

The Role of Digitization of QRIS and MSME Payments In Encouraging Regional Economic Growth: Empirical Evidence of agencies/Cities In The Special Region of Yogyakarta

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Abstract.

Digital transformation in the payment system is believed to be able to increase transaction efficiency and encourage economic growth. However, empirical evidence on the contribution of payment system digitalization to regional economic growth still shows mixed results, especially in developing countries. This study aims to analyze the role of payment digitalization through the Quick Response Code Indonesian Standard (QRIS) and the development of Micro, Small, and Medium Enterprises (MSMEs) on the Gross Regional Domestic Product (GDP) of districts/cities in the Special Region of Yogyakarta for the period 2015–2025, by controlling the influence of the quality of human resources and tourism activities. QRIS digitalization was measured using dummy variables that distinguish the period before and after QRIS was used massively after 2020. The study used balanced panel data in five districts/cities for eleven years with a Fixed Effect Model (FEM) approach selected based on the Chow and Hausman test. The results of the study show that the model is simultaneously significant with an Adjusted R² value of 0.9953. The development of MSMEs, the quality of human resources proxied using the average length of schooling, and tourist visit activities have a positive and significant effect on GDP, while the digitization of payments through QRIS has a positive effect but is not statistically significant. These findings indicate that the digitization of the payment system has not directly encouraged an increase in regional economic output, but acts as a supporting infrastructure that strengthens transaction efficiency and the digital economy ecosystem, while its effectiveness is highly dependent on the support of the real sector (MSMEs) and the quality of human resources. Therefore, the development of QRIS needs to be integrated with policies to empower MSMEs, improve the quality of education, and develop the tourism sector to realize inclusive and sustainable regional economic growth.

Keywords: QRIS; Payment System Digitalization; MSMEs; Regional Economic Growth and Panel Data.

I. INTRODUCTION

Economic growth is one of the main indicators used to evaluate the success of a region's development because it reflects the economy's ability to create added value, expand employment opportunities, and improve community welfare (Todaro & Smith, 2020). At the regional level, economic growth is represented through the Gross Regional Domestic Product (GDP) which describes the total added value generated by all economic sectors in a region (Sukirno, 2016). Therefore, the increase in GDP is not only a measure of regional economic performance, but also the basis for the formulation of development policies oriented towards regional productivity, equity, and competitiveness.

The development of economic growth theory shows that the determinants of growth no longer rely solely on the accumulation of capital and labor as described in neoclassical theory (Solow, 1956). Endogenous growth theory places innovation, technological advancement, the quality of human resources, and institutions as factors that can increase long-term productivity (Romer, 1990). In this context, digital transformation is seen as one of the new drivers of economic growth because it is able to change the way people produce, distribute, and consume goods and services through increased efficiency, reduced transaction costs, and expanded access to markets (Seto, 2019).

The development of the digital economy in Indonesia has shown a very rapid acceleration in recent years. Increasing internet penetration, smartphone use, electronic commerce, and digital financial services have changed people's transaction patterns from cash-based payment systems to digital payments. Bank Indonesia noted that digital payment transactions in 2024 will reach 34.5 billion transactions or grow 36.1% (year-on-year), while transaction volume through QRIS increased by 175.2% (year-on-year) (Bank Indonesia, 2025). This growth shows that the digital payment system has developed into one of the important infrastructures that supports national economic activities.

As part of this transformation, Bank Indonesia launched the *Quick Response Code Indonesian Standard* (QRIS) as a national standard for QR code-based payments that integrates various payment system service providers (Bank Indonesia, 2019). QRIS not only simplifies payment mechanisms, but also expands financial inclusion and improves transaction efficiency for the public and business actors (Sriekaningsih, 2020). Until the first semester of 2025, QRIS has been used by around 57 million users and 39.3 million merchants, of which more than 93% come from the MSME group, with a total transaction of 6.05 billion transactions worth Rp579 trillion (Bank Indonesia, 2025). These developments show that QRIS has become one of the main instruments in strengthening Indonesia's digital economy ecosystem.

