

A Tale of Three Channels: Real Estate Shocks and Firm Investment in China

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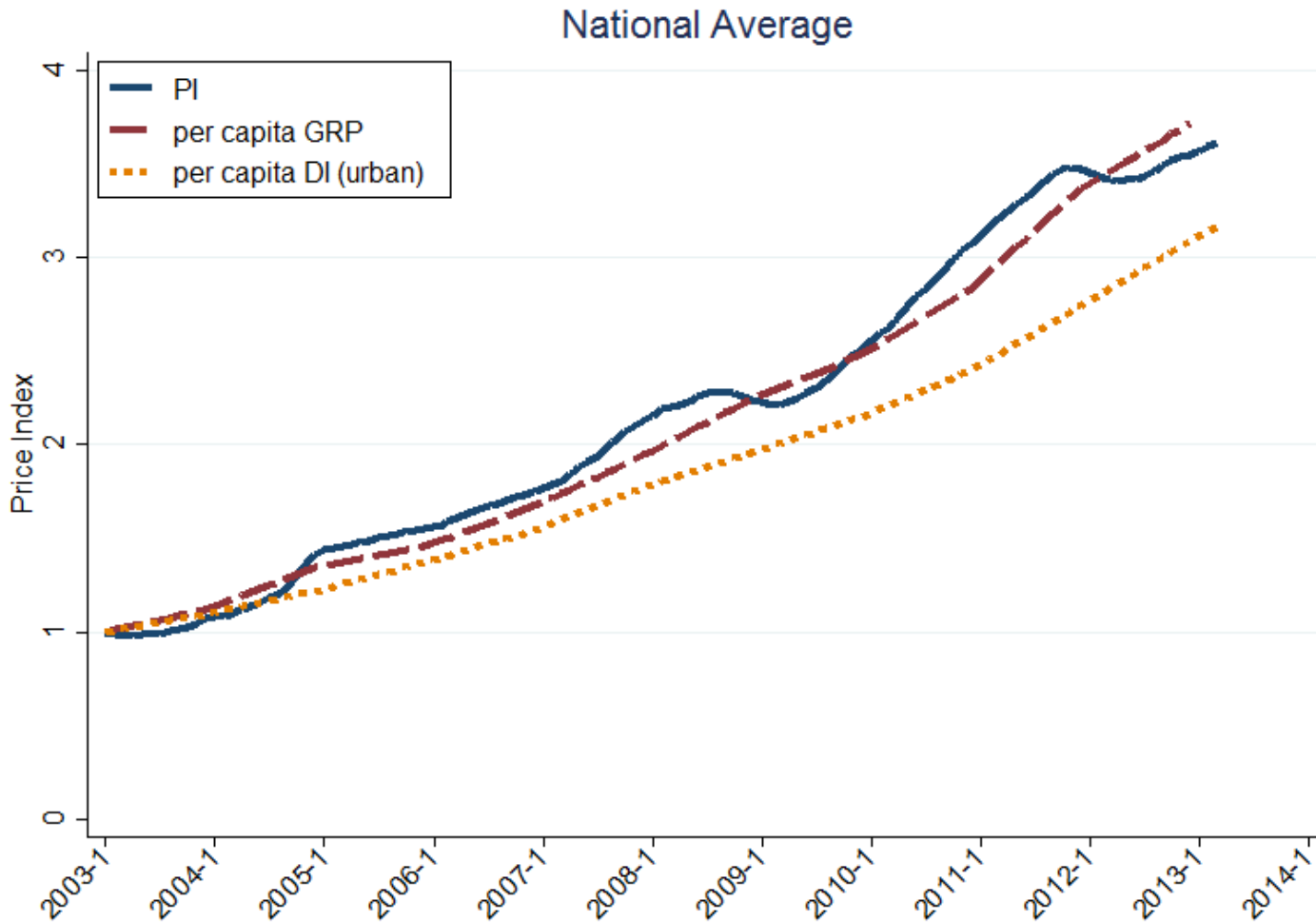
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Real Estate Boom in China

Fang, Gu, Xiong and Zhou (2015)



Research Questions

Real estate fluctuations have important implications for long-run growth and business cycles (Liu, Wang and Zha, 2012)

- How do real estate shocks affect firm investment in China?
- How do banks allocate credit in response to real estate shocks?
- How do real estate shocks affect the efficiency of resource allocation?

Spectacular price boom and substantial variation across the country to examine these questions

A Tale of Three Channels

- Different channels for a real estate boom to affect firm investment
 - **The collateral channel**: it relaxes financial constraints faced by land-holding firms
 - Gan (2007) and Chaney, Sraer and Thesmar (2012)
 - **The speculation channel**: it may induce firms to speculate in real estate investment unrelated to their core businesses
 - Chen and Wen (2014) and Miao and Wang (2014)
 - **The crowding out channel**: it crowds out bank credit to firms with land-holdings as collateral
 - Bleck and Liu (2014) and Chakraborty, Goldstein and MacKinlay (2014)
- A systematic analysis of these channels is lacking
 - What is the net effect of a real estate boom?

