Mobile Money, Interoperability and Financial Inclusion

M. K. Brunnermeier N. Limodio L. Spadavecchia

LIFT-IFC Conference

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FinTech

The Rise of Mobile Money

The Rise of Mobile Money

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The Rise of Mobile Money

Widespread digital payment system

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Widespread digital payment system

Beyond payments: risk-sharing, remittances, lending

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Less on the financial institution

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Less on the financial institution: the mobile money company

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Interoperability

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The Rise of Mobile Money

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Interoperability: a competition-enhancing policy to facilitate payments across platforms

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Research Question

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How does interoperability affect the behaviour of mobile money companies

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How does interoperability affect the behaviour of mobile money companies and financial inclusion?

This Paper

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Theoretical Framework

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Many potential models & equilibria

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Many potential models & equilibria, ours data-oriented

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Tradeoff between competition & financial inclusion

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Evidence on *fees* and regulation of mobile money

Mobile Money and Interoperability

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Mobile
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Vertical Integration

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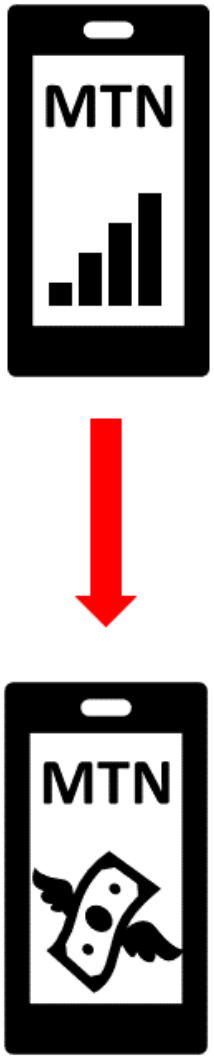
Mobile Money and Interoperability

Vertical Integration **Tradeoff**



Mobile Network

Mobile Money

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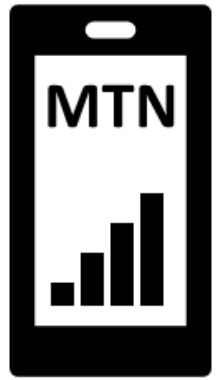
Mobile Money and Interoperability

Vertical Integration **Tradeoff**

High Fees



Mobile Network

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Mobile Money and Interoperability

Big Network

Vertical Integration **Tradeoff**

High Fees

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Mobile Money

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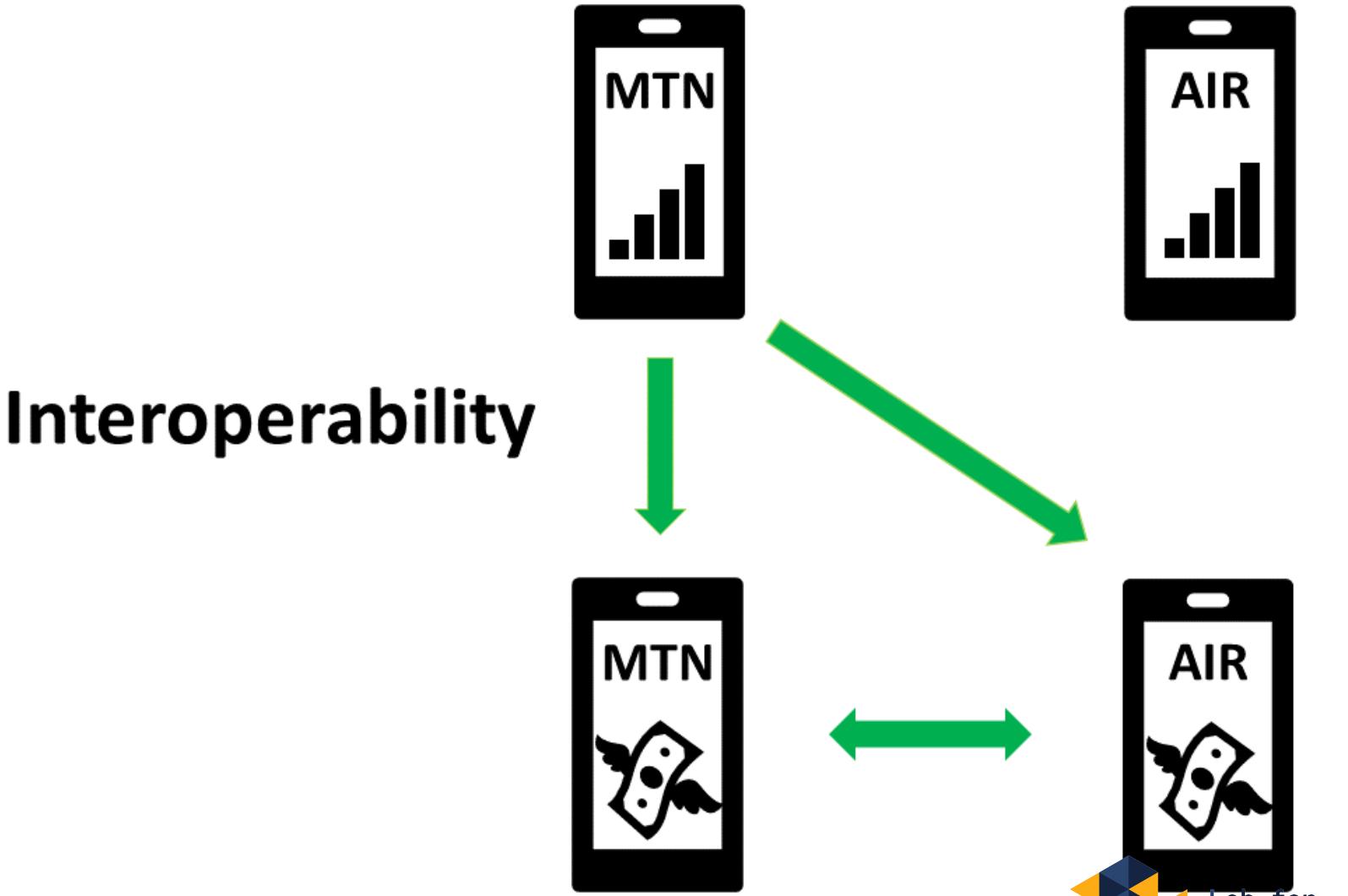
Mobile Money and Interoperability



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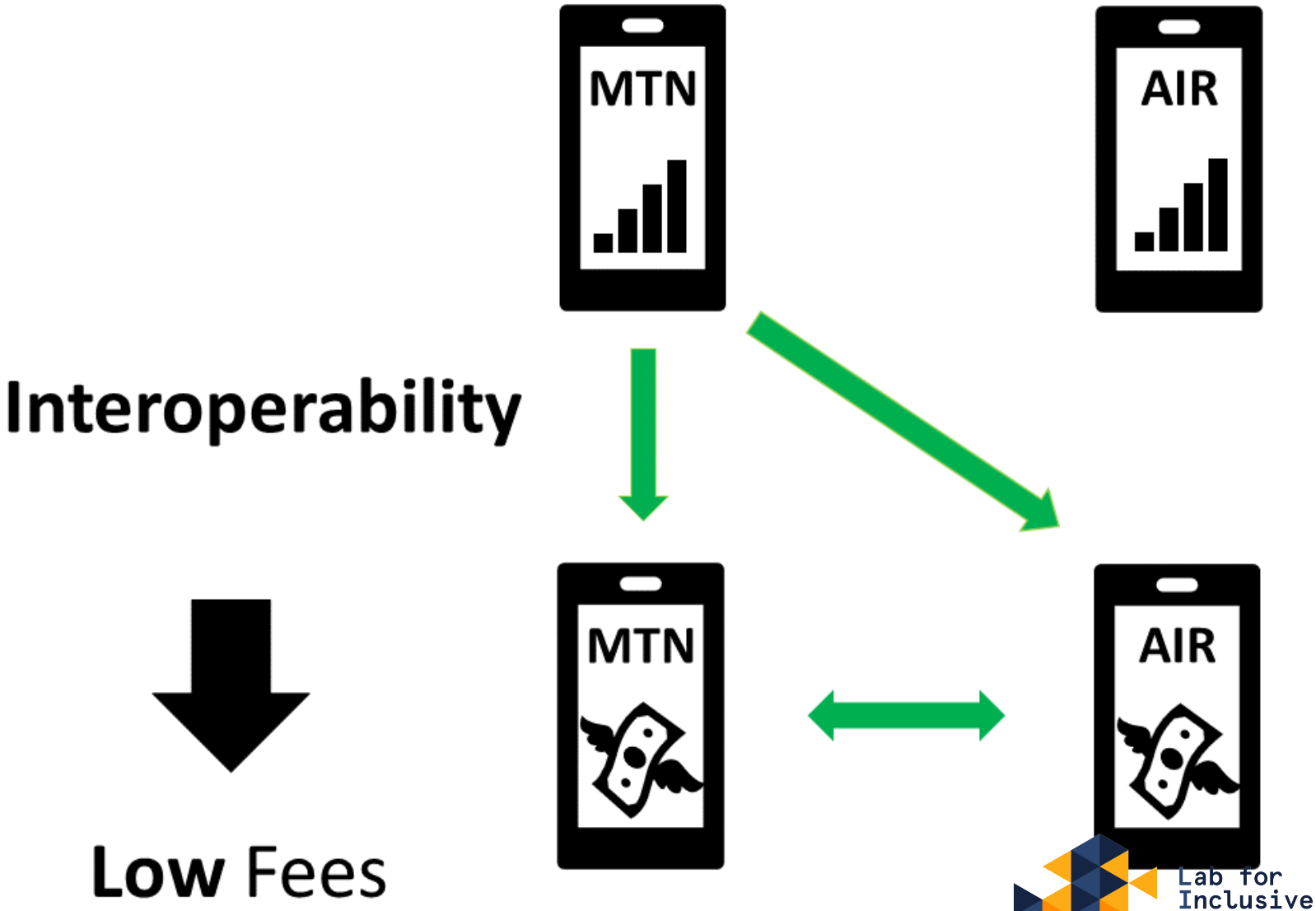
Mobile Money and Interoperability



