Digitalization Spillovers from Formal to Informal Firms: Adoption of ICT in Zambia

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Overview

Main Question: How does the presence of formal (=registered) firms affect technology adoption among informal businesses in Zambia?

Approach: Using geocoded data to explore differences in geographic proximity.

Main result: The likelihood of an informal business using technology increases with the proximity to large formal firms.

Motivation

1. Size and importance of the informal sector:

   - Much of the economic activity in the world comes through the informal sector (Schneider and Hassan; 2016; Loayza, 2016; Elgin et al., 2021);

   - The informal sector, on average, accounts for about 1/3 of GDP and is associated with a range of policy and developmental challenges (Ohnsorge and Yu, 2022).

2. Lower levels of productivity in the informal sector:

   - Evidence points to lower productivity levels of informal businesses (De Mel et al., 2008; Bardasi et al., 2011, La Porta and Shleifer 2014; Ulyssea 2020; Aga et al., 2021; Aberra et al., 2022);

   - Some estimates show that the average informal business is only 1/4 as productive as the average firm operating in the formal sector (Amin and Okou, 2020).

Motivation

3. Digital technologies have a positive effect on market access and productivity:

   - The gains of ICT adoption have received significant attention (Cardona et al., 2013; Goldfarb and Tucker, 2019; Hjort and Poulsen, 2019; Cirera et al., 2022);

   - Evidence on the impact on the informal sector is limited, but growing (Jensen, 2007; Muto and Yamano, 2009; Paunov and Rollo, 2016; Islam and Jolevski, 2019).

Contributions

1. Examines spillover effects from the formal sector to the informal sector in the use of technology.

2. Provides insights into the heterogeneity of these spillovers and their channels, which is relevant for potential policy interventions.

3. Utilizes a unique geo-coded dataset of both formal and informal businesses.
   - GPS location of formal firms and informal businesses.
   - Calculation of geographic distance as a proxy for spillover effects from formal to informal sector.

Data

Data Sources

- The paper uses firm-level survey data collected by the World Bank in Zambia in 2019:
    - Enterprise Survey (formal firms, 5 or more employees);
    - Micro Enterprise Survey (formal firms, less than 5 employees);
    - Informal Sector Business Survey (informal businesses, all sizes).

- Main variables:
    - Location of the business (ES and MES)
    - Business characteristics (ISBS).

- Why Zambia?
  All three surveys were conducted in 2019.

Summary Statistics: Digital Variables by Survey Type

	Formal	Micro	Informal
Number of Firms	601	97	914
Min 1 Person with Computer Skills (%)		82.74	54.55
Use of Computers (%)		28.25	4.18
Use of Tablets (%)		3.80	7.85
Use of Cell-/Smartphone (%)		75.46	57.91
Website/Social Media (%)	56.66	16.00	3.49
Business Bank Account (%)	95.78	51.36	11.96
Mobile Money (MM) (%)		44.46	44.67
Technology Licensed by Foreign-Owned Company (%)	8.61		

Notes: All variables, except number of firms, are in % of all firms. Applied sampling weights use the weak definition. Number of firms may vary for some variables.

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Empirical Methodology

Baseline Model

$$Adoption_i = \beta_0 + \beta_1 Distance_i + \beta_2 X_i + \varepsilon_i \, ,$$

- $Adoption_i$ is the ICT adoption of informal business i: PC, tablet, cell phone, and mobile money.

- $Distance_i$ is the distance of informal business i to its closest formal firm.

- X_i are controls of informal business i:

  - _Business characteristics_: number of workers in the last month, number of years in operation, labor productivity, sector dummy;
  - _Owner characteristics_: age, education, prior experience in the same type of business;
  - _City dummies._

- Standard errors are clustered by city (Lusaka, Ndola, and Kitwe).

- Logit regression (Ai & Norton, 2003).

Summary Stats

Endogeneity Concerns

Is location choice of informal businesses a potential endogeneity concern?

- Digital adoption is not the main driver for location choices (Howard et al., 2016).

- 68% of informal businesses are located in existing fixed premises (with the majority located in household premises), which are unlikely to have been chosen strategically.

- Businesses may be inclined to operate in a certain neighborhood / area, but they cannot determine the exact distance to the closest formal firm: Distance depends on the availability of premises, infrastructure, decisions of other firms, etc.

