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## Is Fintech Lending and Financial Inclusion Able to Accelerate Indonesia's Economic Growth?

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### Abstract

*This research investigates the relationship between fintech lending, financial inclusion, environmental quality, and economic growth in 34 Indonesian provinces from 2019 to 2024. It contributes to the literature by integrating these three dimensions within an analytical framework to assess regional economic growth in Indonesia. Based on provincial panel data, the study applies a Fixed Effects Model (FEM). The results indicate that fintech lending and ATM card ownership are positively and significantly associated with economic growth. In contrast, electronic money, third-party funds, and the Human Development Index (HDI) exhibit no statistically significant relationships with economic growth. The Environmental Quality Index has a positive but statistically insignificant coefficient, whereas population size is negatively and significantly associated with economic growth. These findings suggest that the relationships between digital financial development, financial inclusion, environmental quality, and economic growth vary across the indicators examined. From a policy perspective, the findings highlight the importance of strengthening fintech lending governance, expanding access to financial services and financial literacy, and formalizing development policies that consider demographic dynamics and environmental quality.*

**Keywords:** Fintech Lending, Financial Inclusion, Population, HDI, Environmental Quality, Economic Growth

**JEL Classification:** G23, O16, O15, O44, Q56

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### Introduction

Economic growth is influenced by community activities, capital formation, and the use of technology in producing output, so adopting modern technology is a crucial factor affecting economic growth (Sutjiono & Leng, 2024). In recent years, Indonesia's economic growth from 2019 to 2024 has fluctuated, although the growth rate has decreased over the last two (2) years. Indonesia has the greatest economic potential in Southeast Asia, and its strategic position supports rapid economic growth.

The financial industry plays a crucial role in the economy and continues to evolve to meet changing societal needs. Innovation in this sector is reshaping the foundations of central banking and transforming financial service users' experiences (Harahap et al., 2017). Industry 4.0 transformation encourages accelerated technological innovation. Modern technological innovations have increasingly penetrated the financial sector, marked by the rise of *financial technology (fintech)*. Fintech platforms have enabled several financial ecosystems, such as e-wallets, digital payments, *crowdfunding*, and *P2P lending*. Compared with traditional bank services and products, fintech products offer greater flexibility, inclusivity, dynamism, transparency, and efficiency (Rjoub et al., 2023).

Fintech's contribution to economic growth goes beyond adopting digital technology; it is defined by its ability to eliminate financial frictions and improve resource allocation efficiency. Fintech can cut transaction and financing costs, speed up and improve the accuracy of financial decision-making, and reduce information asymmetries by leveraging technologies such as big data, artificial intelligence, and online platforms. These methods allow financial resources to be more efficiently allocated toward productive purposes. These activities promote economic growth. Fintech can also help to boost economic growth by increasing the use of financial services and expanding access to formal financial systems (Daud et al., 2024). In general, technological improvement can foster innovation and technology dissemination, improve decision-making, and reduce production costs, leading to higher output and economic expansion (Vu, 2011). Additionally, by expanding and bolstering the use of digital technology, fintech can encourage more effective resource allocation (X. Li et al., 2025). As a result, fintech's influence on economic growth is driven not only by the existence of digital technologies but also by their capacity to reduce financial constraints, improve resource allocation and economic efficiency, and promote positive economic activity. In China, *fintech* and its components have a significant effect on the economy due to economic expansion, and a 10% increase in *fintech adoption* is assumed to increase economic growth by 8%. Previous studies show that fintech positively influences economic growth by facilitating financial transactions, improving financial efficiency, strengthening economic stability, reducing transaction costs, and mitigating information asymmetry. Fintech lending can further promote economic growth by expanding access to credit, particularly for micro, small, and medium-sized enterprises (MSMEs) that need financing to support their operations. This structural transformation may facilitate economic diversification, enhance inclusiveness, and strengthen economic resilience, thereby contributing to sustained long-term economic growth (Adedokun, 2021; Sharma, 2016).

Fintech and financial inclusion complement each other in promoting economic growth. Financial inclusion supports economic development by broadening access to financial services, facilitating access to capital for entrepreneurial activities, encouraging savings, and expanding investment opportunities, thereby stimulating overall economic growth. This concept is consistent with the United Nations 2030 Agenda for Sustainable Development, which identifies financial inclusion as a key mechanism for supporting sustainable development and advancing the Sustainable Development Goals (SDGs), particularly SDG 8 on decent work and economic growth. Broader access to financial services enables more of the population to participate in the formal financial system. However, empirical findings regarding the relationship between financial inclusion and economic growth remain diverse. Research in Organization of Islamic Cooperation (OIC) member countries indicates that financial inclusion can stimulate economic growth, while other evidence points to a causal link between these two variables. By facilitating access to financial resources and encouraging productive economic activities, financial inclusion can support more equitable and sustainable growth. Its contribution is further strengthened by financial innovation, which expands the availability and diversity of financial products and services. These developments give individuals and businesses more opportunities to invest, manage their finances through formal channels, and participate in broader economic activities (Odeniran & Udejaja, 2018).

