Reflection on:

Digitalization, Firm Performance, and Internationalization of Micro Firm in India

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The opinion expresses is personal and does not represent the views of IFG on this issue

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What does the paper discuss?

- **Objective** : Examine the role of digital adoption on firm performance and internationalization of Indian micro enterprises.
  - **Proxy:** Twelve dummy variables representing the adoption of various types of ICT.
- **Data :** World Bank Enterprise Survey on Micro Firms (ESM) consists of 836 micro firms spread across nine cities in 2022 (cross section)
- **Method:** OLS for sales and productivity and probit for internationalization.
- **Main conclusion**: digital adoption is significantly associated with improvement in firm sales, output per worker, and increases the probability of firms export participation.

Why should we be careful with impact assessment?

Firm Performance

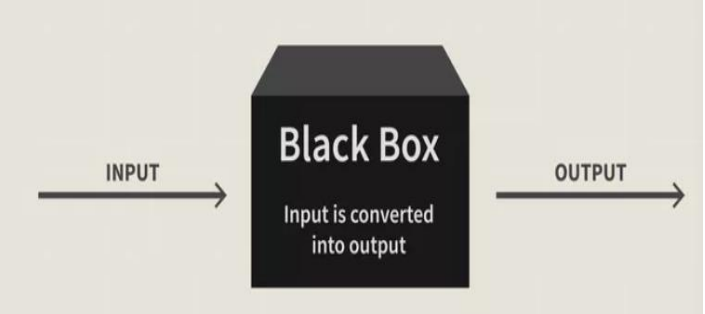
$$Y_{ic} = Digitalization_{ic} + Z + \epsilon_{ic} \qquad (1)$$

- Y represents firm performance
  - Firm Sales
  - Firm Productivity
- We estimation Equation 1 using OLS

Firm Exports

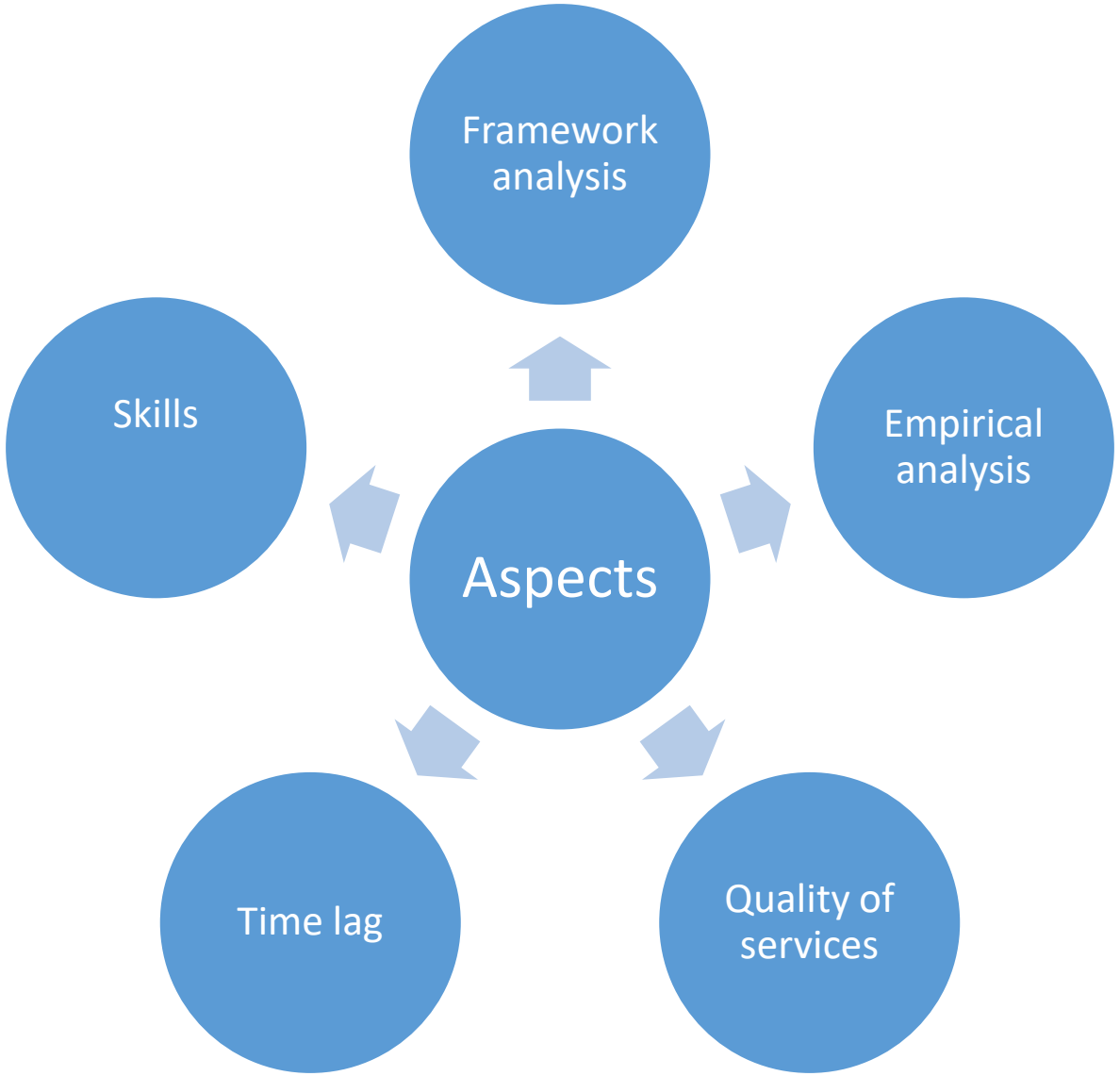
$$Pr(Export_{ic} = 1) = \phi(\alpha_1 + Digitalization_{ic} + Z + \epsilon_{ic}) \qquad (2)$$

- Dependent Variable is firm Exports
- We estimation Equation 2 using Probit model