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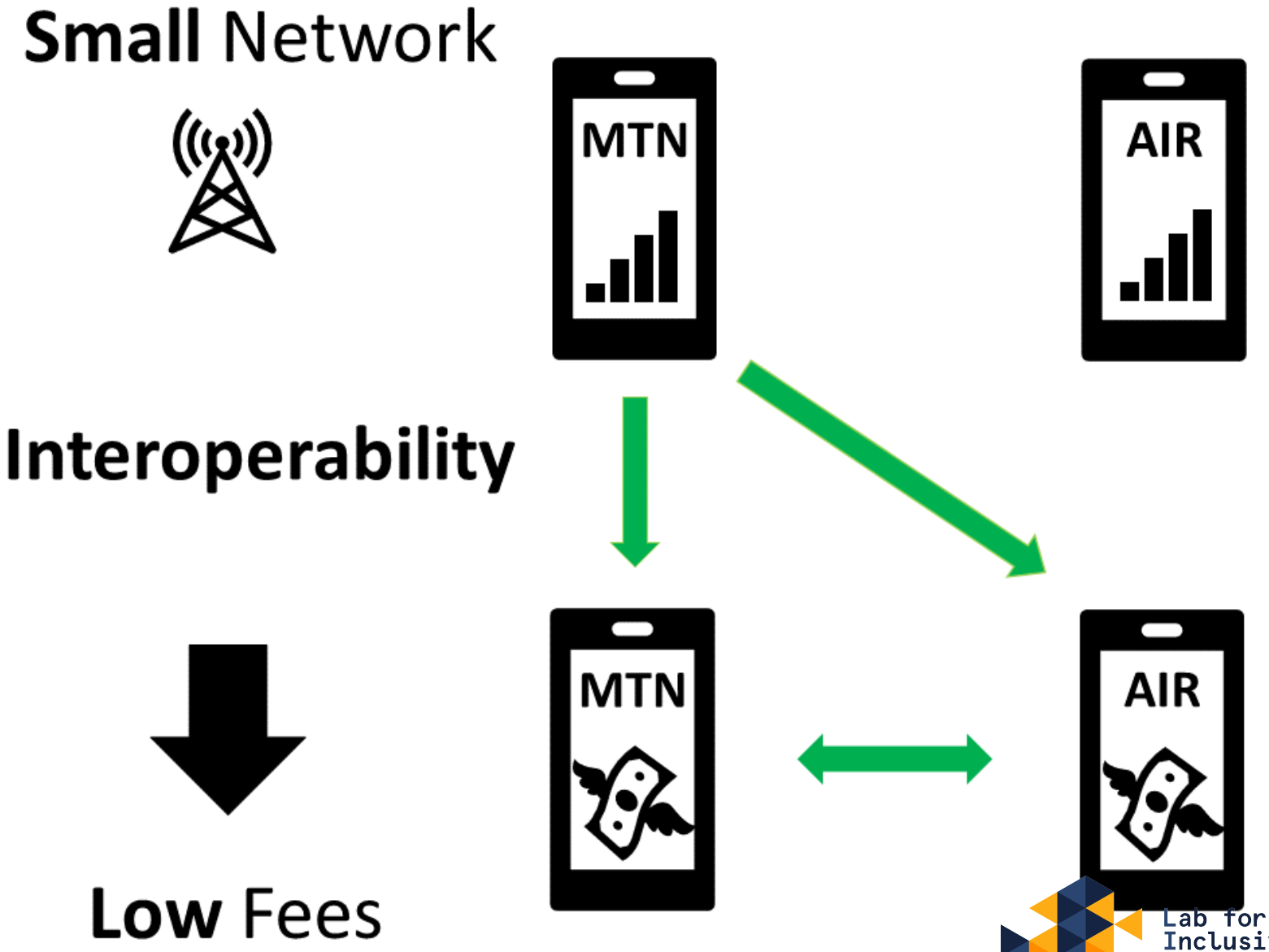

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Paper in 2 pictures - 1 fees

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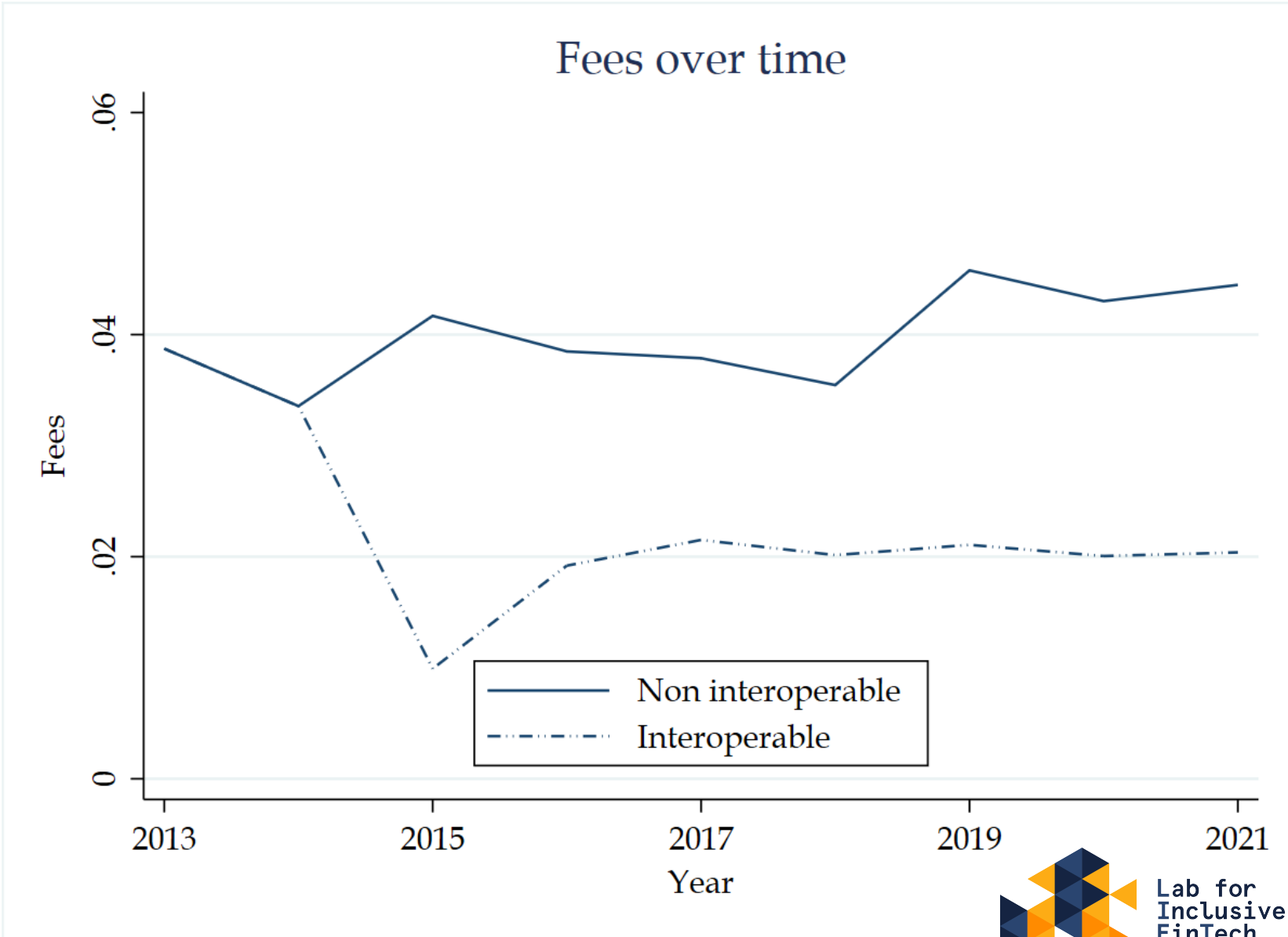
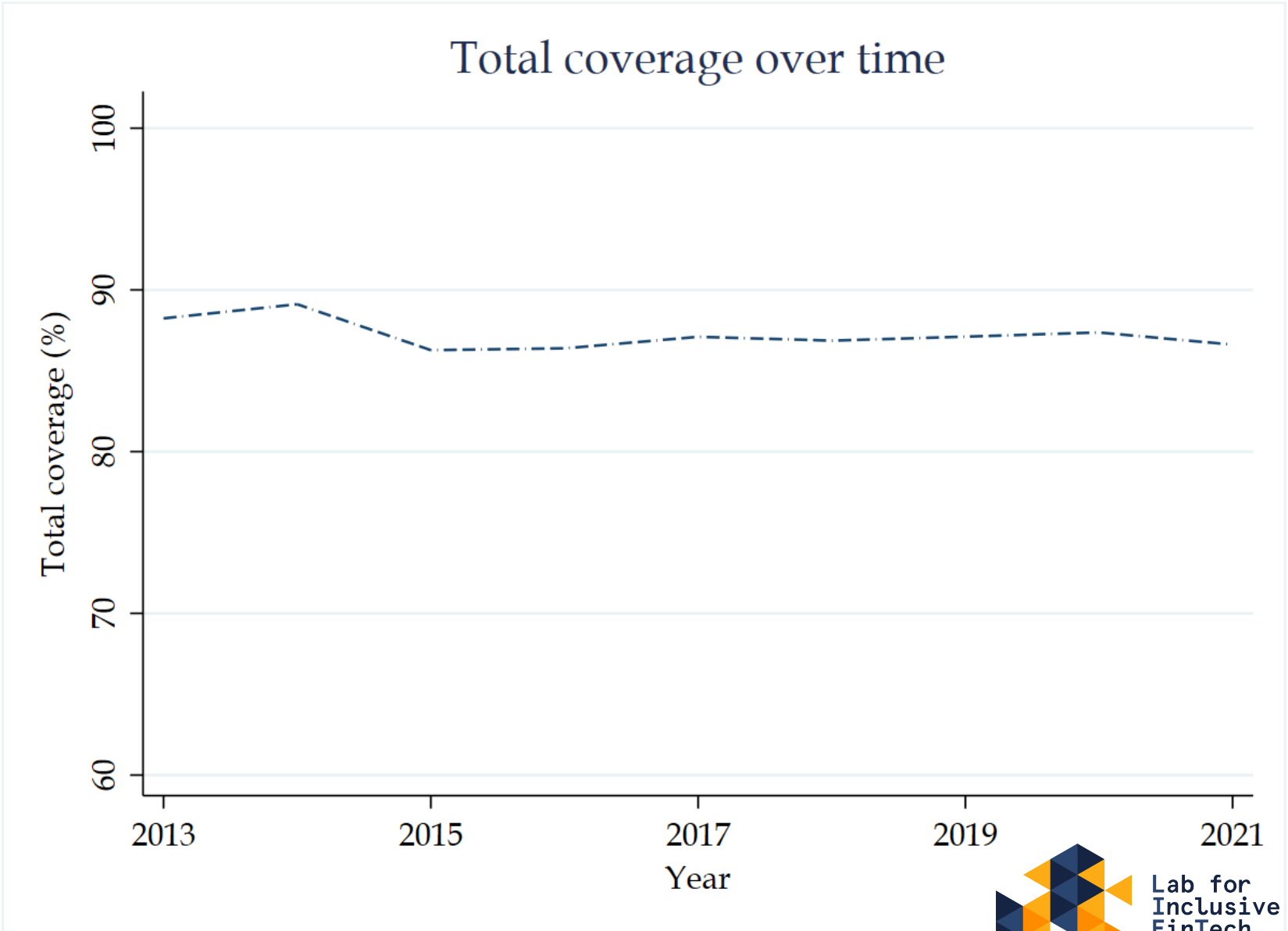


