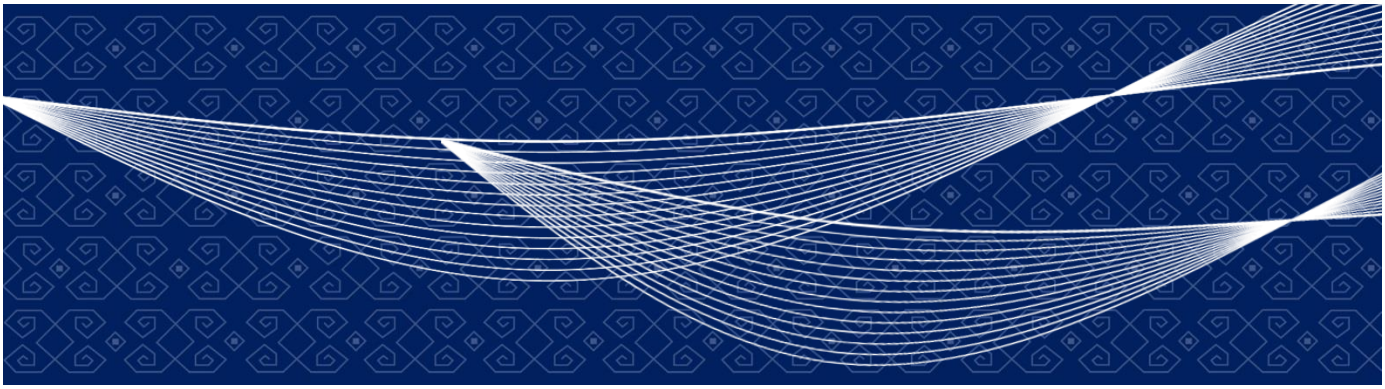
BANK INDONESIA
BANK SENTRAL REPUBLIK INDONESIA



RP/SSP/01/2023

WORKING PAPER

DIGITAL ADOPTION, BUSINESS PERFORMANCE, AND FINANCIAL LITERACY IN ULTRA-MICRO, MICRO, AND SMALL ENTERPRISES IN INDONESIA

Yoga Affandi, Masagus M. Ridhwan, Irwan Trinugroho, Danny Hermawan

2023

DIGITAL ADOPTION, BUSINESS PERFORMANCE, AND FINANCIAL LITERACY IN ULTRA-MICRO, MICRO, AND SMALL ENTERPRISES IN INDONESIA

Yoga Affandi[a], Masagus M. Ridhwan[a], Irwan Trinugroho[b], Danny Hermawan[a]

[a] Bank Indonesia Institute, Bank Indonesia, [b] Universitas Sebelas Maret, Indonesia

Abstract

This study investigates the factors affecting digital adoption by ultra-micro, micro, and small enterprises (UMSEs) based on a survey of 5,035 UMSEs in 17 major provinces in Indonesia. Utilizing the survey data, we also construct a digital adoption index that can be used to evaluate the regional adoption level variations. The result shows that several factors notably owner demographic characteristics, firm-specific factors, business environment, connectivity infrastructure quality, and culture are associated with the disparity in digital adoption by UMSEs. Our finding also shows a positive and significant correlation between digital adoption on business performance (sales growth). We further found strong evidence of the impact of digital adoption on the level of financial literacy of UMSEs' owners. The latter result suggests that improving digital adoption among micro businesses (UMSEs) could be a lever to enhance their financial literacy. All in all, these findings suggest the vital role of digital transformation for micro-businesses in achieving growth and competitiveness in the global market, undoubtedly requiring robust support from policymakers.

Keywords: Digital Adoption, Ultra-Micro, Micro and Small Enterprises, Firm Performance, Financial Literacy.

JEL Classification: L25, O33, R11

Acknowledgment: Irwan Trinugroho acknowledges financial support from Bank Indonesia

Disclaimer: The views and analysis from this study are solely responsible for the authors, without implicating to Bank Indonesia

1. Introduction

1.1 Background

Micro-businesses notably ultra-micro, micro, and small enterprises (UMSEs) play significant roles in the economy, more particularly in developing countries like Indonesia. Typically, the micro-business is the source of both income generation and job creation for most households (Mead & Liedholm, 1998; Trinugroho et al., 2022). UMSEs could be also an informal social safety net by providing alternative jobs following extraordinary situations (Resosudarmo et al., 2012; Falentina et al., 2021). However, some issues related to the productivity and long-term viability of those kinds of firms remain in place even though the government has provided some affirmative policies and facilities (Falentina et al., 2021; Trinugroho et al., 2022).

Over the last two decades, digital transformation has been massive in all sectors mainly due to the penetration of Information and Communication Technology (ICT) notably via the Internet. UMSEs, to some extent, have also adopted digital technology in their business activities, for instance, e-commerce, online marketing, digital payment, and digital banking services including in Indonesia (see, for example, Ridhwan et al., 2023). Nevertheless, the adoption level remains uneven across UMSEs, especially in developing countries. Some previous studies have highlighted the benefits of digital adoption by micro, small, and medium enterprises. By studying European SMEs, Skare et al. (2023) provide evidence that digital transformation in small and medium enterprises significantly impacts business activity, competitiveness, input costs, access to finance, and skilled labor demand. In the context of Indonesia, find that the adoption of digital technology is essential for micro and small enterprises, especially during the COVID-19 pandemic (Trinugroho et al., 2022; Ridhwan et al., 2023).

1.2 Research Objectives

1. Accordingly, this study is aimed to contribute by examining the digital adoption of UMSEs, and what factors are able to explain the adoption variations across regions in Indonesia.
2. This paper also contributes to the literature on micro businesses' digitalization by empirically assessing determinants of the adoption of digital business by ultra-micro, micro, small, and medium enterprises (UMSEs) in Indonesia in 2023.
3. Another contribution of this study we also examine whether the digital adoption index may affect the UMSEs' financial literacy. Our dataset is sourced from the Bank Indonesia Institute (BINS) Survey of Ultra-Micro, Micro, and Small Enterprises. The data are not publicly available.

Based on field survey data, we could build a comprehensive index to measure the level of digital transformation by each enterprise. To do so, we identify five business processes of UMSEs which are E-procurement, point of sales (POS), E-marketing, E-commerce, and Digital Payment. These five aspects could potentially be transformed into a digital adoption index. However, some previous studies only employ separate indicators (using dummy variables) to

identify digital adoption. The index, instead, not only identifies whether a firm has adopted but also takes into account the usage dimension to more precisely measure the level of adoption.

2. Literature Review

Digital transformation in business entities has been intensively explored in the academic literature. Santoso et al. (2020) contend that penetration of the internet and smartphones is the most significant driver of digital adoption both from the supply and demand sides. Likewise, Trinugroho et al. (2017), in a survey to measure the readiness level for digital financial services, found that the quality of infrastructure increases the readiness to use digital financial services in Indonesia. From a different angle, scholars from the management and behavioral science field mostly employ the technology acceptance model (TAM) to explain the determinants of digital adoption by individuals or organizations. For instance, in a literature review paper, Kajol et al. (2022) conclude that there are fifteen behavioral factors derived from TAM that motivate the adoption of digital financial transactions as well as digital adoption. Furthermore, the massive digital innovation in finance is also driven by the development of e-commerce which requires support from the financial services sector in several aspects, especially payment transactions. Wirdiyanti et al. (2022) empirically confirm this hypothesis by providing evidence that engagement in e-commerce by micro, small, and medium enterprises could lead to better performance of those firms. Moreover, financial inclusion has also improved following the adoption of e-commerce.

The benefits of digital adoption especially by small businesses have also been highlighted in the literature. For instance, by studying micro and small enterprises (MSEs) in South Africa, Gaglio et al. (2022) find that the use of social media and a business mobile phone for surfing the internet has a positive effect on innovation and that innovation conditional on the use of these technologies has a positive effect on labor productivity. Trinugroho et al. (2022) document that digital adoption, measured by three indicators which are digital payment, point of sales, and online marketing, is positively associated with the performance of small businesses during the COVID-19 pandemic. On the other side, Buck et al. (2023) argue that data security and privacy issue is the most potential dark side of digital adoption.

