

DIGITAL TECHNOLOGY ADOPTION AND PARTICIPATION IN GVC: AN EMPIRICAL STUDY ON INDONESIA MICRO AND SMALL MANUFACTURING FIRMS

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Abstract

MSMEs have become the backbone of Indonesia economy and promote inclusive economic development. However, Indonesia MSMEs' participation in global value chain (GVC) is still limited. The development of digital economy in Indonesia might benefit MSMEs to access resources and inputs, expand to larger market, not only domestic market, but also international market. Digital transformation in economy supports their performance, i.e., increase in market share, business innovation, and more efficient business operation. Digital economy would offer opportunities for MSMEs to become parts of GVC. Since Indonesia experienced rapid development in digital economy, in which more MSMEs utilize digital technologies, such as internet and digital platform, this study aims to observe whether MSMEs digital and technology adoption will increase their probability to participate in global value chain. Therefore, this study aimed to observe whether MSMEs digital and technology adoption will increase their probability to participate in GVC. This study used logit model regression is to analyze firm-level microdata from Indonesia micro and small manufacturing firms, a survey dataset from Indonesia Statistics (BPS). There were still limited studies particularly for Indonesia MSMEs participation in GVC and their digital adoption in Indonesia. By observing large dataset from firm-level data, the result of this paper provided comprehensive analysis and empirical evidence on how technology adoption for MSMEs relates to probability of MSMEs participation in GVC.

Keywords: Digital Technology Adoption, Financial Access, Global Value Chain, Manufacture, MSMEs, International Trade

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INTRODUCTION

MSMEs have prominent roles in Indonesia economy. According to BPS (2021), about 99% enterprises in Indonesia are categorized as MSMEs. They contribute to 60.5% of national output and 98% of employment. In addition, MSMEs also contributes to export activities. According to data from BPS (2021), the value of non-oil and gas MSMEs exports reached Rp 339.19 trillion or 15.77% of Indonesia's total non-oil and

gas exports. It indicates that Indonesia MSMEs' participation in export is relatively small compared to large firms. In addition, their participation in international economic activities, such as global value chain (GVC) is still relatively limited.

There are several advantages for MSMEs participating in international activities, including export, import, and their participation in GVC. According to self-selection hypothesis, firms' engagement in international activities required them to be efficient in allocating resources. To this extent, self-selection hypothesis explains that only efficient and productive firms have more chance to enter export market^{1,2,3}.

In line with this, GVC provides opportunities for firms to increase efficiency and productivity, as firms can outsource certain tasks to other counterparts in several countries where cost of production, including labor costs, are lower, thus it allows firms to produce efficiently and be more competitive⁴. Furthermore, firms participating in GVC often have access to advanced technologies from their counterparts within the chain, thus it leads them fostering innovation and improving their own capabilities, and new knowledge about management know-how through business interactions among the firms participating in GVC. In addition, they can expand their business and to access new markets and consumers, as products can be marketed and distributed globally.

Firms' participation in GVC has been described, in several previous studies, as their engagement in global market, including export its products and import inputs used in the production process, as well as being suppliers to their counterparts within the production networks^{5,6}. Based on theoretical concept, GVC defined as global networks that connecting labor and production processes among the participating countries and regions^{7,8}. Firms, particularly in manufacturing sector, participates in GVC when their value-added outcome utilized inputs originated from at least two or more various

¹ Andrew B. Bernard and J. Bradford Jensen, 'Why Some Firms Export', *Review of Economics and Statistics*, 2004, 561–69, doi:10.1162/003465304323031111.

² David Greenaway and Richard Kneller, 'Exporting and Productivity in the United Kingdom', *Oxford Review of Economic Policy*, 20.3 (2004), pp. 358–71, doi:10.1093/oxrep/grh021.

³ Marc J Melitz, *The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity*, *Econometrica*, 2003, LXXI.

⁴ S. Urata and Y. Baek, *The Determinants of Participation in Global Value Chains: A Cross-Country, Firm-Level Analysis*, *ADB Working Paper*, 2020.

⁵ Javier López González and others, 'Participation and Benefits of SMEs in GVCs in Southeast Asia', 2019, doi:10.1787/3f5f2618-en.

⁶ Urata and Baek, *The Determinants of Participation in Global Value Chains: A Cross-Country, Firm-Level Analysis*.