Premises Stats

Empirical Results

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Baseline Results

	(1) PC	(2) Tablet	(3) Phone	(4) MM
Distance of Informal to Closest Formal Firm	-0.596*	-0.741***	-0.180***	-0.202***
	(0.349)	(0.130)	(0.028)	(0.073)
Num. of People Who Worked Last Month	0.337***	0.244	0.133***	0.019
	(0.109)	(0.186)	(0.048)	(0.082)
Years in Operation	-0.064***	-0.044**	0.001	0.006
	(0.018)	(0.020)	(0.013)	(0.022)
Age of Main Owner	-0.016	0.030	0.010**	0.005**
	(0.011)	(0.024)	(0.004)	(0.002)
Owner's Education (1=above secondary)	1.228***	0.108	1.021***	0.114
	(0.348)	(0.755)	(0.218)	(0.099)
Prior Experience in Same Type of Business	1.041***	0.707	0.361	0.203
	(0.041)	(0.503)	(0.303)	(0.586)
Sector Dummy (1=manuf, 0=services (inc. retail))	-1.093*	-0.471	0.065	0.268*
	(0.616)	(0.824)	(0.133)	(0.158)
Number of Observations	901	901	901	891

Robustness Checks

- Additional Controls
    - Productivity: Informal labor productivity, formal labor productivity, both;
    - Elevation/nighttime light emission: proxies for infrastructure, such as electricity and connectivity.

- Alternative Distance Measures (Results: Next slide)
    - Baseline: Distance of informal to closest <u>formal</u> firm (ES & Micro);
    - Distance of informal to closest formal firm with website;
    - Distance of informal to closest ES firm;
    - Distance of informal to Micro firm.

Robustness: Alternative Measures of Distance

	(1) PC	(2) Tablet	(3) Phone	(4) MM
Distance of Informal to Closest Formal Firm (Baseline)	-0.596*	-0.741***	-0.180***	-0.202***
	(0.349)	(0.130)	(0.028)	(0.073)
Distance of Informal to Closest Formal Firm With Website	-0.399	-0.659***	-0.152***	-0.154***
	(0.329)	(0.221)	(0.036)	(0.042)
Distance of Informal to Closest ES Firm	-0.604***	-0.417*	-0.216***	-0.196**
	(0.206)	(0.235)	(0.048)	(0.085)
Distance of Informal to Closest Micro Firm	-0.396	-0.421	-0.106	-0.122
	(0.293)	(0.317)	(0.099)	(0.169)

Heterogeneity

- Owner's level of education: Being close to a formal firm generates a higher level of adoption when the owner is also highly educated, particularly for PC adoption.

- Permanent location: The effect of distance on the adoption of digital technologies is significant if the location of the informal business is permanent in nature.

Spillover Channels

- Competition
  - Does competition incentivize informal businesses to adopt digital technologies?
  - Proxy: Number of informal businesses in a square (150mx150m).

- Value-Chain Linkages
  - Are informal businesses that interact with other firms or businesses more likely to adopt digital technologies?
  - Proxy: Source of main inputs stemming from another business.

Source of Inputs

		Formal Micro	Informal
Main Customer	Individuals	91.48	93.90
	Business (<5)	3.25	2.84
	Business (>5)	1.98	2.58
Source of Inputs, Goods, and Supplies	Individuals	39.55	44.96
	Business (<5)	14.69	28.30
	Business (>5)	36.83	20.31
	Self-produce	1.43	4.30

Spillover Channel: Competition

	(1) PC	(2) Tablet	(3) Phone	(4) MM
Number of Informal Businesses Within Square	0.007	0.036	0.036***	0.037***
	(0.009)	(0.022)	(0.005)	(0.012)
Number of Observations	987	987	986	962

→ **Positive sign means more adoption!**

Spillover Channel: Value-Chain Linkages

- Do spillovers occur through the same or different sector?