Moreover, some reveal that digital adoption particularly by micro and small enterprises could enhance the level of financial inclusion. Financial inclusion means all initiatives making formal financial services accessible and affordable, particularly for underprivileged people (Omar and Inaba, 2020) across three aspects which are access, usage, and quality of financial services. Digital adoption by small businesses could help in improving the financial inclusion of micro and small enterprises as mobile digital payments can provide structured information related to daily transactions that are needed in applying for lending. Avom et al. (2023) provide evidence that adoption of mobile money in 50 African countries promotes financial inclusion in a range of 12–14 %. Similarly, at the micro level, using household surveys in China, Yang and Zhang (2022) document that fintech adoption significantly affects household consumption and consumption inequality.

In addition, digital adoption is also associated positively with financial literacy which means that the use of digital platforms could improve the level of individual financial literacy. Using country-level data, Lo Prete (2022) documents that higher financial literacy is correlated with the use of digital payments. Likewise, Yang et al. (2023) provide evidence in China that financial literacy increases the use of digital finance, such as mobile payments, online borrowing, and online financial products.

3. Methodology

Data

To achieve the objectives of this study, a field survey of UMSEs has been conducted, and we obtained 5,035 firms which were reached using either in-person or online surveys. The large number of observations is essential to mitigate the potential sample selection bias. For the regional economic development data, it is gathered from the Statistics Office Bureau.

Multistage sampling is employed in the survey combining quota (province level) and convenience sampling. However, we also consider proportionately balancing the following factors in deciding the observations: 1) business sector, 2) rural/urban, and 3) firm size. The survey covers 17 major provinces in Indonesia, and they cover around 80 percent of the Indonesian economy.

- Sumatera island: North Sumatera, West Sumatera, Riau, Lampung, and South Sumatera;
- Java-Bali island: DKI Jakarta, Banten, West Java, Central Java, DI Yogyakarta, East Java, Bali;
- Kalimatan island: West Kalimantan, East Kalimantan and North Kalimantan;
- Sulawesi island: South Sulawesi and Central Sulawesi.
- The scale of UMSEs is classified based on their revenue in the last financial year and adhering to the latest regulations set by the Indonesian Government, as stipulated in *PP No. 7 Tahun 2021*.[1]

Following Ridhwan et al. (2023), the classification of micro-businesses is divided into four categories: ultra-micro, micro, small, and medium enterprises, as shown in Table 1. Ultra-micro enterprises are defined as those with an annual revenue not exceeding Rp 250 million. Meanwhile, the definition of micro, small, and medium enterprises aligns with current Indonesian regulations.

Table 1 UMSME criteria based on annual revenue

Type of Enterprise	Revenue Criteria (Indonesian Rupiah / Rp)	Reference
Ultra-micro enterprise	Maximum 250 Million	Novelty of this study
Micro enterprise	>250 Million – 2 Billion	Indonesian government law *(PP No.7 Tahun 2021)*
Small enterprise	>2 Billion – 15 Billion	
Medium enterprise	>15 Billion – 50 Billion	

[1] Further details, see, https://jdih.setkab.go.id/PUUdoc/176384/PP_Nomor_7_Tahun_2021.pdf

Digital Adoption Index

We construct an index to measure the digital adoption by UMSEs that range from 0 (not adopted at all) to 1 (fully adopted digital). As explained previously, we identify five business processes of UMSEs which are procurement, recording and bookkeeping, payment, marketing, and sales. These five aspects could potentially be transformed into digital. Thus, we consider the channels through which UMSEs adopt digital technology: e-procurement, point of sales, digital payment, e-marketing, and e-commerce.

Table 2A. Measurement of Digital Adoption Index[2]

No	Sub-Index	Indicator	Measure
1	E-Procurement	Does your business carry out procurement (purchase of goods) online?	Dummy
		Does your business make online payments to suppliers?	Dummy
		Of all your needs for procuring production materials or business inventory, what percentage do you do the procurement online?	Percentage
2	Point of Sales	Do you use a digital cashier/point of sales (POS) application in your business activities?	Dummy
		What features do you use in your digital cashier (POS) application?	Percentage
3	E-Marketing	Do you market your products online?	Dummy
		What social media do you use?	Percentage
		Do you regularly update information about your business products/services on social media?	Dummy
		Have you ever used paid advertising on social media to market your products?	Dummy
		Does your business have a website?	Dummy
		Do you regularly update information about your business products/services on your website?	Dummy
		Of your total marketing costs, what percentage is allocated to online marketing?	Percentage
4	Digital Payment	What digital / non-cash payment alternatives do you provide?	Percentage
		If you provide QRIS, what percentage of payments via QRIS is your total business income?	Percentage
		What percentage of your business income do you receive through digital payments from your total business income?	Percentage
5	E-Commerce	Do you use e-commerce to sell your products?	Dummy
		Please mention the e-commerce used to sell your products	Percentage

[2] We perform Cronbach's Alpha to check the reliability of each sub-index and aggregate index. Results show that the all Cronbach's Alpha scores are higher than 0.6 which mean that our index and sub-indexes are reliable (Malhotra & Dash, 2010).

No	Sub-Index	Indicator	Measure
		What percentage of your total sales are obtained through e-commerce sales?	Percentage

E-procurement is the procurement of goods carried out by micro and small businesses by utilizing technology and online media. Point of sales is the use of an application by UMSEs to support the transaction recording and bookkeeping that could provide the following information: sales, product prices, customer data, inventory as well as income, expenses, and profits. Digital payment is a non-cash payment method. E-marketing is advertising products through online media such as social media and websites. E-commerce is sales through e-commerce platforms.

Previous studies employ dummy variables to identify digital adoption. In this study, our digital adoption index is not only identifying whether a firm has adopted a digital technology but also taking into account the usage dimension to more precisely measure the level of adoption. Table 1 provides the detailed measures (indicators) of our digital adoption index. Each sub-index (e-procurement, point of sales, digital payment, e-marketing, and e-commerce) consists of two dimensions: adoption and usage.

Definition of Variables

As previously mentioned, we conduct several empirical estimations to investigate the determinants of digital adoption as well as to examine the effect of digital adoption on firm performance, financial inclusion, and financial literacy. The following table provides the description and measurement of variables.

Table 2B. Description and Measurements of Variables

Variable	Notation	Indicator	Description	Source
Digital Adoption	DIGI	Digital Adoption Index	An index that is composed of five aspects of digital adoption by UMSEs (online marketing, e-commerce, digital payment, point of sales, and e-procurement). It not only covers whether they adopt those digital channels, but it also takes into account the extent to which the technology is utilized.	Research Survey
Firm Performance	PERF	Sales growth	Annual sales growth (percentage)	Research Survey
Finance Inclusion	INCL	Finance Inclusion Index	An index that consists of 2 aspects including bank account usage and e-payment services provision.	Research Survey
Financial Literacy	LIT	Financial Literacy Index	An index that consists of 7 basic financial problem questions.	Research Survey
Firm-Specific Factors	FIRM	Firm Age	Calculated as (2023 – year when firm	Research Survey

Variable	Notation	Indicator	Description	Source
			established)	
		Sectoral	A set of dummy variables consisting of six sectors: 1. Agriculture 2. Transportation 3. ICT (Information, communication, and technology) 4. Industry 5. Trade 6. Other services	Research Survey
		Firm Size	1. Ultra-micro (1: annual revenue less than IDR250 million, 0: otherwise) 2. Micro (1: annual revenue less than IDR2 billion and more than IDR250 million, 0 :otherwise) 3. Small (1: annual revenue more than IDR2 billion and less than IDR15 billion, 0: otherwise)	Research Survey
		Business License	Dummy variable (1: has license, 0: otherwise)	Research Survey
		Home-based location	Categorical variable equals 2 if the business site is the same as the household residence, 1 otherwise	Research Survey
Owner Demographic Characteristics	OWNR	Age	Calculated as (2023 – year when owner born)	Research Survey
		Education	Scale 1-7: 1. No schooling 2. Elementary school 3. Junior school 4. Senior school 5. Diploma I/III 6. Undergraduate/Diploma IV	Research Survey

Variable	Notation	Indicator	Description	Source
			7. Graduate/Doctoral	
		Gender	A dummy variable (1: male, 0: female)	Research Survey
Business Environment	BUS	Digital Competition	a dummy variable for the availability of online payment for other firms surrounding. 1 means yes, 0 otherwise	Research Survey
		Banking Relationship	A dummy variable (1: borrow money from bank, 0: otherwise)	Research Survey
ICT Infrastructure	INFRA	Smartphone Society	Scale 1-5 (measuring the extent to which society where the UMSEs exist uses smartphone in their activities)	Research Survey
		Technology awareness	Scale 1-5	Research Survey
Culture	CULT	Trust to digital	Scale 1-5 (measuring the extent to which people have trust in digital in general)	Research Survey
Demographic and Community characteristics	DEM	Java	A dummy variable of island (1: Java, 0: non-java)	Research Survey
	ELE	Elevation	The average elevation of districts above the sea surface where SMEs operate	USGS
	NET	Internet user	The average internet user of districts in Indonesia	Susenas

Empirical Methods

To address the research questions, we employ the following models.

