Intra-Network Trade, Reallocations, and Productivity Growth: Micro Evidence from China

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Introduction

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- These networks, founded on the basis of ownership, organization, and social connections, are emerging as important mechanisms for the movement of goods, services, capital, and technology across economic entities.

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- This paper examines how varieties of trade within Chinese business networks, including trade in goods and services, capital and credit flows, and technology sourcing, affect micro productivity growth.

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  - Access to capital and technology is still constrained by lagging financial and technology markets;
  - Policy distortions have led to significant misallocations of resources (Hsieh and Klenow, 2009);
  - Intra-network trade and capital reallocations account for, respectively, over 40 and 50 percent of total trade and capital flows for firms included in the sample.

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  - **Technology sourcing:** direct technology transfer.

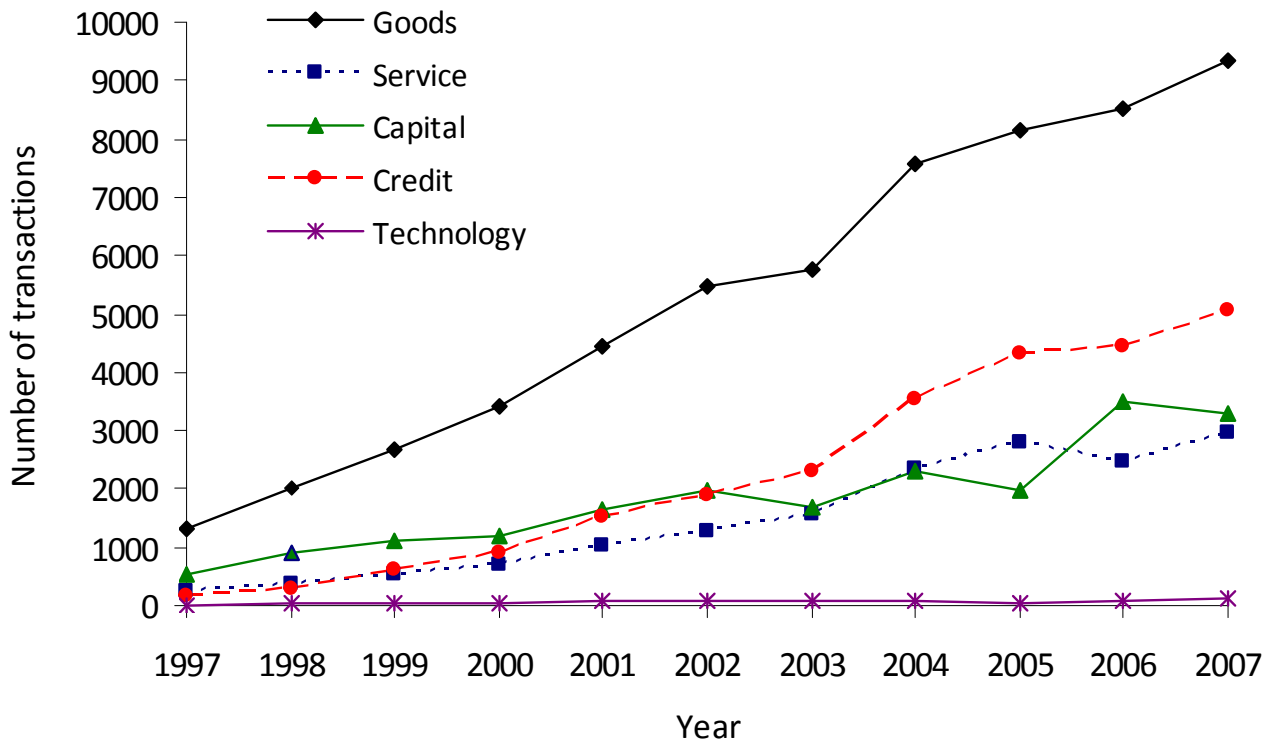

Figure 1: The number of intra-network transactions over time

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- Existing macro evidence suggests trade exerts an unambiguous positive effect (e.g., Frankel and Romer, 1999; Dollar and Kraay, 2004), but finds relatively weak support for an exogenous positive effect of capital inflows (e.g., Borensztein et al., 1998; Alfaro et al., 2004).

