The Effect of House Prices on Fertility: Evidence from House Purchase Restrictions

Ziqian Liu[1] Yu Zhang[2]

[1]Guanghua School of Management, Peking University, and Foster School of Business, University of Washington, ziqian.liu.0717@gmail.com

[2]Guanghua School of Management, Peking University, yuzhang@gsm.pku.edu.cn

Motivation

- The birth rate declined amid a surge in urban house prices in China from 2016 onward.
  - urban house prices increased by 54% from 2016 to 2021.
  - the birth rate decreased from 13.6‰ in 2016 to an average of 9.3‰ in 2017–2021, and continued to drop further.
  - this great birth decline sparked concerns of a looming demographic crisis: labor shortages, increased burden of elderly care, slow down economic growth.
  - globally, it could affect global demographics, and shift patterns of economic and political power patterns.
- Assessing the causal impact of house prices on fertility during this period is **critical yet challenging**.

Motivation

- Assessing the causal impact of house prices on fertility during this period is **critical yet challenging**:
  - demographic shifts can influence house prices, which in turn reflect future expectations.
  - the 1st generation of studies directly assumes that indices of local house prices, external to an individual, is exogenous to fertility.
  - the 2nd generation of studies adopt the Saiz (2010) supply elasticity strategy.
  - but superstar cities tend to be inelastic cities. They behave differently (Van Nieuwerburgh and Weill, 2010, Gyourko, Mayer, and Sinai, 2013, Davidoff, 2016).

What We Do

- We use a quasi-experiment, **unintended spillovers from house purchase restrictions**, to estimate the causal effect of house prices on fertility.
    - in 2016, to cool down the overheated housing market, major Chinese cities implemented house purchase restrictions to curtail local investment purchases.
    - investment demand redirected to nearby unregulated prefectures (**"treated cities"**).
    - house prices increased significantly compared to farther away unregulated cities (**"control cities"**).
    - fundamentals did not diverge (**"plausibly exogenous"**).
- We assess **the treatment effect of the house price shock** on:
  (1) the city-level birth rate, (2) individual-level fertility,
  (3) individual-level new marriages, and
  (4) household-level investment on children's education.

What We Find

- The house price shock accounted for a **non-negligible part** of the aggregate birth rate decline.
    - We estimate that the policy alone led to 2.46 million fewer births in the nearby unregulated prefectures, accounting for 10.4% of the aggregate reduction in births.
- The treatment effect came from a group that is **unexpected** but not surprising.
    - fertility declined for ruralites with no urban homeownership.
    - hard to get married.
    - educational opportunities.

Literature

- Real effect of house prices:
  - **consumer spending**: Mian et al. (2013), Aladangady (2017), Guren et al. (2021), Deng et al. (2022), Sodini et al. (2023).
  - **investment**: Chaney et al. (2012), Martin et al. (2021).
  - **entrepreneurship**: Adelino et al. (2015), Schmalz et al. (2017).
  - **labor productivity**: Berstein et al. (2021), Gu et al. (2021).
- House prices and demographics:
  - **effect on house prices**: Mankiw and Weill (1989).
  - **effect on fertility**: e.g. Becker (1960). Yi and Zhang (2010), Lovenheim and Mumford (2013). Dettling and Kearney (2014), Clark, Yi, and Zhang (2020), Liu, Liu, and Wang (2023). Tan, Zhang, Zhang, and Ang (2023, 70/90 reform).
  - **competitive marriage market**: Wei and Zhang (2011), Wei, Zhang, and Liu (2017).
- Fertility and human capital formation:
  - **aggregate growth**: e.g. Barro and Becker (1989), Becker, Murphy, and Tamura (1990).
  - **dispersion in educational resources**: e.g. De La Croix and Doepke (2003), Chetty et al. (2014), Heckman and Landerso (2022).

Ruralites and Urban Homeownership in China

- Essential for **marriage prospects** and **school quality**.
- **Social status** and marriage:
  - Prerequisite for men, signaling financial stability.
- **Educational opportunities**:
  - Linked to property within school's catchment area.
  - Priority: Local hukou, property ownership, and residential location.
- Ruralites **buy urban homes** for marriage and education prospects:
  - 17% of rural vs. 85% of urban households own urban homes.
  - 83% view urban homeownership necessary for marriage.
- Urban homes are tradable; rural homes are not.
  - Rationale for rural homes' non-tradability: Ruralites are **entitled** to land for shelter in village born.
  - Urban house price increases **raise barriers** for rural individuals, affecting marriage and education.

Background: House Purchase Restrictions

Empirical Strategy: We study the impact of plausibly exogenous spillovers, from the imposition of restrictions on housing asset purchases in certain large Chinese cities, on nearby unregulated cities.

Origin of the House Purchase Restrictions:

- During 2012-2016, house prices grow at a high speed of 14.9% annually in Tier 1 cities, but slower than 3% in Tier 3 cities.
- In September 2016 and March 2017, two rounds of policy changes named House Purchase Restrictions were implemented in all Tier 1 and many Tier 2 cities to contain surging house prices. ▸ list of regulated cities
- The policy changes targeted curbing housing market speculators and include:
    - raising down payment requirement to higher levels for 2nd homes
    - outright forbidding the purchase of 2nd, 3rd houses by one family

The Treatment: the HPR spillover shocks

Simultaneous with the imposition of HPRs in the regulated cities, the **nearby unregulated cities** appeared to experience a sharp increase in home sales and house prices.

- Immediately after 2016m9, house prices and transactions surge in the nearby non-regulated cities cities. ▸ examples ▸ volume patterns
- Out-of-town web searches from regulated cities for real estate in nearby non-regulated cities also increase. ▸ search patterns
- We define the **treatment group** as the **nearby non-regulated cities**.
- We define the **control group** as the **far away non-regulated cities**.
- We define 2017 as the first full year when house prices in treatment group were impacted.
- We define 2018 as the first full year when fertility in treatment group were impacted, considering the pregnancy period.

The Treatment: the HPR spillover shocks

Treatment designation:

- We define the **treatment group** as the **nearby non-regulated cities**.
- We define the **control group** as the **far away non-regulated cities**.

More specifically:

- If a city is within 250 km of a regulated city, then it belongs to the treatment group.
- Otherwise, it belongs to the control group. (Deng et al., 2022)
- Quintessentially, we adopt a spatially heterogeneous treatment effect strategy.
- One concern is the arbitrariness of the 250 km cutoff or the discrete treatment designation. Robustness checks:
    - alternative discrete cutoffs: 300 km, 200 km, or
    - model the treatment effect to decay continuously with distance.

Regression Model

- Because the cities are inherently different in distance from the regulated cities, the urban literature has shown such initial conditions may predict growth rate differences (Glaeser, Scheinkman, and Shleifer, 1995). Thus, we adopt a difference-in-differences specification that explicitly takes this into account (Wolfers, 2006, and Bilinski and Hatfield, 2019):

$$Y_{i,t} = \sum_{\tau \leq k \leq T} \beta_k \times Treat_i \times \mathbb{I}_{t=k} + \Gamma X_{i,t} + \gamma(i)t + \alpha_i + \delta_t + \epsilon_{i,t}.$$

  The coefficient of interest is the mean of the post-period $beta_k$'s, which measure the average treatment effect after the house purchase restriction spillover shock.The specification imposes little structure on the response dynamics while allowing the estimated group-specific (or city-specific) time trends to identify preexisting trends.

