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The role of digital technology towards the convergence of economic growth in ASEAN+3

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Abstract

The role of digital technology development has changed the global economy constellation to a more dynamic state in terms of easiness and efficiency in all sectors of economic activity and social community including those of ASEAN countries. The role of digital technology in the economy is crucial to improve the acceleration and the convergence of the economic growth in all countries. This research aims at analyzing the influence of digital technology towards the convergence of economic growth in ASEAN+3 countries. The data used are panel data from ASEAN+3 countries including all member of ASEAN and plus three other countries such as China, Korea, and Japan within the period of 2001-2015. The analysis method used is dynamic panel Arellano-Bond Generalized Method of Moments (GMM) with Gross Domestic Product (GDP) and the fixed broadband subscription per 100 people as the variables. The finding reveals that the role of the technology is significant to reach conditional beta-convergence in which low-income countries indicates the ability to be convergent with nearly similar growth their counterparts. Meanwhile, the half-life value for conditional beta-convergence model requires 10 years to reach the steady state of condition from its convergence process with acceleration reaching 0.069% / year.

Keywords: Digital Technology; Economic of Growth; Convergence; Dynamic Panel

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1. Introduction

The global economy dynamics cannot be separated from the development of digital technology with unlimited space and time in several countries in all level of society. The revolution of digital technology contributes to the development of developing countries (Zwass, 2003). Digital technology has enable businesses and is more efficient in terms of transaction cost. Moreover, it also creates new businesses and gives advantages for the investment as the complementary aspects for human capital and institutional changes. The number of internet users has grown rapidly in a decade. On the other hand, it faces complexity and dynamics of the value chain in business.

As one of the developing regional economy area nowadays, in its 2025 blue print, ASEAN mentions that the direction of ASEAN economy integration from 2016 to 2025 is improving digital technology to increase the economic growth (ATKearney, 2017). ASEAN has potential to be the top five digital economies in the world in the year of 2025 in which digital economy will be able to increase GDP of $ 1 trillion in 10 years ahead. In the period of 2000 to 2015, fixed broadband subscription penetrates 10% in Malaysia, Thailand and Vietnam and more than 80% people uses internet in Singapore, and 70% internet users can be found in Malaysia and Brunei as well as 20% in Lao People's Democratic Republic and Cambodia (World Bank, 2016). Master plan ASEAN Connectivity in 2025 mentions technology innovation as one of the strategy to reach connectivity in line with the potentials of economic growth in ASEAN countries as supported by infrastructure provision, digital service regulation, best practice for open data and an increase in the technology accessibility for Micro, Small and Medium Scale Business. The study's purpose is to find out the influence of digital technology towards the convergence of economic growth in ASEAN+3 countries.

2. Theoretical background and empirical studies

2.1. Theoretical background

The influence of technology to economic growth cannot be separated from the role of human capital in growth theory. Lucas (1990) mentioned that human capital is a determinant of economic growth, meanwhile Romer (1990) explains that the economic growth depends on research and development. In this case, human capital is also considered as the determinant of growth convergence in both developed and developing countries (Lucas, 1988; Romer, 1986). Solow (1956) stated that the determinant of economic growth is change in technology and science in improving skills and efficiency. Furthermore, the new theory on economic growth argued that technology becomes the source of economic growth (Verspagen, 2000).

The first Neoclassical Model was developed by Solow (1956, 1967) with grow model introducing convergence concept, while the new endogen grow model proposed by Romer (1986) and Lucas (1988) stating that it is technology that becomes the driving factors for the growth. In this case, the accumulation of knowledge plays important role for the growth. The study by Grossman and Helpman (1994) emphasized technology diffusion amongst countries. Further, it states that the advanced technology is transferred to

various countries where Research and Development becomes very crucial. It is also mentioned that in endogen growth model, in long term period, the growth will depend on the government policy such as tax, intellectual property rights, legal law, governance, democracy, education system, and the openness in supporting the regional economic growth. According to Solow model occurs for two reasons, first, the high potentials in capital return in countries with low revenues by increasing capital flow and second, countries with low income and technological gap with the developed countries will have fast growing productivity. The capital return in developing countries are lower compared to their developed counterparts. Hence, the capital flow is influenced by security and the government policy instead of income. Even in countries with higher capital return level may not be able to withdraw the international capital flow due to politics and economical risks and insecure environment. Furthermore, there is no evidence of developing countries having higher productivity growth (Kalbasi, 2010).