1. *Factors affecting digital adoption*

$$Index_i = X_i.\gamma + \theta_k + \theta_l + \varepsilon_i \quad (1)$$

Where y_i represents the dependent variable of each digital index for observation *i*. X_i is a matrix of other owner and MSEs characteristics for observation i, with γ as the vector of coefficients. θ_k and θ_l represent sectoral dummy variables and district characteristics variables for categories *k* and *l*. Lastly ε_i is the error term for observation *i*

2. *Impact of digital adoption on firm performance*

$$SalesGrowth_i = \beta Index_i + X_i.\gamma + \theta_k + \theta_l + \varepsilon_i \quad (2)$$

Where $SalesGrowth_i$ represents the outcome variable for observation *i*, β is the coefficient for the independent variable $Index_i$, which seems to indicate the effect of digitalization on the dependent variable. X_i is a matrix of other owner and MSEs characteristics for observation i, with γ as the vector of coefficients. θ_k and θ_l represent sectoral dummy variables and district characteristics variables for categories *k* and *l*. ε_i is the error term for observation *i*

3. Impact of digital adoption on firm-level financial Literacy

$$FinLit_i = \beta Index_i + X_i.\gamma + \theta_k + \theta_l + \varepsilon_i \quad (3)$$

Where $FintLit_i$ represents the Financial Literacy Index for observation *i*, β is the coefficient for the independent variable $Index_i$, which seems to indicate the effect of digitalization on the dependent variable. X_i is a matrix of other owner and MSEs characteristics for observation i, with γ as the vector of coefficients. θ_k and θ_l represent sectoral dummy variables and district characteristics variables for categories *k* and *l*, then ε_i is the error term for observation *i*.

We are fully aware that there is potential endogeneity in models 2 & 3 as some may argue that higher digital indexes are related to some unobserved variables in the error. Thus, in order to isolate the issue, we employ two-stage least squares (2SLS) to estimate the models. The instrumental variables are digital competition and signal strength for models 2 and 3, respectively. The following is the first-stage equation of our IV estimation:

4. First-stage Instrumental Variable (IV) estimates for predicting digital adoption indexes in business performance outcome

$$Index_i = \beta DigCompetition_i + X_i.\gamma + \theta_k + \theta_l + \varepsilon_i \quad (4)$$

where *DigCompetition* is the availability of online payment for surrounding UMSEs at enterprise *i*.

5. First-stage Instrumental Variable (IV) estimates for predicting digital adoption indexes in financial literacy outcome

$$Index_i = \beta SignalStrenght_i + X_i.\gamma + \theta_k + \theta_l + \varepsilon_i \quad (5)$$

where *Signal Strength* is the signal speed of UMSEs location at enterprise *i*.

4. Results/Analysis

4.1. Descriptive Statistics of Variables

Table 3 presents a comprehensive overview of various economic and demographic characteristics of 5,035 respondents, revealing a modest sales growth among businesses with

an average of around 19%. The digital adoption indexes show varying levels of adoption with E-procurement reaching a relatively higher mean (29.2%) than others and the aggregate index of those five indexes denotes a mean of 20.3%. The data also reflects a mix of both nascent and long-established firms, with a diverse owner demographic in terms of age, education, and gender. There is also a substantial use of smartphones and the internet, suggesting people are well-intertwined with the technology. Many of the respondents are located on Java Island, a place known for its tech-savvy development.

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Sales Growth	5,035	0.193	0.152	0.000	1.000
Fin Literacy Index	5,035	0.719	0.202	0.000	1.000
Fin Inclusion Index	5,035	0.741	0.314	0.000	1.000
Aggregate Index	5,035	0.203	0.176	0.000	0.824
Index E-commerce	5,035	0.162	0.254	0.000	0.944
Index E-Procurement	5,035	0.292	0.371	0.000	1.000
Index POS	5,035	0.100	0.257	0.000	1.000
Index Digital Payment	5,035	0.203	0.175	0.000	0.889
Index E-Marketing	5,035	0.260	0.202	0.000	0.964
Firm Age	5,035	6.810	5.837	0.000	75.000
Business License	5,035	0.384	0.486	0.000	1.000
Home Based Location	5,035	0.353	0.478	0.000	1.000
Owners Age	5,035	34.725	11.715	16.000	87.000
Dummy Male	5,035	0.373	0.484	0.000	1.000
Education	5,035	4.606	1.080	1.000	7.000
Digital Competition	5,035	0.702	0.457	0.000	1.000
Banking Relationship	5,035	0.171	0.376	0.000	1.000
Internet Connectivity	5,035	3.906	0.673	1.000	5.000
Smartphone Society	5,035	0.952	0.215	0.000	1.000
Technology Awareness	5,035	0.796	0.164	0.200	1.000
Trust to Digital	5,035	0.760	0.121	0.200	1.000
Internet Use	5,017	0.667	0.094	0.305	0.840
Elevation	5,034	271.970	252.054	1.014	1509.357
Log Sales	5,035	7.971	0.495	6.556	10.079
Log GDP	5,035	4.783	0.206	4.569	5.475
Dummy Java (the rest of regions = 0)	5,035	0.773	0.419	0.000	1.000

As mentioned before, we group each UMSE based on its revenue. Ultra-micro belongs to businesses having less than IDR250 million. Micro businesses are businesses gaining between IDR250 million and IDR2 billion. Subsequently, we classify businesses with revenue between IDR2 billion and IDR15 billion as small-scale businesses.

Figure 1 depicts the survey result on the digital adoption index by firm type. There is a noticeable trend that bigger businesses scale seem to utilize digital adoption indexes more than their cohorts It indicates a bigger businesses are more engaged and integrated with digital business practices than their smaller counterparts. The lower index of ultra-micro businesses could be a signal of the importance of more support in their digital adoption process.

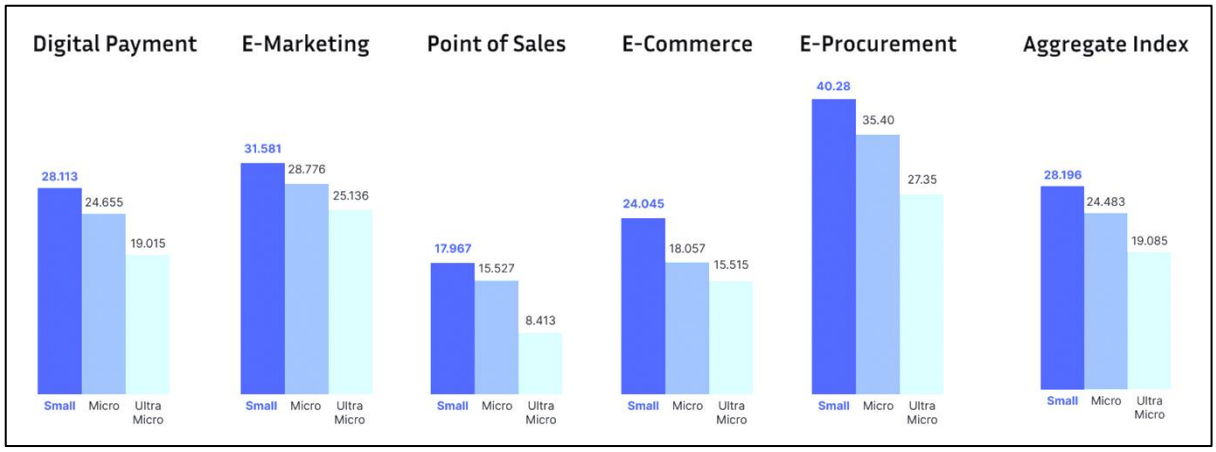


Figure 1. Average digital adoption index by company scale

If we look deeper into the average index by each sector, we find that health, education, and other services score the highest average index by 24.05 (Figure 2). This sector might be more robust in terms of the measured criteria, possibly driven by high levels of digital transformation and innovation in this sector. On the other side, agriculture, livestock, forestry, and fishery have the lowest score of 13.86, suggesting that these primary industries may be facing challenges that hinder their performance of development. Nevertheless, each sector's index could be influenced by a range of factors, including market demand, regulatory environments, and investments in technology[3].

