

Conference Paper

The Causality of Economic Growth and Development of Telecommunications Infrastructure in ASEAN

Purwanti and Dyah Maya Nihayah

Faculty of Economics, Universitas Negeri Semarang

Abstract

The study aims to analyze the causality between development of telecommunications infrastructure and economic growth in ASEAN. The study uses annual time series data from ten ASEAN member countries for the period 1986-2015. The variables employed in this study are development of telecommunications infrastructure and economic growth which analyzed using granger causality test. The evidences show that there is unidirectional causality between development of telecommunications infrastructure and economic growth in Brunei Darussalam, Lao PDR, Myanmar, and Philippines in line with the views of SLH. Then Singapore shows bidirectional causality in accordance with the views of FBH. Indonesia, Cambodia, Malaysia, Thailand, and Vietnam in line with the views of NLH show no causal relationship between the two variables

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Corresponding Author:

Purwanti

purwanti1504@gmail.com

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1. Introduction

The development of telecommunications should be driven by infrastructure in support of access to information so that economic activity will run more efficiently. The telecommunications infrastructure is important not only for economic growth but also to connect the domestic market to the international area. The 21st century as today is characterized by the efforts made by the countries in building the country through telecommunications systems. The developed countries began to build telecommunications infrastructure since before 21st century, while the developing countries begin when these countries are realizing how important telecommunications infrastructure in economic growth. The era of globalization requires a state has the ability to acquire, exploit and process the infrastructure of telecommunications to boost economic growth and improve the national competitiveness.

The development of telecommunications has been felt and deemed necessary by the government of countries as a tool to stimulate economic activity which increasingly

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connected. The economic activities that globally connected requires each country to develop the telecommunications infrastructure. The development and improvement of telecommunications infrastructure is not only carried out by individual countries, but also in an area. The development of telecommunications infrastructure in an area will eliminate the effect of distance and physical barriers.

The importance of the development telecommunications infrastructure is also felt by the ASEAN member countries to support economic cooperation or integration so that the smoothness of information becomes extremely necessary. Recognizing the necessity of information as a basic need, the ASEAN member countries put the telecommunications through digital innovation into the Master Plan on ASEAN Connectivity 2025 (MPAC) as one of the strategies to improve ASEAN connectivity. Moreover, as a consequence has the endorsement of the ASEAN region within the framework of *the* ASEAN Economic Community (AEC) and in order to meet the demands of the world to reach the Millennium Development Goals (MDGs), the connectivity among countries in the region is crucial as an effort to encourage economic activity across country. However, the condition of telecommunications infrastructure in ASEAN countries still showed a gap.