- We also find no evidence that GRP growth, public education expenditures, or number of hospital beds diverge between the treatment and control groups.

- The outcome variable $Y_{i,t}$ can be (1) the city-level birth rate, (2) individual-level fertility, (3) individual-level new marriage, or (4) household-level educational investments.

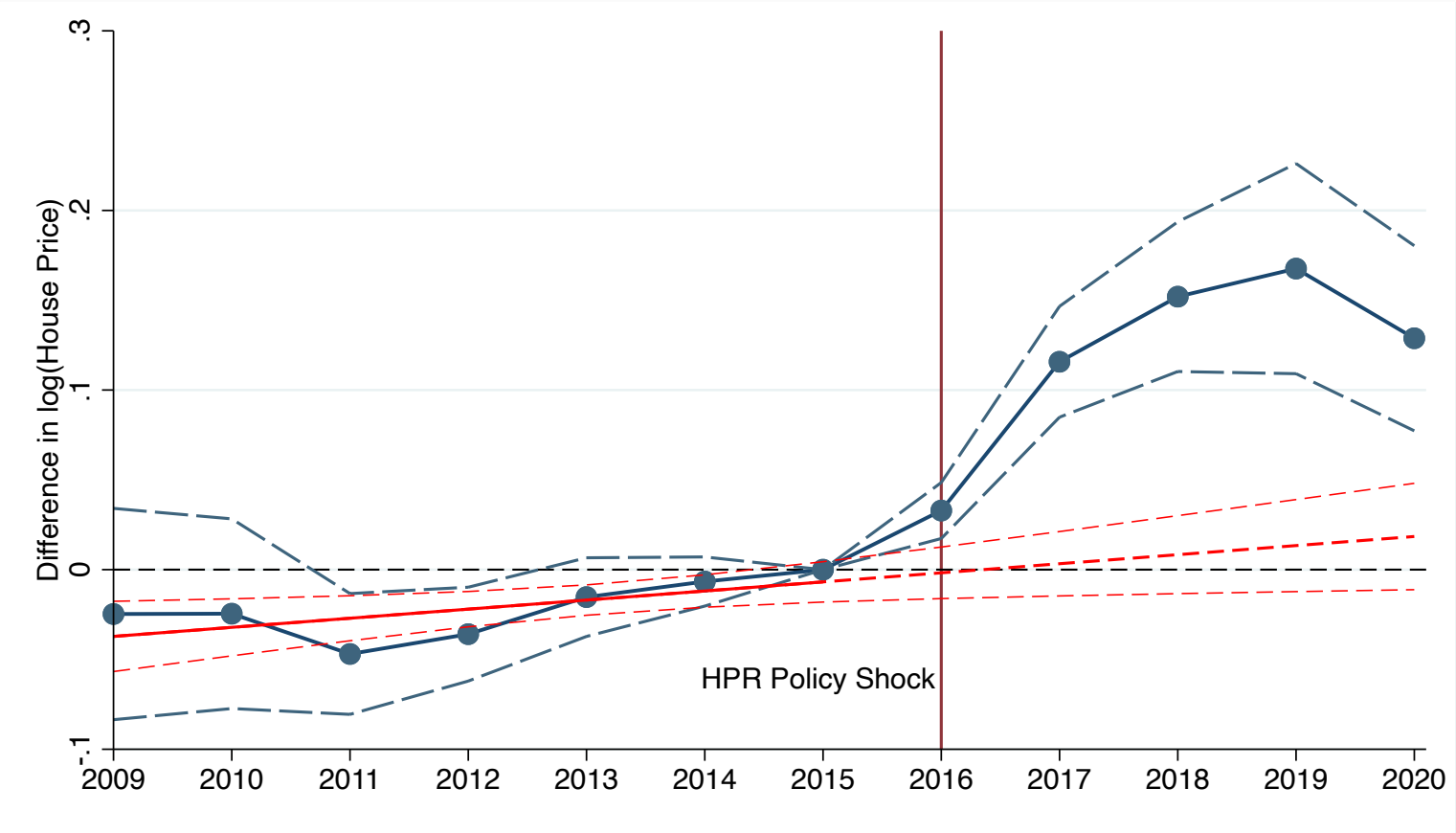
Assessing both city-level and individual-level data

Data sources:

- City-level:
  - Annual birth rates, scraped from Statistical Communiqués (2009-2021).
  - City-level urban house price indices from CityRE.
  - Control variables from City Statistical Yearbooks.
- Micro-level:
  - Data from China Family Panel Studies (CFPS), six waves: 2010, 2012, 2014, 2016, 2018, 2020.
  - Focus on women of childbearing age (15 to 44).
  - Meticulously reconstructed records of births at the annual level.
  - Meticulously reconstructed records of new marriages at the biennial level.
  - Household educational expenditures at the biennial level.
  - Demographic, economic, and social controls include age, education level, marital status, party membership, urban residence, migratory status, health score, housing tenure, per capita family net income, and mortgage debts.

The House Price Shock

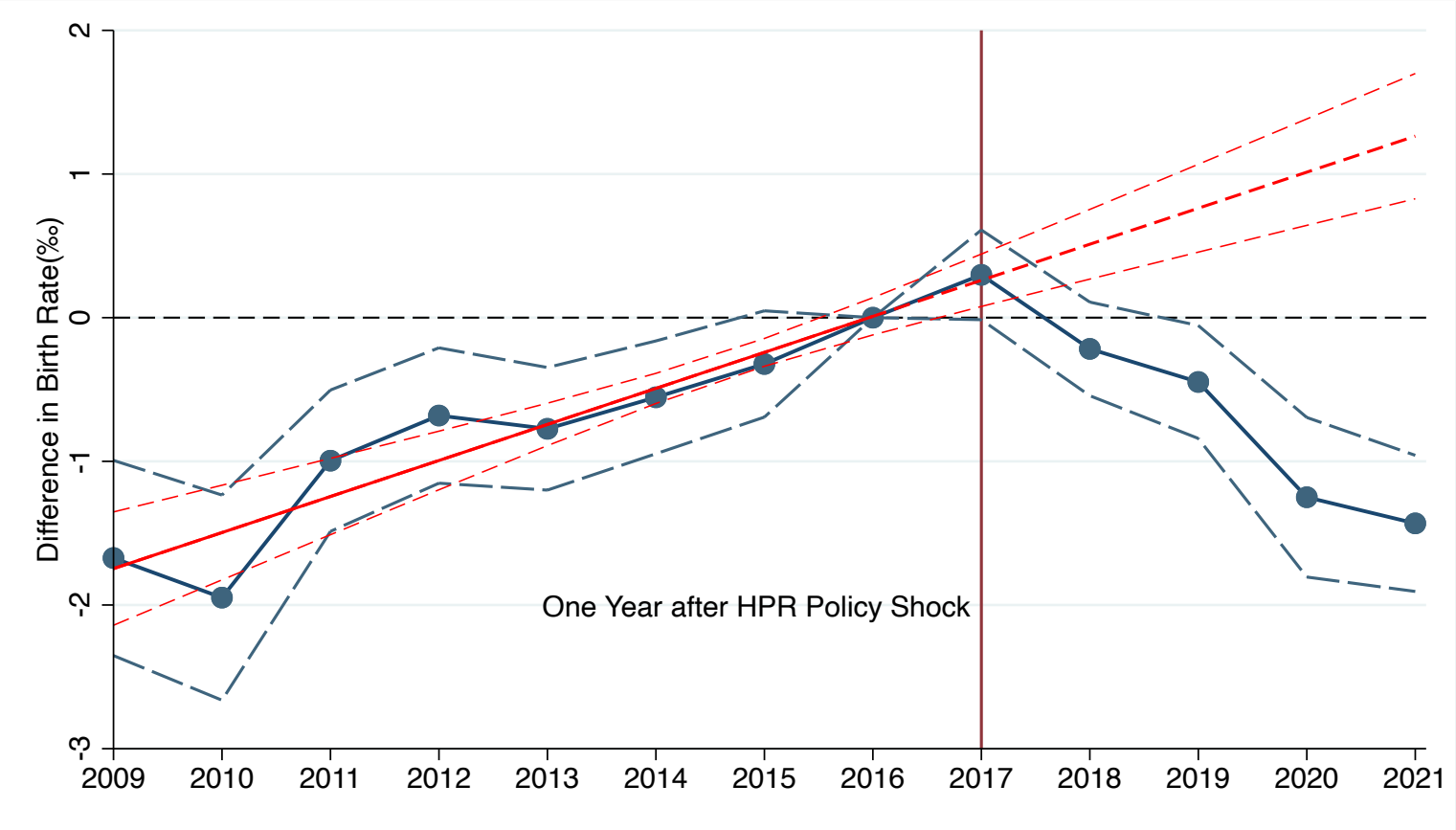
- Urban house prices in treated cities surged abnormally post-HPR spillover shock, deviating from pre-existing trends.
- Urban house price gap between treated and control cities:
  - 9% above trend in 2017.
  - 12% above trend in 2018 and 2019.



