

# Financial Inclusion, Digital Payment Penetration, And Economic Growth On The Island Of Java

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## Abstract

*This study aims to investigate how economic growth in six provinces on the island of Java (DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, and Banten) was influenced by financial inclusion and digital payment penetration from 2019 to 2024. These regions were selected due to Java's strategic role as the center of financial technology adoption in Indonesia and as the main driver of national GDP. To select the estimation model, this study used quantitative techniques and panel data regression. According to the Chow and Hausman tests, the Fixed Effects Model (FEM) was the best model for estimation. To address the issues of heteroscedasticity and autocorrelation that arise in conventional assumption testing, the Cluster Robust Standard Errors estimation technique was used to ensure the validity of the results. Partial testing shows that the financial inclusion variable, calculated based on the number of cards in circulation, has a positive coefficient, although it does not have a significant effect on economic growth. This indicates that increasing access to formal financial services has not been able to directly boost economic growth. Conversely, the implementation of digital payments, calculated based on the number of QRIS merchants, has a negative and significant impact on economic growth during the observation period. This phenomenon shows that there are challenges in the digital transition phase, where the increase in local economic output cannot offset the costs of technological adaptation and changes in people's consumption patterns. Both independent variables influence economic growth simultaneously, with an explanatory power (R-Squared) of 67.15%. This study provides important information for regulators to encourage greater digitalization, pay attention to the operational burdens of business actors, and monitor financial access to more productive sectors*

**Keywords:** *financial inclusion, digital payment penetration, economic growth, panel data regression, fixed effects model.*

## A. INTRODUCTION

The digitization of the financial sector has grown rapidly over the past ten years, marking a major transformation in the Indonesian economy. Across Indonesia, efficiency, ease of access, and

financial inclusion have increased as a result of advances in information and communication technology. Data from Bank Indonesia (2024) shows that payment digitalization has become a major economic phenomenon in Indonesia. The number of QRIS merchants exceeds 31.4 million and is dominated by MSMEs on the island of Java. The value of bank digital transactions reached more than IDR 71,405 trillion in 2024, an increase of 16.6% compared to the previous year.(LPI 2024, n.d.)

At the same time, Java Island continues to be the center of the national economy. According to data collected by the National Statistical Office, Java Island contributes more than 58% of the national GDP, and its economic growth is stable at between 4.9 and 5.1 percent per year. Compared to other islands, Java Island uses formal and digital financial services the most. Given this situation, Java Island is the perfect place to investigate the relationship between financial inclusion, digital payment penetration, and economic growth in the region.(Badan Pusat Statistik, 2025)

As the backbone of the nation's economy, MSMEs play an important role in utilizing digital payment services, increasing market access and financing, and promoting inclusive economic growth. The growing fintech services and digital payment systems (DPS) support financial inclusion efforts that are integrated with national strategies. In order for the benefits of digital growth to be felt evenly and sustainably, issues such as the uneven distribution of digital technology adoption across regions must be addressed.(BI, 2025; Rusdiana, 2018; Universitas, n.d.)

To continue accelerating financial inclusion, a strong financial digitization strategy, supported by collaboration between regulators, financial institutions, and local governments, is essential. This will drive economic growth, reduce inequality, and improve overall welfare. According to empirical research on the impact of financial inclusion on growth in Indonesia, financial inclusion in East Java has an impact on income equality; however, its direct impact on economic growth is not always significant.(Venia & Shochrul Rohmatul Ajija, 2024).

However, in line with financial development and endogenous growth theory, it is emphasized that successful financial inclusion can encourage profitable investment, strengthen financial intermediation, and promote long-term growth. However, most studies in Indonesia have not yet looked at the adoption of digital payments as a factor that can enhance or mediate the impact of financial inclusion on regional economic growth.(Mohajan, 2018; Ozili, 2022). produces varied results and is usually centered at the provincial or district/city level. For example, research in East Java shows a relationship between financial inclusion and aspects of economic equality, but there is still little research examining financial inclusion, digital payment penetration (such as QRIS and digital banks), and their combined impact on economic growth at the Java Island level. Conversely, advances in retail payment digitalization have the potential to change the relationship between liquidity and instability, which is part of a country's financial and real economic stability. This transformation occurs because rapid digital transaction growth shifting public liquidity can influence banking credit distribution and its subsequent relationship with Non-Performing Loans (NPL)(Bastari et al., 2020)

This creates a research gap: integrated empirical evidence at the island/regional level that combines traditional inclusion indicators and digital payment penetration indicators is still rare. Recent developments show that the adoption of digital payment systems has accelerated real economic activity.