Road Map

- Data description
- Empirical results on examining the three channels
- A quasi-policy experiment using the home purchase restriction policy (限购令)
 - Repeated-treatment: Adopted by 46 cities in 2010 and gradually abolished after 2012
- Effect of real estate shocks on efficiency of resource allocation

Land Purchase in China

- Since the real estate reform in 1990s, local governments routinely sold land (lease holds) in the primary land market
 - The size of the secondary land market (where buyers are not local governments) is relative small
- Rigid zoning restrictions
 - **Industrial land** designated for industrial and manufacturing facilities
 - **Commercial land** for commercial and business facilities
 - **Residential land** for residential facilities
 - Difficult to change the category after initially set by government
 - Manufacturing firms cannot use commercial land and residential land for production purposes

Land Transaction Data

- All land transactions in 2000-2015, 1.65 million transactions in 295 cities
 - Hand collected from Ministry of Land and Resources
 - Land buyer, land area, total payment, land usage, location, and transaction price
- We merge the transactions with all publicly listed firms by firm names (including subsidiaries)
 - Delete finance, insurance, real estate, construction, and mining industries
 - 38,213 land transactions by 2,174 publicly listed firms
 - 2,054,506,896 square meters, and total payment 2341.2 billion RMB, 14.76% of all transactions

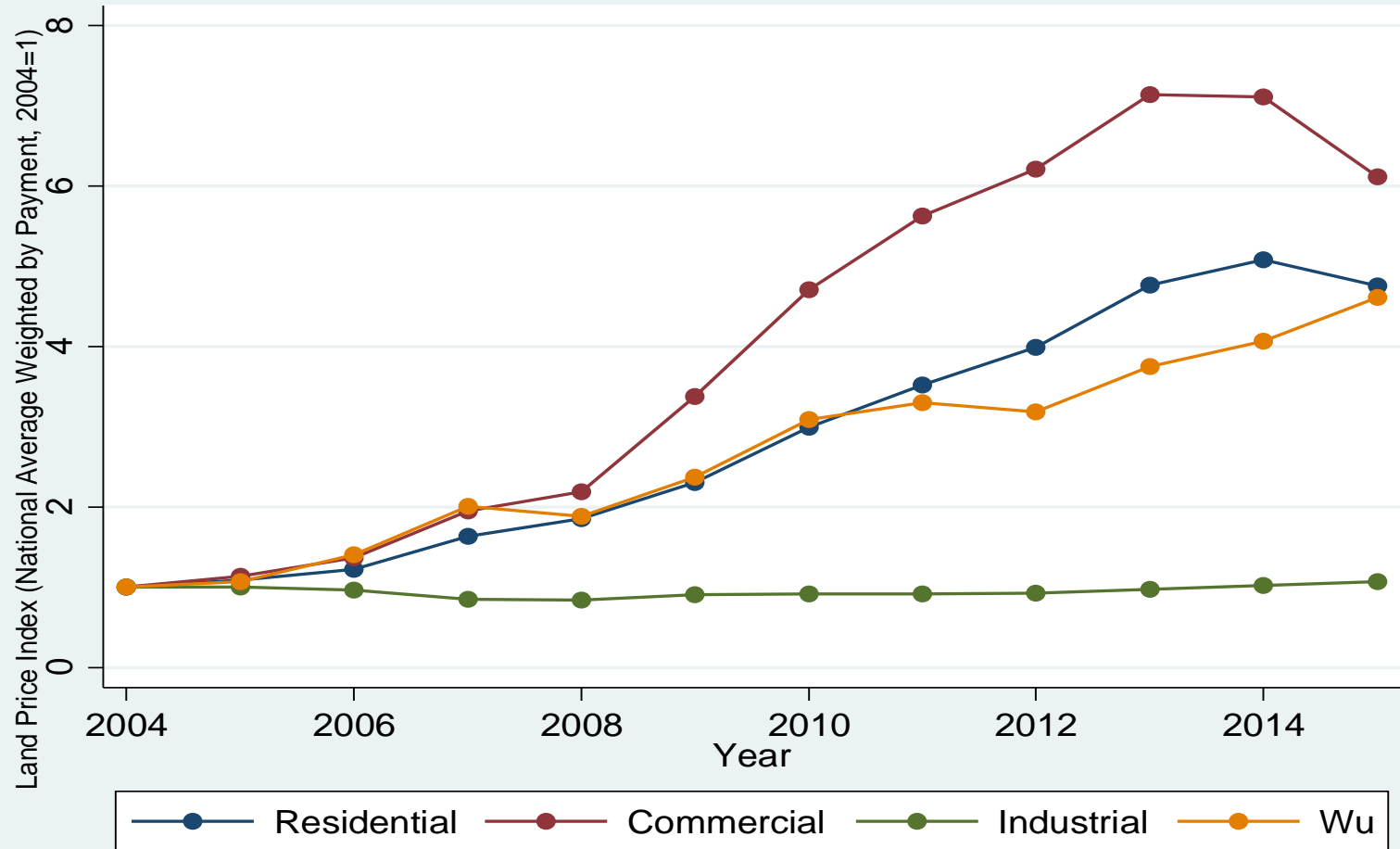
Land Price Indices

- To construct a precise measure of the land value for the land-holding companies after the initial purchase
- Following Deng, Gyourko and Wu (2012), we adopt the hedonic price regression approach:

$$- \ln P_{i,k,c,t} = \beta_{k,c,0} + \sum_{s=1}^T \beta_{k,c,s} \cdot 1_{s=t} + \theta_{k,c} X_i + \varepsilon_{i,t},$$

1. Street ID dummy (9-digit administrative unit)
2. Size of the land parcel
3. Subcategories of land usage (54 types, e.g. public housing)
4. Method of transaction (an indicator for transaction through listing bidding or English auction, and invited bidding and bilateral agreement excluded)
5. A subjective evaluation of land quality (11 ranks)

