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Drivers of E-Commerce Success in Java Island: Implications for Indonesia's Digital Economy

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Abstract

E-commerce in Indonesia, particularly on Java Island, has shown rapid development, contributing significantly to national digital transactions. This study aims to analyze the factors influencing the growth of e-commerce on Java Island during the 2015–2023 period. The research employs a panel data regression model, examining variables such as communication expenditure, population size, the number of BTS towers, mobile phone ownership, and the number of e-commerce actors. The key findings reveal that communication expenditure, mobile phone ownership, and the number of e-commerce actors significantly influence digital transactions. These findings underscore the importance of enhancing digital infrastructure, improving internet access, and empowering digital MSMEs to support the growth of e-commerce in Indonesia. Promoting e-commerce growth by improving internet infrastructure in areas with poor connectivity is a crucial first step the government can take to enhance internet access equity across Java Island.

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1. Introduction

E-commerce has rapidly evolved into a global trend, dominating the way people shop worldwide (Din et al., 2022; Dumanska et al., 2021). The significant rise in e-commerce transactions is evident from data showing that in 2022, global transactions reached $5.2 trillion, projected to grow to $6.3 trillion in 2023 and $8.1 trillion in 2024 (Voniatis, 2023). This growth reflects a substantial shift in global consumption patterns, driven by factors such as digitalization, technological advancements, and changing consumer preferences. The digital transformation has reshaped trade dynamics, making transactions more accessible and significantly contributing to economic growth(Rahmawati et al., 2024; Warsiman et al., 2024)

In the ASEAN region, Indonesia stands out as a major force in the e-commerce sector. In 2022, e-commerce transactions in ASEAN totaled $99.5 billion, with Indonesia contributing more than half, or 52%, amounting to approximately $52 billion (Economy Sea, 2022). Future projections suggest that Indonesia's e-commerce sector will continue to expand rapidly, growing from $52.93 billion in 2023 to $86.81 billion by 2028, with a compound annual growth rate (CAGR) of 10.4% (International Trade Adminstration, 2024).

The success of Indonesia's e-commerce sector is closely linked to various interrelated key factors, particularly structural elements such as advancements in digital infrastructure, smartphone penetration, and the growing presence of digital MSMEs (Feranita et al., 2023). Several studies have shown that e-commerce is Bubanja (2022), Neeraj Bali et al (2021), the progress of digital MSMEs (Agustina et al (2024); Wardhani, et al (2025) Kuruwitaarachchi et al (2020), Pramono et al (2021), and demographic factors such as a large population size (Wang, 2020) and increasing internet penetration rates (Ikiz, 2020; Irtyshcheva, 2021; Liu, Luan, et al., 2021).
In Indonesia, e-commerce has experienced rapid growth, with Java Island serving as the primary hub for national digital transactions. In 2022, Indonesia had a population of 276,639,440 people, making it the fourth most populous country in the world (Bloomberg, 2023). A significant portion of Indonesia’s population resides on Java Island, with West Java Province being the most populous, accounting for 17.66% of Indonesia’s total population. The large population size, coupled with the high number of digital MSMEs operating in the region, has driven the rapid growth of e-commerce on Java Island. According to data from the Badan Pusat Statistik (2023), Central Java Province recorded the highest number of digital MSMEs in Indonesia, followed by East Java and West Java. The growth of digital MSMEs in Java Island has been a key factor contributing to the region's significant share of national e-commerce transactions. For instance, in 2020, e-commerce transactions on Java Island amounted to IDR 210.605 trillion, accounting for 79.1% of Indonesia's total e-commerce transactions. Although Java’s contribution has slightly declined in subsequent years, the region still accounted for 75% of national e-commerce transactions in 2022 (Bank Indonesia, 2023).