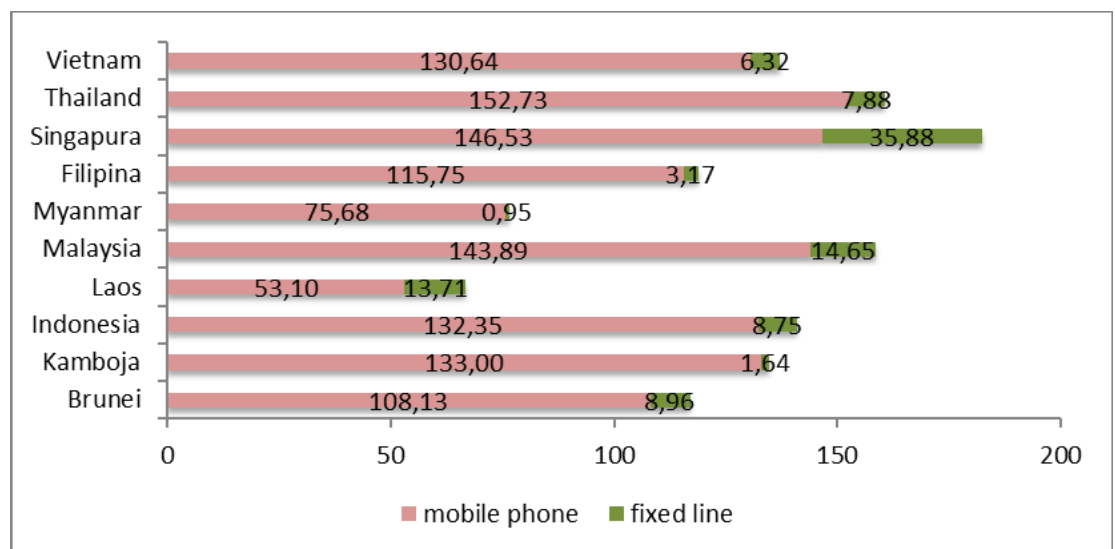


Figure 1: Telecommunications Infrastructure of ASEAN Countries (percent). Source: World Development Indicator (2015).

Based on Figure 1 Singapore has a total penetration with a very high percentage that reached 146.53 percent for penetration of *mobile phone* and 35.88 percent for penetration of *fixedline*. On the other side, Myanmar has a penetration of *fixed-line* that did not even reach one percent, and Lao PDR has a penetration of *mobile-phone* far below the average of 53.10 percent from the average of 119.18 percent. Based on the condition,

the telecommunications infrastructure of ASEAN countries showed a significant digital divide. The digital divide in a region will impede coordination that causes inefficient and not optimal economic activity which resulted in low competitiveness and will further impact on the economy.

A sturdy economic area needs to be supported by adequate telecommunications infrastructure in order to maintain the strength of integration. Telecommunications transmission rates in a country is measured from the level of teledensity..Shiu and Lam (2008) assert that "Teledensity is defined as the number of fixedline and mobile phone subscribers per 100 persons". Teledensity is a standard measurement used to measure the telephone lines per 100 inhabitants in a country. Through the international telecommunication organization or ITU (International Telecommunication Union), the people can monitor the progress of teledensity worldwide.

As pointed out previously that to fulfill the demands of the world in achieving the MDGs is related to telecommunications as one configuration of technological development. The importance of telecommunications for a particular country's economy has been asserted by the ITU that for every 1% growth in teledensity will increase 3% of a country's economic growth [19]. It supports the Solow model that technological advances led to the increasing value of multiple variables simultaneously and steadily (balanced of growth) in the long run, so the economy of a country will be good [14].

Telecommunications infrastructure as a dominant factor in the economy, has a sturdy foundation for its role as a tool in the dissemination of information in the information society. The telecommunications infrastructure is regarded as a strategic aspect to fulfill the needs of the mobilization of a nation power. The role of the telecommunications infrastructure in promoting economic growth has been much discussed in the literature of economics Tella et al (2007) stated that "the development of a modern nation to its full potential in contemporary world can never be attained without adequate telecommunications infrastructure". Development of a nation in modern era, can not be achieved without adequate telecommunications infrastructure.

Several studies have been conducted on the effect of the telecommunications infrastructure to economic growth. However, the phenomenon that happened was the emergence of new ideas and studies (*research gap*) which states that the telecommunication infrastructure and economic growth affect each other or have a bidirectional relationship (causal), and did not even have a relationship.

Dutta (2001), Ding and Haynes (2006), Stetsenko (2007), Tella et al (2007), Ahmed and Krishnasamy (2012) stated that the development of telecommunications infrastructure through other infrastructure and production factors capable of stimulating

economic growth. These results in line with the view of the Supply-Leading Hypothesis (SLH), which argues that the development of telecommunications infrastructure is a prerequisite for economic growth. This is in accordance with what is stated by the ITU that the relationship runs from telecommunications infrastructure to economic growth (unidirectional causality).

