

THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON THE VALUE ADDED OF MANUFACTURING SECTOR: COMPARING ASIAN COUNTRIES BY INCOME GROUP LEVELS

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Received: 15 March 2020 Revised and Accepted: 19 June 2020

ABSTRACT: Information and Communication Technology (ICT) is extremely necessary for the majority aspects of our lives. ICT, as well, plays a significant role in the manufacturing industries. It forms the idea for many advances in all aspects in modern times as well as manufacturing technologies. It is considered to be a key strategy for countries to elevate the value added, no exception in Asian countries. Nowadays, Asia has become the world's manufacturing hub. However, Asian countries are all at different levels of the economy. Analyzing each level will allow us to examine specific patterns of ICT diffusion in the manufacturing sector. Thus, this study aims to analyze the impact of ICT on Manufacturing Value Added (MVA) in Asian countries by the type of income group levels, namely: lower-middle, upper-middle, and high-income countries. This study uses data from 35 Asian countries from 2010 until 2018. By applying robust panel data analysis, this study provides commendable evidence that ICT significantly contribute to the increase of value added of the manufacturing sector in Asian countries, with different impacts for different types of group levels. The study supports the policy recommendation that the government should increase attention in the diffusion of ICT to fasten and boost value added of the manufacturing sector.

KEYWORDS: Asia; Manufacturing Value Added; ICT; Panel Data; Income Groups

I. INTRODUCTION

One of the most important changes within the world economy over the last forty years is that the shift of industry from high income to developing countries. The share of world manufacturing output produced by developing countries nearly doubled, increasing to over a third of worldwide production from 1992 to 2012. Growth of manufactured exports has greatly exceeded the growth of manufacturing output that developing countries have gained world market shares in both simple and complicated manufactured products. Nowadays, East Asia, led by China, produces over one-fifth of global manufacturing value added in the world (UNIDO, 2018).

Over the past fifty years, East, South and South-East Asian countries experienced the greatest structural change as stronger as the increase in productivity levels. They did not solely by shifting employment from low (agriculture) to high productivity sectors (manufacturing and services), but additionally by improving productivity within those sectors, on the base of high investment levels. The share of manufacturing in total value added and employment remained relatively high in most Asian countries, though it declined since 2007 in some of them. Some countries (e.g. the Rep. of Korea and China) have successfully managed to industrialize, managing to expand productivity and employment in manufacturing for long periods of time, whereas others in South East Asia and South Asia face the risk of stalling industrialization, as they cannot expand both variables in parallel. Exports of manufactures had a greater impact on industrialization in Asia than in other developing regions. First, Asian countries account for 90 per cent of developing country exports of manufactures to the world; second, Asian countries managed establishing production and learning linkages between exporting sectors and the rest of the economy, contrasting with African and Latin American countries where manufacture exports expansions are checked by the rise of manufacture imports.

There is a wide research emphasizing the role of manufacturing as an engine of growth. (Forbes, 2017) stated that Asia has become a manufacturing hub, but like most economies, it started with the agriculture sector.

It advances rural industry and moves toward more complicated manufacturing. (Kaldor, 1960) conceptually introduced the benefits of manufacturing. He postulated and tested empirically the “engine of growth hypothesis” with a simple cross country estimate over two different time periods (1952 and 1964) in twelve OECD countries. He theorized some empirical regularities which incorporate the advantages of the manufacturing sector over the entire economy. He proposed three laws on these empirical regularities:

1. The manufacturing sector is the engine of GDP growth.
2. Productivity growth of the manufacturing sector is positively associated with the growth of the manufacturing sector’s output.
3. Productivity growth of the non-manufacturing sector is positively related to the growth of the manufacturing sector’s output.

Since the primary Kaldor experiment, the issue remains relevant because numerous growing literatures are focusing on the role of manufacturing in different countries, particularly lower-middle economies. The econometric literature has made some methodological progress on counting the benefit of manufacturing. (Lavopa & Szirmai, 2012) using a sample of 92 countries from 1960 to 2010 support the engine of growth hypothesis for manufacturing. (Pacheco-López & Thirlwall, 2013) work on a sample of 89 countries from 1990 to 2011 and reveal that trade is the most important channel from manufacturing growth to economic growth. (Acevedo, Mold, & Perez Caldentey, 2009) test the first Kaldor law for eighteen Latin American countries. They support the first Kaldor’s law. However, they cannot confirm that manufacturing is the most significant engine of growth if compared to the services sector. Similar results for seven Latin American countries are found by (Libanio & Moro, 2006).

During the last four decades, most economies in developing Asia have undergone a huge structural change, particularly in the composition of their sectoral shares. Beginning in the 1960s, the structures of production and exports of the East Asian economies underwent significant changes. Specifically, the contribution of manufacturing value added to GDP, and that of manufacturing employment in total employment increased significantly. Starting with Japan and the East Asian economies, then Southeast Asia, and then the PRC, these economies experienced significant economic transformation.

(Felipe, 2018) from Asian Development Banks (ADB) reported that the manufacturing sectors of a number of Asian economies, particularly Malaysia; the Republic of Korea; Singapore; and Taipei, China, have undergone significant transformations and shifted their manufacturing output to more technology and scale intensive subsectors. This shift upward is a vital part of the structural change because the growth productions of more sophisticated manufactured products become faster. In the PRC and India, the shift to more technology and scale intensive subsectors is happening more slowly; whilst in most other Asian countries the evidence is lacking.