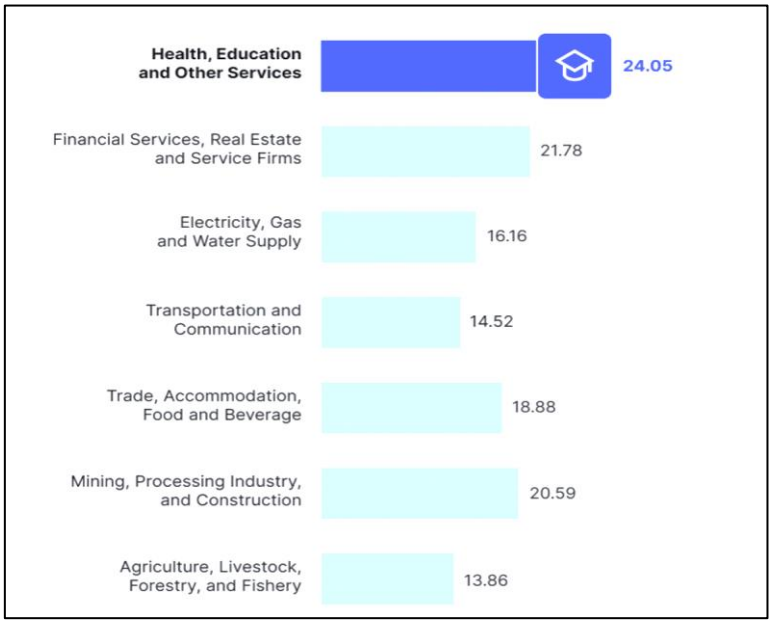


Figure 2. Average index by sectors

[3] For the rest of the descriptive analysis, please click a link as follows: https://rb.gy/vmcbir

4.2. Empirical Results

As explained earlier, our study is dedicated to empirically investigating the determinants of digital adoption by UMSEs in Indonesia. Moreover, we also test the effect of digital adoption on firm performance, financial inclusion, and financial literacy. To examine the determinants of digital adoption, we include several aspects including firm-specific factors, owner demographic characteristics, business environment, quality of ICT infrastructure, and culture that potentially determine digital adoption by micro and small enterprises. Our dependent variable in the first empirical model is digital adoption which has been explained in the previous section. We use sales growth as the proxy of firm performance. For financial inclusion and financial literacy, we build indexes to measure these two explained variables.

Table 4 presents the regression results of factors affecting digital adoption based on Equation 1. In Table 5, we provide the empirical results on the effect of digital adoption on firm performance (sales growth). Table 6 exhibits the more robust regression results on the effect of digital adoption on firm performance by instrumenting the index with the digital competition variable. Tables 7 and 8 are regression results on the effect of digital adoption on financial literacy with signal strength as the instrumental variable.

Table 4. Factors Affecting Digital Adoption Index

	(1) Aggregate Index	(2) Index E-commerce	(3) Index EProcurement	(4) Index POS	(5) Index Digital Payment	(6) Index EMarketing
Firm Age	-0.00191***	-0.00141*	-0.00373***	-0.000885	-0.000614	-0.00290***
	(-4.83)	(-2.22)	(-4.14)	(-1.31)	(-1.50)	(-6.38)
Business License	0.0114*	-0.00740	0.0210*	0.0256**	-0.00977*	0.0275***
	(2.48)	(-1.00)	(2.00)	(3.27)	(-2.06)	(5.21)
Home Based Location	0.0255***	0.0210**	0.0244*	0.0450***	0.0236***	0.0134**
	(5.70)	(2.92)	(2.39)	(5.90)	(5.11)	(2.61)
Owners Age	-0.00212***	-0.00273***	-0.00247***	-0.00183***	-0.00165***	-0.00194***
	(-10.69)	(-8.56)	(-5.45)	(-5.40)	(-8.03)	(-8.47)
Dummy Male	-0.0164***	-0.0275***	-0.0405***	0.0226**	-0.0132**	-0.0235***
	(-3.75)	(-3.91)	(-4.05)	(3.02)	(-2.92)	(-4.66)
Education	0.0199***	0.0232***	0.0269***	0.0170***	0.0148***	0.0175***
	(9.87)	(7.18)	(5.86)	(4.94)	(7.12)	(7.54)
Digital Competition	0.130***	0.141***	0.197***	0.0354***	0.137***	0.138***
	(26.44)	(17.88)	(17.64)	(4.24)	(27.01)	(24.43)
Banking Relationship	0.0196***	0.00629	0.0284*	0.0436***	0.0125*	0.00726
	(3.44)	(0.69)	(2.18)	(4.48)	(2.11)	(1.11)
Smartphone Society	0.0248*	0.0345*	0.0322	0.00964	0.00731	0.0403***
	(2.52)	(2.18)	(1.43)	(0.57)	(0.72)	(3.56)
Technology Awareness	0.103***	0.0433*	0.204***	0.0909***	0.108***	0.0694***
	(7.66)	(2.00)	(6.64)	(3.97)	(7.76)	(4.49)
Trust to Digital	0.169***	0.0186	0.320***	0.0770*	0.142***	0.288***
	(9.35)	(0.64)	(7.76)	(2.50)	(7.59)	(13.85)
_cons	-0.171***	-0.0406	-0.357***	-0.166***	-0.118***	-0.172***
	(-7.56)	(-1.12)	(-6.94)	(-4.32)	(-5.04)	(-6.61)
Industry	YES	YES	YES	YES	YES	YES
N	5035	5035	5035	5035	5035	5035

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As presented in Table 4, we find that the business environment which is measured by competitive pressure is positively associated with digital adoption. Moreover, technological awareness and trust in digital significantly and positively affect digital adoption. Moreover, digital adoption by UMSEs is higher in a society where the smartphone has been widely

utilized. Furthermore, UMSEs having relationships with commercial banks are more likely to adopt digital technology.

Moreover, owner demographic characteristics matter in explaining the disparity in the use of digital technologies, in particular elders are less likely to exploit digital technologies for their business. It is also found that digital technology is more likely adopted by more educated owners. Moreover, digital technologies are more utilized by UMSEs in which the owners are women.

Turning to firm-specific factors, we find that older firms are negatively associated with the digital adoption aspect except for the point of sales and digital payment. The separation of business and owner house has a positive and significant effect on all digital adoption aspects. Similarly, having a business license could increase digital adoption by UMSEs.