The success of e-commerce in Java Island has been further bolstered by increased digital technology penetration and advancements in communication infrastructure. Research by

Yahya & Sugiyanto (2019) highlights that e-commerce in Indonesia is highly concentrated on Java Island, reflecting its role as the country's economic center, characterized by high purchasing power and superior technological support compared to other regions in Indonesia. In 2023, Java Island is projected to contribute approximately 83.8% of Indonesia's total e-commerce transactions (Supply Chain, 2023). This reinforces Java Island's position as the epicenter of Indonesia's digital economy, driven by technological advancements and better infrastructure .

Research on e-commerce has been extensively conducted by scholars worldwide. Altemimi & Alasadi,(2022) and Ilxamova, (2019) stated that technology is an inseparable component of e-commerce. According to Orzol dan Szopik, (2022) emphasized that the development of information and communication infrastructure is essential to enhance the adoption of e-commerce solutions. Similarly, Fan dan Qiuyan, (2019) highlighted both the opportunities and challenges of significant growth for SMEs seeking to expand their businesses into the Chinese market through cross-border e-commerce (CBEC). A large population presents a vast market potential for e-commerce. According to (Lu et al., 2019), the greater the population, the more potential customers are likely to engage in online shopping.
Several studies have explored the relationship between e-commerce and Gross Domestic Product (GDP), including those by (Chen, 2021; Hossain, 2022; Jin, 2019 dan Yurtkur, 2019). Fedirko et al, (2021) also found a significant positive impact of e-commerce. Their study reported that a 1% increase in e-commerce and ICT investment would lead to a 0.02% increase in employment in Ukraine, 0.14% in Poland, and 0.17% in Austria. Similarly, GDP could rise by 0.07% in Ukraine, 0.2% in Poland, and 0.07% in Austria. Research by Anuj et al. (2018) demonstrated an increase in e-commerce's contribution to India's GDP. Supporting this, Ramadhan, (2019) concluded that improved welfare leads to higher purchasing power, sustaining economic growth and price stability.

The uniqueness of this research lies in its innovative approach, which employs panel data analysis for provinces on Java Island—the epicenter of e-commerce in Indonesia. This study also incorporates variables that have not been previously examined in related literature, such as e-commerce infrastructure, communication expenditure, the number of BTS towers, and the number of urban and rural areas with strong signal coverage. The research not only maps the key factors influencing e-commerce growth but also explores the complex interactions among variables to uncover the mechanisms driving Java Island's dominance in Indonesia's digital economy. Furthermore, it offers strategic solutions to address the digital divide through data-driven policy recommendations, aiming to promote a more equitable distribution of digital economic growth across other regions in Indonesia.

The contributions of this study are expected to provide valuable insights for various stakeholders, including the government, industry players, and academics. Practically, the findings can serve as a reference for formulating policies to support the development of the e-commerce sector beyond Java Island, ensuring a more equitable distribution of digital economic growth across Indonesia. The policy recommendations derived from this study can also guide other regions in Indonesia to enhance their digital economic potential by leveraging improved and more evenly distributed communication infrastructure.

Academically, this research is anticipated to pave the way for further studies in the field of e-commerce and the digital economy.

2. Literature Review

E-Commerce

In recent decades, e-commerce has undergone a significant transformation, not only reshaping how consumers shop but also revolutionizing how companies operate (Gimeno-Arias et al., 2024; Li et al., 2024). E-commerce plays two primary roles in the digital economy (Anvari and Norouzi, 2016). *First*, as a more effective and efficient information-gathering tool, it provides consumers with quick and easy access to information about products, services, and prices offered by various providers. *Second*, e-commerce replaces many traditional processes previously performed manually within companies. This digital transformation enables businesses to operate faster, more flexibly, and more cost-efficiently, while simultaneously creating a more enjoyable experience for consumers (Ratnasari et al., 2024).