The view of *Demand-Following Hypothesis* (DFH) states that economic growth could boost the development of telecommunications infrastructure. Shiu and Lam (2008), Pradhan et al (2014), Kaur and Malhotra (2014) hold the view that the telecommunications infrastructure is only a minor role in the economy. Increasing economic growth extends an impact on the development telecommunications infrastructure. Economic growth will increase somebody's ability to access information. It makes telecommunications infrastructure emerges in many forms to fulfill the needs of the community. These results provide a different view that the relationship runs in the opposite direction (unidirectional causality).

Onakoya et al (2012) with a view of Feedback Hypothesis (FBH) stated that the economic growth and development of telecommunications infrastructure are able to complement and support each other, and it causes these two variables affect each other. The Telecommunications infrastructure is indispensable for economic growth and development of telecommunications infrastructure requires a strong economic growth. This view argues that telecommunications infrastructure and economic growth has a two-way relationship (bidirectional causality).

Wilson et al (2014), Ramlan and Ahmed (2009) maintain that there is no causal relationship between the development of telecommunications infrastructure and economic growth (no causality). These results are consistent with the views of Non-Leading Hypothesis (NLH) which states that the development of telecommunication infrastructure and economic growth are not mutually affecting.

The divergent views due to the different circumstances of each of the factors that influence the development of telecommunication infrastructure and economic growth and it is no exception in ASEAN countries. ASEAN is a region consisting of the majority of developing countries, so the development of telecommunications infrastructure is very important to do.

The dynamics of the development of telecommunications in worldwide-society and has realized the importance of the role of telecommunications in the economy of a country, the researchers found it necessary to analyze the causality of development

of telecommunications infrastructure and economic growth in ASEAN. This study analyzed using the Granger Causality Test that consists of variables DTI (Development of Telecommunications Infrastructure) and economic growth (GDP growth).

2. Methods

This study uses a quantitative econometrics approach and uses secondary data sourced from the International Telecommunications Union (ITU) in order to obtain the data variable of Development of Telecommunications Infrastructure Index (DTI index), World Development Indicators and the United Nations Conference on Trade and Development (UNCTAD) in order to obtain the data variable of GDP growth.

This research using *time series* data from each of the ASEAN member countries, that are Brunei Darussalam, Cambodia, Philippines, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand, and Vietnam from the period of 1986 to 2015. The data obtained will be analyzed further by granger causality method to determine the direction of the relationship of two variables in each country. Then the results of the analysis will be interpreted for further deduced.

Before executing the granger causality test, the first step should be a stationary or unit root test. The stationary test is important in the analysis of time series data. The stationary data shows the average and variance are constant. This study uses Phillips-Perron (PP) for the unit root test. The strength of Phillips-Perron (PP) test is the absence of problems in selecting a lag as well as very appropriate for data time series with significant changes as structural break (increase in inflation sudden, rise in wholesale price index, etc.) [4]. When the unit root test each variable is not stationary, it must be tested further to determine on which degree of integration the variable will be stationary.

The second step is determining the optimal lag length (lag length criteria). The most crucial question when analyzing the model of lag is how to determine the length of lag itself. The use of appropriate lag is very important. A few lag applied to be potentially problematic bias specification whereas too many lag applied will spend degree of freedom, thus the estimation to be inefficient [3]. There are several statistical information multivariate criteria, including AIC, SIC and HQ. The use of multiple criteria can be executed to find a more optimal lag.

The next step is granger causality test. The initial idea of causality test is that cases in the past can lead to cases in the present, but future cases can not cause the current cases [7]. This test determine whether an endogenous variable can be treated

as exogenous. Furthermore the causality test used in this study is to determine the relationship between the Development of Telecommunications Infrastructure (DTI) and economic growth (GDP growth). The granger causality equation model can be written as follows.

$$\text{Growth}_t = \sum_{i=1}^n \alpha_i \text{DTI}_{t-i} + \sum_{j=1}^n \beta_j \text{Growth}_{t-j} + u_{2t} \quad (1)$$

$$\text{DTI}_t = \sum_{i=1}^n \lambda_i \text{DTI}_{t-i} + \sum_{j=1}^n \delta_j \text{Growth}_{t-j} + u_{1t} \quad (2)$$

The next step to determine the causal relationship is F test by comparing the calculated F and F table. If the value of calculated F larger than F table then being rejected of the null hypothesis means that X causes Y or vice versa [10]. Moreover, it can be determined by using *probability* value which compared with the critical value. If the value of *probability* is less than the critical value of 5% then a rejection of the null hypothesis means DTI led to GDP *growth* and or GDP *growth* cause DTI.