Table 5. Digital Adoption and Business Performance (Sales Growth)

	(1) Sales growth	(2) Sales growth	(3) Sales growth	(4) Sales growth	(5) Sales growth	(6) Sales growth
Aggregate Index	0.137***					
	(0.0133)					
Index E-Commerce		0.0336***				
		(0.00867)				
Index E-Procurement			0.0572***			
			(0.00603)			
Index POS				0.00930		
				(0.00840)		
Index Digital Payment					0.150***	
					(0.0128)	
Index E-Marketing						0.107***
						(0.0113)
Transportaion	1.129	1.425	1.459	1.383	1.188	1.376
	(1.077)	(1.087)	(1.079)	(1.091)	(1.074)	(1.079)
ICT	-4.417*	-4.278*	-4.384*	-4.415*	-4.990**	-4.014
	(2.501)	(2.524)	(2.505)	(2.528)	(2.494)	(2.506)
Industry	1.694	2.115*	2.026*	2.195*	2.064*	1.472
	(1.150)	(1.160)	(1.151)	(1.161)	(1.146)	(1.154)
Trade	-0.941	-0.472	-0.888	-0.328	-0.692	-0.446
	(1.114)	(1.123)	(1.116)	(1.124)	(1.109)	(1.114)
Other Services	2.774**	3.601***	2.822***	3.649***	3.108***	3.068***
	(1.080)	(1.086)	(1.082)	(1.088)	(1.074)	(1.080)
Elementary school	6.349	6.966	6.639	7.043	6.260	6.470
	(4.651)	(4.693)	(4.659)	(4.700)	(4.638)	(4.660)
Junior high school	3.021	3.447	3.191	3.513	2.920	3.067
	(4.518)	(4.559)	(4.526)	(4.565)	(4.505)	(4.527)
Senior high school	3.810	4.594	4.224	4.755	3.760	3.769
	(4.441)	(4.481)	(4.448)	(4.487)	(4.428)	(4.449)
Diploma 1/III	3.181	4.356	3.788	4.642	3.096	3.381
	(4.485)	(4.525)	(4.491)	(4.530)	(4.472)	(4.493)
Undergraduate	2.239	3.517	2.920	3.821	2.255	2.367
	(4.455)	(4.494)	(4.461)	(4.500)	(4.442)	(4.464)
Graduate/Doctoral	1.567	3.092	2.552	3.521	1.929	1.870
	(4.686)	(4.727)	(4.691)	(4.732)	(4.670)	(4.694)
Java	-2.522***	-2.210***	-2.356***	-2.065***	-2.536***	-2.139***
	(0.512)	(0.517)	(0.512)	(0.516)	(0.511)	(0.511)
Male	-0.793*	-1.044**	-0.817*	-1.183***	-0.796*	-0.794*
	(0.437)	(0.441)	(0.438)	(0.441)	(0.435)	(0.438)
Owner age	0.0295	-0.00280	0.00816	-0.0118	0.0280	0.0196
	(0.0207)	(0.0207)	(0.0205)	(0.0206)	(0.0206)	(0.0207)
Firm age	-0.0711*	-0.105***	-0.0804**	-0.113***	-0.0865**	-0.0694*
	(0.0396)	(0.0398)	(0.0396)	(0.0398)	(0.0393)	(0.0397)
Business license	-2.643***	-2.657***	-2.482***	-2.621***	-2.389***	-2.843***
	(0.519)	(0.524)	(0.520)	(0.525)	(0.518)	(0.521)
Legal permit	6.187***	6.935***	6.106***	6.989***	6.284***	6.393***
	(0.685)	(0.687)	(0.688)	(0.688)	(0.682)	(0.685)
Ultra micro	-5.165***	-7.145***	-6.125***	-7.397***	-4.952***	-6.113***
	(1.503)	(1.503)	(1.496)	(1.509)	(1.498)	(1.496)
Micro	-4.611***	-5.419***	-5.034***	-5.595***	-4.588***	-5.017***

	(1.400)	(1.411)	(1.401)	(1.413)	(1.395)	(1.401)
Sales (log)	0.434*	0.0672	0.275	0.0514	0.443*	0.331
	(0.252)	(0.251)	(0.250)	(0.253)	(0.250)	(0.251)
Elevation	0.000735	0.000743	0.000664	0.000717	0.000540	0.000658
	(0.000909)	(0.000917)	(0.000910)	(0.000918)	(0.000906)	(0.000910)
Internet use	-2.653	-0.465	-0.937	0.504	-3.065	-1.204
	(2.490)	(2.509)	(2.479)	(2.499)	(2.483)	(2.482)
_cons	13.55**	21.33***	16.80**	21.65***	13.19*	14.84**
	(6.833)	(6.847)	(6.817)	(6.874)	(6.805)	(6.839)
R-squared	0.645	0.638	0.643	0.637	0.647	0.643
Number of Observation	5,016	5,016	5,016	5,016	5,016	5,016

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Next, we investigate the impact of digital adoption on firm performance measured by sales growth in Table 5. Our empirical results exhibit that the aggregate digital adoption is positively associated with sales growth which means that the wider the adoption, the higher the performance. If we look at the details, the adoption of e-procurement, digital payment, e-marketing, and e-commerce has a positive correlation with firm performance. Only the adoption of point of sales does not correlate with sales growth.

Table 6. Digital Adoption and Sales Growth (IV: Digital Competition)

	(1)	(2)	(3)	(4)	(5)	(6)
	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth
Aggregate Index	0.115***					
	(0.0353)					
Index E-Commerce		0.113***				
		(0.0356)				
Index E-Procurement			0.0750***			
			(0.0232)			
Index POS				0.396***		
				(0.147)		
Index Digital Payment					0.111***	
					(0.0342)	
Index E-Marketing						0.0999***
						(0.0308)
Transportaion	1.203	1.361	1.471	-1.778	1.273	1.397
	(1.080)	(1.096)	(1.080)	(1.768)	(1.076)	(1.079)
ICT	-4.517*	-4.150	-4.457*	-6.273**	-4.913**	-4.120
	(2.501)	(2.544)	(2.506)	(3.103)	(2.501)	(2.505)
Industry	1.813	1.864	1.982*	0.689	2.131*	1.543
	(1.156)	(1.174)	(1.154)	(1.498)	(1.147)	(1.169)
Trade	-0.890	-0.959	-1.111	-2.019	-0.632	-0.481
	(1.128)	(1.152)	(1.145)	(1.492)	(1.115)	(1.115)
Other Services	2.910***	3.345***	2.536**	1.439	3.248***	3.093***
	(1.104)	(1.101)	(1.138)	(1.549)	(1.083)	(1.095)
Elementary school	6.757	7.004	6.696	6.546	6.692	6.734
	(4.646)	(4.726)	(4.656)	(5.606)	(4.635)	(4.653)
Junior high school	3.270	3.433	3.197	3.494	3.203	3.225
	(4.518)	(4.596)	(4.528)	(5.450)	(4.507)	(4.525)
Senior high school	3.991	4.151	4.061	3.466	4.040	3.846
	(4.448)	(4.523)	(4.457)	(5.381)	(4.437)	(4.458)
Diploma 1/III	3.485	3.597	3.539	2.503	3.550	3.503
	(4.499)	(4.575)	(4.508)	(5.470)	(4.487)	(4.506)
Undergraduate	2.522	2.648	2.626	1.168	2.684	2.468
	(4.474)	(4.548)	(4.481)	(5.468)	(4.459)	(4.482)
Graduate/Doctoral	2.008	1.907	2.281	-0.825	2.445	2.056
	(4.708)	(4.793)	(4.710)	(5.882)	(4.685)	(4.714)
Java	-2.499***	-2.680***	-2.494***	-3.345***	-2.452***	-2.178***
	(0.530)	(0.559)	(0.531)	(0.790)	(0.525)	(0.512)
Male	-0.840*	-0.742	-0.699	-1.919***	-0.880**	-0.805*
	(0.448)	(0.463)	(0.460)	(0.594)	(0.444)	(0.451)
Owner age	-0.0637	-0.0687*	-0.0600	-0.0116	-0.0825**	-0.0607
	(0.0414)	(0.0414)	(0.0420)	(0.0610)	(0.0390)	(0.0419)
Firm age	-2.594***	-2.723***	-2.414***	-2.951***	-2.413***	-2.795***
	(0.518)	(0.528)	(0.524)	(0.636)	(0.521)	(0.521)
Business license	6.338***	6.793***	5.837***	6.476***	6.482***	6.443***
	(0.710)	(0.696)	(0.770)	(0.844)	(0.697)	(0.703)

Legal permit	-5.640***	-6.218***	-5.726***	-0.539	-5.687***	-6.262***
	(1.593)	(1.564)	(1.588)	(3.153)	(1.584)	(1.537)
Ultra micro	-4.789***	-4.851***	-4.842***	-2.937	-4.868***	-5.060***
	(1.423)	(1.444)	(1.423)	(1.966)	(1.415)	(1.411)
Micro	0.347	0.161	0.342	1.316**	0.319	0.297
	(0.266)	(0.256)	(0.267)	(0.564)	(0.263)	(0.262)
Sales (log)	0.000733	0.000856	0.000657	0.00152	0.000584	0.000664
	(0.000909)	(0.000926)	(0.000911)	(0.00114)	(0.000907)	(0.000910)
Elevation	-2.090	-3.133	-1.427	-5.960	-2.092	-1.080
	(2.611)	(2.780)	(2.558)	(3.864)	(2.605)	(2.531)
Internet use	16.00**	20.26***	15.78**	0.836	16.30**	16.09**
	(6.941)	(6.852)	(6.973)	(11.20)	(6.902)	(6.944)
R-squared	0.644	0.632	0.643	0.482	0.646	0.643
Number of Observation	5,016	5,016	5,016	5,016	5,016	5,016

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 6, we continue to analyze the impact of digital adoption on business performance by using digital competition that is the availability of online payment for surrounding firms as the instrumental variable. And, the result constantly provides evidence that digital adoption both aggregate adoption and all sub-indexes is associated with higher sales growth of the UMSEs. This result tends to confirm findings from several previous studies e.g. Falentina et al. (2022).