Average Treatment Effects

Treatment Effect on City-level Birth Rates

- Significant deviation from trend in city-level birth rates in treated cities for four years post-treatment.
- Reduction on average 1–2‰.
- Positive pre-trends in birth rates & house prices in treated cities (in-migration).
    - Necessity of exogenous shock to estimate house price impact on fertility.



Semi-elasticity of Birth Rates to House Prices

- Birth rate abnormally decreased in treated prefectures after the house price shock triggered by house purchase restriction spillovers.
- The preferred semi-elasticity suggest a 10% exogenous house price increase, fundamentals unchanged, reduces the birth rate by 0.876‰.

Table 2: DID Estimated Effects of HPR Spillovers on Birth Rates and House Prices (City-level)

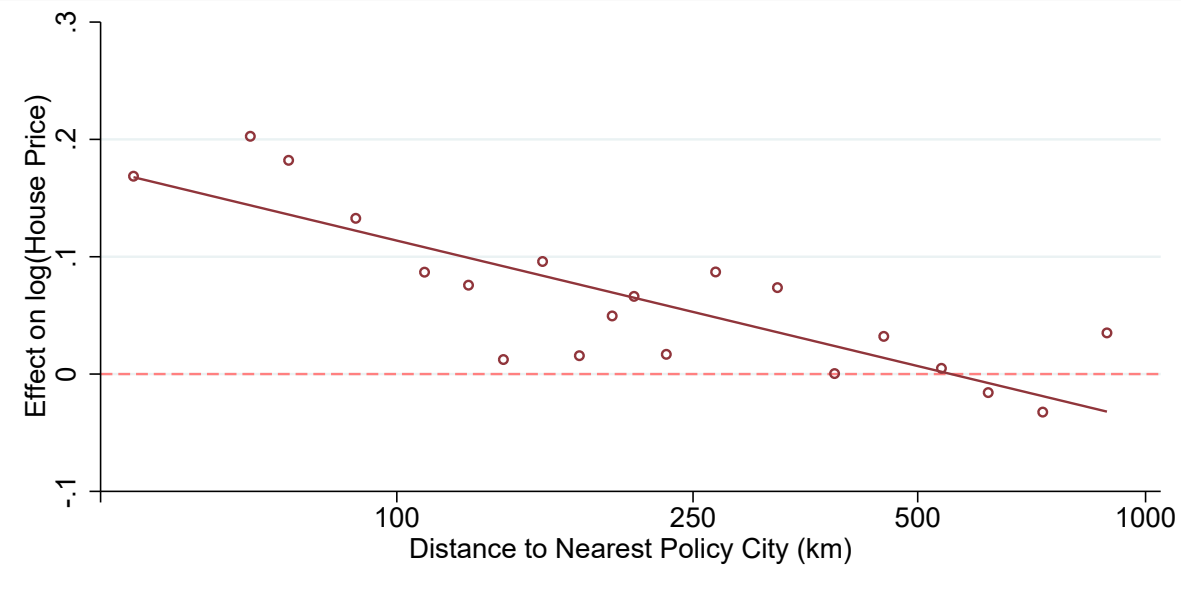
	(1) log(House Price)	(2) log(House Price)	(3) Birth Rate(‰)	(4) Birth Rate(‰)	(5) Birth Rate for the Next Year (IV)	(6) Birth Rate for the Next Year (IV)
Treat × Post	0.138***	0.124***	-1.557***	-1.683***		
	(0.030)	(0.030)	(0.305)	(0.293)		
log(House Price)					-7.099***	-8.760***
					(2.233)	(2.555)
Mean	8.544	8.544	10.723	10.723	8.544	10.723
R^2	0.971	0.940	0.877	0.820	-0.392	-0.540
Observations	2589	2589	2589	2589	2589	2589
City FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
City Trend	yes	no	yes	no	yes	no
Group Trend	no	yes	no	yes	no	yes
City Controls	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Aggregating treatment effects over unregulated cities

- identification assumption: house prices and fertility would have continued along pre-existing trends.
- cities within 551 km of a regulated city displayed abnormally high house prices.
- average house price increase 8.4%. combined population 840 million.
- average birth rate reduction 0.73‰ ($= 0.084 \times -8.76$).
- birth shortfall of 2.46 million babies (0.73‰$\times$ 840 million $\times$ 4 years).



Fertility reduction consistent in the microdata

- Among the CFPS panel individuals, the house price shock abnormally reduced the number of newborns in the treatment prefectures.