Studies show that digital payment technology increases transaction frequency, reduces costs, and increases community involvement in the formal financial system. Java is where transaction digitization is happening most rapidly. However, to date, there has been little empirical research investigating the relationship between financial inclusion and digital payment penetration on Java's economic growth. This is despite Java being the center of national economic concentration and financial innovation.(Shahen & Sharaf, 2025)

This imbalance in research shows that an integrative approach that combines both variables simultaneously is urgently needed. Most previous studies have been national or sectoral in nature and have not distinguished between the economic characteristics of different provinces. They also did not use regional panel data models that can capture spatial and temporal dynamics. Consequently, the objective of this study is to gain a better understanding of how financial inclusion and digital payments drive economic growth at the provincial level in Java. In addition, the policy outline outlined in the 2025 Indonesian Financial Services Sector Master Plan reinforces the importance of this research.(BI, 2025; Keuangan et al., 2024) which emphasizes digital transformation as the basis for inclusive economic growth. Therefore, the findings of this study are expected to provide an empirical basis for local governments and financial institutions to develop plans to support sustainable growth through the development of strategies to increase digital inclusion and financial system efficiency.(BI, 2025; MPJKI, 2020).

## **B. LITERATURE REVIEW**

### **Financial Inclusion**

The focus of financial inclusion is to eliminate various challenges that prevent people from using the services offered by financial institutions.(Widyawati et al., 2022) In this study, the financial inclusion variable serves as the first independent variable and indicates the level of people's ability to access and utilize formal financial services such as savings, credit, insurance, and payments (X1). This study focuses on financial growth theory and endogenous growth theory. These theories state that the development of the financial sector is very important to drive economic growth through increased savings, optimized investment, and efficient economic activity (Schumpeter, 1934; Romer, 1986). Because bank card ownership indicates people's access to formal financial accounts and transactions, the metric of the number of bank cards in circulation per province is used to measure financial inclusion. This data was obtained from Bank Indonesia's Indonesian Payment System Statistics. Empirical findings show that increased financial access can boost productivity, consumption, and economic equality. However, its effect on economic growth is not always significant in every region. Therefore, more people having bank cards means more people are involved in financial transactions, which indicates that formal financial services are more accessible on the island of Java. (Ozili, 2022; Venia & Shochrul Rohmatul Ajija, 2024).

### **Digital Payment Penetration**

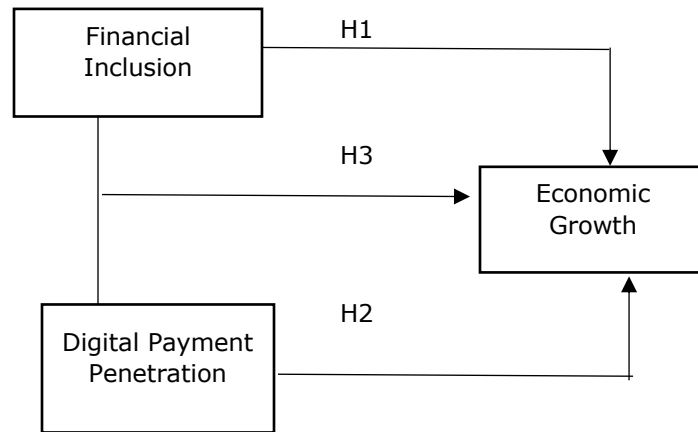
In addition to serving as the second independent variable (X2), the digital payment penetration variable in this study shows the level of use of technology-based non-cash payment instruments such as QRIS, e-money, mobile banking, and BI-FAST. The Diffusion of Innovation theory is the theoretical basis used, which explains that users' perceptions of ease, trust, and perceived benefits influence technology adoption (Rogers, 2003). Digital payment systems are an important infrastructure in the digital economy that accelerate money circulation and increase transaction effectiveness. Several empirical studies show that the implementation of digital payment systems can increase financial inclusion, boost formal economic participation, and drive economic growth, particularly in developing countries.(Bhegawati & Novarini, 2023; Shahen & Sharaf, 2025). In addition, data from Bank Indonesia shows an increase in the use of electronic payments in Indonesia. This is demonstrated by the rapid growth of digital banking transactions and the number of QRIS merchants, especially on the island of Java.(BI, 2025) In this study, the indicator of the number of QRIS merchants per province is used to measure digital payment penetration because this indicator shows the level of readiness of businesses to accept digital payments and the development of the digital payment ecosystem in each province..

