Digital Infrastructure and Income Level: Drivers of E-Commerce in Southeast Asian Countries

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ABSTRACT

Aims: This study aims to determine and analyze the effect of GDP per capita and digital infrastructure e-commerce in six Southeast Asian countries.
Study design: This research applies a descriptive quantitative approach.
Methodology: We included internet, fixed broadband, mobile broadband, and mobile cellular as indicators of digital infrastructure. The method used in this research is panel data regression with a fixed effect model (FEM). This research uses secondary data by taking annual data from the period 2017 to 2023 in six Southeast Asian countries such as Indonesia, Malaysia, Singapore, Thailand, Philippines, Vietnam.
Results: The results of this study indicate that GDP per capita, internet and fixed broadband, and mobile cellular have a positive and statistically significant effect on e-commerce. Meanwhile, mobile broadband has no positive effect on e-commerce.
Conclusion: This research is expected to be a consideration for governments in the six Southeast Asian countries to reduce technological backwardness by improving the equity and quality of ICT access to maximize the potential of e-commerce in the digital economy.

Keywords: Digital Economy, E-Commerce, GDP per Capita, Internet, ICT

1. INTRODUCTION

The digital revolution that began at the beginning of the 21st century became the essence of the birth of the industrial era 4.0, which significantly changed how people work and interact (Schwab, 2017). This transformation not only replaces physical machines with digital systems but also overhauls consumption patterns and business models and creates new economic opportunities that are more efficient and effective. Southeast Asia (SEA) is entering the “Digital Decade”, where the digital economy is growing rapidly due to consumer and business behavior shifts. This is marked by the massive digital transformation by innovative MSME players utilizing technology and the emergence of “Unicorn” technology companies such as Shopee, Lazada, Tokopedia, Gojek, and Traveloka (World Bank, 2019). Temasek (2022) estimates that the impact of the internet economy could reach US$1 trillion by 2030. The government launched the “ASEAN Digital Masterplan 2025,” which focuses on improving digital infrastructure and ICT access to catch up with industry 4.0 and accelerate post-pandemic economic recovery (World Bank, 2019). E-commerce is one form of representation of economic digitalization that has successfully created a multiplier effect (Armunanto et al., 2021). The ability of e-commerce to increase efficiency and productivity and expand market share gives it the potential to become a new driver of economic growth (Kinda, 2019).

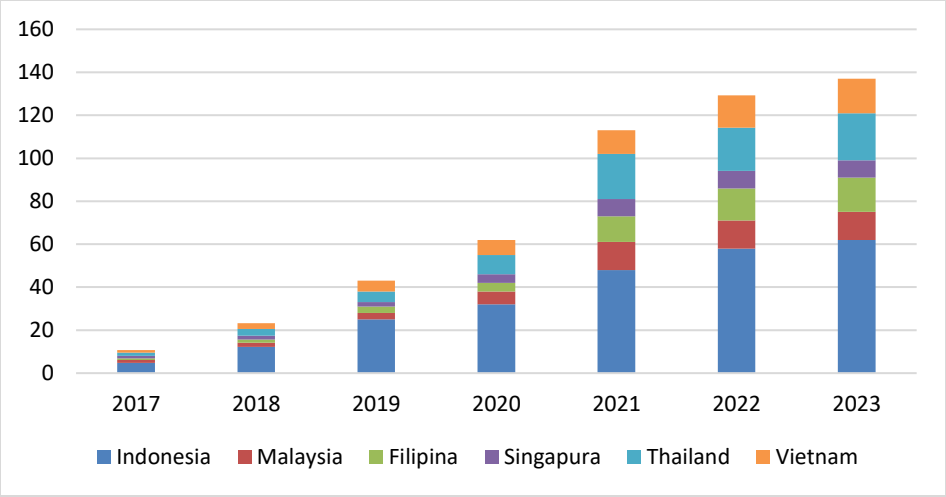

Figure 1. E-Commerce Transaction Value in SEA Countries (in billion US$)
Source: Google, Temasek Holdings, dan Bain & Company (2025)

E-commerce has been the most significantly growing sector in the last seven years and contributes the most to the digital economy in Southeast Asia. Figure 1 shows that the value of e-commerce transactions grew rapidly from only US$10.9 billion in 2017 to US$137 billion by 2023. Indonesia has been the country that has contributed the most to e-commerce transactions in ASEAN over the past seven years. The restrictions on physical activity during the COVID pandemic have made people reduce their shopping activities directly to offline stores and choose online through e-commerce (Badan Strategi Kebijakan Luar Negeri, 2022). Temasek (2022) projects that the transaction value of the e-commerce sector will exceed US$200 billion by 2025. The level of e-commerce progress in a country can be determined by technological factors seen from the development of telecommunications infrastructure and also economic factors that can be seen from GDP and average income. Developing countries face significant challenges in implementing e-commerce due to inadequate telecommunications infrastructure, such as low internet speed, poor network quality, and the high cost of access to internet services (Mthembu, 2018).