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- The above findings are also confirmed at the micro level (e.g., Javorcik, 2004; Keller and Yeaple, 2009; Goldberg, Pavcnik, et al., 2010; Arnold, Mattoo and Javorcik, forthcoming).

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1. How **different varieties of trade** influence productivity growth by helping firms overcome different types of economic friction;
2. The role of trade and investment **within the networks and boundaries of firms**.

Introduction

This paper is also related to a growing literature that emphasizes the role of economic networks (Casella and Rauch, 2001).

- Hoshi et al. (1991): the role of bank ties in investments in Japan;
- Grief (1993): the role of trader networks in overcoming barriers to international trade;
- Feenstra et al. (1999): the role of business groups in export quality and variety;
- Hochberg et al. (2007): the role of manager connections in the performance of venture capital;
- Khwaja et al. (2011): the effect of director networks on bank credit access and financial viability in Pakistan.

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2. **Varieties of trade flows and reallocations** (especially capital, credit, and technology flows);
3. **Accounting for selection of firms into intra-network trade**

Micro Transaction Data

- The paper exploits a unique micro transaction dataset published by CSMAR which reports related-party transactions of over 32,000 public and private Chinese companies in the period of 1997-2007.

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  - transaction value;
  - relation of related party.

Micro Transaction Data

Based on transaction type and transaction description, five varieties of intra-network trade and reallocations are identified:

1. **Goods**: commodity transactions including sales of final goods and procurement of raw materials;
2. **Services**: provision or acceptance of maintenance, repair, consulting, and other services;
3. **Capital**: sales or purchases of assets, stocks, and shares, debt transactions, provision or acceptance of loans and donations;
4. **Credit**: provision or acceptance of loan guarantees;
5. **Technology**: technology transfer and R&D collaboration.

Financial Data

The micro transaction dataset is merged with a panel dataset, QIN, published by Bureau van Dijk.

- Qin reports comprehensive financial, operation, and ownership information in 2000-2009 for over 460,000 Chinese public and private companies.
- The financial information, including revenue, employment, asset and investment, is used to estimate firm productivity and productivity growth based on Olley and Pakes (1996).