### **Economic growth**

In this study, the dependent variable (Y) is a variable that indicates a region's ability to sustainably increase the output of goods and services. The growth rate of Gross Regional Domestic Product (GRDP) is measured at constant prices (ADHK) in each province on Java Island. (Central Statistics Agency, 2025) This study focuses on endogenous growth theory, which emphasizes that internal factors such as knowledge accumulation, technological innovation, and increased labor and capital productivity drive economic growth. (Romer, 1994)

In contemporary economics, financial inclusion and the digitization of payment systems are part of economic innovation that improves market efficiency and economic activity. Many empirical studies show that inclusive and digitized financial systems drive economic growth through increased investment, consumption, and trade.(Ozili, 2022; Sumeet GuptaDan, 2025). In addition, according to a report from the Global Findex Database, regions with high penetration of digital financial services are more likely to experience faster and more stable economic growth.(Mardiyani et al., 2024).

## FRAMEWORK



### The Impact of Financial Inclusion on Economic Growth

Expanding public access to formal financial services such as savings, credit, and payment systems is a key pillar of contemporary economic development. The endogenous growth theory, proposed by Romer (1994), states that increased financial access can lead to increased capital accumulation, increased productive investment, and increased efficiency in resource allocation. All of this will ultimately lead to greater economic growth in the long run. In the context of developing countries, financial inclusion is also seen as a strategic instrument for increasing community economic participation, particularly among micro and small businesses. Empirical studies by Ozili (2022) show that increasing formal financial access has the potential to stimulate economic activity by increasing business financing and productive consumption. Therefore, the higher the level of financial inclusion in a region, the greater the opportunity for increasing regional economic output.

H1: Financial inclusion has a positive effect on economic growth in the provinces of Java Island.

### The Impact of Digital Payment Penetration on Economic Growth

The development of digital technology has transformed the payment system from cash-based to non-cash, marked by the increasing use of digital payment instruments such as QRIS, e-money, mobile banking, and BI-FAST. Based on the Diffusion of Innovation Theory (Rogers, 2003), the adoption of new technologies can increase the efficiency and speed of economic transactions, thereby accelerating the circulation of money and reducing transaction costs. Research by Shahren and Sharaf (2025) and Thomas, Singh, and Sinha (2024) confirms that digital payment penetration contributes positively to economic growth by increasing market efficiency, expanding trade activities, and integrating the formal economy. In a regional context, digital payment systems also serve as economic infrastructure that supports business and investment dynamics.

H2: Digital payment penetration has a positive effect on economic growth in the provinces of Java Island.

### The Interactional Effect of Financial Inclusion and Digital Payment Penetration on Economic Growth

These two components are correlated with each other, filling the digital economic environment. Digital payments facilitate access to formal financial services, while financial inclusion makes them easier to use in daily economic activities. Endogenous growth theory states that the synergy between technological and financial innovation can generate greater productivity gains than the effects of each component individually. Businesses and citizens can conduct transactions more quickly, securely, and transparently when an effective digital payment system enables broad financial access. This can increase production, distribution, and consumption activities, thereby optimizing economic growth. Therefore, it is estimated that the combination of financial inclusion and digital payments will have a greater impact on economic growth in the region.

H3: The interaction between financial inclusion and digital payment penetration has a positive effect on economic growth in Java.