National Land Prices



Land Prices in 12 Major Cities

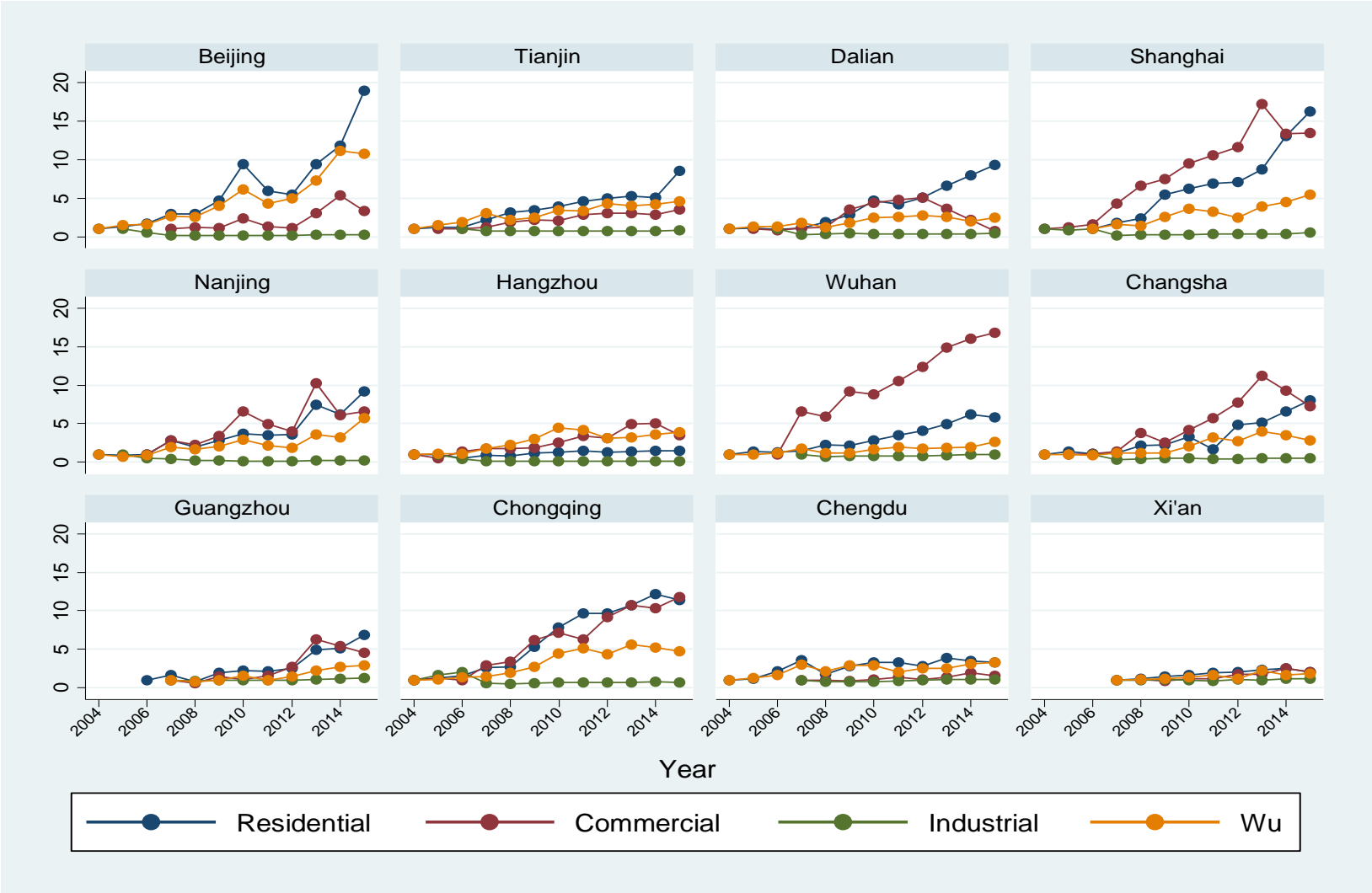


Table A1 The Correlation Matrix of Land Price Index/Change

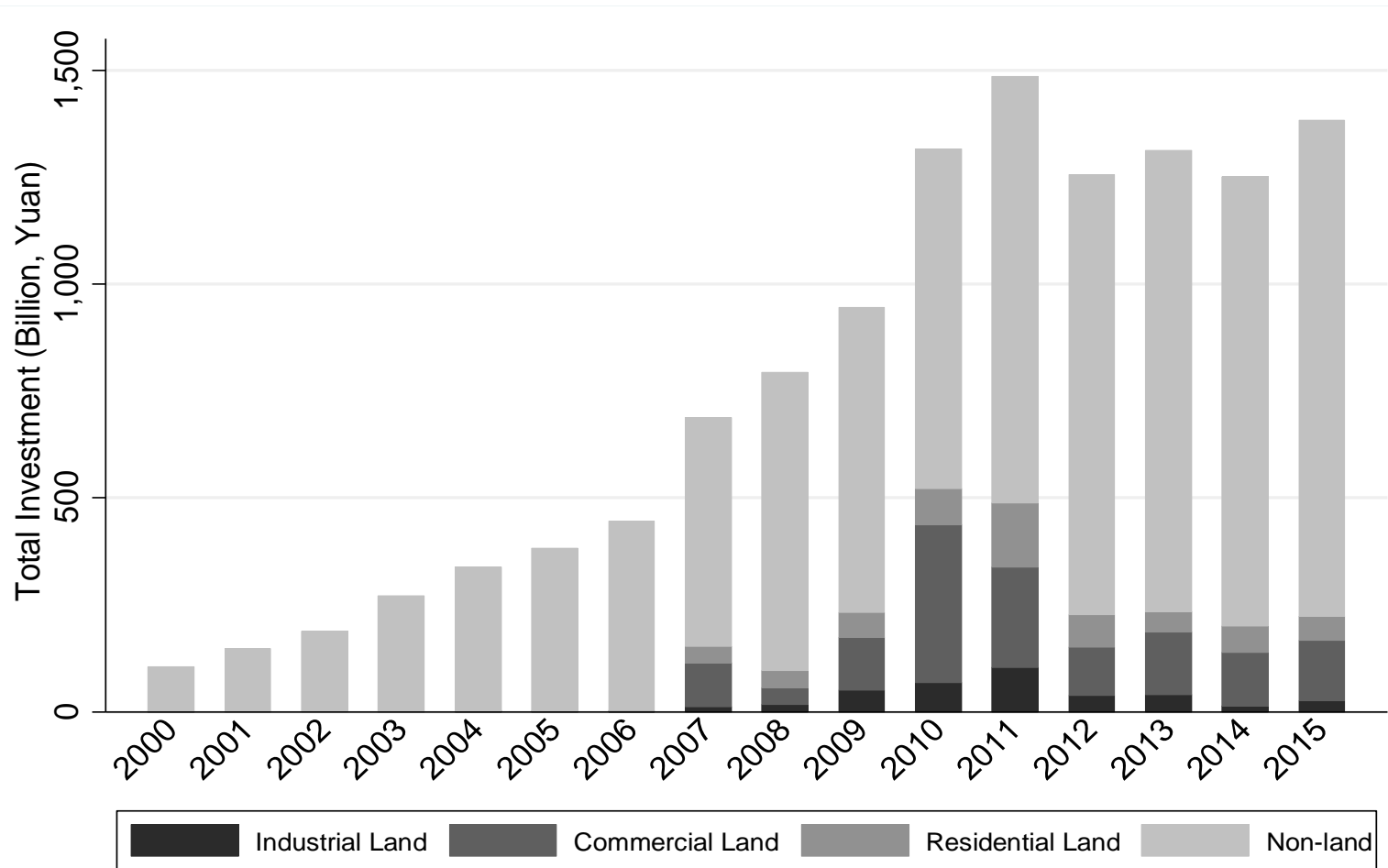
	Commercial Land Price Growth Rate	Residential Land Price Growth Rate	Industrial Land Price Growth Rate	Wu's Land Price Index Growth Rate
Commercial Land Price Growth Rate	1			
Residential Land Price Growth Rate	0.4066	1		
Industrial Land Price Growth Rate	-0.2043	0.0133	1	
Wu's Land Price Index Growth Rate	0.3373	0.4065	-0.1788	1

	Commercial Land Price Index	Residential Land Price Index	Industrial Land Price Index	Wu's Land Price Index
Commercial Land Price Index	1			
Residential Land Price Index	0.5335	1		
Industrial Land Price Index	-0.1212	-0.1789	1	
Wu's Land Price Index	0.2524	0.7745	-0.3459	1

Other Data

- Land Values
 - Measure the value of each firm's land holdings by initial transaction prices of each land parcel adjusted by the land price index of the city
- Firm investment
 - Annual sample of 30,344 firm-year observations in 2000-2015 for 3,112 unique firms
 - Four components: Non-land, residential land, commercial land, industrial land
- Innovation activities
 - Annual R&D expenditure
 - Successful grant applications filed by each firm in each year
 - We count invention patents and utility model patents, but not design patents
 - 57,234 patents granted to 1,330 listed firms in 2000-2015.

Firm Investment



Summary Statistics

Table 1. Summary Statistics

