

The Impact of Telecommunications Infrastructure, Fintech, and E-Commerce on Economic Growth in Indonesia

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Abstract

This study aims to investigate how the development of telecommunications infrastructure, fintech, and e-commerce influences economic growth in Indonesia. It employs a quantitative approach using secondary data and time series analysis from 2020 to 2023. The telecommunications infrastructure is represented by fixed broadband and mobile cellular subscriptions, while the fintech aspect is evaluated through the value of transactions in fintech, and e-commerce is assessed based on its transaction values. The findings reveal a significant positive correlation, both simultaneously and individually, among telecommunications infrastructure, fintech, and e-commerce in relation to economic growth in Indonesia.

Keyword: *Economic Growth, Telecommunications Infrastructure, Fintech, E-Commerce.*

A. INTRODUCTION

Economic expansion represents a multifaceted process shaped by various interconnected factors. Understanding the background and the factors that drive and hinder economic growth is crucial for formulating appropriate policies and approaches aimed at fostering long-term and broad-based economic progress.

Infrastructure is a critical foundation for a country's economic growth. Adequate infrastructure availability can stimulate various economic sectors and enhance societal welfare. Infrastructure is regarded as a lever for the economy, influenced by technological developments that drive innovation to improve production efficiency. Information, as an economic commodity, is particularly vital in today's digital era. Thus, adequate infrastructure, especially in telecommunications technology, is essential to support the dissemination of information within the economy. This context has led to the emergence of the term "*digital economy*," which is a part of the innovations associated with the fourth industrial revolution. This revolution is characterized by rapid and fundamental changes in the economy, highlighting integrated systems, automated processes, algorithmic learning, and instantaneous information flows.

Indonesia is increasingly recognizing the digital economy as a promising area for development. Enhancing telecommunications infrastructure is crucial for bolstering the nation's economy by supporting the digital sector, which in turn influences economic growth (Yamali & Putri, 2020). The function of information and communication technologies (ICT)), especially the internet, has become vital in finance and trade. The ongoing rapid digitalization is also impacting these sectors, highlighted by the rise of financial technology (fintech) and electronic commerce (e-

commerce). Fintech serves as a new technology-based financial instrument, while e-commerce acts as a new technology-based trade instrument that facilitates and accelerates economic transactions, especially in challenging economic conditions.

Fintech leverages innovation to upgrade and robotize monetary administrations and forms. It envelops different applications and administrations, from advanced installments and online loaning to robotized contributing and riches administration. This innovation empowers more proficient, reasonable, and comprehensive budgetary administrations.

Table 1. Data on Electronic Money Transactions and E-Commerce for the Last 3 Years (in Trillions of Rupiah)

Year	Fintech Transaction	e-Commerce Transaction
2021	305,44	401
2022	407,53	476,3
2023	457,73	453,75

The preceding data indicates that fintech advancement in Indonesia has experienced substantial growth in recent years. The population of fintech firms operating in Indonesia has steadily expanded on an annual basis. Additionally, the rising population in Indonesia is a contributing factor to the increase in fintech and e-commerce users, which impacts financial transactions and online shopping activities among the community. E-commerce platforms and digital transactions increasingly influence people’s perceptions with their practicality, convenience, and efficiency, alongside the growing number of internet and social media users, the majority of whom are young, digitally literate consumers (Widagdo, 2016).