Table 7. OLS – Digital Adoption and Financial Literacy

	(1)	(2)	(3)	(4)	(5)	(6)
	FinLitIndex	FinLitIndex	FinLitIndex	FinLitIndex	FinLitIndex	FinLitIndex
Aggregate Index	0.000654***					
	(0.000174)					
Index E-Commerce		0.000365***				
		(0.000113)				
Index E-Procurement			0.0000447			
			(0.0000793)			
Index POS				0.000334***		
				(0.000109)		
Index Digital Payment					0.000885***	
					(0.000169)	
Index E-Marketing						0.000285*
						(0.000149)
Transportation	-0.0190	-0.0178	-0.0174	-0.0202	-0.0190	-0.0176
	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0141)	(0.0142)
ICT	0.0799**	0.0812**	0.0801**	0.0789**	0.0765**	0.0811**
	(0.0329)	(0.0329)	(0.0329)	(0.0329)	(0.0329)	(0.0329)
Industry	-0.0449***	-0.0437***	-0.0425***	-0.0438***	-0.0434***	-0.0444***
	(0.0151)	(0.0151)	(0.0151)	(0.0151)	(0.0151)	(0.0152)
Trade	0.0229	0.0240	0.0255*	0.0247*	0.0236	0.0256*
	(0.0147)	(0.0146)	(0.0147)	(0.0146)	(0.0146)	(0.0146)
Other Services	-0.0815***	-0.0782***	-0.0778***	-0.0790***	-0.0806***	-0.0788***
	(0.0142)	(0.0142)	(0.0142)	(0.0142)	(0.0141)	(0.0142)
Elementary school	-0.0233	-0.0211	-0.0202	-0.0213	-0.0247	-0.0215
	(0.0612)	(0.0612)	(0.0613)	(0.0612)	(0.0611)	(0.0612)
Junior high school	-0.0267	-0.0252	-0.0245	-0.0249	-0.0279	-0.0255
	(0.0594)	(0.0594)	(0.0595)	(0.0595)	(0.0593)	(0.0595)
Senior high school	-0.000817	0.00172	0.00340	0.00266	-0.00222	0.00111
	(0.0584)	(0.0584)	(0.0585)	(0.0584)	(0.0583)	(0.0585)

Diploma 1/III	0.0268	0.0303	0.0333	0.0320	0.0246	0.0305
	(0.0590)	(0.0590)	(0.0591)	(0.0590)	(0.0589)	(0.0590)
Undergraduate	0.0213	0.0252	0.0284	0.0269	0.0196	0.0251
	(0.0586)	(0.0586)	(0.0587)	(0.0586)	(0.0585)	(0.0587)
Graduate/Doctoral	0.0414	0.0453	0.0504	0.0471	0.0412	0.0465
	(0.0616)	(0.0616)	(0.0617)	(0.0616)	(0.0615)	(0.0617)
Java	0.0341***	0.0345***	0.0361***	0.0354***	0.0334***	0.0361***
	(0.00674)	(0.00674)	(0.00674)	(0.00672)	(0.00673)	(0.00672)
Male	-0.00323	-0.00369	-0.00473	-0.00568	-0.00283	-0.00401
	(0.00575)	(0.00575)	(0.00576)	(0.00574)	(0.00574)	(0.00576)
Owner age	-0.00196***	-0.00205***	-0.00215***	-0.00208***	-0.00192***	-0.00208***
	(0.000273)	(0.000270)	(0.000269)	(0.000269)	(0.000271)	(0.000271)
Firm age	0.00144***	0.00133**	0.00126**	0.00127**	0.00140***	0.00135***
	(0.000520)	(0.000519)	(0.000520)	(0.000518)	(0.000518)	(0.000522)
Business license	0.0403***	0.0399***	0.0405***	0.0400***	0.0417***	0.0398***
	(0.00683)	(0.00684)	(0.00684)	(0.00684)	(0.00683)	(0.00685)
Legal permit	-0.0467***	-0.0436***	-0.0436***	-0.0434***	-0.0471***	-0.0445***
	(0.00901)	(0.00896)	(0.00905)	(0.00896)	(0.00898)	(0.00900)
Ultra micro	0.0716***	0.0647***	0.0612***	0.0663***	0.0755***	0.0640***
	(0.0198)	(0.0196)	(0.0197)	(0.0196)	(0.0197)	(0.0197)
Micro	0.0759***	0.0735***	0.0714***	0.0732***	0.0772***	0.0726***
	(0.0184)	(0.0184)	(0.0184)	(0.0184)	(0.0184)	(0.0184)
Sales (log)	0.00649**	0.00504	0.00471	0.00567*	0.00701**	0.00535
	(0.00331)	(0.00327)	(0.00329)	(0.00329)	(0.00330)	(0.00330)
Elevation	0.0000263**	0.0000266**	0.0000261**	0.0000268**	0.0000252**	0.0000260**
	(0.0000119)	(0.0000120)	(0.0000120)	(0.0000120)	(0.0000119)	(0.0000120)
Internet use	0.0594*	0.0630*	0.0740**	0.0696**	0.0533	0.0702**
	(0.0327)	(0.0327)	(0.0326)	(0.0325)	(0.0327)	(0.0326)
_cons	0.539***	0.571***	0.576***	0.559***	0.527***	0.561***
	(0.0899)	(0.0893)	(0.0896)	(0.0895)	(0.0896)	(0.0899)
R-squared	0.934	0.934	0.934	0.934	0.934	0.934
Number of Observation	5,016	5,016	5,016	5,016	5,016	5,016

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To answer the final research question, we also estimate the impact of digital adoption on the level of financial literacy of UMSEs' owners. Subsequently, we employ 2SLS estimations (Table 8) using signal strength as an instrumental variable, and this method is basically to tackle potential bias from the endogeneity issue of business performance and financial aspect. Our results show that digital adoption is positive and significantly associated with financial literacy, suggesting that digital adoption increases among UMSEs correspond to the increase in their financial knowledge as well. In turn, this will boost their business productivity as a whole.