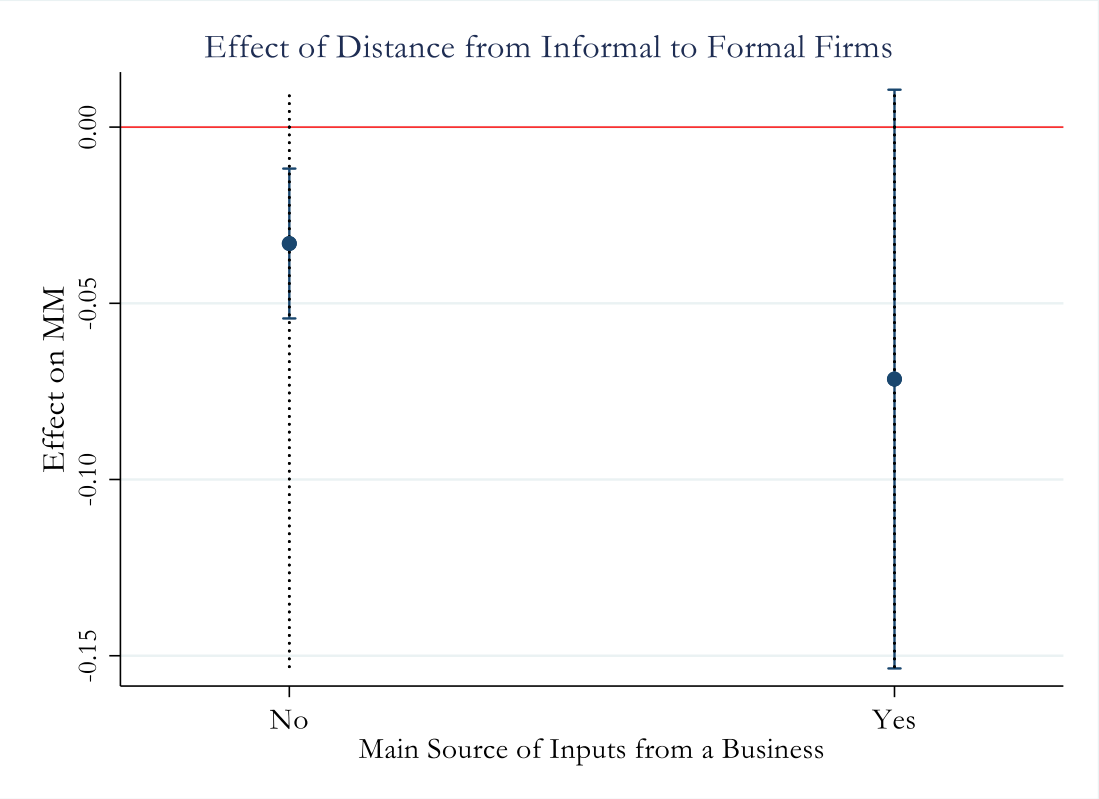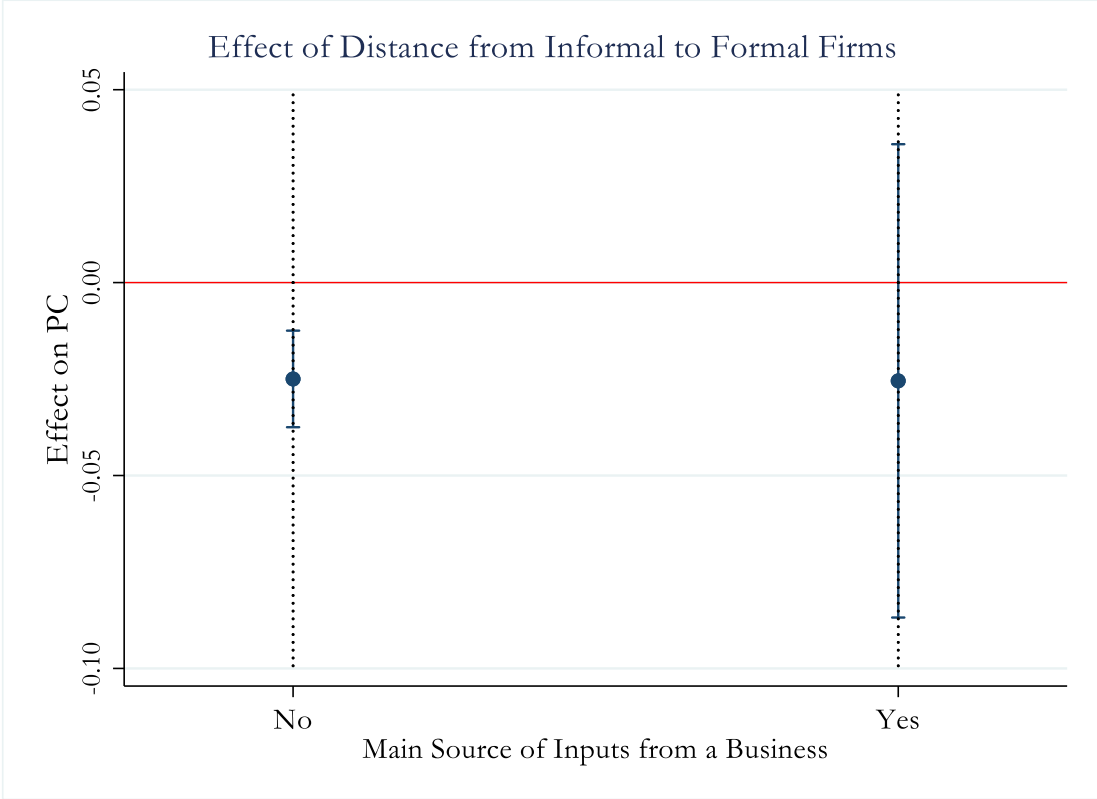|	Informal	Closest ES	Closest Micro
Manufacturing	7%	10%	21%
Retail	82%	5%	47%
Other Services	11%	85%	32%

- Results: Effects of distance to the closest formal firm from a different sector on the adoption of digital technologies are indeed stronger!