3. Results and Discussion

The tests performed in this study aims to determine the direction relationship as well as unidirectional relationship, bidirectional relationship (causal), or no causal relationship through granger causality test between economic growth and development of telecommunication infrastructure of ASEAN countries. The steps before the granger test are data stationary and *lag length* criteria test. Data stationary test aims to see whether the data is stationary or non-stationary. It can be found by comparing the *critical test values* and *absolute values*. If the absolute value PP statistic is greater than the critical value, the null hypothesis is rejected so that the data is stationary.

Based on the data stationary test showed that in average GDP Growth variable of each country is stationary at the level. On the other hand DTI variable in each country has a unit root or data is non-stationary at the level (see Appendix 1). The degree of integration to characterize *non-stationary* process remains to be seen through testing in the *the first difference*.

Appendix 2 shows that procedures of stationary test at the level of *the first difference* obtained the results of the null hypothesis of *unit root* rejected. However, this does not prevail to the countries of Cambodia, Indonesia, Thailand, and Vietnam. The DTI variable still shows the process of non-stationary at the level or at the first difference.

Thus the unit root test for these countries are still to be seen in the second degree of integration (second difference).

Based on a stationary test in the second difference shows that all the variables in each country has been unimpeded from the unit root or data is stationary. The stationary data would avoid from improper modeling and the emergence of spurious regression. Thus, the data that has been stationary can be used for analysis of causality. Before executing the causality test, the next most crucial thing is to determine the lag length criteria.

Based on the test of *lag length criteria* obtained the results that each country has a different lag (see appendix 4). It implies that the treatment of certain variables would an impact on other variables one, two, or three years later in accordance with the optimal lag length. The determination of the optimal lag is an important step before causality test because of the sensitivity of the test towards the lag length criteria.

Once the data is stationary and optimal lag length is known, the next step is granger causality test. The granger causality test shows different evidences from each country because the different conditions. The evidences of causality test show that Cambodia, Indonesia, Malaysia, Thailand, and Vietnam has an independent relationship between DTI and economic growth as in view of NLH. Brunei Darussalam, Lao PDR, Philippines, and Myanmar provide evidence that there is unidirectional causality of DTI to economic growth. The last is Singapore, which provide the evidence bidirectional causality in line with a view of FBH. Based on the data that has been analyzed shows as following.

The view of *Supply-Leading Hypothesis* (SLH) states that the development of telecommunications infrastructure is a precondition for economic growth. Brunei Darussalam, Lao PDR, Myanmar, and Philippines show the results which consistent with the view of SLH that there is a unidirectional relationship between economic growth and the development of telecommunications infrastructure. These results support the findings of Dutta (2001), Ding and Haynes (2006), Stetsenko (2007) and Tella et al (2007).

Brunei Darussalam's telecommunications sector has experienced rapid development and achieve a high enough standard. As in Singapore, Brunei achieved the target of 100% digitalization in the late of 1990s. The penetration rate grew up especially *mobile-phone* in early 2000. Brunei Darussalam has a joint venture with Singapore in the field of education by conducting the INSPIRE program (*Internship Student Program for ICT-related Education*) which aims to provide opportunities for students to improve their knowledge and *skills* in IT with learning experience-based and interaction with professionals.

TABLE 1: Results of Granger Causality Test.

