

The impact of High Speed Rail on industry clustering and housing market

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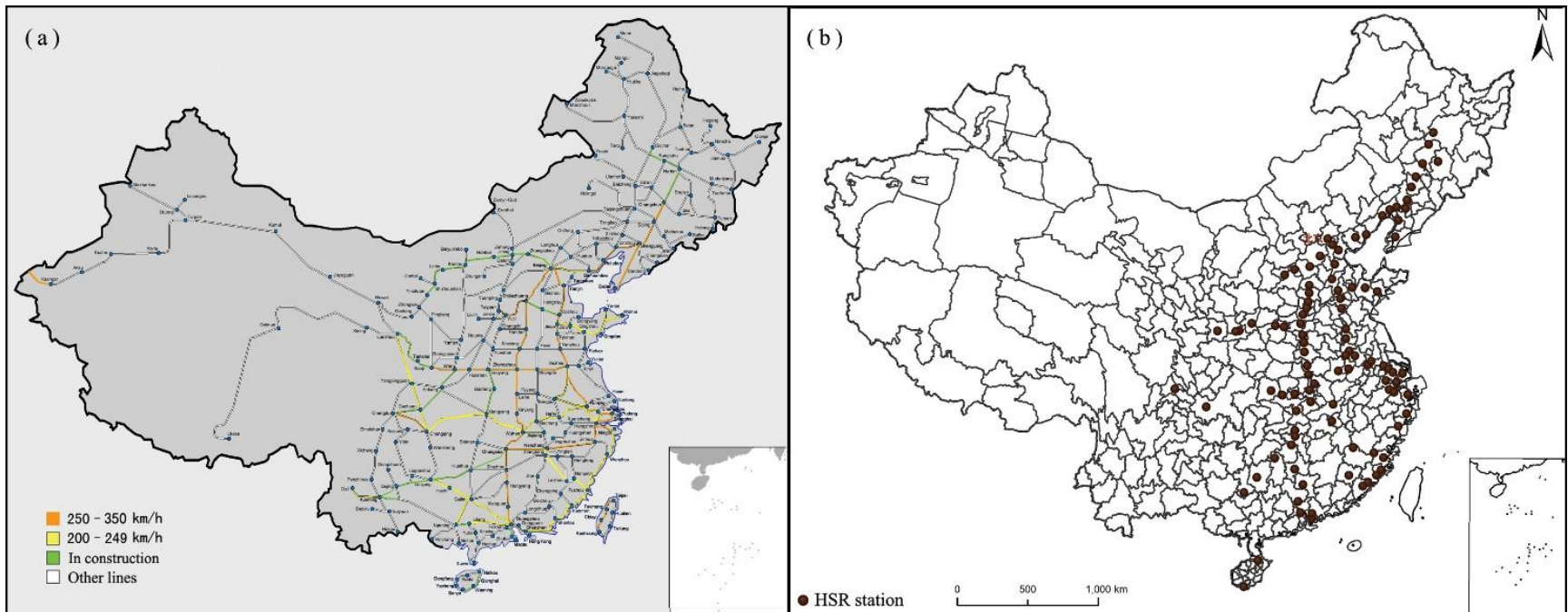
HSR movement

- 250 km per hour, International Union of Railway
- First wave: 1964, Japanese Shinkansen (Tokyo and Osaka)
- Second wave: 1980s, 1990s, European countries, France (TGV), Spanish, German..
- Third wave: 2000 -, China, South Korea, India...
- Substantial development cost, about \$25-30 million per km
- Agglomeration economics

HSR development in China

- 2004, 4+4 networks, 12000 km
- 2009, Speed up due to 4 trillion stimulus package
- 2016, 8+8 networks, 38000km
- 2019, 35000 km, 2/3 world network

HSR network and stops in China in 2013 (11,000 km in 97 cities)



Literatures

- Urban and regional growth (Ahlfeldt and Feddersen, 2017; Shao et al., 2017, Meng et al. 2018; Monzon et al. 2013; Qin, 2017.).
- Accessibility (Jiao et al. 2014, Shaw et al, 2014, Diao, 2018)
- Housing market (Diao et al. 2017, Zheng & Kahn, 2013)
- Rail-air competition (Chen, 2017; Zhang et al, 2017;Jiang et al. 2017)

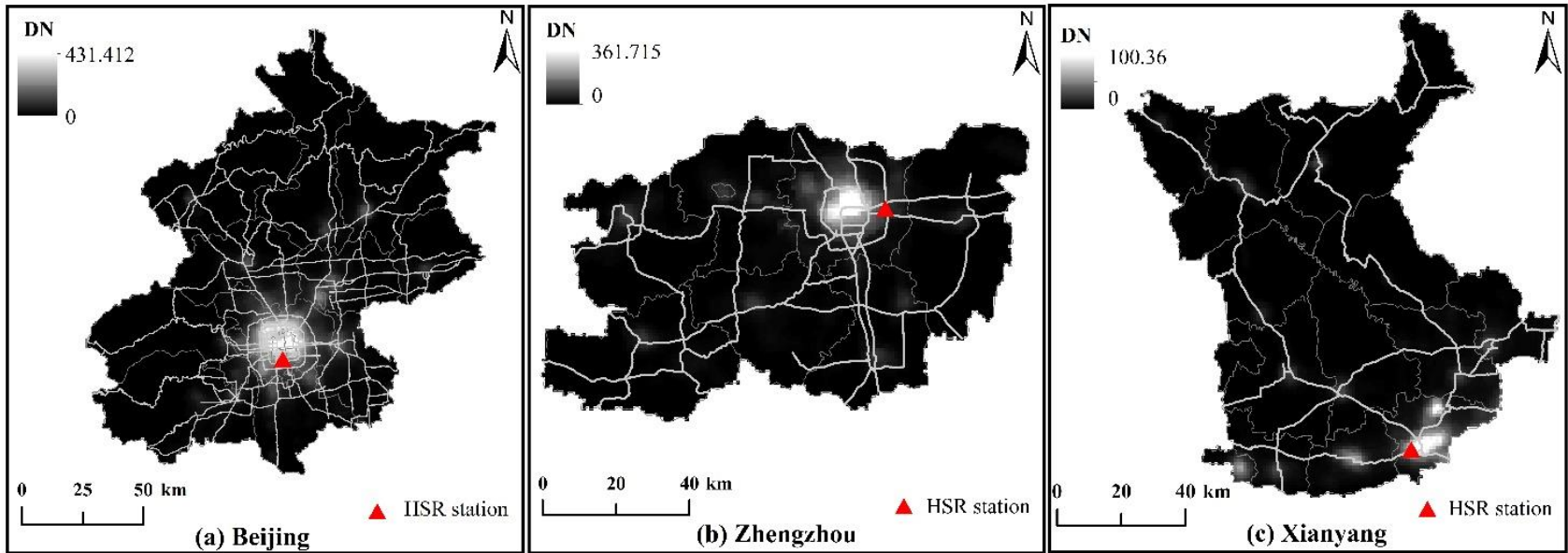
- Planning and implementation: China Railway, Provincial government, local government

- Many under-developed local governments take HSR as a economic development engine and tend to fully leverage the spatial spillover benefits of HSR