Paper in 2 pictures - 2 coverage



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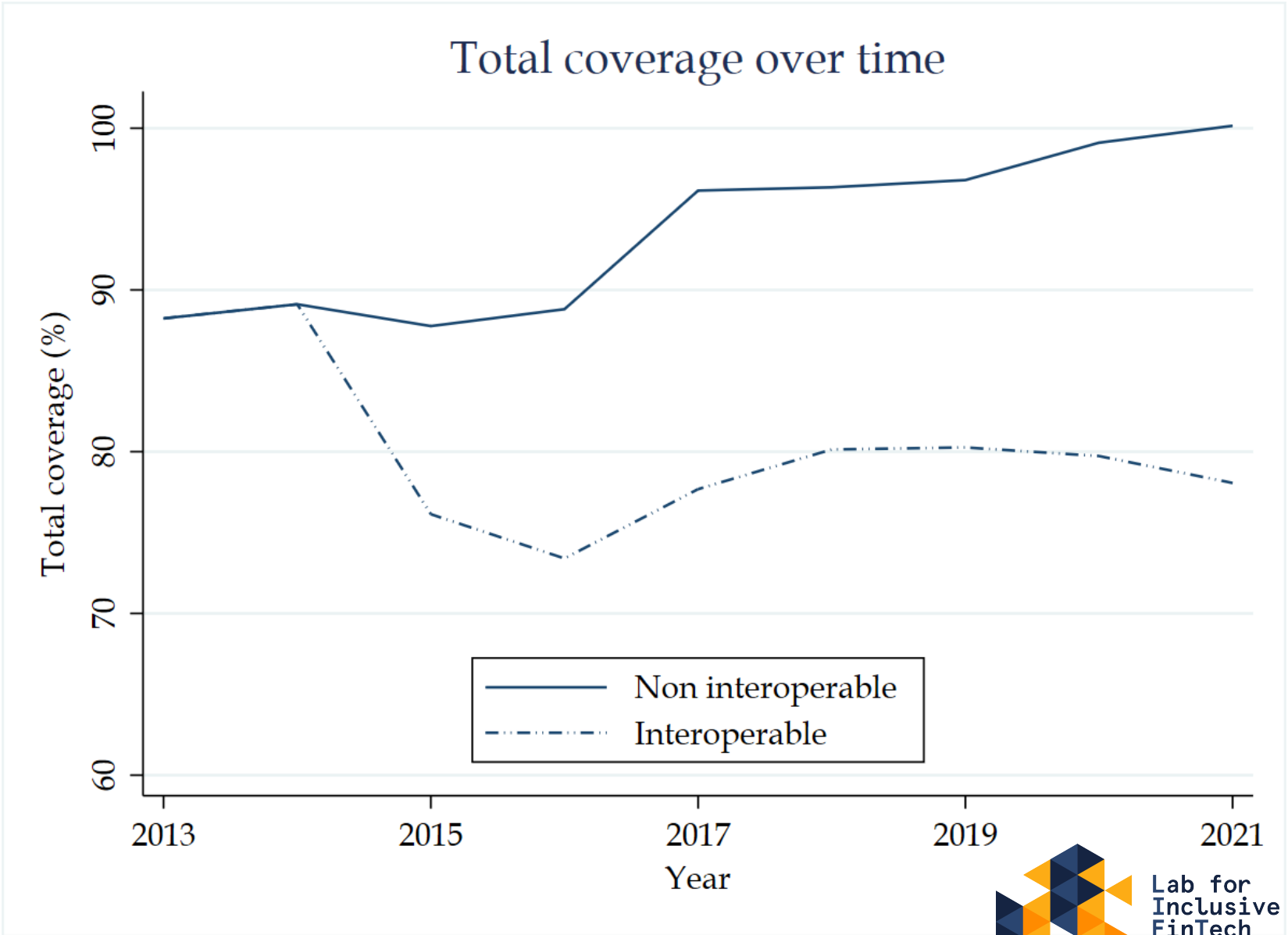

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Descriptive: mobile money fees are high as a % of payment

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decline in fin. inclusion - various metrics of inclusion + amplified by network!

Why do signal & towers ↓ ?

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Variable cost or sunk cost?

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Variable cost or sunk cost? Towers sunk in HICs

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Relevant for the economics of dig. platforms (data servers, infra, innovation)

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Literature - Skipped

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Mixed effects of competition on consumers and investment

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Our contribution: granular data, empirical design, mobile money market

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Our contribution: study the mobile money compar

A “Compressed” Roadmap

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1. Data & Identification

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2. Empirical Analysis

A "Compressed" Roadmap

1. Data & Identification

2. Empirical Analysis

3. Robustness Checks

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Data & Identification

Data

Data

Mobile Money Fees $\rightarrow$ 129 companies in 42 countries, 2010-2021, through Wayback Machines (next slide)

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Fin. Inclusion $\rightarrow$ Global Findex WB & IMF FAS

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Mobile Money Fees - MTN Uganda, March 2023

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Amount (UGX)		Sending Money	
Min	Max	To MTN	To Other Networks
500	2,500	100	100
2,501	5,000	100	100
5,001	15,000	500	500
15,001	30,000	500	500

Note: `https://www.mtn.co.ug/insight/mobile-money-tariffs/`

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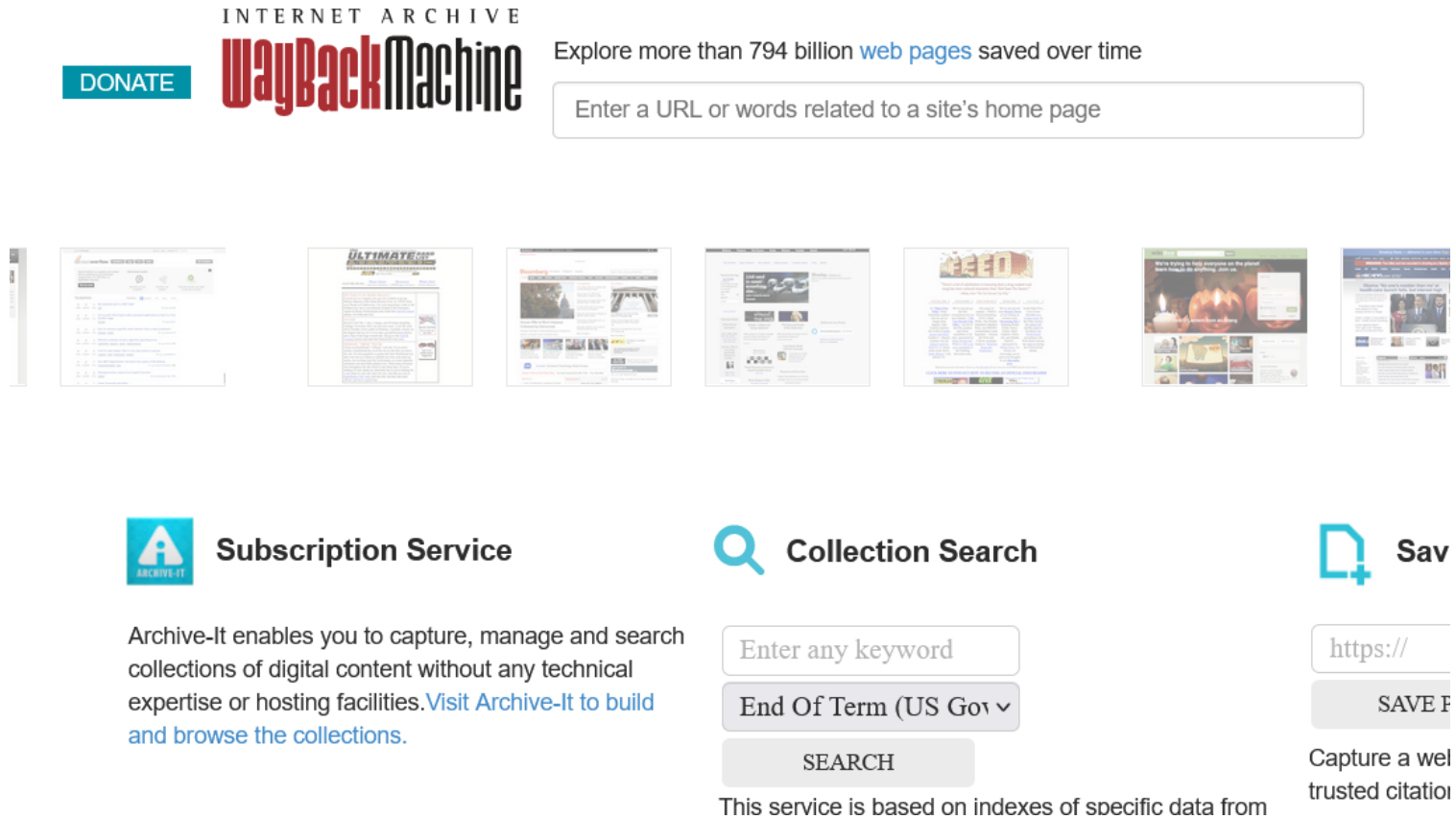
Mobile Money Fees - Wayback Machine



Note: `https://web.archive.org/`

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Descriptives

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1. Summary Stats $\times$

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4. GSMA data at operator-country $\surd$

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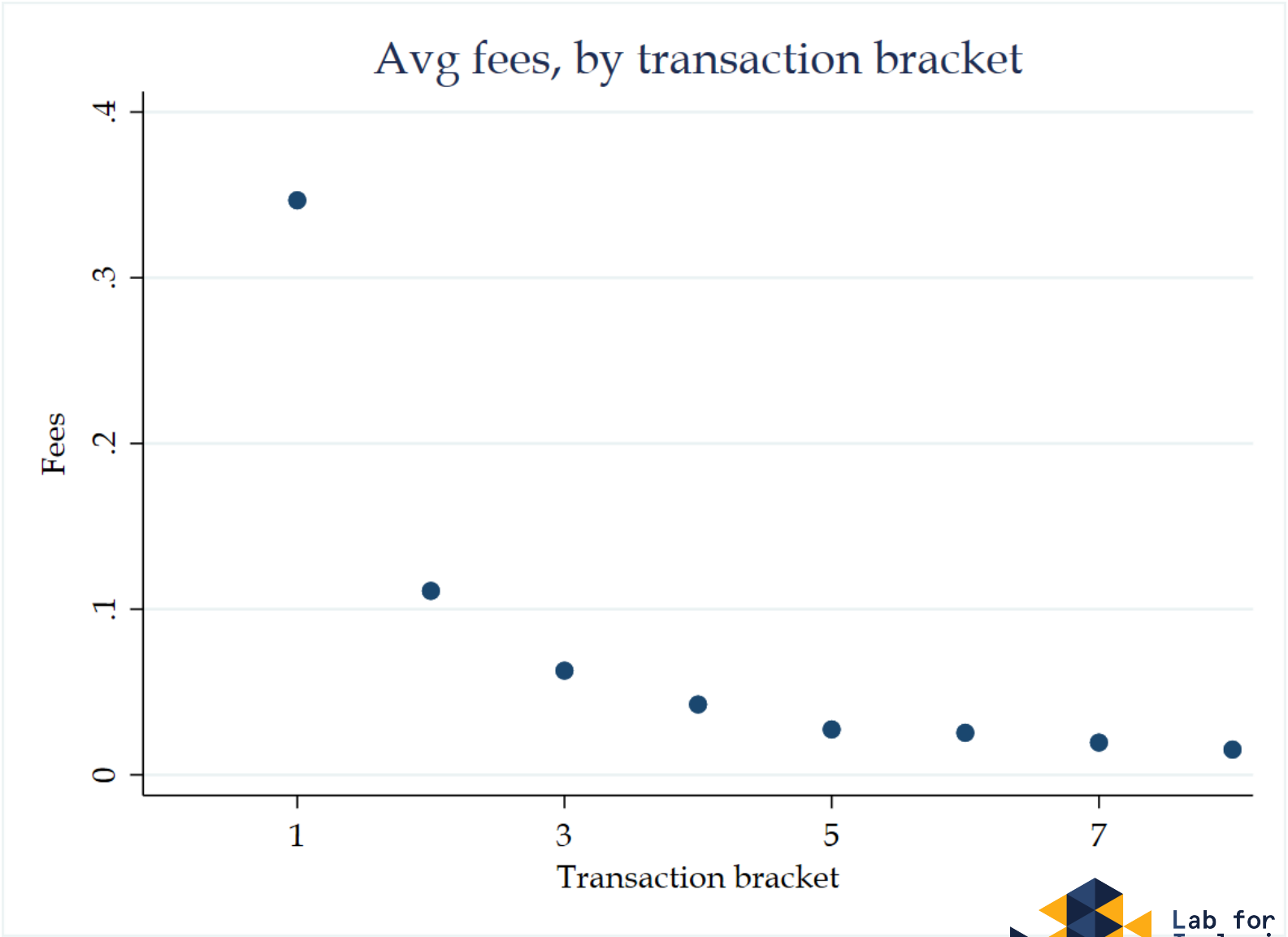

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3. GSMA Data at Operator-Country Level

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Note: example country in Africa