2.2. Empirical studies

Several studies on digital technology role towards economic growth have been done in various countries. Study by Hodrab et al. (2016) mentioned that Information and Communication Technology (ICT) shows positive impact to the economic growth in Arabian Countries, however, such impact is still smaller than that off merging countries and other developed countries. Furthermore, the study conducted by Naymi and Hossain (2016) researching the impact of ICT investment in the economic growth in Bangladesh in the period of 1997 to 2013, revealed that there is a positive relation between ICT and the economic growth. Compared to SAARC countries, Bangladesh was slower. Consequently, infrastructure construction, ICT training, international collaboration and export ICT product promotion etc.

Jamali et al. (2007) used the new neoclassical growth model to identify the determinant for economic growth and the political influence in the 1990s. The results shows that economic growth was determined by copy rights and educational investment. Technology becomes prerequisite in production efficiency and in economic growth. Amavilah's study (2007) estimated technology marginal impact as the knowledge on the economy performance in Botswana, Namibia and South Africa in the period of 1976-2004. The result found that the capital, trade openness and government revenue shares influenced the economy performance and the technological changes as well as basic knowledge to construct technological changes. The term of "manna from heaven" means technology becomes the primary determinant of real per-capita income. Technology is measured by the number of publications increasing through social capability and technological congruence. In contrast to the previous researches, this study analyzes the influence of technology to economic growth convergence in ASEAN+3 countries.

Meanwhile Torero et al. (2002) and Sridhar and Sridhar (2004) emphasized the role of technology in the developing countries are in the form of telecommunication both in fixed form and the mobile ones to increase network and growth. On the contrary, in developed countries, due to differences and life style changes, the demand of mobile communication increases to foster productivity. Consequently, the penetration of fixed broadband cannot reach 100%. The advance of telecommunication penetration level in developing countries is still considered new and low compared to that of developed counterparts. Study by Sridhar and Srihar

(2004) in 28 developing countries in the period 1990-2001, revealed that 1 percent increase of cellular phone boosted up the economic growth in as much as 6.75 percent.

3. Method of analysis

The dynamic panel model of Arellano Bond – Generalized Method of Moment (AB-GMM) was used to analyze the determinant of economic growth and to count the beta convergence of economic growth affected by technology. Beta convergence used in this research was the conditional convergence in ASEAN+3 countries. The use of dynamic panel model is important to eliminate bias and as a consistent predictor of the least square. Baltagi (2005) mentioned that the application of static panel estimation model such as OLS in the dynamic panel equation model becomes bias and inconsistent. According to Anderson and Hsiao (1982), Instrumental Variabel (IV) estimation model can be used by instrumenting the variable correlating with the error. The following is the model specification used for conditional convergence as calculated with the following specification model:

$$\Delta gdp_{i,t} = \beta \Delta \hat{gdp}_{i,t-1} + \gamma \Delta \hat{tech}_{i,t} + v_{i,t}$$

In which, $gdp_{i,t}$ the economic growth in ASEAN+3 countries, $tech_{i,t}$ are the fixed broadband subscriptions per 100 people, whereas $gdp_{i,t-1}$ is the previous year economic growth.

The calculation of beta convergence results in two indicators, the convergence acceleration of economic growth and half-life test. The test of convergence acceleration for economic growth is for calculating how fast the economic growth reaching the steady state, a balance line in which the economic growth are similar in each countries. Half-life Test (t*) indicates time to reach steady state condition from the convergence process of economic growth or time required for reaching half of the convergence of economic growth.