In the modern world, e-commerce exists in various forms tailored to the roles and relationships among market players. Clodeo (2021) identifies seven basic types of e-commerce, differentiated by the relationships between the involved parties: (1) Business-to-Business (B2B), which involves transactions between companies; (2) Business-to-Consumer (B2C), transactions between businesses and individual consumers; (3) Consumer-to-Consumer (C2C), where consumers sell goods or services to other consumers; (4) Consumer-to-Business (C2B), where consumers offer products or services that companies can purchase; (5) Business-to-Administration (B2A), covering transactions between businesses and government institutions; (6) Consumer-to-Administration (C2A), involving consumers interacting with public institutions; and (7) Online-to-Offline (O2O), which connects transactions that start online but conclude in the physical world, such as purchasing online and picking up the product in-store. This diversity of business models reflects the flexibility of e-commerce in meeting the varied needs of market participants.

In Indonesia, the development of e-commerce is inseparable from various interacting factors driving its rapid growth. According to Ramadhani (2022), key factors contributing to the rapid expansion of e-commerce in Indonesia include: (1) population growth, which creates a large domestic market for digital transactions; (2) rising income levels, boosting purchasing power and increasing potential consumption via online platforms; (3) increased smartphone usage, enabling convenient access to e-commerce platforms anytime and anywhere; (4) increased internet penetration, allowing more individuals to engage in e-commerce activities; (5) high social media penetration, effectively supporting product promotion and marketing; and (6) the growth of financial technology (fintech) companies, providing easier and safer payment and transaction solutions within the e-commerce ecosystem.

The internet has become the primary driver of e-commerce, expanding market access and enabling consumers to conduct cross-border transactions without visiting the seller's country. With technological advancements, e-commerce also offers businesses opportunities to deliver more personalized services, improve operational efficiency, and reduce costs. This

contributes to forming new business models that prioritize efficiency, speed, and convenience for consumers (Terzi, 2011).

However, despite the rapid growth of Indonesia's e-commerce sector, its success is not solely driven by technological and social factors but also by supporting infrastructural variables such as the quality and distribution of telecommunication signals, the number of BTS towers, and communication costs. Previous research has shown that e-commerce adoption heavily depends on the availability of adequate infrastructure, especially in regions not yet fully covered by digital technology. Therefore, it is essential to explore further how these infrastructural factors play a role in accelerating e-commerce growth, particularly in Java, which dominates Indonesia's digital transactions.

E-Commerce Infrastructure

Information and communication technology (ICT) plays a crucial role in facilitating an efficient and secure e-commerce ecosystem. As explained by Altemimi & Alasadi (2022), Ilxamova (2019), Min & Tan (2022), and Xing et al (2019), e-commerce cannot thrive without robust ICT integration. This technology encompasses various aspects, from hardware and software to the systems and protocols governing online transactions. In this regard, Deshpande (2021) emphasizes that the growth of the e-commerce sector heavily depends on the advancement of ICT in a country, making in-depth ICT infrastructure development essential to strengthening the sector.

According to Saadatmand et al (2019) e-commerce infrastructure comprises three main components that synergistically support seamless transactions: hardware, software, and human resources. Hardware includes physical infrastructure such as servers, data storage devices, and networking equipment that ensure the smooth operation of online transactions. Software, on the other hand, consists of applications and operating systems enabling the hardware to function effectively. Without appropriate software, hardware becomes ineffective. The final component, human resources, is equally important in creating and managing e-commerce systems. The individuals designing, building, and maintaining this infrastructure ensure the system operates smoothly and securely.

As the foundation for e-commerce development, this infrastructure must support several critical functions essential for online business operations (Verhoef et al., 2021). First, it must provide a secure environment for online transactions, ensuring customer data protection and safe payment processes. Security is paramount in building consumer trust in digital transactions. Second, the infrastructure must manage inventory and product delivery, track product availability, and facilitate efficient product delivery to customers. Third, customer support is an integral component that cannot be overlooked. Robust infrastructure simplifies customer service, whether through live chat, email, or call centers. Fourth, to ensure maximum visibility, websites must be optimized for search engines, making them easy for consumers to find and access.