Statistics	Mean	Std. Dev	p10	Median	p90
	All (24685)				
Gross Investment	448,000,000	2,200,000,000	7,880,429	94,400,000	775,000,000
Non-land Investment	363,200,000	2,150,000,000	3,701,758	83,400,000	695,000,000
Commercial Investment	48,600,000	714,000,000	0	0	0
Residential land Investment	19,800,000	156,000,000	0	0	22,500,000
Industrial Investment	16,300,000	277,000,000	0	0	0
Total Land Value	496,000,000	4,180,000,000	0	0	534,000,000
Residential Land Value	143,000,000	1,640,000,000	0	0	16,500,000
Commercial Land Value	225,000,000	3,020,000,000	0	0	22,400,000
Industrial Land Value	129,000,000	815,000,000	0	0	199,000,000
Tobin's Q	2.009	1.501	0.525	1.549	4.402
Cash Flow	872,000,000	3,630,000,000	-185,000,000	163,000,000	1,870,000,000
Sale	4,570,000,000	15,400,000,000	227,000,000	1,190,000,000	8,550,000,000
Total Asset	6,660,000,000	21,000,000,000	637,000,000	2,150,000,000	11,900,000,000
R&D Expenditure	33,900,000	390,000,000	0	0	34,700,000
Number of New Patent (Invention + Utility Model+1)	2.997	30.844	0	0	4

The Collateral Channel

- Hypothesis: A real estate boom allows land-holding firms to borrow more and invest more

- $$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta \cdot \frac{LandValue_{i,t-1}}{K_{i,t-1}} + \theta X_{it} + \varepsilon_i + \delta_t + \epsilon_{it}$$

- X_{it} : Tobin's Q, end-of-year cash flow, total sale, and total firm asset
- ε_i, δ_t : Firm, year fixed effects
- Following Chaney, Sraer, and Thesmar (2012)
- IV analysis skipped