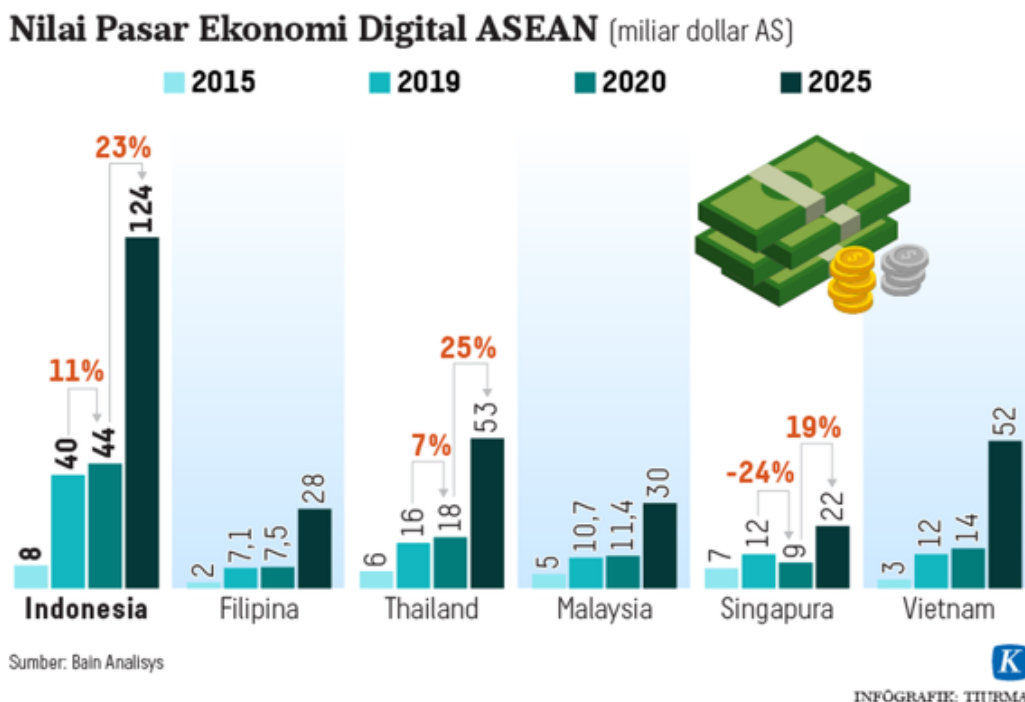


Figure 1. Market Value of the ASEAN Digital Economy

Indonesia, recognized as the largest and fastest-growing internet economy in Southeast Asia, is projected to see its digital economy reach \$124 billion by 2025. In 2019, the digital economy was valued at \$40 billion, reflecting a fourfold increase since 2015, with an impressive average annual growth rate of 49%. The e-commerce and ride-hailing sectors show significant dominance, fueled by a competitive landscape featuring both local and regional participants. All sectors benefit from the growth of digital finance/payment adaptation. This development is accompanied by an increase in investment in this sector, with fewer but larger offers. Digital economic and financial transactions, particularly in e-commerce, are expected to continue growing alongside rising societal expectations.

B. LITERATURE REVIEW

Economic expansion denotes efforts aimed at enhancing the productive capability required to attain greater output, typically expressed through indicators such as Gross Domestic Product (GDP) or Gross Regional Domestic Product (GRDP) for a given geographic area (Adisasmita, 2013). It encompasses not only the increase in the quantity pertaining to the output of products and services but also the improvement of the population's quality of life.

Economic expansion constitutes an important process for a country or region to achieve progress and enhance the welfare of its people. Growth can be achieved by increasing productivity and economic capacity through various factors, such as natural resources, human resources, capital, technology, institutions, and government policies. High economic growth has many benefits, including improving community welfare, reducing poverty, enhancing economic stability, and increasing national competitiveness.

Gross Domestic Product (GDP) comprises multiple elements, including household consumption (C), investment (I), and government expenditure (G), along with net exports, defined as the gap between export and import values (X-M). To analyze a nation's total income, there are three primary approaches. One such approach is the expenditure method, which aggregates a country's spending on goods and services. An example may be interpreted in the following manner.

$$Y = C + I + G + (X - M)$$

Description:

Y = Gross Domestic Product (GDP).

C = Household consumption expenditure.

G = Government spending.

X = exports.

M = imports.

The neo-classical economic flow explores the aspects that can influence economic growth. In its analysis, it can be expressed with the following equation.

$$Q = F(K, L, T, U)$$

where:

Q = output or GDP

K = capital

L = labor

T = technology

U = resources

The equations K, L, T, and U represent the primary factors shaping economic expansion. Several significant elements contribute to driving economic expansion, such as the accumulation of capital, growth in population, and advancements in technology (Arsyad, 2010).

Telecommunications Infrastructure

According to the Indonesian Dictionary (KBBI), infrastructure can be defined as public facilities and services. Public facilities can refer to amenities such as hospitals, roads, bridges, etc. Furthermore, in economic terms, infrastructure represents a form of public capital (N. Gregory Mankiw, 2006). Another definition of infrastructure is that it refers to physical capital facilities and also includes the organizational framework, knowledge, and technology that are essential for the organization of society and their development, encompassing laws, health and education systems, safety systems (John A. Tatom, 1993).