- Location choice of HRS is related to cost-benefit analysis

Spatial spillover effect of HSR

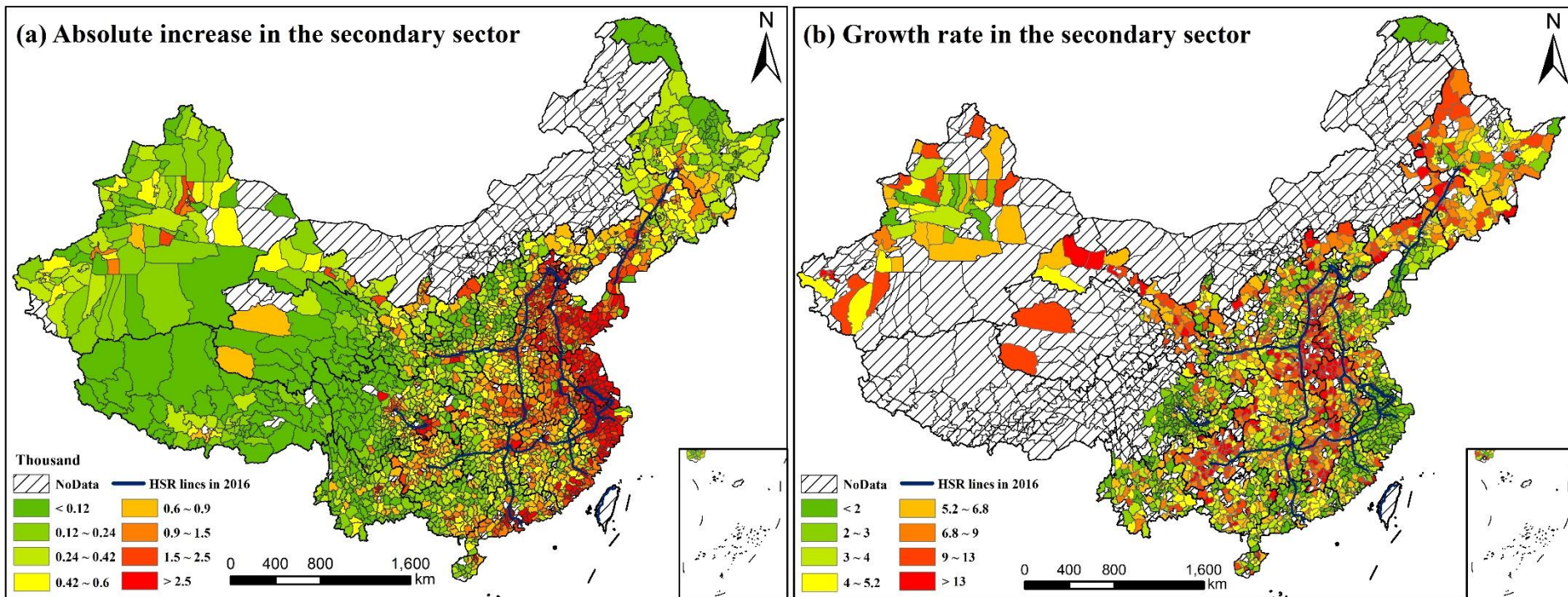
- The intensities of nighttime light image was increased by 27%
- Zheng et al (2019)



HSR and new firm establishment

- Agglomeration benefits VS cost
- Urbanization economics versus localization economics
- Data source: firm registration data, 2004-2016

Figure 1: HSR extension and new firm establishment (2006-2016)

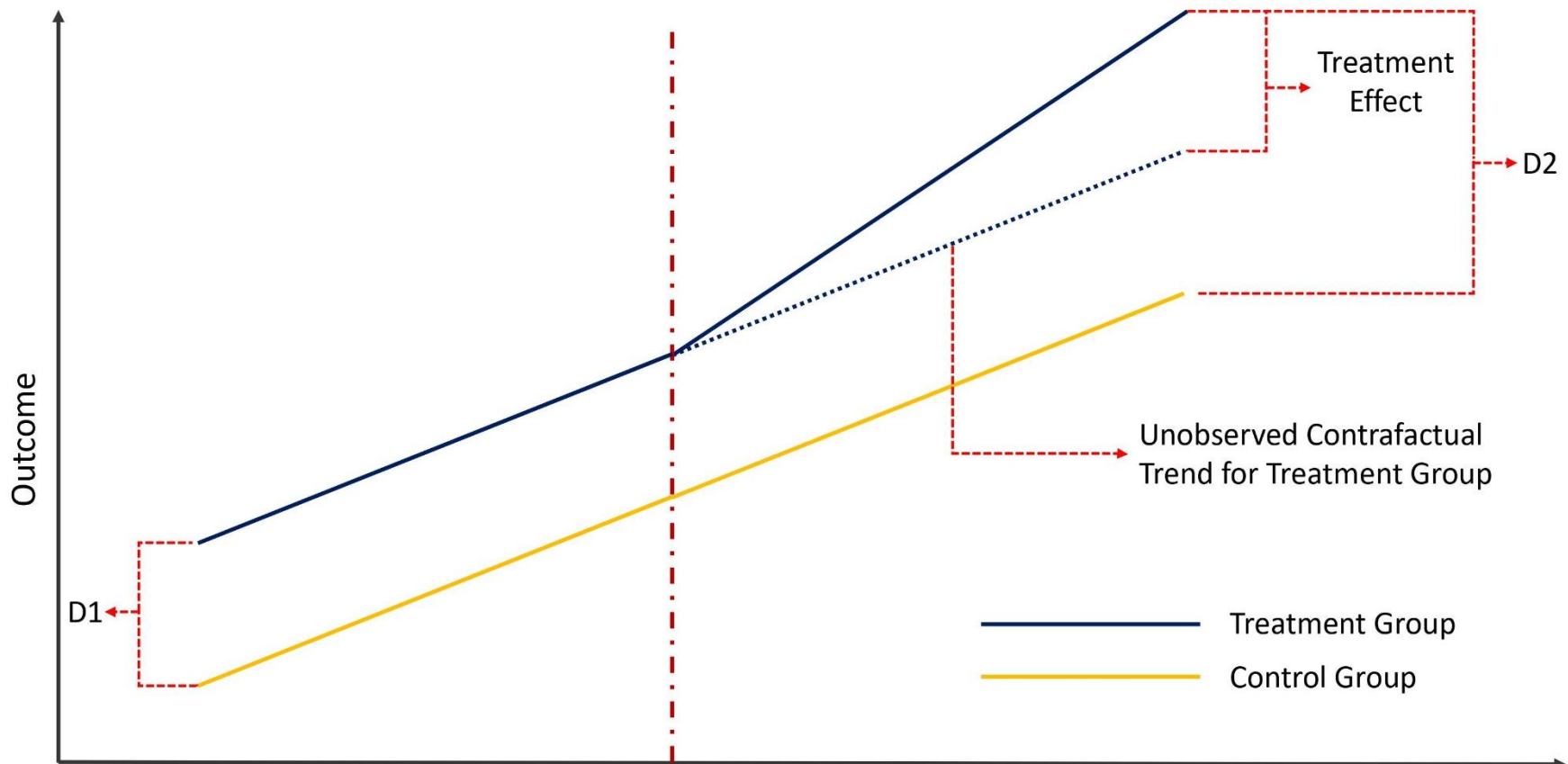


Empirical strategy

- Two way fixed effect DID (Difference-in-differences)

$$Y_{it} = a_0 + a_1 HSR_{it} + a_2 X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Dependent variable is the number of new firms in county i at the year t .