⁷ Gary Gereffi, John Humphrey, and Timothy J Sturgeon, 'Introduction: Globalization, Value Chain an Development', *IDS Bulletin*, 32.3 (2001), pp. 1–8.

⁸ Nana Yang and others, 'Global Value Chain, Industrial Agglomeration and Innovation Performance in Developing Countries: Insights from China's Manufacturing Industries', *Technology Analysis and Strategic Management*, 32.11 (2020), pp. 1307–21, doi:10.1080/09537325.2020.1767772.

countries^{9,10}. In line with these studies, GVC includes international trade activities, such as export and import, as production networks connecting one country to other countries within the production stages.

Scholars have identified MSMEs participating in GVC through either direct and indirect forward participation or direct and indirect backward participation^{11,12}. Those participating by exporting intermediate goods or services directly, known as direct forward participation, or through supplying inputs for other counterparts, such as exporting firms, known as indirect forward participation. In addition, MSMEs engagement in GVC is also defined as input importing activities for their production process, i.e. direct backward participation, or source inputs from their counterparts which import them from abroad, i.e. indirect backward participation. GVC apparently extends new opportunities for MSMEs to participate in global trade¹³. Participating in GVC might benefit MSMEs become more stable and increase productivity through new niches for the supply of products and services at lower costs¹⁴. Additionally, participating in GVC also provides productivity and income growth for MSMEs.

MSMEs encounter several challenges in accessing export market. High sunk cost in front when entering export market becomes barrier for firms, including MSMEs, to enter¹⁵. As for MSMEs, they encounter more barriers to participate in export and engagement in GVC. Several challenges often arise, for instance, due to institutional informality and resources scarcities. Lack of informality and legal status might hinder MSMEs from accessing more resources, including financial access. MSMEs also deal with limited knowledge, struggle to meet global market standards, and encounter inadequate infrastructure, including limited use of technology¹⁶. MSMEs also meet other challenges, such as logistics, high fixed costs, and economies of scale related to exporting¹⁷. For the case of Tanzania, there were several challenges explaining MSMEs'

⁹ Le Thanh Ha, 'Impacts of Digital Business on Global Value Chain Participation in European Countries', *AI and Society*, 2022, doi:10.1007/s00146-022-01524-w.

¹⁰ Robert C. Johnson, 'Measuring Global Value Chains', *Annual Review of Economics*, 10 (2018), pp. 207–36, doi:10.1146/annurev-economics-080217-053600.

¹¹ Emmanuelle Ganne and Kathryn Lundquist, *The Digital Economy, GVCs and SMEs*, 2019.

¹² Javier Lopez-gonzalez, *Mapping the Participation of ASEAN Small- and Medium-*, 2017, doi:10.1787/2dc1751e-en.

¹³ Emmanuelle Ganne and Kathryn Lundquist, *The Digital Economy, GVCs and SMEs*, 2019.

¹⁴ Peter Kuzmisiin and Viera. Kuzmisiinova, 'Small and Medium-Sized Enterprises in Global Value Chains', *Economic Annals-XXI*, 162.11–12 (2017), pp. 22–27, doi:10.21003/ea.V162-05.

¹⁵ Mark J. Roberts and James R. Tybout, 'The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs', *American Economic Review*, 87.4 (1997), pp. 545–64.

¹⁶ Emmanuelle Ganne and Kathryn Lundquist, *The Digital Economy, GVCs and SMEs*, 2019.

¹⁷ Muhammad Ilham Nugroho, 'Global Value Chains Participation to Enhance Export: Evidence from Indonesian Apparel SMEs', *Journal of Socioeconomics and Development*, 5.1 (2022), p. 99, doi:10.31328/jsed.v5i1.3499.

limited participation in GVC, including challenges in global market expansion, regulation and investment climate, lack of skill and production capacity, as well as limited financial access¹⁸. In line with this, lack of access to finance, limited technology and information access are some barriers which hinder MSMEs participation in GVC¹⁹. To this extent, this paper would like to observe financial access as one of key factors for MSME participating in GVC.

Rapid development of digital economy in Indonesia poses opportunities for MSMEs to expand to larger market, not only domestic market, but also international market. Digital technology adoption also would provide them to access resources, inputs, as well as finance. Digitalization has become crucial strategies for firms, especially in MSMEs²⁰. New digital technologies adoption, such as data analytics, digital communication, and artificial intelligence, are being implemented across sectors of business activities²¹. New possibilities raised from digitalization lead firms to adapt to these innovations and technology.