Land Value and Gross Investment

Table 2. The Effect of Land Value on Firm Gross Investment

	Gross Investment			
	(1)	(2)	(3)	(4)
Land Value _{t-1}	0.104*** (0.021)			
Land Value _{t-1} ^{Commercial}		0.084*** (0.025)		
Land Value _{t-1} ^{Residential}			0.032** (0.015)	
Land Value _{t-1} ^{Industrial}				0.021 (0.058)
Tobin's Q	0.010 (0.009)	0.010 (0.009)	0.010 (0.009)	0.010 (0.009)
Sale	0.012** (0.006)	0.012** (0.006)	0.012** (0.006)	0.012** (0.006)
Cash Flow	0.019*** (0.004)	0.020*** (0.004)	0.020*** (0.004)	0.020*** (0.004)
Total Investment	0.062*** (0.020)	0.065*** (0.020)	0.065*** (0.020)	0.066*** (0.020)
Number of Observations	23255	23255	23255	23255
Adj. R-squared	0.349	0.344	0.344	0.343

The Speculation Channel

- Hypothesis: A real estate boom not only gives land-holding firms more financing but may also induce them to pursue more housing speculation and reduce innovation activities

$$Y_{i,t} = \alpha + \beta \cdot \frac{LandValue_{i,t-1}}{K_{i,t-1}} + \gamma \cdot \Delta LandPriceIndex_{i,t-1} + \eta \cdot \frac{LandValue_{i,t-1}}{K_{i,t-1}} \cdot \Delta LandPriceIndex_{i,t-1} + \theta X_{it} + \varepsilon_i + \delta_t + \epsilon_{it}$$

- $Y_{i,t}$: investment in a type (non-land, residential, commercial land, industrial land) or R&D expenditure, and patent applications
- $\Delta LandPriceIndex_{i,t-1}$: price change of overall land, industrial land, or commercial land

Firm Investment and Commercial Land Price Change

Table 3. The Interactive Effects of Land Value and Land Price Change on Different Types of Firm Investment

Panel A	Non-land Investment			Residential Land Investment		
	(1)	(2)	(3)	(4)	(5)	(6)
Price Change _{t-1} ^{Commercial} (PCC)	-0.051*** (0.014)	-0.038 (0.027)	-0.037* (0.017)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
Land Value _{t-1} (LV)		0.025*** (0.009)	0.027*** (0.009)		0.005*** (0.001)	0.005*** (0.001)
PCC*LV			-0.023** (0.010)			0.002 (0.002)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.396	0.397	0.397	0.128	0.13	0.13
	Commercial Land Investment			Industrial Land Investment		
	(7)	(8)	(9)	(10)	(11)	(12)
Price Change _{t-1} ^{Commercial} (PCC)	0.011** (0.004)	0.011** (0.004)	0.005 (0.003)	-0.001 (0.001)	-0.001 (0.001)	0 (0.001)
Land Value _{t-1} (LV)		0.001 (0.003)	-0.001 (0.003)		0 0.000	0 0.000
PCC*LV			0.016** (0.007)			-0.001 (0.001)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.121	0.121	0.126	0.083	0.083	0.083

Firm Investment and Residential Land Price Change

Panel B	Non-land Investment			Residential Land Investment		
	(13)	(14)	(15)	(16)	(17)	(18)
Price Change _{t-1} ^{Residential} (PCR)	-0.043*** (0.015)	-0.035 (0.025)	-0.033* (0.016)	0.004** (0.002)	0.004* (0.002)	0.003* (0.002)
Land Value _{t-1} (LV)		0.025*** (0.009)	0.025*** (0.009)		0.005*** (0.001)	0.005*** (0.001)
PCR*LV			0.001 (0.006)			0.002 (0.001)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.396	0.397	0.397	0.128	0.131	0.131
	Commercial Land Investment			Industrial Land Investment		
	(19)	(20)	(21)	(22)	(23)	(24)
Price Change _{t-1} ^{Residential} (PCR)	0.003 (0.003)	0.003 (0.003)	0.002 (0.002)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Land Value _{t-1} (LV)		0.000 (0.003)	0.000 (0.003)		-0.000 (0.000)	-0.000 (0.000)
PCR*LV			0.003 (0.003)			-0.000 (0.000)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.120	0.120	0.120	0.083	0.083	0.083

Firm Investment and Industrial Land Price Change

Panel C	Non-land Investment			Residential Land Investment		
	(25)	(26)	(27)	(28)	(29)	(30)
Price Change _{t-1} ^{Industrial} (PCI)	0.007 (0.021)	0.004 (0.021)	0.003 (0.021)	0.008 (0.006)	0.007 (0.005)	0.008 (0.006)
Land Value _{t-1} (LV)		0.025*** (0.009)	0.024*** (0.009)		0.005*** (0.001)	0.006*** (0.001)
PCI*LV			0.003 (0.027)			-0.002 (0.004)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.395	0.396	0.396	0.128	0.131	0.131
	Commercial Land Investment			Industrial Land Investment		
	(31)	(32)	(33)	(34)	(35)	(36)
Price Change _{t-1} ^{Industrial} (PCI)	0.005 (0.004)	0.005 (0.004)	0.003 (0.004)	-0.001 (0.002)	-0.001 (0.002)	0.001 (0.001)
Land Value _{t-1} (LV)		0.000 (0.003)	0.000 (0.003)		0.000 (0.000)	0.000 (0.000)
PCI*LV			0.007 (0.008)			-0.004 (0.003)
Number of Observations	10850	10850	10850	10850	10850	10850
Adj. R-squared	0.12	0.12	0.12	0.083	0.083	0.085

Firm Innovation and Commercial Land Price Change

Table 4. The Interactive Effects of Land Value and Land Price Change on Firm Innovation Activities