In the World Bank's infrastructure report, infrastructure is divided into two types (Bank, 1994):

1. Economic infrastructure refers to physical resources that give administrations and are utilized in generation and last utilization, counting open utilities (broadcast communications, drinking water, sanitation, and gas), open works (dams, water system channels, and waste), and the transportation segment (railroads, ports, streets).
2. Social infrastructure refers to assets that support the health and skills of the community, including healthcare (hospitals), education (schools and libraries), and recreation (parks, entertainment venues, museums).
3. Administrative/institutional foundation incorporates law authorization, authoritative control, coordination, and social perspectives.

One type of infrastructure that is the focus of this research is telecommunications infrastructure. The term telecommunications emerged from the integration of information technology and communication technology. Telecommunications technology combines computing with high-speed communication channels that transmit data, voice, and video. Coordination in the development of economic infrastructure is also required to respond more quickly to market demands. The economic linkage that is realized must have a strong infrastructure foundation. Information, as an economic commodity with value, has become an essential part of the economy.

Fintech

Financial technology (fintech) may be broadly described as an innovation within the technological domain that emerges and develops within the financial industry (Narastri & Kafabih, n.d.). The core of fintech lies in the adoption of computer networks and the internet applied to financial services. The emergence of fintech in the financial industry is propelled by the swift progression of information and communication technology, marked by the advent of the internet. Fintech has transformed the way people conduct transactions, making them faster and easier (Wajuba et al., 2021). With fintech, individuals, especially small and medium-sized enterprises (SMEs), can access financial services more easily and quickly. In this regard, fintech can facilitate financial transactions such as borrowing, payment transactions, and investments, making them faster, easier, and more efficient.

All financial transactions within the fintech system are conducted using digital technology, allowing people to complete financial transactions without face-to-face interactions. In the past, processes like borrowing money from a bank or making payment transactions required direct contact; however, with fintech, individuals can simply use devices connected to the internet to carry out these transactions without needing to visit a bank or meet in person (Hendro Basuki & Husein, 2018).

According to Simorangkir et al. (2021), Indonesia is witnessing the swift expansion of three major categories of fintech services:

1. Peer-to-Peer (P2P) Lending

Simply put, peer-to-peer (P2P) credit platforms is a form of financial technology that offers online lending services. This approach connects borrowers with lenders, enabling them to make loan agreements through a digital platform (Wajuba et al., 2021). With P2P lending, individuals seeking capital to finance their businesses no longer need to visit financial institutions like banks. They can simply use internet-enabled devices to conduct their loan transactions.

2. Equity Crowdfunding

Equity crowdfunding represents a fintech model that facilitates capital-raising activities for financing a project (such as a specific business or social activity) through digital platforms. This fintech allows individuals to socially invest in the development or financing of a business more quickly because it is internet-based. This type of fintech is similar to P2P lending, but the key difference in equity crowdfunding is that investors are positioned as business owners.

3. Digital Payment System

Fintech in the form of a digital payment system allows individuals to make online payments without going through banks or conducting transactions directly (Andaiyani et al., 2020). With this fintech, people can pay electricity bills, purchase mobile credit, buy goods online, and more, all through an application. Examples of digital payment system applications include e-money, credit or debit-based payment instruments.

E-Commerce

E-commerce refers to all forms of transactions, whether sales or purchases, conducted online or using computer networks. According to Fitcher (2003), e-commerce encompasses all purchases and sales made by business entities, consumers, governments, and public or private sector organizations, facilitated by computer networks. E-commerce is defined as commercial transactions involving the exchange of value that occurs through or utilizes digital technology between individuals.

The Impact of Telecommunications Infrastructure on Economic Growth

The effective utilization of telecommunications infrastructure directly lowers transaction costs and enhances the quality of marketing information, while indirectly speeding up the flow of information. Telecommunications are essential for improving living standards, promoting innovation, encouraging entrepreneurship, and boosting the economy. They also facilitate trade and regional integration, facilitate the provision of information and insights sharing, enable international communication and enhance the efficiency of financial transaction processes. Additionally, telecommunications contribute positively to research and development, trade, and financial growth, while enhancing workforce efficiency and skills, which in turn supports economic growth (Majeed et al., 2018).

Telecommunications also influence trade from various angles. For instance, internet technology has created a foundation for market updates, business, and products and services, further developing e-commerce and boosting economic growth. Telecommunications infrastructure in the modern era also impacts economic growth through smooth foreign investment and positive export values (Majeed et al., 2018).