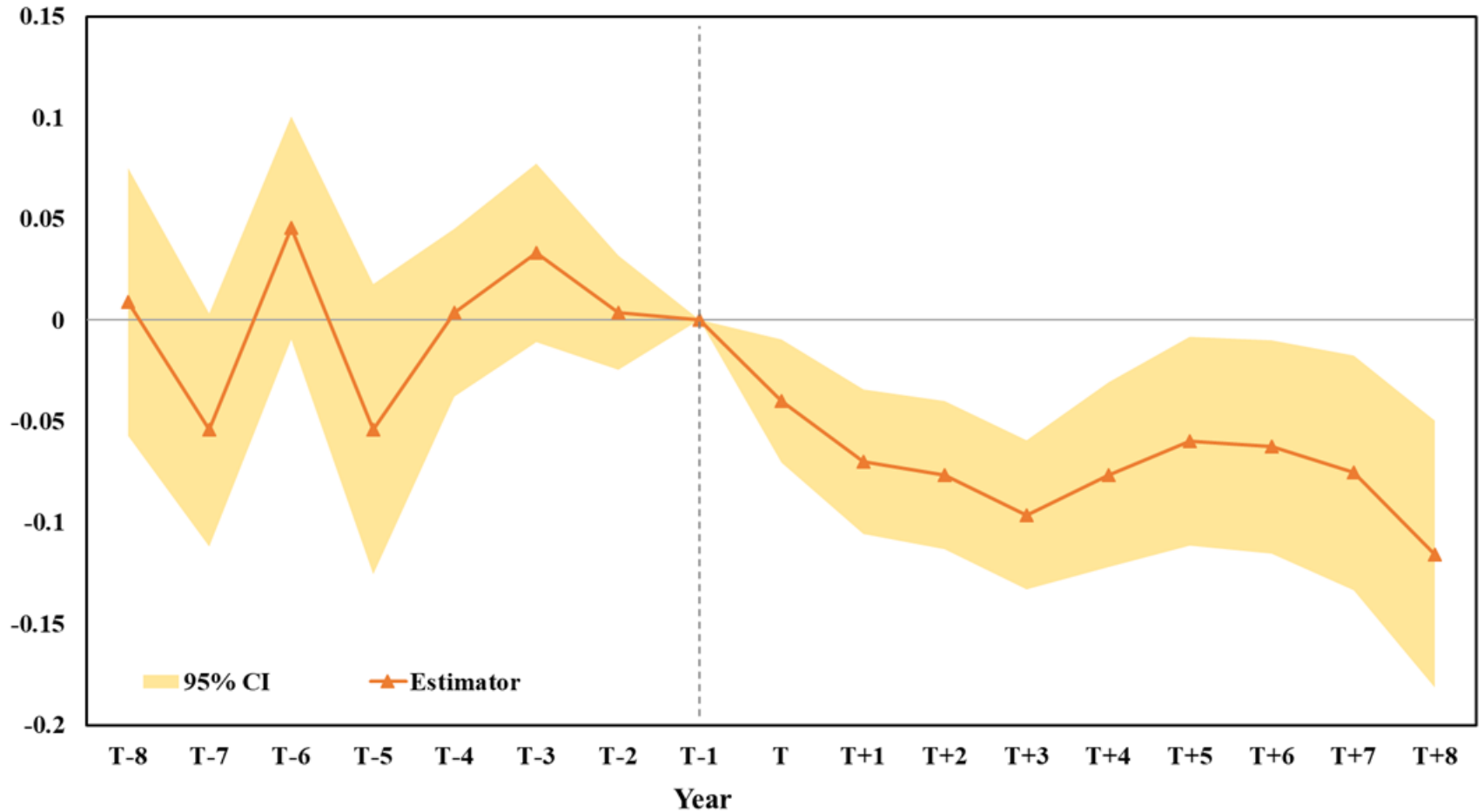


Baseline results

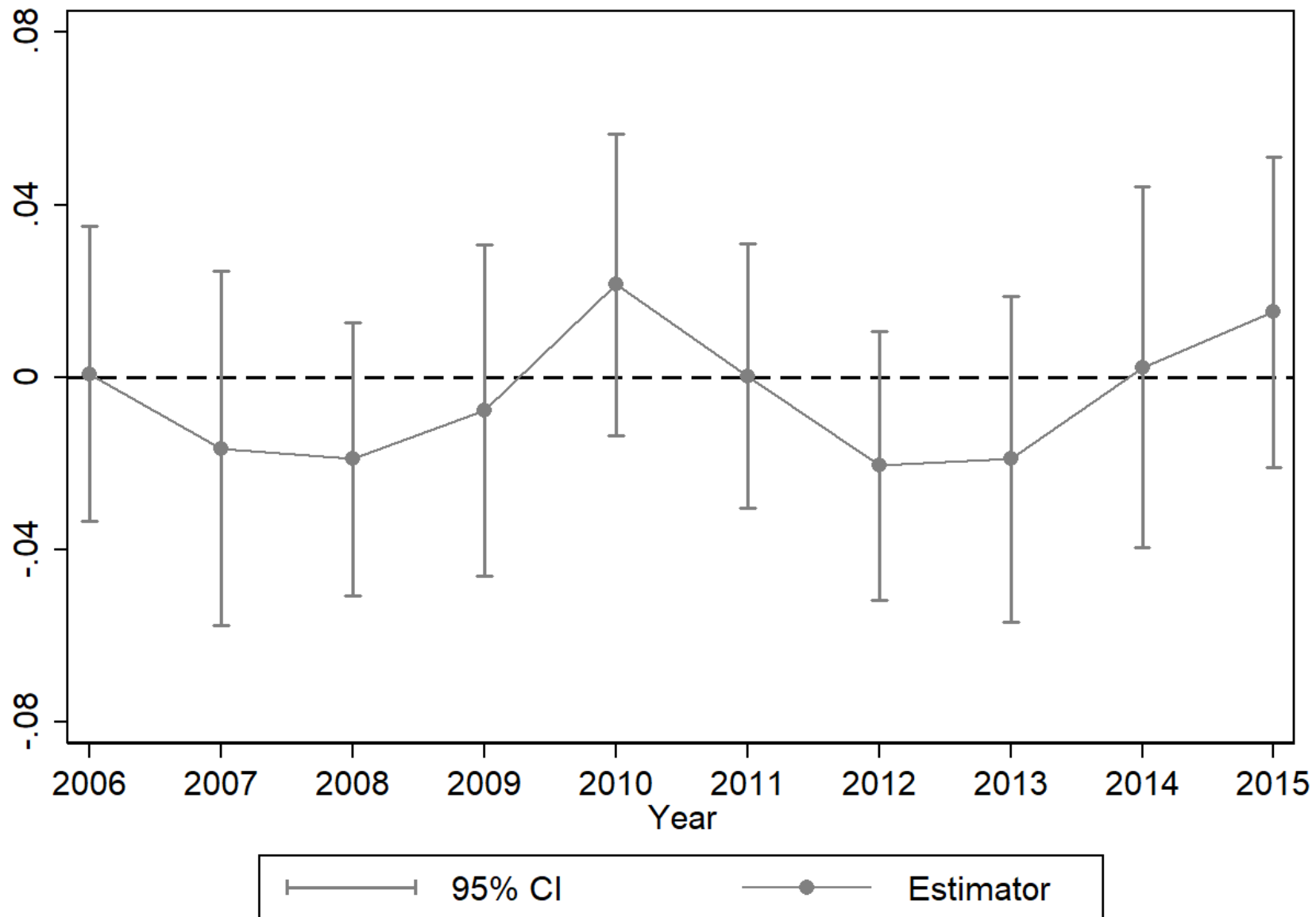
	Pooled OLS			Difference-in-differences				PSM & Difference-in-differences		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treat	-0.0194	0.0478	-0.0183							
	(0.0365)	(0.0372)	(0.0162)							
Treat×After				0.134***	-0.102***	-0.105***	-0.044***	-0.130***	-0.132***	-0.0612***
				(0.0212)	(0.0183)	(0.0183)	(0.0149)	(0.0211)	(0.0207)	(0.0180)
L.Plant Stock			0.796***				0.538***			0.544***
			(0.0208)				(0.0216)			(0.0386)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County effects	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Province trend	No	No	No	No	No	Yes	Yes	No	Yes	Yes
R2	0.784	0.809	0.920	0.769	0.839	0.839	0.851	0.838	0.838	0.854
Observation	26715	26715	24660	26715	26715	26715	24660	10400	10400	9600