Panel A	R&D Expenditure (Logged)		Patent (Logged)	
	(1)	(2)	(3)	(4)
Price Change _{t-1} ^{Commercial} (PCC)	-0.022** (0.010)	-0.014 (0.010)	-0.051** (0.024)	-0.02 (0.024)
Land Value _{t-1} (LV)	0.01 (0.008)	0.011 (0.009)	-0.034*** (0.011)	-0.026** (0.012)
PCC*LV		-0.019*** (0.007)		-0.075*** (0.022)
Number of Observations	1984	1984	8523	8523
Adj. R-squared	0.701	0.703	0.796	0.797

Firm Innovation and Residential Land Price Change

Panel B	R&D Expenditure (Logged)		Patent (Logged)	
	(5)	(6)	(7)	(8)
Price Change _{t-1} ^{Residential} (PCR)	-0.004 (0.009)	0.001 (0.009)	-0.007 (0.020)	0.011 (0.022)
Land Value _{t-1} (LV)	0.010 (0.008)	0.01 (0.008)	-0.034*** (0.011)	-0.033*** (0.011)
PCR*LV		-0.008 (0.006)		-0.032** (0.014)
Number of Observations	1984	1984	8523	8523
Adj. R-squared	0.7	0.7	0.796	0.796

Firm Innovation and Industrial Land Price Change

Panel C	R&D Expenditure (Logged)		Patent (Logged)	
	(9)	(10)	(11)	(12)
Price Change _{t-1} ^{Industrial} (PCI)	-0.017 (0.014)	-0.007 (0.014)	-0.01 (0.032)	0.005 (0.033)
Land Value _{t-1} (LV)	0.01 (0.008)	0.013 (0.009)	-0.034*** (0.011)	-0.029*** (0.011)
PCI*LV		-0.038 (0.024)		-0.04 (0.027)
Number of Observations	1984	1984	8523	8523
Adj. R-squared	0.7	0.701	0.796	0.796

Evidence for the Speculation Effect

- In response to an increase in commercial land price and value of land holding, firms tend to
 - Increase investment to commercial land and reduce non-land investment
 - Reduce innovation activities
- The usual endogeneity problem of real estate shocks being correlated with firms' investment opportunities is not a particular concern.

The Crowding Out Channel

- Hypothesis: A real estate boom reduces investment of non-land-holding firms
- Bank Loan Level Analysis
 - A loan level dataset for the publicly listed firms
 - Obtained from RESSET and CSMAR
 - 81,872 loans made to 2,862 publicly listed firms in 2000-2015
 - Information on collateral and bank branch of the lender
- $Collateral_{i,b,t} = \zeta + \lambda * \Delta LandPriceIndex_{b,c,t} + \theta X_{i,t} + \mu_{ib} + \iota_{bt} + \tau_{bc} + \pi_{i,b,c,t}$

Land Price Change and Loans of Different Types

Table 5. Land Prices and Accessibility of Bank Loans, Loan-Level Analysis from 2000 to 2015

	Loans with Real Estate Collateral	Loans with Non-Real Estate Collateral	Loans without Collateral	Real Estate Collateral =2; Non-Real Estate Collateral=1; No Collateral=0
Panel A	(1)	(2)	(3)	(4)
Price Change _{t-1} ^{Commercial} (Bank Branch City)	0.059*** (0.004)	0.076*** (0.004)	-0.060*** (0.005)	0.044*** (0.006)
Number of Observations	41930	41930	41930	41930
Adj. R-squared	0.314	0.288	0.301	0.294
Panel B	(5)	(6)	(7)	(8)
Price Change _{t-1} ^{Residential} (Bank Branch City)	0.049*** (0.003)	0.050*** (0.002)	-0.054*** (0.003)	0.059*** (0.005)
Number of Observations	41930	41930	41930	41930
Adj. R-squared	0.314	0.283	0.302	0.296
Panel C	(9)	(10)	(11)	(12)
Price Change _{t-1} ^{Industrial} (Bank Branch City)	-0.005 (0.006)	0.000 (0.006)	-0.001 (0.007)	0.001 (0.009)
Number of Observations	41930	41930	41930	41930
Adj. R-squared	0.308	0.275	0.297	0.293

The Crowding Out Channel (Cont'd)

- Hypothesis: A real estate boom reduces investment of non-land-holding firms
- Analysis of non-land-holding firms

$$Y_{it} = \alpha + \beta * \Delta LandPriceIndex_{i,c,t-1} + \theta X_{it} + \varepsilon_i + \delta_t + \epsilon_{it}$$

