

# Conglomerate Formation in China

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# Understanding China's Growth (and Recent Slowdown)

- Why does China have a thriving private sector?
  - “The Fundamental Institutions of China's Reforms and Development” (Xu, Journal of Economic Literature, 2011)
  - “Institutional Foundations of China's Growth and Slowdown” (Bai, Hsieh and Song, prepared for NBER Macro Annual 2019)
- Lack of evidence on the (in)formal institutions
- This paper: Conglomerate as a special institutional arrangement
  - Overcome (institutional) frictions
  - Strike special deals with **many** private businesses

# Road Map

- Data and basic facts
- Identifying “conglomerates” and their main patterns
- A model of network formation, its empirical predictions and aggregate implications
- Future work

# China's Firm Ownership Network Data

- Firm Registration Data of **State Administration for Industry and Commerce**
- All firms, including holding companies (28 million firms, 11 million exit)
- Owner can be individual or legal persons (firms or holding companies)

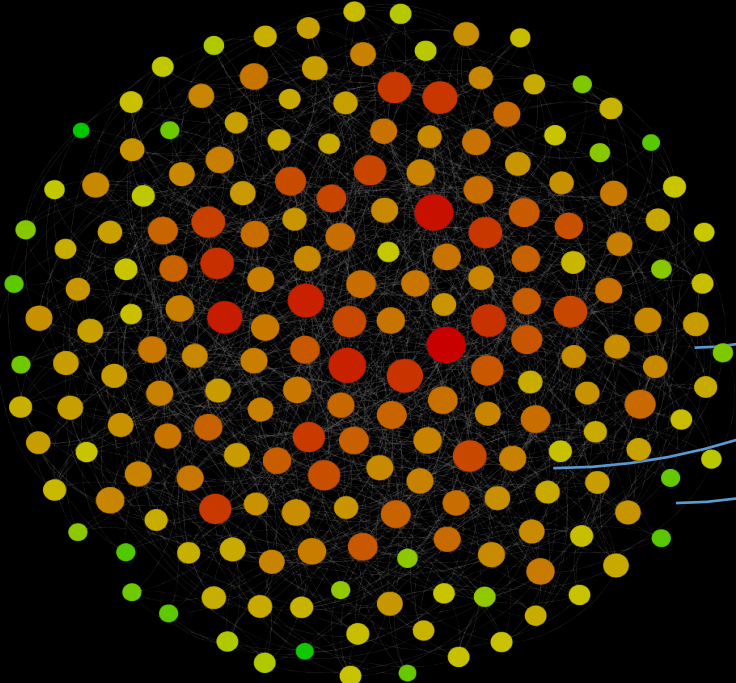
# China's Firm Ownership Network Data (cont'd)

- Owners in 2015 (or exit date)
  - Name and ID of legal person (including holding companies) and individuals
  - Equity share in 2015 (or exit date) of each owner
  - Change in legal person owners from 2004 to 2014 for 11 provinces (no equity information, robustness check)
- Registered capital, year of establishment, exit year
- Matched with NBS data on industrial firms

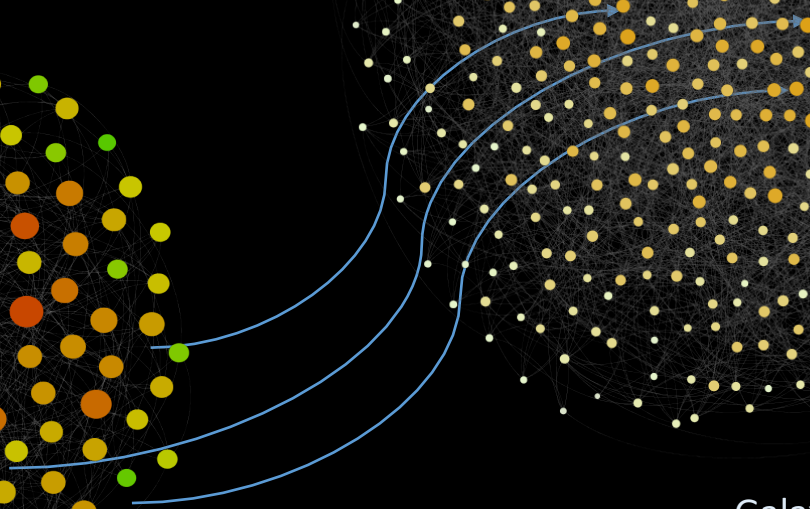
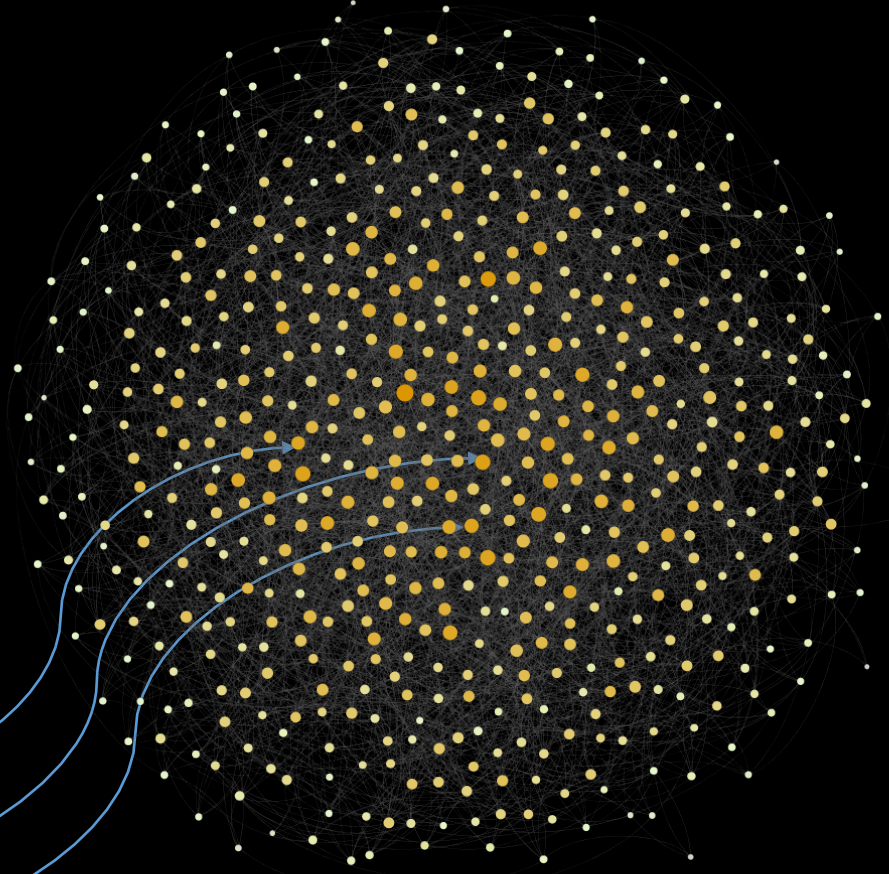
# Economic Activity Dominated by Two Largest Connected Networks

- Connected by Legal Person Ownership
  - 4% by firms and 48% by registered capital
  - 0.75% reduction by removing listed firms
- Connected by Individual Person Ownership
  - 11% by firms and 15% by registered capital
  - 0.35% reduction by removing listed firms
- Firms connecting the two networks (i.e., firms in both the two networks)
  - 0.8% by firms and 4.7% by registered capital

Galaxy 1  
(700K Firms, 48% of Total Registered Capital)

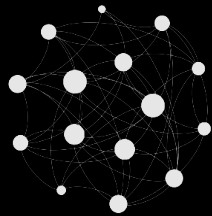


Galaxy 2  
(2M Firms, 15% of Total Registered Capital)



1995

Galaxy 1  
(50K Firms, 1.6% of All firms and 31%  
of Total Registered Capital)

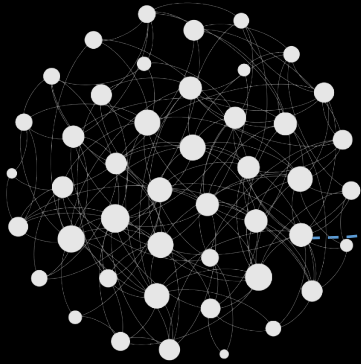


No Significant Galaxy 2



2000

Galaxy 1  
(160K Firms, 3.8% of All firms, 46% of  
Total Registered Capital)

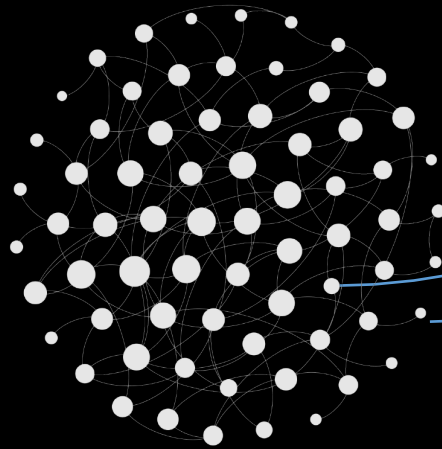


No Significant Galaxy 2

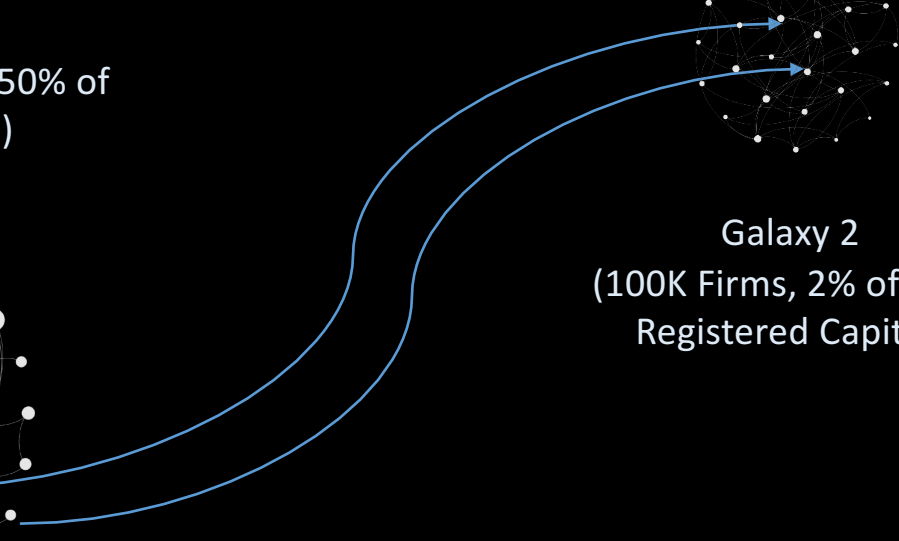
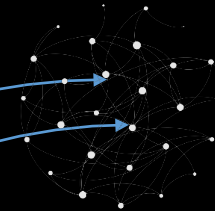


2005

Galaxy 1  
(240K Firms, 4% of All Firms, 50% of  
Total Registered Capital)

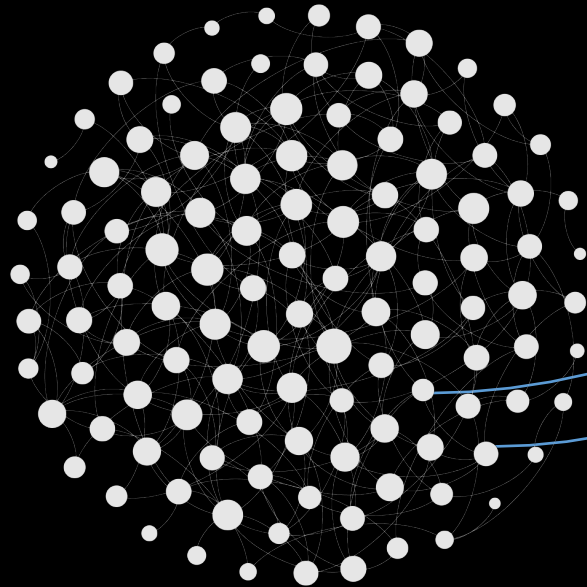


Galaxy 2  
(100K Firms, 2% of Total  
Registered Capital)