Table 3: DID Estimated Effects of HPR Spillovers on the Number of Newborns (Individual-level)

	(1) Newborns	(2) Newborns	(3) Newborns	(4) Newborns
Treat × Post	-0.025***	-0.028***	-0.024**	-0.027***
	(0.010)	(0.010)	(0.010)	(0.010)
Mean	0.061	0.061	0.061	0.061
R^2	0.041	0.038	0.046	0.043
Observations	78408	78408	78408	78408
Individual FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
City Trend	yes	no	yes	no
Group Trend	no	yes	no	yes
Individual Controls	no	no	yes	yes
Family Controls	no	no	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fertility reduction consistent under alternative distance cutoffs

(a) DID robustness check of using alternative distance cutoff: 200 km

	(1) log(House Price)	(2) log(House Price)	(3) Birth Rate(‰)	(4) Birth Rate(‰)	(5) Newborns	(6) Newborns
Treat×Post	0.151***	0.142***	-1.349***	-1.454***	-0.023**	-0.023**
	(0.029)	(0.029)	(0.324)	(0.310)	(0.010)	(0.010)
Mean	8.544	8.544	10.723	10.723	0.061	0.061
R^2	0.971	0.940	0.875	0.819	0.038	0.043
Observations	2589	2589	2589	2589	78408	78408
City FE	yes	yes	yes	yes	no	no
Individual FE	no	no	no	no	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
City Trend	yes	no	yes	no	yes	no
Group Trend	no	yes	no	yes	no	yes
City Controls	yes	yes	yes	yes	no	no
Individual Controls	no	no	no	no	yes	yes
Family Controls	no	no	no	no	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(b) DID robustness check of using alternative distance cutoff: 300 km

	(1) log(House Price)	(2) log(House Price)	(3) Birth Rate(‰)	(4) Birth Rate(‰)	(5) Newborns	(6) Newborns
Treat×Post	0.160***	0.142***	-1.564***	-1.610***	-0.026***	-0.025***
	(0.030)	(0.030)	(0.305)	(0.291)	(0.010)	(0.010)
Mean	8.544	8.544	10.723	10.723	0.061	0.061
R^2	0.971	0.940	0.877	0.819	0.038	0.043
Observations	2589	2589	2589	2589	78408	78408
City FE	yes	yes	yes	yes	no	no
Individual FE	no	no	no	no	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
City Trend	yes	no	yes	no	yes	no
Group Trend	no	yes	no	yes	no	yes
City Controls	yes	yes	yes	yes	no	no
Individual Controls	no	no	no	no	yes	yes
Family Controls	no	no	no	no	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

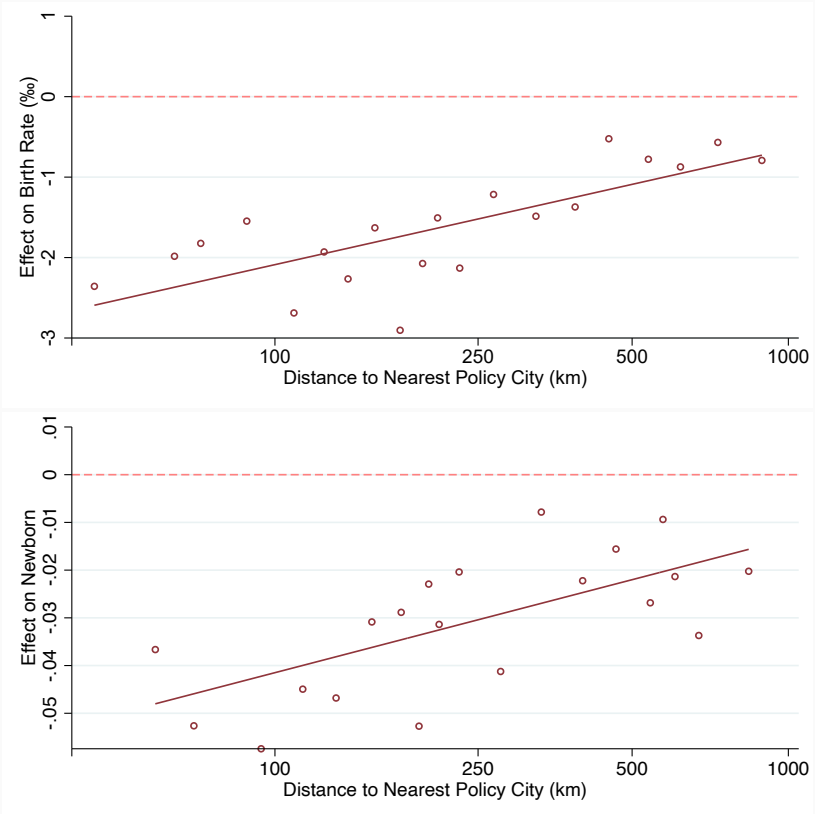
Fertility reduction consistent under continuous distance specification

(c) DID robustness check of using continuous distance specification

	(1) log(House Price)	(2) log(House Price)	(3) Birth Rate(‰)	(4) Birth Rate(‰)	(5) Newborns	(6) Newborns
log(Distance)×Post	-0.125***	-0.113***	0.884***	0.953***	0.013**	0.012***
	(0.016)	(0.016)	(0.173)	(0.170)	(0.006)	(0.005)
Mean	8.544	8.544	10.723	10.723	0.061	0.061
R^2	0.973	0.944	0.876	0.819	0.038	0.043
Observations	2589	2589	2589	2589	78408	78408
City FE	yes	yes	yes	yes	no	no
Individual FE	no	no	no	no	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
City Trend	yes	no	yes	no	yes	no
Group Trend	no	yes	no	yes	no	yes
City Controls	yes	yes	yes	yes	no	no
Individual Controls	no	no	no	no	yes	yes
Family Controls	no	no	no	no	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$



Fertility reduction not driven by treatment prefectures potentially urbanizing faster

- Instead, we find faster urbanization prefectures to have higher birth rates, consistent with urban living facilitating producing and raising offsprings.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative "Treatment Designation": $\Delta X_{2016-2021}$ >Median($\Delta X_{2016-2021}$)	$X =$ Urbanization Rate		$X =$ Share of Primary Industry GDP		$X =$ Share of Primary Industry GDP (Incl. Agri. Services)		$X =$ Share of Primary Industry Emp.	
Dependent Variable: Birth Rate(‰)								
$\text{Treat}_{Alternative} \times \text{Post}$	0.627*	0.738**	0.200	-0.101	0.002	0.003	-1.294**	-1.304**
	(0.352)	(0.339)	(0.331)	(0.318)	(0.504)	(0.439)	(0.535)	(0.505)
R^2	0.876	0.828	0.872	0.825	0.872	0.825	0.872	0.824
Obs	2658	2658	2658	2658	2658	2658	2658	2658
City FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
City Trend FE	yes	no	yes	no	yes	no	yes	no
Group Trend FE	no	yes	no	yes	no	yes	no	yes
City Control	yes	yes	yes	yes	yes	yes	yes	yes

Standard errors in parentheses

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Fertility reduction not related to One-Child Policy relaxation

- Potentially, treated prefectures had OCP relaxation birth waves before the shock, and births fell down after.
- We find no evidence that treated prefectures had any larger OCP relaxation birth waves before the shock. They were no different.

	(1) Birth Rate(‰)	(2) Birth Rate(‰)	(3) Newborns	(4) Newborns
$\text{Treat}_{HPRSpillover} \times \text{Post}_{OCP}$	0.029	-0.263	-0.003	-0.005
	(0.321)	(0.293)	(0.016)	(0.016)
Mean	11.347	11.347	0.066	0.066
R^2	0.875	0.806	0.053	0.049
Observations	1799	1799	48022	48022
City FE	yes	yes	no	no
Individual FE	no	no	yes	yes
Year FE	yes	yes	yes	yes
City Trend	yes	no	yes	no
Group Trend	no	yes	no	yes
City Controls	yes	yes	no	no
Individual Controls	no	no	yes	yes
Family Controls	no	no	yes	yes

Standard errors in parentheses

$^{*}\ p < 0.1, ^{**}\ p < 0.05, ^{***}\ p < 0.01$

Mechanisms

Overview of Mechanism Tests

- We next assess whether cost for living space or other costs urban house price represents, such as access to education, account for the fertility effects.
- Also, we examine whether the reduction occurred primarily in married couples, or there is also an effect on marriage itself.
- Finally, from the perspective of human capital formation, we explore whether there is an intensive margin response in parents' expenditure on children's education that accompanies the extensive margin fertility decline.