However, the relationship between payment system digitalization and economic growth still shows inconclusive empirical results. Several studies have found a positive relationship between QRIS use and economic growth. Syam et al. (2025) show that the increase in users, merchants, and the value of QRIS transactions contributes to household consumption, MSME digitalization, and financial inclusion which ultimately supports Indonesia's economic growth. Similarly, Rahmawati (2025) found that the use of QRIS in MSMEs is able to accelerate economic activity through increasing transaction efficiency and strengthening the small business sector. Meanwhile, Khonsanova et al. (2025) show that the growth in QRIS transaction volume has the potential to boost the growth of Indonesia's digital economy. However, different results were found by Desfikasari et al. (2026) who concluded that the volume and nominal of QRIS transactions have not had a significant effect on national economic growth.

These findings indicate that the digitalization of the payment system is not an independent factor, but is part of a broader economic ecosystem. The efficiency of transactions generated by QRIS will only have an economic impact if it can be translated into increased production, trade, and value-added creation activities. In this context, Micro, Small, and Medium Enterprises (MSMEs) have a central role because they are the main actors in domestic economic activities as well as the business groups that use digital payments the most (Suci, 2017). The use of QRIS allows MSMEs to reduce transaction costs, accelerate cash flow, improve financial records, and expand access to markets and formal financial services (Alifia et al., 2024). Therefore, the contribution of digitalization to economic growth is expected to take place through increasing the productivity of the real sector, especially MSMEs.

On the other hand, the effectiveness of digital transformation on economic growth is also greatly influenced by the capacity of the real sector and the quality of human resources in absorbing the benefits of digitalization. The higher the quality of human capital, the greater the ability of business actors to adopt and utilize digital technology to increase productivity, because workforce skills and capacity are important factors in ensuring that technology can be applied effectively in economic activities (Dabla-Norris et al., 2023). In addition, tourism activities also form local aggregate demand which has the potential to strengthen the interaction between payment digitalization and strengthening the MSME sector. Thus, the digitalization of the payment system and the development of MSMEs are two main components that complement each other in forming a regional economic growth ecosystem, with the quality of human resources and tourism activities playing as supporting factors that also determine their effectiveness.

This relationship is very relevant in the Special Region of Yogyakarta (DIY) which has an economic structure based on trade, services, education, tourism, creative economy, and MSMEs. Based on data from the Central Statistics Agency, the economy of Yogyakarta will grow by 5.03% in 2024 with a GDP value on the basis of the prevailing price reaching around Rp193.51 trillion, supported by the recovery of the trade, services, and tourism sectors (Yogyakarta Provincial Central Statistics Agency, 2025). These characteristics make DIY an area with a high transaction intensity while relatively quickly adopting digital payment innovations, thus providing a representative context to examine the relationship between digital transformation, the real sector, and economic growth. In addition, during the 2015–2025 research period, data from district/city panels showed an increasing trend in GDP, the number of MSMEs, QRIS adoption, human resource quality, and tourism activities at the same time, so that DIY can be seen as a natural laboratory in analyzing regional economic growth dynamics.

Although research on QRIS and MSMEs has grown rapidly, most studies still place the two variables separately. Research on QRIS generally focuses on technology adoption or financial inclusion (Aryawati et al., 2022), while MSME studies emphasize entrepreneurship and job creation (Suci, 2017). In addition, most studies use national or cross-provincial data so that they have not been able to capture the heterogeneity of economic characteristics at the district/city level. As a result, there is still room for research to explain how payment system digitalization and MSME development interact in influencing regional economic growth.

Based on these gaps, this study aims to analyze the role of payment system digitalization through QRIS and the development of MSMEs on the Gross Regional Domestic Product (GDP) of districts/cities in the Special Region of Yogyakarta during the period 2015–2025 using a panel data regression approach, with the average length of school and the number of tourist visits as control variables. In contrast to the previous research, this study integrates digital transformation and real sector strengthening in an empirical framework at the district/city level so as to better capture regional economic heterogeneity. The findings of the study are expected not only to enrich the literature on the determinants of regional economic growth in the digital era, but also to provide an empirical basis for policy formulation that supports the strengthening of the digital payment ecosystem and the empowerment of MSMEs.

