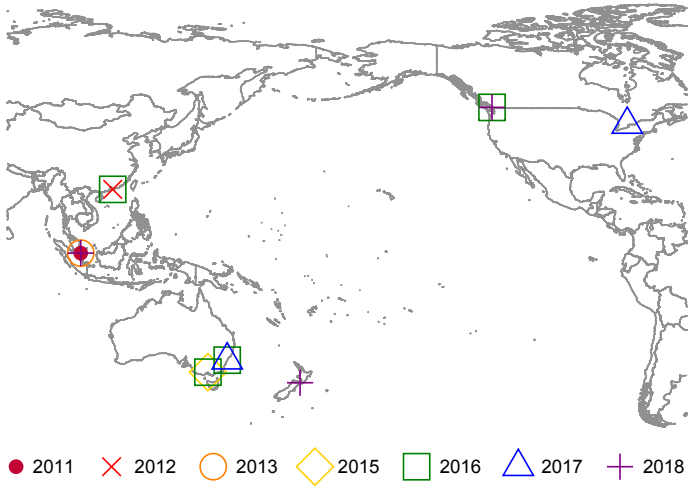
Contributions

1. **Non-local Capital Flows**
   - International: Badarinza & Ramadorai (2016), Favilukis et. al. (2013, 2016), Justiniano et. al. (2013), Li, Shen, and Zhang (2019)
   - Domestic: Chinco & Mayer (2016), Favilukis & Van Nieuwerburgh (2017), DeFusco et. al. (2018)
2. **Impacts of Immigration on Housing Markets**
   - Sá (2014), Saiz (2003, 2006), Saiz & Wachter (2011), Akbari & Aydede (2012); Pavlov & Somerville (2016)
3. **Macroprudential Policy Spillovers**
   - Corporate taxation, e.g. Clausing (2013), Gergen (2016)
   - "Global savings glut," e.g. Bernanke (2005)
   - Taxation based on residential status, c.f. Many countries
4. **Measuring Housing Supply Elasticity**
   - Regulatory Environment: Gyourko, Saiz, Summers (2007), Gyourko and Krimmel (2019), Glaeser & Ward (2009)
   - Measuring Elasticities: Saiz (2010), Baum-Snow & Han (2019), Cosman, Davidoff & Williams (2018)

Data

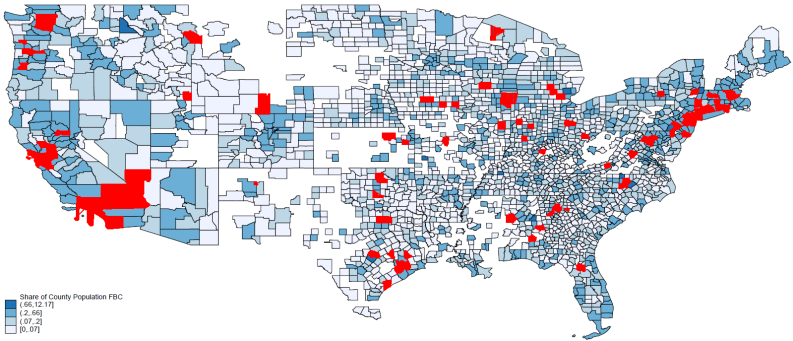
- **Prices**
  - CoreLogic Deeds Database 2010-2018
  - Robustness: Zillow Home Value Index, Zillow Rent Index
- **Quantities**
  - Stock: American Community Survey, 2011
  - Flow: Building Permits, 2010–2018
- **Identifying Variation**
  - Foreign-Born Population: American Community Survey, 2011, 2013
  - Foreign Home Purchases: National Association of Realtors Reports, 2010–2019

Temporal Variation: $Post_t = 1\{t \geq 2011q4\}$



Singapore (2011q4) led a wave of foreign-buyer tax policy adoptions.

Geographic Variation: $FBC_i = 1\left\{\frac{FBCpop_i}{pop_i} \geq 99^{th} percentile\right\}$



Define "treated" zip codes to be those with foreign-born Chinese (FBC) population shares in the top 1% of the national sample of zip codes. FBC=1: 231, FBC=0: 19,843.

Counties shown for ease of inspection.