Event study

$$Y_{it} = b_0 + \sum_{\tau} B_{T\tau} HSR_j \times \mathbf{1}[\tau = T] + b_2 X_{it} + \mu_j + \tau_t + \varepsilon_{it} \quad (2)$$



Falsification test



Urban vs suburban

	(1)	(2)	(3)	(4)
HSR	-0.0436***	-0.0609***		
	(0.0149)	(0.0154)		
Nearby		-0.0557***		
		(0.0131)		
HSR×Urban			0.00600	-0.00916
			(0.0190)	(0.0195)
Nearby ×Urban				-0.0407
				(0.0426)
HSR×Suburban			-0.0732***	-0.0917***
			(0.0196)	(0.0201)
Nearby ×Suburban				-0.0574***
				(0.0135)
L.Plant Stock	0.538***	0.534***	0.537***	0.533***
	(0.0216)	(0.0216)	(0.0217)	(0.0216)
Controls	Yes	Yes	Yes	Yes
County effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Province linear trend	Yes	Yes	Yes	Yes
R2	0.851	0.852	0.852	0.852
Observation	24660	24660	24660	24660

Excluding provincial capital cities

- Inconsequential place approach (Redding and Turner, 2015)

	(1)	(2)	(3)	(4)
HSR	-0.0444***	-0.0613***		
	(0.0168)	(0.0172)		
Nearby		-0.0564***		
		(0.0140)		
HSR×Urban			0.00880	-0.00653
			(0.0228)	(0.0232)
Nearby×Urban				-0.0434
				(0.0444)
HSR×Suburban			-0.0722***	-0.0897***
			(0.0214)	(0.0218)
Nearby×Suburban				-0.0577***
				(0.0145)
L.Plant Stock	0.539***	0.535***	0.539***	0.535***
	(0.0202)	(0.0202)	(0.0202)	(0.0202)
Controls	Yes	Yes	Yes	Yes
County effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Province linear trend	Yes	Yes	Yes	Yes
R2	0.850	0.850	0.850	0.850
Obs	22440	22440	22440	22440

New versus renew

	All		New		Renew	
	(1)	(2)	(3)	(4)	(5)	(6)
HSR	-0.0436***		-0.0535***		-0.0187	
	(0.0149)		(0.0173)		(0.0252)	
HSR×New		-0.0530***				
		(0.0172)				
HSR×Re_New		-0.0157				
		(0.0254)				
HSR×Urban				-0.0068		0.0130
				(0.0260)		(0.0257)
HSR×Suburban				-0.0713***		-0.0860
				(0.0210)		(0.0540)
L.Plant Stock	0.538***	0.538***	0.532***	0.531***	0.533***	0.533***
	(0.0216)	(0.0216)	(0.0225)	(0.0225)	(0.0208)	(0.0208)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Province linear trend	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.851	0.851	0.849	0.849	0.851	0.851
Observation	24660	24660	23329	23329	21119	21119

Heterogeneity by regions

	Eastern		Central		Western		Northeastern	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HSR	-0.0226		0.0391*		-0.215***		-0.00307	
	(0.0222)		(0.0233)		(0.0397)		(0.0374)	
HSR×Urban		-0.0056		0.0909**		-0.112**		0.0441
		(0.0263)		(0.0379)		(0.0561)		(0.0443)
HSR×Suburban		-0.0329		0.0102		-0.271***		-0.0378
		(0.0300)		(0.0282)		(0.0490)		(0.0508)
L.Plant Stock	0.726***	0.725***	0.386***	0.384***	0.538***	0.537***	0.541***	0.548***
	(0.0412)	(0.0412)	(0.0334)	(0.0335)	(0.0401)	(0.0404)	(0.0466)	(0.0475)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province linear trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.874	0.874	0.882	0.882	0.830	0.830	0.888	0.889
Obs	6540	6540	6756	6756	9240	9240	2124	2124

Heterogeneity by regions- cons

	(1)	(2)
HSR×Eastern	-0.0438*	
	(0.0224)	
HSR×Central	0.0417*	
	(0.0225)	
HSR×Western	-0.159***	
	(0.0350)	
HSR×Northeastern	-0.0952***	
HSR×Eastern×Urban		-0.0156
		(0.0252)
HSR×Central×Urban		0.0947***
		(0.0332)
HSR×Western×Urban		-0.0697
		(0.0475)
HSR×Northeastern×Urban		-0.0415
		(0.0426)
HSR×Eastern×Suburban		-0.0598*
		(0.0315)
HSR×Central×Suburban		0.0109
		(0.0288)
HSR×Western×Suburban		-0.207***
		(0.0455)
HSR×Northeastern×Suburban		-0.139***
		(0.0483)
L.Plant Stock	0.537***	0.537***
	(0.0219)	(0.0220)
Controls	Yes	Yes
County effects	Yes	Yes
Year effects	Yes	Yes
Province linear trend	Yes	Yes
R2	0.852	0.852
Obs	24660	24660

Conclusion

- New firm establishment is declined about 4.4% after HSR
- The effect is entirely captured by suburban/rural areas
- Great heterogeneities: regions and sectors.
- Our results show the HSR can change the industrial clustering pattern and strengthen the regional inequality.
- Our study enriches literatures in HSR planning and accessibility, TOD, polycentric development and place-based policy.