Economic growth greatly affects environmental sustainability because the two are inseparable and influence each other. When optimizing economic growth, we must still pay attention to environmental quality, not just natural resource use. Under the 2015 Paris Agreement, Indonesia has committed to reducing greenhouse gas emissions through both domestic efforts and international cooperation. Despite its substantial carbon stocks and its position among the world's ten largest greenhouse gas emitters, Indonesia's carbon emissions have continued to rise, reaching 812,22 million tons in 2024 (Our World in Data, 2026). Several studies on environmental quality show a positive relationship with economic growth, where improvements in environmental quality in developing countries are followed by higher economic growth (Fakher & Abedi, 2017). Conversely, some empirical studies have identified a negative association between environmental performance and economic growth. This mixed evidence may reflect the complex nature of the growth environment nexus, as conceptualized by the Environmental Kuznets Curve (EKC) hypothesis, which posits a nonlinear relationship characterized by an inverted U-shaped curve.

The empirical evidence highlights a research gap, as previous studies on fintech and financial inclusion have predominantly focused on national-level analyses or cross-country comparisons. This study extends the existing literature by integrating a broader range of variables and applying econometric techniques to examine their relationships. Further investigation is also needed because

environmental quality is measured using different indicators, including carbon emissions and the Environmental Quality Index, while previous studies have reported mixed findings regarding the relationship between environmental quality and economic growth, ranging from positive to negative associations.

This study aimed to examine how Indonesia's economic development is influenced by fintech, financial inclusion, population size, the Human Development Index (HDI), and environmental quality. In addition to providing empirical evidence. This study also contributes academically to environmental economics and sustainable development by examining the roles of fintech and environmental quality in economic growth. It also offers insights for the government in formulating economic development policies that balance technology use, economic growth, and environmental preservation.

## Literature Review

### *Economic Growth*

A model that has been put forth to explain economic growth is the Solow Model. Robert Solow argues that technical progress and production factors are the two most important determinants of economic growth.

$$Y_t = A_t f(K_t, L_t) \quad (1)$$

According to classical economics, which Solow's theory largely maintains, capital accumulation, population growth, and technological developments continue to drive economic growth. Technology use generates positive technological spillover effects, and technology transfer can contribute positively to economic growth. Technology can also reduce information asymmetry in the provision of financial services. However, technological investment does not necessarily lead to immediate improvements in firm productivity, as organizations may face adjustment costs, implementation delays, and managerial challenges associated with technological change. Integrating new technologies into existing business processes requires time and organizational adaptation. Furthermore, technology may even reduce productivity if it is not properly managed and effectively implemented (Schweikl & Obermaier, 2020). Some evidence suggests that technology contributes to GDP growth (Narayan, 2019).

### *Fintech Lending*

Fintech is a combination of finance and information technology. Considering the increasing breadth of the internet and the rapid use of information technology, the use of telephones and digital technology (Song & Appiah-Otoo, 2022). Improved technology boosts productivity and innovation, which boosts economic growth. Investment through P2P lending systems will affect national income. Both Song and Appiah-Otoo, (2022) and Wajuba et al. (2021) revealed a positive association between P2P lending and economic growth. Indonesia's strong P2P lending development has boosted economic growth. P2P lending innovation has influenced inclusive development. P2P lending gives MSMEs and investors access to platforms, boosting income across numerous industries (Wajuba et al., 2021). Growing *fintech* not only offers innovative products but also strengthens overall financial market dynamics, contributing to economic growth (Liu & Chu, 2024). Fintech positively influences economic growth by making financial transactions easier, including cash transfers, savings, investments, and access to borrowing.

H1: Fintech lending has a positive impact on economic growth.