Architecture of Intra-Network Trade

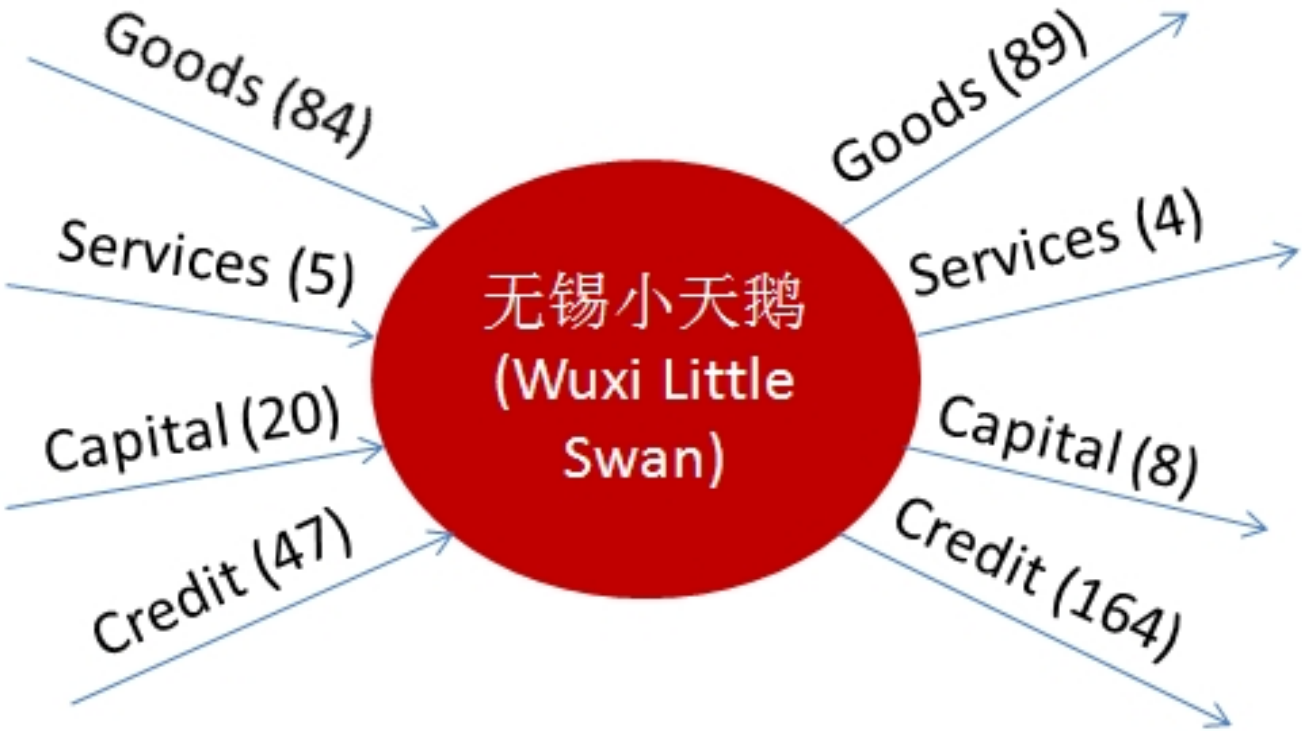

Figure 2: An example of intra-network trade

Architecture of Intra-Network Trade

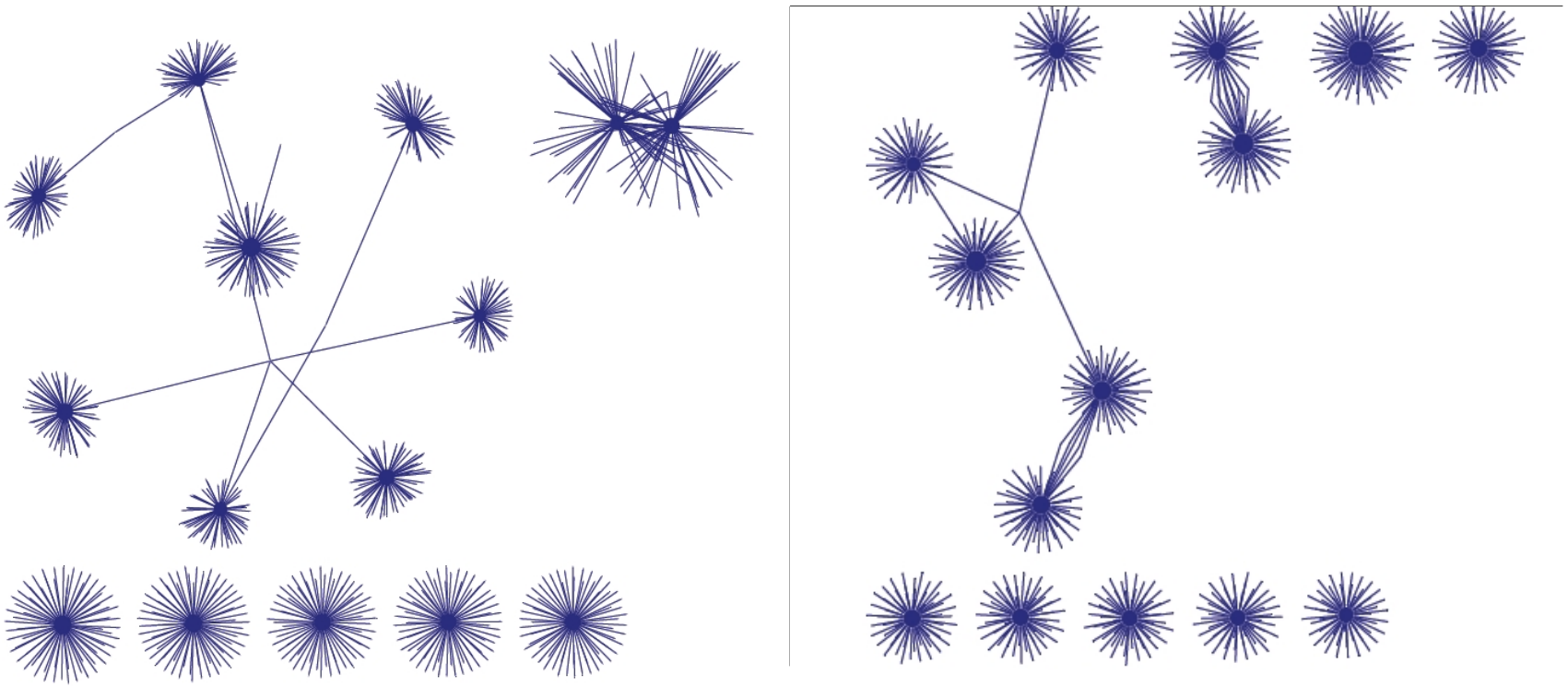

Figure 3: The trading networks of