HSR and city cluster strategy



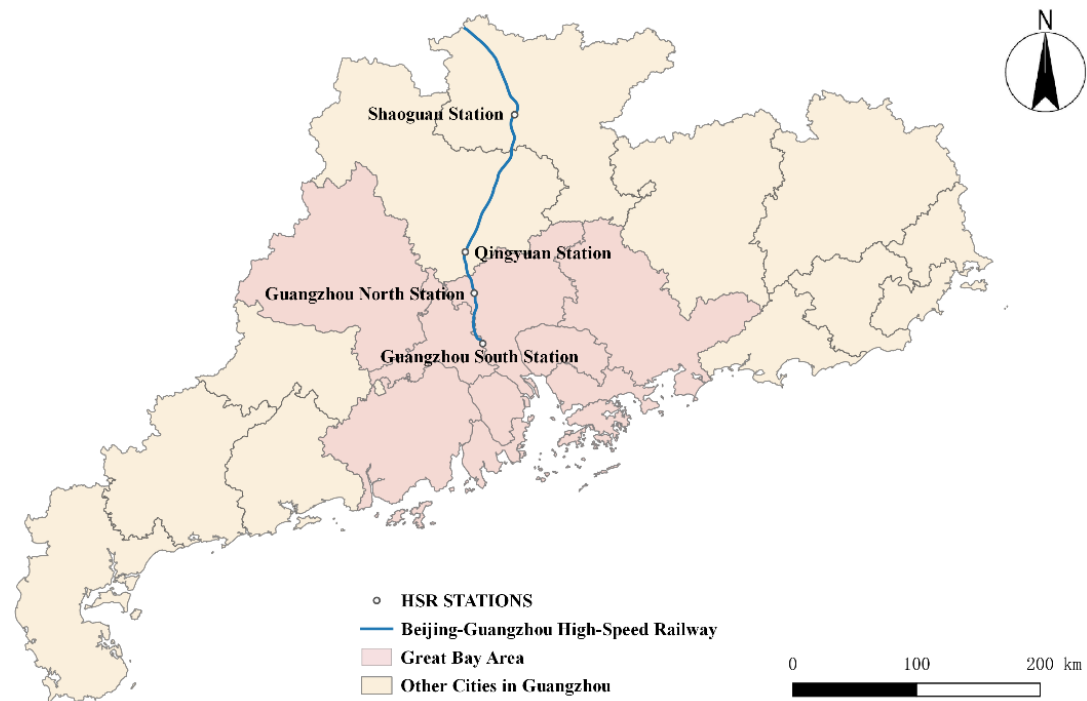
HSR expansion in GBA

GBA: Pearl river delta +HK, Macau

Ares: 56,000 sq km²

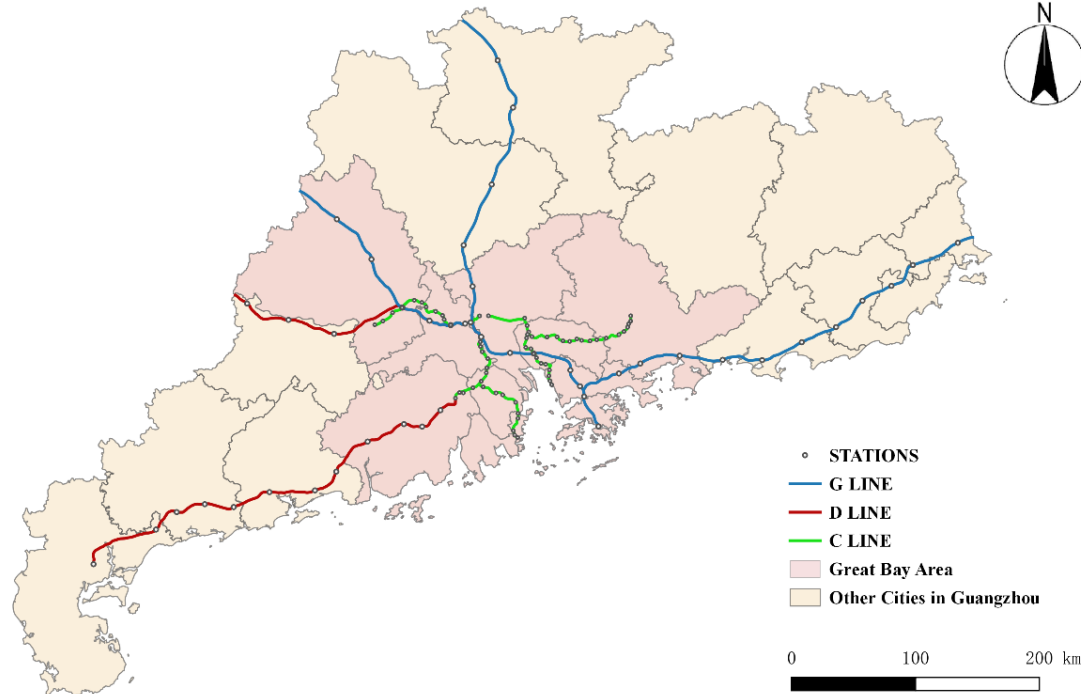
Pop: 71 million

GDP per capita: 23,300 USD



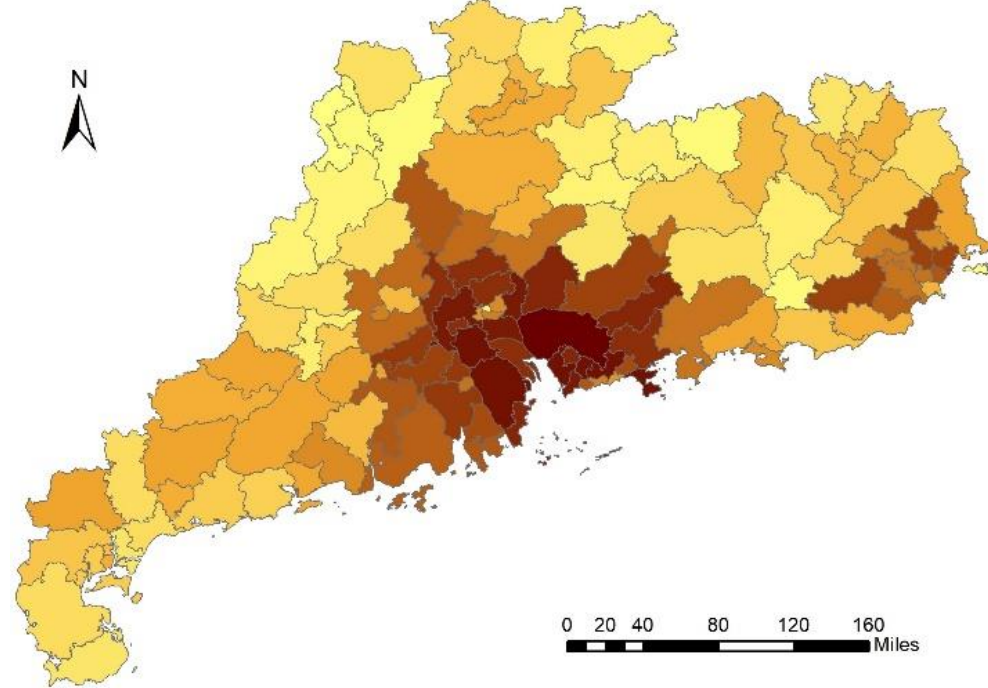
Panel 1-B: HSR network in 2018

Panel 1-A: HSR network in 2010