In line, MSMEs' adoption in information, communication, and technology (ICT) will reduce production cost and improve their efficiency in production. As for MSMEs, utilization in ICT, such as automated system and data cloud-based operation, helped more rapid and accurate business process; thus, more efficient resource allocation²². Not only supporting firms' production capacities and business performance, which led to more efficient business operation, it also enlarges MSMEs' market share, and penetrate export market. The use of digital technology could assist firms develop their business in foreign market²³. Digitalization can also serve as tools to connect firms with the global market, aiming to seize greater market opportunities. Utilization of digital technologies, such as internet usage, would facilitate firms in exploring market potentials and consumers at low costs²⁴. As their market expanded to global market due to digitalization and production

¹⁸ Francis Lwesya, 'SMEs' Competitiveness and International Trade in the Era of Global Value Chains (GVCs) in Tanzania: An Assessment and Future Challenges', *Small Business International Review*, 5.1 (2021), p. e325, doi:10.26784/sbirv5i1.325.

¹⁹ Shujiro Urata, *Enhancing SME Participation in Global Value Chains: Determinants, Challenges, and Policy Recommendations*, 2021 <www.adbi.org>.

²⁰ Benjamin Dethine, Manon Enjolras, and Davy Monticolo, 'Digitalization and SMEs' Export Management: Impacts on Resources and Capabilities', *Technology Innovation Management Review*, 10.4 (2020), pp. 18–34.

²¹ Margherita Pagani and Catherine Pardo, 'The Impact of Digital Technology on Relationships in a Business Network', *Industrial Marketing Management*, 67 August (2017), pp. 185–92, doi:10.1016/j.indmarman.2017.08.009.

²² Erkkö Autio and Kun Fu, *Digital Framework Conditions and the Productivity Potential of a Country's Entrepreneurial Dynamic: A Study of Selected ADB Member Economies*, 31 August 2022.

²³ Francesca Sanguineti, Giovanna Magnani, and Antonella Zucchella, 'Technology Adoption, Global Value Chains and Sustainability: The Case of Additive Manufacturing', *Journal of Cleaner Production*, 408 February (2023), p. 137095, doi:10.1016/j.jclepro.2023.137095.

²⁴ Inutu Lukonga, 'Harnessing Digital Technologies to Promote SMEs in the MENAP Region', *IMF Working Papers*, 2020.135 (2020), p. 1, doi:10.5089/9781513550770.001.

capacity upgraded, it would benefit them and increase their sales revenue²⁵. Moreover, Digital adoption also potentially improve MSMEs capacity to mitigate the external shocks, for instances during covid pandemic shocks²⁶. Within the global value chain, MSMEs utilizing digital technology might have opportunities to improve their productivity by strengthen their linkage to other large enterprises and integrate within production network. Therefore, this paper would focus on analyzing the impact of digital technology adoption on MSMEs' participation in GVC.

This paper would like to empirically assess that digital technology adoption would provide more opportunities for MSMEs to participate in GVC for the case of Indonesia. Although studies on development digital technology and MSMEs have been widely become interesting for many scholars, empirical research which relates digital technology adoption and MSMEs participation in GVC are still limited. It might be due to limited availability data on MSMEs participation in GVC, particularly for Indonesian MSMEs. This study used large micro-level dataset to observe whether digital technology adoption influencing the chance of GVC participation for the case of MSMEs. While previous study for Indonesia case, particularly only observed on factors determining MSMEs export participation and used primary data collection by survey²⁷, this paper would fill in the gap in the literatures by providing empirical studies utilizing secondary database on MSMEs' firms level data, to capture their participation in GVC, defined as their international engagement through exporting commodities and importing inputs. This study also introduced a novel empirical study on GVC for the case of MSMEs in Indonesia, particularly those in manufacture sector, to include digital technology adoption and financial access as determinant factors in explaining their GVC participation.

RESEARCH METHODS

This paper applied logit model to analyze whether digital technology adoption and financial access determine the probability of MSMEs to participate in GVC. The equation of logit model²⁸ used in this study are as follows:

$$g(x) = \ln\left(\frac{\mu_i}{1-\mu_i}\right) = x_i b = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} \quad (1)$$

$$\mu = \ln\left(\frac{\exp(xb)}{1+\exp(xb)}\right) = \frac{1}{1+\exp(-xb)} \quad (2)$$

²⁵ S. Mustafa and N. Beaumont, 'The Effect of Electronic Commerce on Small Australian Enterprises', *Technovation*, 24.2 (2004), pp. 85–95, doi:10.1016/S0166-4972(02)00039-1.