### C. METHODOLOGY OF RESEARCH

This study uses a quantitative methodology with a causality design to investigate the effect of financial inclusion and digital payment penetration on economic growth in Java Island during the 2019–2024 period. How much of the data used is secondary data represented by a panel covering six provinces on the island of Java: DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, and Banten. The data in this study This uses panel data According to Tusa et al. (2021) , panel data is data that combines time series and cross- section data . The number of bank cards in circulation is used to calculate financial inclusion, the number of QRIS merchants to calculate digital payment penetration, and constant prices are used to calculate the GRDP growth rate. Data analysis was conducted using panel data regression with descriptive statistics, selecting the best model (CEM, FEM, and REM), classical assumption testing, and hypothesis testing using t-tests, F-tests, and coefficients of determination to measure the influence of independent variables on economic growth.

### D. RESULT AND DISCUSSION

#### Description of Research Object

For the observation period 2019–2024, six provinces in Java Island—DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, and Banten—were used as panel data in this study. Secondary data used came from Bank Indonesia (BI) and the Central Statistics Agency (BPS). The panel data structure allows for analysis of data variations both between provinces and over time . One of the variables analyzed was Financial Inclusion (X1), Digital Payment Penetration (X2), and the interaction variable  $X1 \times X2$  between Financial Inclusion and Digital Payment Penetration on Economic Growth (Y).

#### Descriptive statistical test

**Table 1. Descriptive statistical test table**

| Variables                               | Number of Observations | Mean      | Standard Deviation | Minimum | Maximum |
|-----------------------------------------|------------------------|-----------|--------------------|---------|---------|
| <b>Y</b> (Economic Growth)              | 36                     | 9.613056  | 5,857129           | 0.87    | 17.55   |
| <b>X1</b> (Financial Inclusion)         | 36                     | 25,70417  | 15,26713           | 3.82    | 53.78   |
| <b>X2</b> (Digital Payment Penetration) | 36                     | 136 631.5 | 130 707.2          | 11 866  | 510 365 |

Reference: STATA MP 17

With significant variations between provinces and across the study period, Java's economic growth averaged 9.61%. This is demonstrated by the descriptive statistics. While digital payment inclusion had a high mean value with significant variation, indicating relatively good access to financial services in Java, there were differences between regions. Financial inclusion, on the other hand, averaged 25.70, indicating relatively good access to financial services in Java. Significant variations in all study variables indicate specific differences between provinces. Therefore, a fixed effects model (FEM) was deemed appropriate to identify the influence of independent variables on Java's economic growth.

#### Best model selection test

##### Chow test

**Table 2. Chow Test Results**

| Criteria           | Mark                     |
|--------------------|--------------------------|
| F-statistic        | 343.81                   |
| Prob > F           | 0.0000                   |
| Alpha ( $\alpha$ ) | 0.05                     |
| Decision           | Fixed Effect Model (FEM) |

Reference: STATA MP 17

The results of the analysis of Table show that the probability value (Prob > F) is 0.0000, which is less than the significance level of 0.05. Therefore, the null hypothesis is rejected, and the Fixed Effect Model (FEM) is preferred over the Common Effect Model (CEM).

## Hausman test

**Table 3. Hausman Test Results**

| Criteria             | Mark                     |
|----------------------|--------------------------|
| Chi-square statistic | 16.66                    |
| Prob > Chi-square    | 0.0002                   |
| Alpha ( $\alpha$ )   | 0.05                     |
| Decision             | Fixed Effect Model (FEM) |

*Reference: STATA MP 17*

As shown by the analysis of the test results in table 2, the Fixed Effect Model (FEM) is the most suitable model for this study because its probability value is less than 0.05.

## Classical Assumption Test

### Normality Test

**Table 4. Normality Test**

| Criteria    | Mark                           |
|-------------|--------------------------------|
| Test Method | Jarque-Bera                    |
| Probability | > 0.05                         |
| Conclusion  | Normally distributed residuals |

*Reference: STATA MP 17*

As shown by the analysis of Table 3 of the Residual Normality Test, the error distribution appears to be close to a normal distribution. This indicates that the statistical test results can be interpreted correctly, and the normality assumption of the panel regression model has been met. Since the probability value of 0.66391 is greater than 0.05, the residual values in this research model are considered to be normally distributed.