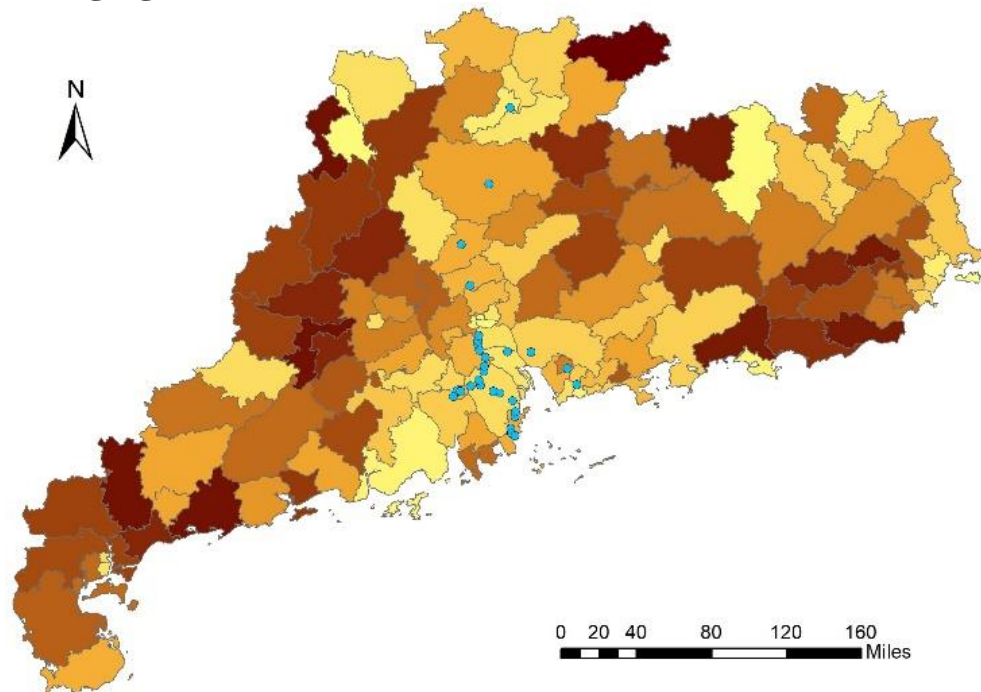
Stylized fact- manufacturing

Source: Industry survey data, 1998-2013

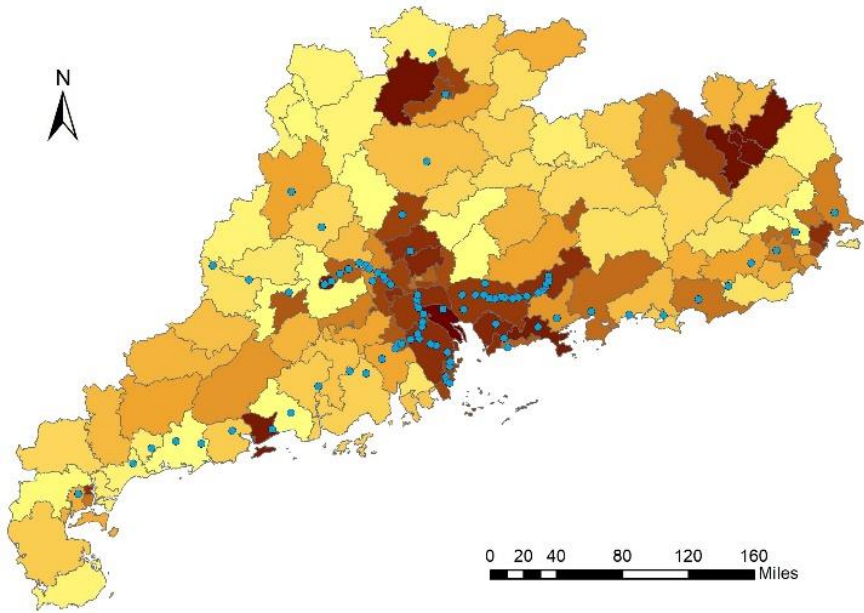


Panel 2-A Number of employment in 2009
(ranging from 139-2252215)

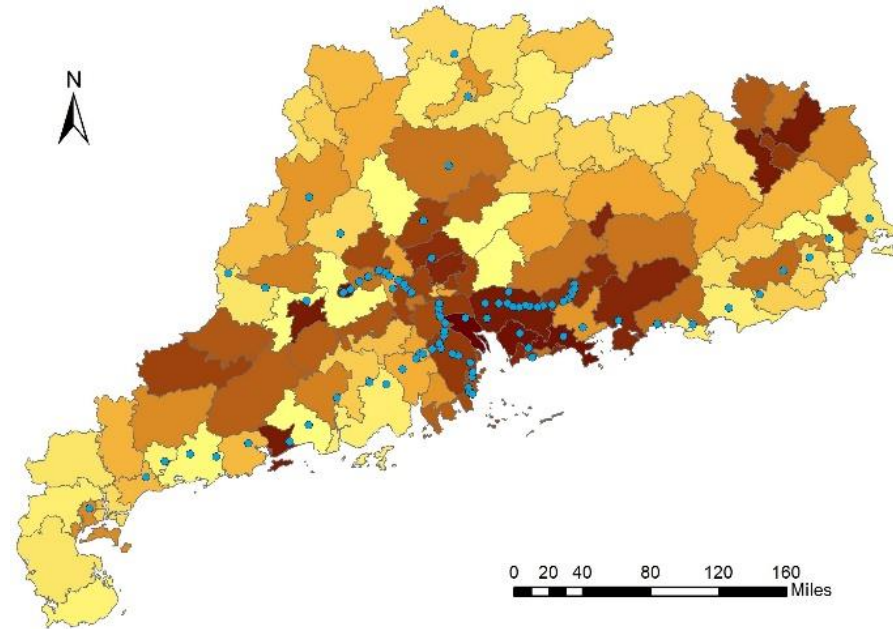
Panel 2-B The ratio of employment in 2013 to 2009
(ranging from 0.8-6)