This research offers a new contribution to the development of the regional economic growth literature by shifting the analytical approach from a partial relationship to a more integrative approach. In contrast to most previous studies that place the digitalization of payment systems or the development of MSMEs as determinants that are analyzed separately, this study views the two factors as mutually interacting components in shaping the dynamics of regional economic growth. This approach provides a more comprehensive perspective on how economic transformation takes place at the regional level.

The *first contribution* of this research lies in the integration of two dimensions of economic development, namely digital transformation and strengthening the real sector, in one empirical framework. The digitalization of payments through QRIS represents technological transformation, while the development of MSMEs reflects the capacity of the real sector in creating added value and productivity (Romer, 1990). The two dimensions were analyzed simultaneously to explain the variation in regional economic growth, by controlling the influence of the quality of human resources and tourism activities, thus resulting in a more complete analytical framework than the conventional approach that tests each variable independently.

The *second contribution* lies in the use of QRIS as an indicator of digital transformation that is directly linked to regional macroeconomic indicators. Most research on QRIS still focuses on aspects of technology adoption, consumer behavior, financial inclusion, or micro-business performance (Aryawati et al., 2022; Alifia et al., 2024). This study expands the scope of the analysis by evaluating whether the massive adoption of QRIS has implications for the growth of the Gross Regional Domestic Product (GDP). Thus, this study relates the literature on digital payment systems with the literature on regional economic growth, which until now is still relatively limited.

The *third contribution* is the use of district/city panel data in the Special Region of Yogyakarta during the period 2015–2025, thus allowing analysis of variations between regions as well as changes between times. This approach provides a better ability to capture the heterogeneity of regional economic characteristics compared to research that only uses national, cross-provincial, and cross-section data. The selection of DIY also provides empirical added value because this region has a unique economic structure, characterized by the dominance of the service, education, tourism, creative economy, and relatively high adoption of digital payments (Yogyakarta Provincial Central Statistics Agency, 2025).

The final contribution lies in the way this research positions digitalization as part of the regional economic development ecosystem, not just payment technology innovation. In this study, QRIS is not treated as the ultimate goal of digitalization, but rather as an instrument that strengthens the efficiency of economic activities, supports the productivity of MSMEs, and increases the effectiveness of regional development policies (Romer, 1990). This perspective results in a broader understanding that economic growth in the digital era is not only determined by the adoption of technology, but also by the ability of regions to integrate technology and real sectors in a mutually supportive development ecosystem.

Thus, this research is expected not only to provide empirical evidence on the determinants of regional economic growth, but also to enrich a conceptual perspective on how digital transformation and real sector capacity can be integrated in explaining the dynamics of regional economic development in the digital economy era.

II. LITERATURE REVIEW

The neoclassical economic growth theory developed by Solow (1956) explains that long-term output growth is determined by the accumulation of capital, labor, and technological advancement, where technology is treated as an exogenous factor. The weakness of this assumption is answered by Romer's (1990) theory of endogenous growth, which places innovation, knowledge accumulation, and human capital as factors produced internally by economic activity itself so as to be able to drive productivity in a sustainable manner. It is within this framework that digital transformation, including the digitalization of payment systems, is seen as a form of endogenous technological advancement that lowers transaction costs, expands the participation of business actors in the formal financial system, and encourages real sector productivity (Seto, 2019). *The Quick Response Code Indonesian Standard* (QRIS), as a national QR code standard launched by Bank Indonesia to integrate all payment system service providers (Bank Indonesia, 2019), is a concrete manifestation of this transformation that simplifies non-cash payment mechanisms, expands financial inclusion, and improves transaction efficiency for consumers and business actors (Srikaningsih, 2020).

Empirically, the use of QRIS has been proven to increase the efficiency of MSME transactions (Prasetyo & Hidayat, 2021) while encouraging an increase in micro and small business income (Alifia et al., 2024), in line with Bank Indonesia's data which recorded QRIS transaction growth of 175.2% (year-on-year) in 2024 and a reach of 57 million users and 39.3 million merchants worth Rp579 trillion in the first semester of 2025 (Bank Indonesia, 2025a, 2025b). However, most of these studies still focus on the micro level and have not been widely tested for their influence on macro-regional indicators such as GDP (Aryawati et al., 2022; Atarwaman et al., 2023). The efficiency of these transactions will only have a real impact if translated into an increase in production activities by real business actors, and in this case Micro, Small, and Medium Enterprises (MSMEs) hold a central role as the backbone of the domestic economy (Suci, 2017) which is theoretically explained through Schumpeter's entrepreneurship theory, where innovation and small entrepreneurial activities are the main drivers of added value creation and employment (Schumpeter, 1934). The contribution of MSMEs of more than 60% to national GDP and the absorption of around 97% of the workforce in the business world (DJPb, 2025), plus the fact that MSMEs are the largest users of QRIS to reduce transaction costs and expand market access (Alifia et al., 2024), confirm that the development of MSMEs and payment digitalization are two mutually reinforcing determinants in encouraging regional GDP growth.