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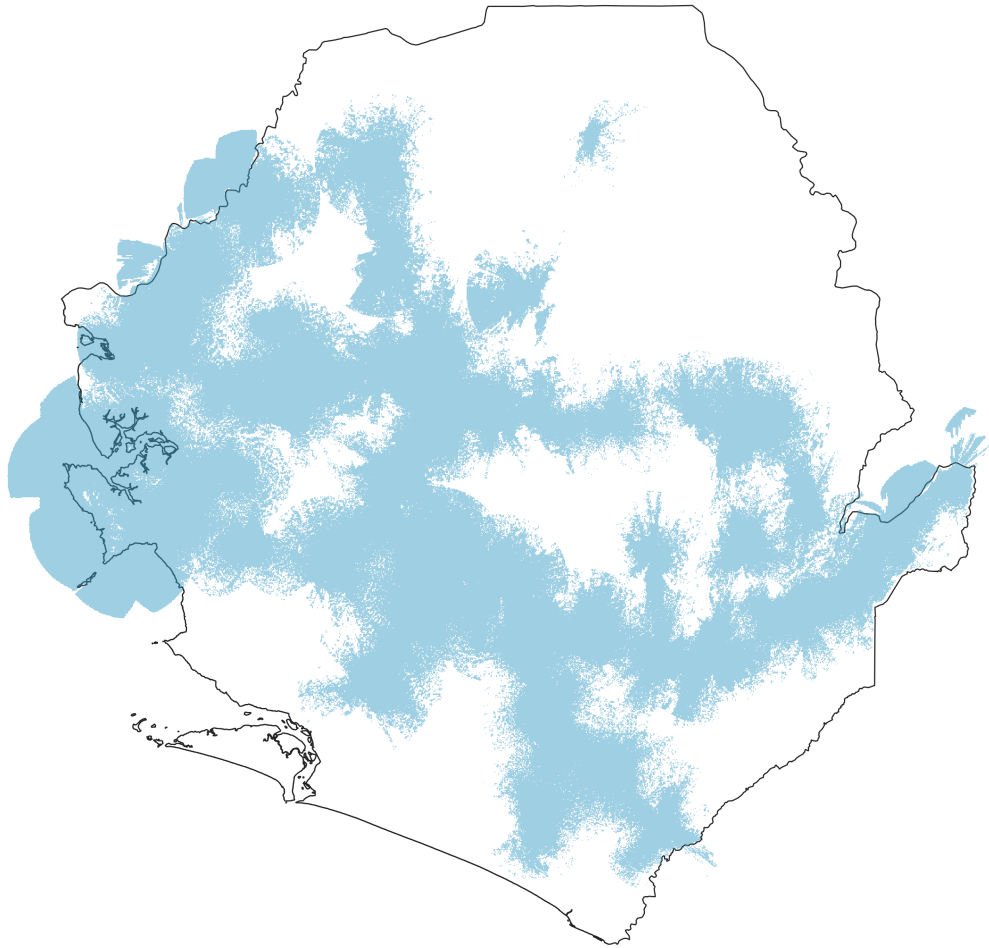

Note: example country in Africa, operator 1

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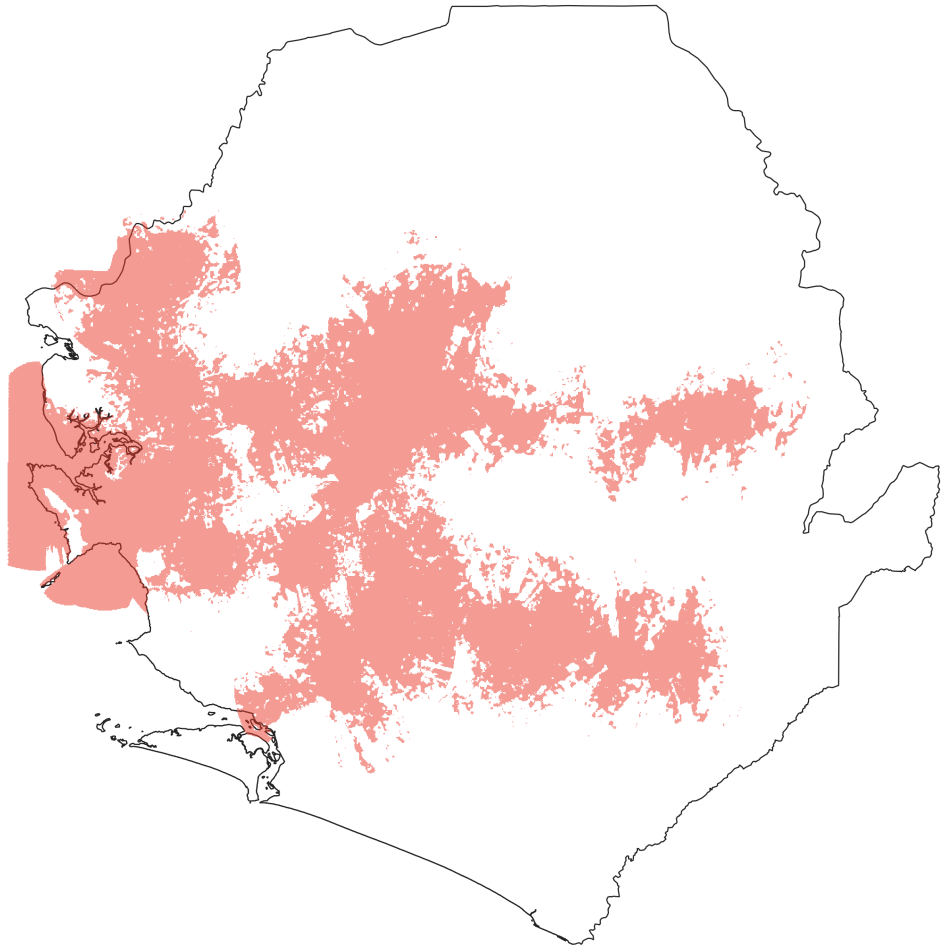

Note: example country in Africa, operator 2

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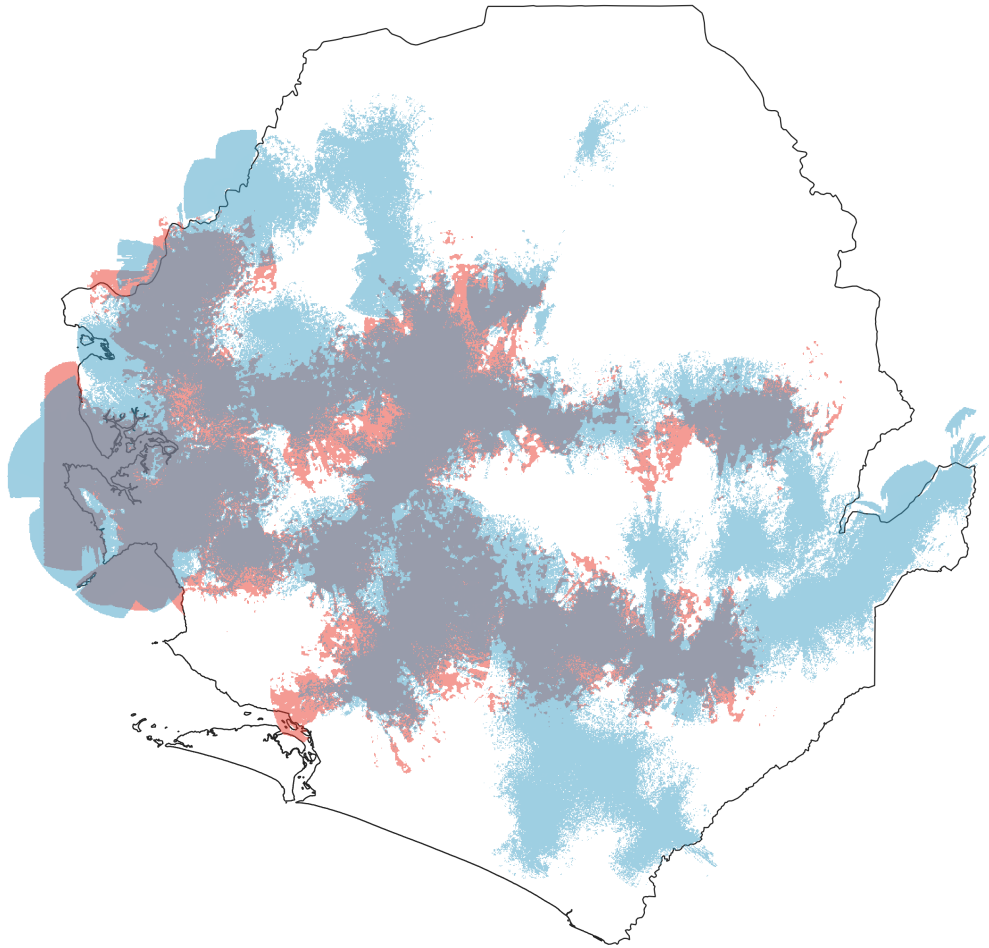

Note: example country in Africa, operators 1 & 2

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Identification: Interoperability - 2015

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Interoperability - 2017

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Interoperability - 2019

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Interoperability - 2021

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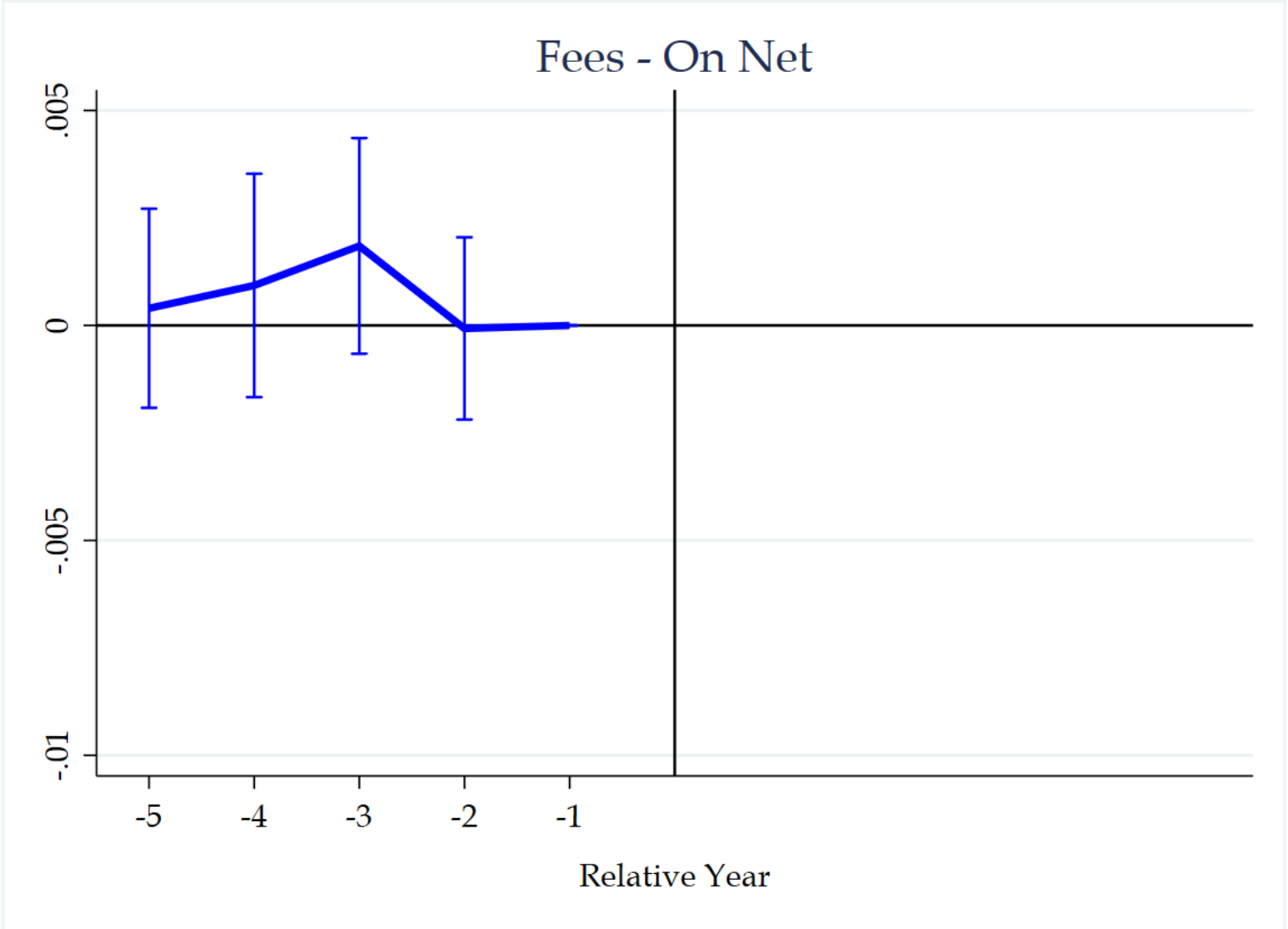
Empirical Analysis