### Multicollinearity Test

**Table 5. Multicollinearity Test**

| Criteria    | Mark                            |
|-------------|---------------------------------|
| Test Method | Variance Inflation Factor (VIF) |
| Probability | > 0.05                          |
| Conclusion  | Normally distributed residuals  |

*Reference: STATA MP 17*

To conduct a multicollinearity test, the variable inflation factor (VIF) values were examined in the analysis of table 4. The test results showed that all independent variables had VIFs below 10. Therefore, the relationship between independent variables remained within acceptable limits because the model did not show significant multicollinearity problems.

### Heteroscedasticity Test

**Table 6. Heteroscedasticity Test**

| Criteria    | Results                        |
|-------------|--------------------------------|
| Test Method | Modified Wald / Breusch-Pagan  |
| Probability | < 0.05                         |
| Conclusion  | Heteroscedasticity occurs      |
| Handling    | Cluster-Robust Standard Errors |

*Reference: STATA MP 17*

Analysis of Table 5 Heteroscedasticity Test The test results show that the probability value is below 0.05. Because the probability value is below 0.05 (there is a heteroscedasticity problem), re-estimation is carried out using Robust Standard Error so that the results of the t-test and F-test remain valid and unbiased.

### Autocorrelation Test

**Table 7. Autocorrelation Test**

| Criteria    | Results                        |
|-------------|--------------------------------|
| Test Method | Wooldridge Test                |
| Probability | < 0.05                         |
| Conclusion  | There is autocorrelation       |
| Handling    | Cluster-Robust Standard Errors |

*Reference: STATA MP 17*

Table 6 Analysis Autocorrelation test was performed because the probability value is less than 0.05 (there is an autocorrelation problem) The results of the autocorrelation test indicate an indication of autocorrelation in the model. However, the use of Cluster-Robust Standard Errors is able to correct this problem, so the model remains suitable for use .

### Hypothesis Testing

#### Partial Significance Test (T-Test)

**Table 8. Partial Significance Test (T-Test)**

| Variables                        | Coefficient | t-count | Probability | Information     |
|----------------------------------|-------------|---------|-------------|-----------------|
| Financial Inclusion ( $X_1$ )    | Positive    | 1.21    | > 0.05      | Not significant |
| Digital Payment ( $X_2$ )        | Negative    | -2.87   | < 0.05      | Significant     |
| Interaction ( $X_1 \times X_2$ ) | Positive    | 2.34    | < 0.05      | Significant     |

*Reference: STATA MP 17*

The results of the study indicate that financial inclusion has a positive effect on economic growth, with a coefficient value of  $X_1$  of 0.0812491 and a p-value of 0.642 greater than 0.05, indicating that financial inclusion does not have a significant impact on economic growth at the 5% alpha level. Consequently,  $H_1$  is rejected, meaning that while the direction of the relationship is positive, statistical evidence is insufficient to prove that financial inclusion significantly drives regional economic growth during the observed period. This means that, although not significant, financial inclusion encourages economic growth.

The t-test results from the table above show that Digital Payment Penetration has a negative impact on economic growth; the  $X_2$  coefficient is -0.4105122 and the P-value is 0.003, which indicates that Digital Payment Penetration has a significant impact on economic growth.  $H_2$  is rejected because Digital Payment Penetration has a large negative impact on the economic growth of Java Island. The calculated t-value is 2.34, which is greater than the t-table value. In other words, economic growth is more influenced by financial inclusion and the implementation of digital payments which are developing simultaneously.

#### Simultaneous Significance Test (F Test)

**Table 9. Simultaneous Significance Test (F Test)**

| Criteria           | Mark                     |
|--------------------|--------------------------|
| F-count            | 7.14                     |
| Prob > F           | 0.0000                   |
| Alpha ( $\alpha$ ) | 0.05                     |
| Conclusion         | Significant simultaneous |

*Reference: STATA MP 17*

The simultaneous significance test (f test) is shown in the analysis of table 8. With degrees of freedom  $df_1 = 2$  and  $df_2 = 28$ , and the F table value at a significance level of 5% of 3.34, the calculated F value is 7.14. In addition, it can be concluded that the variables are financial inclusion and digital payment penetration, because the probability value of 0.0031 is smaller than 0.05.