Countries	Null Hypothesis	P-Value	Description	Conclusion
Brunei Darussalam	DTI does not granger cause GDP growth	0.0094	Rejection of H_0	Unidirectional (SLH)
	GDP growth does not granger cause DTI	0.4834	Acceptance of H_0	
Cambodia	DTI does not granger cause GDP growth	0.9764	Acceptance of H_0	Independent (NLH)
	GDP growth does not granger cause DTI	0.2754	Acceptance of H_0	
Indonesia	DTI does not granger cause GDP growth	0.9401	Acceptance of H_0	Independent (NLH)
	GDP growth does not granger cause DTI	0.9353	Acceptance of H_0	
Lao PDR	DTI does not granger cause GDP growth	0.0085	Rejection of H_0	Unidirectional (SLH)
	GDP growth does not granger cause DTI	0.9751	Acceptance of H_0	
Malaysia	DTI does not granger cause GDP growth	0.0986	Acceptance of H_0	Independent (NLH)
	GDP growth does not granger cause DTI	0.0829	Acceptance of H_0	
Myanmar	DTI does not granger cause GDP growth	0.0208	Rejection of H_0	Unidirectional (SLH)
	GDP growth does not granger cause DTI	0.2462	Acceptance of H_0	
Philippines	DTI does not granger cause GDP growth	0.0207	Rejection of H_0	Unidirectional (SLH)
	GDP growth does not granger cause DTI	0.7021	Acceptance of H_0	
Singapore	DTI does not granger cause GDP growth	0.0299	Rejection of H_0	Bidirectional (FBH)
	GDP growth does not granger cause DTI	0.0350	Rejection of H_0	
Thailand	DTI does not granger cause GDP growth	0.9593	Acceptance of H_0	Independent (NLH)
	GDP growth does not granger cause DTI	0.3466	Acceptance of H_0	
Vietnam	DTI does not granger cause GDP growth	0.9392	Acceptance of H_0	Independent (NLH)
	GDP growth does not granger cause DTI	0.3165	Acceptance of H_0	

Source: secondary data, processed

Myanmar has the institution engaged in the development of ICT called the *Myanmar Computer Federation (MCF)*, in 1998 the institution has opened public access centers throughout the country to allow access to telecommunications for its citizens. The Philippines, the government's deregulation of the telecommunications sector in

1995 made the market sector more competitive so that the companies concerned will be more flexible in developing infrastructure telecommunications. The Lao PDR government has a goal to raise living standards and improve the competitiveness of traded business global by prioritizing the development of communication technology. The telecommunications sector, growing rapidly for 29 years and became a pioneer in the national development of economy. Since 1993-1994 the government of Lao PDR began to open up foreign investment in telecommunications. It has implications for the improvement of the provider, so that the particularly penetration of mobile-phone is increasing and now the service has covered the entire country.

The *Feedback Hypothesis* (FBH) stated that the economic growth and development of telecommunications infrastructure is able to complement and reinforce each other, making both variables mutually causal. The research found that Singapore has a bidirectional causality between the development of telecommunications infrastructure and economic growth which is in line with the results of Onakoya et al (2012). Singapore, has the smallest land area among all the countries of Southeast Asia. As a small country with limited natural resources, Singapore had to rely on the knowledge as a key asset of the development. Realizing that, since the beginning of the development of ICT, the Singapore's government has established a policy to reduce the digital divide by developing a knowledge-based economy. In addition, the Singapore's government privatize Singapore Telecommunications Limited (SingTel) in order to more freely this company build infrastructure. Therefore, Singapore now has a well-developed and fast-developed ICT infrastructure. Since the 1990s, the telecommunications infrastructure for fixed telephone network in Singapore has achieved of 100% digitalization consisting of the expansion of fiber-optic network that connects all of the telephone and the submarine cable network that provides global connections [2].