The progress of the digital economy sector should be followed by an increase in digital infrastructure, if this is not fulfilled, it can cause a digital divide. The digital divide refers to the gap between people with adequate access to ICT and those with poor access to ICT or even no access at all (Soomro et al., 2020). The digital divide phenomenon in Southeast Asia indicates that the current rapid development of ICT is not accompanied by equitable access to all levels of society. In fact, having a superior telecommunications infrastructure is the substance of digital transformation (ASEAN, 2022). The diffusion of ICT has significantly reduced production costs, improved resource allocation efficiency, and encouraged more significant investment into economic sectors. However, the impact of ICT still depends on each country's level of development (Habibi & Zabardast, 2020).

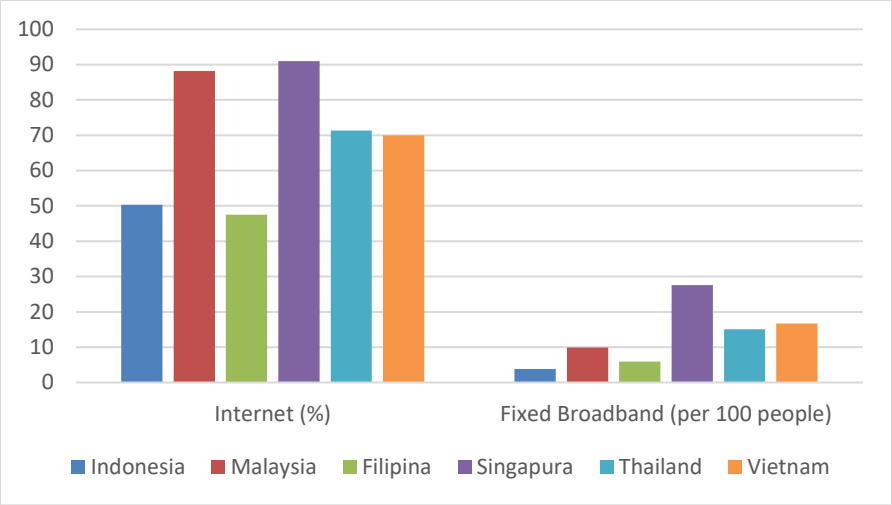

Figure 2. Average Internet Access in SEA Countries 2017-2023
Source: World Bank (2025)

Figure 2 above shows that developing countries such as Indonesia, Malaysia, the Philippines, Thailand, and Vietnam face more complex challenges transitioning to a digital economy than developed countries such as Singapore due to limited telecommunications and financial infrastructure (Oloyede et al., 2023). The International Monetary Fund (IMF) states that there is a correlation between income and the Digital Adoption Index. The higher the income level of a country, the higher the digital adoption index, and vice versa (IMF, 2018). According to Jula et al. (2024), GDP per capita is essential in influencing consumer behavior, market dynamics, technological innovation, and the overall expansion of digital trade. People with high incomes are more able to afford digital access, such as electronic devices and high-speed internet services. They are more likely to fulfill their needs for goods and services through e-commerce than people with low incomes (Olumekor et al., 2024).

Internet connectivity is fundamental to developing the digital economy. A country's digital infrastructure quality can be measured by the internet penetration rate, which is the percentage of the total population that can access the internet (ASEAN, 2022). Figure 2 shows that most people in Indonesia and the Philippines still lack internet access. Broadband infrastructure has a role in expanding internet access and supporting the development of the digital economy in various regions (DJPPI, 2024). High-quality broadband connectivity triggers innovation, encourages economic growth, and efficiency in exchanging goods and services. Broadband can be divided into two types: fixed and mobile. Fixed broadband has a more stable connection than mobile broadband, making it more suitable for business and trade activities. The low fixed broadband service usage level, as shown in Figure 2, is because the average subscription price is still relatively expensive in ASEAN countries (ITU, 2020a). This makes most people in developing countries prefer mobile broadband services to fixed broadband (Oloyede et al., 2023).