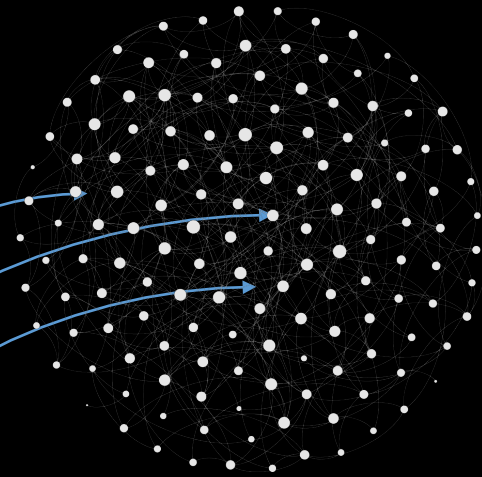


2010

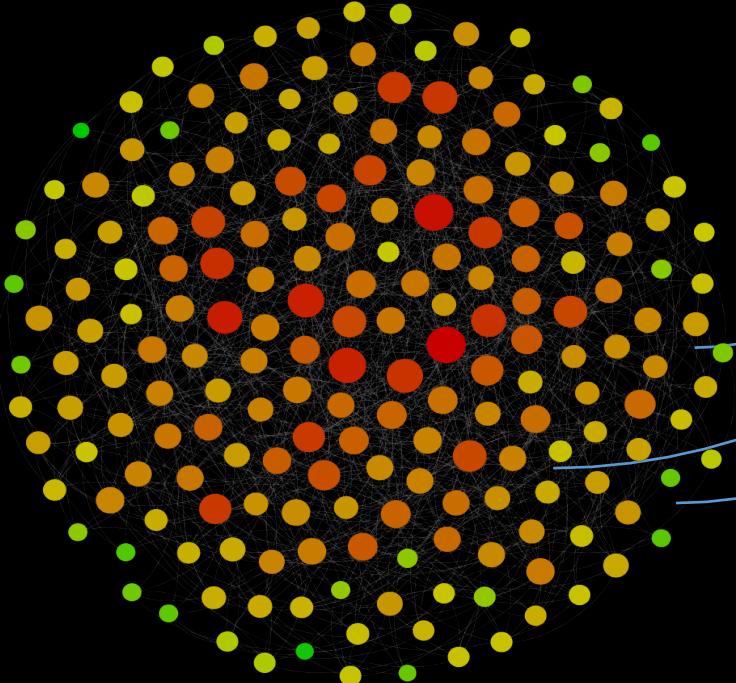
Galaxy 1  
(400K Firms, 4.3% of All Firms, 52% of  
Total Registered Capital)



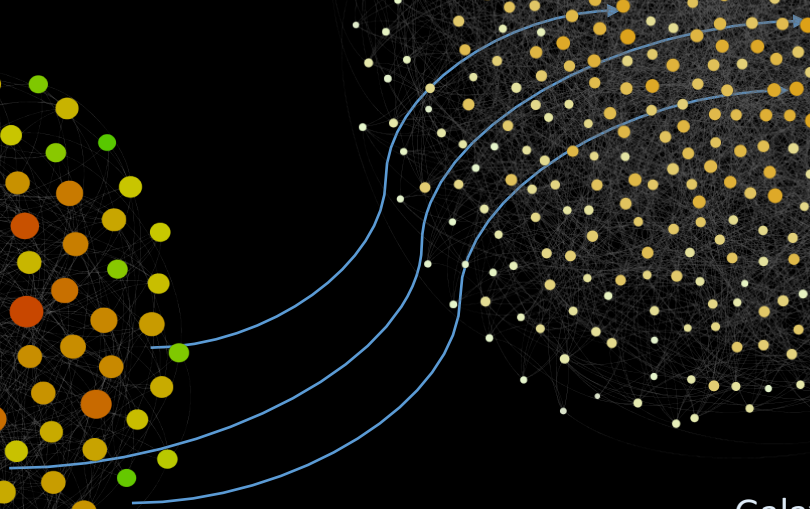
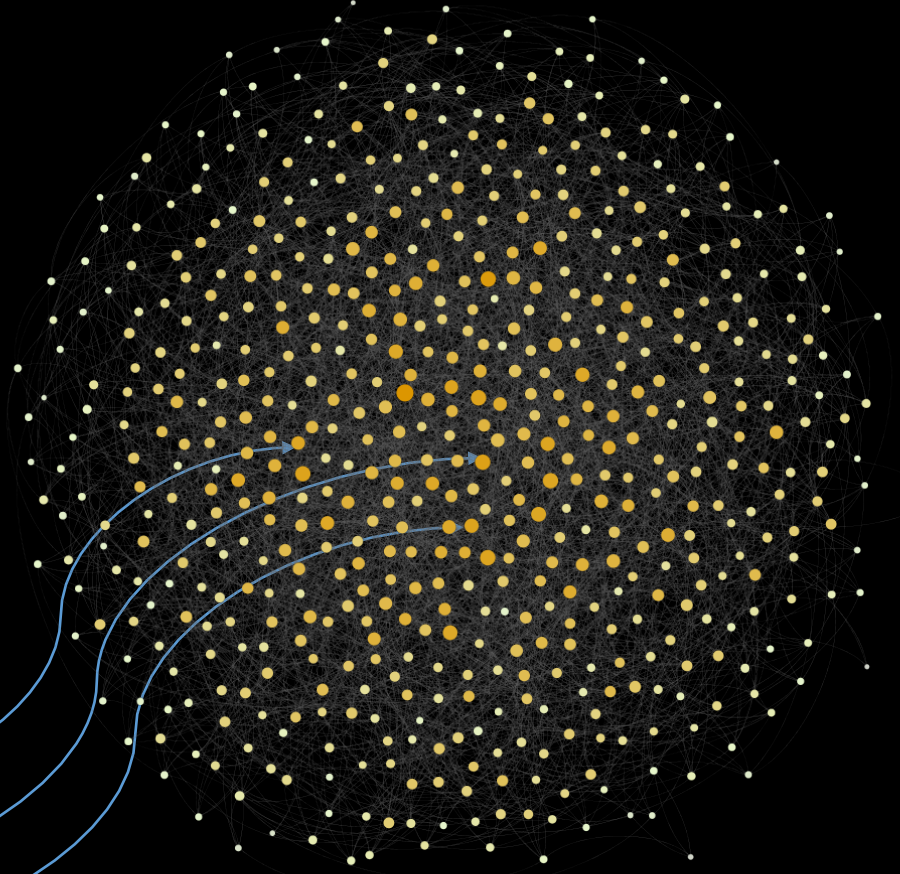
Galaxy 2  
(500K Firms, 7% of Total  
Registered Capital)



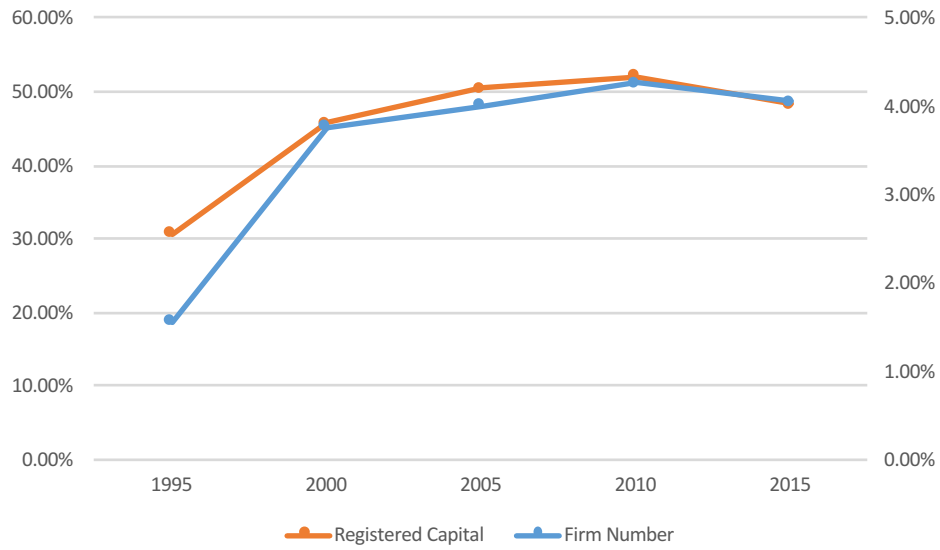
Galaxy 1  
(700K Firms, 48% of Total Registered Capital)



Galaxy 2  
(2M Firms, 15% of Total Registered Capital)

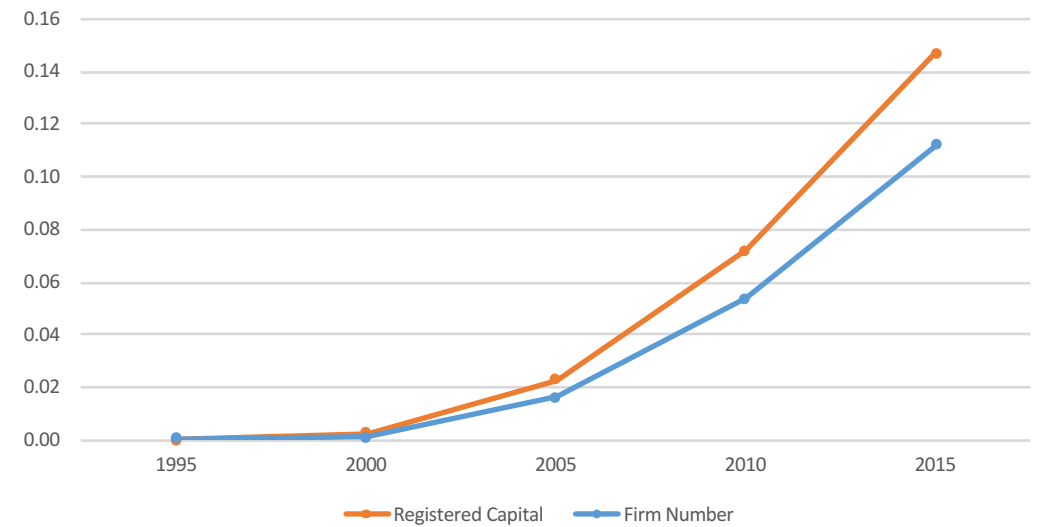


Relative Size of Galaxy 1



# Dynamics of Galaxy Relative Size

Relative Size of Galaxy 2



# Galaxies in Germany

- 2.9 million German firms in Orbis
  - 0.52 million with legal-person shareholders (20% > 6% in China)
- 0.26 million in Galaxy 1
  - $0.26/0.52 = 50.5\% < 64.8\%$  in China
- 87 thousand in Galaxy 2
  - $0.087/2.9 = 3\% \ll 11\%$  in China

# Some Stylized Facts

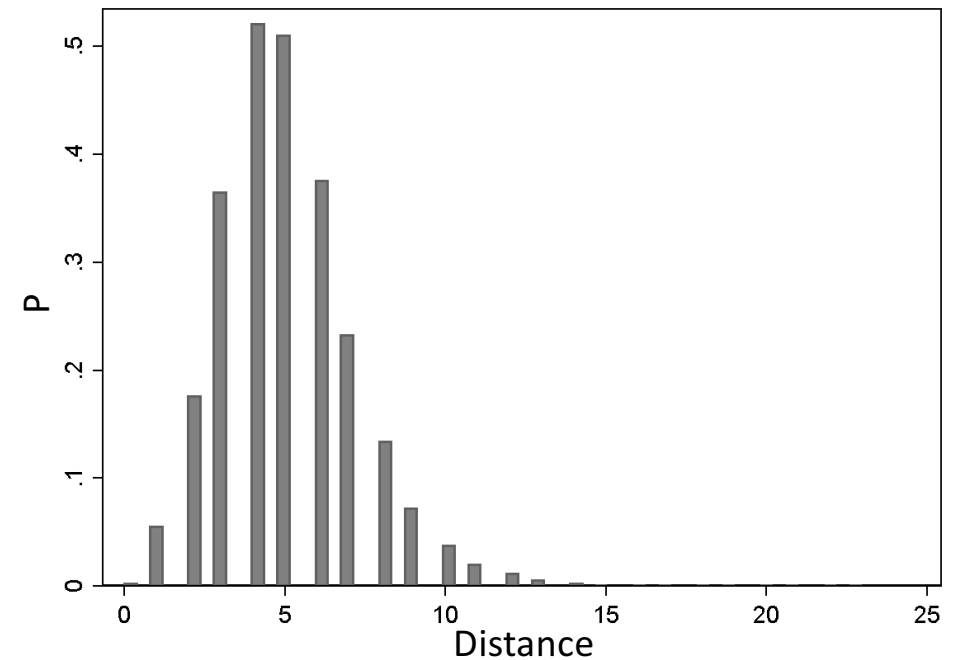
- Extensive and intensive margins: Firm size, age, ownership, YK ...
- Firms connecting the two galaxies: Peripheral in G1 and center in G2
- Center in G1 (by closeness): Big SOEs
  - Germany: Financial institutions (DEUTSCHE BANK AG; COMMERZBANK AG; UNICREDIT BANK AG; DZ BANK AG; DEUTSCHE ZENTRAL-GENOSSENSCHAFTSBANK ...)