Non-Leading Hypothesis (NLH) hold the view that there is a complete lack of any sort of relationship between telecommunications infrastructure and economic growth. The results showed that the five countries in the ASEAN region, that are Indonesia, Malaysia, Thailand, Vietnam, and Cambodia consistent with the view of NLH that the DTI and economic growth have independent relationship in the period of 1986-2015. These results support findings from Wilson et al (2014), Ramlan and Ahmed (2009), which indicates the absence of a causal relationship between the two variables.

Indonesia, investment and development of telecommunications infrastructure is only carried out in a decent area of business and finance. Although currently the government is aggressively developing of telecommunications infrastructure by implemented palapa ring program since 2015 with the construction of submarine fiber optic, but the

development has not been able to reach into all areas [8]. As a result, some areas can not access telecommunications infrastructure. This suggests that there is still a digital divide among regions in Indonesia.

The digital divide does not only exist in Indonesia, in Thailand the digital divide that occurs between urban and rural areas is quite high. Vietnam, the digital divide occurs because of the availability of telecommunications infrastructure is still below of the average so the economic impact arising from infrastructure of telecommunications is low. Not only in Vietnam, Cambodia also has low infrastructure conditions as well as political and business environments that do not support so the interest of investment especially in the telecommunications is decreased (*The Global Information Technology Report, 2015*). Although the government has adopted a policy of ICT education which aims to improve access to basic education through the use of technology but Cambodia has a weak regulation as the foundation for the spread of market telecommunications.

Support the research of Ahmed and Ramlan (2009) conducted in Malaysia inline with the view of NLH that the development of telecommunications infrastructure in the short-term completely lack of any sort of relationship on economic growth. Investment in telecommunications infrastructure encourage the use of in government environmental, social, and individuals, but has not been able to boost economic growth. Government investment more focused in Kuala Lumpur than other cities. Although the total investment in the telecommunications sector rose from 0.73% of GDP in 1987-1991 to 1.52% in 1992-1995, but the greatest increase occurred in Kuala Lumpur, which reached 30% [16]. The next trend showed a similar increase until now. The concentration of network development of telecommunications infrastructure in Kuala Lumpur make the urban citizens easier to access telecommunications services, but a similar condition is not found in rural areas. Thus, indirectly a digital divide has been created because of the disparity level of investment in products of telecommunications and services between the capital and other regions.

The telecommunications infrastructure has not adequate to be the driving engine for economic growth in these countries. This can be caused by many factors such as lack of investment in telecommunications. Norton (1992), Nadiri and Nandi (2003), and Roller and Waverman (2001) in Ahmed and Krishnasamy (2012) states that "investment in telecommunications infrastructure, with its ability to create spillover effects through network externalities, can impact growth far more significantly than that in any other alternative infrastructure". Investment in telecommunications infrastructure has impact directly on the economy through output of telecommunications industry

and indirectly through the output of other sectors such as manufacture, agriculture, services and others.

The development of telecommunications infrastructure network must also be supported by developments in other sectors. The increase of telecommunications infrastructure itself can not stimulate of economic growth. Thus, the development in the sectors which with the development of telecommunications infrastructure will be able to support and complement each other in promoting economic growth should be a concern, as the business environment, education, human resources through skill training so that the maximum advantage from the telecommunications system can be achieved.

4. Conclusion

Based on the analysis by the granger causality method, the causality between the development of telecommunications infrastructure (DTI) and economic growth in ASEAN member countries show different results. Brunei Darussalam, Lao PDR, Myanmar, and Philippines showed the evidence in line with the view of Supply Leading Hypothesis (SLH) that there is a unidirectional causality which argued that causality runs from DTI to economic growth. Singapore shows the evidence that there is abidirectional causality in accordance with the view of Feedback Hypothesis (FBH) which suggests that DTI and economic growth are mutually causal. Indonesia, Cambodia, Malaysia, Thailand, and Vietnam provide the evidence that there is no causality between the two of variables, consistent with the view of Non-Leading Hypothesis (NLH).

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