ICT plays an important role in various sectors and industries. It strives to make everything simpler in the manufacturing sector. It helps drastically in delivering just in time insights, swift visibility, and seamless innovation for implementing modern solutions in manufacturing. The worldwide development of ICT shows an increasing trend (Figure 1). It can be seen, from five indicators of ICT, two indicators show a very striking development: mobile cellular telephone subscriptions and active mobile-broadband subscriptions. It indicates that internet penetration has shown rapid development in the whole economies. Out of five ICT indicator, only fixed-telephone subscription shows a declining trend.

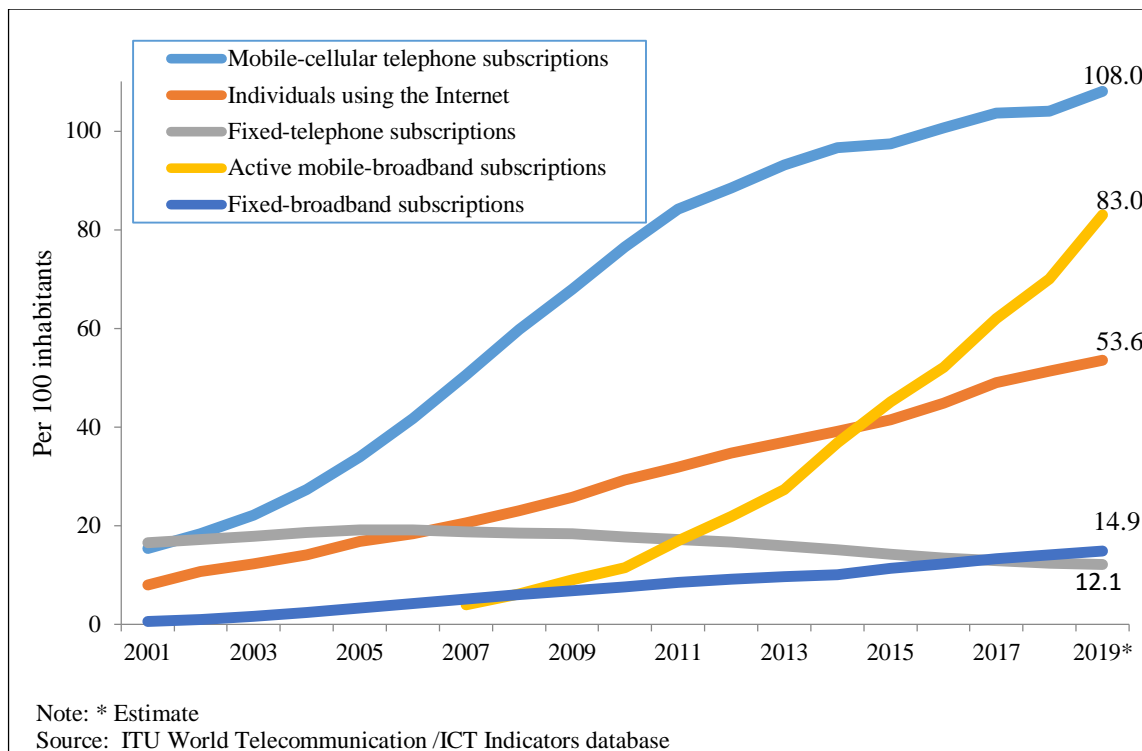


Figure 1. Global ICT developments (ITU, 2018)

The development of ICT is not only happening on the global scale but also regional, including in Asia. Nowadays, internet penetration in Asia is 48 per cent, in which in 2021 is expected to reach 59 per cent by 2021. Meanwhile, the penetration of smartphone is 35 per cent and should be grown to 44 per cent by 2021. These numbers might seem daunting, but Asia is a massive region and has a lot of opportunity for e-commerce to grow, which lies in densely populated markets, in which the penetration of smartphone surpass the world’s penetration. In addition, 48 per cent of online shoppers in Asia prefer to shop online via desktop, which is lower than the global average, 19 per cent of online shoppers use mobile, and 25 per cent claim to have no preference (Statista, 2017). Thus, it is obvious that ICT plays a significant and massive role in the growth of e-commerce and stimulate the development of the manufacturing sector. However, it should be aware that the role of ICT for the manufacturing value added may differ according to the country’s economy, namely lower-middle, upper-middle, and high income. Hence, this study aims to analyze the impact of ICT on the manufacturing value added of Asian countries based on their level of economies.

II. LITERATURE REVIEW

There are numerous studies related to the importance of the manufacturing sector, how to measure the added value of economic growth, as well as the factors that influence its added value. (Houseman, Bartik, & Sturgeon, 2015) studies how to measuring manufacturing; (Felettigh & Oddo, 2016) also study about market shares in manufacturing value added, and (Bhat, 2014) analyze the manufacturing sector and growth prospect. (Cantore, Clara, Lavopa, & Soare, 2017) reveals manufacturing as an engine of growth using a sample of 80 countries for the period 1980–2010. However, (Haraguchi, Cheng, & Smeets, 2017) finds that the manufacturing sector’s value added to world GDP has not changed significantly since 1970.