Recall: Ruralites and Urban Homeownership in China

- Essential for **marriage prospects** and **school quality**.
- **Social status** and marriage:
  - Prerequisite for men, signaling financial stability.
- **Educational opportunities**:
  - Linked to property within school's catchment area.
  - Priority: Local hukou, property ownership, and residential location.
- Ruralites **buy urban homes** for marriage and education prospects:
  - 17% of rural vs. 85% of urban households own urban homes.
  - 83% view urban homeownership necessary for marriage.
- Urban homes are tradable; rural homes are not.
  - Urban house price increases **raise barriers** for rural individuals, affecting marriage and education.

Cost for shelter does not explain fertility effect of house price shock

- The fact that we find a significant reduction in fertility responses among rural dwelling owners (column 2) but essentially a nil effect among urban owners (column 4), suggests that the role of housing as shelter does not fully explain the fertility reduction.

Table 5: Heterogeneous Treatment Effects by Housing Tenure in Rural and Urban Areas

	(1)	(2)	(3)	(4)
		Rural	Rural	Urban
	Does Not	(Does Not Own	(Does Own	(Does Own
	Own Any	Urban Home)	Urban Home)	Urban Home)
Dependent Variable: Number of Newborns				
Treat × Post	-0.020	-0.039***	0.011	-0.004
	(0.045)	(0.012)	(0.054)	(0.018)
R^2	0.054	0.058	0.009	0.013
Observations	6259	46965	7334	17533
Individual FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
City Trend	no	no	no	no
Group Trend	yes	yes	yes	yes
Individual Controls	yes	yes	yes	yes
Family Controls	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Gap in education resources is related to the fertility response

- among rural dwelling owners with no urban homeownership, the fertility reduction is statistically and economically more significant in counties where rural schools are more distant.
- these results are consistent with the idea that one factor driving the rural individuals' fertility reduction response to an positive urban house price shock is the gap in education resources.

	Rural (Does Not Own Urban Home)	
	(1)	(2)
	Schools Distant	Schools Nearby
Dependent Variable: Number of Newborns		
Treat × Post	-0.061***	-0.029
	(0.020)	(0.022)
R^2	0.068	0.058
Observations	11478	12535
Individual FE	yes	yes
Year FE	yes	yes
City Trend	no	no
Group Trend	yes	yes
Individual Controls	yes	yes
Family Controls	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

House price shock reduced fertility among the rural married

- We find rural dwelling owners with no urban homeownership to be the only group to have a significant fertility decline among the married after the urban house price shock.

Heterogeneous Treatment Effects Among the Married Population, by Housing Tenure in Rural and Urban Areas

	(1)	(2)	(3)	(4)
		Rural	Rural	Urban
	Does Not	(Does Not Own	(Does Own	(Does Own
	Own Any	Urban Home)	Urban Home)	Urban Home)
Dependent Variable: Number of Newborns				
Treat×Post	-0.034	-0.034**	0.022	0.001
	(0.065)	(0.016)	(0.080)	(0.025)
R^2	0.053	0.081	0.036	0.051
Observations	3616	32702	5428	12091
Individual FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
City Trend	no	no	no	no
Group Trend	yes	yes	yes	yes
Individual Controls	yes	yes	yes	yes
Family Controls	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

House price shock reduced marriage prospects for ruralites

- We find rural dwelling owners with no urban homeownership to be the only group to have a significant marriage rate decline among women of childbearing age after the urban house price shock.

	(1)	(2)	(3)	(4)
		Rural	Rural	Urban
	Does Not	(Does Not Own	(Does Own	(Does Own
	Own Any	Urban Home)	Urban Home)	Urban Home)
Dependent Variable: New Marriage				
Treat×Post	-0.101	-0.028***	0.030	-0.002
	(0.080)	(0.016)	(0.061)	(0.033)
R^2	0.071	0.084	0.166	0.085
Observations	1325	16437	1615	5479
Individual FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
City Trend	no	no	no	no
Group Trend	yes	yes	yes	yes
Individual Controls	yes	yes	yes	yes
Family Controls	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Competitive savings motive and fertility reduction among the ruralites

- Prefectures with a higher local sex ratio is associated with a stronger fertility reduction among the ruralites. These areas also experience a sizeable reduction in new marriage among the rural male, and in fertility among the rural married.
- These new findings showcase the mechanisms in Wei and Zhang (2011).

Table 9: Treatment Effects Among Rural Dwelling Owners with no Urban Homeownership, by Local Sex Ratio

Dependent variables	Newborn		New marriage		New marriage (men)		Newborn (married)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Local sex ratio	High	Low	High	Low	High	Low	High	Low
Treat×Post	-0.064***	-0.018	-0.030*	-0.031	-0.052	-0.012	-0.057**	-0.014
se	(0.017)	(0.017)	(0.016)	(0.029)	(0.040)	(0.031)	(0.023)	(0.022)
Individual FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
City Trend FE	no	no	no	no	no	no	no	no
Group Trend FE	yes	yes	yes	yes	yes	yes	yes	yes
Individual Control	yes	yes	yes	yes	yes	yes	yes	yes
Family Control	yes	yes	yes	yes	yes	yes	yes	yes
R2	0.0623	0.0458	0.0701	0.0967	0.0770	0.1257	0.0831	0.0700
Obs	21877	25088	7620	8817	7957	9137	15257	17445

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Parents' investment on children's education

- Ruralites with no urban homeownership increased private educational investment, possibly as a strategic adaptation to limited resources and public education opportunities in face of higher urban house prices.
- Groups with urban homeownership reduced private educational investment, albeit statisically insignificantly. Possibly, housing and human capital investment act as substitutes.

	(1)	(2)	(3)	(4)
		Rural	Rural	Urban
	Does Not Own Any	(Does Not Own Urban Home)	(Does Own Urban Home)	(Does Own Urban Home)
Dependent Variable: Educational Investments				
Treat×Post	0.605	0.582***	-0.636	-0.269
	(0.962)	(0.153)	(1.039)	(0.610)
R^2	0.640	0.287	0.406	0.321
Observations	734	15285	1733	4217
Household FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
City Trend	no	no	no	no
Group Trend	yes	yes	yes	yes
Family Controls	yes	yes	yes	yes

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Model as micro-foundation and a lens to interpret result

- We construct an OLG model to analyze the effects of urban house prices on decisions regarding fertility, marriage, and educational investments.
- We borrow from the frameworks of Barro and Becker (1989) and De la Croix and Doepke (2003).
- Individuals live for three periods: young, mid, and old age.
  - young: resolution of marriage uncertainty.
  - mid-age: work, purchase housing, produce offspring, and decide children's educational investments.
  - old age: divide property among their children (if any).
- Bellman equation for mid-age:

$$V(q_t, h_{t-1}^{ur}, h_{t-1}^{ru}, M_t) = \max_{\{c_t, h_t^{ur}, n_t, e_t\}} \ln(c_t) + \gamma \ln(h_t) + \alpha M_t + \beta a(n_t) n_t E_t V(q_{t+1}, (1-\delta)\frac{h_t^{ur}}{n_t}, h_t^{ru}, M_{t+1}).$$

where q is human capital, n is number of offsprings, and M is marriage.