²⁶ John Dilyard, Shasha Zhao, and Jacqueline Jing You, 'Digital Innovation and Industry 4.0 for Global Value Chain Resilience: Lessons Learned and Ways Forward', *Thunderbird International Business Review*, 63.5 (2021), pp. 577–84, doi:10.1002/tie.22229.

²⁷ Mohamad Dian Revindo and others, 'Factors Affecting Propensity to Export: The Case of Indonesian SMEs', *Gadjah Mada International Journal of Business-Sept.-Dec*, 21.3 (2019), pp. 263–88 <<http://journal.ugm.ac.id/gamaijb>>.

²⁸ Joseph M. Hilbe, *Practical Guide to Logistic Regression*, 1st Editio (Chapman and Hall/CRC, 2015), doi:10.1201/b18678.

The logit model above expressed by equation (1) and (2), where μ represents probability which response the value of $g(x)$ is equal to 1. $g(x)$ is a dummy variable of 1 if firms i participate in GVC. Additionally, the parameter x_{i1}, \dots, x_{ip} is a set of main independent variables, such as firm i 's financial access and digital technology adoption, firm size, output, worker education, certification obtained, patents, innovation, training, and agglomeration location. The parameter $\frac{\mu_i}{1-\mu_i}$ represents the formula for odds, which is the ratio of success probability to failure probability. Logit model regression is estimated using maximum likelihood estimation, given in equation (2).

Table 1. List of Variables in Logit Model

Variable	Name of Variables	Description	Units	Expected Signs
Dependent	GVC	A dummy variable, defined as Firm' participation in GVC, equals to 1 if firm conducts import and/or export, otherwise 0	Dummy	
Independent	Digital	A dummy variable, defined as firm's adoption in digital technology, equals to 1 if firm utilizes internet, otherwise 0	Dummy	(+)
	Output	Firm's production outcome, the larger output relates to larger firm's size.	Natural logarithm	(+)
	Worker Education	Firm's worker with higher education, graduated from high school or above.	Person	(+)
	Age	Number of years firm establishment	Years	(+)
	Bank Loan	A dummy variable, defined as firm's financial access, equals to 1 if firm have access to bank loans, otherwise 0	Dummy	(+)
	Certificate	A dummy variable, defined as firm's skill, equals to 1 if firm have obtained skill certification, otherwise 0	Dummy	(+)

Variable	Name of Variables	Description	Units	Expected Signs
	Patent	A dummy variable, defined as firm's Research and Development, equals to 1 if firm have patent, otherwise 0	Dummy	(+)
	Innovation	A dummy variable, defined as firm's innovation, equals to 1 if firm have innovation, otherwise 0	Dummy	(+)
	Train	A dummy variable, defined as firm conducts training for employees, equals to 1 if firm have access to external loans, otherwise 0	Dummy	(+)
	Size	A dummy variable, defined as small firms, equals to 1 if firm has more than five employees, otherwise 0 means micro firms	Dummy	(+)
	Location	A dummy variable, defined as firm's location in agglomeration area, equals to 1 if firm located in industrial center otherwise 0	Dummy	(+)
	Finance	A dummy variable, defined as firm's financial access, equals to 1 if firm have access to external loans, otherwise 0	Dummy	(+)

Source: Author's compilation from BPS survey of micro and small manufacturing sector data source

To examine the objective of this study, this paper used secondary firm-level data from The Survey of Micro and Small Manufactures, sourced from BPS in 2020. The survey was conducted annually and provides micro-level data with a total number of 88,891 observations. The survey has limit in collecting different respondents in every survey year, therefore, it only provides cross-section dataset. Despite its drawback, the survey offers comprehensive information and large observation to capture the characteristics of micro and small firms, particularly in manufacturing sectors. This survey also collected information regarding to firms' business activities, including export and import activities, which also relate to the GVC, as well as their digital technology adoption activities. The variables used in this study can be seen in Table 1.