Land Price Change and Investment of Non-land-holding Firms

Table 6. Effects of Land Price Fluctuations on Non-land-holding Firms

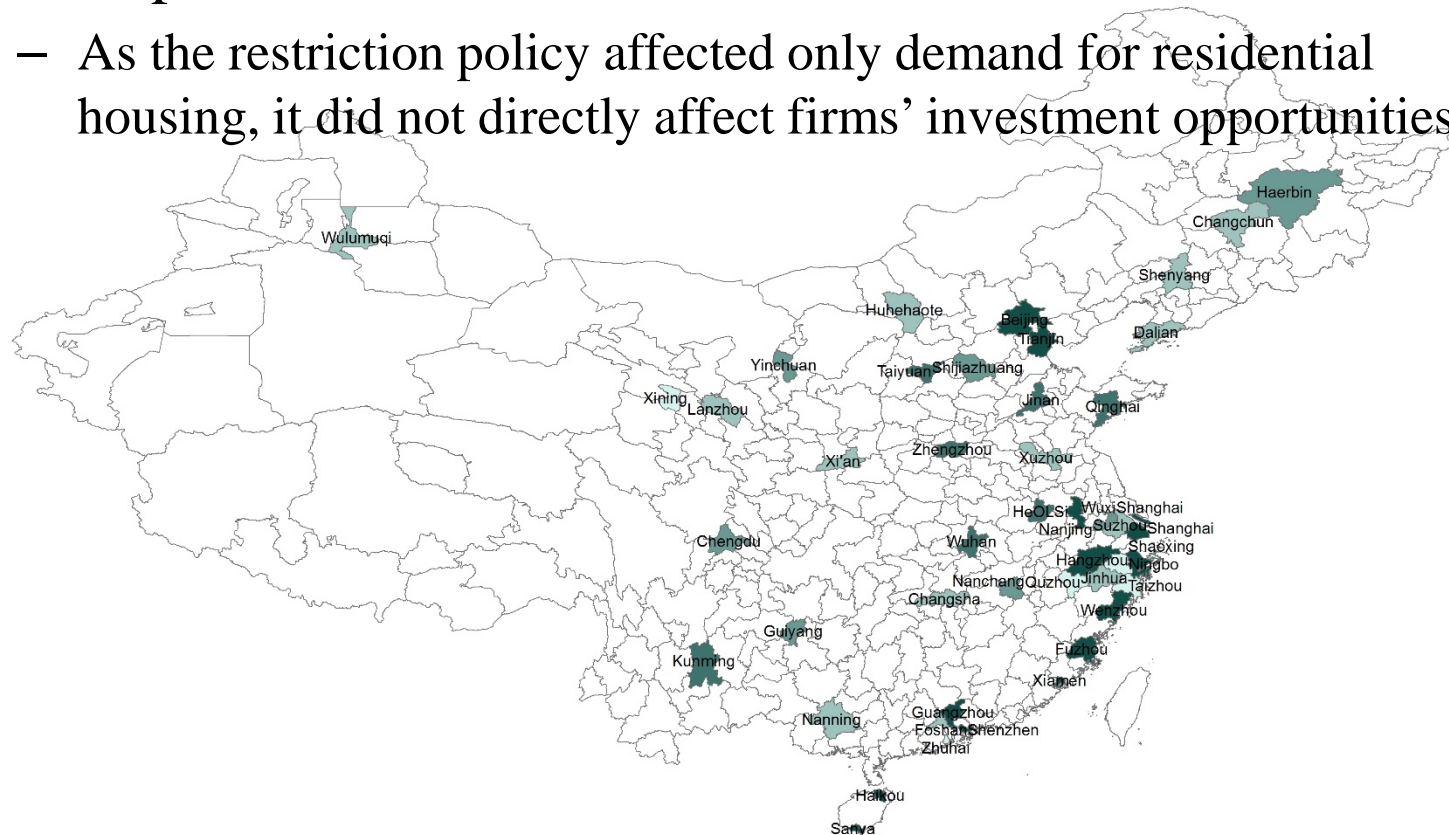
	R&D Expenditure		
	Gross Investment	(Logged)	Patent (Logged)
Panel A	(1)	(2)	(3)
Price Change $t-1$ ^{Commercial}	-0.151** (0.065)	-0.217*** (0.063)	-0.564*** (0.088)
Number of Observations	2595	614	2595
Adj. R-squared	0.546	0.753	0.729
Panel B	(4)	(5)	(6)
Price Change $t-1$ ^{Residential}	-0.387*** (0.078)	-0.040 (0.028)	-0.103 (0.071)
Number of Observations	2777	614	2777
Adj. R-squared	0.535	0.736	0.701
Panel C	(7)	(8)	(9)
Price Change $t-1$ ^{Industrial}	-0.031 (0.033)	-0.019 (0.100)	-0.005 (0.114)
Number of Observations	2659	622	2659
Adj. R-squared	0.527	0.732	0.702

Evidence for the Crowding Out Effect

- In response to a real estate boom, banks are more likely to grant loans with land collateral
- Consequently firms without land-holdings invest less and reduce innovation activities
- This result may be subject to the usual endogeneity concern of real estate shocks being correlated with firms' investment opportunities