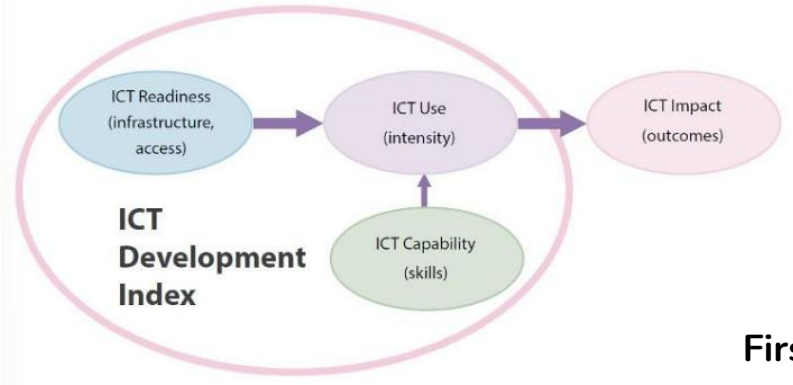
- Access demand vs usage demand
- Probably better with Heckman
- Endogeneity

Reflection


Framework analysis
Skills
Empirical analysis
Aspects
Time lag
Quality of services

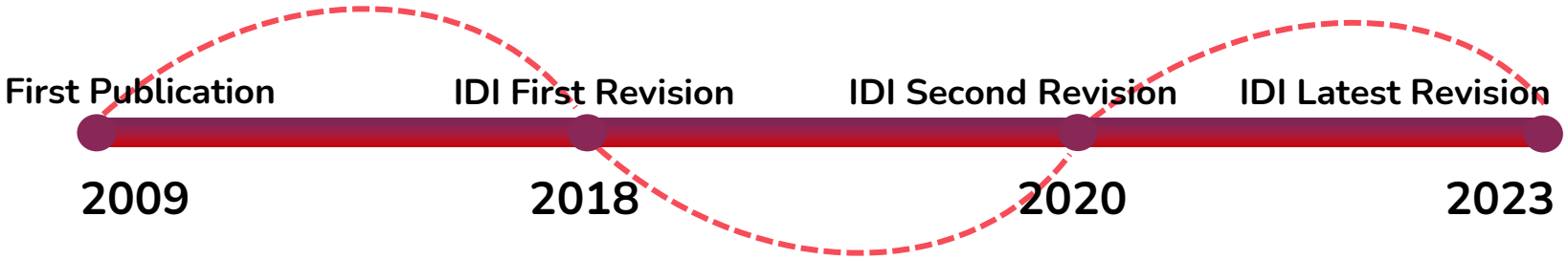
1. Framework analysis

The ICT Framework (ITU)



Source: ITU (2001)

The ICT Development Index (IDI) is a composite index used to monitor and compare information and communication technology (ICT) developments between countries over time.



The IDI Sub-Index

ICT Access	ICT Use	ICT Skill
Percentage of households with a computer	Percentage of households with Internet access	Mean years of schooling
Percentage of households with Internet access	Active mobile-broadband subscriptions per 100 pop.	Gross enrolment ratio (Secondary level)
International bandwidth (bit/s) per Internet user	Mobile broadband Internet traffic per mobile broadband subscription	Gross enrolment level (Tertiary level)
Percentage of the population covered by mobile networks: At least 3G; At least LTE/WiMax		
Fixed-broadband subscriptions (weighted by speed) per 100 population		

2. Empirical strategy

Telecommunications Infrastructure and Economic Development: A Simultaneous Approach

By Lars-Hendrik Röller and Leonard Waverman*

In this paper we investigate how telecommunications infrastructure affects economic growth. We use evidence from 21 OECD countries over a 20-year period to examine the impacts that telecommunications developments may have had. We jointly estimate a micromodel for telecommunication investment with a macro production function. We find evidence of a significant positive causal link, especially when a critical mass of telecommunications infrastructure is present. Interestingly, the critical mass appears to be at a level of telecommunications infrastructure that is near universal service. (*JEL* O57, O47, L69)

(1) $GDP_{it} = f(K_{it}, HK_{it}, TELECOM_{it}, t)$.

The coefficient on *TELECOM* in equation (1) estimates the one-way causal relationship flowing from the stock of telecommunications infrastructure to economic output. To differentiate between the two effects, that is, the income elasticity of telecommunications infrastructure as well as the impact of TELECOM on GDP, we specify three other equations, which endogenize the demand and supply of telecommunications infrastructure and its investments.

Demand for telecommunications infrastructure:

(2) $TELECOM_{it} = h(GDP_{it}/POP_{it}, TELP_{it})$.

(3) $TTI_{it} = g(TELP_{it}, Z_{it})$.

Telecommunications infrastructure production function:

(4) $TELECOM_{it} - TELECOM_{i,t-1} = (TTI_{i,t}, R_{it})$.

JOURNAL ARTICLE

Mobile telecommunications and the impact on economic development

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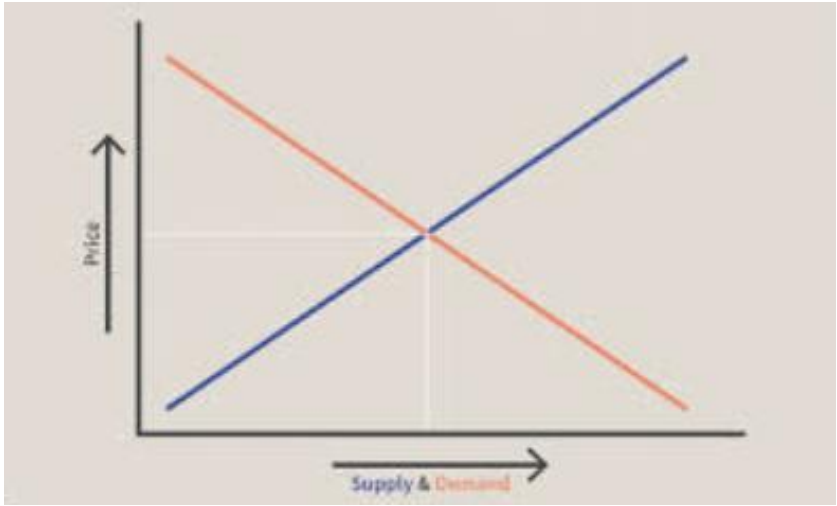
Harald Gruber, Pantelis Koutroumpis