### *Financial Inclusion*

Changes in financial performance alter a person's interest, affecting financial inclusion and economic growth. Development of financial system elements includes risk management, savings, and lower transaction costs (Demirguc-Kunt et al., 2005). Van et al. (2020) found that financial inclusion boosts economic growth. However, financial inclusion can hinder economic growth (Taqi et al., 2021). Financial inclusion supports SDGs 2, 3, 4, 8, and 9. Financial inclusion will increase access to savings accounts, investment, credit cards, and direct loans, supporting SDG 8. Financial inclusion creates jobs (Choudhary et al., 2025). Financial inclusion enables companies and individuals to easily access and use more affordable financial products (Le et al., 2025).

Financial inclusion comprises three dimensions: access, availability, and usage. The access dimension measures the extent to which the general public can access financial services, with the number of bank account holders serving as an indicator of financial inclusion. E-money card ownership is used to measure the adoption of electronic money among the Indonesian population. The availability dimension is measured by the number of bank branches and automated teller machines (ATMs), which facilitate various banking transactions, from account opening to complaint resolution. ATMs also provide convenient access to cash withdrawals and deposits, of the on a 24-hour basis, without requiring customers to queue at bank branches. These indicators serve as proxies for assessing financial inclusion, particularly among low-income populations (Erlando et al., 2020; Hanivan & Nasrudin, 2019; Sarma & Pais, 2011).

H2: Financial inclusion has a positive impact on economic growth.

### **Population**

Solow (1956) assumes steady population growth and economic growth. Population expansion boosts labor supply and production per worker. However, as the population grows, physical capital per worker decreases, lowering productivity and output. As physical capital per worker falls, productivity and output decline. Thus, population expansion hinders economic development (Abebaw, 2019). According to Simon in the research Ibey et al. (2024), debate continues over whether population size has a positive or negative relationship with economic growth. The positive view is that population growth encourages technological advances and innovation, which in turn spur business competition and expand market size in line with population growth, encouraging entrepreneurs to establish new businesses. Meanwhile, the negative view is that population growth leads to poverty and low per capita income. Previous research has found that population growth is positively correlated with economic growth. The results show that population growth contributes positively to economic growth in both the short and long term (Ibey et al., 2024; Tartiyus et al., 2015). Sethy and Sahoo (2015) and Tumwebaze and Ijjo (2015) found similar results, showing a positive correlation between population growth and per capita economic growth in India and the East and South Africa Region. However, there are conflicting studies as research Huang and Xie (2013), which found that population growth in general has a negative influence on economic growth, even though the growth of the population in disadvantaged areas actually has a positive impact.

H3: Population has a positive impact on economic growth.

### **Human Development Index**

The Human Development Index includes life expectancy, average schooling time, and per capita expenditure adjusted for purchasing power parity. Strong human development growth indirectly boosts economic growth (Muqorrobin & Soejoto, 2017). Human development and economic progress will increase with education and health investment (Hoa et al., 2016). Solow's theory focuses on the growing factors of production. A higher Human Development Index encourages accelerated economic growth, in line with the increasing absorption of human capabilities in resource management. Some of the studies that have analyzed the relationship between HDI and economic growth include (Hoa et al., 2016; Taqi et al., 2021), which state that there is a positive contribution of human resources to per capita income as well as efforts to encourage the economy in the future (Taqi et al., 2021).

H4: Human Development Index has a positive impact on economic growth

### **Environmental Quality**

The Environmental Kuznets Curve (EKC) theory states that economic growth initially worsens environmental quality but eventually improves it. It shows that the environmental performance index positively and significantly affects economic growth in emerging nations (Fakher & Abedi, 2017). CO<sub>2</sub> and income in ASEAN-8 are negatively correlated. Pollution directly reduces output and human and labor productivity, lowering income.

On the other hand, the relationship between economic growth and environmental degradation can be explained by the Environmental Kuznets Curve (EKC) theory, as further developed by

(Panayotou, 2000). This theory suggests that the relationship between economic activity and environmental degradation changes as a country progresses through different stages of economic development. In the initial stage (pre-industrial economies), economic development tends to drive the intensive exploitation of natural resources to increase per capita income, while environmental sustainability remains a secondary concern. In the subsequent stage (industrial economies), the dominance of the manufacturing sector and the expansion of production activities may exacerbate environmental degradation due to increased pressure on natural resources and rising pollution levels. In the final stage (post-industrial economies), the economic structure gradually shifts from manufacturing toward the service sector. This transformation reflects growing public awareness of the environmental consequences of economic activities and the importance of pursuing sustainable development.