RESULT AND DISCUSSION

Indonesia Micro and Small Manufacturing Firms Overview

Based on data from IMK Survey, the number of micro and small manufacturing firms in Indonesia reached 4.21 million units. By sectors, about 36% of them are in the food sectors, or about 1.52 million units. The largest share of micro and small manufacturing firms is in Java, which is around 63.11%, followed by other regions such as Sumatra (14.60%), Bali and Nusa Tenggara (9.27%), Sulawesi (8.27%), and the rest are scattered in other regions.

Apparently, from the survey, number of micro and small manufacturing firms engaged in export activities were still limited, which are about 15,670 firms or around 0.19%. They mostly sold their products for domestic market. In terms of inputs, they also sourced from domestic suppliers, while only small part of them imported from abroad, i.e. about 5,528 firms or about 0.13%. Indonesia's limited participation in GVC was also confirmed by ADB (2019) mentioning that Indonesia's decreasing trend in GVC participation, both forward and backward linkages, as more low-tech manufacturing commodities dominated its exports.

Despite these limited numbers of firms engaging in international activities, many micro and small manufacturing firms had already utilized internet, which are about 690,156 firms, or about 16.4%. These firms dominantly belong to these sectors, such as food industry (29.67%), apparel (22.66%), and wood industry (7.39%). Of those using internet, they utilized it for selling their products (84%) and promoting their products (52%). As more firm adopting digital technology, i.e. internet, there will be more possibility for firms to promote and sell their products, not only for domestic, but also global market. Thus, adoption in digital technology is crucial for micro and small manufacturing firms to engage in GVC.

Table 2 displays sectoral numbers of micro and small manufacturing firms used as observations in this study. This study utilized 88,891 micro and small manufacturing firms which were sampling firms observed from IMK Survey in 2020. From this observation, the largest share of these micro and small firms is about 24.78% belongs to food industry, while 13.39% firms conduct manufacturing in wood industry and 13.01% are in apparel industry. About 20.37% of the observation have already adopt digital technology, i.e. internet connection.

Distribution of micro and small manufacturing firms by GVC participation also displayed in Table 2. These firms conducted either exporting their product, and/or importing raw or intermediate materials from abroad. The definition of GVC participation follows Urata & Baek (2020) highlighting that firms participating in GVC manage to produce efficiently through exporting products and importing resources from abroad. Micro and small manufacturing firms engaging in GVC mostly found in these sectors, as follows: Food Industry (21.13%), Wood Industry (15.77%), Apparel Industry (13.52%) and Non-metallic Minerals Industry (12.39%).

Table 2: Micro and Small Manufacturing Firm Distribution by Sector

KBLI Code	Sector	Share of Total Observation (%)	Share of GVC Participation (%)
10	Food	24.78	21.13
11	Beverages	4.54	3.66
12	Tobacco	2.59	2.82
13	Textiles	7.35	5.63
14	Apparel	13.01	13.52
15	Leather	1.91	2.54
16	Wood	13.39	15.77
17	Paper	0.35	1.13
18	Printing	1.93	1.41
19	Petroleum	0.00	0.00
20	Chemicals	1.25	0.85
21	Pharmaceuticals	0.54	0.56
22	Rubber	0.66	0.28
23	Non-metallic	9.32	12.39
24	Basic	0.27	0.00
25	Fabricated	5.86	2.25
26	Computing	0.05	0.00
27	Electrical	0.07	0.00
28	Machinery	0.17	0.00
29	Motor	0.19	0.00
30	Other	0.78	0.28

KBLI Code	Sector	Share of Total Observation (%)	Share of GVC Participation (%)
31	Furniture	4.89	7.32
32	Other	5.74	8.45
33	Repairs	0.35	0.00
Total Firms		88,891	355

Source: Author’s calculation from BPS survey of micro and small manufacturing sector data source

Digital Adoption and GVC Participation of Micro and Small Manufacturing Firms

This study intended to observe whether adoption in digital technology would benefit MSMEs to have more opportunities in participating in GVC. First, this section provides empirical evidence on how firms have different characteristics, and their probability in digital adoption, for those participating in GVC and those not. For these purposes, this study applied statistical test to observe mean difference the two groups, i.e. firms participating in GVC and firms not participating in GVC.