Economic Policy, Volume 26, Issue 67, 1 July 2011, Pages 387–426,
https://doi.org/10.1111/j.1468-0327.2011.00266.x
Published: 12 August 2014



3. Quality of services

Bias Measurement (Middleton, 2013)

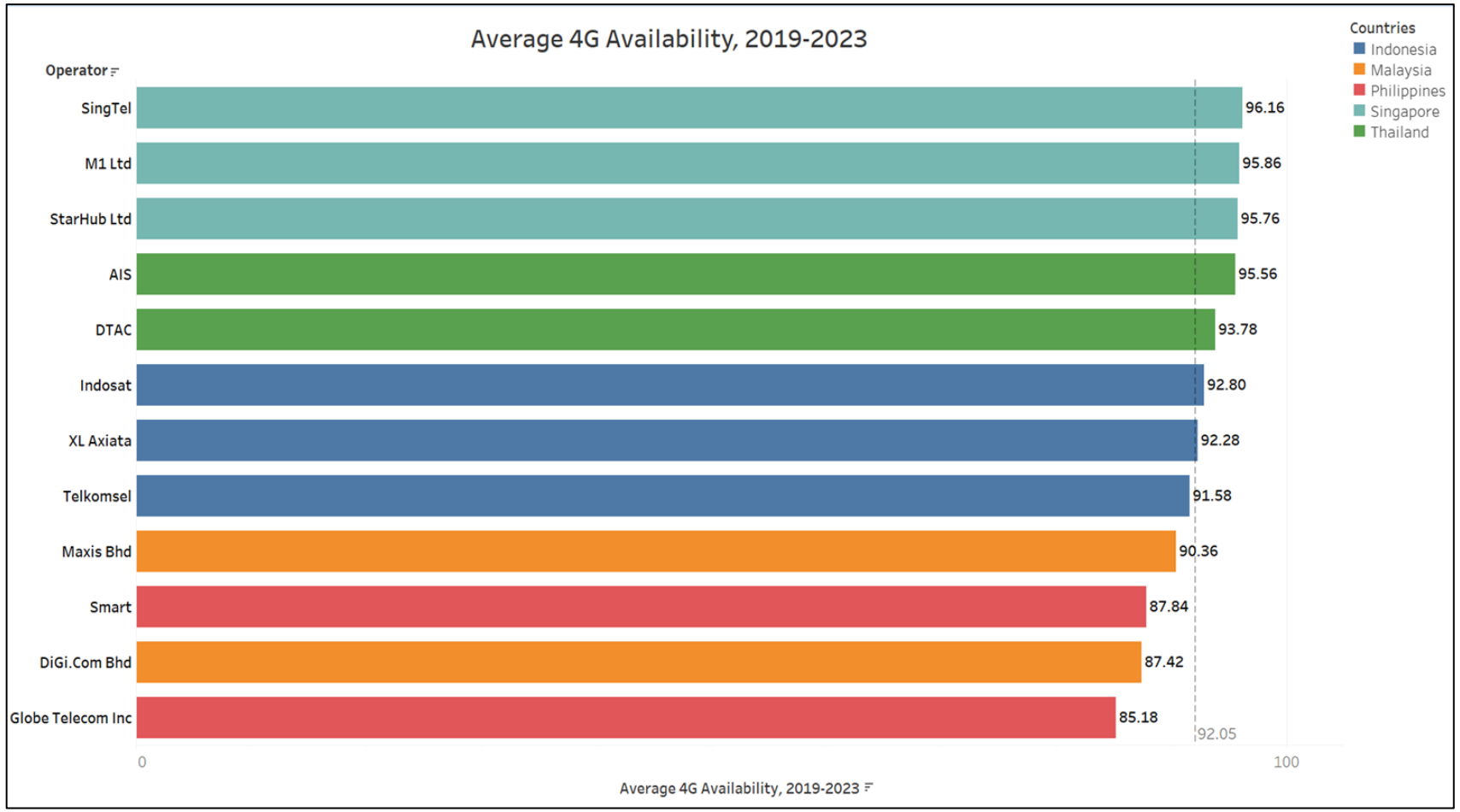
Difference in connection: 2G, 3G, Wifi (Fibre), 4GLTE

Internet speed, influenced by connectivity through BTS. BTS is a network component of cellular communication systems that receive and send signals. Based on PODES 2020 (BPS, 2020), there are still 46.468 villages or around 55% of the observed villages still have no BTS available.

		2G (GSM/GPRS)	3G (HSPA, HSPA+)	Wi-Fi (with fibre)	4G LTE
Applicability	Application breadth	◔	◑	●	●
	Degree of mobility	●	●	◔	●
	Responsiveness	◔	◑	●	●
	Richness / data-intensity	◔	◑	●	●
	Application criticality	◔	◔	◕	◕
	Device type	Feature phone, smartphone	Tablet, smartphone	PC/laptop, tablet, smartphone	PC/laptop, tablet, smartphone
Performance (typical measured)	Download speed (Mbps)	0.01 – 0.13	1 – 5	20 – 30	10 – 40
	Upload speed (Mbps)	0.008 – 0.13	0.2 – 0.5	2 – 10	1 – 15
	Latency (ms)	300– 700 (GPRS)	100 – 200	10 – 20	50 – 150

Even the same technology might yield different performance

Average 4G Availability (in % average time users are connected to the 4G network), 2019-2023.