H5: Environmental Quality has a positive impact on economic growth

## Research Method

This study investigates the relationship between fintech lending, financial inclusion, population, human development, environmental quality, and economic growth across 34 provinces in Indonesia. Financial inclusion is represented by three indicators: ATM cards, electronic money (e-money), and third-party funds. The analysis covers the 2019-2024 period, selected to capture the evolving landscape of fintech lending in Indonesia. Since 2019, the sector has grown substantially, reflected in the expansion of lending platforms licensed by the Financial Services Authority (Otoritas Jasa Keuangan/ OJK) and the growth of peer-to-peer (P2P) lending disbursements. This period therefore provides a relevant empirical context for examining the association between digital financial development and provincial economic growth. The period also reflects the Indonesian government's commitment to accelerating digital transformation, as shown by the publication of the White Book entitled Indonesia Digital for Future Economy & Inclusive Urban Transformation. The policy initiative provides a strategic foundation for promoting a more inclusive, equitable, and broad digital economy. Furthermore, the 2019-2024 period encompasses substantial changes in the economic and financial ecosystem, covering the pre-COVID-19 period, the COVID-19 pandemic, and the post-pandemic recovery. These distinct phases were associated with changes in digital technology adoption, fintech lending activities, and financial inclusion dynamics.

Table 1. Definition of Variables

| Variable                      | Operational Definition                                            | Measurement unit | Expected Effect    | Data Source                          |
|-------------------------------|-------------------------------------------------------------------|------------------|--------------------|--------------------------------------|
| Economic growth               | Gross Regional Domestic Product divided by the total population   | Thousand rupiah  | Dependent variable | BPS                                  |
| Fintech                       | Distribution of loans to Loan Recipients                          | Billion rupiah   | Positive           | FSA                                  |
| Financial Inclusion: ATM Card | Number of ATMD card/ instruments                                  | Million          | Positive           | BI                                   |
| E-Money                       | Number of electronic money cards/ instruments                     | Million          | Positive           | BI                                   |
| Third Party Fund              | Composition of Third-Party Funds of Commercial Banks Based        | Billion rupiah   | Positive           | FSA                                  |
| Population Size               | Total population                                                  | Thousand         | Positive           | BPS                                  |
| Human Development Index       | Composite index measuring education, health, and living standards | Index (0 -100)   | Positive           | BPS                                  |
| Environmental Quality         | Environmental Quality Index                                       | Index (0 -100)   | Positive           | Ministry of Environment and Forestry |

Environmental quality uses IKLH proxies obtained through the Ministry of Environment and Forestry. The dependent variable is economic growth, while the independent variables include fintech lending, financial inclusion, population, HDI, and environmental quality. Fintech lending refers to research (Song & Appiah-Otoo, 2022; Sutjiono & Leng, 2024; Wajuba et al., 2021). The financial inclusion variable in the study includes 3 (three) dimensions: access, availability, and usage. The financial inclusion component in the research (Anindyantha, 2020; Mufida, 2025) is measured as follows: availability with the number of ATM machine indicators, access with e-money card indicators, and usage with the Third-Party Fund indicator. In addition, the population variable, the Human Development Index refers to the research (Abebaw, 2019; Hoa et al., 2016; Huang & Xie, 2013; Taqi et al., 2021; Tartiyus et al., 2015; Tumwebaze & Ijjo, 2015). Another variable is environmental quality (Abdouli & Hammami, 2017; Borhan et al., 2012; Fakher & Abedi, 2017; Li et al., 2015).

The data were examined using panel data regression. The Hausman test and the Lagrange multiplier test were used to assess which model was most appropriate for the panel data. This study employed traditional assumption tests, including multicollinearity (VIF), heteroscedasticity (modified Wald test), and autocorrelation (Wooldridge test), as well as t-tests, F-tests, and the coefficient of determination ( $R^2$ ). The following is a model of the panel data regression equation is as follows.

$$IGDPPC_{it} = \alpha + \beta_1 lFintech_{it} + \beta_2 ATMCard_{it} + \beta_3 lEMon_{it} + \beta_4 lThirdPartyFund_{it} + \beta_5 lPOP_{it} + \beta_6 HDI_{it} + \beta_7 IKLH_{it} + \varepsilon_{it} \quad (2)$$

## Results and Discussion

Table 2 summarizes the descriptive statistics of the variables included in the empirical analysis. Economic growth exhibits a mean value of 11.007, with observations ranging from 9.885 to 12.749. Fintech lending records an average value of 12.093, with a minimum of 11.308 and a maximum of 12.614. Financial inclusion, measured using ATM cards, electronic money (e-money), and third-party funds, reports mean values of 0.178, 13.635, and 10.736, respectively. These statistics provide an overview of the distribution and variation of the main explanatory variables across the 34 Indonesian provinces during the observation period.