Research Design: Differences-in-Differences

For zipcodes, i, and quarter, t:

$$hpi_{it} = \alpha + \beta FBC_i \times Post_t + \zeta_i + \theta_t + \varepsilon_{it}$$

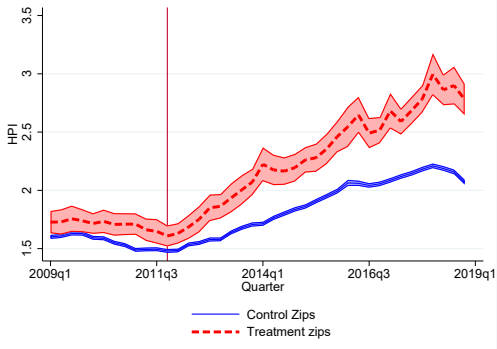
- Baseline specifications include zip and quarter fixed effects
- Additional specifications add geography-specific time trends
- Standard errors clustered by trend geography

Parallel Trends Assumption: Zip codes with higher or lower fractions of foreign-born Chinese population would see similar house price trends in the absence of a foreign capital shock

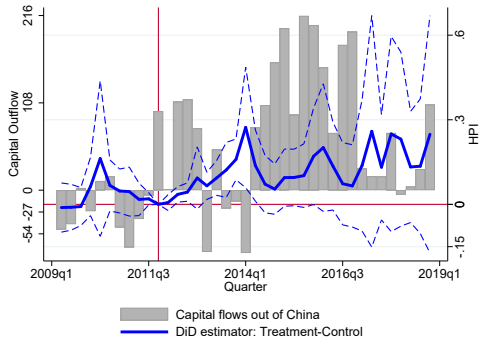
Assumption

Differences-in-Differences Results

House prices increase 8–17pp in FBC locations in the post-period



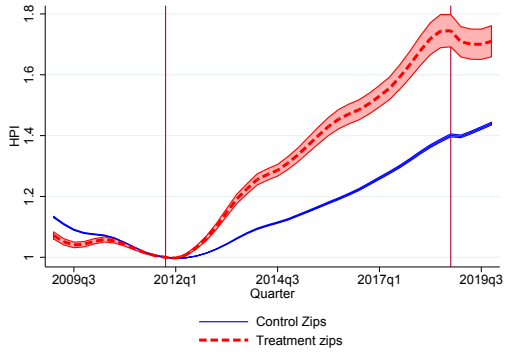
(a) Raw Data



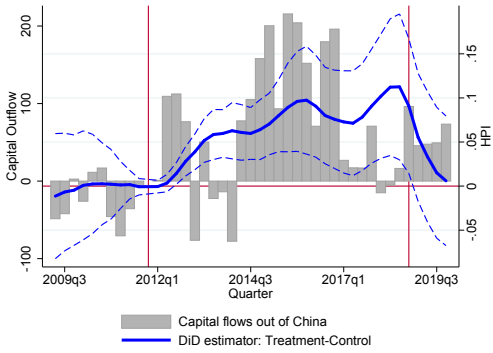
(b) DiD Estimator

Note: Panel (b) uses regression estimates from the baseline DiD, adding commuting zone trends, as in column (4) of the DiD results: $hpi_{it} = \beta FBC_i \times qtr_t + \zeta_i + \theta_t + CZ_i \times t + \varepsilon_{it}$. Table

Differential Growth Fell after Onset of US-China Trade War



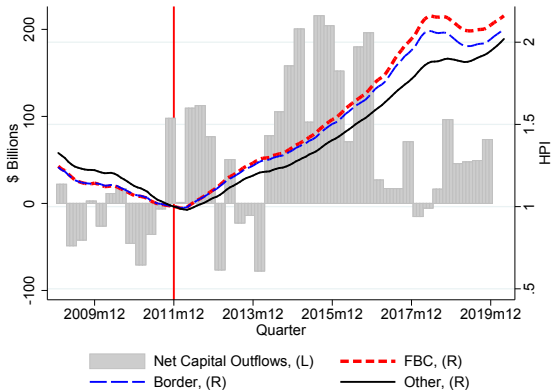
(a) Raw Data



(b) DiD Estimator

Note: Panel (b) uses regression estimates from the baseline DiD, adding city-level trends, as in column (4) of the DiD results: $hpi_{it} = \beta FBC_i \times qtr_t + \zeta_i + \theta_t + Czone_i \times t + \varepsilon_{it}$. hpi_{it} constructed using Zillow's Home Value Index, averaged quarterly.