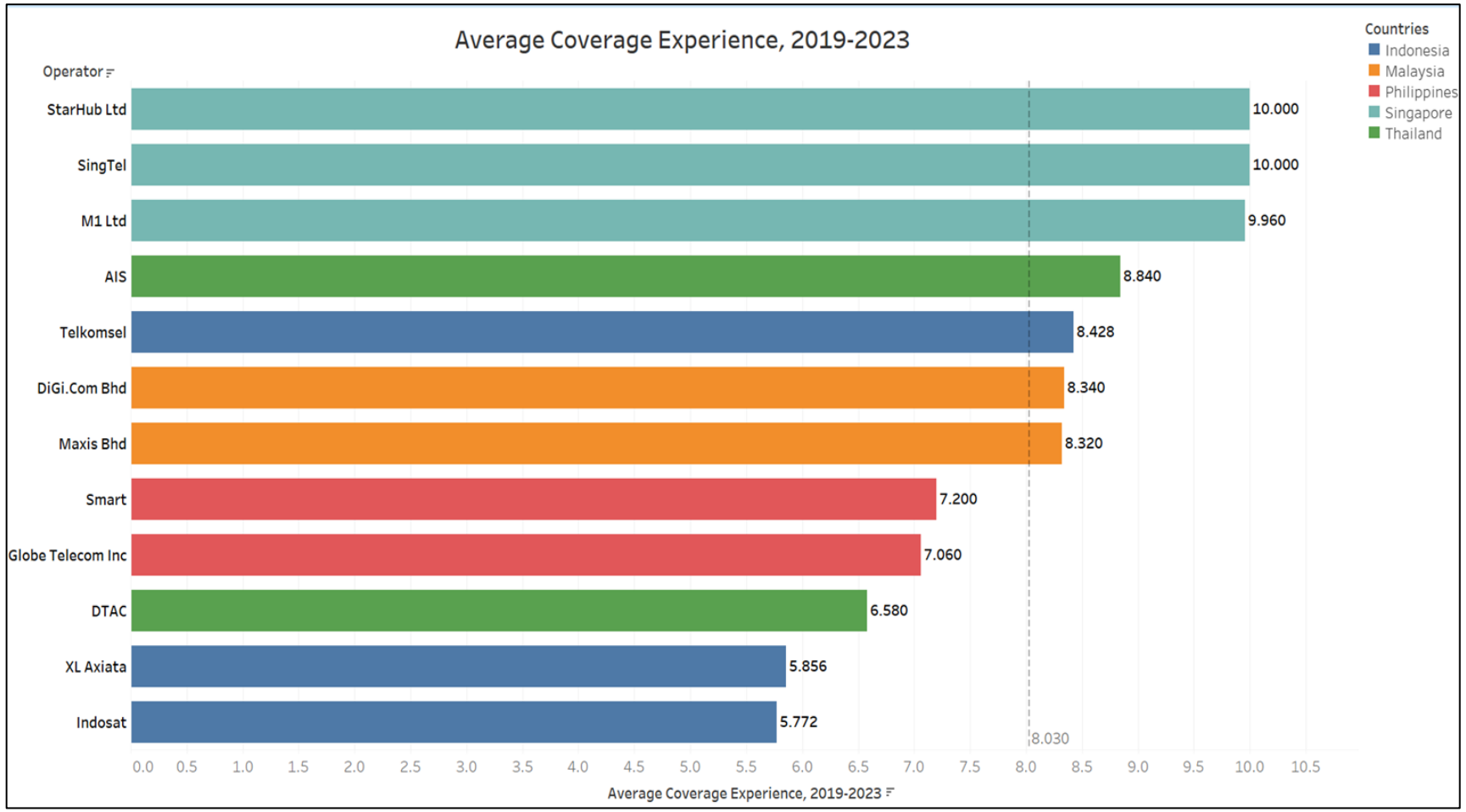
- 4G Availability measures the average percentage of time that users can connect to the 4G network of a specific operator.

- On average, Singapore's operators have the highest value, followed by Thailand, Indonesia, Malaysia, and the Philippines.

Sumber: OpenSignal (2023)

Even the same technology might yield different performance (2)