On-net Fees, specification

$$Y_{ict} = \alpha_i + \beta_t + \sum_{k=-5}^{5} \gamma_k I\{K_{ict} = k\} + \varepsilon_{ict}$$

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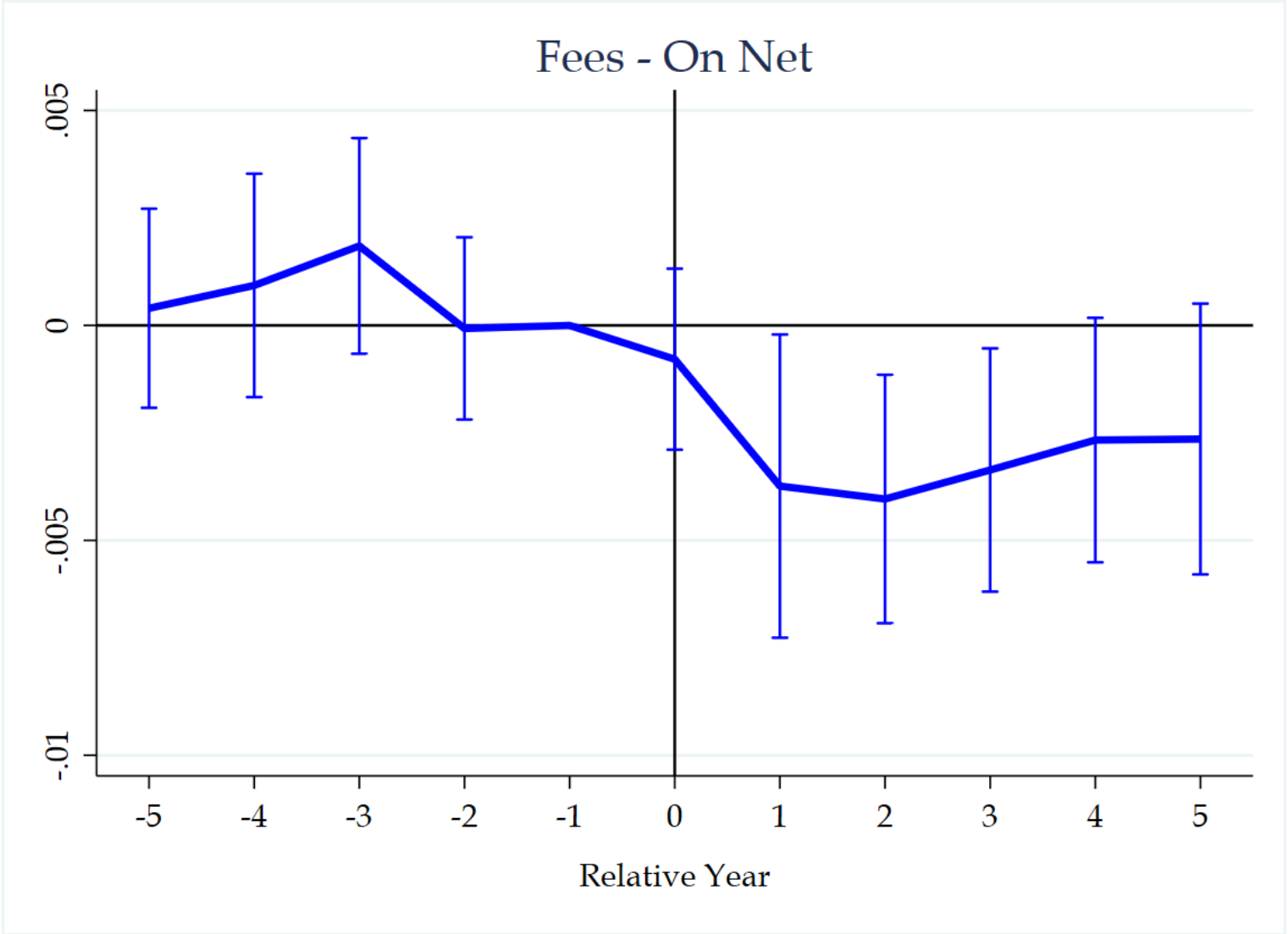

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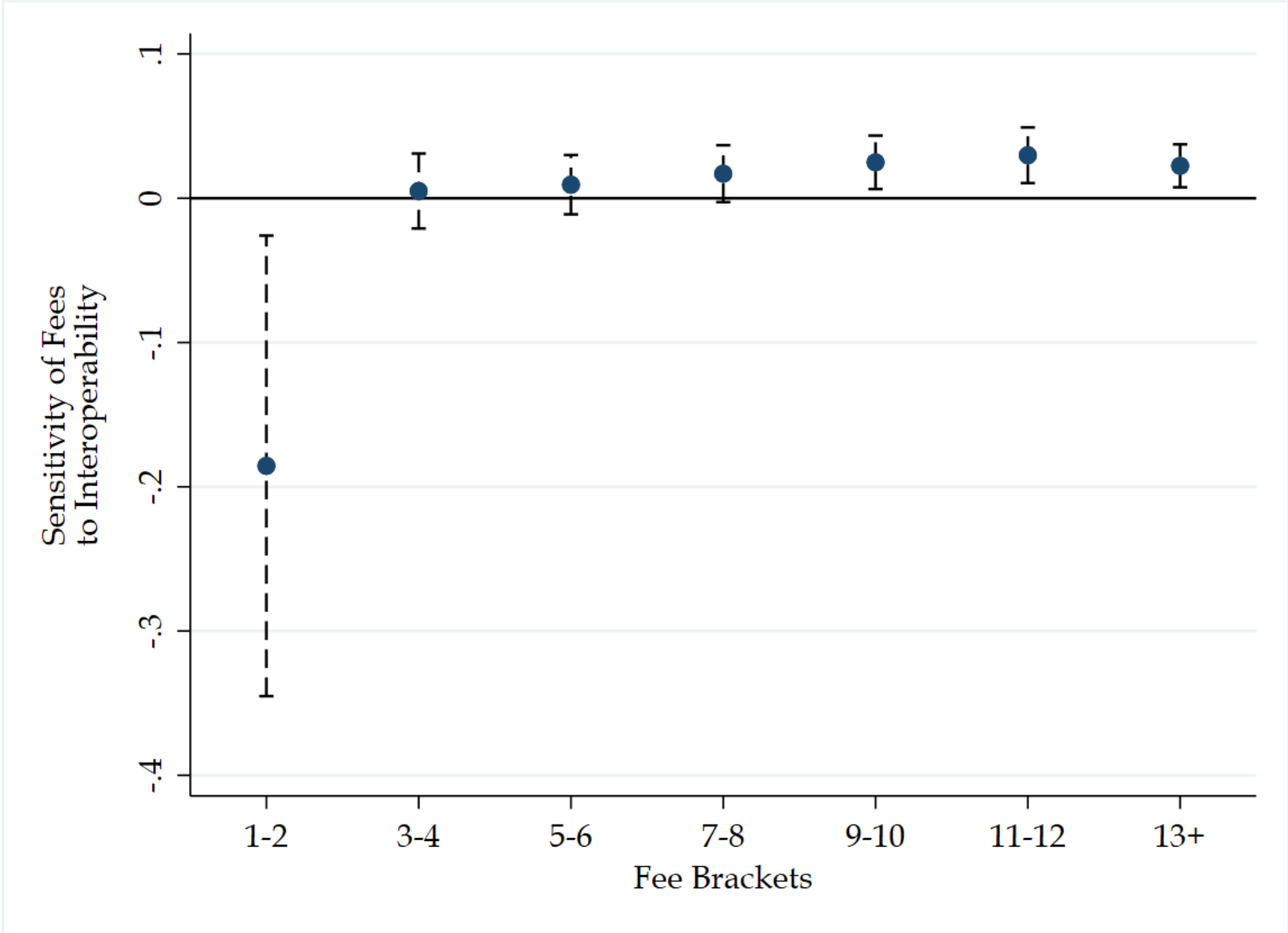

On-net Fees, specification

$$Y_{bicy} = \alpha_b + \beta_i + \gamma_y + \sum_b \delta_b Interoperability_{icy} \times \alpha \quad \varepsilon_{icy}$$

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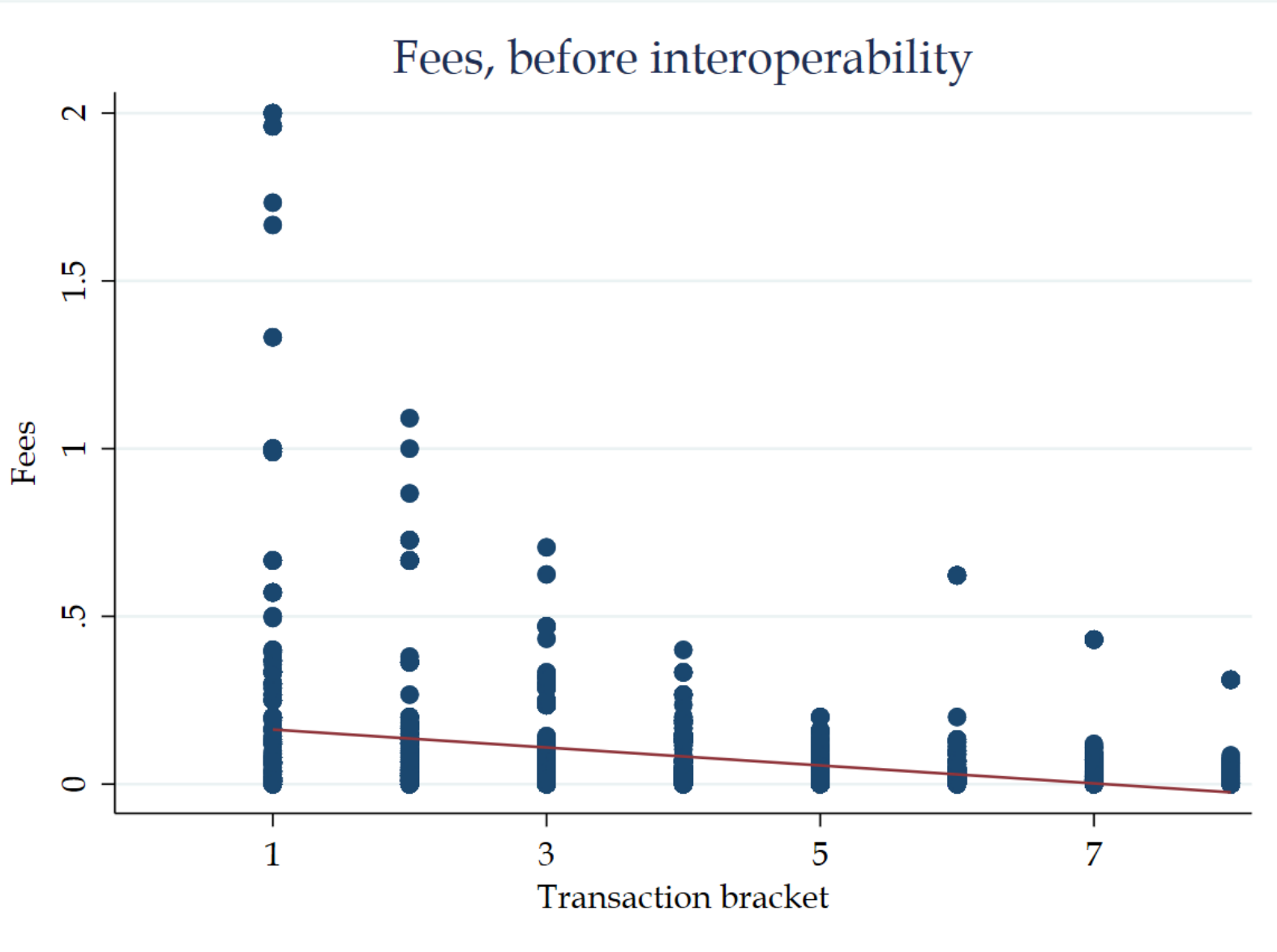