Testing Value-Chain Linkages

$$Adoption_i = \beta_0 + \beta_1 Distance_i + \beta_2 Input\ Source_i + \beta_3 Distance_i \times$$

$$Input\ Source_i + \beta_4 X_i + \varepsilon_i,$$

- $Adoption_i$ is the ICT adoption of informal business *i*.

- $Distance_i$ is the distance of informal business *i* to its closest formal firm (baseline measure).

- $Input\ Source_i$ denotes the variable the source of main inputs.

- X_i are controls of informal business *i* (may vary by interaction).

- Standard errors are clustered by region/city.

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Results: Value-Chain Linkages

Value-Chain Linkages Results Intuition

- Linkages are loose: 70% of these businesses reported that their relationship with suppliers exists merely for a year.

- Spillovers occur mainly from large formal firms and from a different sector.

  - But most informal businesses report buying their products from individual people rather than other businesses/firms.

  - Within businesses, inputs are bought more from micro than large formal firms.

- We have no information on whether inputs are bought from formal or informal businesses or from which sector. Hence, our proxy might not adequately capture the linkages between formal and informal businesses.

Conclusion

- RQ: We study spillovers in the use of digital technologies from formal to informal businesses by exploring differences in geographic proximity.

- Data: Geocoded and firm-level data from the 2019 World Bank Enterprise Surveys in Zambia.

- Result: A shorter geographic distance to large formal firms is associated with a significantly higher likelihood of digital adoption by informal businesses.

- Channels: Competition can explain the higher likelihood of adoption, but the value-chain channel seems to be weak.

THANK YOU!

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Appendix

Summary Statistics

	Micro	Informal
Distance of Informal to Closest Formal Firm (Baseline)		0.96
Distance of Informal to Closest ES Firm		1.43
Distance of Informal to Closest Formal Firm (Enumerated)		0.68
Distance of Informal to Closest Formal Firm with Website		1.81
Distance of Informal to Closest Micro Firm		1.52
Distance of Micro to Closest ES Firm	1.00	
Distance of Informal to Closest Formal Firm (same sector)		1.67
Distance of Informal to Closest ES Firm (same sector)		2.56
Distance of Informal to Closest Formal Firm (diff sector)		1.28
Distance of Informal to Closest ES Firm (diff sector)		1.55
Number of Formal Firms Within Square		0.88
Number of Informal Businesses Within Square		12.49
Num. of People Who Worked Last Month	2.23	2.04
Years in Operation	5.25	3.30
Age of Main Owner	35.60	37.72
Owner's Education (1=above secondary)	0.59	0.12
Prior Experience in Same Type of Business (1=yes)	0.24	0.24
Sector Dummy (1=manuf, 0=services (inc. retail))	0.09	0.07
Formal Labor Productivity (log)		10.43
Informal Labor Productivity (log)		8.47
Elevation		1249.02
Nighttime Lights Emission		35.46

Permanent Location

Type of Premises	Obs	Percent
Household	415	41.05
Non-household with permanent structure	274	27.1
Non-household with temporary structure	270	26.71
Non-fixed premises, including hawkers	52	5.14
Total	1,011	100

Back to Endogeneity

Heterogeneous Effects: Value-Chain Linkages

	(1) PC	(2) Tablet	(3) Phone	(4) MM
Distance of Informal to Closest Formal Firm	-0.518***	-0.898***	-0.188***	-0.146***
	(0.175)	(0.292)	(0.033)	(0.048)
Input from a Business	-0.282	0.445	0.492	0.753**
	(0.776)	(1.148)	(0.355)	(0.309)
Interaction Distance x Input Business	-0.199	0.207	0.002	-0.150
	(0.579)	(0.181)	(0.109)	(0.230)
Num. of People Who Worked Last Month	0.312***	0.288***	0.146***	0.039
	(0.078)	(0.098)	(0.044)	(0.073)
Years in Operation	-0.056***	-0.048***	-0.003	0.003
	(0.012)	(0.017)	(0.015)	(0.026)
Age of Main Owner	-0.019*	0.031	0.011***	0.006**
	(0.011)	(0.025)	(0.004)	(0.003)
Owner's Education (1=above secondary)	1.281***	-0.017	0.938***	0.007
	(0.438)	(0.988)	(0.122)	(0.032)
Prior Experience in Same Type of Business	1.123***	0.693	0.334	0.176
	(0.040)	(0.493)	(0.309)	(0.585)
Sector Dummy (1=manuf, 0=services (inc. retail))	-0.965	-0.589	0.036	0.237**
	(0.671)	(0.977)	(0.152)	(0.110)
Number of Observations	897	897	897	887

Notes: MM denotes mobile money. Sampling weights applied. Standard errors are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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