the largest **goods** suppliers (left) and recipients (right)

Architecture of Intra-Network Trade

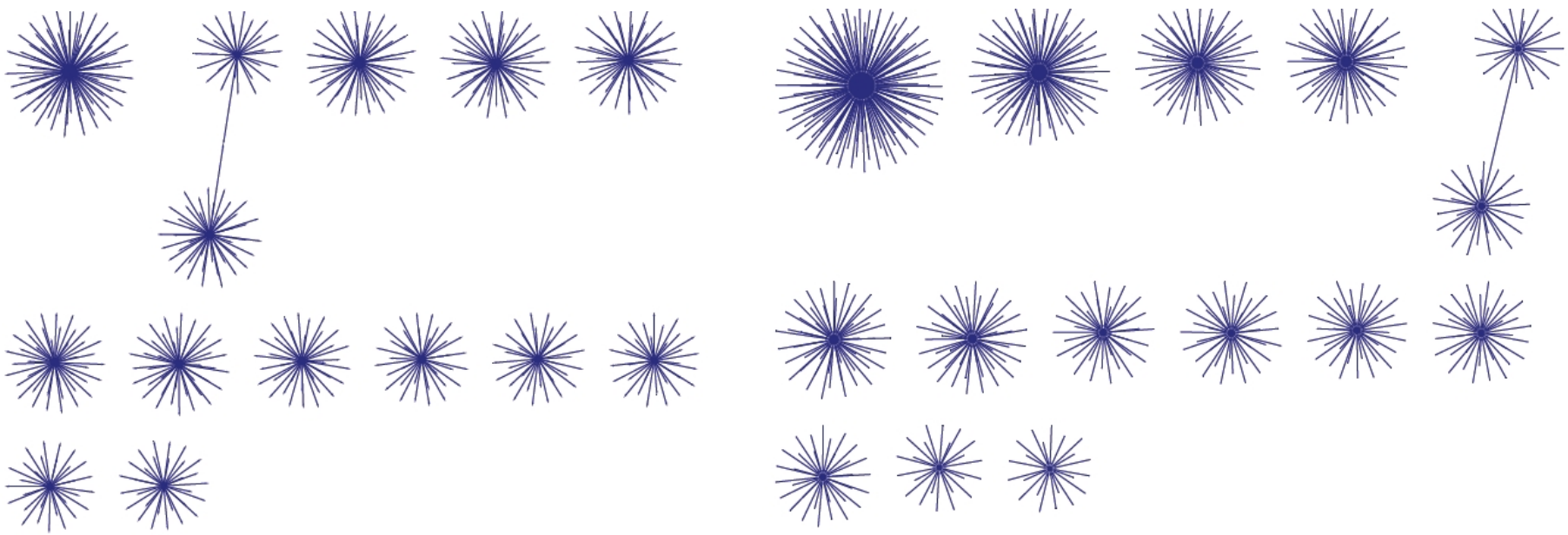

Figure 4: The trading networks of the largest **capital** suppliers (left) and recipients (right)