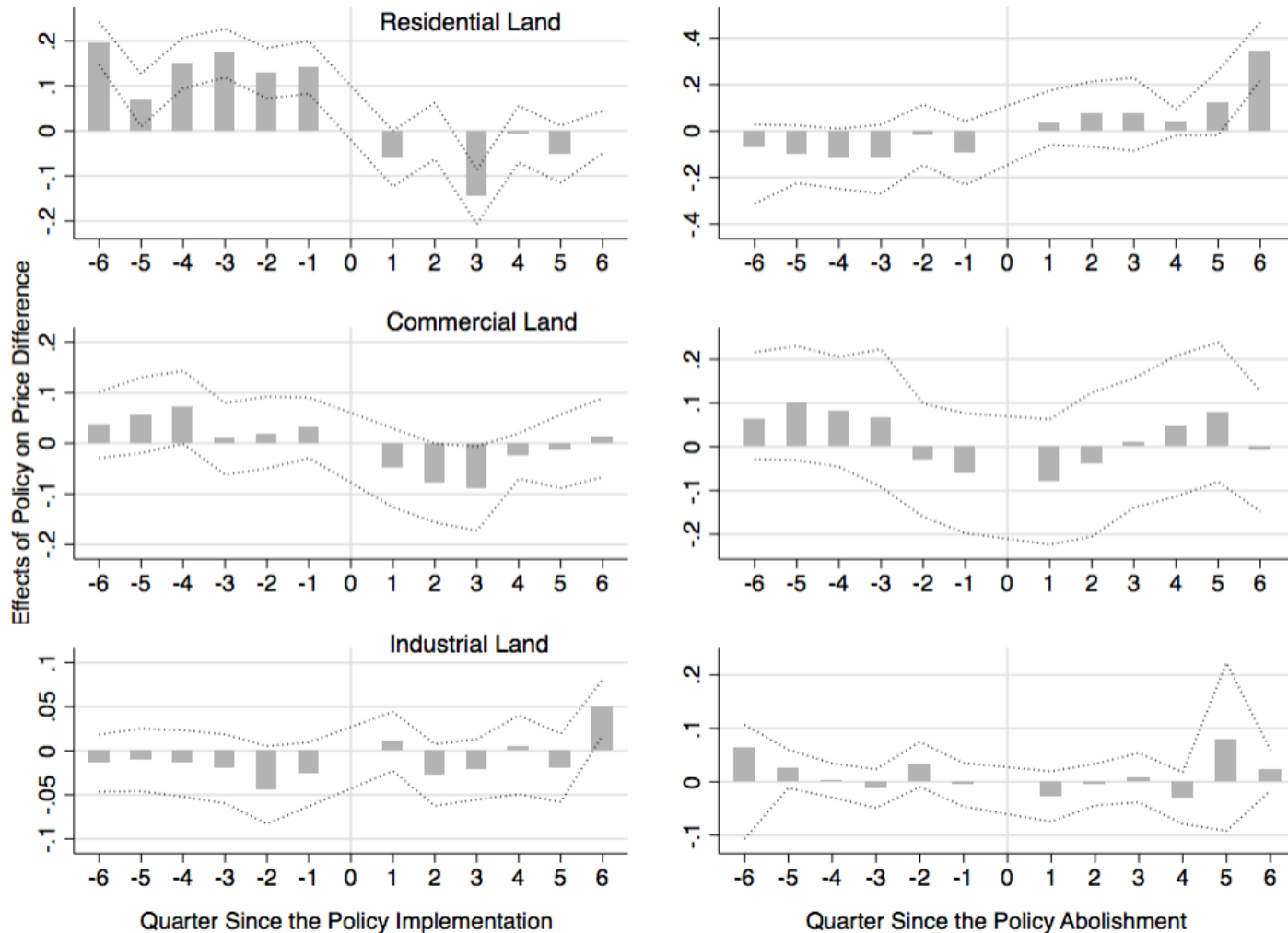
A Quasi-Policy Experiment

- In 2010, 46 cities adopted policies of restricting residential home purchases to cool the real estate boom
 - As the restriction policy affected only demand for residential housing, it did not directly affect firms' investment opportunities



Did the Policy Affect Land Price?

$$LandPrice_{c,t} = \alpha + \beta Treated_c * EventTime_{c,t,\epsilon t} + \sum \lambda_j * t * City_j + \epsilon_t + \gamma_c + \mu_{c,t}$$



A Quasi-Policy Experiment (Cont'd)

- Diff-in-diff analysis of firm investment:

$$Y_{i,t} = \alpha + \beta * Treated_i * PolicyPeriod_{i,t} + \sum_i \lambda_i * t + \varepsilon_i + \zeta_t + \varphi_{i,t}$$

- $Treated_i$ is a dummy for firm headquarter in one of 46 treated cities
- $PolicyPeriod_{it}$ is a dummy for city i and year t in the restriction policy

Effect of the Policy Shock on Non-land-holding Firms

Table 8. The Policy Shock on Non-land-holding Firms in the Treated Cities, 2000-2015

	Gross Investment	R&D Expenditure	New Patent Applications
	(1)	(2)	(3)
Treated Cities* Policy Period	0.481***	0.149**	0.136*
	(0.080)	(0.069)	(0.077)
Firm Specific Time Trend	Yes	Yes	Yes
Number of Observations	5887	619	5887
Adj. R-squared	0.544	0.679	0.725

Effects of the Policy Shock

- Among firms affected by the policy shock,
 - Non-land-holding firms make more investment and increase innovation activities (reversal of the crowding out effect)
- These findings help to
 - Provide assurance on the endogeneity problem
 - Confirm symmetric effects on the negative side

Real Estate Boom and Efficiency of Resource Allocation

- A real estate boom affect allocation efficiency on both sides:
 - Mitigate financial constraints of land-holding firms through the collateral effect
 - Distort efficiency through the speculation effect and crowding out effect
- Follow Hsieh and Klenow (2009) to measure TFP (total factor productivity) loss due to resource misallocation
 - % of output gain from hypothetical reallocation to the real output
 - Data from China's National Taxation Statistics Data from 2008 to 2011, measured in 47 manufacturing sectors, city level

Land Price Change and TFP losses

Table 9. Land Price Change and TFP Loss from Misallocation, 2000-2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price Change ^{Commercial}	0.095**	0.066*		0.116**	0.170**			0.244***
	(0.043)	(0.040)		(0.051)	(0.069)			(0.071)
Price Change ^{Residential}		0.066*		-0.052		0.126**		0.003
		(0.040)		(0.070)		(0.060)		(0.084)
Price Change ^{Industrial}			-0.058	-0.081			-0.043	-0.079
			(0.060)	(0.084)			(0.078)	(0.104)
Number of Observations	963	963	963	963	963	963	963	963
Adj. R-squared	0.565	0.57	0.544	0.535	0.598	0.601	0.583	0.64

Conclusion

- Evidence for a real estate boom to generate not only the well-known collateral effect but also a speculation effect and a crowding out effect
- On net, a real estate boom leads to less (rather than more) efficient resource allocation in China