The type of data in this study are secondary panel data in a combination of time series and cross section data with time period of 2001-2015 in ASEAN+3 countries including Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam plus the other three, China, Korea and Japan. The total observations are 195. The variable used are Gross Domestic Product (GDP) annual percentage growth rate at market prices based on constant 2010 U.S. dollars, and fixed broadband subscriptions per 100 people.

4. Result of analysis

4.1. The Digital technology and the conditional beta convergence of Economic growth in ASEAN+3

The beta convergence in the economic growth in ASEAN+3 consists of absolute and conditional beta convergence. Absolute beta convergence does not depend on the characteristic of each observed object due to diverse economy condition and the same level of convergence. On the other hand, in conditional beta

convergence, each observed object reaches the steady state depending on the characteristics of each region and other factors.

Table 1. Estimated Results of Absolute Beta Convergence of Economic growth in ASEAN+3

Dependent Variable: D(GDP)		
Independent Variable	Coefficient	t-Statistic (Probability Value)
D (GDP (-1))	-0.359	-158.647(0.000)
J-Statistic = 12.999; Prob.-value = 0.369		
Arellano-Bond Test: AR (1) m-stat = -2.276; Prob.-value = 0.023		
AR (2) m-stat = -1.815; Prob.-value = 0.069		
Speed of Adjustment λ (%/year) = 0.068		
Half-life (year) = 10.149		

Source: *Data processed, 2017*

Table 1 shows the estimated result of absolute beta convergence using GMM Arellano-Bond two step estimator shows a significant parameter with p-value as much as 0,000 the first lag influence in the economic growth. Dynamic panel model with GMM Arellano-Bond approach has met the criteria as the best model statistically, in terms of its consistency and its valid instrument variable. The residual diagnostic test of Arellano-Bond (AB) of m_2 indicates p-value of 0.069 or does not reject the null hypothesis. The half-life test for absolute beta convergence model demonstrates quite high value of 10.15 years' time needed to reach steady state condition from convergence process or to reach half state of convergence.

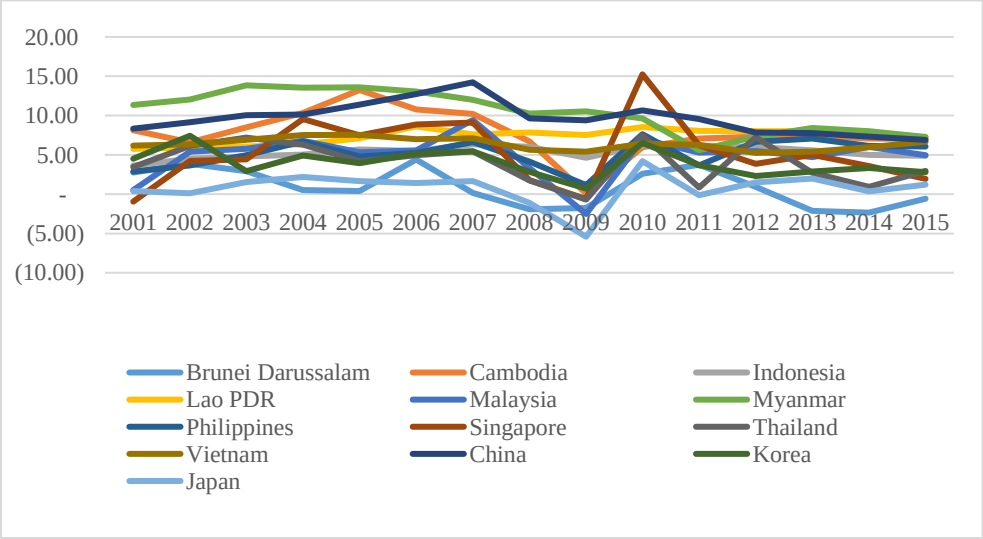

Figure 1. Trend of Economic Growth in ASEAN+3 Countries (Source: http://www.worldbank.org)