The Impact of Fintech on Economic Growth

According to Keynesian Growth Theory, increased consumption and investment are two of the three key factors influencing economic growth in a closed economic system. Economic growth is defined as the rise in the quantity of goods and services produced in a region over a specific time frame. When consumption rises, it signals a higher demand for goods and services, prompting businesses to boost their production to satisfy this demand. Consequently, the expansion in product and service output serves as a crucial driver of overall economic expansion (Sudirman, 2018).

The same applies to investment activities. When the value of investment in a region rises, it indicates an increase in capital formation. Capital is a crucial factor of production because, with capital, companies can finance overall production costs. This indicates that when there is an increase in capital investment in a region, it can lead to a rise in the generation of product and service output, ultimately enhancing aggregate growth (Sudirman, 2018).

The Impact of E-Commerce on Economic Growth

E-commerce serves as a clear indication that rapid technological advancements will influence the economy. Through internet-based technology, the movement of product and service transactions originating from producers or sellers to consumers can take place with considerable ease and speed. Subsequently, the utilization of the internet enhances the spread of ideas and information, thereby stimulating both innovation and entrepreneurial activities. Thus, it may be inferred that e-commerce implementation serves as a catalyst for economic expansion of ideas and innovations for users who can manage the internet as an opportunity for profit (Getha Fety Dianari, 2018).

Hypothesis

The hypothesis of this research posits that the advancement of infrastructure, fintech, and e-commerce is expected to exert both simultaneous and partial effects toward the trajectory of Indonesia's economic expansion between 2020 and 2023.

C. METHOD

This study adopts a descriptive quantitative approach to elucidate the variables being examined and their interrelationships. The study relies on secondary data presented as time-series observations. Data analysis will be conducted using Eviews and Microsoft Excel software.

This study aims to evaluate the influence of fintech and e-commerce advancement in Indonesia, as well as the effect of telecommunications infrastructure on the country's economic growth, both partially and simultaneously. Due to data constraints, the analysis focuses on the years 2020 to 2023 across 34 provinces.

For data analysis, the study employs a panel data regression approach, which encompasses three model types: the pooled model, the fixed-effects specification, and the random-effects specification. The pooled model and the fixed-effects specification both employ the ordinary least squares (OLS) method for estimation, while the random-effects model applies the Generalized Least Squares (GLS) technique.

As noted by Sriyana (2015), the pooled model presumes that both the intercept and slope remain consistent across different cross-sectional units and time periods. The equation for the panel regression estimated under the pooled model is:

$$\hat{Y} = \beta^0 + \beta^1 X_1 + \beta^2 X_2 + \beta^3 X_3 + \beta^n X_n + \varepsilon^{\wedge}$$

Where :

\hat{Y} = economic growth

X_1 = Fixed Broadband Subscription, Mobile Cellular Subscription (in %)

X_2 = Usage of Server-Based Electronic Money Devices (in million units)

X_3 = Percentage of Sellers Using E-Commerce (in %)

β^0 = Constant

β^1, β^2, \dots = regression coefficient

Within this analytical process, the Ordinary Least Squares (OLS) technique is applied for multiple linear regression using EViews software. The factors affecting Indonesia's economic growth can be represented by the following function: Fixed Broadband Subscription, Mobile Cellular Subscription, the number of server-based devices, and the number of sellers utilizing e-commerce across 34 provinces in Indonesia.

D. RESULTS AND DISCUSSION

This study employs EViews software for analysis. The dataset consists of a time series with 136 samples spanning 2020 to 2023 across 34 provinces. It includes data on Indonesia's economic growth, obtained from the Central Statistics Agency (BPS). The key variables under investigation are the number covering fixed broadband subscriptions and mobile cellular subscriptions across the 34 provinces, the usage of server-based devices as a fintech indicator, and the percentage of sellers engaging in e-commerce within these provinces during the specified period.

Chow Test Results

The table below displays the outcomes of the Chow Test, which is used to examine whether there is a structural break within the regression model.

Table 2. Chow Test

Effect Test	Statistic	df	Prob
Cross-section F	3.378261	33.98	0.0000
Cross-section Chi-square	109.595584	33	0.0000

The probability value of 0.0000 falling below the 0.05 threshold suggests that the Fixed Effects Model (FEM) represents the preferred choice.

Hausman Test Results

The table below displays the outcomes of the Hausman Test, which serves to identify the most suitable model between the Fixed Effects and Random Effects specifications.