Table 2. Statistic Descriptive

| Variable               | Obs | Mean   | Std. Dev. | Min    | Max    |
|------------------------|-----|--------|-----------|--------|--------|
| <i>IGDPPC</i>          | 204 | 11.007 | .571      | 9.885  | 12.749 |
| <i>lFintech</i>        | 204 | 12.093 | .423      | 11.308 | 12.614 |
| <i>ATMCard</i>         | 204 | .178   | .298      | .000   | 1.708  |
| <i>lEMon</i>           | 170 | 13.635 | 2.479     | .693   | 20.323 |
| <i>lThirdPartyFund</i> | 199 | 10.736 | 1.516     | 2.906  | 15.319 |
| <i>lPOP</i>            | 204 | 15.307 | 1.019     | 13.269 | 17.734 |
| <i>HDI</i>             | 204 | 72.247 | 3.811     | 60.44  | 84.15  |
| <i>IKLH</i>            | 204 | 71.873 | 6.896     | 42.84  | 84.22  |

Table 3. Correlation Matrix

| Variables                  | (1)    | (2)    | (3)    | (4)    | (5)    | (6)    | (7)    | (8)   |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|-------|
| (1) <i>IGDPPC</i>          | 1.000  |        |        |        |        |        |        |       |
| (2) <i>lFintech</i>        | 0.203  | 1.000  |        |        |        |        |        |       |
| (3) <i>ATMCard</i>         | 0.114  | -0.217 | 1.000  |        |        |        |        |       |
| (4) <i>lEMon</i>           | 0.046  | 0.172  | 0.496  | 1.000  |        |        |        |       |
| (5) <i>lThirdPartyFund</i> | 0.114  | 0.011  | 0.294  | 0.366  | 1.000  |        |        |       |
| (6) <i>lPOP</i>            | -0.075 | -0.003 | 0.684  | 0.706  | 0.307  | 1.000  |        |       |
| (7) <i>HDI</i>             | 0.531  | 0.292  | 0.241  | 0.455  | 0.363  | 0.227  | 1.000  |       |
| (8) <i>IKLH</i>            | -0.114 | 0.193  | -0.624 | -0.668 | -0.390 | -0.644 | -0.478 | 1.000 |

The correlation matrix in Table 3 indicates that the pairwise correlation coefficients among the explanatory variables are all below 0.70 in absolute value. This suggests that no strong linear associations exist between the variables, providing preliminary evidence that severe multicollinearity is unlikely to pose a substantial concern in the regression analysis.

When estimating panel data, several stages are needed to test the best model to use. Table 4

shows the results of the Breusch and Pagan Lagrangian Multiplier Test; if the probability value is  $< 0.05$ , then the Random Effect Model is better than OLS.

Table 4. Uji Breusch and Pagan Lagrangian Multiplier Test

|                           |        |
|---------------------------|--------|
| Probabilitas > chi-square | 0.0000 |
|---------------------------|--------|

The Breusch and Pagan LM Test has a probability of 0.0000, which is  $< 0.05$ . Thus, the Random Effects model was selected. So, the test was continued with the Hausman Test, where the probability value was  $< 0.05$ ; therefore,  $H_0$  was rejected, so the Fixed Effect Model (FEM) was better than the Random Effect Model (REM).

Table 5. Hausman Test

|                             |        |
|-----------------------------|--------|
| Probabilitas > chi-square 2 | 0.0000 |
|-----------------------------|--------|

The Hausman test has a p-value of  $< 0.05$ , so it rejects  $H_0$ , and the Fixed Effect Model is the best. Furthermore, classical assumption tests, including multicollinearity, heteroscedasticity, and autocorrelation, are as follows. Table 6 shows that the VIF value is  $< 10$ , so there is no problem of multicollinearity. In terms of heteroscedasticity, assuming  $H_0$  has no heteroscedasticity problem while  $H_1$  has a heteroscedasticity problem. Based on Table 7, the p-value is  $< 0.05$ ; therefore,  $H_0$  is rejected, indicating a heteroscedasticity problem.