The economic growth in ASEAN+3 countries tended to experience long term convergence. Although in 2009, it decreased after global economy crisis in 2008, it revived again in 2010. The differences of economic growth from time to time becomes smaller and smaller with denser line convergence among the countries and reaches its balance convergence. Meanwhile, the conditional beta convergence is each observed object reached

steady state depending on the characteristics of each region and other factors. The affecting variable is fixed broadband subscription per 100 people as the proxy of digital technology role. The role of technology is crucial to drive the economy sector particularly the business sector in correspond to the increase of internet users in ASEAN+3 countries.

The technology development in ASEAN countries as evidenced in the increased internet users from year to year to year has less significant differences compared to those in industrial countries in Asia such as Korea, Japan and China. Singapore, Malaysia and Brunei Darussalam are still leading in the development of technology followed by other ASEAN countries including Philippines, Thailand, Vietnam, Indonesia and the least developed Lao PDR. China is still positioned in the same place as The Philippines compared to other industrial countries such as Korea and Japan.

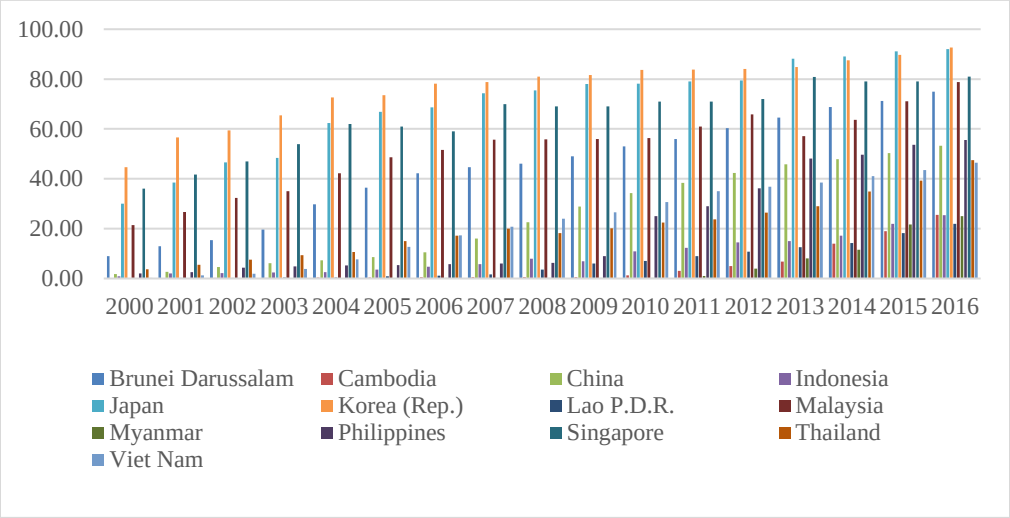

Figure 2. The Percentage of Internet Users in ASEAN+3 (Source**:** ITU World Telecommunication/ICT Indicators Database)

Such condition occurs similarly in the other parts of the world related to the development internet users. The increase of internet users is dominated by Asia Pacific countries and is followed by The US, Europe and the smallest increase is Arab, meanwhile Africa shows higher users. It indicates a turn in which higher internet users were mostly found in developed countries to those in developing countries with higher percentage of technological awareness.

It is also demonstrated that the penetration development of technology indicator such as fixed telephone subscription, mobile cellular telephone subscriptions, active mobile broadband and fixed broadband subscription shows that developing countries still dominates compared to developed or less developing countries (LDCs). Despite a decrease in the penetration trend for fixed telephone subscription after 2012 caused by the change of life style in the society in which they prefer mobile communication. Mobile cellular has the biggest penetration compared to other Information Communication Technology (ICT) as the innovation in telecommunication devices also develops.