Digital infrastructure plays a vital role in developing technologies that support a region’s e-commerce ecosystem. Hussein et al., (2020) stated that the main factors in achieving success in adopting e-commerce are infrastructure adaptability and technology compatibility. If the available technological infrastructure is inadequate, other factors, such as internet connectivity cannot function optimally, potentially hindering the implementation and adoption of

e-commerce in a region (Kabir et al., 2020; UNCTAD, 2019). Infrastructure challenges are often found in developing countries where the internet network quality is low and unstable, the cost of subscription to internet access is high, and the logistics network has not been integrated. In fact, internet infrastructure is a crucial element in operating e-commerce platforms, including smooth transactions. Therefore, efforts to transform the digital economy in developing countries must prioritize increased investment in developing and distributing digital infrastructure throughout the region (Mthembu et al., 2018; UNCTAD, 2019).

Most other studies (Appiah-Otoo & Song, 2021; Bahrini & Qaffas, 2019; Haftu, 2019; Myovella et al., 2020; Ximei et al., 2024) focus on analyzing the effect of ICT infrastructure such as internet, fixed broadband, mobile cellular, and landline on economic growth as proxied by GDP and GDP per capita. Based on these studies, there are still inconsistencies in the research results. Appiah-Otoo & Song (2021) recommend that future researchers raise topics related to e-commerce due to the ICT revolution. Therefore, we conduct research related to the effect of income and ICT infrastructure on the value of e-commerce transactions, which, to our knowledge, has not been done by many other researchers, especially in the Southeast Asia region, so that it can be a novelty in this study. This study empirically analyzes the endogenous growth theory by Romer (1990) and the diffusion of innovation theory by Rogers (2003). The endogenous growth theory by Romer (1990) emphasizes that the accumulation of knowledge and technology can drive economic growth in the long run. The diffusion of innovation theory by Rogers (2003) explains how an innovation is introduced, evaluated, and accepted or rejected by people in a social system.

2. METHODOLOGY

This study uses secondary data by taking annual data on e-commerce, GDP per capita, internet, fixed broadband, mobile broadband, and mobile cellular for the period 2017-2023 in SEA countries namely Indonesia, Malaysia, Singapore, Thailand, Philippines, and Vietnam sourced from the World Bank database, ITU, and the “e-Conomy SEA” report from Google, Temasek, and Bain Company. The total number of observations in this study is 42.

Table 1. Operational Definition of Variables

Variables	Definition	Data Source
E-Commerce (EC)	Gross merchandise value of Business to Consumer (B2C) and SMEs on marketplaces (US$)	Google, Temasek, and Bain Company
GDP per Capita (GDPPC)	Gross domestic product divided by population in mid-year. Based on constant 2015 prices US$	World Bank
Internet (INT)	Percentage of individuals using the internet	World Bank
Fixed Broadband (FB)	*Fixed broadband subscriptions* per 100 people	International Telecommunications Union (ITU)
Mobile Broadband (MB)	*Mobile broadband subscriptions* per 100 people	International Telecommunications Union (ITU)
Mobile Cellular (MC)	*Mobile cellular subscriptions* per 100 people	International Telecommunications Union (ITU)

The mathematical panel data regression equation based on the dependent and independent variables used in this study is as follows:

$$EC = \beta 0 + \beta 1\ GDPPCit + \beta 2\ INTit + \beta 3\ FB\ it + \beta 4\ MB\ it + \beta 5\ MC\ it + \varepsilon\ it \quad \ldots\ldots\ldots\ldots (1)$$

This study uses the Log-Lin model with a natural logarithm approach where only the dependent variable is transformed into logarithm form to form a new equation as follows:

$$LN\_EC\ it = \beta 0 + \beta 1\ LN\_GDPPC\ it + \beta 2\ INT\ it + \beta 3\ LN\_FB\ it + \beta 4\ LN\_MB\ it + \beta 5\ LN\_MC\ it + \varepsilon\ it \quad \ldots\ldots\ldots\ldots (2)$$

where LN is the natural logarithm; EC is e-commerce; GDPPC is GDP per capita; INT is the internet; FB is fixed broadband; MB is mobile broadband; MC is mobile cellular; β0 is constant; β1,2,3,4,5 is coefficient; ε is an error term; i is a cross-section; t is time-series.