Table 6. Variance Inflation Factor

|                        | VIF   | 1/VIF |
|------------------------|-------|-------|
| <i>IKLH</i>            | 3.175 | .315  |
| <i>IPOP</i>            | 3.106 | .322  |
| <i>lEMon</i>           | 2.862 | .349  |
| <i>ATMCard</i>         | 2.256 | .443  |
| <i>HDI</i>             | 1.827 | .547  |
| <i>lFintech</i>        | 1.582 | .632  |
| <i>lThirdPartyFund</i> | 1.265 | .791  |
| Mean VIF               | 2.296 | .000  |

Table 7. Heteroscedasticity

|           |             |
|-----------|-------------|
| Chi2 (34) | Prob > chi2 |
| 3633.07   | 0.0000      |

Table 8. Wooldridge Test

|           |          |
|-----------|----------|
| F (1, 33) | Prob > F |
| 367.242   | 0.0000   |

$H_0$  assumes no autocorrelation problem, while  $H_1$  assumes an autocorrelation problem. Based on Table 8, p-value  $< 0.05$ , we reject  $H_0$ , so there is an autocorrelation problem. Accordingly, the regression model was estimated using robust standard errors to account for potential heteroskedasticity and autocorrelation (Stock & Watson, 2008).

This is the result of the regression estimation as presented in Table 9. Testing of the partial influence of the independent variables on the dependent variable was carried out with the t-test and juxtaposed the results of the t-calculated value and t-table. In addition, the probability value is also considered. The following table presents the results of the t-test based on the selected model of the Fixed Effect Model.

Table 9. Regression Estimation Results

| VARIABLES              | (1)<br>IGDPPC (OLS)   | (2)<br>IGDPPC (REM)    | (3)<br>IGDPPC (FEM)    | (4)<br>IGDPPC (FEM<br>Robust) |
|------------------------|-----------------------|------------------------|------------------------|-------------------------------|
| <i>IFintech</i>        | 0.141<br>(0.0977)     | 0.193***<br>(0.0260)   | 0.197***<br>(0.0259)   | 0.197***<br>(0.0264)          |
| <i>ATMCard</i>         | 0.610***<br>(0.201)   | 0.0803*<br>(0.0466)    | 0.0743<br>(0.0456)     | 0.0743*<br>(0.0432)           |
| <i>lEMon</i>           | -0.0397<br>(0.0243)   | 0.0157<br>(0.0136)     | 0.0137<br>(0.0140)     | 0.0137<br>(0.0126)            |
| <i>lThirdPartyFund</i> | -0.0120<br>(0.0261)   | 0.00261<br>(0.00690)   | 0.00202<br>(0.00677)   | 0.00202<br>(0.00383)          |
| <i>lPOP</i>            | -0.138**<br>(0.0614)  | -0.117***<br>(0.0394)  | -0.144***<br>(0.0441)  | -0.144***<br>(0.0496)         |
| <i>HDI</i>             | 0.0907***<br>(0.0128) | 0.0179***<br>(0.00487) | 0.0139***<br>(0.00504) | 0.0139*<br>(0.00708)          |
| <i>IKLH</i>            | 0.00393<br>(0.0111)   | 0.00528<br>(0.00474)   | 0.00811*<br>(0.00486)  | 0.00811<br>(0.00556)          |
| Constant               | 5.156***<br>(1.692)   | 8.548***<br>(0.753)    | 9.036***<br>(0.815)    | 9.036***<br>(0.970)           |
| Observations           | 170                   | 170                    | 170                    | 170                           |
| R-squared              | 0.373                 |                        | 0.820                  | 0.820                         |
| Number of Codes        |                       | 34                     | 34                     | 34                            |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Based on Table 10, several variables significantly influence economic growth, namely *fintech lending*, ATM Card, population, and HDI. In contrast, E-Money, third-party funds, and IKLH did not significantly influence economic growth. Furthermore, the F-test produced a probability value of 0.0000 (< 0.05), which means the research model can explain the relationship between the variables. Together, the variables of *fintech lending*, ATM cards, *E-money*, Third-Party Funds, population, Human Development Index, and IKLH influence economic growth in 34 Indonesian provinces.

Table 10. Regression Model

| Variable                    | Notes                  | t-stats | Probability | Remarks         |
|-----------------------------|------------------------|---------|-------------|-----------------|
| <i>Fintech Lending</i>      | <i>IFintech</i>        | 7.46    | 0.000       | Significant     |
| ATMCard                     | <i>ATMCard</i>         | 1.72    | 0.095       | Significant     |
| E-Money                     | <i>lEMon</i>           | 1.09    | 0.283       | Not Significant |
| Third-Party Funds           | <i>lThirdPartyFund</i> | 0.53    | 0.602       | Not Significant |
| Total population            | <i>lPOP</i>            | -2.91   | 0.006       | Significant     |
| Human Development Index     | <i>HDI</i>             | 1.97    | 0.058       | Significant     |
| Environmental Quality Index | <i>IKLH</i>            | 1.46    | 0.154       | Not Significant |
| Constant                    | cons                   | 9.32    | 0.000       |                 |