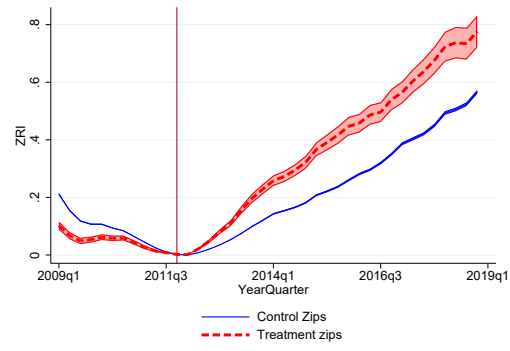
Example: Seattle's Housing Market 2009-2019



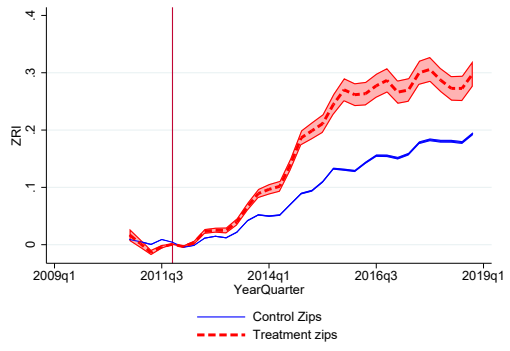
Note: Seattle's monthly Zillows Home Value Index, by zipcode foreign-born status. There are 9 FBC zipcodes, 22 border zipcodes, and 116 other zipcodes

Foreign Buyers Affect Local Affordability

Both prices and rents differentially rise, but prices rise more



2018 Price Gap: 20%



2018 Rent Gap: 10%

Identifying Elasticities

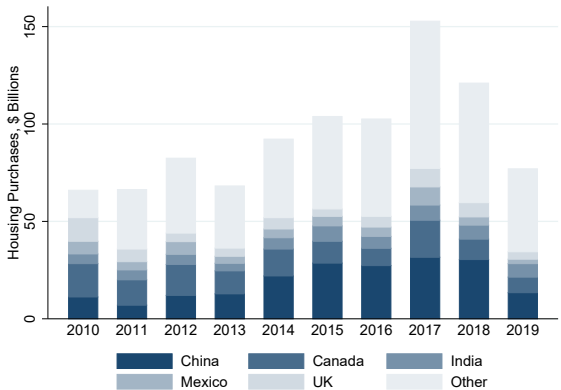
Endogeneity concerns can bias the estimated impact of foreign capital flows on house prices and quantities:

1. Reverse causality
2. Measurement error

We can use **foreign buyer taxes** interacted with a zipcode's **foreign-born population share** as a demand shifter to **instrument for foreign capital flows** into the U.S.

1. Estimate price elasticities w.r.t. foreign capital flows: $\frac{\partial ln(HPI)}{\partial ln(f)} = \gamma^{hpi}$
2. Estimate quantity elasticities w.r.t. foreign capital flows: $\frac{\partial ln(Q)}{\partial ln(f)} = \gamma^{Q}$
3. Combine 1. & 2. to create **price elasticity of supply**: $\frac{\partial ln(Q)}{\partial ln(HPI)} = \eta$

Foreign Investment in U.S. Housing by Country of Origin



Source: Transaction volume by country from NAR's annual "Profile of International Activity in U.S. Residential Real Estate." Capital outflows from SAFE, time series of balance of payments, and are defined as the quarterly sum of: 2.2.1.2. Portfolio Investment, 2.2.1.4. Other Investment, and 3. Net errors and omissions.

Index Intuition | Index Summary

Define Expected Capital Flows (ECF_{it}):

$$ECF_{it} = \sum_{o \in O} capflow_{ot} \times \frac{FBpop_{co}^{2011}}{FBpop_{o}^{2011}}$$

$$1 = \sum_{i} \frac{FBpop_{co}^{2011}}{FBpop_{o}^{2011}}$$

$$O = \{\text{Canada, China, India, Mexico, United Kingdom}\}$$

i denotes zipcode, t denotes quarter, o denotes origin country

Multinational IV Design with Local Interaction

1. **Bartik-style instrument for capital flows (simplified):**

$$ln(ECF_{it}) = \alpha + \beta fracFB_i \times Post_t + \zeta_i + \theta_t + \varepsilon_{it}$$