Architecture of Intra-Network Trade

Table 1: Correlations between Varieties of Trade

	Goods	Service	Capital	Credit	Tech
Panel A: Correlations at the transaction level					
Goods	1.00				
Service	0.11	1.00			
Capital	0.05	0.08	1.00		
Credit	0.01	0.04	0.07	1.00	
Tech	0.03	0.05	0.03	0.01	1.00
Panel B: Correlations at the firm pair level					
Goods	1.00				
Service	-0.09	1.00			
Capital	-0.31	-0.01	1.00		
Credit	-0.31	-0.08	-0.05	1.00	
Tech	0.00	0.06	0.02	0.00	1.00

Estimating Architecture of Intra-Network Trade

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1. The number of firms to source from in each variety of trade: N^s_{jk}
2. The number of firms to supply in each variety of trade: N^r_{jk}
3. The likelihood function for intra-network trade: $\Pr\left(g_{ijk} = 1\right)$

Estimating Architecture of Intra-Network Trade

Table 2: The Number of Suppliers in Intra-Network Trade

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Number of suppliers	All	Goods	Service	Capital	Credit	Tech
Revenue	0.04***	0.03***	0.01***	0.01***	0.01***	0.001***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Network-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	121,785	121,785	121,785	121,785	121,785	121,785
R square	0.23	0.23	0.21	0.25	0.25	0.17
Root MSE	0.42	0.36	0.18	0.19	0.18	0.04

Estimating Architecture of Intra-Network Trade

Table 3: The Number of Recipients in Intra-Network Trade

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Number of recipients	All	Goods	Service	Capital	Credit	Tech
Productivity	0.001	0.01***	0.000	-0.002***	-0.003***	0.0002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Market potential	0.02***	0.02***	0.002***	0.004***	0.002***	0.0002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Network-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	96,321	96,321	96,321	96,321	96,321	96,321
R square	0.25	0.24	0.24	0.29	0.27	0.17
Root MSE	0.45	0.39	0.18	0.21	0.19	0.04

Estimating Architecture of Intra-Network Trade

Table 4: The Determinants of Intra-Network Trade Linkages

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
Trade dummy	All	Goods	Service	Capital	Credit	Tech
Revenue (recipient)	0.04***	0.04***	0.08***	0.03***	0.02***	0.07**
	(0.003)	(0.003)	(0.01)	(0.01)	(0.01)	(0.03)
Productivity (supplie	0.02***	0.03***	-0.01	-0.03***	-0.08***	0.09
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.07)
Distance	-0.01	0.004	-0.02**	-0.04***	-0.01	-0.08**
	(0.01)	(0.004)	(0.01)	(0.01)	(0.01)	(0.04)
Same city	0.22***	0.17***	0.37***	0.08	0.20***	-0.37
	(0.05)	(0.02)	(0.06)	(0.05)	(0.05)	(0.23)
Same industry	0.02	0.01	0.20***	0.15***	0.40***	0.39*
	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)	(0.22)
Network-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	160,110	160,110	160,110	160,110	160,110	160,110
Pseudo R2	0.04	0.04	0.03	0.02	0.03	0.02

Estimating Gains from Intra-Network Trade

Table 5: The Effect of Intra-Network Trade on Productivity Growth

Dependent variable:	(1)	(2)	(3)	(3)
Productivity growth	Baseline	Two-stage	Two-stage	Two-stage NLS
Goods	-0.01	-0.48	-0.47	-0.55
	(0.05)	(0.36)	(0.42)	(0.42)
Service	-0.004	-0.48	-0.54	-0.44
	(0.003)	(0.29)	(0.33)	(0.54)
Capital	0.03***	1.68**	1.87**	1.53***
	(0.01)	(0.85)	(0.93)	(0.74)
Credit	-0.01	-1.57**	-1.75***	-1.27***
	(0.01)	(0.49)	(0.52)	(0.62)
Technology	0.04*	0.88***	0.92***	1.00
	(0.2)	(0.25)	(0.27)	
Revenue	-0.02***	-0.02***	-0.03***	-0.08***
	(0.001)	(0.001)	(0.003)	(0.003)
Sigma				2.10**
				(1.003)
Network-Year FE	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes
Obs.	86,384	86,384	86,384	86,384
R square	0.29	0.29	0.32	0.35
Root MSE	0.52	0.52	0.52	0.52