Average Coverage Experience (scale 0-10), 2019-2023



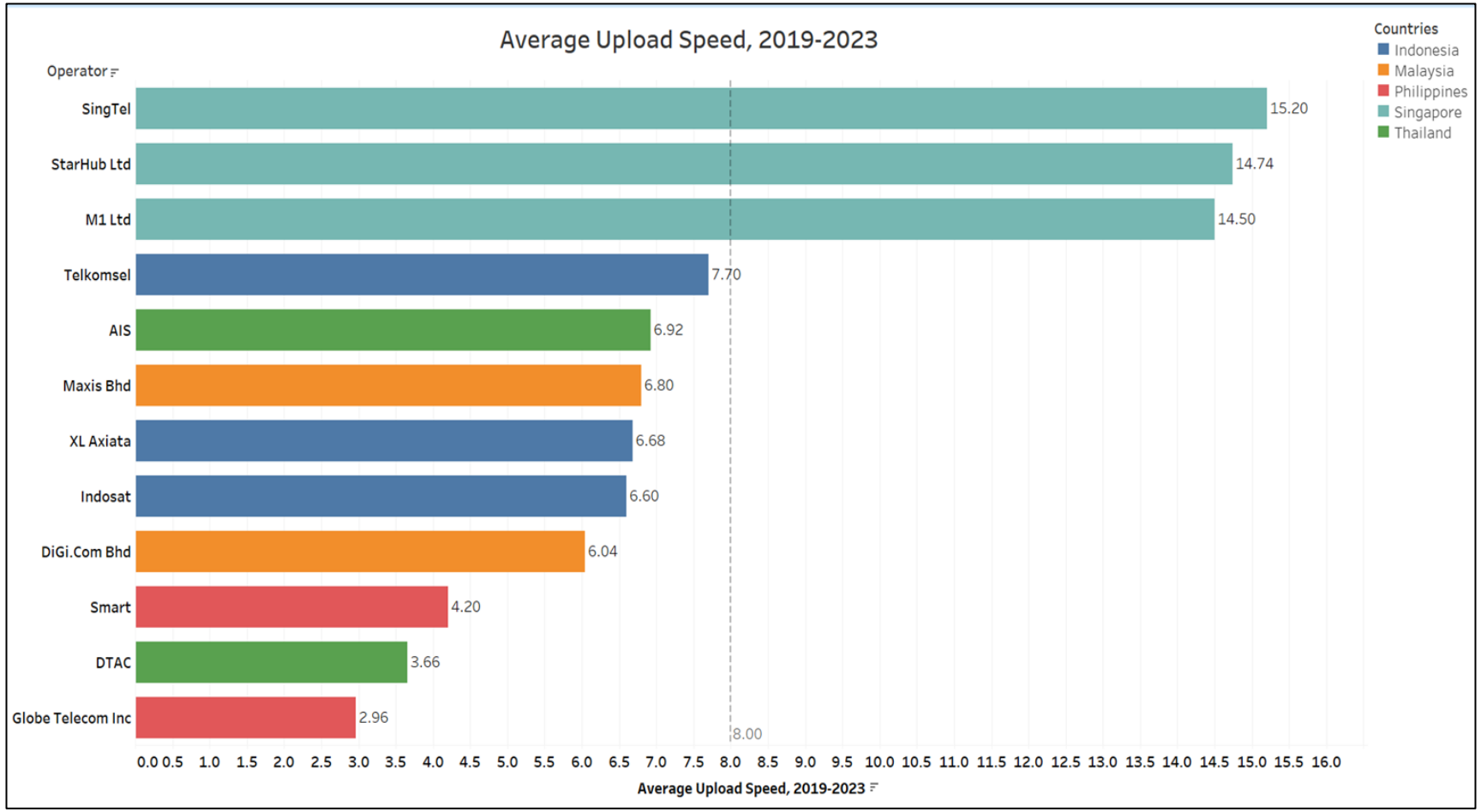
- 4G Coverage Experience measures the quality of 4G coverage as perceived by users on the operator's network, rated on a scale of 0-10.

- On average, Singapore's operators have the highest rating, followed by Thailand (AIS), Indonesia (Telkomsel), Malaysia, and the Philippines."

Sumber: OpenSignal (2023)

Even the same technology might yield different performance (3)

Average Upload Speed (mbps), 2019-2023



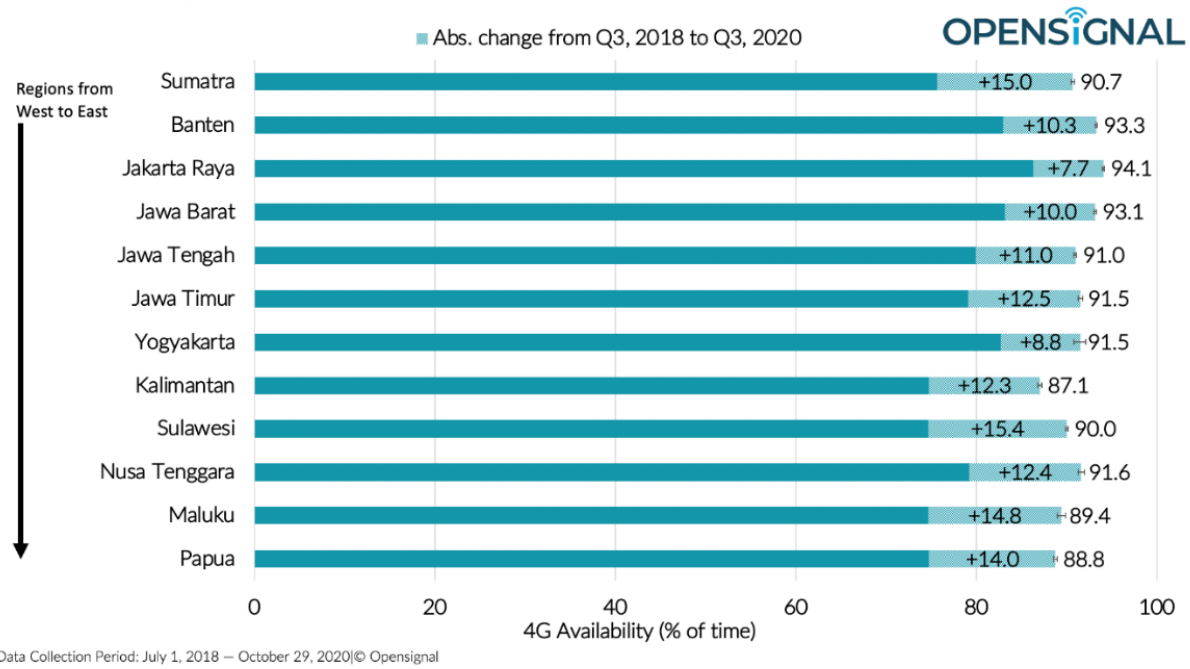
- Upload Speed Experience measures the average upload speed experienced by Opensignal users across the operator networks.

- On average, Singapore's operators have the highest rating, followed by Indonesia (Telkomsel), Thailand (AIS), and Malaysia (Maxis).

