Firm Networks, Risk Sharing and Resilience to Shocks Among Small Firms in Tanzania

Parth Chawla [1] Daniel Putman [2] Jess Rudder [3]

[1]University of California, Davis

[2]Michigan State University

[3]Oregon State University

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Introduction

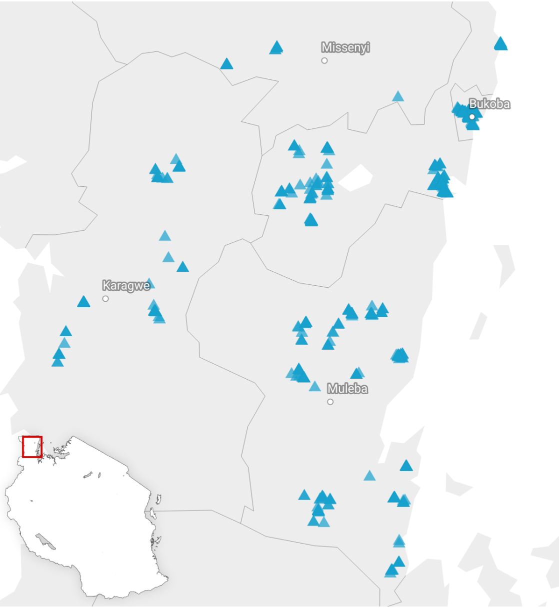
- Small informal firms in developing countries often have limited access to credit markets.
- They build long-term relationships with suppliers and customers for gaining access to credit, better prices, and additional benefits.
- These benefits typically extended within established networks; to firms that have developed a reputation through repeated transactions (McMillan and Woodruff, 1999; Ghani and Reed, 2022; Rudder and Dillon, 2024).
- Our aim is to investigate whether these networks enable firms to engage in risk-sharing and recover more easily from shocks.

Introduction

- We survey small firms in rural areas of Tanzania's Kagera region.
- Gather information on which other firms are in their trading, credit, supply chain and information networks.
- We also simulate larger networks by using the aggregate relational data (ARD) methodology (Breza et al., 2021).
- ARD lets us recover key features of the broader network (degree distribution, centrality, clustering) at much lower cost than a full network census.
- We compare ARD-based measures with the conventional network data and use both to study how network position relates to risk-sharing and resilience.

Context and Data

- **Baseline survey**
  - 743 small non-farm firms in Kagera.
  - Owner characteristics, firm sector, location, revenue, employees, credit use, recent shocks, and how they were affected or responded.
- **Midline + Phone follow-up**
  - Surveyed an additional 494 firms.
  - Updated shocks and operating status for firms already in our baseline sample.



Location of firms in the Kagera region of Tanzania

Subsector Composition

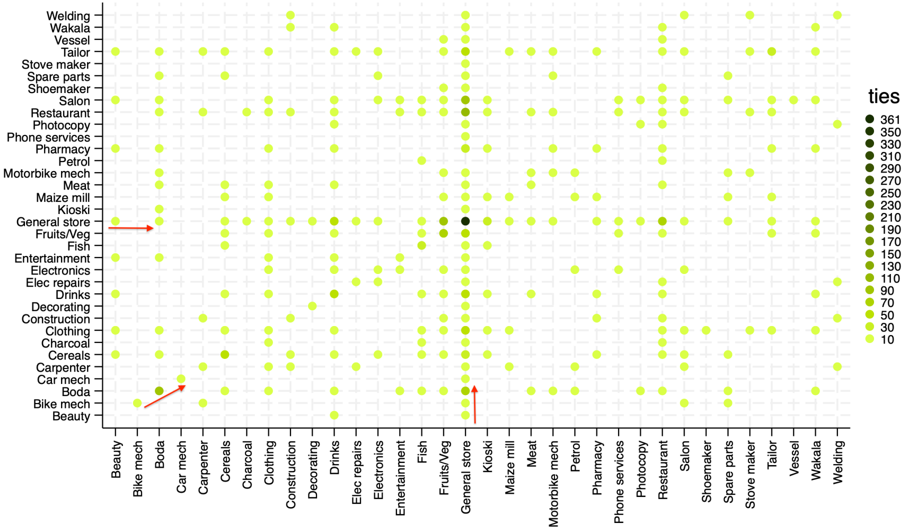
- Sample consists mostly of small retail and service firms:
  - General stores (24%)
  - Restaurants (9%)
  - Fruits/vegetables sellers (9%)
  - Boda (7%)
  - Tailors (7%)
  - Clothes/shoes stores, salons/barbershops, drinks vendors (4-7%)
- Long tail of specialized stores/services (grains, fish, mechanics, electronics, welding, pharmacies).
- Avg. number of full-time employees = 0.26 (median = 0).

Context and Data

- **Conventional network data**
  - **Trading and credit links:** firms they buy from (for the household or the business), buy from on credit, sell to, sell to on credit, and firms they borrow from or lend to.
  - **Operational support:** who they would ask to watch the shop if they stepped away for 30 minutes or for a week, and who they would ask to break a large bill.
  - **Informational support:** who they ask about input prices, sales prices, or general business advice.

Context and Data

- **ARD data**
  - Based on an earlier census of 9,000 firms in 100 communities where we recorded basic traits (tells us how many firms of different types exist).
  - Our survey sample is a subsample of these census firms, and we ask them ARD-style questions of the form "How many other firms do you know that..."
    - have at least one employee?
    - have been open for more than 10 years?
    - are operated by a woman?
    - have an owner/manager with some tertiary education?
    - have a visible sign with the firm name?
    - operate in the same sector as your firm?
    - provide service/product X?
  - We combine these counts with the census to estimate a network formation model and simulate the broader network.