Asian countries experienced a new challenge in manufacturing. (Biswas, 2016; Faruq & Telaroli, 2011; Jomo, 2003; Mazumdar & Sarkar, 2013; Sun, 2004) studies the growth process of manufacturing in Asia, as an emerging manufacturing hub. Furthermore, advance in manufacturing is needed in the digital era. (Brennan & Vecchi, 2017; Garetti & Taisch, 2012; Knapčiková & Balog, 2019; Tassej, 2014) studies competition in advanced manufacturing; the need for improved growth models, strategies, policies; the trends and research challenges for sustainable manufacturing. (Taisch, Stahl, & Tavola, 2012) reveal trends and challenges of ICT in manufacturing for 2020. ICT has a significant and positive role in increasing the manufacturing value added. (Aboal & Tacsir, 2018; Adnan & Zen, 2017; Omae & Ateya, 2011; Tewari & Misra, 2012) explore and validate the strong relationship between ICT and manufacturing value added. There are numerous cross-country evidences the ICT adoption to increase manufacturing production (Gallego, Gutiérrez, & Lee, 2015; Gono, Harindranath, & Özcan, 2013; Kılıçaslan, Sickles, Kayış, & Gürel, 2017; Madonsela, Mbecke, & Mbohwa, 2013; Mitra, Sharma, & Végonzonnès-Varoudakis, 2016; Olamide, Oyebisi, & Olabode, 2014; Pillay, 2016).

In analyzing the influence of ICT on manufacturing value added, it is necessary to include control variables, namely labor and capital. Numerous studies have concluded that labor and capital have a positive and significant impact on manufacturing production and value added (Adejumo, 2013; Anyanwu, 2018; Baker & Holsinger, 1996; Baranwal, 2019; Berndt, Morrison, & Rosenblum, 1992; Creamer, Dobrovolsky, & Borenstein, 2015; Deliktas, Önder, & Karadag, 2009; Fajana, 1973; Goldar, 2000; Goldar & Ishigami, 1999; Hejazi & Pauly, 2003; Karadag, Deliktas, & Önder, 2004; Kochan, Lansbury, & Verma, 2005; Miyamoto, 2003; Nagaraj, 1994; Rani & Unni, 2004; Ritchie, 2002; Rowthorn, 1995; Teal, 2016; Vivarelli, Evangelista, & Pianta, 1996; Wang, 2009; Zheng, Soosay, & Hyland, 2008).

The previous literature mainly discussed country-specific evidence on ICT adoption in manufacturing value added. Therefore, this study bridges comparative analysis of the role of ICT, labor, and capital in manufacturing value added by the level of economies among Asian countries.

III. METHODOLOGY

3.1. Data Sources

We use the Manufacturing Value Added (% of GDP), from World Bank as the response variable. This indicator is a measure of manufacturing output as a share of a country's economy. Meanwhile, ICT indicators, as the predictor variable, that we use are fixed-broadband subscriptions per 100 inhabitants, fixed-telephone subscriptions per 100 inhabitants, percentage of individuals using the internet, mobile-cellular telephone subscriptions per 100 inhabitants, and secure internet servers per 1 million people. These ICT data are taken from the International Telecommunication Union (ITU) and the World Bank. In addition, we use employment in industry (% of total employment) as a proxy of labor variable and gross capital formation (% of GDP) as a proxy of the capital variable. We also use group level of economies, namely: lower-middle, upper-middle, and high-income countries to analyze specific patterns in each group. All data are collected from 2010 to 2018. This study analyses 35 Asian Countries due to the incompleteness of the country data.

3.2. Data Analysis

We use balanced panel data analysis to estimate the impact of ICT indicators, as proxy of technology adoption (fixed-broadband subscriptions per 100 inhabitants, fixed-telephone subscriptions per 100 inhabitants, percentage of individuals using the internet, mobile-cellular telephone subscriptions per 100 inhabitants, and secure internet servers per 1 million people), on Manufacturing Value Added (MVA) as a per cent of GDP of Asian countries. We adopt the extension of Cobb Douglass production function as follow:

$$MVA_{it} = f(\text{FixedBB}_{it}, \text{FixedTelp}_{it}, \text{Internet}_{it}, \text{MobileCell}_{it}, \text{SecureServers}_{it}, \text{Labor}_{it}, \text{Capital}_{it}) \quad (1)$$

where at period t and country i , MVA refers to Manufacturing Value Added (% of GDP), FixedBB is fixed-broadband subscriptions per 100 inhabitants, FixedTelp is fixed-telephone subscriptions per 100 inhabitants, Internet is the percentage of individuals using the internet, MobileCell is mobile-cellular telephone subscriptions per 100 inhabitants, SecureServers is secure internet servers per 1 million people, Labor is employment in industry (% of total employment), and Capital is the gross capital formation (% of GDP).

We allowed for the time and country effect as our model utilized the panel estimation technique. The fixed effect assumed constant error for each Asian country. The panel data estimation for v and u assumed that each country has its own behavior and influenced by different factors represented by the slope and intercepts that is constant across countries and time. In this paper, we analyze the impact of predictor variables on MVA by income group levels separately. There are two kinds of panel regression methods, namely the fixed effect model and random effect model.