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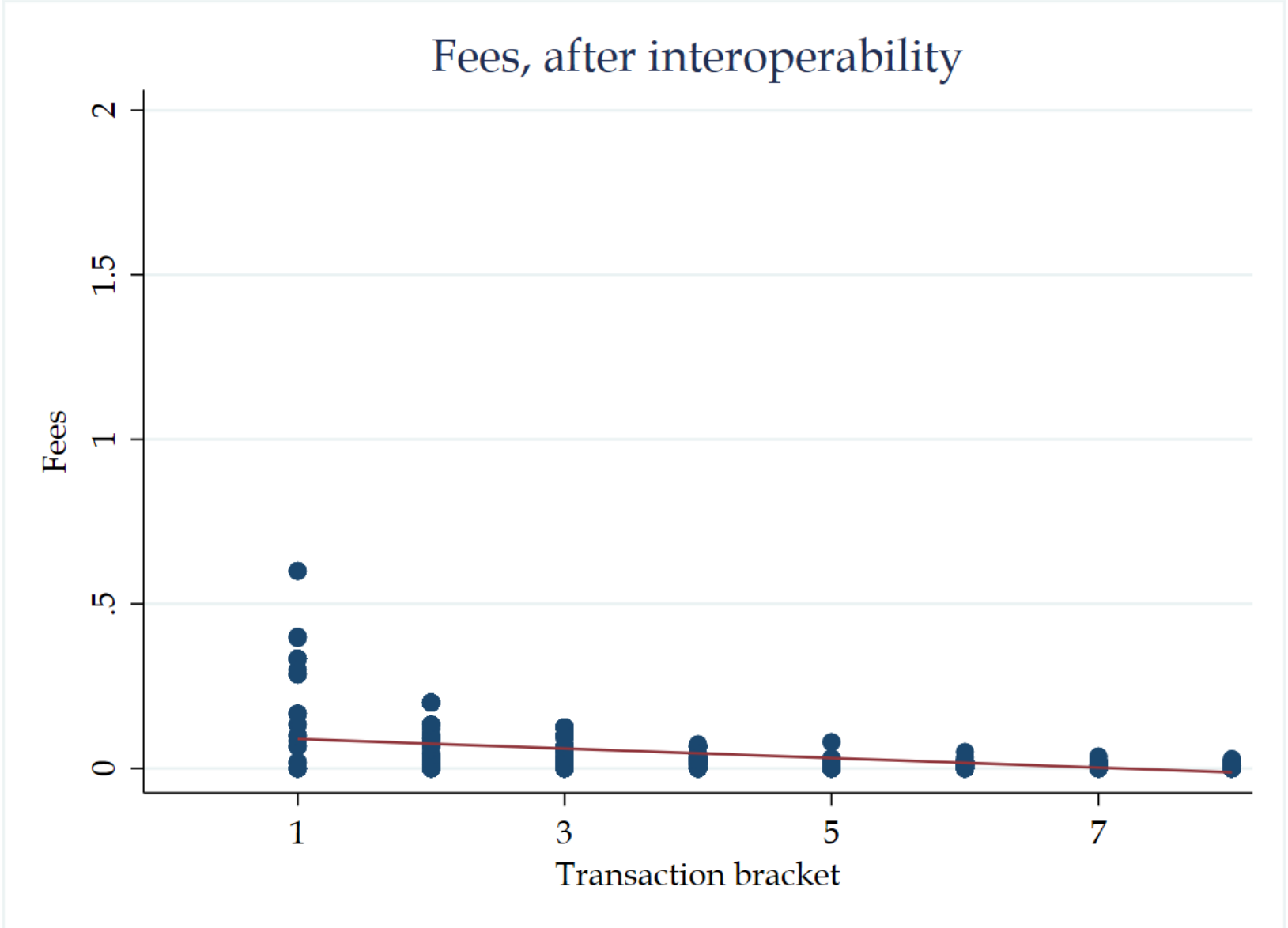

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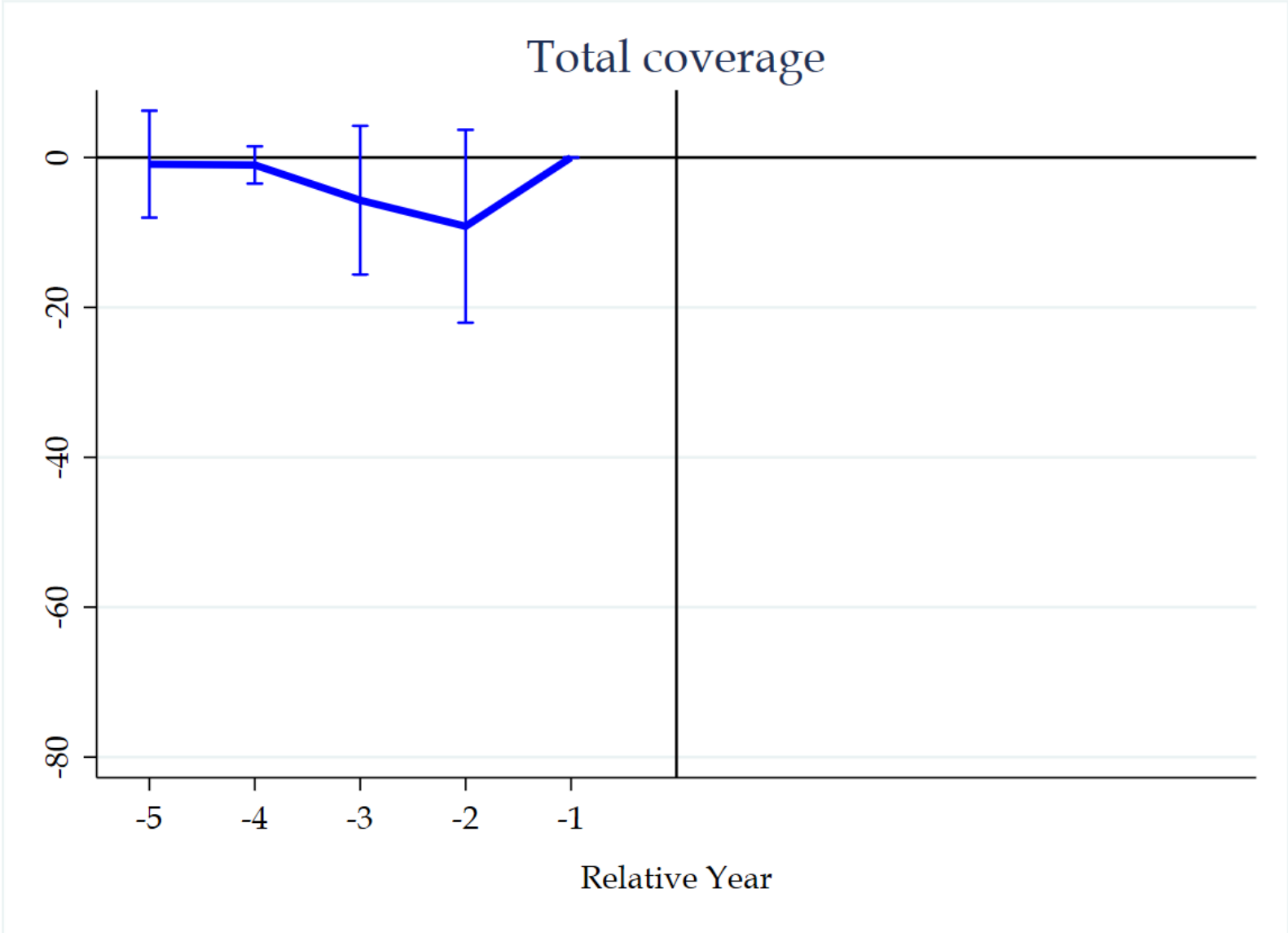
Operator-District Evidence



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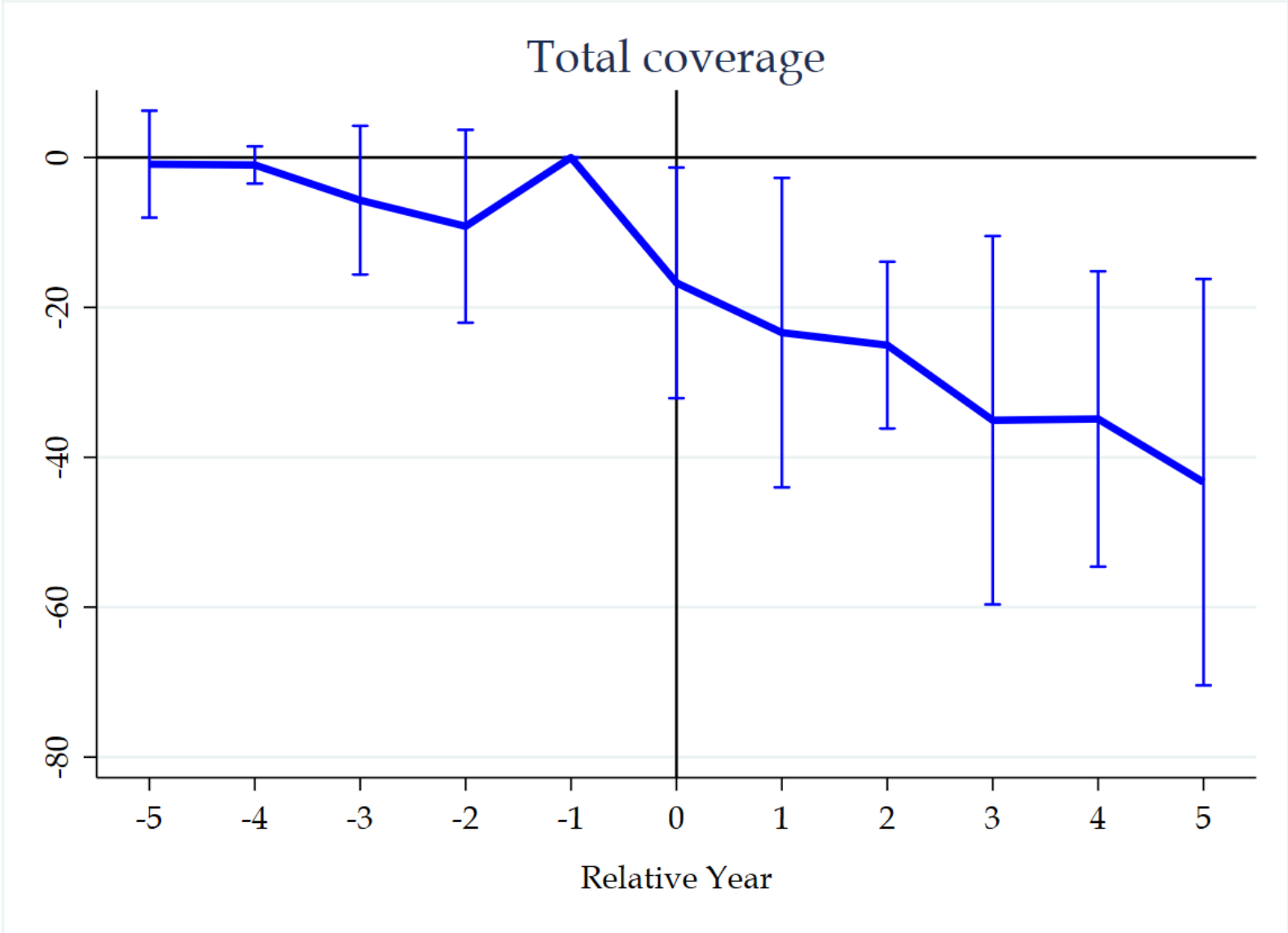