# 772 Central and Provincial SOEs as the Center of Galaxy 1

Closeness Distribution



Distance Distribution



Correlation between closeness and distance: -0.86

Closeness(i) =  $1 / \text{Sum}(\text{distance}(i,j), j \neq i)$ , standardized into [0,1].

Distance: distance to the set of core firms (central and provincial SOEs).



# State-Centered $\neq$ State-Owned

		Direct + Indirect Equity Shares		Controlling Shareholder	
		Firm Number	RC share in Galaxy 1	Firm Number	RC share in Galaxy 1
772 SOEs	Threshold	772	10.5%	772	10.5%
Firms Controlled by 772 SOEs	50%	40,234	26.0%	43,943	26.6%
	25%	52,446	29.9%	57,897	30.9%
	10%	63,678	32.8%	73,457	34.0%
	5%	69,385	33.9%	81,524	35.7%

# Connectivity and Firm Characteristics (Current Network)

Legal-Person Firms							
	log RC	Age	SOE	log Y	log YK	log YL	log TFP
Galaxy 1	2.295	3.359	0.204	0.616	-0.370	0.323	0.149
	(0.002)	(0.006)	(0.001)	(0.005)	(0.006)	(0.005)	(0.005)
Sample	Full	Full	NBS	NBS	NBS	NBS	NBS
Firms in Galaxy 1							
	log RC	Age	SOE	log Y	log YK	log YL	log TFP
Closeness	5.048	4.910	1.163	2.136	-0.757	1.148	0.665
	(0.018)	(0.054)	(0.007)	(0.038)	(0.047)	(0.040)	(0.038)
Distance	-0.230	-0.421	-0.083	-0.100	0.041	-0.052	-0.027
	(0.001)	(0.004)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Sample	Full	Full	NBS	NBS	NBS	NBS	NBS

Natural-Person Firms							
	log RC	Age	SOE	log Y	log YK	log YL	log TFP
Galaxy 2	0.843	0.304	-0.045	0.031	-0.079	0.014	-0.009
	(0.001)	(0.004)	(0.001)	(0.005)	(0.006)	(0.005)	(0.005)
Sample	Full	Full	NBS	NBS	NBS	NBS	NBS
Firms in Galaxy 2							
	log RC	Age	SOE	log Y	log YK	log YL	log TFP
Closeness	2.195	4.241	0.011	0.603	-0.594	0.211	0.003
	(0.010)	(0.029)	(0.007)	(0.035)	(0.042)	(0.035)	(0.034)
Sample	Full	Full	NBS	NBS	NBS	NBS	NBS

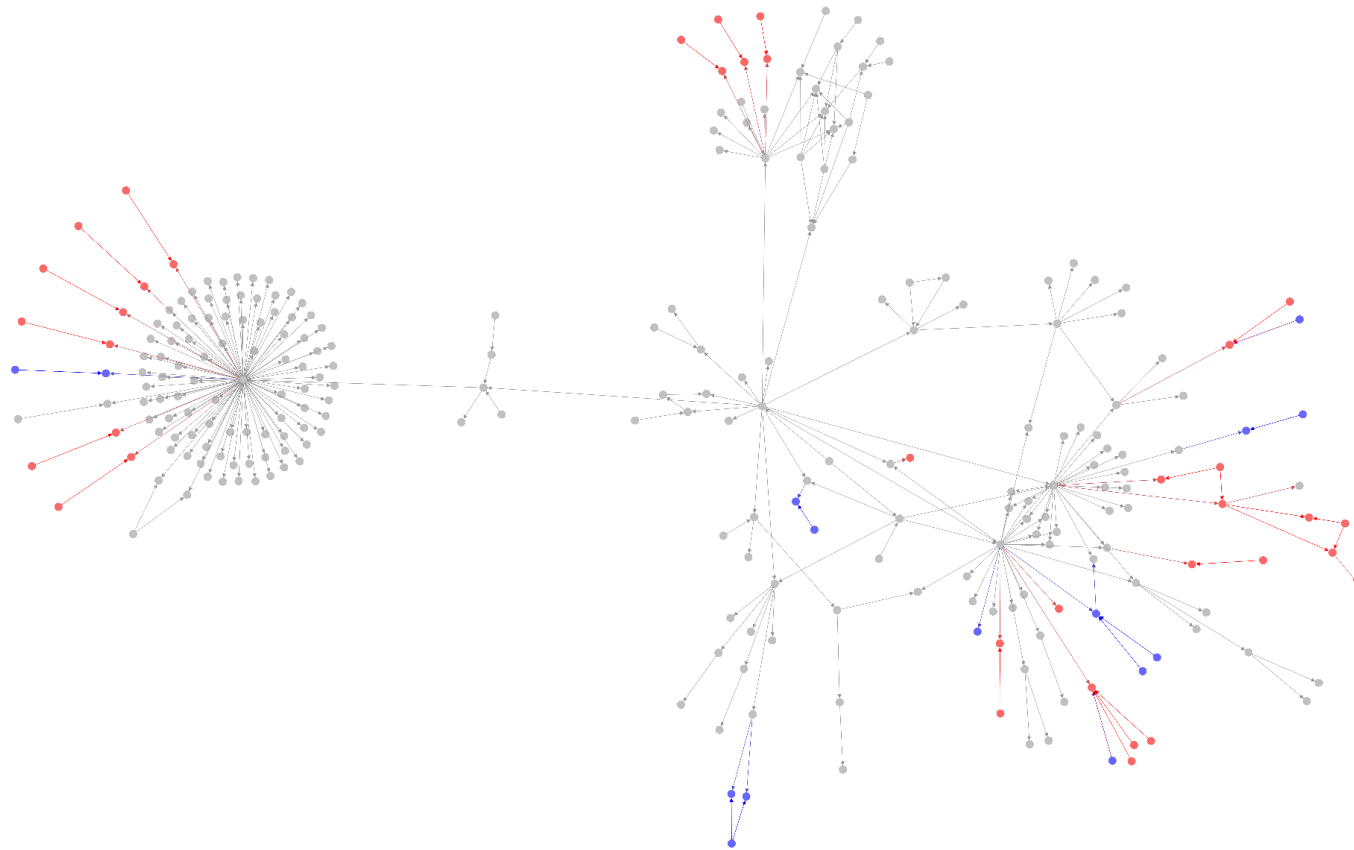
Closeness(i) =  $1 / \text{Sum}(\text{distance}(i,j), j \neq i)$ , standardized into [0,1] (0, periphery; 1 center)

# Connectivity and Firm Characteristics (Current Network, Cont'd)

	G1 = 1	Closeness in G1	Distance in G1	G2 = 1	Closeness in G2
log TFP	0.117	0.029	-0.367	0.034	0.019
	(0.003)	(0.002)	(0.031)	(0.003)	(0.003)
log YK	-0.075	-0.018	0.232	-0.020	-0.015
	(0.001)	(0.001)	(0.013)	(0.001)	(0.001)
log YL	-0.044	-0.009	0.108	-0.023	-0.009
	(0.002)	(0.001)	(0.024)	(0.002)	(0.002)
Age	0.005	0.001	-0.013	-0.001	0.003
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
SOE	0.581	0.089	-1.874		
	(0.003)	(0.001)	(0.019)		
N	301,246	55,418	55,418	301,246	51,590

Using eccentricity and historical network data: Very similar results

# All Companies Owned by East Hope



- Red: State JV
- Grey: Solely Owned by East Hope
- Blue: Private JV

## JV of East Hope Group

### Agriculture

- Beijing Fangshan Hope Animal Feed Co.
- East Hope Change Animal Nutrition Co.
- Beijing Beautiful Hope Animal Feed Co.
- Wuhu Hope Animal Feed Co.
- Funing Hope Animal Feed Co.
- Yangzhou Hope Animal Feed Co.
- Xinyang East Hope Animal Nutrition Co.
- Nanyang Hope Animal Feed Co.
- Xunxian Zhongyuan Hope Animal Feed Co.
- East Hope (Neiqiu) Livestock Co.

### Heavy Industry

- East Hope (Sanmenxia) Alumina Co.
- CNMC Alumina Development Co.
- Chongqing Pengwei Petroleum and Chemical Co.
- Chongqing Liangjiang Energy Development Co.
- Wulong Hongneng Coal Co.
- Chongqing Zhengxin Alumina Co.
- Chongqing Zhengyang New Material Co.
- Sanmenxia Dachang Mining Co.
- Hulun Buir Shenbao Dongneng Coal Co.
- Xinjiang Tianlong Hope Energy Co.
- Baotou Horizon Environment Protection Technique Co.

### Other

- Shanghai Yehai Trade Co.
- Bright Dairy & Food Co.
- Minsheng Life Insurance Co.
- Chengdu East Hope Tianxiang Real Estate Co.
- Chengdu Dongxiang Property Management Service Co.

#### Notes:

1. Joint ventures established by East Hope Group and SOEs are highlighted by *Red*, while joint ventures established by East Hope Group and other private firms, excepted for the other three Hope Groups held by Mr. LIU Yongxing's brothers, are highlighted by *Blue*.
2. Within each industry, joint ventures are sorted by dates of establishment.