Fixed Effect Model:

$$MVA_{it} = \alpha_i + \beta_1 \text{FixedBB}_{it} + \beta_2 \text{FixedTelp}_{it} + \beta_3 \text{Internet}_{it} + \beta_4 \text{MobileCell}_{it} + \beta_5 \text{SecureServers}_{it} + \beta_6 \text{Labor}_{it} + \beta_7 \text{Capital}_{it} + u_{it} \quad (2)$$

where $u_{it} \sim N(0, \sigma_u^2)$. An individual intercept α_i are included to control for individual-specific and time-invariant characteristics. That intercepts are called fixed effects. Independent variables cannot be time-invariant. All time-invariant variables effects are represented by the intercept. Fixed effects capture individual heterogeneity. The estimation methods of the fixed effect model are Least Square Dummy Variable (LSDV) estimator or the fixed effect estimator. However, it is not feasible to use the least square dummy variable estimator when N is large.

Random Effect Model:

$$MVA_{it} = \alpha + \beta_1 FixedBB_{it} + \beta_2 FixedTelp_{it} + \beta_3 Internet_{it} + \beta_4 MobileCell_{it} + \beta_5 SecureServers_{it} + \beta_6 Labor_{it} + \beta_7 Capital_{it} + u_{it} \tag{3}$$

The error component (u_{it}) is the sum of the individual specific random component (μ_i) and idiosyncratic disturbances (ϵ_{it}):

$$u_{it} = \mu_i + \epsilon_{it} \tag{4}$$

where $\mu_i \sim N(0, \sigma_\mu^2)$ and $\epsilon_{it} \sim N(0, \sigma_\epsilon^2)$. Independent variables can be time-invariant. The individual random effects are independent. The estimation methods of random effect model are Generalized Least Square (GLS).

IV. RESULTS AND FINDINGS

4.1. Overview of the ICT Indicators and MVA in Asian Countries

The trend of MVA in Asian countries by level of economies can be seen in Figure 2 to 4. It can be concluded that in general MVA is constant, except for Oman which has drastically decreased. This is interesting because in the ICT era, technological disruption in all aspects including the manufacturing sector should be able to encourage increased added value.

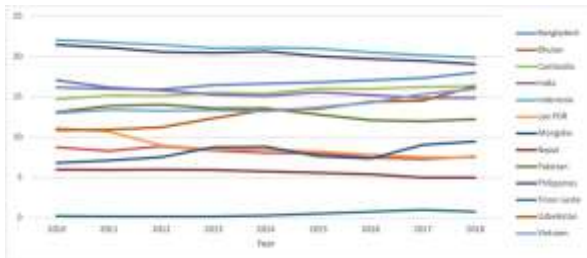


Figure 2. MVA (% of GDP) of Lower-Middle Income Asian Countries

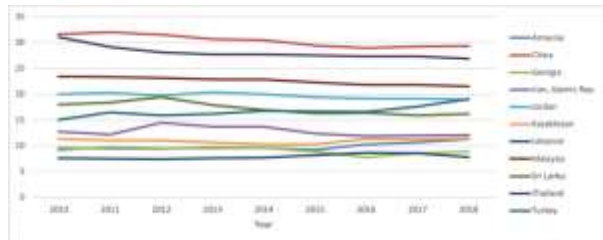


Figure 3. MVA (% of GDP) of Upper-Middle Income Asian Countries

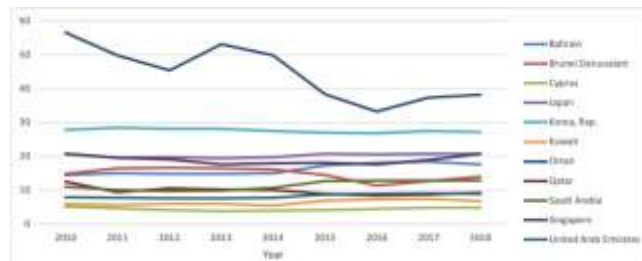


Figure 4. MVA (% of GDP) of High-Income Asian Countries

The ICT indicators use in this study are explained in the data source. The development of ICT indicators by the income group for the Asian countries are presented in Figure 5 to 19.

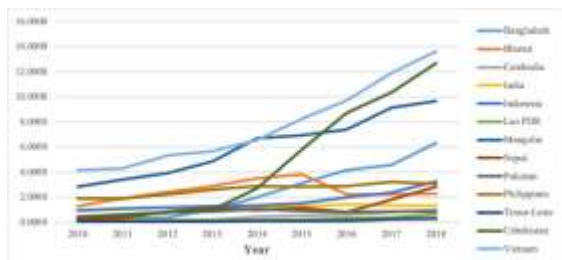


Figure 5. Fixed broadband subscriptions per 100 inhabitants of Lower-Middle Income Asian Countries