2. **Regress prices and quantities on instrumented capital flows:**

$$ln(HPI_{ct}) = \gamma^{hpi} ln(\widehat{ECF_t^c}) + \gamma_M^{hpi} ln(\widehat{ECF_t^c}) \times CBSA_c + \eta^{ct}$$

$$\frac{dQ_{ct}}{Q_c} = \gamma^{Q} ln(\widehat{ECF_t^c}) + \gamma_M^{Q} ln(\widehat{ECF_t^c}) \times CBSA_c + \nu^{ct}$$

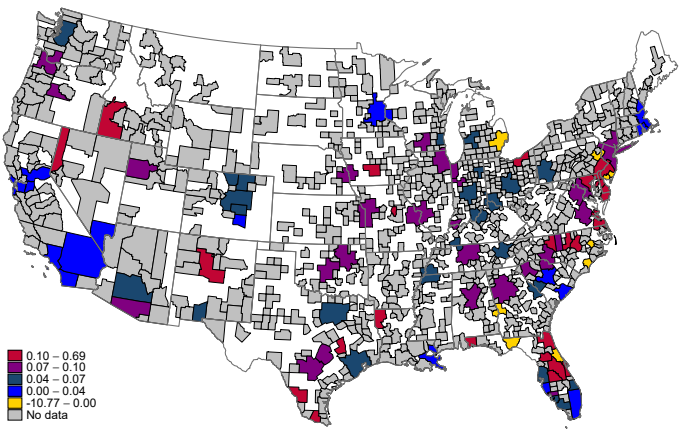
3. **Combine price and quantity elasticities:**

$$\eta^M = \frac{\gamma^Q + \gamma_M^Q}{\gamma^{hpi} + \gamma_M^{hpi}}$$

η^M is a CBSA's house price elasticity of supply

IV requirements

Geographic Distribution of Local House Price Elasticities



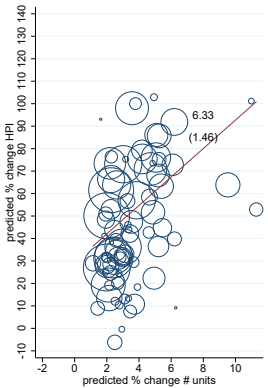
Most Inelastic:

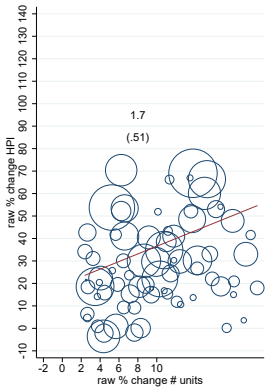
1. Providence, RI
2. San Francisco, CA
3. Boston, MA
4. Minneapolis - St. Paul, MN
5. Sacramento, CA

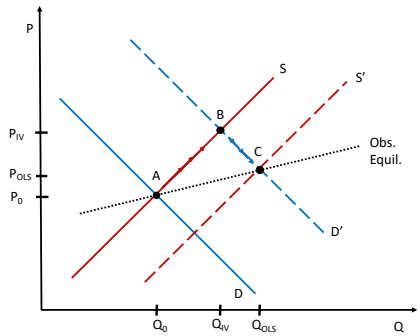
Most Elastic:

1. Salisbury, MD
2. Ocala, FL
3. Lakeland, FL
4. Virginia Beach - Norfolk, VA
5. Trenton, NJ

Predicted Slope > Raw Data Slope







$$\overline{\eta}^{M}_{predicted} = 0.16 < 0.59 = \overline{\eta}^{M}_{raw}$$

Trimmed of outliers to show middle 90% of CBSAs.

Conclusion

1. Our paper sheds new light on the extent of spillovers from international macroprudential policies on the U.S. economy

2. We document sharp price response in local U.S. housing markets to capital outflows from China
   - **House prices increase 8–17pp** more in FBC zipcodes in the post period

3. We use variation in demand driven by exposure to foreign by taxes to provide new estimates of the price elasticity of supply in 91 US cities
   - The US housing market is **relatively inelastic**, at $\eta = 0.1$ on average
   - Contact us for the spreadsheet of elasticities! (also available at our websites)

DiD Assumption: Parallel Trends

Key Assumption: Zip codes with higher or lower fractions of foreign-born Chinese would see similar house price trends in the absence of a foreign capital shock

- Concerns:
  - Are these two groups comparable?
  - Do immigrants sort based on house prices?
- Solutions:
  - Geographic and time trend controls
  - Additional analysis using matching and synthetic control estimation

Covariate Balance Back

Covariate Balance

Notes: This table shows pre-period balance for relevant housing and labor market characteristics. FBC=1 defined as $FBC_i = 1\left\{\frac{FBCpop_i}{pop_i} \geq 99^{th} percentile\right\}$ for zip code i. All data at the zip code level, excepting permits data, which is at the county level. All data at the quarterly level, excepting employment, establishment, and payroll data, which is annual. Standard errors in parentheses, clustered by CBSA. Significance: *** p<0.01, ** p<0.05, * p<0.1.