Two primary factors significantly contribute to the growth of e-commerce: broad internet coverage and the use of electronic data for transactions. Easily accessible and affordable

internet availability allows almost all segments of society to connect to the digital world, while the use of electronic data simplifies information exchange between sellers and buyers. The strength of digital infrastructure, including efficient and integrated data centers, becomes a key determinant in ensuring smooth e-commerce transactions. Without adequate infrastructure, digital transactions can be disrupted, eroding consumer trust and hindering the development of the digital market.

Furthermore, a large population also serves as one of the main drivers of e-commerce growth. Countries with large populations, such as Indonesia, have vast market potential for digital transactions. Lu et al (2019) explain that although not all individuals within the population will shop online, the larger the population, the more potential consumers participate in e-commerce.

3. Research Methods

This study utilizes secondary data in the form of panel data, which combines two dimensions: time series data and cross-sectional data. The time series data covers the period from 2015 to 2023, while the cross-sectional data encompasses provinces on Java Island. The variables analyzed in this research were adopted from previous studies, including e-commerce transaction value, communication costs, population size adopted from (Lu et al., 2019). The information and communication technology variable (ICT) Orzol and Szopik, (2022) represented by the number of BTS towers.The number of villages/cities with strong mobile phone signals, the percentage of households owning mobile phones adopted from Kumhar, (2022) , and the number of e-commerce entrepreneurs adopted from (Pramono et al, 2021; Rahayu and Day,2015). The data sources used in this study come from Badan Pusat Statsitik , Bank Indonesia, the Ministry of Communication and Information Technology (Kominfo), the Indonesian Internet Service Providers Association (APJII), the Ministry of Cooperatives and SMEs, as well as other relevant sources related to the research topic.

To analyze the factors influencing e-commerce transaction values on Java Island, a panel data regression model is employed with the following formulation:

$$\mathrm{LNTEC_{it}} = \beta_0 + \beta_1 \mathrm{LNKOM_{it}} + \beta_2 \mathrm{LNPOP_{it}} + \beta_3 \mathrm{BTS_{it}} + \beta_4 \mathrm{SNL_{it}} + \beta_5 \mathrm{CEL_{it}} + \beta_6 \mathrm{UECOM_{it}} + \varepsilon_{it}$$

Where:

TE	=	E-commerce Transaction Value
KOM	=	Communication Costs
POP	=	Population Size
BTS	=	Number of BTS Towers
SLN	=	Number of Villages/Cities with Strong Signal Coverage
CEL	=	Percentage of Households with Mobile Phones
UECOM	=	Number of E-commerce Business Actors

The selection of the appropriate regression model between the Fixed Effects Model (FEM) and the Random Effects Model (REM) is conducted through statistical tests such as the Chow Test, the Lagrange Multiplier (LM) Test, and the Hausman Test. These tests aim to determine whether a fixed effects model or a random effects model is more suitable. Additionally, this research also performs classical assumption tests to ensure that the regression model meets

validity criteria, including residual normality tests, heteroscedasticity tests, and autocorrelation tests. Finally, hypothesis tests such as the F-test and t-test are used to examine the simultaneous and individual effects of the independent variables on the e-commerce transaction value. With this systematic approach, the study aims to provide a deeper understanding of the factors influencing the development of e-commerce on Java Island and to offer policy recommendations that can support the sector's growth in the future.

4. Result

This study employs panel data comprising time series from 2018 to 2023 and cross-sectional data from six provinces on the island of Java, namely Jakarta, West Java, Central Java, Yogyakarta Special Region, East Java, and Banten. To determine the most appropriate panel data model, three testing stages are employed: the Chow Test, the Hausman Test, and the Lagrange Multiplier (LM) Test. *First* the Chow Test is used to determine whether the most suitable model is the Common Effect Model (CEM) or the Fixed Effect Model (FEM).

The results of the panel data model testing involved three stages: the Chow test, Hausman test, and Lagrange Multiplier (LM) test. Based on the data analysis, it was found that the probability value was smaller than 0.05, indicating that the Fixed Effects Model (FEM) was the best model. Therefore, the selected model for further analysis is the FEM, as explained in Table 1.