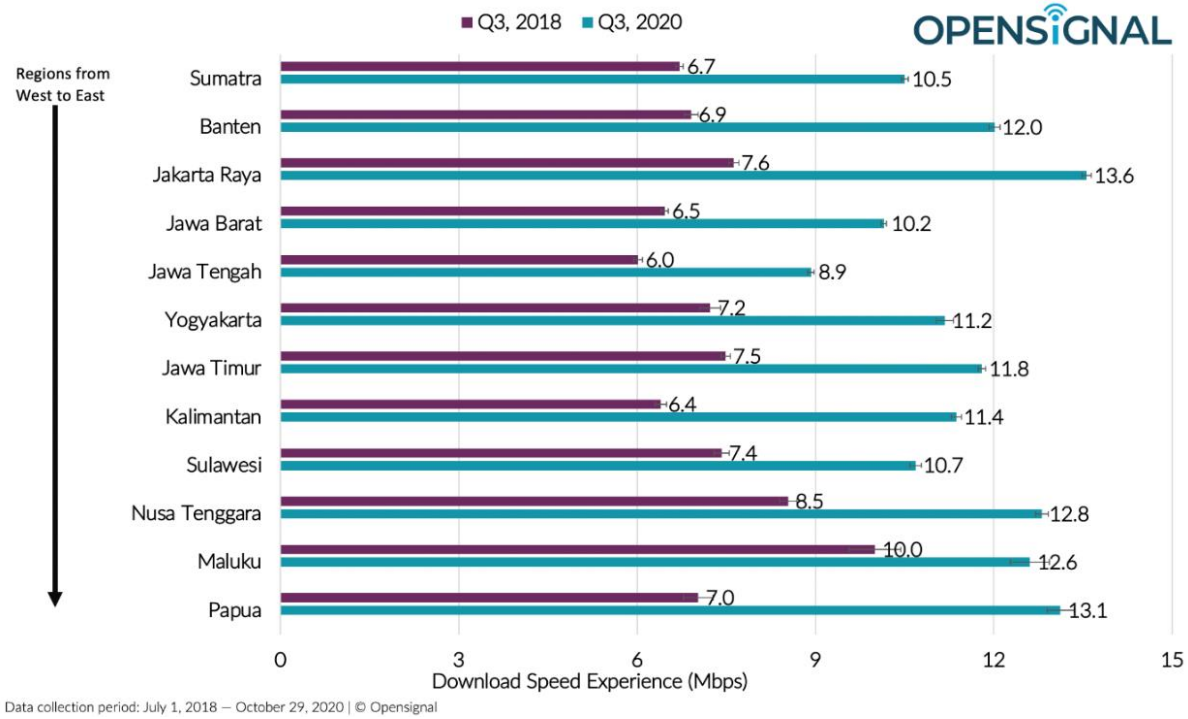
Sumber: OpenSignal (2023)

Even within country, quality of services is different

In the case of Indonesia, quality of services is worsened in the eastern part



Source: Khatri (2020)



Source: Khatri (2020)

3. Time lag in measuring the impact

Innovation in the service sector will continue to drive much higher economic growth. Previous research by GSMA (2018) explained that the impact of innovation in providing telecommunications services will begin to be felt within five years and will take 15 years to become a mature ecosystem with a profound impact on the global economy.

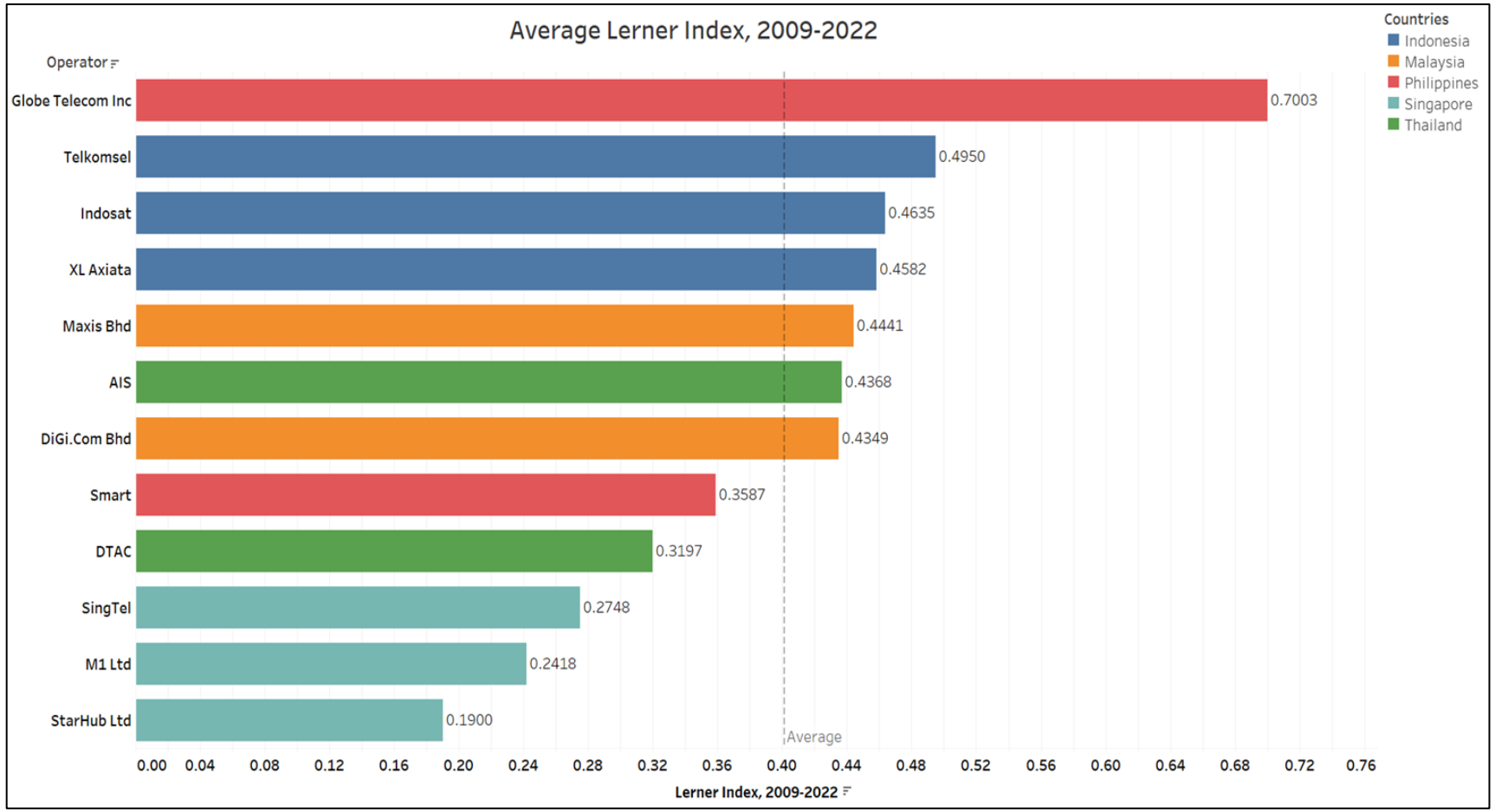
Application	Projected Annual Growth	Projected Market Share
eHealth services	N/A	$554.3 Billion (2025)
Assisted and autonomous vehicles	17% (2017–2025)	$225.2 Billion (2025)
Immersive experiences (AR/VR)	69% (2017–2022)	$100 Billion (2022)
Video surveillance and analytics	14% (2016–2023)	$55 Billion (2023)
Fixed Wireless Access (FWA)	84% (2019–2025)	$40 Billion (2025)
Machine remote control	N/A	$15.1 Billion (2022)
Process automation/cloud robotics	23% (2019–2024)	$9.8 Billion (2022)