Table 8. 2SLS – Digital Adoption and Financial Literacy (IV: Signal Strength)

	(1) FinLiteracyIndex	(2) FinLiteracyIndex	(3) FinLiteracyIndex	(4) FinLiteracyIndex	(5) FinLiteracyIndex	(6) FinLiteracyIndex
Aggregate Index	0.007***					
	(0.00220)					
Index E-Commerce		0.007***				
		(0.00258)				
Index E-Procurement			0.0182			
			(0.0153)			
Index POS				0.007***		
				(0.00236)		
Index Digital Payment					0.006***	
					(0.00175)	
Index E-Marketing						0.006***

						(0.001)
Transportation	-0.036**	-0.025	-0.018	-0.077***	-0.029*	-0.0222
	(0.0172)	(0.0194)	(0.0481)	(0.0274)	(0.0159)	(0.0162)
ICT	0.0780**	0.104**	0.0789	0.0534	0.0539	0.101***
	(0.0380)	(0.0454)	(0.112)	(0.0448)	(0.0369)	(0.0379)
Industry	-0.0729***	-0.0698***	-0.109	-0.0725***	-0.0497***	-0.0855***
	(0.0195)	(0.0225)	(0.0755)	(0.0225)	(0.0168)	(0.0210)
Trade	-0.0107	-0.0152	-0.164	-0.00122	0.00884	0.0173
	(0.0198)	(0.0242)	(0.166)	(0.0215)	(0.0168)	(0.0168)
Other Services	-0.129***	-0.1000***	-0.357	-0.117***	-0.103***	-0.113***
	(0.0221)	(0.0207)	(0.239)	(0.0230)	(0.0170)	(0.0190)
Elementary school	-0.0612	-0.0466	-0.161	-0.0503	-0.0551	-0.0545
	(0.0715)	(0.0836)	(0.239)	(0.0823)	(0.0681)	(0.0704)
Junior high school	-0.0530	-0.0431	-0.132	-0.0369	-0.0504	-0.0504
	(0.0690)	(0.0810)	(0.221)	(0.0795)	(0.0658)	(0.0681)
Senior high school	-0.0514	-0.0409	-0.176	-0.0215	-0.0403	-0.0539
	(0.0692)	(0.0807)	(0.249)	(0.0784)	(0.0654)	(0.0685)
Diploma 1/III	-0.0516	-0.0448	-0.256	-0.00948	-0.0347	-0.0405
	(0.0722)	(0.0843)	(0.315)	(0.0800)	(0.0676)	(0.0704)
Undergraduate	-0.0638	-0.0557	-0.279	-0.0207	-0.0408	-0.0568
	(0.0725)	(0.0845)	(0.325)	(0.0799)	(0.0672)	(0.0710)
Graduate/Doctoral	-0.0655	-0.0736	-0.294	-0.0367	-0.0220	-0.0486
	(0.0784)	(0.0935)	(0.356)	(0.0872)	(0.0707)	(0.0756)
Java	0.00914	-0.00286	-0.0645	0.0169	0.0151	0.0308***
	(0.0109)	(0.0160)	(0.0873)	(0.0110)	(0.00938)	(0.00781)
Male	0.0160*	0.0227*	0.106	-0.0198**	0.0108	0.0159*
	(0.00890)	(0.0121)	(0.0945)	(0.00906)	(0.00763)	(0.00879)
Owner age	0.000303	0.000468	0.00498	-0.000296	-0.000356	-0.000251
	(0.000767)	(0.000954)	(0.00605)	(0.000712)	(0.000573)	(0.000619)
Firm age	0.00366***	0.00323***	0.0120	0.00203***	0.00242***	0.00376***
	(0.00911)	(0.000969)	(0.00915)	(0.000739)	(0.000654)	(0.000923)
Business license	0.0385***	0.0295***	0.0808**	0.0311***	0.0499***	0.0272***
	(0.00790)	(0.00998)	(0.0409)	(0.00962)	(0.00795)	(0.00863)
Legal permit	-0.0889***	-0.0583***	-0.329	-0.0535***	-0.0737***	-0.0774***
	(0.0167)	(0.0132)	(0.241)	(0.0125)	(0.0129)	(0.0141)
Ultra micro	0.196***	0.158***	0.521	0.193***	0.172***	0.143***
	(0.0447)	(0.0421)	(0.391)	(0.0509)	(0.0373)	(0.0321)
Micro	0.130***	0.126***	0.270	0.121***	0.117***	0.107***
	(0.0270)	(0.0311)	(0.178)	(0.0295)	(0.0238)	(0.0233)
Sales (log)	0.0279***	0.0156***	0.0861	0.0293***	0.0227***	0.0222***
	(0.00765)	(0.00578)	(0.0691)	(0.00925)	(0.00610)	(0.00619)
Elevation	0.0282**	0.0365**	0.0154	0.0407**	0.0193	0.0238*
	(0.0138)	(0.0166)	(0.0415)	(0.0167)	(0.0133)	(0.0136)
Internet use	-0.112*	-0.184*	-0.434	-0.0456	-0.0847	-0.0304
	(0.0650)	(0.0973)	(0.440)	(0.0588)	(0.0562)	(0.0474)
_cons	0.0897	0.370***	-1.157	0.120	0.192	0.162
	(0.173)	(0.140)	(1.484)	(0.193)	(0.144)	(0.155)
R-squared	0.912	0.878	0.237	0.882	0.920	0.914
Number of Observation	5,016	5,016	5,016	5,016	5,016	5,016

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Policy Recommendation

Several policy implications could be provided according to our results. We provide strong evidence that digital adoption is beneficial for MSEs in improving their performance. Digital adoption has also been found to contribute to enhancing the financial inclusion of UMSEs and the financial literacy of the owners of UMSEs. However, the level of digital adoption of MSEs in Indonesia is still relatively lower. It has also been found that UMSEs may have adopted some digital technologies, however, the usage of that digital technology is

relatively lower. Therefore, encouraging, assisting, and facilitating UMSEs to digitally transform their business processes should be intensively and continuously conducted by governmental organizations, financial services providers, non-governmental organizations, the academic community, and other stakeholders. Our results also document that technology awareness and trust in digital are important factors in digital adoption by UMSEs in Indonesia. Therefore, improving digital literacy should be massively done. Most of the UMSEs in Indonesia do not have legal entities and business permits. Moreover, most of them do not separate their account from the owner's account. Those factors are found to have a significant effect on digital adoption. Therefore, more flexible regulations on legal entities and business permits should be applied for UMSEs.

6. Conclusion

In this paper, we examine the digital adoption by ultra-micro, micro, and small enterprises in Indonesia employing a survey of 5,035 UMSEs in 17 major provinces. We build an index to measure the digital adoption index by identifying business processes of UMSEs that potentially could be transformed with digital technology. Thus, we consider the channels through which UMSEs adopt digital technology: e-procurement, point of sales, digital payment, e-marketing, and e-commerce. Moreover, this digital adoption index not only identifies whether a firm has adopted a digital technology but also takes into account the usage dimension to more precisely measure the level of adoption. The average digital adoption index is 20.33 out of 100. E-procurement has the highest level of adoption, while, point of sales is the lowest one. There is a significant gap in the digital adoption between UMSEs in Java Island and outside Java Islands. Moreover, digital adoption by small enterprises is higher than adoption by ultra-micro and micro enterprises.

Having the digital adoption index enables us to investigate the determining factors explaining the disparity in digital adoption by UMSEs in Indonesia. Our results reveal that several aspects including firm-specific factors, owner demographic characteristics, business environment, ICT infrastructure quality, and culture matter in explaining the disparity in digital adoption by UMSEs. Going deeper, we also find evidence that digital adoption significantly improves the performance of UMSEs. Lastly, digital adoption contributes to enhancing the level of financial literacy.

References

Avom, D., Bangaké, C., & Ndoya, H. (2023). Do financial innovations improve financial inclusion? Evidence from mobile money adoption in Africa. *Technological Forecasting and Social Change*, *190*. https://doi.org/10.1016/j.techfore.2023.122451

Buck, C., Clarke, J., de Oliveira, R.T., Desouzaa, K., Maroufkhani, P. (2023). Digital transformation in asset-intensive organisations: The light and the dark side. *Journal of Innovation & Knowledge* 8,100335.

Falentina, A.T., Resosudarmo, B.P., Darmawan, D., Sulistyaningrum, E. 2021. Digitalisation and the performance of micro and small enterprises in Yogyakarta, Indonesia. *Bulletin of Indonesian Economic Studies*, 57(3), 343–369.

Gaglio, C., Kraemer-Mbula, E., & Lorenz, E. (2022). The effects of digital transformation on innovation and productivity: Firm-level evidence of South African manufacturing micro and small enterprises. *Technological Forecasting and Social Change*, *182*. https://doi.org/10.1016/j.techfore.2022.121785

Lo Prete, A. 2022. Digital and financial literacy as determinants of digital payments and personal finance. *Economics Letters* 213, 110378.