# East Hope's Expansion through Ownership Network

- All State JVs are outside Sichuan (home province)
- State JVs are the oldest and private JVs are the youngest
- Agriculture: 116 companies (9 state JVs; 1 private JV)
  - State JVs are on average 9.7 year older than non-JVs (i.e., those solely owned by East Hope).
  - Among the 10 oldest companies, 7 are state JVs (recall 9 state JV in total).
- Heavy industry (aluminum, energy, etc.): 60 companies (9 state JVs; 1 private JV)
  - State JVs are on average 3.0 years older than non-JVs.
- Other industries: 39 companies (1 state JVs; 4 private JVs)

# Identifying “Conglomerates” in the Firm Network

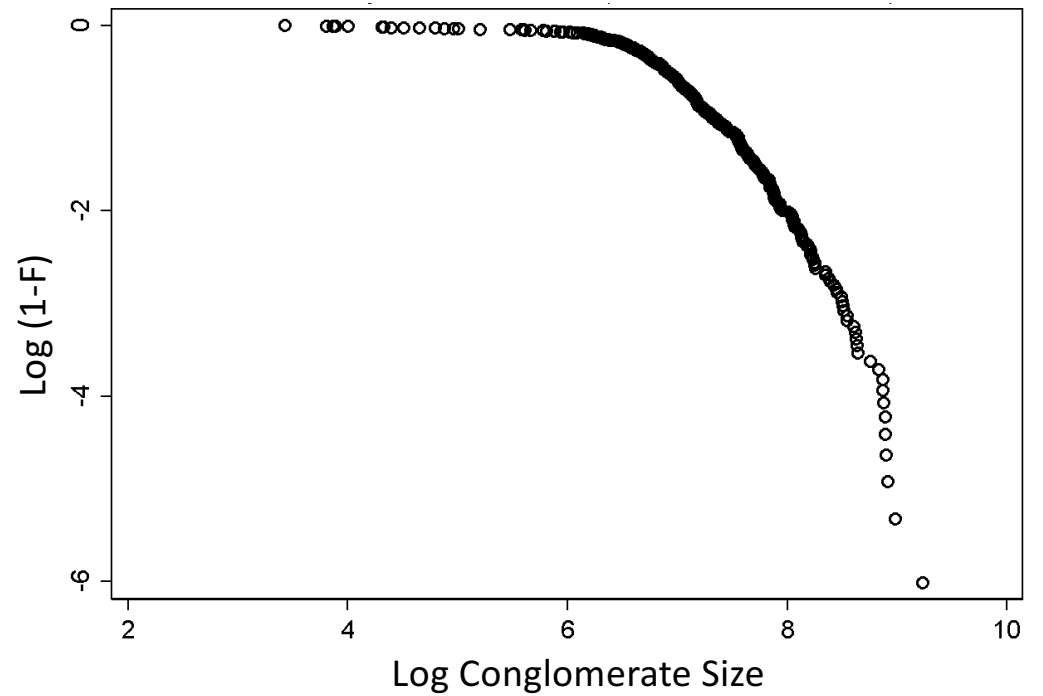
- Identify communities (conglomerates) in the first galaxy (700k firms)
- Method: Multilevel algorithm (“Fast Unfolding of Communities in Large Networks”, Blondel et al., 2008)
- Results: 413 communities (or conglomerates) identified, with modularity = 0.94 (from -1 to 1, a measure of performance in network partition)
- Other algorithms: informap ( $m=0.86$ ), walktrap ( $m=0.83$ ) and label propagation ( $m=0.82$ )

# Basic Information

## Summary Statistics

	Mean	Median	Std	Min	Max
Firm Number	1702.8	1187.0	1544.0	31.0	11014.0
RC (0.1 Billion Yuan)	1544.4	686.8	2491.1	0.9	23098.5

### Conglomerate Size Distribution





# Growth of Conglomerates

Year	Number of Conglomerate	Mean of Conglomerate Size
1995	212	245.4
2000	308	512.5
2005	334	731.5
2010	372	1088.1
2015	413	1702.8

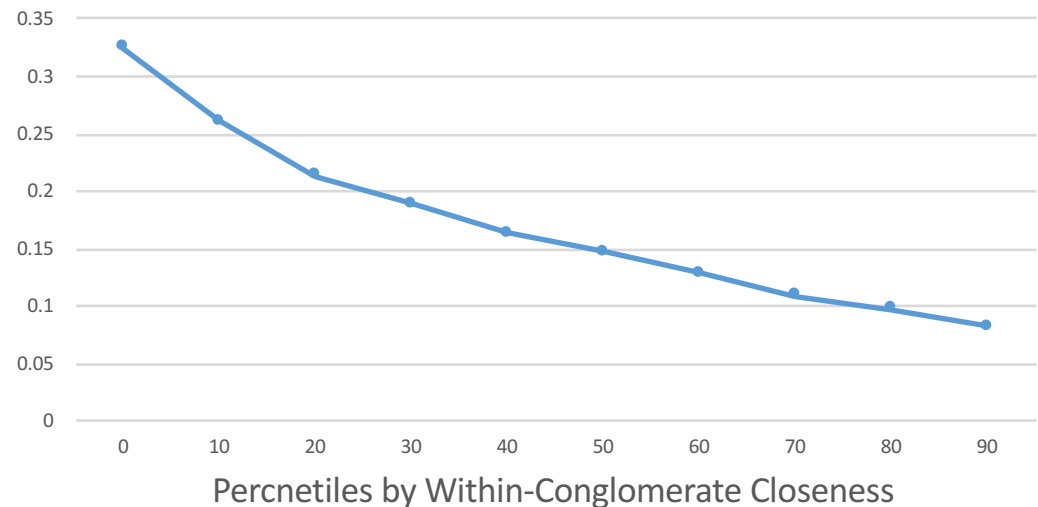
# Conglomerate Stability

- Conglomerate ID: Conglomerate  $j$  in period  $t$  is identical to conglomerate  $i$  in period  $t - 1$  if  $(j, t)$  has the maximum number of incumbent firms in  $(i, t - 1)$

Proportion of Incumbent Firms Staying in the Same Conglomerate

95-00	44.97%
00-05	40.60%
05-10	42.20%
10-15	42.40%

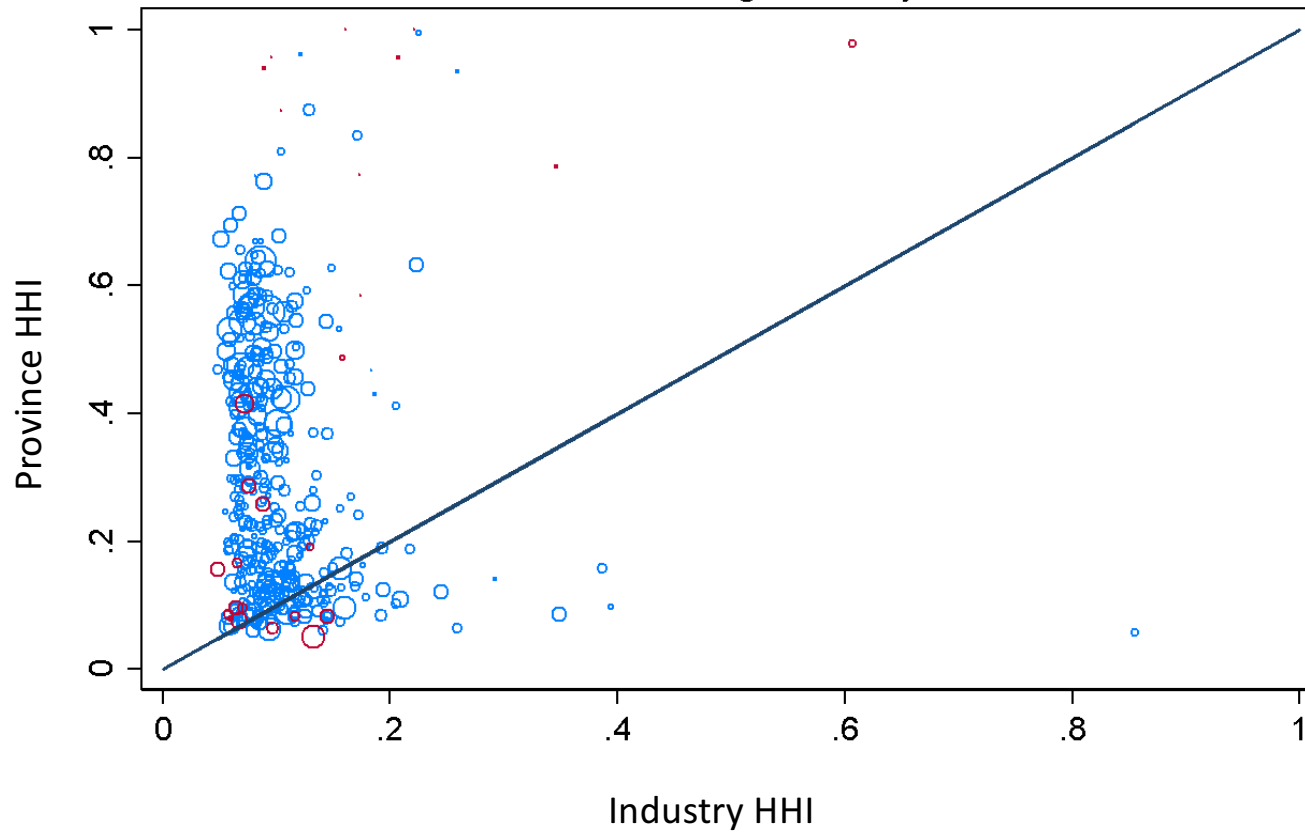
Annual Rate of Incumbent Firms Exiting Conglomerate



# State-Centered Conglomerates

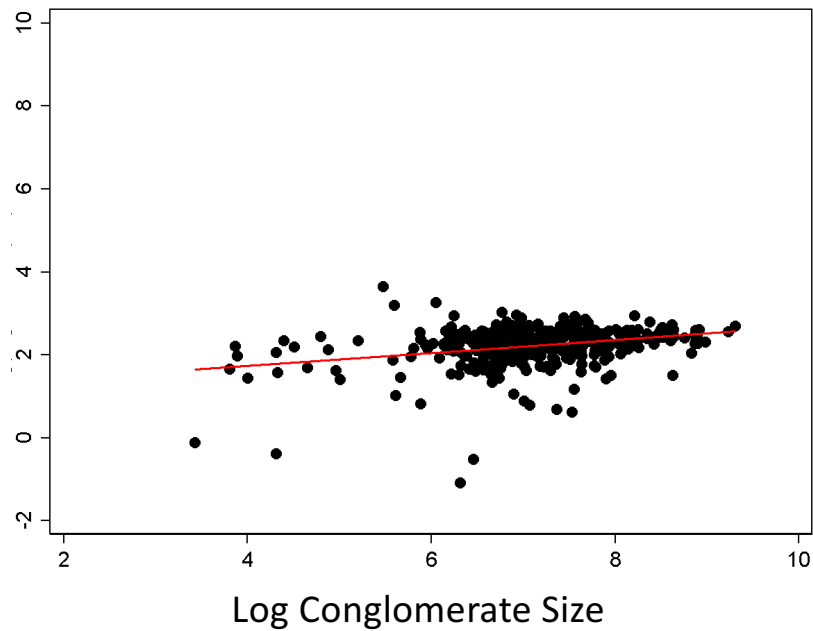
- 772 central and provincial SOEs in 210 conglomerates
- These SOEs are in the center of their conglomerate (with much higher closeness, larger size and lower YK).
- Closeness within conglomerate is highly correlated with distance to the 772 SOEs (correlation: -0.72).
- The 210 “state-centered” conglomerates account for two-thirds of Galaxy 1 by firm number and registered capital.