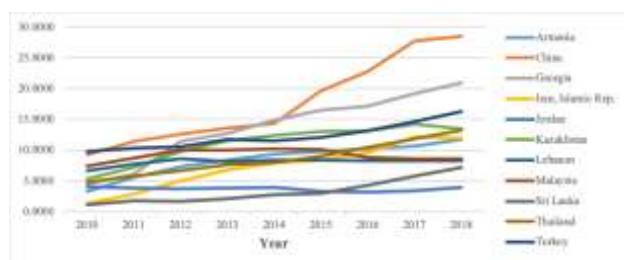


Figure 6. Fixed broadband subscriptions per 100 inhabitants of Upper-Middle Income Asian Countries

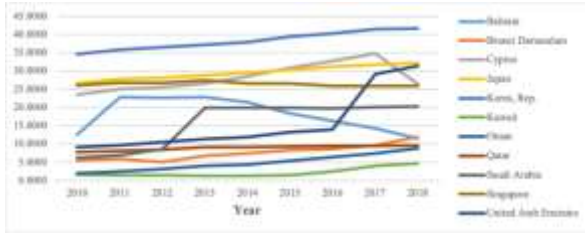


Figure 7. Fixed broadband subscriptions per 100 inhabitants of High-Income Asian Countries

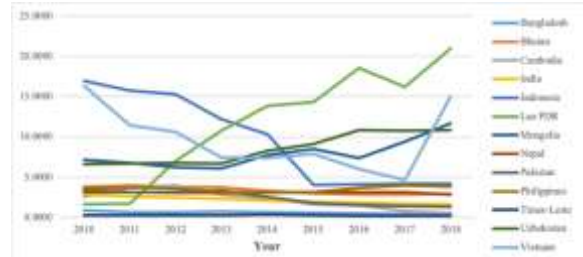


Figure 8. Fixed telephone subscriptions per 100 inhabitants of Lower-Middle Income Asian Countries

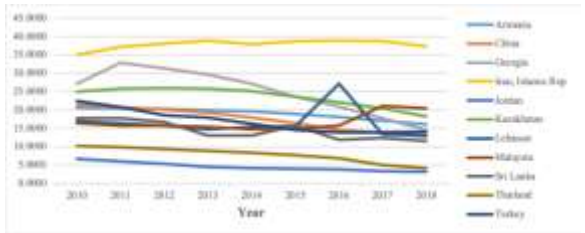


Figure 9. Fixed telephone subscriptions per 100 inhabitants of Upper-Middle Income Asian Countries

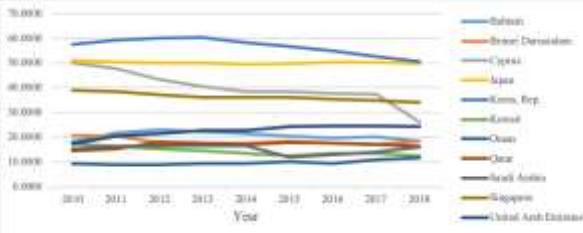


Figure 10. Fixed telephone subscriptions per 100 inhabitants of High-Income Asian Countries

For fixed broadband subscriptions (Figure 5-7), shows an increasing trend for most lower-middle and upper-middle-income countries, whilst for the high-income group, some of the countries experiencing slight increasing, while others experiencing decline trends such as Cyprus, Singapore, and Bahrain. Meanwhile, mixed trends have been shown by fixed telephone subscriptions. For lower-middle-income as shown in Figure 8, some countries experienced very high growth such as Lao PDR. On the contrary, some countries are experiencing a decrease, such as Vietnam and Indonesia. The remaining countries have relatively constant development. The trend of fixed telephone subscription in 10 upper-middle countries shows a decreasing trend, except Iran (Figure 9). In high-income countries, the trend of fixed telephone subscription has relatively constant (Figure 10).

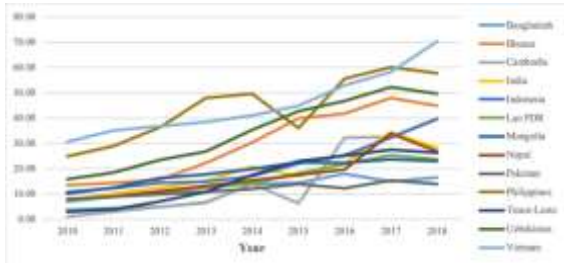


Figure 11. Percentage of Individuals using the Internet of Lower-Middle Income Asian Countries

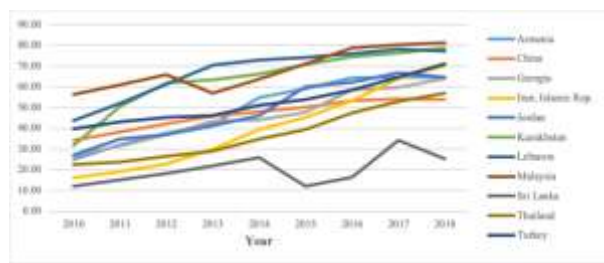


Figure 12. Percentage of Individuals using the Internet of Upper-Middle Income Asian Countries

As illustrated in Figure 11-13, the percentage of individuals using the internet shows a positive trend in all income group countries. However, the percentage amount for each income group is different, the highest percentage belong to high-income countries, followed by upper-middle and lower-middle-income countries.