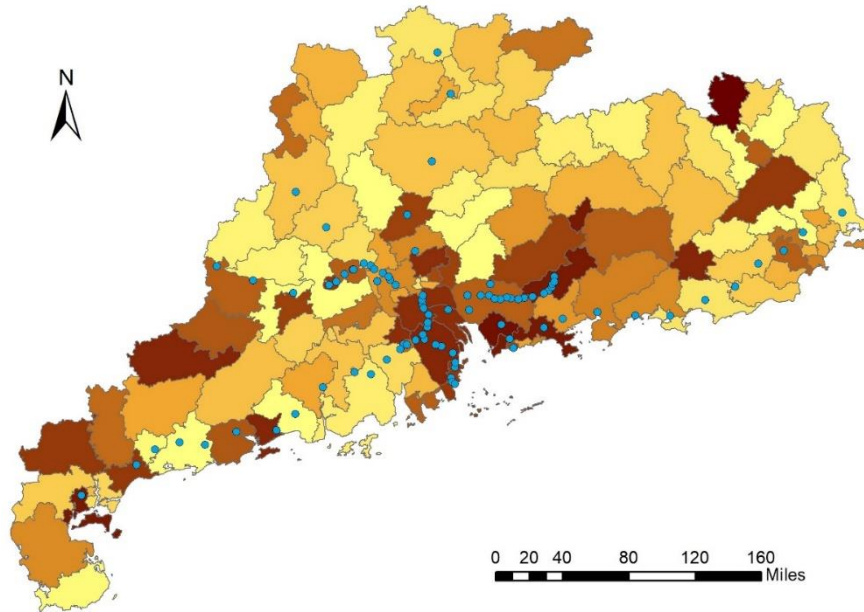
Stylized fact- service sector



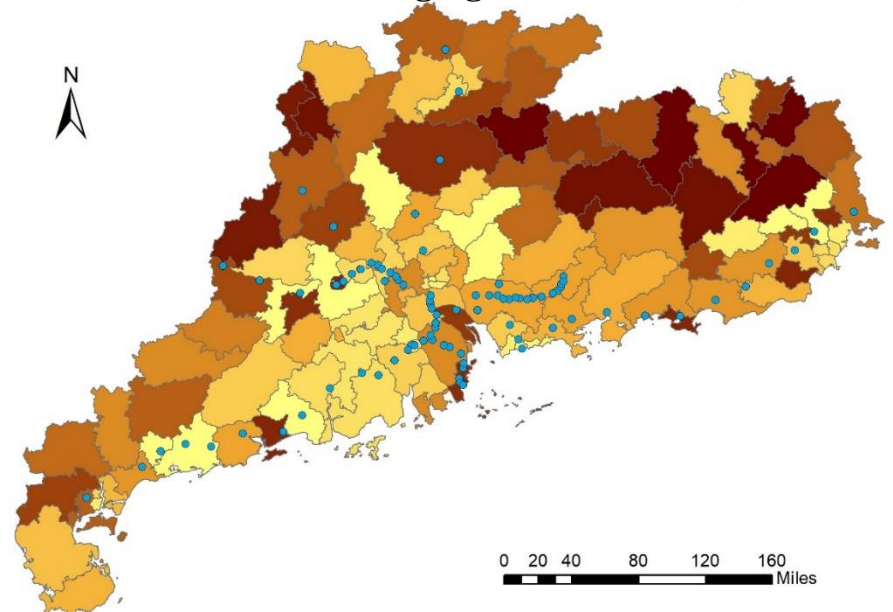
Panel 3-A: IT (ranging from 1.39-44.64)



Panel 3-B: Retail (ranging from 1.69-27.77)



Panel 3-C: Hotel (ranging from 1.42-27.77)



Panel 3-D: Real Estate (ranging from 1.89-12.47)

Robustness check- industry transfer park policy

Industry transfer parks: 34 parks established from 2005 to 2012
13 counties with ITPs have HRS service

	(1)	(2)	(3)	(4)
	log(Emp)	log(Firm)	LQ_Emp	LQ_Firm
HSR	-0.0947	-0.185**	-0.0133	0.0006
	(0.0671)	(0.0750)	(0.0085)	(0.0079)
Controls	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
R2	0.961	0.977	0.932	0.928
Observations	745	745	745	745

Conclusion

- HSR has causal impact on industry clustering
- Large scale manufacturing moves out from central GBA
- Service sectors cluster in
- Urban and suburban districts exhibit reverse trends
- The moving out of R.E has implications on housing market

The impact of HSR in housing market- Shenzhen

Shenzhen: 0.3-13 million (1980-2018)
2000 square km
GDP per capita 29230 USD



HSR and metro ridership

Table 1: Shenzhen Metro network extension

	Number of Lines	Length (km)	Ridership (million)	Ridership per km (million)	Population (million)
2005	2	22	57.66	2.62	8.28
2006	2	23	89.9	3.91	8.71
2007	2	24	117.65	4.90	9.12
2008	2	25	135.5	5.42	9.54
2009	2	25	138.23	5.53	9.95
2010	4	64	162.71	2.54	10.37
2011	5	177	459.85	2.60	10.47
2012	5	177	781.29	4.41	10.55
2013	5	177	917.15	5.18	10.63
2014	5	177	1036.75	5.86	10.78
2015	5	177	1121.88	6.34	11.38
2016	8	285	1297.13	4.55	11.91
2017	9	297	1655.45	5.57	12.53
2018	9	297	1886.51	6.35	13.03

Research design

The metro network remains unchanged from 2011-2015.

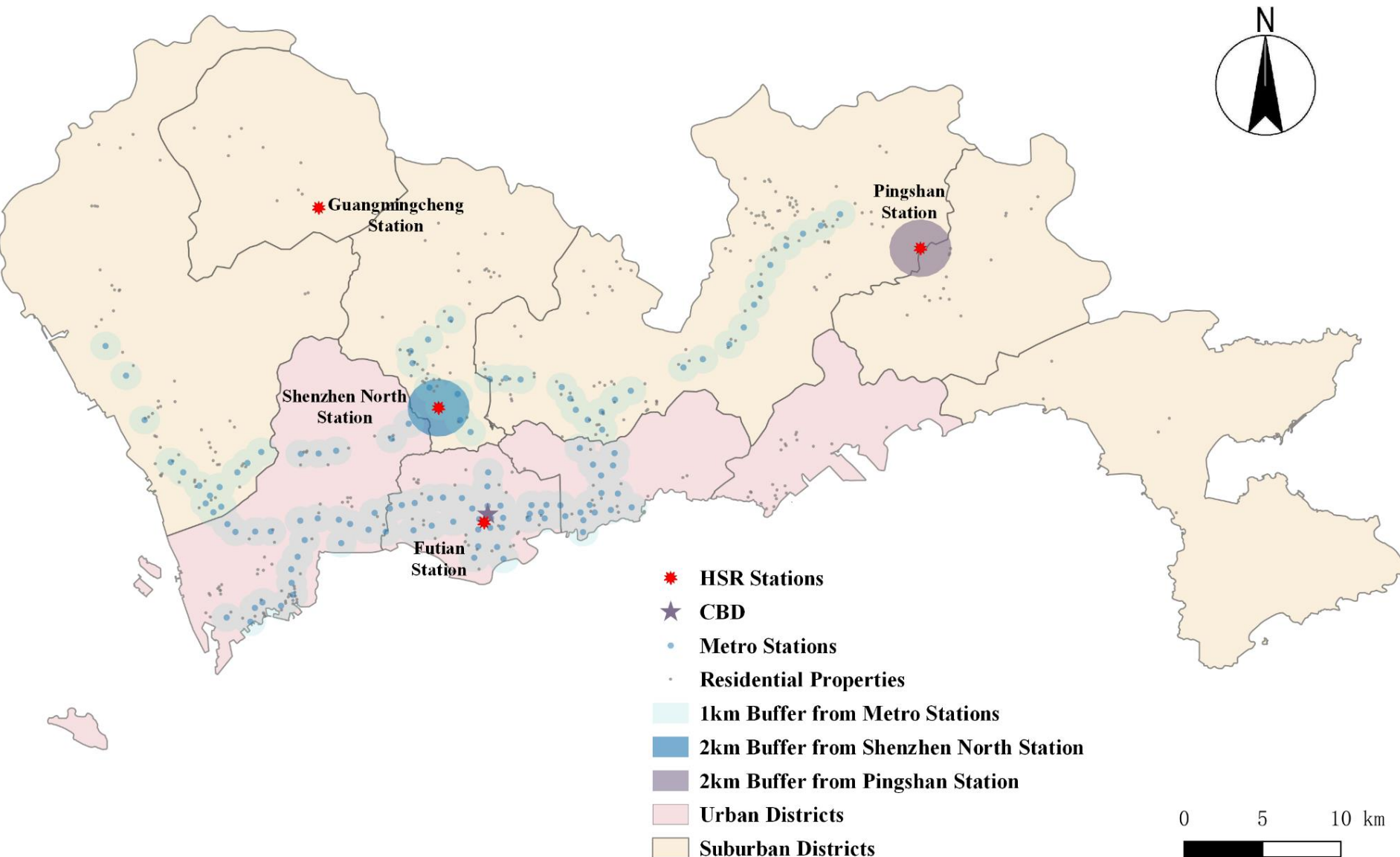
The first HSR line was operated at the end of 2011, and its extension was in service at the end of 2015.