# Regional and Sectoral Concentrations

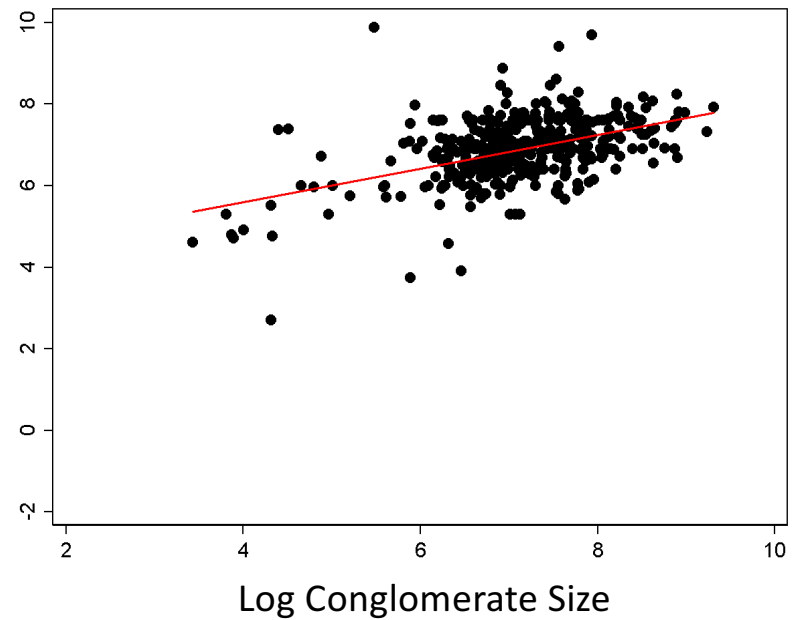


# Conglomerate Size vs. Average/Top Firms

Average Log RC in a Conglomerate



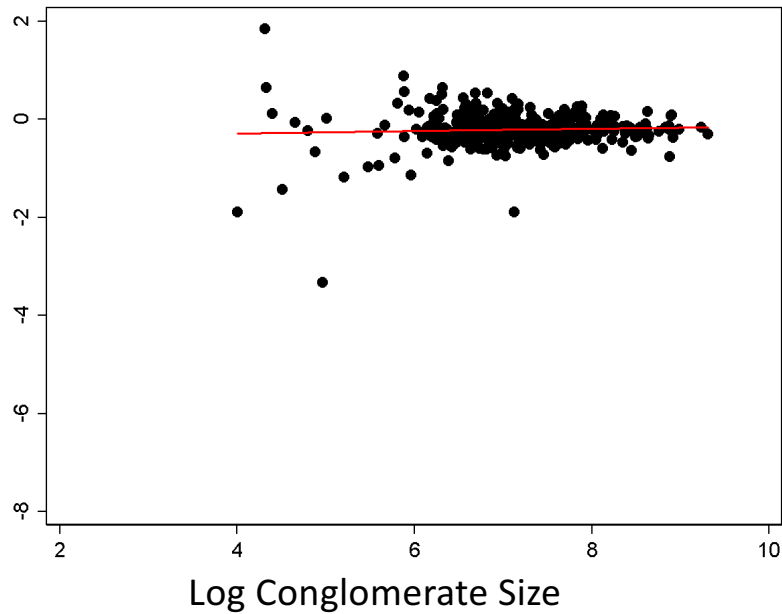
The 99<sup>th</sup> Percentile Log RC in a Conglomerate



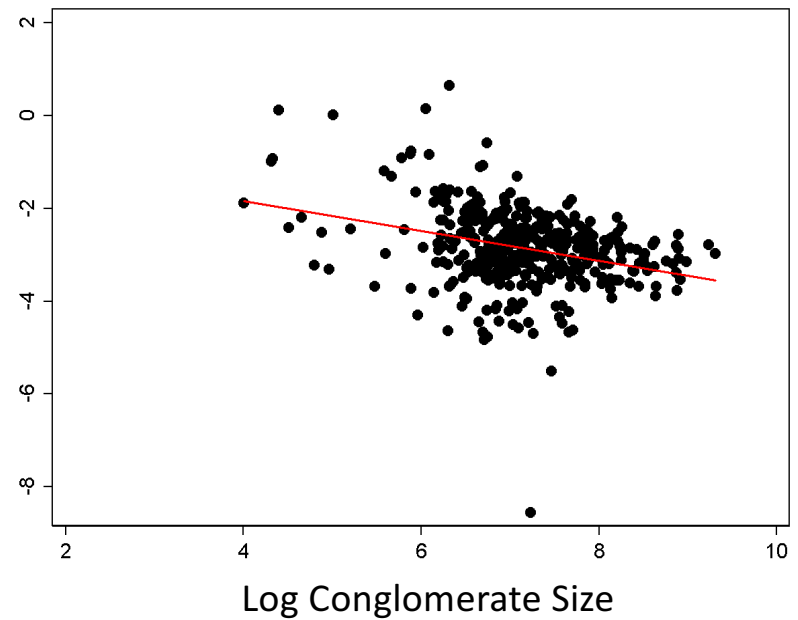
Robustness check: Using Log RC of the core firms in the center of conglomerate

# Conglomerate Size vs. Average/Top Firms

Average Log YK in a Conglomerate (NBS Sample)



The 1<sup>st</sup> Percentile Log YK in a Conglomerate (NBS Sample)



Robustness check: Using Log YK of the core firms in the center of conglomerate



# Within-Conglomerate Variations

	Log RC	Log RC	Log RC	Log RC	Log TFP	Log TFP	Log TFP	Log TFP	Log YK	Log YK	Log YK	Log YK
Distance	-0.232				-0.030				0.044			
	(0.001)				(0.003)				(0.003)			
C. Distance		-0.077	-0.060	-0.088		-0.004	-0.004	-0.006		0.020	0.018	0.021
		(0.001)	(0.001)	(0.001)		(0.002)	(0.002)	(0.002)		(0.002)	(0.003)	(0.002)
C. Distance * C. State Dummy			-0.051				0.002				0.006	
			(0.002)				(0.004)				(0.005)	
C. Distance * Log C. Size				-0.069				-0.014				0.010
				(0.001)				(0.003)				(0.003)
C. FE	+	+	+	+	+	+	+	+	+	+	+	+
R2	0.08	0.03	0.04	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02
N	703,128	471,849	471,849	471,849	55,443	37,123	37,123	37,123	56,040	37,548	37,548	37,548



# Summary of the Stylized Facts

- Network features: Firm size, age and SOE share (YK) negatively (positively) correlated with firm distance to the center of the network
- Conglomerate analysis: Firm size, age and SOE share (YK) negatively (positively) correlated with distance to the center of a conglomerate
- Conglomerate analysis: Strong correlation between conglomerate size and the top firm size or the bottom YK ratio in a conglomerate (weak correlation between conglomerate size and the average firm size or YK ratio in a conglomerate)

# Take-Aways

- Growth of incumbent conglomerates is the key.
- Firms in the center of a conglomerates are important for the size (and growth?) of the conglomerate.
- No severe misallocation across conglomerates

# A Simple Model

- Consider an economy without financial intermediary.
- All firms produce the same goods by a decreasing-return-to-scale production technology:  $Y_i = Z_i K_i^\alpha$ , where firm TFP,  $Z_i$ , is constant and exogenous.
- Assume constant saving rate ( $s$ ).

# Firm Dynamics

- $N(t)$  incumbents and  $1 - N(t)$  potential entrants
- Incumbents own capital and invest in matched entrants via random search.
- The new entrants will make production, return a fixed proportion of output to their investors and then become incumbents (capital owners) in the subsequent periods.
- Myopic: Both incumbents and potential entrants are run by one-period-lived entrepreneurs (can be relaxed).

# Firm Characteristics and Distributions

- Incumbents:  $(A, Z^c)$ , where  $A \in \{A_1, \dots, A_I\}$  is capital owned by incumbent at the beginning of each period and  $Z^c \in \{Z_1, \dots, Z_I\}$  is the incumbent's TFP.
- Potential entrants:  $Z^e$ , where  $Z^e \in \{Z_1, \dots, Z_J\}$  is the entrant's TFP.
- The initial distributions are  $P^c(A, Z^c, 0)$ ,  $P^e(Z^e, 0)$  and  $N(0)$ .

# One-to-One Matching

- An incumbent randomly meets a potential entrant in each period and then form a joint venture under some conditions.
- Extension: Allowing joint venture between incumbents.

# Capital Allocation in a Joint Venture

- In a matched pair, the incumbent will allocate capital by

$$\pi^c(A, Z^c, Z^e) = \max_K Z^c (A - K)^\alpha + \beta Z^e K^\alpha$$

- Denote  $K(A, Z^c, Z^e)$  the capital allocation rule. Then, the entrant's profit is

$$\pi^e(A, Z^c, Z^e) = (1 - \beta) Z^e K(A, Z^c, Z^e)^\alpha$$

- $\beta$  captures contractual frictions (efficient capital allocation by Nash Bargaining)

# Capital Allocation in a Joint Venture

- Fixed cost  $C$  for forming/maintaining a joint venture (paid by incumbent)
- Surplus for incumbent and entrant are

$$\widehat{\pi}^c(A, Z^c, Z^e) = \max\{\pi^c(A, Z^c, Z^e) - Z^c A^\alpha - C, 0\}$$

$$\widehat{\pi}^e(A, Z^c, Z^e) = \pi^e(A, Z^c, Z^e)$$

- Incumbent more capital + Entrant high TFP => More surplus of the joint venture



# Random Search

- Incumbent and entrant's search efforts are  $\lambda^c(A, Z^c, t)$  and  $\lambda^e(Z^e, t)$ .
- Search cost is  $SC(\lambda^i)$ , where  $SC(\cdot)$  is homogeneous of degree 1, convex and satisfies  $SC(0) = 0, SC'(\cdot) > 0, SC''(\cdot) > 0, \lim_{x \rightarrow \infty} SC(x) = \infty$ .
  - Example:  $SC(\lambda^i) = \frac{B}{\eta} (\lambda^i)^\eta$ , where  $\eta > 1$ .

# Random Search

- “Market tightness” on incumbent and entrant sides:

$$\theta^c(t) = \min \left\{ \frac{\sum_{Z^e} \lambda^e(Z^e, t) P^e(Z^e, t)}{\sum_{A, Z^c} \lambda^c(A, Z^c, t) P^c(A, Z^c, t)}, 1 \right\}, \theta^e(t) = \min \left\{ \frac{\sum_{A, Z^c} \lambda^c(A, Z^c, t) P^c(A, Z^c, t)}{\sum_{Z^e} \lambda^e(Z^e, t) P^e(Z^e, t)}, 1 \right\}$$

- The rate for an incumbent  $(A, Z^c)$  to meet a potential entrant  $Z^e$ :

$$\lambda^c(A, Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t), \text{ where } \Gamma^e(Z^e, t) = \frac{\lambda^e(Z^e, t) P^e(Z^e, t)}{\sum_{Z^e} \lambda^e(Z^e, t) P^e(Z^e, t)}$$

- The rate for an entrant  $Z^e$  to meet an incumbent  $(A, Z^c)$ :

$$\lambda^e(Z^e, t) \cdot \theta^e(t) \cdot \Gamma^c(A, Z^c, t), \text{ where } \Gamma^c(A, Z^c, t) = \frac{\lambda^c(A, Z^c, t) P^c(A, Z^c, t)}{\sum_{A, Z^c} \lambda^c(A, Z^c, t) P^c(A, Z^c, t)}$$

# Optimal Search Efforts

- The optimal search effort for incumbents and potential entrants:

$$\max_{\lambda^c} \lambda^c \theta^c \sum_{Z^e} \widehat{\pi}^c(A, Z^c, Z^e) \cdot \Gamma^e(Z^e, t) - SC(\lambda^c)$$

$$\max_{\lambda^e} \lambda^e \theta^e \sum_{A, Z^c} \widehat{\pi}^e(A, Z^c, Z^e) \cdot \Gamma^c(A, Z^c, t) - SC(\lambda^e)$$

- The FOCs solve  $\lambda^c = \lambda^c(A, Z^c, t)$  and  $\lambda^e = \lambda^e(Z^e, t)$ .
- Denote the matching rate:  $M(A, Z^c, Z^e, t) = 1$  if  $\widehat{\pi}^c(A, Z^c, Z^e) > 0$  and 0 otherwise.

# Evolution of Capital

- Incumbent's next-period capital is  $A - K(A, Z^c, Z^e) + s \cdot (A, Z^c, Z^e)$ .
- Denote  $\Phi^c(A'|A, Z^c, Z^e) = 1$  if  $A' \neq A$  and 0 otherwise.
- The current entrants will become incumbents in the next period, with capital  $K(A, Z^c, Z^e) + \pi^e(A, Z^c, Z^e)$ .
- Likewise, Denote  $\Phi^e(A'|A, Z^c, Z^e) = 1$  if  $A' > 0$  and 0 otherwise.