Between-subsector ties. Y: Reporting firm subsector, X: Partner subsector.

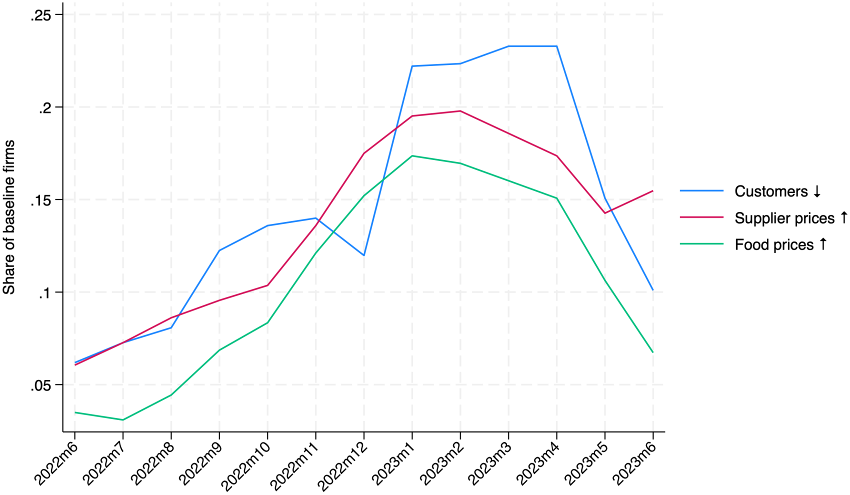
Network Characteristics (Baseline)

- **Degree centrality**
  - Definition: number of direct connections (within village).
  - Mean degrees $= 2.4$ (SD $= 2.2$), range 0-18 $\Rightarrow$ most firms have few links; some are highly connected.
- **Eigenvector centrality**
  - Definition: high if connected to other well-connected firms (influence).
  - Mean $= 0.01$, median $= 0$, max $= 1 \Rightarrow$ a very small set of "hub" firms.
- **Betweenness centrality**
  - Definition: no. of times a firm lies on shortest paths between others.
  - Mean ≈ 22, median ≈ 0.33, max $\approx 541 \Rightarrow$ a few firms are key bridges.
- **Communities**
  - Network is fragmented: mean community size ≈ 20; largest $= 55$.

Shock Prevalence in the Past Year

Shock type	Share of baseline firms (%)
Sudden decrease in customers relative to last year	59.9
Price increase of business supplies	56.5
Price increase of household food staples	38.6
Illness of a household member	14.9
Theft	14.1
A key supplier was no longer available	11.0
Drought/low rainfall affecting crops	7.1
Unexpected expenditure	6.5
Death of livestock	4.3
A key employee left the business	2.3
Flood/heavy rainfall damaging roads/access to markets	2.0
Fire/flood affecting business structure	1.2
Defrauded (by supplier or phone scam)	0.8

Monthly Incidence of Shocks



Connected Firms More Likely to Get Credit After Shocks

Y: Any credit from another firm after shock	(1) Degree	(2) Betweenness	(3) Community size
Network measure	0.0110***	0.000595**	0.00265***
	(0.00333)	(0.000284)	(0.000524)
Observations	656	656	656
Subsector FE	Yes	Yes	Yes
Village FE	Yes	Yes	Yes

ARD Network Characteristics

- **Much denser than the conventional network**
  - Mean density $= 0.22$ (vs. ≈ 0.003 in survey network).
  - Interpretation: ARD fills in missing ties; network much more connected.
- **Almost everyone is connected**
  - Mean number of connected components $= 1.5$ (95% between 1 and 5); Giant component share $= 0.98$, Avg. shortest path in it $= 2.0$.
  - Interpretation: a typical village network is basically one large cluster containing most firms (high reachability).
- **There is meaningful local clustering**
  - Mean clustering coefficient $= 0.29$.
  - Interpretation: given that A is linked to B and C, B and C are also linked 29% of time on average.

ARD Network Characteristics

- **Skewed degrees**
  - Mean degree $= 14.3$ (SD $= 6.2$), 95% ≈ 4.6-48.7.
  - Interpretation: some firms have many more links than others.
- **More hubs and bridges**
  - Mean ev centrality $= 0.12$ (vs. 0.01 in survey), range 0.04-0.29.
  - Mean betweenness ≈ 49 (vs. ≈ 22 in survey), 95% ≈ 0.2-228.
  - Interpretation: more firms play hub/bridge roles, a small core still looks especially central.

Connected Firms More Likely to Get Credit After Shocks (Also with ARD)

Y: Any credit from another firm after shock	(1) Degree	(2) Betweenness	(3) EV
Network measure	0.00441**	0.000135	0.527***
	(0.00177)	(8.64e-05)	(0.150)
Observations	645	645	645
Subsector FE	Yes	Yes	Yes
Village FE	Yes	Yes	Yes

Conclusion

- Survey network appears fragmented; ARD fills in missing links and reveals a denser, more connected network.
- Both survey and ARD networks show large heterogeneity in centrality; a small set of firms play central roles.
- Central firms are more likely to obtain credit after shocks in both survey and ARD networks.
- ARD appears to be a cost-effective way to recover the main network structure and identify central firms without full network enumeration.

Thank you!

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