Kajol, K., Singh, R., & Paul, J. (2022). Adoption of digital financial transactions: A review of literature and future research agenda. *Technological Forecasting and Social Change*, *184*. https://doi.org/10.1016/j.techfore.2022.121991

Kusumawardhani, N., Pramana, R., Saputri, N.S., Suryadarma, D. 2023. Heterogeneous impact of internet availability on female labor market outcomes in an emerging economy: Evidence from Indonesia. *World Development* 164, 106182.

Malhotra, N. K., & Dash, S. J. M. R. (2010). *Marketing research: an applied orientation*. Pearson.

Mead, D. C., & Liedholm, C. (1998). The dynamics of micro and small enterprises in developing countries. *World development*, *26*(1), 61-74.

Resosudarmo, B.P., Sugiyanto C., Kuncoro, A. 2012. Livelihood Recovery after Natural Disasters and the Role of Aid: The Case of the 2006 Yogyakarta Earthquake. *Asian Economic Journal* 26 (3): 233–59.

Räisänen, J., Tuovinen, T. 2020. Digital innovations in rural micro-enterprises. *Journal of Rural Studies* 73, 56–67

Ridhwan, M. M., Suryahadi, Ismail, A., & Hidayat, A.A. (2023). The Dynamics of Digitalization of Ultra-Micro, Micro, Small, and Medium Enterprises During COVID-19 Pandemic and Recovery Periods:
Evidence from Indonesia. Bank Indonesia Working Paper (*forthcoming*).

Skare, M., de Obesso, M. D. L. M., & Ribeiro-Navarrete, S. (2023). Digital transformation and European small and medium enterprises (SMEs): A comparative study using digital economy and society index data. *International Journal of Information Management*, 68, 102594.

Santoso, W., Trinugroho, I., Risfandy, T. 2020. What Determine Loan Rate and Default Status in Financial Technology Online Direct Lending? Evidence from Indonesia. *Emerging Markets Finance and Trade* 56(2), 351-369.

Sánchez-Rodríguez, C., Martínez-Lorente, A. R., & Hemsworth, D. (2020). E-procurement in small and medium sized enterprises; facilitators, obstacles and effect on performance. *Benchmarking: An International Journal*, 27(2), 839-866.

Trinugroho, I., Sawitri, H.S.R., Toro, M.J.S, Khoiriyah, S., Santoso, A.B. 2017. How ready are people for cashless society. *Jurnal Keuangan dan Perbankan*, 21(1): 105–112.

Trinugroho, I, Pamungkas, P., Wiwoho, J., Damayanti, S.M., Pramono, T. 2022. Adoption of digital technologies for micro and small business in Indonesia. *Finance Research Letters* 45, 102156.

Wirdiyanti, R., Yusgiantoro, I., Sugiarto, A., Harjanti, A. D., Mambea, I. Y., Soekarno, S., & Damayanti, S. M. (2022). How does e-commerce adoption impact micro, small, and medium enterprises' performance and financial inclusion? Evidence from Indonesia. *Electronic Commerce Research*, 1-31.

Yang, L., Zou, H., Shang, C., Ye, X., & Rani, P. (2023). Adoption of information and digital technologies for sustainable smart manufacturing systems for industry 4.0 in small, medium, and micro enterprises (SMMEs). *Technological Forecasting and Social Change*, *188*. https://doi.org/10.1016/j.techfore.2022.122308

Yang, T., & Zhang, X. (2022). FinTech adoption and financial inclusion: Evidence from household consumption in China. *Journal of Banking and Finance*, *145*. https://doi.org/10.1016/j.jbankfin.2022.106668

Yang, J., Wu, Y., Huang, B. 2023. Digital finance and financial literacy: Evidence from Chinese households. *Journal of Banking and Finance* 156, 107005.

Appendix.

Table 1. Correlation Matrix

	Aggregate Index	Index Ecommerce	Index EProcurement	Index POS	Index Digital Payment	Index EMarketing	Fin. Literacy Index	Fin. Inclusion Index	Sales Growth	Firm Age	Business License
Aggregate Index	1.000										
Index Ecommerce	0.705	1.000									
Index EProcurement	0.799	0.408	1.000								
Index POS	0.524	0.197	0.184	1.000							
Index Digital Payment	0.732	0.462	0.489	0.267	1.000						
Index EMarketing	0.709	0.416	0.479	0.196	0.507	1.000					
Fin. Literacy Index	0.077	0.089	0.016	0.057	0.097	0.038	1.000				
Fin. Inclusion Index	0.441	0.296	0.298	0.169	0.491	0.362	0.219	1.000			
Sales Growth	0.166	0.059	0.163	0.028	0.179	0.161	-0.153	0.068	1.000		
Firm Age	-0.195	-0.136	-0.150	-0.061	-0.136	-0.206	-0.026	-0.095	-0.035	1.000	
Business License	0.080	0.027	0.057	0.050	0.019	0.132	0.037	0.115	0.021	0.005	1.000
Home Based Location	0.102	0.050	0.059	0.106	0.103	0.049	-0.050	0.036	0.064	0.089	-0.036
Owners Age	-0.243	-0.196	-0.163	-0.100	-0.205	-0.209	-0.141	-0.165	0.003	0.389	0.133
Dummy Male	-0.074	-0.077	-0.073	0.040	-0.058	-0.092	-0.022	-0.025	-0.024	0.069	-0.010
Education	0.250	0.169	0.178	0.118	0.201	0.227	0.085	0.216	0.010	-0.146	0.118
Digital Competition	0.444	0.310	0.327	0.120	0.426	0.425	0.150	0.366	0.050	-0.151	0.186
Banking Relationship	0.035	-0.004	0.023	0.060	0.023	0.018	0.018	0.021	0.023	0.152	0.146
Smartphone Society	0.125	0.086	0.093	0.037	0.099	0.134	0.071	0.099	-0.027	-0.021	0.026
Technology Awareness	0.193	0.085	0.162	0.094	0.193	0.151	0.034	0.145	0.228	-0.009	-0.134
Trust to Digital	0.232	0.090	0.186	0.084	0.202	0.275	0.032	0.148	0.036	-0.073	0.006
Log Sales	0.125	0.080	0.064	0.121	0.131	0.061	0.029	0.137	0.112	0.134	0.163
Log GDP	0.120	0.128	0.056	0.040	0.141	0.087	-0.154	0.008	0.078	-0.010	-0.049
Dummy Java	0.115	0.117	0.084	0.057	0.110	0.033	0.120	0.135	-0.065	-0.067	-0.038
Internet Use	0.101	0.109	0.629	0.041	0.098	0.051	0.019	0.037	-0.009	-0.013	-0.159
Elevation	-0.029	-0.042	-0.016	-0.027	-0.009	-0.005	0.031	-0.042	0.007	0.001	0.069

Continued

	Home Based Location	Owners Age	Gender Male	Education	Digital Competition	Banking Relationship	Smartphone Society	Technology Awareness	Trust to Digital	Log Sales	Log GDP	Dummy Java	Internet Use	Elevation
Home Based Location	1.000													
Owners Age	0.026	1.000												
Dummy Male	0.139	0.053	1.000											
Education	0.061	-0.119	0.003	1.000										
Digital Competition	0.049	-0.163	-0.067	0.173	1.000									
Banking Relationship	0.064	0.175	0.028	0.005	0.055	1.000								
Smartphone Society	0.024	-0.020	-0.006	0.051	0.177	0.034	1.000							
Technology Awareness	0.152	-0.067	0.013	0.131	0.094	-0.021	0.085	1.000						
Trust to Digital	0.047	-0.074	-0.028	0.162	0.149	0.029	0.079	0.232	1.000					
Log Sales	0.181	0.085	0.145	0.096	0.110	0.173	0.043	0.142	0.004	1.000				
Log GDP	0.116	0.029	0.054	-0.006	0.048	0.009	0.030	0.084	-0.115	0.162	1.000			
Dummy Java	0.020	-0.141	0.023	0.030	0.189	0.052	0.021	-0.007	0.014	0.067	-0.117	1.000		
Internet Use	0.039	-0.055	-0.031	0.0306	0.072	-0.049	0.063	0.093	-0.011	0.036	0.234	0.025	1.000	
Elevation	-0.045	0.012	0.004	0.013	0.009	0.016	-0.007	-0.042	-0.003	-0.058	-0.219	0.098	-0.407	1.000