In addition to the real sector, the quality of human resources represented by the Average School Length (RLS) plays an important role in the endogenous growth framework because it increases the ability of the workforce to absorb and adapt new technologies (Romer, 1990), although its influence on regional growth is relatively small compared to other factors and is not always significant in some regions (Kustanto, 2020). Tourism activity is also an important determinant as explained by tourism-led growth theory, where tourist visits encourage local aggregate demand through accommodation consumption, transportation, and the creative economy, thereby increasing regional output (Feriyanto, 2020), which is confirmed by empirical findings that increased tourist visits have a positive and significant impact on GDP in various provinces (Budhi & Sanjaya, 2024; Mukaffi & Haryanto, 2022). These two variables are used as control variables in this study because they help shape regional capacity to absorb the benefits of payment digitalization and strengthen the MSME sector.

Overall, previous research has shown that QRIS, MSMEs, human capital, and tourism each have an influence on economic growth, but the majority of studies place these variables separately and most of them are conducted at the provincial or national level so that they have not adequately captured economic heterogeneity between regions. This study fills this gap by integrating QRIS and MSMEs simultaneously in

the data of district/city panels in the Special Region of Yogyakarta, with the average length of school and the number of tourist visits as control variables, as illustrated in the following frame of mind.

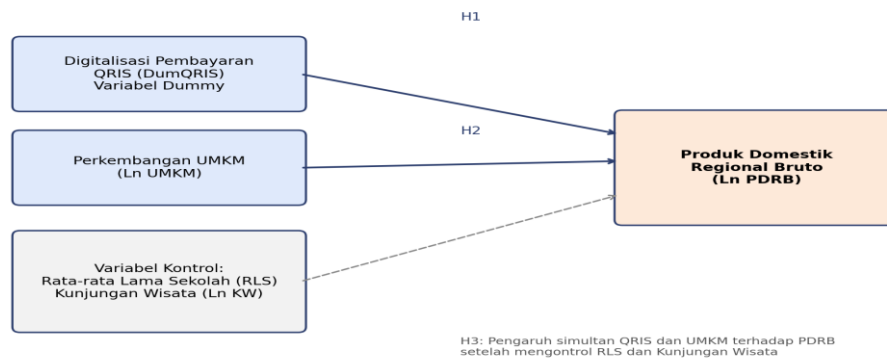


Figure 1. Research Framework

Based on this frame of thought, this study suspects that the digitization of the payment system through QRIS has a positive and significant effect on the GDP of districts/cities in the Special Region of Yogyakarta (H1), the development of MSMEs has a positive and significant effect on the GDP of districts/cities in the Special Region of Yogyakarta (H2), as well as the digitization of the QRIS payment system and the development of MSMEs simultaneously have a significant effect on the GDP of districts/cities in the Special Region of Yogyakarta after controlling the average length of school and the number of tourist visits (H3).

III. RESEARCH METHODOLOGY

This study uses a quantitative approach with panel data to analyze the role of payment system digitalization through the *Quick Response Code Indonesian Standard* (QRIS) and the development of Micro, Small, and Medium Enterprises (MSMEs) to the Gross Regional Domestic Product (GDP). The quantitative approach was chosen because it allows the objective testing of causal relationships between variables through econometric analysis, so as to be able to produce measurable empirical evidence in explaining the factors that influence regional economic growth.