Model as micro-foundation and a lens to interpret result

We capture how urban housing ownership relates to **offspring's education quality and marriage prospects**.

- In urban areas, public school catchment is often linked to property ownership, affecting the educational opportunities of entering better schools.

$$\bar{q}_t = \bar{q}, h_t^{ur} \in \{0\} \quad \text{versus} \quad \bar{q}_t = \bar{q}(1+\kappa) > \bar{q}, h_t^{ur} \in [\underline{h}, \infty)\,.$$

- Private investments (paid by household) and public investments (school quality) in education combine to produce human capital (De La Croix and Doepke 2003 and De la Croix and Doepke 2004).

$$q_{t+1} = (e_t)^{\mu} \cdot (\bar{q}_t)^{1-\mu}$$

- Urban housing ownership improves relative attractiveness for marriage, therefore affecting an offspring's probability π of getting married (Wei and Zhang 2011 and Wei, Zhang, and Liu 2017).
- Rural housing only produces housing consumption.

$h_t^{ut} \uparrow$ shock: Not only (1) marginal rise in shadow cost and reduction in dynastic utility, but (2) inframarginal exit from urban housing.

Model as micro-foundation and a lens to interpret result

- Simplified model with $\gamma = 0, \phi = 0, n_t \in \{0, 1\}$, and generation $t + 1$ being the last generation.
- Proposition 1 *A sufficiently large increase in the urban house price causes inframarginal responses on housing tenure, fertility, and private educational investment in the simplified model focusing on school quality and marriage prospects. Furthermore, there is a one-to-one mapping between generation t rural individuals' preferences and endowment parameters and one of two strategic responses: (1) exit the urban housing market, with fertility unchanged, but increase private educational investment in children, (2) exit the urban housing market and reduce fertility.*
- Given Proposition 1, with heterogeneity in rural individuals' preferences and endowments, this simplified model analytically generates that after a $h_t^{ut} \uparrow$ shock, fertility on average declines, but private educational investment in children born on average rises. Both reflect strategic adaptation to prohibitive costs of better marriage prospects and alternative urban educational opportunities.

Conclusion

- Chetty et al. (2014) indicate that a child's prospects for upward mobility in the U.S. are greatly influenced by relocating to the right areas and are negatively impacted by residential segregation.
- Heckman and Landerso (2022) show that family residential decisions in Denmark are typically made early in children's lives, often before their birth.
- Our findings, in the context of China's great birth decline, show how surges in urban house prices influence family residential choices, impacting marriage and childbearing dynamics, especially for rural residents.
- Policymakers need to consider these unintended consequences when designing housing regulations.
- In addition, future research should explore how the remaining rural population decides between staying in declining rural areas or overcoming barriers to urbanization.
- Understanding these dynamics is crucial for addressing demographic challenges and promoting sustainable economic growth.

Thank you!

Background: House Purchase Restrictions

Table 2: First Round of House Purchase Restrictions

City	Policy Shock	Date Effective
Beijing	• Raise the down payment: from 35% to 40% for the 1st house; from 35% to 50%-70% for the 2nd house.	2016.9.30
Changsha	• Price-cap regulation: the average transaction price cannot increase further.	2016.11.25
Chengdu	• Raise the down payment: from 35% to 40% for the 2nd house.	2016.10.9
Fuzhou	• Raise the down payment: to 30% for the 2nd house .	2016.10.14
Guangzhou	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resident purchases: cannot own more than 2 houses.	2016.10.1
Haikou	N/A	N/A
Hangzhou	• Restrictions on non-resident purchases: cannot own more than 1 house in city center areas. • Raise the down payment: from 30%-40% to 50% for the 2nd house.	2016.9.20
Hefei	• Restrictions on resident purchases: cannot own more than 2 houses. • Raise the down payment: to 40%-50% for the 2nd house.	2016.10.1
Huizhou	N/A	N/A
Jinan	• Raise the down payment: from 20% to 30% for the 1st house; from 20% to 30%-40% for the 2nd house.	2016.10.2
Nanchang	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resident purchases: cannot own more than 2 houses.	2016.10.8
Nanjing	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resident purchases: cannot own more than 2 houses.	2016.9.25
Qingdao	N/A	N/A
Sanya	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resident purchases: cannot own more than 2 houses.	2016.10.1
Shanghai	• Decrease credit supply (by rationing).	2016.10.19
Shenzhen	• Restrictions on purchases: cannot own more than 1 house. • Raise the down payment: to 30%-50% for the 1st house.	2016.10.4
Shijiazhuang	• Raise the land tax: to 3% for the 2nd house.	2016.10.1
Tianjin	• Restrictions on non-resident purchases: cannot own more than 1 house. • Raise the down payment: to 40% for the 1st house purchased by nonresidents.	2016.9.30
Wuhan	• Restrictions on non-resident purchases: cannot own more than 1 house. • Raise the down payment: to 25% for the 1st house; to 50% for the 2nd house.	2016.10.3
Wuxi	• Raise the down payment: to 40% for the 2nd house.	2016.10.2
Xiamen	• Restrictions on non-resident purchases: those who own 1 house can only purchase additional houses with areas larger than 180 m^2. • Restrictions on resident purchases: those who own 2 houses can only purchase additional houses with areas larger than 180 m^2. • Raise down payment: to 30% for the 1st house; to 40% for the 2nd house.	2016.10.5
Zhengzhou	• Restrictions on non-resident purchases: those who own 1 house can only purchase additional houses with areas larger than 180 m^2. • Restrictions on resident purchases: those who own 2 houses can only purchase additional houses with areas larger than 180 m^2. • Raise down payment: to 30% for the 1st house; to 40% for the 2nd house.	2016.10.2