Table 1. Parameter Estimation Results Using the Fixed Effect Method

Variabel	Coefficient	Probability
Constant	29,82	0,48
Communication Expenditure*	4,38	0,00
Population Size	5,18	0,22
Number of BTS Towers	0,00	0,87
Number of Villages/Cities with Strong Signals	-0,00	0,13
Mobile Phone Ownership*	0,09	0,01
Percentage of E-Commerce Businesses*	0,07	0,00
* Significant at 5% level	R^2 = 0,73	Prob >chi2 = 0,000

Source: Data processed (2024)

Based on the estimation results using the Fixed Effects Model (FEM), the coefficient of determination (R^2) is 0.73, indicating that this model can explain 73% of the variation in e-commerce transactions, while the remaining portion is explained by other factors. The Prob > chi^2 value of 0.0000 indicates that the variables in the model collectively have a significant effect on e-commerce transactions. The estimation results reveal that communication expenditure, mobile phone ownership, and the percentage of e-commerce businesses significantly impact e-commerce transactions, with coefficients of 4.38, 0.09, and 0.07, respectively. On the other hand, the variables population size, number of BTS towers, and number of villages/cities with strong signals do not show a significant influence on e-commerce transactions in Java.

Discussion

Based on the estimation of the e-commerce transaction model using the Fixed Effects Model (FEM), the coefficient of determination (R^2) was found to be 0.73. This indicates that the model can explain 73% of the variations in e-commerce transactions, while the remaining 27% is influenced by other factors. The Prob > chi^2 value of 0.0000 demonstrates that all variables in this model collectively have a significant effect on e-commerce transactions in Java. The constant of 29.82% indicates that if all other variables remain constant, e-commerce transactions in Java are estimated to increase by 29.82%. Partial analysis results show that communication expenditure, as the primary factor influencing e-commerce transactions, has a significant positive effect. For every 1% increase in communication expenditure, e-commerce transactions increase by 4.38%. This rise in communication spending is closely linked to more people accessing the internet, which in turn encourages them to shop online more frequently, particularly through social media and e-commerce platforms. This finding aligns with the study by Moghddam et al (2024), which revealed that internet users frequently exposed to product content on social media are more likely to make impulsive purchases.

The second factor influencing e-commerce transactions is population size. Population size has a positive but insignificant effect on e-commerce transactions. A large population not only serves as a potential market for e-commerce but also contributes to the emergence of new e-commerce entrepreneurs. However, despite Java Island being home to the largest population in Indonesia, purchasing power across its residents is unevenly distributed. This disparity in purchasing power diminishes the significance of population size as a determinant of e-commerce transactions on the island. This finding aligns with studies conducted by Cuong (2021), Social et al (2024), and Yahya et al (2020), which suggest that online shopping tendencies are higher among individuals with greater income levels. As a result, the volume of e-commerce transactions does not necessarily correlate with population size. Another factor contributing to the insignificant relationship between Java's population size and e-commerce transactions is the low level of consumer trust in online shopping. Cuong (2023) noted that consumers are often concerned about the risks associated with online shopping compared to offline shopping.

The third factor that has a positive but insignificant influence on e-commerce transactions is the number of BTS towers. The more BTS towers that are established in a region, the better the telecommunications access becomes. However, improved communication access does not necessarily have a direct impact on e-commerce transactions in Java. BTS towers do not play a major role in e-commerce transactions. Social networks Social et al (2024) and promotions and pricing perspectives Cuong (2021), along with influencers, are considered more influential factors in online purchasing decisions.

The number of villages and cities with strong mobile phone signals has a negative and insignificant impact on e-commerce transactions in Java. Although access to the internet is relatively good, the strength of mobile network signals and internet connections is not evenly distributed across villages and cities on Java. Many villages and cities may have a strong mobile signal, but the internet speed is still slow. Some areas still experience slow speeds, and the cost of providing internet services in remote areas is higher than in urban areas. This

hinders the optimal growth of e-commerce in certain regions, even when internet access is available. In 2018, nearly 80% of villages were not connected to the internet, particularly in rural areas of Sumatra, Java, and Bali, which are the three most densely populated islands in Indonesia (World Balnk Blogs, 2022). Despite having the largest number of internet users in ASEAN, with 220 million users, Indonesia's internet speed is only 29 Mbps (mobile broadband) and ranks ninth out of the 11 ASEAN countries (Yuniar, 2024).