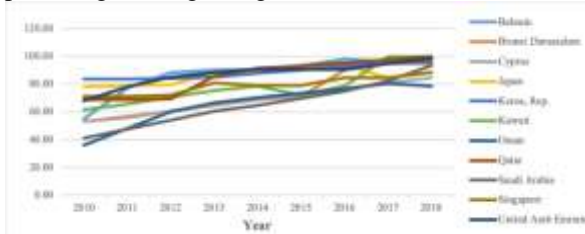


Figure 13. Percentage of Individuals using the Internet of High-Income Asian Countries

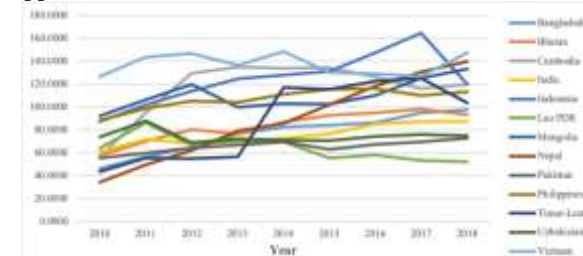


Figure 14. Mobile-cellular telephone subscriptions per 100 inhabitants of Lower-Middle Income Asian Countries

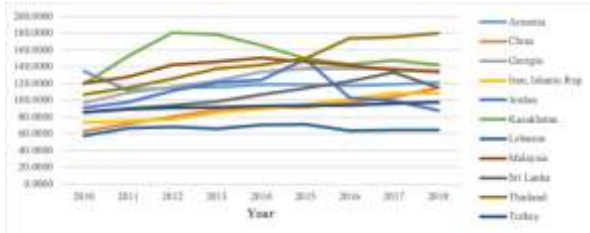


Figure 15. Mobile-cellular telephone subscriptions per 100 inhabitants of Upper-Middle Income Asian Countries

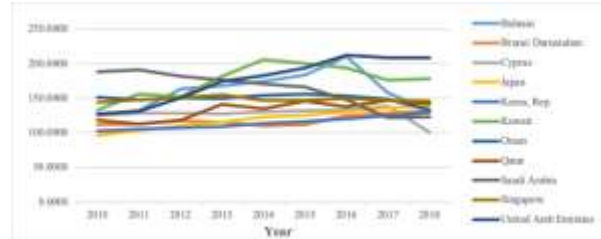


Figure 16. Mobile-cellular telephone subscriptions per 100 inhabitants of High-Income Asian Countries

As shown in Figure 14-16, the mobile cellular telephone subscriptions for all income group are experiencing a positive trend. However, it's increasing as not high as a percentage of individual using the internet. The last ICT indicator used is a secure internet server per 1 million people. As portrayed in Figure 17-19, the development of this indicator shows a rapid and positive trend since 2015. As we know, 2015 is the year of the beginning of the industrial revolution 4.0 and the invasion of the digital economy.

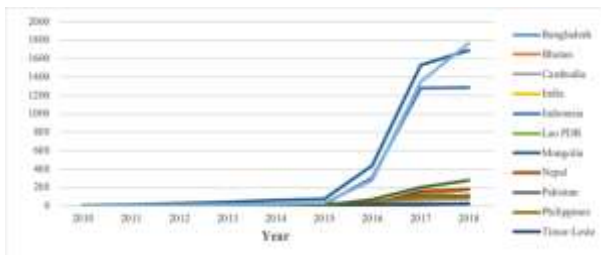


Figure 17. Secure internet server per 1 million people of Lower-Middle Income Asian Countries

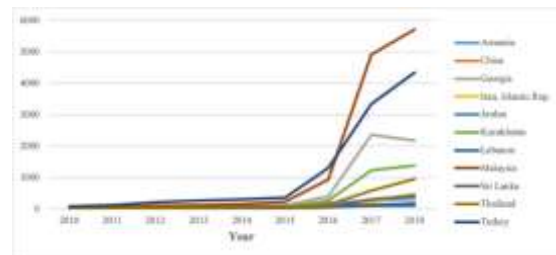


Figure 18. Secure internet server per 1 million people of Upper-Middle Income Asian Countries

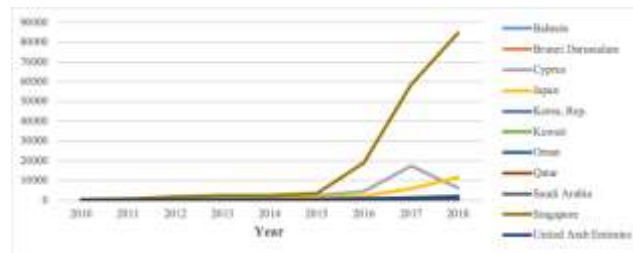


Figure 19. Secure internet server per 1 million people of High-Income Asian Countries

Looking at the development of ICT indicators above, there are some different patterns for each of the income group. To analyze the impact of ICT on manufacturing value added (MVA), we use the statistical method namely the panel regression separately for these income groups.

4.2 The Impact of ICT on the Manufacturing Value Added (MVA) by Income Group

Recent studies on panel data analysis have become more popular among researcher. This part of the analysis is talking about the impact of ICT on MVA in 35 Asian countries based on the respective income group. Therefore, we have three panel regression models, namely for lower-middle, upper-middle, and high income. In this part, we begin several diagnostics. Table 1 gives the summary of diagnostics for three panel regression models.