Source: Nokia (2019)

The adoption of 5G in the **medical** world will make eHealth as the service with projected market share of **554.3 billion USD** in **2025**

4. Market structure and affordability

Average Lerner Index (scale 0-1), 2009-2022



- The Lerner Index is a measure of a company's market power or monopoly level.

- On average, the operator in the Philippines, Globe, has the highest value, followed by three companies in Indonesia, Malaysia (Maxis), and Thailand (AIS).

Sumber: Bloomberg (2023)

Market Structure and affordability

Government Intervention

The limited availability of telecommunications infrastructure in the 3T Regions, which has implications for unaffordable internet prices for the household (Monopoly power), requires the government to intervene in the market.

What kind of Government Intervention?

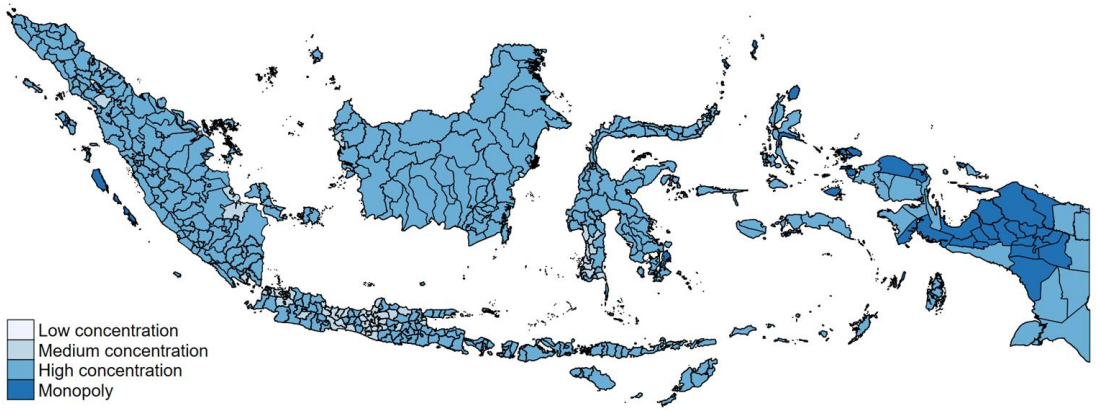
- The Form of Technical Progress
- Regulatory Changes
- Market Structure
- Price of Telecommunication Services

Source: Boylaud & Nicoletti (2001)

Clustering Government Intervention in Indonesia

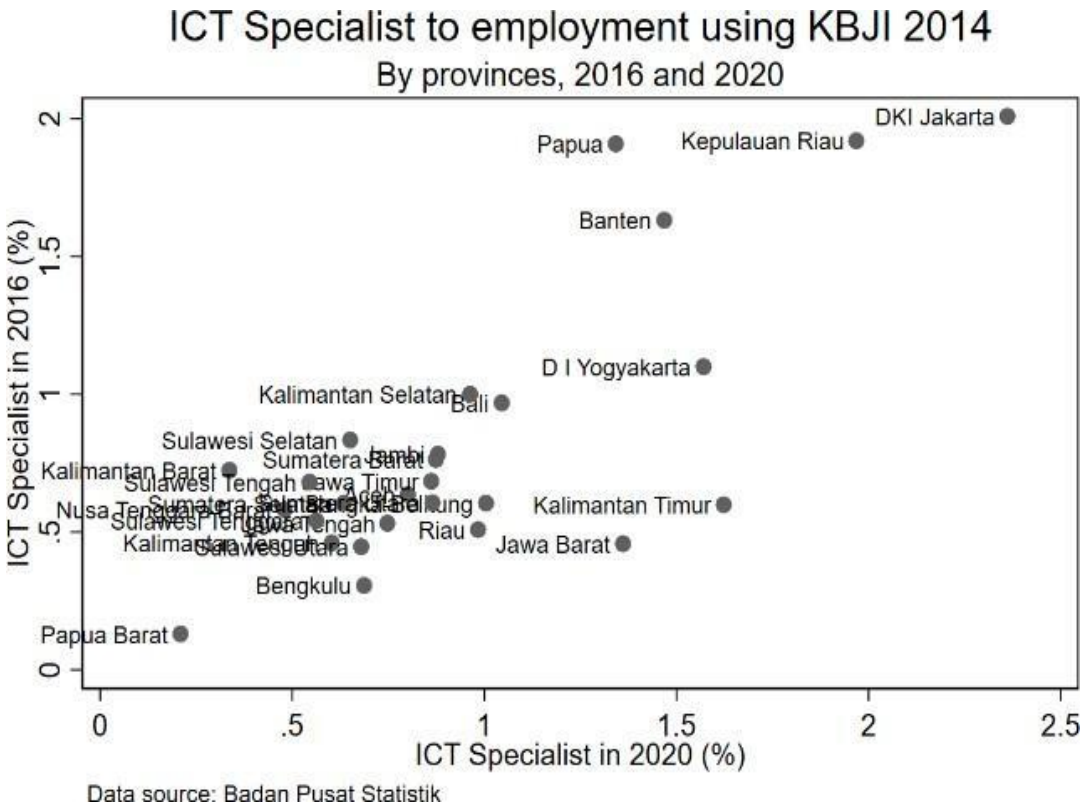
Indicators		HHI			
		Low	Medium	High	Monopoly
Affordability	<5 percent	No intervention	No Intervention	Light intervention	Light intervention
	>5 percent	No Intervention	No intervention	Light intervention	Strong intervention