Table 3: Descriptive of Variables

Variables	N	Mean	Std. Dev	Min	Max
GVC	88,891	0.004	0.063	0	1
Digital	88,891	0.20	0.403	0	1
Output	88,891	15.187	2	9.547	24.74
Worker Education	88,891	0.764	1	0	19
Age	88,891	14.840	11	0	118
Bank Loan	88,891	0.078	0.268	0	1
Certificate	88,891	0.012	0.108	0	1
Patent	88,891	0.007	0.082	0	1
Innovation	88,891	0.038	0.192	0	1
Train	88,891	0.03	0.171	0	1

Variables	N	Mean	Std. Dev	Min	Max
Size	88,891	0.09	0.286	0	1
Location	88,891	0.016	0.126	0	1
Finance	88,891	0.129	0.336	0	1

Source: Author’s calculation from BPS survey of micro and small manufacturing sector data source

Table 3 shows descriptive statistics for variables used for empirical analysis in this study. Table 4 displays the results of statistical test for mean difference test. The results show that all variables, except age, have significant differences for the two firm groups, i.e. those participating in GVC and those non-GVC firms. The differences between GVC firms and non-GVC firms are positive and significant at 99%. This result highlights that micro and small manufacturing firms participating in GVC, in average, are more likely to use internet, than those not participating in GVC. In addition, micro and small firms participating in GVC, in average, larger in size, produce more output, have more access to finance, more educated worker, equipped with more skilled as they provided more training for employees, more likely to conduct innovation, obtained patent and certification licenses, and located in agglomerated industrial area, compared to those non-GVC micro and small firms. These results confirmed previous studies explaining that firms exposed to international activities, e.g. exporting more superiority, in terms of productivity, performance and firms’ characteristics, compared with those not engaging in internationalization^{29,30}.

Table 4. Results of Mean Difference Statistical Test

Variables	GVC	Non-GVC	Difference	Prob (diff<0)	Prob (diff=/0)	Prob (diff>0)
Digital	0.453521	0.202697	0.250824	0.0000	0.0000	1.0000
Output	15.935	15.184	0.752	0.0000	0.0000	1.0000
Worker Education	2.059	0.759	1.300277	0.0000	0.0000	1.0000
Age	14.417	14.841	-0.425	0.7635	0.473	0.2365
Bank Loan	0.161	0.078	0.083	0.0000	0.0000	1.0000

²⁹ Andrew B Bernard and others, ‘Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987’, *Brookings Papers on Economic Activity: Microeconomics*, May, 1995, pp. 67–119.

³⁰ Peter Kuzmisiin and Viera. Kuzmisiinova, ‘Small and Medium-Sized Enterprises in Global Value Chains’, *Economic Annals-XXI*, 162.11–12 (2017), pp. 22–27, doi:10.21003/ea.V162-05.

Variables	GVC	Non-GVC	Difference	Prob (diff<0)	Prob (diff=/0)	Prob (diff>0)
Certificate	0.045	0.012	0.033313	0.0000	0.0000	1.0000
Patent	0.048	0.007	0.041	0.0000	0.0000	1.0000
Innovation	0.121	0.038	0.082962	0.0000	0.0000	1.0000
Train	0.115	0.030	0.086	0.0000	0.0000	1.0000
Size	0.268	0.089	0.178286	0.0000	0.0000	1.0000
Location	0.039	0.016	0.023	0.0002	0.0005	0.9998
Finance	0.242	0.129	0.113379	0.0000	0.0000	1.0000

Source: Author's estimation from BPS survey of micro and small manufacturing sector data source

This study further applied logit model regression to observed whether adoption in digital technology significantly determine firm's participation in GVC, for the case of micro and small manufacturing firms. This model also allowed to observe other determinant factors explaining firms' participation in GVC, such as output, size, access to finance, workers' education, training and skill, firm innovation and development, and firms' location indicating agglomeration aspect. There are three logit model specification with several variable combinations, displayed in Table 6. Those three specifications of logit model have fitted the best estimations and significantly proved the goodness of fit test, displayed in Table 5 below.

Based on the Hosmer and Lemeshow's goodness of fit tests, displayed in Table 5, the goodness of fit test can assess the difference between observed and expected or predicted probabilities as categories at all levels of predicted values³¹. The null hypothesis is that the model is a good fit of the data, while the alternative hypothesis is that the model is not a good fit. This statistical test is whether to reject H_0 if the p-value is smaller than the alpha. The p-value results from the three models are smaller than alpha (0.1), then there is evidence that the models follow the rule of goodness of fit, thus the results are valid to be interpreted.