Mobile phone ownership has a positive and significant impact on e-commerce transactions, with a regression coefficient of 0.09. This means that a 1% increase in the percentage of households owning a mobile phone will lead to an increase in e-commerce transactions. Currently, a large number of potential customers can be reached through online platforms. The growingcu access to the internet and the use of smartphones also help expand the e-commerce market share. This is consistent with research by Min et al (2021), which states that smartphone usage has a significant influence on e-commerce sales. As the e-commerce market share grows, e-commerce entrepreneurs strive to enter and improve the products and services they offer. Today, 56.2% of internet users shop online via mobile phones, while 43.8% use other mediums for online shopping (Techinasia, 2024). Research by Srivastava & Thaichon (2023) indicates that mobile phones are the primary device used to access e-commerce platforms.

The final independent variable is e-commerce actors. The regression coefficient for e-commerce actors has a positive and significant impact on e-commerce transactions. The regression coefficient value is 0.07, meaning that a 1% increase in the number of e-commerce actors will increase e-commerce transactions by 0.07%. E-commerce entrepreneurs play a crucial role in e-commerce transactions. As the number of e-commerce entrepreneurs increases, consumers have more choices to select products that match their needs and desired prices. Our findings also reveal that performance improvements resulting from e-commerce adoption will drive better inclusion of MSMEs (Micro, Small, and Medium Enterprises) in the financial system through access to and use of a broader range of financial products and services. Moreover, collaboration between financial institutions and e-commerce platforms will accelerate financial inclusion for MSMEs in Indonesia. The widespread use of smartphones and high-speed internet enhances e-commerce activity (Wirdiyanti et al., 2023).

Based on the panel data regression results, factors that significantly affect e-commerce growth in Java Island include communication expenditure, mobile phone ownership, and the number of e-commerce actors. Higher communication expenditure encourages more people to access the internet, which, in turn, boosts e-commerce transactions, particularly through social media and marketplace platforms. Additionally, the growing number of mobile phone ownership in households makes it easier for consumers to shop online, as mobile devices have become the primary means of accessing e-commerce platforms. The increasing number of e-commerce actors is also a key factor, as it provides more options for consumers, boosts market competition, and encourages innovation in products and services. To support sustainable growth, a synergy between government policies, businesses, and society is needed to enhance digital infrastructure, expand internet access, and promote digital economic inclusion, particularly for MSMEs that want to enter the e-commerce ecosystem.

5. Conclution and Suggestion

This study shows that communication expenditure and mobile phone ownership are the most significant factors in increasing e-commerce transactions on Java Island. A 1% increase in communication expenditure can boost e-commerce transactions by 4.38%, indicating the importance of internet access in driving online shopping activities. Additionally, the more households that own mobile phones, the greater the potential for e-commerce transactions. The number of e-commerce actors also has a positive impact on transaction volume, suggesting that a variety of product choices encourages consumers to shop more.

However, factors such as population size, BTS towers, and strong internet access in villages did not show a significant impact on e-commerce transactions. Despite the large population on Java Island, uneven purchasing power and low consumer trust in online shopping remain key barriers. Moreover, although telecommunication infrastructure has improved, the quality of internet access in some areas is still limited, affecting the ability of e-commerce to grow uniformly.

To foster more inclusive e-commerce growth, there needs to be an improvement in internet infrastructure in areas with poor network quality, along with better policies to enhance consumer trust in online transactions. Future research could explore the psychological factors of consumers and the impact of MSME digitalization in expanding the e-commerce market, aiming to create an ecosystem that supports the development of a more equitable and inclusive digital economy in Indonesia.

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