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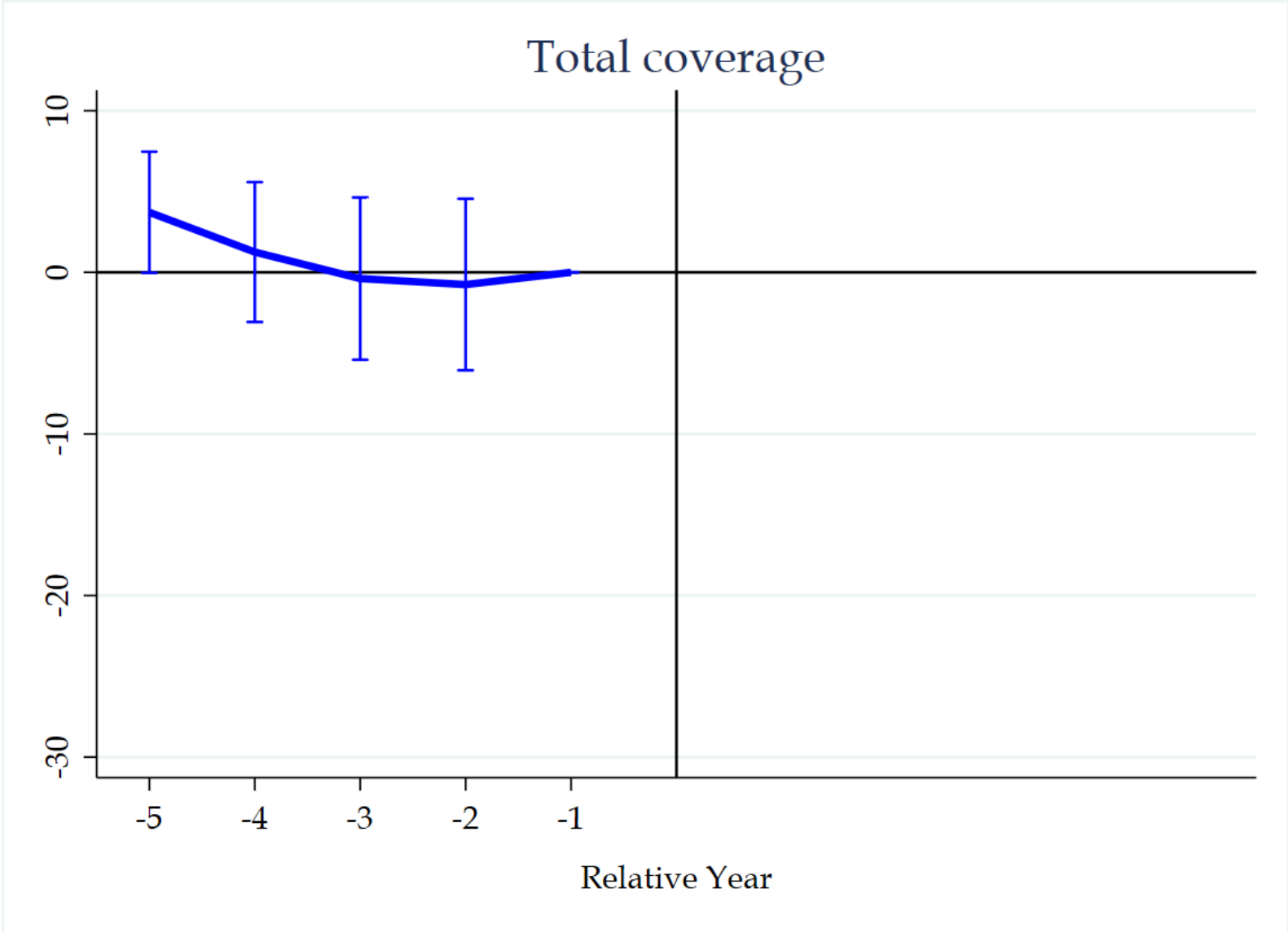
Table: Network Coverage and Interoperability - Operator-District Level

Variables	(1) Total Coverage	(2) Probability of Signal
$Interoperability_{icy}$	-4.811**	-0.036*
	(2.149)	(0.021)
Operator-District FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,113,012	1,113,012
Mean Dep. Var.	67.4	0.856

Note: Clustered SEs at the operator level.

District Evidence



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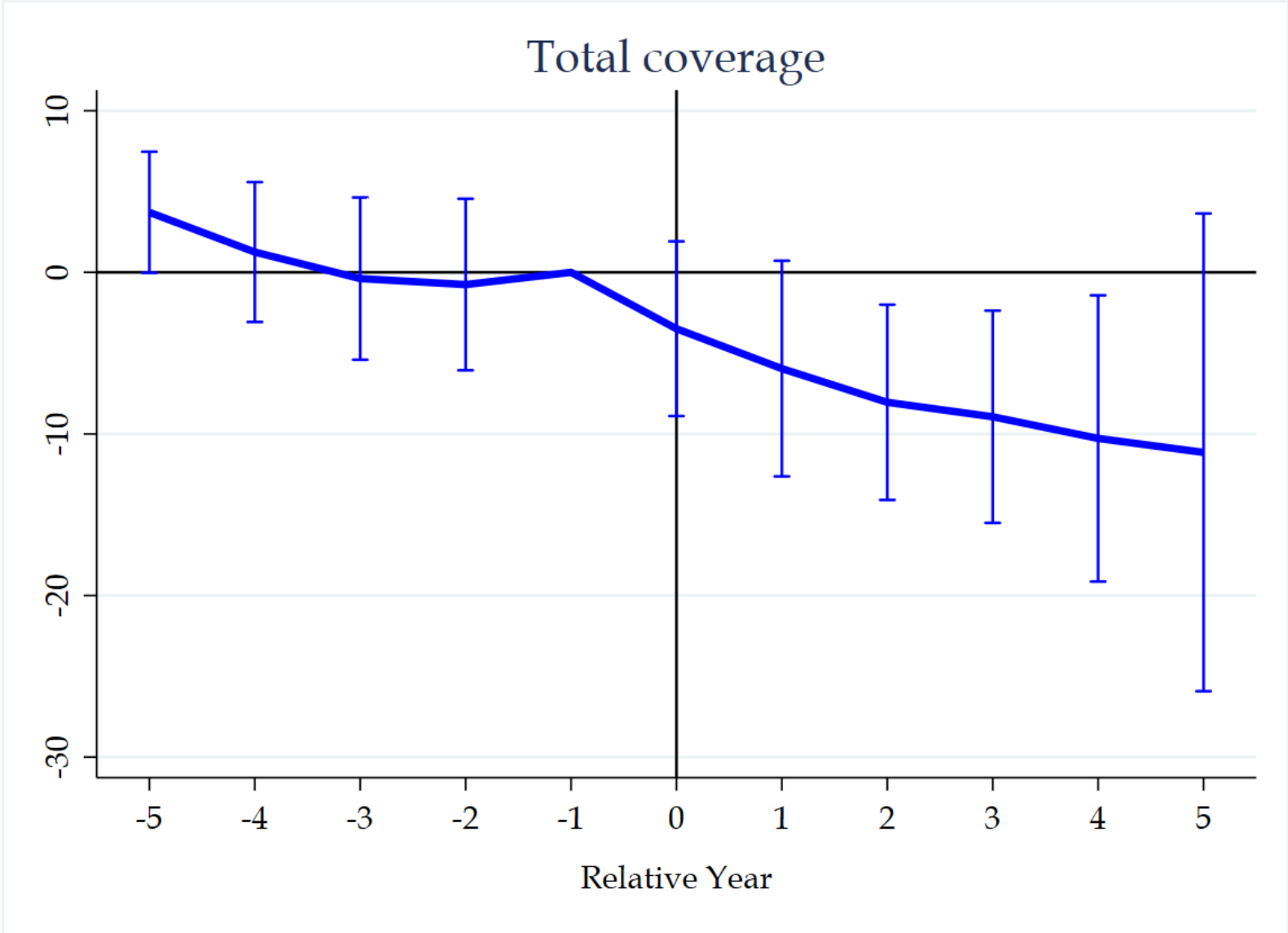

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Table: Network Coverage and Interoperability - District Level

Variables	(1) Total Coverage	(2) Prob. Signal	(3) Number MNOs
$Interoperability_{icy}$	-5.024**	-0.034*	-0.186**
	(2.147)	(0.020)	(0.077)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	569,760	569,760	569,760
Mean Dep. Var.	65.2	0.825	1.673

Note: Clustered SEs at the district level.

Financial Inclusion

Table: Financial Inclusion and Interoperability

Variables	(1) Access Emerg. Funds	(2) Domestic Remittances	(3) Wage on Phone	(4) Num. of Accounts	(5) Num. of Trans.s
$Inter.ty_{cy}$	-0.040	-0.078***	-0.062	-0.042	-0.256***
	(0.048)	(0.019)	(0.080)	(0.117)	(0.088)
Ind. Cont.	Yes	Yes	Yes		
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	90710	75026	17263	360	230
M. D. V.	0.456	0.286	0.119	16.592	20.074

Note: Clustered SEs at the country level.