³¹ Joseph M. Hilbe, *Practical Guide to Logistic Regression*, 1st Editio (Chapman and Hall/CRC, 2015), doi:10.1201/b18678.

Table 5: Hosmer and Lemeshow Goodness of Fit (GOF) Test

Model	X-Squared	df	p-value
Model 1	11.751	8	0.1627
Model 2	9.1438	8	0.3303
Model 3	4.823	8	0.7763

Source: Author’s estimation from BPS survey of micro and small manufacturing sector data source

Table 6 showed estimation results of logit model regression. The results highlight that variable of digital is consistently significant and positive in determining probability of GVC participation at 1%, for the three model specifications. It proved that micro and small manufacturing firms adopting digital technology, i.e. internet, have more probability to engage in GVC activities, i.e. around 72% to 77% higher probability, than those not using internet. Internet usage is highly essential in creating new market opportunities for domestic manufacturing firms to participate in GVC through export-import activities that involve forward and backward linkages. The positive influence of technology usage on GVC participation is also confirmed by previous study explaining that the use of technology such as websites will make it easier for business to import more inputs and export their finished products³².

Table 6. Results of Logit Model Regression

Dependent Variable: GVC			
	(1)	(2)	(3)
Digital	0.749***	0.724***	0.776***
Output		0.072*	
Worker Education	0.122***	0.143***	0.121***
Age	0.005	0.007	0.005
Bank Loan	0.333**	0.010***	0.009***
Finance		0.470***	

³² Rainer Lanz and others, *E-Commerce and Developing Country-SME Participation in Global Value Chains*, WTO Staff Working Paper, 2018 <<http://hdl.handle.net/10419/190765>>.

Dependent Variable: GVC			
	(1)	(2)	(3)
Certificate	-0.007	0.014	0.006
Patent	0.508*	0.508	0.492
Innovation	0.330*	0.314*	0.341*
Train	0.835***	0.853***	0.846***
Location	0.738***	0.777***	0.769***
Size	0.594***		0.623***
Constant	-6.220***	-7.351***	-6.224***

Source: Author's estimation from BPS survey of micro and small manufacturing sector data source.

Additionally, labor input is essential to determine firm's participation in GVC. This determinant factor is captured by variables such as worker's education, and worker's skills obtained through training. The number of educated employees influenced on a firms' participation in the GVC significantly. The positive coefficient shows that the more educated workers, who graduated from high school, employed by firms, the greater chances firms participating in GVC. Moreover, firms conducting training for workers have more probability to participate in GVC, i.e. 83% to 84% more chances than those not providing training for their workers. Training is important and essential for employees to enhance their skills and development. These results imply that, not only level of education embed on workers, trained and skilled workers also allow firms to produce more efficient and productive. Thus, it further enables them to participation in GVC. The empirical results align with previous study highlighting that skilled labor as the strongest determinant of participation in backward and forward global value chains³³. Likewise, human capital factors which also include level of education have a significant positive influence on GVC participation.

This study also considered that research and development (R&D) was important for firms to be able to compete in global market. Variables such as innovation and patent are proxies that explaining firms' activities in innovation and R&D. The variable of innovation also showed significant and positive in explaining probability on GVC participation, for the three model specifications, at 10%. Significantly, micro and small manufacturing firms conducting innovation in their production process have more opportunities to participate in GVC, i.e. about 31% to 33% more probability of chances to engage in GVC. As for patent, micro and small manufacturing firms having patent

³³ Nadege D. Yameogo and Kebba Jammeh, 'Determinants of Participation in Manufacturing GVCs in Africa: The Role of Skills, Human Capital Endowment and Migration', *Determinants of Participation in Manufacturing GVCs in Africa: The Role of Skills, Human Capital Endowment and Migration*, July, 2019, doi:10.1596/1813-9450-8938.

licenses have more chance to participation in GVC, proved in the model (1), at 10%. These results provide empirical evidence on how R&D and innovation can advantage micro and small manufacturing firms to produce products with higher quality and more competitive in the global market³⁴.