Table 2: Characteristics of HSR stations

HSR Station	Opening Time	Line	Location	Connected to Metro network
Shenzhen North	26-Dec-11	First and Second	Suburb	Yes
GM station	26-Dec-11	First	Rural	No
Futian	30-Dec-15	First	Urban CBD	Yes
Pingshan	28-Dec-13	Second	Rural	No

We choose to study the causal impact of the city's second HSR line to the housing market from 2012-2015.

Metro network and the spatial distribution of housing complex



The direct impact of HSR to housing values

$$P_{ijt} = a_0 + a_1 HSR_j * After_t + a_2 X_{ijt} + \mu_j + \tau_t + \varepsilon_{it} \quad (1)$$

Treatment group: housing complex located with 2 km of HSR stations

Control group: housing complex located between 2-4 km of HSR stations

	Pingshan (small)				Shenzhen North (HSR hub)			
	(1) within 6 months	(2) within 12 months	(3) within 18 months	(4) within 24 months	(5) within 6 months	(6) within 12 months	(7) within 18 months	(8) within 24 months
HSR x After	-0.0443	-0.0470	-0.0150	-0.0141	-0.133***	-0.115***	-0.127***	-0.119***
	(0.0739)	(0.0682)	(0.0275)	(0.0338)	(0.0341)	(0.0242)	(0.0285)	(0.0293)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Housing fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,354	8,175	11,729	13,905	12,370	15,676	18,522	21,024
R-squared	0.935	0.938	0.931	0.934	0.969	0.972	0.976	0.980

Robustness check

We know number of High Speed trains for each station
Continuous version DID regression

	Pingshan (small)				Shenzhen North (HSR hub)			
	(1) within 6 months	(2) within 12 months	(3) within 18 months	(4) within 24 months	(5) within 6 months	(6) within 12 months	(7) within 18 months	(8) within 24 months
HSR x log(Train+1)	-0.0150 (0.0251)	-0.0160 (0.0232)	-0.00508 (0.00591)	-0.00804 (0.00620)	-0.166** (0.0549)	-0.141*** (0.0411)	-0.0760* (0.0400)	-0.0736* (0.0387)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Housing fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,354	8,175	11,729	13,905	12,370	15,676	18,522	21,024
R-squared	0.935	0.938	0.931	0.934	0.969	0.972	0.976	0.980

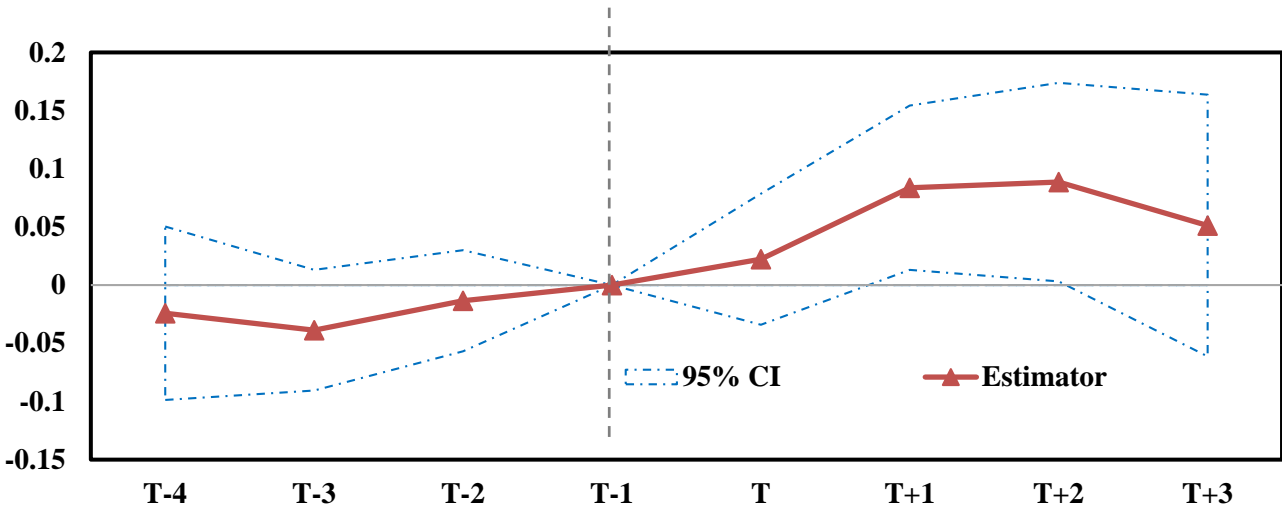
The overall network effect

Treatment group: 1 km catchment area of metro stations

Control group: 1-2 km far away from metro stations

	(1) 6 months	(2) 12 months	(3) 18 months	(4) 24 months
Metro x After	0.0230 (0.0240)	0.0322 (0.0264)	0.0633* (0.0365)	0.0697* (0.0383)
Housing characteristics	Yes	Yes	Yes	Yes
Housing complex fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
R-squared	0.978	0.979	0.979	0.978
Observations	69,764	88,911	109,568	132,410

Event study:



Redistribution effect

	(1) 5-15 minutes	(2) 15-25 minutes	(3) 25-35 minutes	(4) 35-45 minutes	(5) 45-55 minutes	(6) >55 minutes
Metro x After	-0.0769** (0.0362)	0.636* (0.346)	0.166*** (0.0452)	0.292*** (0.0323)	-0.0712 (0.127)	-0.0140 (0.0447)
Housing characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Housing complex fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,092	16,860	22,554	18,569	14,326	10,424
R-squared	0.980	0.979	0.986	0.989	0.978	0.978

Conclusion

- We measure redistribution effect of HSR on housing values through metro network
- Large scale HSR station drives down nearby housing values, while small HSR station has no effect
- The overall network effect is positive, indicating the benefits of improved inter-city accessibility can be capitalized into housing values
- However, there is a strong redistribution effect through metro networks.

Contribution:

- We identify the impact of inter-city transportation on intra-city housing market through two channels.
- This study contributes to the literatures in network effect.
- This study is also related whether the benefits of HSR are generative or redistributive.

Q & A

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