# Evolution of Incumbents and Entrants

- The measure of matched entrants with  $A'$  and  $Z^e$ :  $N^{e,c}(A', Z^e, t) =$

$$P^e(Z^e, t) \cdot (1 - N(t)) \cdot \sum_{A, Z^c} \lambda^e(Z^e, t) \cdot \theta^e(t) \cdot \Gamma^c(A, Z^c, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^e(A'|A, Z^c, Z^e)$$

- The measure of incumbents with  $A'$  and  $Z^c$ :  $N^{c,c}(A', Z^c, t) =$

$$\sum_A P^c(A, Z^c, t) \cdot N(t) \cdot \sum_{Z^e} \lambda^c(A, Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^c(A'|A, Z^c, Z^e) \\ + P^c(A', Z^c, t) \cdot N(t) \sum_{Z^e} [1 - \lambda^c(A', Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t) \cdot M(A', Z^c, Z^e, t)]$$

# Aggregate Dynamics

- The measure of entrants evolves by

$$N(t + 1) = \sum_{A, Z^c} N^{c,c}(A, Z^c, t) + \sum_{A, Z^c} N^{e,c}(A, Z^c, t)$$

- The distributions evolve by

$$P^c(A, Z^c, t + 1) = \frac{N^{c,c}(A, Z^c, t) + N^{e,c}(A, Z^c, t)}{N(t + 1)}$$

$$P^e(Z^e, t + 1) = \frac{N^e(Z^e, t) - \sum_A N^{e,c}(A, Z^c, t)}{1 - N(t + 1)}$$

# Outcomes

- Firm TFP, size and YK distributions
- A connected network (all initial incumbents are connected)
- Conglomerate Formation
- Distance and degree distributions

# Ownership Layer Distribution

- Define  $D(x|A, Z^c, t)$  the distribution of incumbents  $(A, Z^c)$  on the ownership layers (i.e., the distance to the “ultimate” capital owner),  $x = 1, 2, \dots$ .
- The measure of matched entrants with  $A', Z^e$  and  $x + 1$ :

$$ND^{e,c}(x + 1|A', Z^e, t) = P^e(Z^e, t) \cdot (1 - N(t))$$

$$\cdot \sum_{A, Z^c} D(x|A, Z^c, t) \cdot \lambda^e(Z^e, t) \cdot \theta^e(t) \cdot \Gamma^c(A, Z^c, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^e(A'|A, Z^c, Z^e)$$



# Ownership Layer Distribution (cont'd)

- The measure of incumbents with  $A'$ ,  $Z^c$  and  $x$ :

$$ND^{c,c}(x|A', Z^c, t)$$

$$= \sum_A D(x|A, Z^c, t) \cdot P^c(A, Z^c, t) \cdot N(t) \cdot \sum_{Z^e} \lambda^c(A, Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^c(A'|A, Z^c, Z^e)$$

$$+ D(x|A', Z^c, t) \cdot P^c(A', Z^c, t) \cdot N(t) \cdot \sum_{Z^e} [1 - \lambda^c(A', Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t) \cdot M(A', Z^c, Z^e, t)]$$

- Evolution:

$$D(x|A, Z^c, t + 1) = \frac{ND^{c,c}(x|A, Z^c, t) + ND^{e,c}(x|A, Z^c, t)}{N(t + 1)}$$

# Degree Distribution

- Define  $Q(x|A, Z^c, t)$  the distribution of incumbents  $(A, Z^c)$  on the degrees (i.e., the number of invested firms),  $x = 0, 1, \dots$ .
- The measure of matched entrants with  $A', Z^e$  and 0:

$$NQ^{e,c}(0|A', Z^e, t) = P^e(Z^e, t) \cdot (1 - N(t))$$

$$\cdot \sum_{A, Z^c} \lambda^e(Z^e, t) \cdot \theta^e(t) \cdot \Gamma^c(A, Z^c, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^e(A'|A, Z^c, Z^e)$$

# Degree Distribution (cont'd)

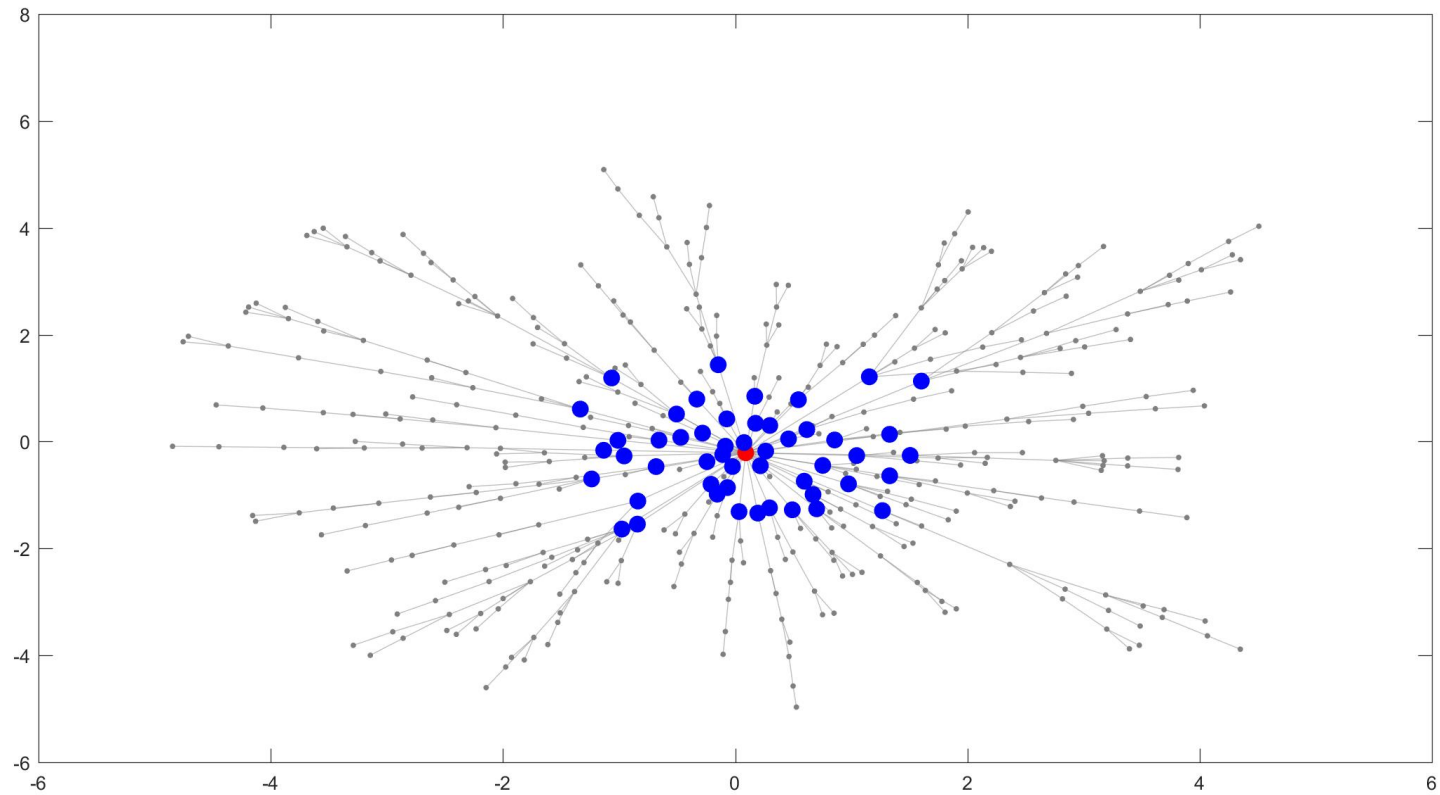
- The measure of incumbents with  $A'$ ,  $Z^c$  and  $x + 1$ :

$$NQ^{c,c}(x + 1|A', Z^c, t)$$
$$= \sum_A Q(x|A, Z^c, t) \cdot P^c(A, Z^c, t) \cdot N(t) \cdot \sum_{Z^e} P^e(Z^e, t) \cdot M(A, Z^c, Z^e, t) \cdot \Phi^c(A'|A, Z^c, Z^e)$$
$$+ D(x + 1|A', Z^c, t) \cdot P^c(A', Z^c, t) \cdot N(t) \cdot \sum_{Z^e} [1 - \lambda^c(A', Z^c, t) \cdot \theta^c(t) \cdot \Gamma^e(Z^e, t) \cdot M(A', Z^c, Z^e, t)]$$

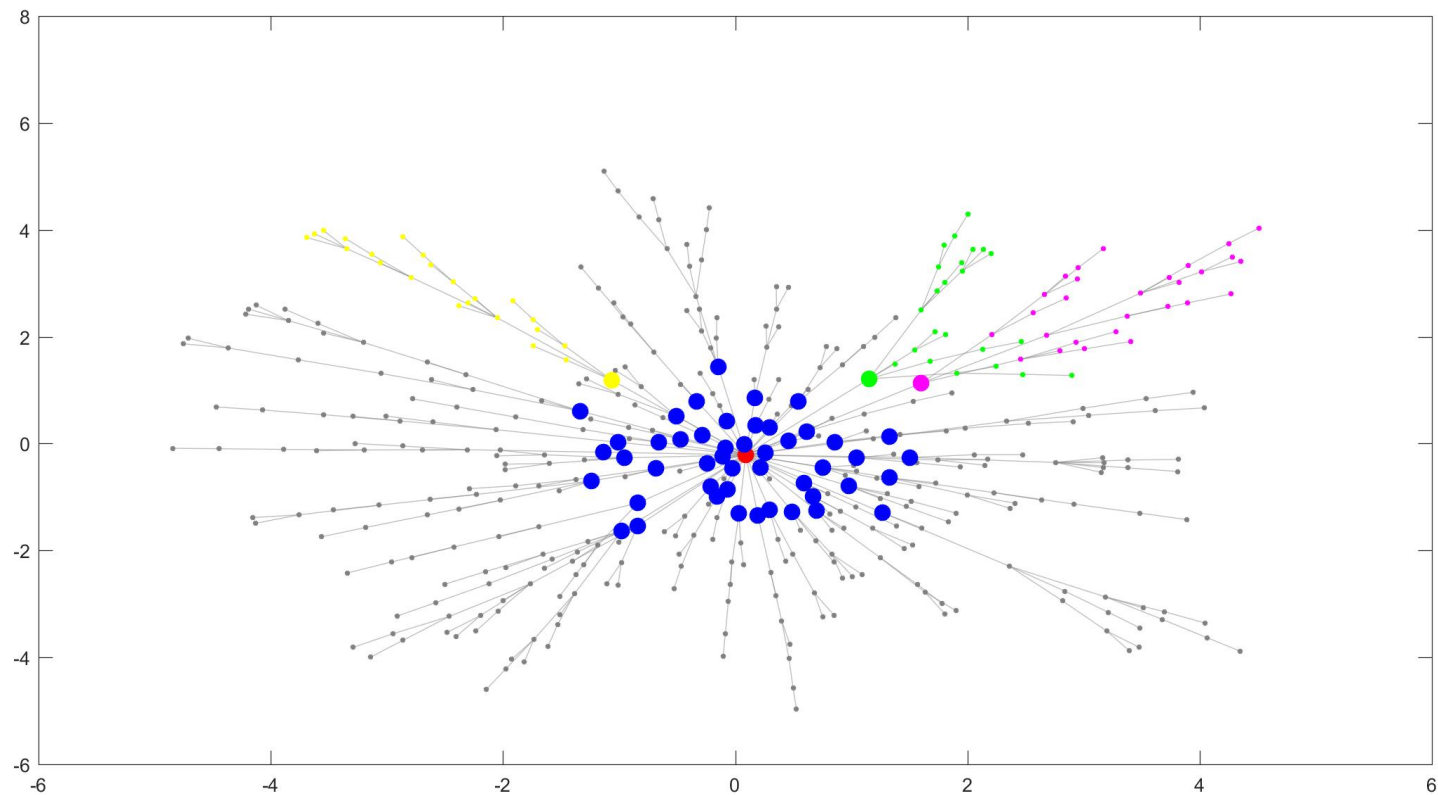
- Evolution:

$$Q(x|A, Z^c, t + 1) = \frac{NQ^{c,c}(x|A, Z^c, t) + NQ^{e,c}(x|A, Z^c, t)}{N(t + 1)}$$

# Simulations (50 Initial Incumbents)



# Three Largest Conglomerates among 50 Identified by Multilevel algorithm



# Structural Estimation (VERY PRELIMINARY)

- Targeted moments for firms in Galaxy 1 (six moments): Variance of firm size, TFP and YK and their covariance with distance to the center (central and provincial SOEs)
- Targeted moments for conglomerates in Galaxy 1 (seven moments): Variance of conglomerate size, variance of top/bottom firm size, TFP and YK in a conglomerate and their covariance with conglomerate size

# Specification and Estimation

- Simulated method of moments: Estimating  $\beta$ ,  $s$ ,  $\sigma_{\log K}$ ,  $\sigma_{\log Z}$ ,  $\eta$  and  $C$
- Very preliminary: Identity matrix, Grid search on coarse parameter space, no standard errors ...