Table 3. Hausman Test

Test	Chi-Sq. Statistic	Chi-Square df	Prob.
Cross-section random	10 822 835	4	0.2

Similarly, the probability value of 0.0286, also below the 0.05 threshold, supports the selection of the Fixed Effects Model (FEM). Thus, given the results of both the Chow and Hausman tests, the Fixed Effects Model (FEM) is determined to be the most suitable model for this research.

Classical Assumption Tests

Given that the FEM has been chosen, it is necessary to perform classical assumption tests. The assumptions evaluated include multicollinearity and heteroscedasticity.

The table below displays the multicollinearity test results, indicating the degree of correlation among the predictor variables.

Table 4. Multicollinearity Test

	X1 (Fix)	X2 (Mobile)	X3 (Fintech)	X4 (Ecommerce)
X1 (Fix)	1	0.13770067	0.835822184	0.480656586
X2 (Mobile)	0.137700872	1	0.104015949	0.206093288
X3 (Fintech)	0.835822184	0.10401595	1	0.289276655
X4 (Ecommerce)	0.408065659	0.20609329	0.289276655	1

The correlation coefficients are as follows: X1 and X2 = 0.1337 < 0.85, X1 and X3 = 0.8358 < 0.85, X1 and X4 = 0.4807 < 0.85, X2 and X3 = 0.1040 < 0.85, X2 and X4 = 0.2061 < 0.85, and X3 and X4 = 0.2893 < 0.85. This indicates that multicollinearity is not present, allowing the model to pass the multicollinearity test.

To examine whether the regression model meets the required assumptions of constant variance, a heteroscedasticity test was conducted. The comprehensive results are presented in the subsequent figure.

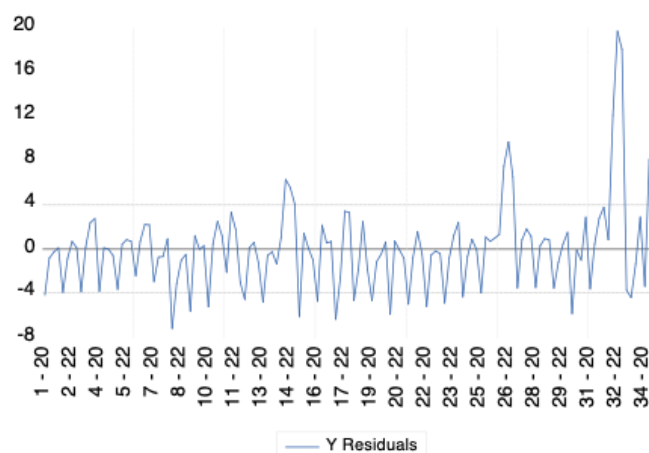


Figure 2. Heteroscedasticity Result

The residual graph shows that values remain within the specified boundaries set at 500 and -500 suggesting, that the variance of the residuals remains consistent. Consequently, there is no indication of heteroscedasticity, and the model effectively meets the requirements of the heteroscedasticity test (Napitupulu et al., 2021).

Panel Data Regression Equation

The following equation represents the panel regression framework employed in this study: $Y = 10.05 - 2.19 \cdot X1 - 0.08 \cdot X2 + 0.03 \cdot X3 + 0.12 \cdot X4$. The constant coefficient of 10.05 suggests that without Fixed Broadband (X1), Mobile Cellular (X2), Fintech (X3), and E-Commerce (X4), GDP is projected to increase by 1005%. The beta coefficient to Fixed Broadband (X1) is -2.19, suggesting that if other variables are held constant, a 1% increase in X1 will lead to a 219% decrease in GDP (Y). Conversely, a 1% decrease in X1 will result in a 219% increase in Y.

The beta coefficient for Mobile Cellular (X2) is -0.08, indicating that if other variables remain constant, a 1% increase in X2 will cause GDP (Y) to decline by 8%. Conversely, a 1% decrease in X2 will increase Y by 8%. The beta coefficient for Fintech (X3) is 0.03, implying that when the remaining variables are held constant, a 1% increase in X3 will lead to a 3% rise in GDP (Y). Conversely, a 1% decrease in X3 will lead to a 3% decrease in Y. The beta coefficient for E-Commerce (X4) is 0.12, indicating that if other variables remain constant, a 1% increase in X4 will raise GDP (Y) by 12%. Conversely, a 1% decrease in X4 will decrease Y by 12%.