back

Background: House Purchase Restrictions

Table 3: Second Round of House Purchase Restrictions

City	Policy Shock	Date Effective
Beijing	• Raise the down payment: to 60%-80% for the 2nd house. • Decrease credit supply: stop providing mortgages lasting longer than 25 years.	2017.3.17
Changsha	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resident purchases: cannot own more than 2 houses. • Raise the down payment: to 30% for the 1st house; to 35%-40% for the 2nd house.	2017.3.18
Chengdu	• Restrictions on purchases: each family can only own 1 house.	2017.3.23
Fuzhou	• Raise the down payment: to 50% for the 2nd house. • Restrictions on resale: owner needs to hold a house for 2 years before resale.	2017.3.28
Guangzhou	• Raise the down payment: from 30% to 40%-70% for families that ever applied for mortgages.	2017.3.17
Haikou	• Restrictions on non-resident purchases: cannot own more than 1 house. • Restrictions on resale: owner needs to hold a house for 2 years before resale.	2017.4.14
Hangzhou	• Restrictions on non-resident purchases: cannot own more than 1 house in the city area. • Restrictions on resident purchases: cannot own more than 2 houses in the city area.	2017.3.3
Hefei	• Increase mortgage rate by 10%.	2017.3.20
Huizhou	• Increase mortgage rate by 10%.	2017.3.20
Jinan	• Raise the down payment: to 60% for the 2nd house . • Increase the mortgage rate by 10%. • Restrictions on resale: owner needs to hold a house for 2 years before resale.	2017.4.19
Nanchang	• Restrictions on non-resident purchases: raise the criteria for the purchases. • Restrictions on resident purchases: cannot own more than 1 house.	2017.3.8
Nanjing	• Restrictions on non-resident purchases: raise the criteria for the purchases. • Raise the down payment: from 30%-40% to 50% for the 2nd house.	2017.3.15
Qingdao	• Raise the down payment: from 20 to 30% for the 1st house; from 30 to 40% for the 2nd house.	2017.3.16
Sanya	• Raise the down payment: from 30%-40% to 50% for the 2nd house.	2017.3.11
Shanghai	• Decrease credit supply (by stricter rationing).	2017.3.17
Shenzhen	• Increase mortgage rate by 10%.	2017.3.20
Shijiazhuang	• Raise the down payment: to 30%-40% for the 1st house; to 50%-60% for the 2nd house.	2017.3.17
Tianjin	• Restrictions on non-resident purchases: raise the criteria for the purchases. • Restrictions on resident purchases: each individual cannot own more than 1 house. • Raise the down payment: to 40% for the 1st house purchased by nonresidents.	2017.3.31
Wuhan	• Increase mortgage rate by 10%.	2017.3.20
Wuxi	• Increase mortgage rate by 10%.	2017.3.20
Xiamen	• Restrictions on resident purchases: an individual can only own 1 house.	2017.3.24
Zhengzhou	• Restrictions on non-resident purchases: raise the criteria for the purchases.	2017.3.17

▸ back

Example: HPR Spillovers

Three pairs of cities illustrates the effect of policy spillover shocks on regulated (first) and neighboring (second) cities: Beijing–Tangshan, Hefei–Bengbu, and Wuhan–Xiangyang.

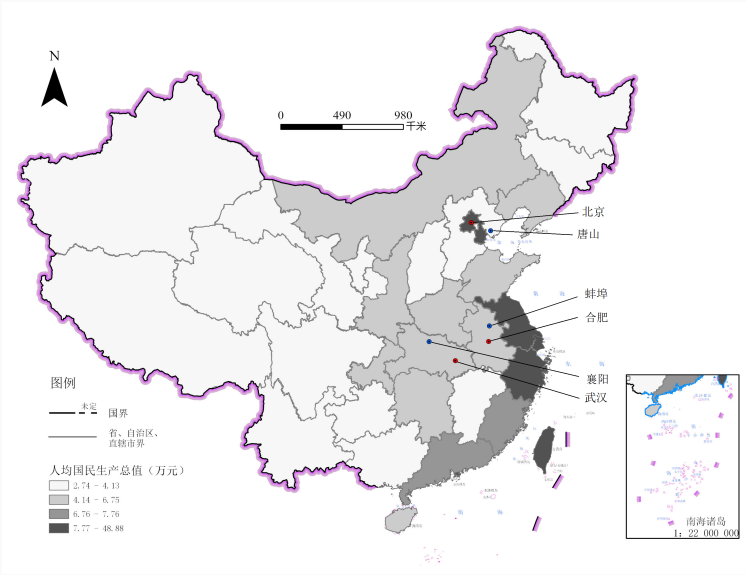
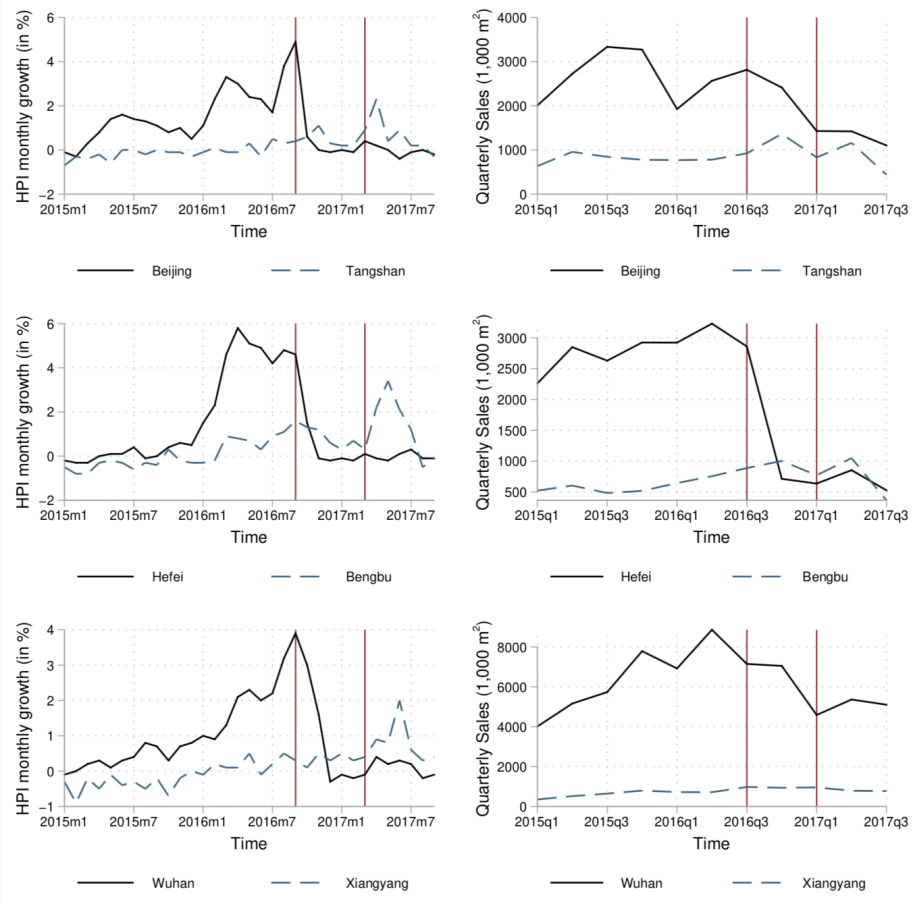
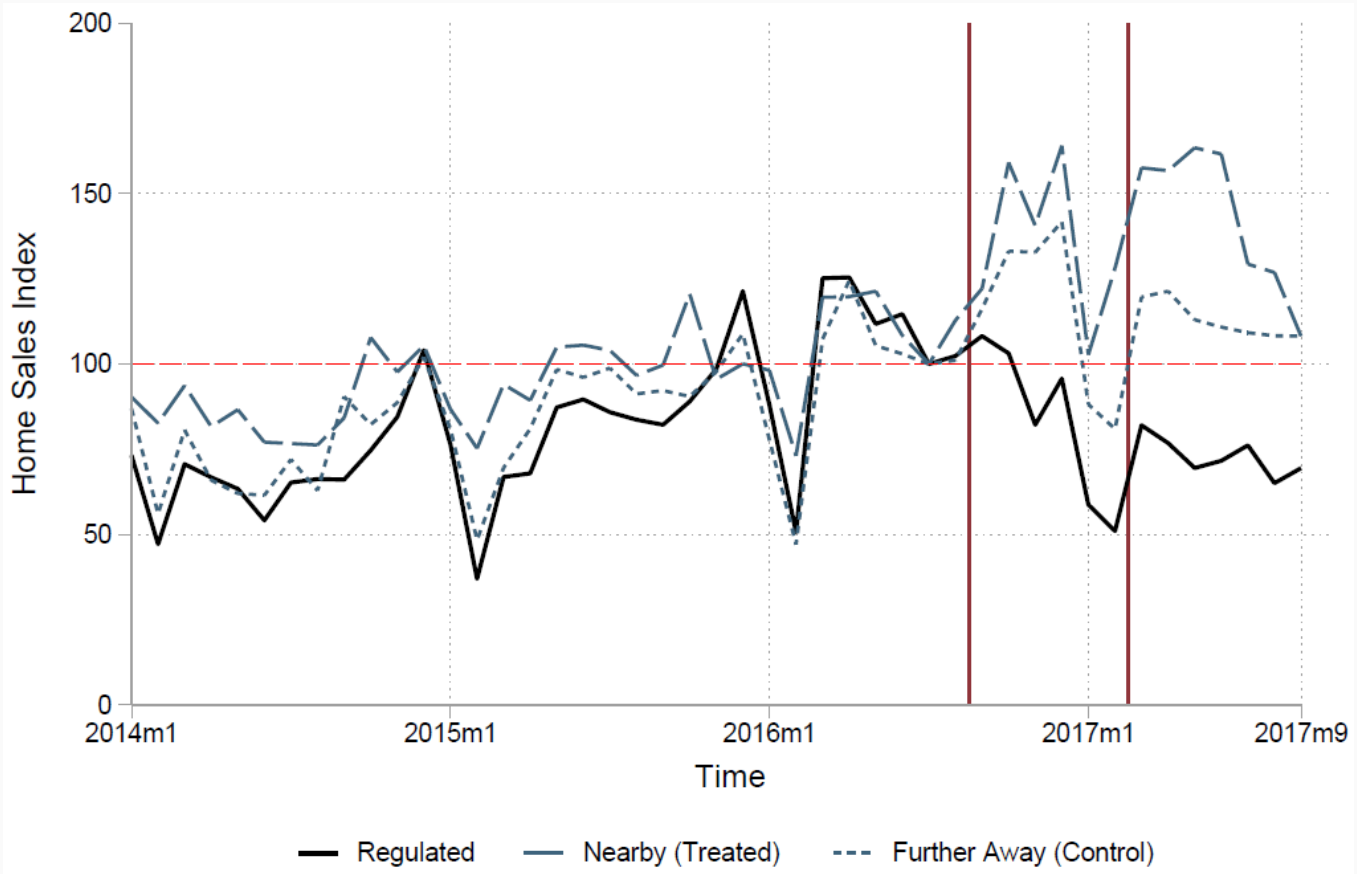