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Variable	FBC=0	FBC=1	Difference
HPI	1.976	1.888	-0.074
	(1.499)	(0.947)	(0.108)
HPI growth, 1 Year	0.041	0.039	0.002
	(0.473)	(0.379)	(0.015)
HPI growth, 5 Years	0.307	0.359	0.057
	(0.861)	(0.824)	(0.058)
Lagged HPI	1.957	1.894	-0.052
	(1.412)	(0.924)	(0.107)
Sales	47.533	54.946	3.806
	(63.620)	(49.402)	(3.914)
Lagged Sales	50.086	55.463	1.903
	(64.917)	(49.641)	(4.042)
Permits: Single Family Units	1,403.915	2,012.000	478.352
	(3,445.920)	(3,527.558)	(672.553)
Permits: All Units	2,220.648	5,550.035	3,123.131**
	(5,150.242)	(6,479.830)	(1,364.078)
Establishments	390.730	1,055.530	638.459***
	(464.619)	(750.433)	(51.042)
Estab. growth, 1 year	-0.001	0.008	0.008***
	(0.075)	(0.037)	(0.002)
Estab. growth, 5 years	-0.010	0.027	0.034***
	(0.178)	(0.104)	(0.009)
Employment	6,059.159	17,673.475	11,180.679***
	(9,004.811)	(17,567.438)	(1,428.239)
Emp. growth, 1 year	0.003	0.009	0.002
	(0.162)	(0.201)	(0.004)
Emp. growth, 5 years	-0.005	-0.010	-0.007
	(0.378)	(0.196)	(0.016)
Annual Payroll (1000s)	241.617	1,098.492	838.187***
	(546.318)	(1,560.161)	(150.819)
2010 Population	16,280.107	34,627.074	17,224.406***
	(15,861.714)	(21,414.273)	(1,680.279)
2011 Population	16,177.837	34,163.547	16,872.781***
	(15,766.526)	(21,106.248)	(1,612.878)
2011 Median Income	55,501.430	80,097.359	23,285.756***
	(21,700.305)	(34,987.082)	(4,515.230)

Differences-in-Differences Results:

House prices increase 8–17% in FBC locations in the post-period

$$hpi_{it} = \alpha + \beta FBC_i \times Post_t + \zeta_i + \theta_t + \varepsilon_{it}$$

	(1) HPI	(2) HPI	(3) HPI	(4) HPI
Post=1 X FBC=1	0.118*	0.167***	0.0781*	0.0950**
	(0.0693)	(0.0316)	(0.0435)	(0.0385)
R^2	0.869	0.899	0.889	0.891
Observations	86768	428903	163355	176224
		Fixed Effects		
Quarter	X	X	X	X
Zip	X	X	X	X
State X Quarter		X		
MSA X Quarter			X	
Zone X Quarter				X

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Index Intuition: 19104 in 2017q1

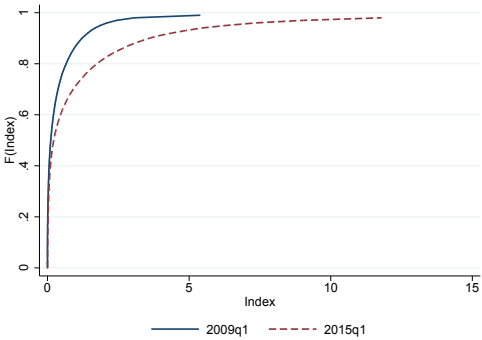
c	$FBpop_{ic}^{2013}$	$FBpop_{c}^{2013}$	$capflow_{ct}, \$B$	$Share_{ict}, \$M$
Canada	140	811,101	4.75	0.82
China	2175	2,241,390	7.9	7.67
India	754	1,896,640	1.95	0.78
Mexico	220	11,604,684	2.325	0.04
UK	185	688,588	2.375	0.64
Other	3845	23,097,640	18.9	3.15
$Index_{it}, \$M$				13.1

$$Share_{ict} = 1000 * capflow_{ct} * \frac{FBpop_{ic}^{2013}}{FBpop_{c}^{2013}}$$