Table 1. Diagnostics of Panel Regression for Three Income Group Levels

Diagnostic s	Null Hypothesis	Lower-Middle Income Countries		Upper-Middle Income Countries		High Income Countries	
		p-value	Conclusion	p-value	Conclusion	p-value	Conclusion
Tests of poolability	Pooled model (OLS) better than fixed effect (within) model	1.279e-05	Fixed effect performs better than OLS	0.0137	Fixed effect performs better than OLS	0.0007	Fixed effect performs better than OLS
Lagrange	No panel	< 2.2e-16	Random	< 2.2e-16	Random	< 2.2e-16	Random

Multiplier Test - (Breusch-Pagan) for random effect	effect; Pooled model (OLS) better than random effect model		effect performs better than OLS		effect performs better than OLS		effect performs better than OLS
Hausman Test	Preferred model is random effects vs. the alternative the fixed effects	< 2.2e-16	Fixed effects perform better than random effects	1.768e-08	Fixed effects perform better than random effects	0.9926	Random effects perform better than fixed effects
F test for individual effects	No individual effect (One-way time effects error component)	< 2.2e-16		< 2.2e-16		< 2.2e-16	
F test for time effects	No time effects (One-way individual effects error component)	0.7460	One-way (individual) effect model	0.2997	One-way (individual) effect model	0.9251	One-way (individual) effect model
Breusch-Pagan Heteroscedasticity Test	Homoscedastic	0.04163	Heteroscedastic	0.011	Heteroscedastic	1.603e-12	Heteroscedastic

Note: significance level using alpha 5 %

Regarding the diagnostic results, our analysis finds that the utilization of panel data is well suited for this type of samples data. This analysis uses GLS instead of OLS to solve the problem of heteroscedasticity. Based on Table 1, the best model for lower-middle-income countries is fixed effect model. The F test for individual effects and time effects concludes that the best model is one-way individual effect model. So, the preferred model is one way (individual) - fixed effect model. Similar to lower-middle-income countries, the best model for upper-middle-income countries is one way - fixed effect model using robust estimation. Meanwhile, the preferred model for high-income countries is one-way individual random effect model. It shows that GLS with random effect should explain better relative to fixed effect model. In other words, MVA in high income Asian countries is influenced by only country-specific random effects. The model estimation results for these three panels regression analysis is shown in Table 2.

Table 2. Impact of ICT on MVA by Income Group

	Lower-Middle Income		Upper-Middle Income		High Income	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	-	-	-	-	11.0560	9.4621
FixedBB	0.4650 ^a	0.0486	-0.0434	0.0407	0.0275	0.1033
FixedTelp	-0.0493 ^b	0.0237	-0.0029	0.0360	-0.1711	0.1676
Internet	0.0305 ^a	0.0094	0.012	0.0106	-0.0649	0.0314
MobileCell	-0.0016	0.0041	0.0215 ^a	0.0075	0.0185	0.0159
SecureServers	-0.0003	0.0003	-0.0001	0.0001	0.0004 ^a	0.0001
Labor	-0.1099	0.0779	-0.1332	0.1141	0.4869 ^b	0.2577
Capital	0.0222 ^b	0.0125	0.0797	0.0356	-0.0502	0.0724
R²	0.5329	-	0.3095	-	0.1303	-
Adjusted R²	0.4415	-	0.1646	-	0.0634	-
F or Chisq. Statistics	15.8115	-	5.1871	-	13.6352	-

^aDenotes significance level for 1 % level

^bDenotes significance level for 5 % level

Based on the results in Table 2, it can be seen that there are differences in the significance of ICT indicators in the three income groups. We find that fixed broadband subscription has a positive and significant impact at 1 % significance level on MVA only at lower-middle-income countries. Over the sample period studied, 100 unit increase in fixed broadband subscription leads to about 0.4650 rises in manufacturing value added. The effect of a fixed broadband subscription is positive on MVA, except for upper-middle-income countries. This is allegedly because the fixed broadband subscription has begun to be abandoned, especially in developed countries because it is less flexible.

The result also shows that fixed-telephone subscription has a negative and significant impact on MVA at 5% significant level. However, fixed telephone subscription significantly affects the MVA only in lower-middle-income countries. The direction of the relationship is negative, in other words, over the sample period studied, 100 unit increase in fixed telephone subscription leads to about 0.0493 declines in MVA. This implies that the MVA does not fully benefit from the fixed telephone subscription. According to the ITU 2017 statistics, the total number of subscribers of fixed-telephone was about 1.26 billion. Due to upgrades in digital technology and the conveniences, by switching to wireless (cellular) or internet-based alternatives, this number has continuously decreased.

Percentage of individual using the internet has a positive and significant impact on MVA only on lower-middle-income countries at 1% level of significance. This means that the data used in this study cannot support the hypothesis that the percentage of individual using the internet positively influences MVA in upper-middle-income countries and high-income countries; even in high-income countries showing a negative relationship.