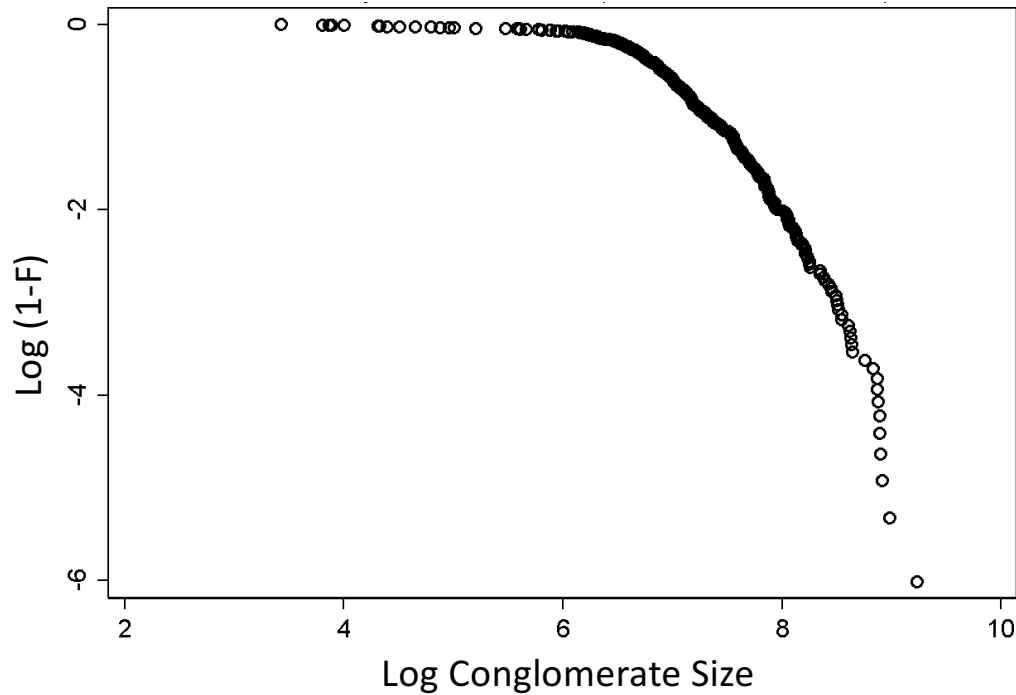
- Predetermined parameters:  $\alpha = 0.5$  and  $N(0) = 0.05$
- Estimated parameters:  $\beta = 0.7$ ,  $s = 0.7$ ,  $\sigma_{\log A} = 1.5$ ,  $\sigma_{\log Z} = 1.0$ ,  $\eta = 0.2$  and  $C = 0.05$

Moments for Firms	Data	Model	Moments for Conglomerates	Data	Model
var(log_RC)	2.626	1.681	var(log_CSize)	0.658	0.711
var(log_tfp)	<b>1.221</b>	<b>0.55</b>	var(log_RC_99th)	0.499	0.491
var(log_yk)	<b>1.643</b>	<b>0.321</b>	var(log_tfp_99th)	<b>1.023</b>	<b>0.114</b>
cov(dist,log_RC)	<b>-0.955</b>	<b>-0.294</b>	var(log_yk_1st)	0.705	0.362
cov(dist,log_tfp)	-0.055	-0.045	cov(log_Csize,log_RC_99th)	0.223	0.353
cov(dist,log_yk)	0.187	0.204	cov(log_Csize,log_tfp_99th)	0.315	0.132
			cov(log_Csize,log_yk_1st)	-0.211	-0.26

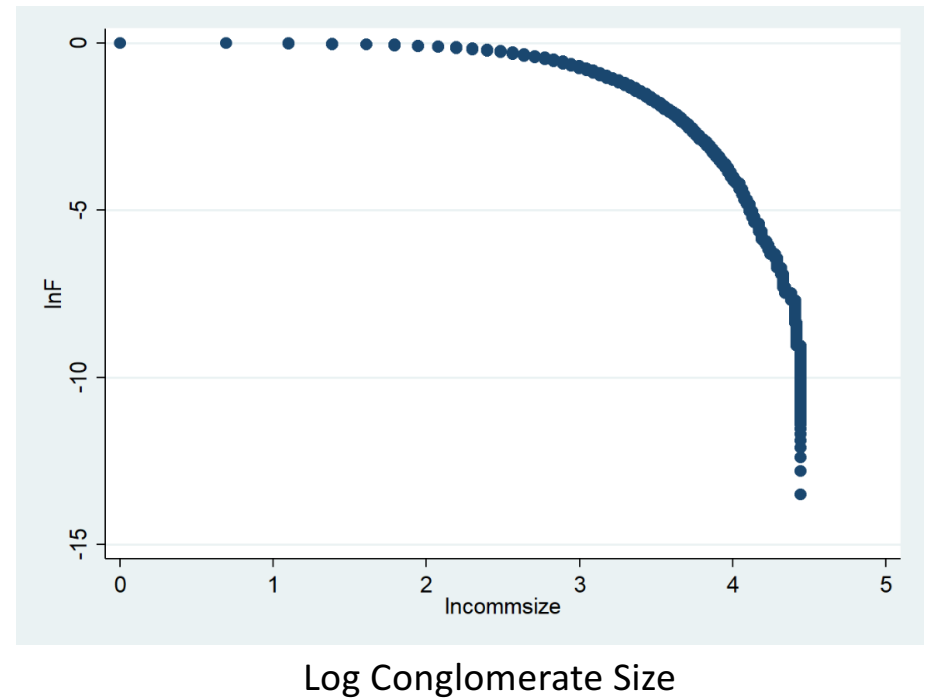


# Simulated Conglomerate Size Distribution

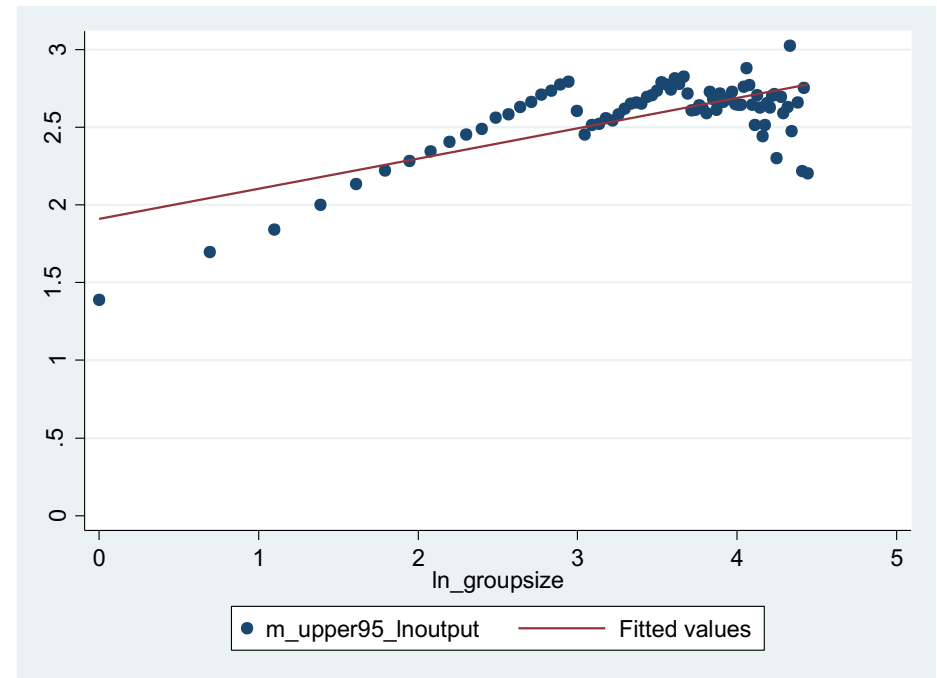
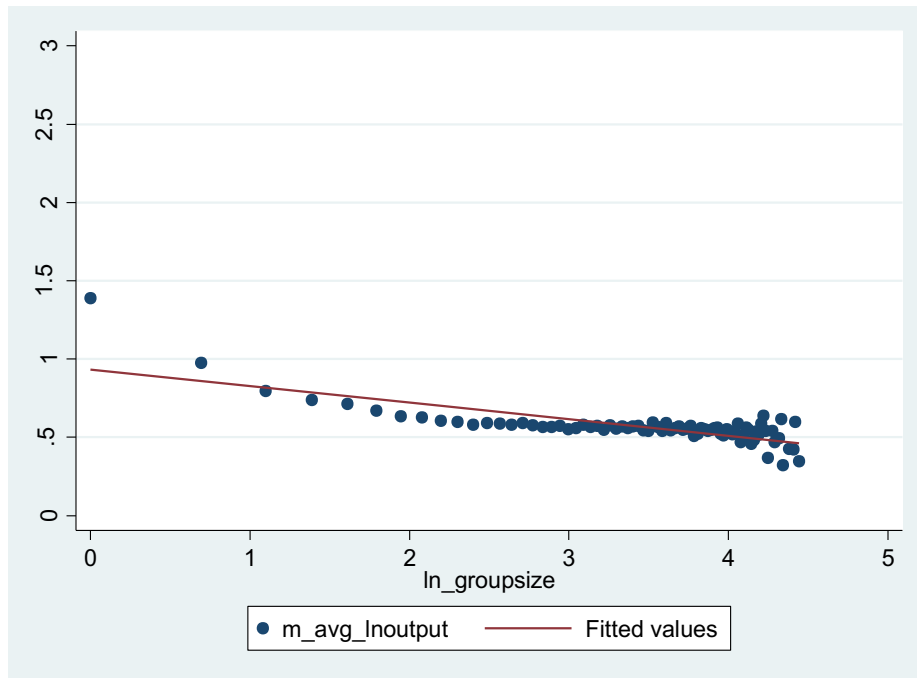
Conglomerate Size Distribution (Data)