Estimating Gains from Intra-Network Trade

Alternative identification strategy

- The formation of "second-degree" linkages: linkages formed indirectly because of direct transactions between partners and third parties

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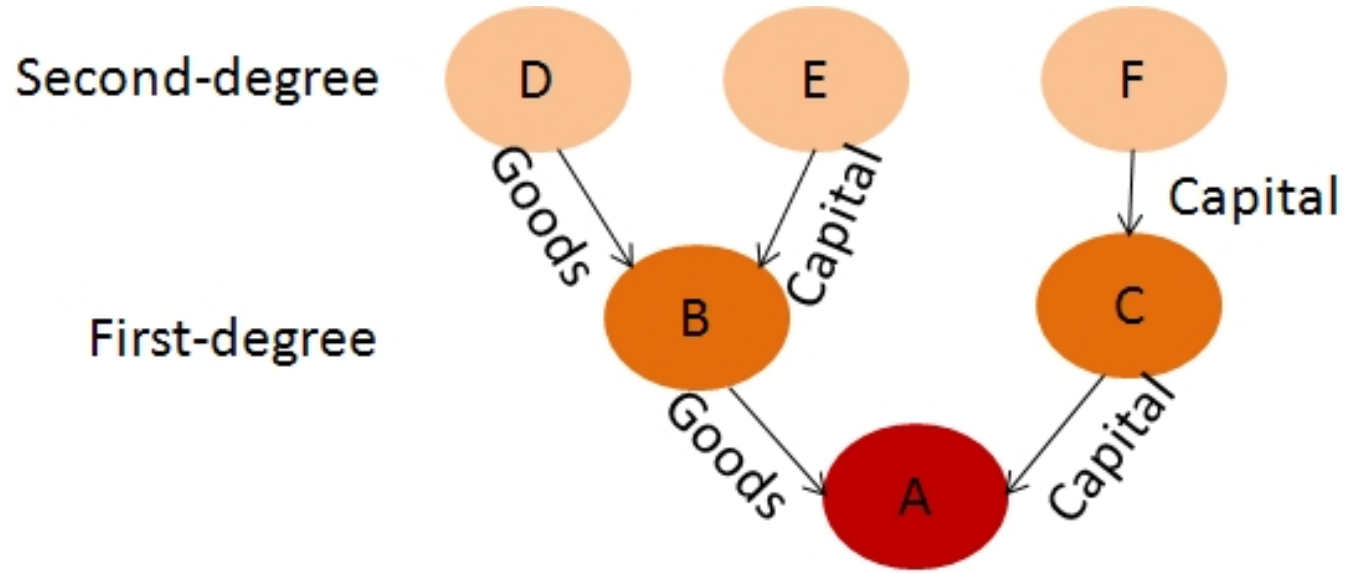
Alternative identification strategy

- The formation of "second-degree" linkages: linkages formed indirectly because of direct transactions between partners and third parties
- To the extent that second-degree linkages occur due to factors that are unrelated to a firm's (future) performance, the impact of second-degree linkages provides essentially an instrumental variable estimate of the impact of direct linkages.