Hypothesis Testing

The results of the hypothesis tests, including the significance levels and statistical values for each variable, are presented in the table below:

Table 5. Hypothesis Testing Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.05018	5.133442	1.957785	0.0524
X1 (Fix)	-2.198386	0.484621	-4.536305	0.0000
X2 (Mobile)	-0.087019	0.05625	-1.547018	0.1243
X3 (Fintech)	0.030272	0.008186	3.697843	0.0003
X4 (Ecommerce)	0.129341	0.046107	2.805224	0.0058

The impacts of the independent variables on the dependent variable are outlined as follows:

- a. For the Fixed Broadband (X1) variable, the computed t-statistic of 4.5363 exceeds the t-table value of 1.9778, and the significance level of $0.0000 < 0.005$ confirms statistical significance. Accordingly, Fixed Broadband (X1) exerts a significant influence on GDP in Indonesia across all 34 provinces during the 2020–2023 period.
- b. For Mobile Cellular (X2), the obtained t-value of 1.5470 is below the t-table reference of 1.9778, accompanied by a significance level of $0.1243 > 0.005$, indicating the absence of a statistically significant effect. Thus, Mobile Cellular (X2) does not significantly impact Indonesia’s GDP over the same timeframe.
- c. For the Fintech (X3) variable, the t-statistic of 3.6978 surpasses the t-table benchmark of 1.9778, with a significance value of $0.0003 < 0.005$, demonstrating statistical significance. This result shows that Fintech (X3) has a substantial positive effect on GDP in Indonesia between 2020 and 2023 across all provinces.
- d. For E-Commerce (X4), the computed t-value of 2.8052 exceeds the critical value of 1.9778, although the significance level of $0.0058 < 0.005$ lies marginally above the standard threshold. Nonetheless, E-Commerce (X4) is interpreted as having a statistically significant effect on Indonesia’s GDP over the 2020–2023 period across the 34 provinces.

F-Test Results

The F-test findings, which evaluate whether the regression model as a whole is statistically meaningful, are presented in the table below:

Table 6. F Test Results

R-squared	0.151237	Mean dependent var	3.538750
Adjusted R-squared	0.125321	S.D. dependent var	4.264242
S.E. of regression	3.988102	Akaike info criterion	5.640580
Sum squared resid	2083.549	Schwarz criterion	5.747663
Log likelihood	-378.5594	Hannan-Quinn criter	5.684095
F-statistic	5.835576	Durbin-Watson stst	0.813658
Prob(F-statistic)	0.000236		

The computed F-statistic of 5.8356 exceeds the F-table benchmark of 2.4408, and the significance level of 0.000236 being below 0.05 confirms statistical significance. This demonstrates that the variables Fixed Broadband (X1), Mobile Cellular (X2), Fintech (X3), and E-Commerce (X4) collectively influence GDP in Indonesia from 2020 to 2023.

Coefficient of Determination (R²)

The findings related to the coefficient of determination (R²), which measure the model’s goodness-of-fit and its ability to account for fluctuations observed in the dependent variable, are presented in the table presented below:

Table 7. Coefficient of Determination (R²)

R-squared	0.151237
Adjusted R-squared	0.125321
S.E. of regression	3.988102
Sum squared resid	2083.549
Log likelihood	-378.5594
F-statistic	5.835576
Prob(F-statistic)	0.000236

The adjusted R-squared coefficient stands at 0.1512, equivalent to 12.53%. This suggests that the independent variables Fixed Broadband (X1), Mobile Cellular (X2), Fintech (X3), and E-Commerce (X4) explains 12.5% of Indonesia’s GDP variation, whereas the remaining 87.5% is attributed to factors outside the scope of this study.

E. CONCLUSION

Drawing from the analytical results and discussion, the author reaches the following conclusions: a) In this study, the growth of telecommunications infrastructure, specifically the number of fixed broadband subscriptions, demonstrates a partial impact on economic growth. In contrast, mobile cellular subscriptions show does not exhibit a statistically significant partial influence on economic expansion. Additionally, the advancement of fintech, indicated by the number of users of server-based devices, also has a partial influence. Meanwhile, the expansion of e-commerce indicated by the proportion of sellers adopting online platforms has a positive influence on economic expansion; and b) the integrated progress of telecommunications infrastructure, fintech, and e-commerce contributes collectively to economic growth between 2020 and 2023.

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