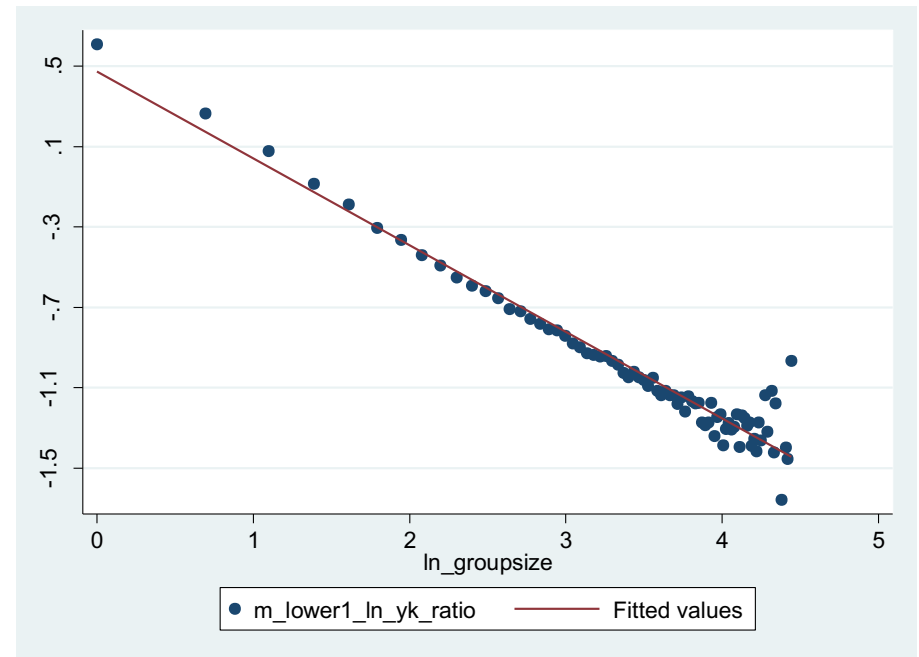
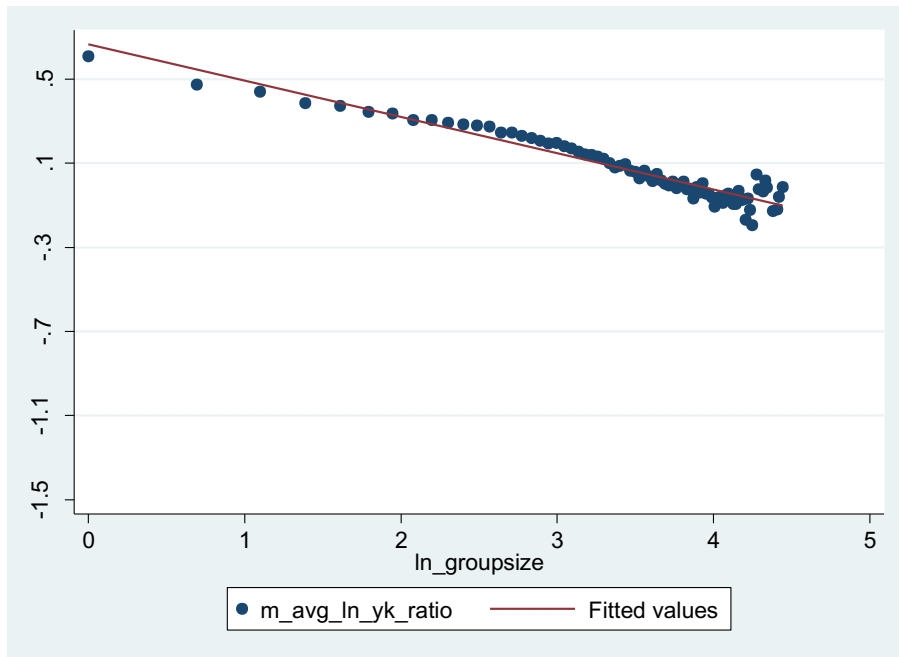
Conglomerate Size Distribution (Simulated)



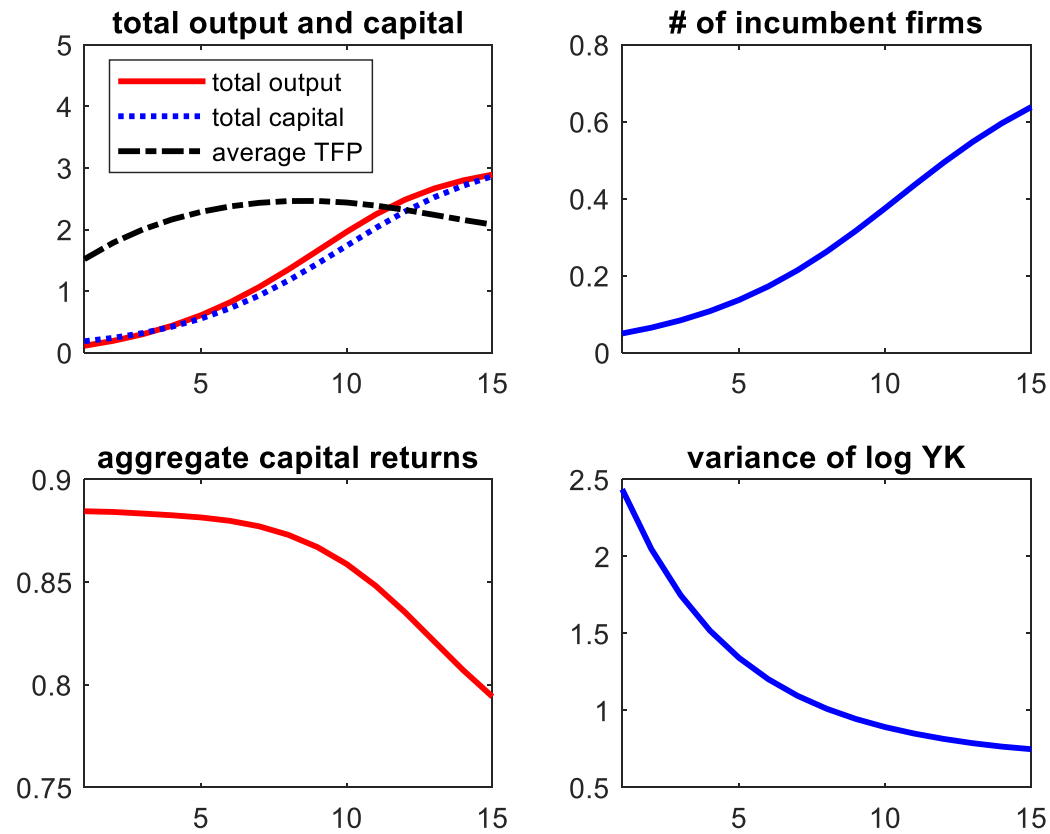
# Simulated Conglomerate Size and Average/Top Log Firm Size



# Simulated Conglomerate Size and Average/Bottom Log Firm YK



# Aggregate Results



# Main Predictions

- Network structures: Firm size and YK negatively correlated with distance to the core
- Conglomerate analysis:
  - Strong correlation between conglomerate size and the top firm size or the bottom YK ratio in a conglomerate (weak correlation between conglomerate size and the average firm size or YK ratio in a conglomerate)
  - Few new conglomerates
- Aggregate implications: Network expansion, firm entry, economic growth and correction of misallocation

# Extension I: Introducing Entrant-Specific Distortions

- Potential entrants face tax/subsidy  $\tau$
- In a matched pair, the incumbent will allocate capital by

$$\pi^c(A, Z^c, Z^e) = \max_K Z^c (A - K)^\alpha + \beta \frac{Z^e}{1 + \tau} K^\alpha$$

- Denote  $K(A, Z^c, Z^e)$  the capital allocation rule. Then, the entrant's profit is

$$\pi^e(A, Z^c, Z^e) = (1 - \beta) \frac{Z^e}{1 + \tau} K(A, Z^c, Z^e)^\alpha$$

# Extension II: Long-Lived Incumbents and Endogenous Matching

- Let  $V^c(A, Z^c)$  be the value function of an incumbent  $(A, Z^c)$  under the stationary distribution  $P^c$  and  $P^e$ .
- In a meeting, the incumbent will allocate and save capital by

$$\max_{K, K'} (1 - \beta) \left( Z^c (A - K)^\alpha - K' + \frac{1}{1 + r} V^c(K', Z^c) \right) \\ + \beta \left( Z^e K^\alpha + \frac{1}{1 + r} V^c(K, Z^e) \right)$$

- $K = 0$  (failed match) or  $K > 0$  satisfying the entry condition.
- $1/(1 + r)$  is a combination of discount factor and exit rate.

# Incumbent's Value Function

- Denote  $K(A, Z^c, Z^e)$  the capital allocation rule and  $K'(A, Z^c, Z^e)$  the saving rule. Then,

$$\begin{aligned}
 & V^c(A, Z^c) \\
 &= \sum_{Z^c, Z^e} P^e(Z^e) \left( (1 - \beta) \left( \begin{aligned} & Z^c(A - K(A, Z^c, Z^e))^\alpha - K'(A, Z^c, Z^e) \\ & + \frac{1}{1+r} V^c(A - K(A, Z^c, Z^e) + K'(A, Z^c, Z^e), Z^c) \end{aligned} \right) \right. \\
 & \quad \left. + \beta \left( Z^e K(A, Z^c, Z^e)^\alpha + \frac{1}{1+r} V^c(K(A, Z^c, Z^e), Z^e) \right) \right)
 \end{aligned}$$

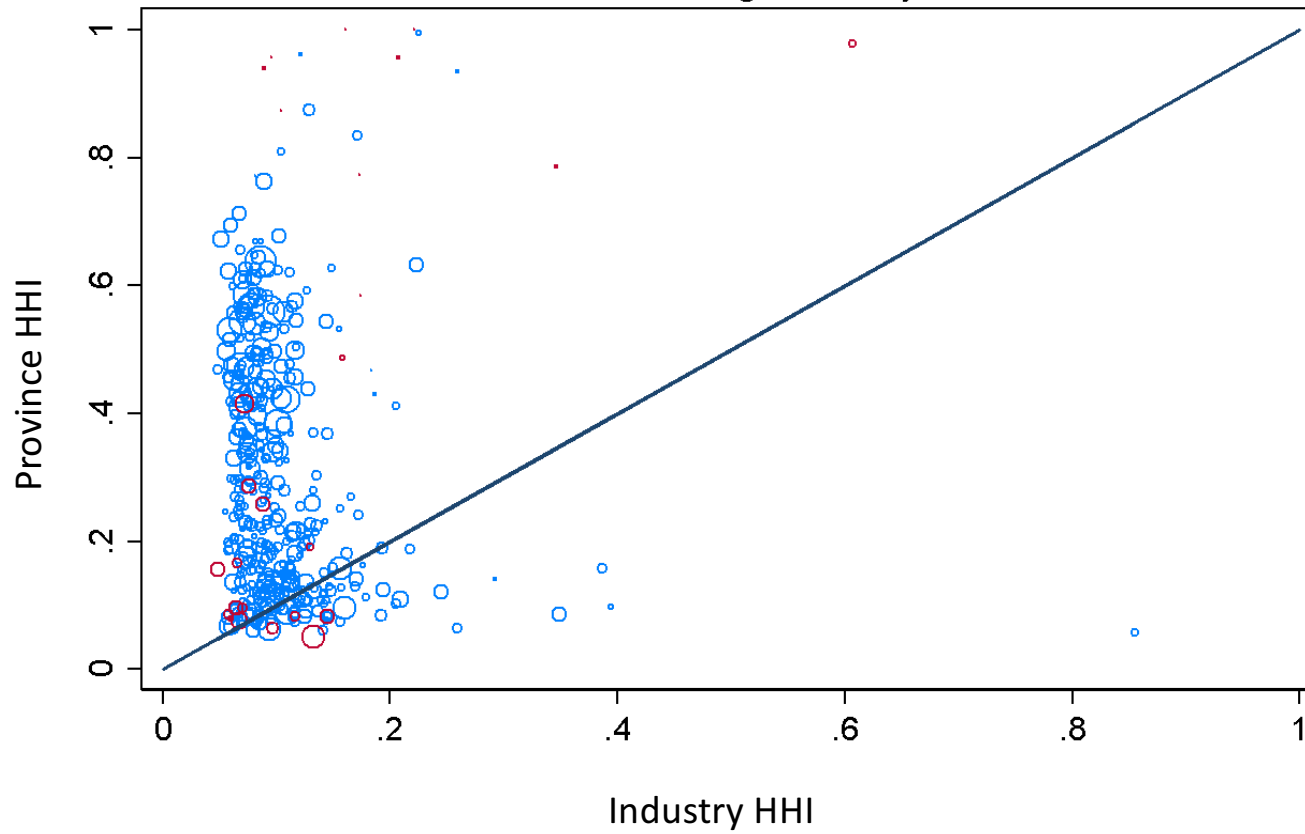
- To be done ...



# Interpretations

- Network as financial intermediary?
- Network as informal institutions?
- Limitations of conglomeration

# Regional and Sectoral Concentrations



# Summary

- Chinese firms are deeply connected through shareholding.
- State-centered conglomerates played a key role in firm entry, resource reallocation and aggregate TFP growth.
- The China model has its strengths and weaknesses. More formal institutions would need to be established for future efficiency gains.

# To-Do List

- Finishing structural estimation
- Allowing matching among incumbents
- Introducing financial intermediary
- ...