The econometric approach in this study uses panel data regression analysis techniques with the statistical software, E-Views. The estimation model in panel data regression consists of three models: Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Three tests need to be done to choose the best model in estimating panel data regression models including the chow test, hausman test, and lagrange multiplier test.

3. RESULTS AND DISCUSSION

Choosing the right model in panel data regression needs to be done so that the resulting estimates are more accurate and valid. The critical value of t based on the t distribution table is 1.688298. If the regression results show that the t-count value is smaller than the t-table and the probability value is greater than 0.05, Ha is accepted while Hb is rejected.

Table 2. T-statistic Test Results

Variables	t-statistic	t-table	Notes
LN_GDPPC	2.302397	1,688298	Positive effect
INT	5.922081	1,688298	Positive effect
LN_FB	3.092264	1,688298	Positive effect
LN_MB	0.195330	1,688298	No positive effect
LN_MC	1.781540	1,688298	Positive effect

Based on the t-statistic test results in Table 2 above, it shows that the GDP per capita (GDPPC), internet (INT), fixed broadband (FB), and mobile cellular (MC) variables have a t-statistic value greater than the t-table. In contrast, the mobile broadband (MB) variable have t-statistic values smaller than the t-table .

The research results of Jula et al. (2024) are in line with the results of this study which state that GDP per capita has a positive and significant effect on e-commerce growth in the long run. Higher income levels can increase people's purchasing power and form an environment that supports the application of digital technology. Transacting in e-commerce basically requires digital devices and high-speed internet, which is more accessible to individuals with higher incomes. The research conducted by Lola & Bakeev (2021) is also in line with the results in this study, where GDP per capita has a positive and significant effect on e-commerce adoption in Russia. Income levels can determine the structure of consumption where households with higher incomes can fulfill their various needs through e-commerce, thus encouraging a shift in consumption patterns to digital platforms. Meanwhile, households with lower incomes tend to prioritize the purchase of basic necessities, making them more suitable for transactions in physical stores rather than e-commerce.

E-Commerce is one of the innovative results of the development of digital technology that depends on the existence of fast and affordable internet access. The internet has become a necessity for the majority of people who have a significant impact on communicating, doing business, learning, shopping, and other purposes. Increasing internet penetration rates can affect shopping behavior and consumer preferences. Younger generations who grew up in the digitalization era tend to do online shopping more often through e-commerce platforms.

The results of research conducted by Zhou et al. (2022) support the results of this study, which found that broadband infrastructure significantly positively affects export trade growth in Chinese cities. Economic activities such as international trade require supporting infrastructure in the form of high-speed internet to support the smooth operation of the system. Broadband infrastructure directly helps improve information efficiency, which in turn leads to lower logistics costs and reduced trade barriers. Broadband infrastructure also affects exports indirectly through industrial structure and technological innovation.

The results of this study are consistent with the research of Edquist (2022) and ITU (2020b) which states that mobile broadband shows a diminishing return effect on the economy when it has passed the saturation point. The use of technologies such as mobile broadband during the diffusion process forms a non-linear (inverted U) pattern between the penetration rate and economic output. This diminishing return effect explains that once the penetration rate of mobile broadband in the six ASEAN countries has passed the saturation point, any additional adoption afterward will no longer have a significant impact on e-commerce. As new users increase, the pattern of use of mobile broadband technology also expands for entertainment and communication and is not limited to online transactions. This shift in technology usage can certainly have an impact on e-commerce

4. CONCLUSION

Based on the panel data regression analysis, the findings are as follows: GDP per capita, Internet, Fixed Broadband, dan Mobile Cellular has a positive and significant effect on e-commerce. Meanwhile, mobile broadband has no positive effect on e-commerce. The findings of this study have several implications for policymakers, particularly for governments to further promote e-commerce transactions and the growth of the digital economy:

a) Increasing Employment Opportunities and Social Welfare: Higher income levels can stimulate consumer purchasing power for goods and services. Improved social welfare can drive demand for more diverse and high-quality products.
b) Expanding Internet Access: Allocating budgets and technical support to expand internet networks to rural and underdeveloped areas to reduce technological disparities, ensuring equal access to e-commerce.
c) Formulating Effective Policies to Reduce Digital Divide: Improving technology accessibility, equalizing digital infrastructure across regions, and enhancing network quality to create an inclusive e-commerce ecosystem and maximize the potential of digital commerce to promote sustainable economic development.

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