Estimating Gains from Intra-Network Trade



- Same-variety second-degree links: $\widetilde{N}_{j,goods} = 1, \widetilde{N}_{j,capital} = 1$

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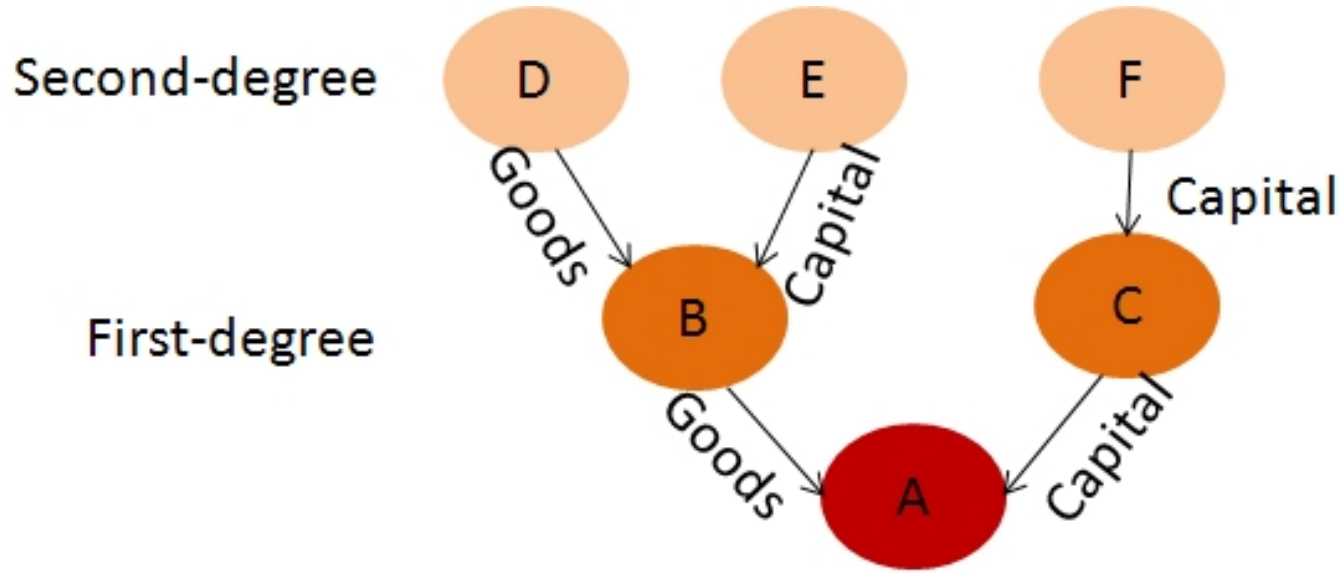

- Same-variety second-degree links: $\widetilde{N}_{j,goods} = 1, \widetilde{N}_{j,capital} = 1$
- Cross-variety second-degree links: $\widetilde{N}'_{j,goods} = 1, \widetilde{N}'_{j,capital} = 2$

Estimating Gains from Intra-Network Trade

Table 6: The Effect of Second-Degree Linkages on Productivity Growth

Dependent variable:	(1)	(2)	(3)
Productivity growth	Same Variety	Same Variety	Cross Variety
Goods	-0.01***	-0.01***	-0.01***
	(0.03)	(0.03)	(0.03)
Service	0.01	0.01	0.001
	(0.01)	(0.01)	(0.01)
Capital	0.02**	0.02**	0.01**
	(0.01)	(0.01)	(0.006)
Credit	-0.04***	-0.04***	-0.003
	(0.01)	(0.01)	(0.01)
Technology	-0.04	-0.02	-0.01
	(0.11)	(0.11)	(0.02)
Revenue	-0.02***	-0.03***	-0.02***
	(0.001)	(0.001)	(0.001)
Network-Year FE	Yes	Yes	Yes
Industry FE	No	Yes	Yes
Obs.	86,384	86,384	86,384
R square	0.28	0.31	0.28
Root MSE	0.52	0.52	0.52

Preliminary Findings

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2. The extent of trade linkages varies sharply across firms;
   - Firms with greater revenue source from more suppliers;
   - Firms with greater market potential become larger suppliers;
   - Goods, services, and technology move from high- to low-productivity firms while capital and credit are reallocated in the reverse direction;
3. Capital and technology inflows are shown to lead to higher productivity growth while credit inflows have a dampening effect.