Financial factors are important in determining firms' activities in global market. Firms, including micro and small firms, confront several barriers, including financial barriers. When they participate in GVC, they face high sunk cost in front, including market penetration cost³⁵. The logit model specifications use interest variable to capture firms' financial access, such as Bank Loan and Finance. Both Bank loan and Finance significantly have influenced the probability of firms participating in GVC. These variables indicate that firms have more chances to engage in the GVC when they have access to external finance, including from formal financial institution such as banks. By obtaining funding from external sources, firms have more probability of 33% to participate in the GVC, than those not having access to external finance, *ceteris paribus*. Moreover, firms having access to formal financing from bank have more chances as well to participate in GVC, than those not having financing from bank. As firms engage in GVC, it requires them to compensate large costs to produce quality goods, market penetration costs, advertising and marketing cost, information costs, etc. Thus, their own capital to finance these high sunk costs would not sufficient. The use of external financing will cover these costs and strengthen their financial capacity. These results also have confirmed previous study stating that access to finance is an important factor for overcoming sunk trade costs, thus it has positively impacted on GVC participation³⁶.

Another significant determinant factor is firm location in industrial center that explaining probability of micro and small manufacturing firm to engage in GVC. Micro and small manufacturing firms located in industrial center have more chances, about 73% to 78%, to be able to participate in GVC, compared to those not in the center. These findings highlight that industrial concentration and agglomeration have important role in explaining firms' probability in GVC participation, as it allows firm within the industrial center enable to build networks, interactions and knowledge spillovers³⁷.

The logit model specifications also include firms' size and age as control variables. Only firms size, which are proxied by size dummy and production size in output, are significant and positive in influencing the probability of firms participating in GVC. This study finds that small firms tend to have more chances, around 60% to 62% of probability, to participate in GVC, compared to micro firms. In terms of production size, firms with

³⁴ Benjamin Dethine, Manon Enjolras, and Davy Monticolo, 'Digitalization and SMEs' Export Management: Impacts on Resources and Capabilities', *Technology Innovation Management Review*, 10.4 (2020), pp. 18–34

³⁵ Mark J. Roberts and James R. Tybout, 'The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs', *American Economic Review*, 87.4 (1997), pp. 545–64.

³⁶ S. Urata and Y. Baek, *The Determinants of Participation in Global Value Chains: A Cross-Country, Firm-Level Analysis*, ADBI Working Paper, 2020.

³⁷ David Greenaway and Richard Kneller, 'Exporting and Productivity in the United Kingdom', *Oxford Review of Economic Policy*, 20.3 (2004), pp. 358–71, doi:10.1093/oxrep/grh021.

larger production scale, have more probability to participate in GVC, at 10% level of significance³⁸.

CONCLUSION

This paper intends to generate comprehensive analysis and to provide empirical evidence on digital technology adoption for MSMEs and their integration to GVC. This paper used specifically data of micro and small firms in manufacturing sector, for the case of Indonesia. This study employed logit model regression to provides empirical evidence on observing determinant factors explaining micro and small manufacturing firms' participation in GVC. The results of this study indicated that digital adoption, i.e. internet use, have positively significant impact on firms' probability to participate in GVC. Workers' higher level of education and training provided to enhance skills are also found to be significant and positive in explaining micro and small manufacturing firms' participation in GVC. Moreover, research and development (R&D), proxied by innovation activities and patent licenses, was important for firms to be able to compete and engage in GVC. This study also highlighted that financial access and industrial agglomeration were significant in determining micro and small manufacturing firms in GVC participation. Firm size, as control variable, is also found to be significant and positive, as determinant in GVC participation.

The results of this study imply that digital technology is crucial for micro and small firms, particularly in manufacturing firms, so that they will have more chances to participate in GVC. Government policies to support micro and small manufacturing firms to be able to participate in GVC need to promote them to utilize digital technology and become part of digital ecosystem. Government needs to equip them with digital literacy and improve their digital skills through capacity trainings, along with providing ICT infrastructures, to be accessible for micro-small firms, including those in manufacturing sectors. Incentive policies related to enhance financial access, both through bank or non-bank financing, for micro and small firms to be able to participate in GVC are vital. Moreover, integrated and comprehensive industry policies are needed to facilitate more industrial centers and to allow more linkages and cooperation between micro-small firms and large firms to build networks, and thus induce more micro-small firms to participate in GVC.

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³⁸ Andrzej Cieřlik, Jan Jakub Michałek, and Krzysztof Szczygielski, 'What Matters for Firms' Participation in Global Value Chains in Central and East European Countries?', *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 14.3 (2019), pp. 481–502, doi:10.24136/eq.2019.023.

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