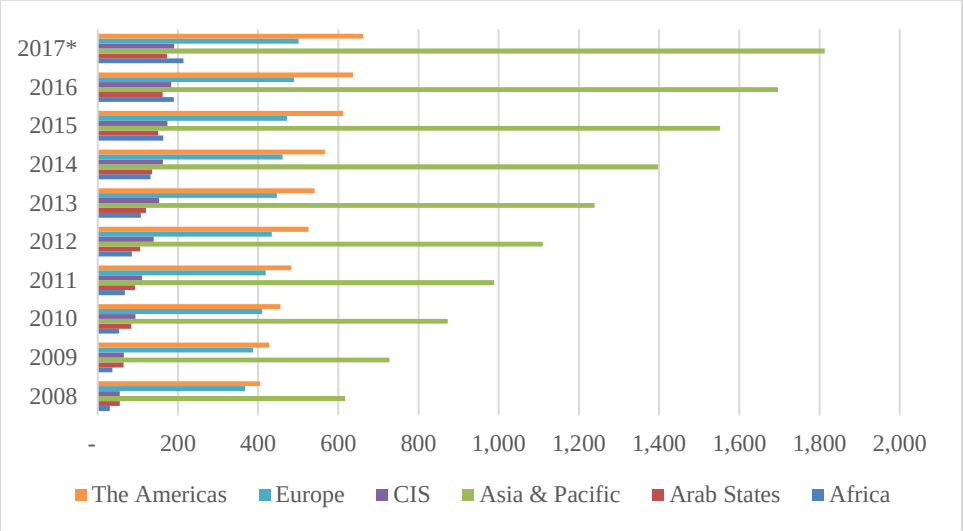

Figure 3. The Percentage of Internet Users in the World (Source: ITU World Telecommunication/ICT Indicators Database)

Table 2. Key ICT indicators (totals and penetration rates in millions)

ICT Indicator	2010	2011	2012	2013	2014	2015	2016	2017*
Fixed-telephone subscriptions								
Developed	553	540	527	516	503	490	479	471
Developing	676	661	653	626	592	556	524	500
LDCs	8	8	9	9	9	8	9	9
Mobile-cellular telephone subscriptions								
Developed	1,404	1,406	1,443	1,479	1,527	1,563	1,603	1,607
Developing	3,887	4,483	4,817	5,183	5,468	5,621	5,909	6,133
LDCs	280	362	426	501	580	638	650	692
Active mobile-broadband subscriptions								
Developed	554	712	829	927	1,015	1,118	1,189	1,227
Developing	253	471	721	1,032	1,645	2,179	2,676	2,993
LDCs	3	11	25	42	95	142	184	219
Fixed broadband subscriptions								
Developed	291	313	328	343	354	370	382	392
Developing	236	285	321	349	377	472	535	588
LDCs	1	1	2	3	5	7	8	10

Source: ITU World Telecommunication/ICT Indicators database

The estimated results using GMM Arellano-Bond two step estimator in table 3 indicates a significant parameter with p-value as much as 0,000 the influence of first lag variable of economic growth and digital technology. The dynamic panel model panel dinamis with GMM Arellano-Bond approach has met the criteria

of the best model statistically referring to its consistence and valid instrument variable indicated by J-Statistic 12.57 value of not rejecting null hypothesis. Meanwhile test for residual diagnostic Arellano-Bond (AB) on m_2 shows p-value of 0.080 or not rejecting null hypothesis on α =5%. Therefore, the estimation can be stated as consistent with no autocorrelation on error first difference in the first order.