Source: Rohman et al (2023)



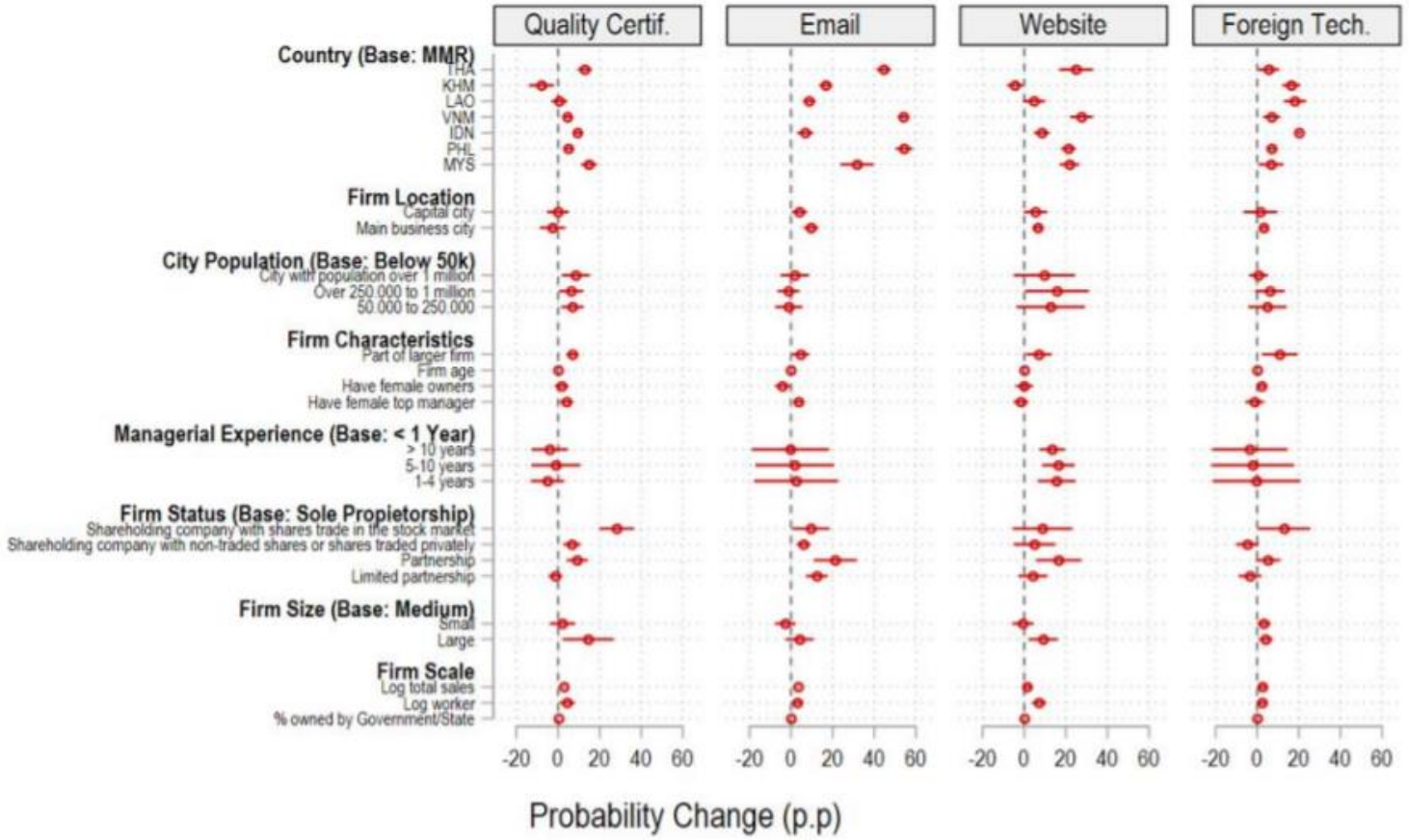
Source: Rohman et al (2023)

5. The man behind the gun (skills)



	GMM		
Variables	**Logarithmic of GDP (1)**	**Logarithmic of GDP per capita (2)**	**Logarithmic of GDP per employment (3)**
Logarithmic of ICT Specialist to employment	**1.217****	**0.0947*****	**0.176****
	(0.475)	**(0.0267)**	**(0.0766)**
Logarithmic of Number of BTS	0.971***	-0.000768	-0.00355
	(0.0276)	(0.00208)	(0.00333)
Logarithmic of people using internet proportion	-0.696***	0.00241	0.00590
	(0.213)	(0.0127)	(0.0266)
Logarithmic of people using smartphone proportion	-1.238***	-0.0380	-0.0425
	(0.472)	(0.0259)	(0.0673)
Inflation rate	0.0415	0.00144	0.00407
	(0.0984)	(0.00493)	(0.00842)
Constant	10.61***	0.151	0.173

Consequently: Disparity of Impact Among SMEs for the Same Type of ICT Adoption in ASEAN



Source: Enterprise Survey Data, 2015-2016. Standard errors are adjusted at the country level.

Attributable to, among others, discrepancies in the quality of services, intensity of use, pricing, market conduct, skills, and government intervention.

LPEM FEBUI (2022) for MoTrade

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