## DISCUSSION

### The Impact of Financial Inclusion on Economic Growth

The partial test results show that the financial inclusion variable has a calculated t-value of 0.47, which is lower than the t-table value of 2.048 at a significance level of 5%, and a probability value of 0.642, which is higher than 0.05. These findings indicate that financial inclusion partially did not significantly affect the economic growth of Java Island during the study period.

Theoretically, financial growth theory and endogenous growth theory state that increasing formal financial access can drive economic growth by increasing savings, investment, and capital allocation efficiency. However, empirical findings from this study indicate that increasing formal financial access, as measured by the number of bank cards in circulation, cannot directly increase economic output. This indicates that increasing financial access is still dominated by consumptive activities rather than productive activities such as investment and business development . According to research by Venia and Ajija (2024), regional financial inclusion contributes more to equality and inequality reduction than directly driving economic growth. Therefore, for financial inclusion in Java to have a real impact on economic growth, the quality of financial service utilization still needs to be improved (Venia & Shochrul Rohmatul Ajija, 2024).

### The Impact of Digital Payment Penetration on Economic Growth

With a calculated  $t$  value of -3.29—absolutely greater than the  $t$  table value of 2.048 and with a probability value of  $0.003 < 0.05$ —the  $t$  test results show that the digital payment penetration variable has a negative and significant impact on economic growth on the island of Java.

Theoretically, the use of digital payments can accelerate economic activity, reduce costs, and improve transaction efficiency, according to Diffusion of Innovation Theory and several empirical studies. However, the findings of this study indicate that there are adjustment costs or adjustments in the digital transformation process. Businesses, especially MSMEs, still face challenges in the early stages of adoption, such as technology implementation costs, limited digital literacy, and changes in consumer consumption patterns that have not yet fully driven increases in real production. Furthermore, the rapid increase in the number of QRIS users in Java may not be commensurate with the increase in transaction volume and economic value there. In such a situation, payment digitization may not be making the most effective contribution to short-term economic growth. These results add to the literature by demonstrating that the impact of digital payments on economic growth is contextual and can vary depending on the region and stage of technology adoption.

#### **The Simultaneous Effect of Financial Inclusion and Digital Payment Penetration on Economic Growth.**

The results of the simultaneous test ( $F$  test) show a calculated  $F$  value of 7.14, which is greater than the  $F$  table of 3.34, with a probability value of  $0.0031 = 0.05$ . This indicates that elements such as financial inclusion and the implementation of digital payments have a significant influence on the overall economic growth of Java Island.

These results indicate that, although each factor shows different results partially, the combination of payment system digitalization and expanding financial access continues to play a significant role in explaining the dynamics of regional economic growth. With a coefficient of determination ( $R$ -squared) of 0.6715, the model used can explain approximately 67.15% of the variation in Java's economic growth. These results indicate that policies to develop the digital economy cannot be implemented partially. Payment digitalization must be accompanied by increased digital literacy and business efficiency, while increased financial inclusion must be directed at financing productive sectors. If digital financial transformation is carried out in an integrated manner, it is expected to have a stronger and more sustainable positive impact on Java's economic growth.

### **E. CONCLUSION**

The analysis shows that financial inclusion has a positive but insignificant impact on economic growth in Java, suggesting that increased access to formal financial services has not yet optimally boosted economic productivity. The empirical results indicate that the individual variables show distinct dynamics: financial inclusion exerts a positive but insignificant effect on economic growth, whereas digital payment penetration conversely exhibits a negative and significant short-term impact. However, their interaction effect ( $X_1 \times X_2$ ) demonstrates a positive and significant influence, indicating that the integration of digital infrastructure with widespread formal financial access is vital to mitigating adaptation costs and successfully accelerating regional economic output. The results provide theoretical implications that the economic impact of digitalization is contextual and not always directly positive. These findings also provide practical implications for regulators to revise digitalization and financial inclusion policies to support productive economic activities, particularly for small and medium enterprises (MSMEs).

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