Table 11. F Test

|                      |        |
|----------------------|--------|
| Probabilities > chi2 | 0.0000 |
|----------------------|--------|

The value of the determination coefficient in this study was 0.820, or 82,00%; this shows that the independent variables in the model can explain the variation in economic growth in Indonesia by 82,00%. Meanwhile, 18,00% of the variation in economic growth was explained by factors other than the variables included in the research model. Therefore, the form of the regression model used is as follows:

$$\begin{aligned}
 LGDPPC_{it} = & 9.036 + 0.197 lFintech_{it} + 0.074 ATMCard_{it} + 0.014 lEMon_{it} + \\
 & 0.002 lThirdPartyFund_{it} - 0.144 lPOP_{it} + 0.014 HDI_{it} + 0.008 IKLH_{it} + \\
 & \varepsilon_{it}
 \end{aligned} \quad (3)$$

According to the regression model estimates, fintech lending has a positive and substantial link with economic growth in 34 Indonesian provinces, with a coefficient of 0,197. This means that if fintech loans rise by 1 percent, holding all other variables constant, economic growth in 34 Indonesian provinces will increase by 0,197 percent. However, the study's findings do not support the hypothesis but are consistent with the findings of [Song and Appiah-Otoo \(2022\)](#), who found a favorable association between fintech and economic growth in China. In the Indonesian context, these findings align with [Maulana and Wiharno \(2022\)](#), showing that the rise of fintech lending benefits the national economy by enabling MSMEs to obtain loans through easily accessible channels that improve liquidity. The loan process, interest rates, fees, loan amounts, and flexibility all entice MSMEs to use fintech lending services. Easier access to finance allows MSMEs to expand their manufacturing activities and increase their revenue. As a result, fintech lending has a favorable impact on the Indonesian economy, promoting overall growth.

The ATM Card variable has been shown to contribute positively and considerably to economic growth (coefficient of 0,074). This implies that, holding other variables constant, each additional ATM card increases economic growth by 0,074 percent. As a tool for digital financial inclusion, ATM cards play an important role in fostering economic growth in developing countries. Research by [Ifediora et al. \(2022\)](#) indicates that providing supporting infrastructure, such as ATMs, facilitates public access to financial services, particularly for underserved communities. Financial institutions also benefit from their expanded role in economic growth. However, this study's findings contradict the theory but are consistent with other research ([Cahyani et al., 2023](#); [Rukmana, 2016](#)), which shows that higher ATM transactions do not improve economic development. The rise of ATM cards will not boost public consumption. People will postpone their consumption because withdrawals must be made through ATMs and funds must be held in a bank account.

Variable E-Money has a positive not significant influence on economic growth, as evidenced by a coefficient value of 0,014. The figure indicates that if E-Money increases by 0,014 units, while other variables remain constant, economic growth will increase by 0,014 percent. These results align with [Ifediora et al. \(2022\)](#), who found that while e-money has the potential to generate economic growth, its impact is not statistically significant. In terms of usage, e-money offers significant benefits, such as low transaction costs, better risk-sharing structures, and support for households responding to economic shocks. Yet, some members of the public remain concerned about using mobile phones and the internet to access formal financial services, including identity theft, cybersecurity risks, personal data misuse, and privacy concerns. Such concerns weaken public trust in digital financial services, leaving individuals exposed to financial shocks, resulting in poor financial planning and lower adoption of financial products and services. As a result, these factors limit the extent to which financial digitalization contributes to economic activity.

The third-party fund variable has a positive but insignificant relationship with economic growth, with a coefficient value of 0.002. An increase in third-party funds by 0.002 percent, holding other variables constant, increases economic growth by 0.002 percent. This finding does not support the hypothesis but aligns with it, suggesting that Third-Party Funds have no significant influence on economic growth. Low literacy levels and poor access to public financial services affect banks' ability to raise Third-Party Funds. The public's low level of knowledge indicates the level of financial literacy in available financial institutions.

The population variable has a negative and significant relationship with economic growth, with a coefficient value of 0.144 percent. This means that a 1 percent increase in population, holding other variables constant, would decrease economic growth by 0.144 percent. These findings are consistent with [Ayana et al. \(2024\)](#) and [Khodaverdian \(2022\)](#). According to [Khodaverdian \(2022\)](#), population growth rarely benefits the economy; instead, its impact on economic growth depends on the economic capacity to transform more people into useful human capital and employment. When job creation, capital accumulation, infrastructure provision, and human capital development fall behind population growth, population growth can lead to resource constraints and lower production per capita, ultimately hurting economic growth.