Mobile cellular telephone subscription has a significant impact on MVA only in upper-middle-income countries at 1% level of significance. The effect is positive so that 100 unit increase in mobile cellular telephone subscription leads to about 0.0215 rises in MVA. Meanwhile, secure internet servers have a significant impact on MVA only in high-income countries at 1% level of significance. The positive sign shows that in high economic countries, security is very important in adopting ICT in the production process of the manufacturing sector.

Of the three income groups, the biggest role of ICT is in the lower-middle-income group. This is seen in R² and adjusted R² which is highest at 0.5329 and 0.4415, respectively. The smallest role of ICT is in the high-income countries group, where ICT only contributes to the MVA of less than 15 per cent. This can be seen in R² and adjusted R², which is only 0.1303 and 0.0634, respectively. From Table 2, we can see that grouping Asian countries into 3 classes has a significant role in controlling the different influence of ICT on MVA.

Table 3. Fixed Effect in The Form of Deviation from The Overall Mean

Lower-Middle Income Countries			Upper-Middle Income Countries		
Countries	Estimate	Standard Error	Countries	Estimate	Standard Error
Bangladesh	3.8605 ^a	1.5089	Armenia	-7.3299 ^a	2.3484
Bhutan	-5.7468 ^a	0.9853	China	12.6605 ^a	3.8017
Cambodia	4.8320 ^a	1.9519	Georgia	-8.5964 ^a	2.1691
India	4.0031 ^a	1.8751	Iran, Islamic Rep.	-3.9425	4.4630
Indonesia	9.5299 ^a	1.6889	Jordan	3.1568	2.9122
Lao PDR	-3.5828 ^a	0.8565	Kazakhstan	-5.3451 ^b	2.8483
Mongolia	-6.0271 ^a	1.5198	Lebanon	-9.9477 ^a	3.0205
Nepal	-7.2954 ^a	1.0601	Malaysia	6.8767 ^a	3.4450
Pakistan	1.7499	1.7633	Sri Lanka	0.5242	3.2560
Philippines	8.4145 ^a	1.1931	Thailand	12.1019 ^a	2.6223
Timor-Leste	-11.9497 ^a	0.7794	Turkey	-0.1584	3.3666
Uzbekistan	1.4484	2.2506			
Vietnam	0.7633	1.6699			

^aDenotes significance level for 1 % level

^bDenotes significance level for 5 % level

Based on Table 3, it can be concluded that in lower-middle-income countries, fixed effects are significantly different from the overall mean of almost all countries, except Pakistan, Uzbekistan, and Vietnam. In other words, these three countries are at an average MVA value in the lower-middle economies group. The three countries with the most deviations that lag behind the average group are Timor-Leste, followed by Nepal and Mongolia. On the other hand, the country with an MVA average far surpassing other countries in the group is Indonesia. This is alleged because foreign investment in Indonesia is growing large (ASEAN Briefing, 2019). In addition, in terms of manufacturing, Indonesia has closed trade ties to China.

In the upper-middle-income countries, the fixed effect significantly different from the overall mean experienced by Armenia, China, Georgia, Kazakhstan, Lebanon, Malaysia, and Thailand. In this group, countries with MVA values far exceeding other countries are China and Thailand. This is alleged because China successfully developed the supply chain. (Asawachintachit & General, 2012) reveal that nowadays Thailand is the automotive manufacturing hub of Asia. However, Lebanon, Georgia and Armenia are still below mean of the group. This shows that even in one income group, there is still a gap in the value added of the manufacturing sector to GDP.

Table 4. Error Components of Random Effect

Effect Component	Share	Variance	Std. Dev.
Idiosyncratic (σ_ϵ)	0.02	6.719	2.592
Individual (σ_μ)	0.98	337.726	18.377
Theta (θ)			0.953

In the case of high-income countries, the random effect can be explained by the variance of the components of the errors. Table 4 shows the error components of random effect, namely: idiosyncratic and individual components; estimated using Swamy-Arora method. From Table 4, we can make a conclusion that the most contributed in error components of the random effect in high-income Asian countries is individual components (variance among countries) with a share of 98 % of the total error. Thus, synergy among high-income countries, lower-middle-income countries, upper-middle-income countries in Asia needs to be improved to create a sustainable global manufacturing value chain, so that the positive impact of manufacturing sector development can be an engine of growth for all countries in Asia.

V. CONCLUSIONS

ICT can significantly contribute to the MVA in Asian countries, with different impacts for different types of economies levels. The study supports the policy recommendation that the government of each country should increase attention in the diffusion of ICT to fasten and increase the MVA in Asia. Of the three income groups, the biggest role of ICT is in the lower-middle-income group. This indicates that the increase in MVA in lower-middle-income countries can be accelerated by an increase in the ICT indicator. The situation is different in high-income countries where the possibility of MVA is already high so that the role of ICT is at its saturation point. It is important for the leaders of Asia countries to take this opportunity to learn and adapt the knowledge of ICT through knowledge sharing such as transfer technology from high-income countries in order to boost MVA. GVCs also can complement industrialization and development of manufacturing sectors. Lower-middle-income countries are required to improve quality and production capacity by optimizing domestic employment, ICT adoption, boosting capital formation by domestic and foreign investment.

VI. ACKNOWLEDGEMENT

The authors gratefully acknowledge the use of the services, facilities, and funding from the Politeknik Statistika STIS.

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