Table 3. The Estimation Result of Conditional Beta Convergence of Economic Growth in ASEAN+3

Dependent Variable: D(GDP)		
Independent Variable	Coefficient	t-Statistic (Probability Value)
D(GDP)(-1)	-0.354	-56.174 (0.000)
D(tech)	0.123	6.674 (0.000)
J-Statistic = 12.567; Prob.-value = 0.322 Arellano-Bond Test: AR (1) m-stat = -2.129; Prob.-value = 0.033 AR (2) m-stat = -1.749; Prob.-value = 0.080 Speed of Adjustment λ (%/year) = 0.069 Half-life (year) = 10.01		

Source: Data processed, 2017

Conditional beta convergence has smaller value of beta coefficient compared to absolute beta one. Such condition shows a convergence process of economic growth in which countries with low economic growth are able to reach convergence similarly as others. Convergence also indicates smaller differential economic growth with dense convergence line during research period to reach long term balance. Meanwhile, half-life value for conditional beta convergence model evidences nearly similar as conditional convergence despite its faster period of 10.01 years required to reach steady state from convergence process or time required to achieve half of convergence with convergence acceleration reaching 0.069% / year. However, compared to the estimation of dynamic panel of GMM without involving three countries such as China, Korea Republic and Japan in table 4, technology does not affect the economic growth in ASEAN countries despite its half-life reaching the steady state faster in 9.025 years.

Table 4. The Estimation Result of Conditional Beta Convergence of Economic Growth in ASEAN

Dependent Variable: D(GDP)		
Independent Variable	Coefficient	t-Statistic (Probability Value)
D(GDP) (-1)	-0.316	-19.267 (0.000)
D(tech)	0.074	0.163 (0.871)
J-Statistic = 6.940; Prob.-value = 0.543 Arellano-Bond Test: AR (1) m-stat = -0.694; Prob.-value = 0.487 Speed of Adjustment λ (%/year) = 0.077 Half-life (year) = 9.025		

Source: Data processed, 2017

It shows that industrial countries such as Japan, China and Korea play important role to improve the economic growth and the convergence process through digital technology. Technological transfer in

technology investment becomes the drive for economic growth in ASEAN countries. Apart from the role of the three countries (China, Korea Republic and Japan), ASEAN has quite significant potential to develop digital technology in the global economy as seen in the fast acceleration of economic growth convergence. The difference in the penetration acceleration and diffusion causes diverse growth amongst the countries.

The direction of ASEAN development in 2025 is becoming smart cities countries and cashless society in the world since ASEAN has potentials of 34.5 million of urban population in 2025 and of 25% percent increased urbanization. Consequently pollution, traffic jam and energy demand will also rise. Thus, responding to such phenomena, ASEAN countries' leaders develop smart cities and connectivity, which is then predicted to support the increase of economic growth of 0.7% point. Therefore, to get involved in modernization and digitalization, ASEAN countries apply a policy by establishing independent institution to work on digital economy called the ASEAN Digital Economy Promotion Board functioning as providing direction of strategy, guidance and advice to ASEAN members and Economic Community (AEC).

Several attempts are made to improve digitalization (Deutsche Bank, 2017):

1- Improving broadband access for business through infrastructure investment and digital literacy improvement as well as awareness on digitalization benefit.
2- Increasing innovation in digital financial service, e-commerce and connected cities
3- improving securities and trust on digital economy
4- strengthening digital local economy through regulation for telecommunication provider and tax
5- Increasing digital innovation in all sectors particularly in education both in rural and urban areas as well as protection of intellectual rights.

5. Conclusion

Digital technology has an important role to achieve economic growth convergence in ASEAN+3 countries. Conditional beta convergence indicates a convergence process of economic growth in which countries with low economic growth are able to converge with similar growth as others. Meanwhile, half-life value for conditional beta convergence model shows a period of 10.01 years of required time needed to reach steady state condition from convergence process or the required time to achieve is half from the convergence with the acceleration reaching 0.069% / year.

The role of industrial countries such as Japan, China and Korea in digital technology transfer is crucial to increase economic growth and accelerate the convergence process in ASEAN countries. However, aside from the role of three countries (China, Korea Republic and Japan), ASEAN has quite great significant potential to develop digital technology to correspond the global economy, as seen in the fast convergence acceleration of economic growth.

On the other hand, the use of technology is still facing the complexity and value chain dynamics in business. Consequently, there are three crucial matters to consider, such as devices, networks and applications as well as prolong innovation development and strengthened regulation and digital securities improvement.

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