The Human Development Index (HDI) shows a positive and statistically significant association with economic growth, with an estimated coefficient of 0.014. These findings suggest that a one-point increase in HDI is associated with a 0.014-point increase in economic growth, *ceteris paribus*. This positive relationship highlights the importance of human development in supporting regional economic performance, potentially through improvements in education, health, and productivity. These findings

align with the results of the study (Hoa et al., 2016; Muqorrobin & Soejoto, 2017; Elistia & Syahzuni, 2018; Taqi et al., 2021; Zhang & Danish, 2019), which show the positive contribution of the Human Development Index to economic growth. There are 3 (three) dimensions that form the HDI, namely education, health, and economy. Higher human development gives communities access to better education and health services. This is human capital development through a healthier, more educated society, which encourages economic growth.

The Environmental Quality Index exhibits a positive but statistically insignificant association with economic growth, with an estimated coefficient of 0.008. This result suggests that a one-point increase in the Environmental Quality Index is associated with a small increase in economic growth, *ceteris paribus*, although the relationship is not statistically distinguishable from zero. This finding differs from Fakher and Abedi (2017), who reported a positive and statistically significant relationship between environmental performance and economic growth. Such differences may reflect variations in country characteristics, study periods, environmental indicators, and empirical specifications. Furthermore, the relationship between environmental conditions and economic performance may be complex, as changes in carbon emissions can have different implications for GDP growth in the short and long run. It is shown that there is an EKC where increasing economic growth will increase environmental pollution. Higher per capita income improves environmental quality.

## Conclusion

This study investigates the relationship between fintech lending, financial inclusion, and economic growth across 34 provinces in Indonesia using panel data estimation. Specifically, it examines the associations of fintech lending, financial inclusion indicators (ATM cards, electronic money, and third-party funds), population, the Human Development Index (HDI), and environmental quality with regional economic growth. The empirical findings reveal that fintech lending and ATM cards are positively and significantly associated with economic growth. In contrast, electronic money, third-party funds, and environmental quality exhibit positive but statistically insignificant relationships. Population demonstrates a significant negative association with economic growth, whereas HDI is positively and significantly associated with regional economic performance. These findings highlight the heterogeneous relationships between digital financial development, socioeconomic characteristics, environmental conditions, and economic growth across Indonesia's provinces.

One limitation of this study is that the indicators used may not fully capture financial inclusion, given its multidimensional nature. Constructing a composite financial inclusion index requires careful consideration of the dimensions and indicators included, as the choice of indicators and aggregation method may affect the measurement results. Furthermore, the Generalized Method of Moments (GMM) estimator was employed to address potential endogeneity arising from reciprocal effects; checks are needed to assess the consistency of the results across alternative indicators and model specifications, particularly because the relationship between environmental quality and economic growth may be nonlinear.

The findings encourage several policy suggestions that need to be taken for the Indonesian government in increasing economic growth, namely: (1) Intensive socialization is needed to the public in making online loans (*fintech lending*) to companies that already have legality licenses from the Financial Services Authority as well as expanding access to credit in encouraging public consumption, increase in working capital, investment, and business expansion; (2) Intensive policies and efforts are needed to increase financial inclusion in order to increase economic growth in every province in Indonesia; (3) As the population increases, employment needs to be expanded and equalized; (4) Improving human quality with synergy between education, health, and economic aspects will encourage the improvement of people's skills in the use of digitalization so that it can optimize existing economic growth; (5) It is necessary for government policies to increase the Environmental Quality Index every year and balance environmental quality and economic growth.

## CRedit Author Statement

**Aqifa Pebrianti:** Formal analysis, writing, original draft, review & editing, data curation, visualization. **Nugroho Saputro:** Review & editing, supervision, funding acquisition. **Lukman Hakim:** Conceptualization, methodology, review & editing, supervision. **Putra Pamungkas:** Conceptualization,

methodology, review & editing, supervision.

## Generative AI Disclosure

The authors used ChatGPT and Grammarly, an AI-assisted language model developed by OpenAI, to check the statistical analysis, improve language clarity and academic writing, refine paragraphs during manuscript revision, and prepare responses to reviewers' comments. The authors were responsible for the study design, data collection, data analysis, and manuscript preparation. The authors critically reviewed and revised all AI-assisted outputs and assume full responsibility for the accuracy, integrity, and final content of the manuscript.

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