Figure 3: Reactions of House Prices and House Sales to the Restrictions - Some Examples



Example: Transaction Volumes Wanes and Waxes

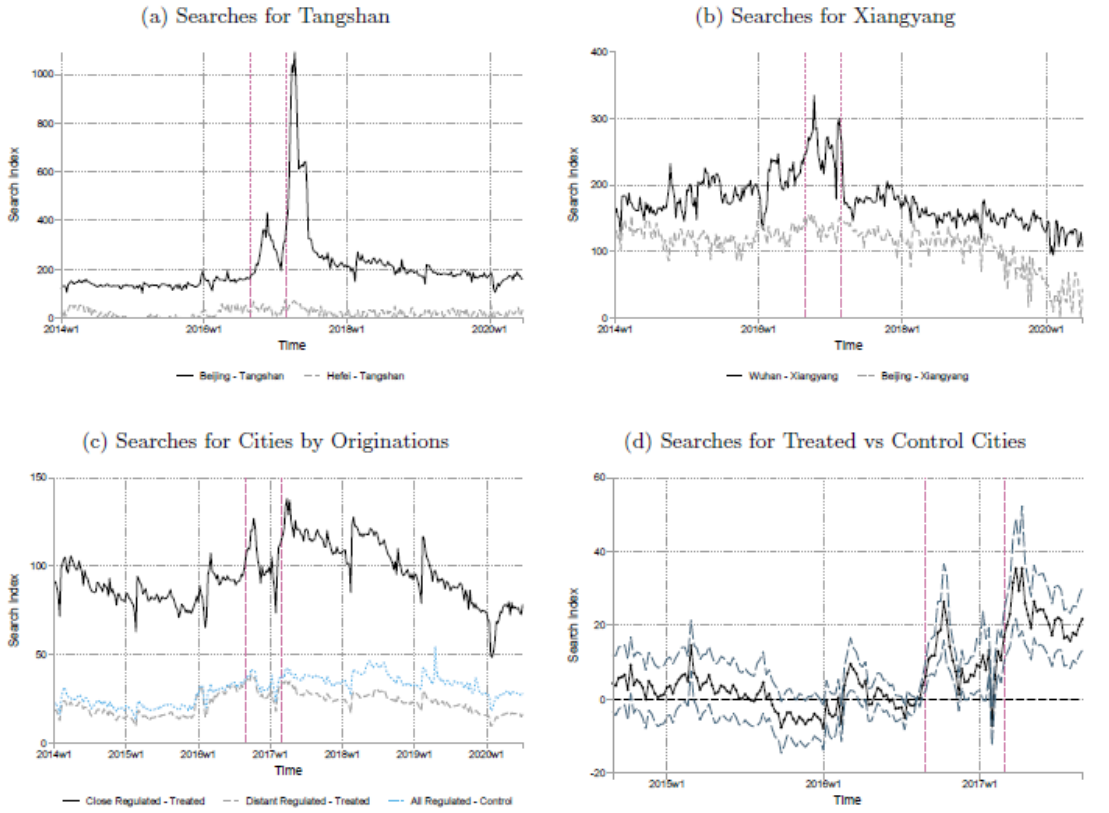
In Deng, Liao, Yu, and Zhang (2022), we also find motivating evidence that reductions in volumes in the regulated cities are consistent with the increase in volumes in the nearby non-regulated cities.



back

Example: Additional Patterns in Out-of-Town Searches

Figure 3: Web Searches of House Prices – Evidence of Out-of-Town Buyers



Notes: This figure plots the intensity of web searches of keywords related to house price and house market of the non-regulated cities originated from regulated cities, to show evidence of out-of-town buyers. We use Baidu search index to measure the intensity of web searches from one city to another. Panel (a) plots the intensity of searches for Tangshan originated from Beijing and Hefei. Both Beijing and Hefei are regulated cities, but Beijing is close to Tangshan and Hefei is distant. Panel (b) plots the intensity of searches for Xiangyang originated from Wuhan and Beijing. Both Wuhan and Beijing are regulated cities, but Wuhan is close to Xiangyang and Beijing is distant. Panel (c) plots the average intensity of searches for treated cities originated from close (<250km) regulated cities, from distant (≥250km) regulated cities, and average intensity of searches for control cities originated from all regulated cities. Treated cities are defined as non-regulated cities within 250km from the closest regulated city and the rest non-regulated cities are control cities. Panel (d) plots the estimated difference in intensity of searches for treated cities and control cities originated from all regulated cities, based on coefficients from a difference-in-differences regression.

back