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$Inter.ty_{cy}$	-0.071*	-0.087***	-0.111**	0.115	-0.145
	(0.041)	(0.018)	(0.047)	(0.103)	(0.119)
$Inter.ty_{cy} \times$	-0.088*	-0.024*	-0.226*	-0.453***	-0.181
$MM\ Network_c$	(0.046)	(0.013)	(0.124)	(0.104)	(0.131)
Ind. Cont.	Yes	Yes	Yes		
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Policy Proposal

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Analogy between supermarkets & telecoms

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Result: *de facto* price discrimination

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Empirical Test: verify whether rural subsidies prevent lower service with interoperability

Table: Interoperability and Rural Subsidies

	Local development		Night Light intensity	
	Rural	Urban	$<$ median	$>$ median
	(1)	(2)	(3)	(4)
$\text{Interoperability}_{ct}$	-7.613***	-2.453***	-5.433***	-0.485***
	(0.417)	(0.193)	(0.624)	(0.145)
Subsidy_{ct}	-1.079***	-4.088***	-1.684***	-0.930***
	(0.324)	(0.123)	(0.201)	(0.052)
$\text{Interoperability}_{ct} \times$	5.527***	-3.205***	4.107***	-0.559***
Subsidy_{ct}	(0.452)	(0.201)	(0.626)	(0.152)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Obs.	183660	386100	94608	94608
Adj. R sq.	0.927	0.888	0.949	0.917
Mean Dep. Var.	61.147	73.380	75.490	94.427

Robustness Checks

Additional

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1. Application of Borusyak, Jaravel and Spiess (2021) Borusyak

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9. Telecommunication Tariffs Telco

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Conclusion

Concluding Remarks

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1. We study the role of interoperability in the mobile money industry

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   $\rightarrow$ tradeoff between competition and fin. inclusion

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   $\rightarrow$ tradeoff between competition and fin. inclusion

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   $\rightarrow$ dissuasion of infrastructure investment

3. The regulation of digital payment platforms $\rightarrow$ My agenda in Finance & Development

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   $\rightarrow$ tradeoff between competition and fin. inclusion

2. What do we learn wrt digital economics?

   $\rightarrow$ benefits & costs of interoperability

   $\rightarrow$ dissuasion of infrastructure investment

3. The regulation of digital payment platforms $\rightarrow$ My agenda in Finance & Development

   $\rightarrow$ Excited to be (even though virtually) at such an exciting conference!

Lab for Inclusive FinTech

Thank You

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1. Borusyak, Jaravel & Spiess (2021) Back

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TWFE has been shown to present several weaknesses to capture ATEs

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First, new work has shown importance of correctly accounting for the staggering of treatments

Second, not considering enough heterogeneous treatment effects

We apply the work of Borusyak et al (2021), which is the ideal reference to address these issues

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Table: Fees and Interoperability - Borusyak et al

Variables	(1) On-Network Fees	(2) Cross-Network Fees
ATE	-0.002**	-0.014***
	(0.001)	(0.004)
Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	611	411

Back

Table: Operator-District and Interoperability - Borusyak et al

Variables	(1) Coverage Share	(2) Probability of any Coverage
ATE	-5.688**	-0.042
	(2.602)	(0.031)
District-Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,113,012	1,113,012

Back

Table: Operator Information and Interoperability - Borusyak et al

Variables	(1) Total Coverage	(2) Market Pe.tion	(3) Total Revenue	(4) Towers	(5) EBIT
ATE	-0.196***	-0.227**	-0.307**	-0.128**	-0.060
	(0.021)	(0.111)	(0.128)	(0.064)	(0.374)
Operator FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	125	1842	1684	280	366
M. D. V.	4.358	2.270	17.989	7.179	16.284

Back

Table: District and Interoperability - Borusyak et al

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of MNOs
ATE	-5.755***	-0.041*	-0.230**
	(1.530)	(0.022)	(0.095)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	569,760	569,760	569,760

Back

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Table: Fees and Interoperability - Sun and Abraham

Variables	(1) On-Network Fees	(2) Cross-Network Fees
ATE	-0.002**	-0.007**
	(0.001)	(0.003)
Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	611	411

Back

Table: Operator-District and Interoperability - Sun and Abraham

Variables	(1) Coverage Share	(2) Probability of any Coverage
ATE	-11.893***	-0.105**
	(4.177)	(0.053)
District-Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,113,012	1,113,012

Back

Table: Operator Information and Interoperability - Sun and Abraham

Variables	(1) Total Coverage	(2) Market Pe.tion	(3) Total Revenue	(4) Towers	(5) EBIT
ATE	-0.230***	-0.251*	-0.316*	-0.115**	-0.020
	(0.087)	(0.148)	(0.171)	(0.058)	(0.425)
Operator FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	125	1842	1684	280	366
M. D. V.	4.358	2.270	17.989	7.179	16.284

Back

Table: Operator-District and Interoperability - Sun and Abraham

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of MNOs
ATE	-9.211***	-0.074*	-0.418**
	(2.645)	(0.041)	(0.174)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	569,760	569,760	569,760

Back

3. Signal & Heterogeneity

Back

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This slide we focus on some key determinants of heterogeneity

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Following empirical model

$$Y_{dcy} = \alpha_d + \beta_y + \gamma \text{Interoperability}_{cy} + \psi \text{Interoperability}_{cy} \times Var + \varepsilon_{dcy}$$

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district & year fixed effects, α_d and β_y

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district & year fixed effects, α_d and β_y

Var - captures distinguishes between rural vs urban districts, following Cattaneo et al (2021) and sat. lights, and dominant operators

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Table: Coverage, Rural Districts and Interoperability

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of Operators
$Interoperability_{cy}$	-4.058***	-0.033***	-0.166***
	(0.080)	(0.000)	(0.002)
$Interoperability_{cy} \times Rural_{dt_0}$	-2.393**	-0.005***	-0.051***
	(0.231)	(0.000)	(0.002)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	569,760	569,760	569,760
Mean Dep. Var.	65.2	0.825	1.673

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Table: Coverage, Nightlights and Interoperability

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of Operators
$Interoperability_{cy}$	-1.803***	-0.006***	-0.046***
	(0.187)	(0.000)	(0.002)
$Interoperability_{cy} \times Lights_{dt_0}$	0.480***	0.001***	0.029***
	(0.198)	(0.000)	(0.002)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	189,216	189,216	189,216
Mean Dep. Var.	84.7	0.936	2.308

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Table: Network Coverage and Interoperability - Operator-District Level

Variables	(1) Total Coverage	(2) Probability of Signal
$Interoperability_{icy}$	4.021	-0.049**
	(4.525)	(0.023)
$Interoperability_{icy} \times$	-10.206**	0.015
$Lights_{jdct_0}$	(4.851)	(0.013)
Operator-District FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,113,012	1,113,012
Mean Dep. Var.	67.4	0.856

Note: Clustered SEs at the operator level.

4. Financial Inclusion Using DHS

Back

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4. Financial Inclusion Using DHS

Back

We also use measures of Fin. Inclusion from another source

4. Financial Inclusion Using DHS

Back

We also use measures of Fin. Inclusion from another source

DHS - great data!

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4. Financial Inclusion Using DHS

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Con: for this data sources no panel & no country FEs (use individual-level controls instead)

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Back

We also use measures of Fin. Inclusion from another source

DHS - great data!

Con: for this data sources no panel & no country FEs (use individual-level controls instead)

Results in line with previous findings

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Table: Financial Inclusion and Interoperability - DHS data

	(1)	(2)
	Probability of Mobile Transaction	
$Interoperability_{cy}$	-0.203***	-0.200***
	(0.004)	(0.005)
$Interoperability_{cy} \times$		-0.242***
$Rural_{icy}$		(0.004)
$Rural_{icy}$		0.035***
		(0.006)
Individual Controls	Yes	Yes
Region FE	Yes	Yes
Year FE	Yes	Yes
Obs.	105,478	105,478
Mean Dep. Var.	0.480	0.480

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5. Clustering at Country Level

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See next slide

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See next slide

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Back

See next slide

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Back

See next slide

Table: Fees and Interoperability

Variables	(1) On-Network Fees	(2) Cross-Network Fees
$Interoperability_{icy}$	-0.002**	-0.013***
	(0.001)	(0.004)
Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	611	411

Back

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Table: Operator-District and Interoperability

Variables	(1) Coverage Share	(2) Probability of any Coverage
$Interoperability_{icy}$	-4.811**	-0.036
	(2.215)	(0.022)
District-Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,113,012	1,113,012

Back

6. Population Weights

Back

Data on global population density - Warszawski et al (2017)

Coverage is pop. count instead of territory

Results are smaller (50%) but very precise

In line with hypothesis of marginal towers

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Table: Operator-District and Interoperability - Pop. Weights

Variables	(1) Coverage Share	(2) Probability of any Coverage
$Interoperability_{icy}$	-4.882**	-0.035**
	(2.022)	(0.017)
District-Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	1,112,880	1,112,880

Back

Table: District Coverage and Interoperability - Pop. Weights

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of Operators
$Interoperability_{cy}$	-4.838**	-0.030	-0.165**
	(2.220)	(0.019)	(0.077)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	645,936	645,936	645,936
Mean Dep. Var.	64.078	0.845	2.009

Back

7. SIMs per user + heterogeneity

Back

Use aggregated data on the number of SIM cards per country

Verify its correlation with interoperability

Effects heterogeneous wrt this variable

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Table: Mobile (SIMs) subscriptions

Variables	(1) Per 100 people	(2) Log Total
$Interoperability_{icy}$	-2.210	-0.043
	(3.746)	(0.059)
Country FE	Yes	Yes
Year FE	Yes	Yes
Obs.	640	640
Mean Dep. Var.	79.617	15.600

Back

Table: Coverage, Nightlights and Interoperability

Variables	(1) Coverage Share	(2) Probability of any Coverage	(3) Number of Operators
$Interoperability_{cy}$	-8.415	-0.030	-0.149
	(6.248)	(0.021)	(0.102)
$Interoperability_{cy} \times SIMs_{ct_0}$	0.057	-0.000	-0.001
	(0.077)	(0.000)	(0.001)
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	569,712	569,712	569,712

Back

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8. M&As Back

We collected data through newspapers and websites

Verify its correlation with interoperability

No effects

Table: Mergers and Acquisitions

Variables	(1) Mergers and Acquisitions	(2)
$Interoperability_{icy}$	-0.018	
	(0.017)	
$Interoperability_{cy}$		-0.010
		(0.007)
Operator FE	Yes	Yes
Year FE	Yes	Yes
Obs.	3408	3408
Mean Dep. Var.	0.009	0.009

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See next slides

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Table: Interoperability Operator and Country - IV

Variables	(1) $Interoperability_{icy}$
$Interoperability_{cy}$	0.330***
	(0.102)
Operator FE	Yes
Year FE	Yes
Obs.	2,340
Mean Dep. Var.	0.034

Back

Table: Fees and Interoperability - IV

Variables	(1) On-Network Fees	(2) Cross-Network Fees
$Interoperability_{icy}$	-0.002	-0.018*
	(0.002)	(0.010)
Operator FE	Yes	Yes
Year FE	Yes	Yes
1st Stage F	32.131	22.376
Obs.	611	411
Mean Dep. Var.	0.053	0.125

Back

Table: Operator-District and Interoperability - IV

Variables	(1) Coverage Share	(2) Probability of any Coverage
$Interoperability_{icy}$	-10.046**	-0.108*
	(4.347)	(0.057)
District-Operator FE	Yes	Yes
Year FE	Yes	Yes
1st Stage F	29.638	29.638
Obs.	1,113,012	1,113,012
Mean Dep. Var.	82.821	0.971

Back

Table: Operator Information and Interoperability - IV

Variables	(1) Total Coverage	(2) Market Pe.tion	(3) Total Revenue	(4) Towers	(5) EBIT
$Inter.ty_{icy}$ -0.186***	-0.333*	-0.168	-0.218*	0.466	
(0.033)	(0.173)	(0.209)	(0.118)	(0.512)	
Operator FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
1st F		97	77	36	56
Obs.	125	1842	1684	280	366
M. D. V.	4.358	2.270	17.989	7.179	16.284

Back

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Fees of Telecommunications

Back

We have operator-level data on fees for calls, text & MBs

regress these on interoperability

next slide

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TelCo Fees

Table: TelCo Fees and Interoperability

Variables	(1) Voice per minute	(2) Data per GB	(3) Messages per SMS
$Interoperability_{icy}$	-0.002	0.003	0.001
	(0.008)	(0.002)	(0.002)
Operator FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Obs.	392	52	121
Mean Dep. Var.	0.077	0.011	0.018

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