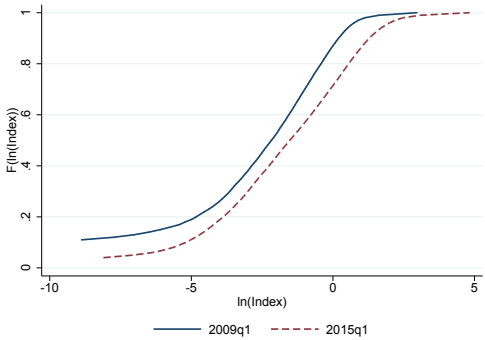
In our sample period, 2009-2015, the index grew from 2.43 to 10.45 in zip code 19104.

Time Series back

Index Summary



(a) $Index_{it}$



(b) $ln(Index_{it})$

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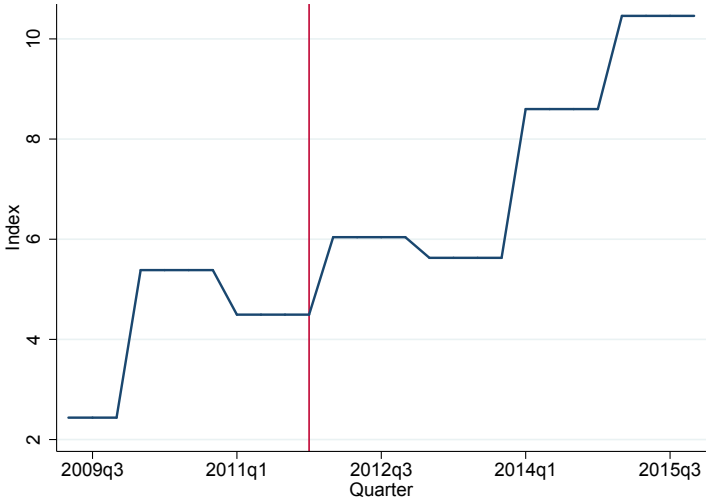
- The distribution of $Index_{it}$ shifts to the right over time as more capital flows into housing
- The share of zip codes with more than M$1 in quarterly inflows increases from 10% in 2009m1 to nearly 30% in 2015q1

Index Intuition: 19104 Time Series



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IV Requirements

Exclusion Restriction: Foreign buyer tax policy changes only impact house prices by diverting capital into the U.S. housing market

$$E[\epsilon_{it}(FBC_i \times Post_t)] = 0$$

Violation

Relevance Criterion: More capital flows into the U.S. housing market after other countries impose foreign buyer taxes

$$E[ln(\widehat{capflow}_{it})(FBC_i \times Post_t)] \neq 0$$

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Exclusion Restriction Violation

Violation: Tech investment and house prices drive results

$$\begin{aligned}\text{Tax policy change} &\rightarrow \text{Foreigners invest in US tech} \\ &\rightarrow \text{Tech cities grow} \\ &\rightarrow \text{Tech city HPI} \uparrow\end{aligned}$$

$$\implies E[\epsilon_{it}(FBC_i \times Post_t)] \neq 0$$

where $Post_t$ is the tax policy change, and the city's tech. status is in ϵ_{it}

Solution: Exclude San Francisco, San Jose, and Seattle from the sample

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Big Tech Results

Results excluding San Francisco, San Jose and Seattle

	(1) HPI	(2) HPI	(3) HPI	(4) HPI
Post=1 X FBC=1	-0.0190	0.132*	0.0616	0.0636
	(0.0523)	(0.0632)	(0.0451)	(0.0569)
R^2	0.876	0.901	0.894	0.892
Observations	76547	415221	162542	149673

Baseline Results

	(1) HPI	(2) HPI	(3) HPI	(4) HPI
Post=1 X FBC=1	0.118*	0.167***	0.0781*	0.0950**
	(0.0693)	(0.0316)	(0.0435)	(0.0385)
R^2	0.869	0.899	0.889	0.891
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Zip	X	X	X	X
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MSA X Quarter			X	
Zone X Quarter				X