The study utilizes panel data that combines *cross-section* and *time series* dimensions, covering five districts/cities in the Special Region of Yogyakarta during the period 2015–2025. The use of panel data was chosen because it has several advantages over the *cross-section* and *time series* approaches separately. Panel data allows the observation of changes in the economic characteristics of each region over time, while accommodating heterogeneity between regions that cannot be observed directly. Thus, this approach is able to produce more efficient parameter estimation, reduce the potential for bias due to unobserved *heterogeneity*, and increase the accuracy in identifying the relationship between independent variables and economic growth.

The selection of the Special Region of Yogyakarta as the object of the research is based on its heterogeneous economic characteristics, with an economic structure supported by the trade, services, tourism, education, creative economy, and MSME sectors. In addition, the development of payment system digitalization in this region shows a relatively rapid trend in recent years, thus providing a relevant empirical context to evaluate the linkage between digital transformation, real sector strengthening, and economic growth. All analyses in this study were carried out using Eviews software through a panel data regression approach with the selection of the best model based on a series of model specification tests.

This study uses secondary data in the form of a balanced data panel consisting of *cross-section* and *time series dimensions*. The analysis unit covers five districts/cities in the Special Region of Yogyakarta, namely Yogyakarta City, Sleman Regency, Bantul Regency, Kulon Progo Regency, and Gunungkidul Regency, with an observation period of 2015–2025, resulting in 55 observations. The use of panel data allows the analysis to be carried out more comprehensively because it is able to capture variations in economic characteristics between regions as well as changes that occur over time.

The research data was obtained from several official sources that have a high level of credibility and consistency, namely the Central Statistics Agency (BPS) and Bank Indonesia. All data were compiled based on the suitability of the observation period and the uniformity of statistical definitions so as to produce a consistent database for econometric analysis. The use of data from official institutions also aims to increase the validity of research results and minimize the potential for measurement bias.

This study uses Gross Regional Domestic Product (GDP) as a dependent variable (Y) which represents the performance of regional economic growth. The independent variable (X) consists of the development of MSMEs as an indicator of real sector capacity (X1) and the digitization of QRIS payments (DumQRIS) as a dummy variable that distinguishes the period before and after QRIS is used massively (X2). In addition, the study included Average School Length (RLS) and number of tourist visits (KW) as control variables to accommodate the influence of the quality of human resources and tourism sector activities on regional economic growth.

To analyze the role of payment system digitalization through QRIS and the development of MSMEs on regional economic growth, this study uses a panel data regression approach. This approach was chosen because it is able to integrate data variations between regions (*cross-section*) and between time series (*time series*), thus producing more efficient parameter estimation than *separate cross-section* and *time series* analysis. In addition, the panel data model allows control of the relatively constant heterogeneity of the characteristics of each district/city during the observation period, so that the estimation of the relationship between variables becomes more accurate. The econometric model used in this study is formulated as follows:

$$\ln PDRBit = \alpha + \beta_1 \ln MSMEsit + \beta_2 DumQRISit + \beta_3 RLSit + \beta_4 \ln KWit + \varepsilon_{it}$$

In the equation, $\ln PDRBit$ measures Gross Regional Domestic Product, $\beta_1 \ln MSMEsit$ measures the number of MSMEs business units, $DumQRISit$ measures the impact before and after the implementation of QRIS digitalization with a value of 1 (one) after the 2020 period, and 0 (zero) before 2020. Meanwhile, $RLSit$ measures the human resources index and $\ln KWit$ measures the number of tourist visits that are the control variables in this study.

In this study, the variables of GDP, MSMEs, and tourist visits (KW) were transformed into the form of natural logarithms, while the Average School Length (RLS) variable was maintained in the form of a level and the DumQRIS variable was treated as a dummy variable (0/1). Logarithmic transformation in non-dummy variables was carried out to reduce the rate of data spread, increase variance stability, minimize potential heteroscedasticity, and reduce the influence of outliers commonly found in regional economic data. The logarithmic transformation allows the regression coefficient of the variable to be interpreted as the *elasticity coefficient*, so that any change of 1% in the independent variable will be followed by a percentage change in the GDP, assuming the other variable remains (*ceteris paribus*). Meanwhile, the coefficient in the DumQRIS variable is interpreted as the mean difference (in logarithm) of GDP between the period after and before QRIS is used massively, while the coefficient in RLS is interpreted as the absolute change in GDP (in logarithm) for each additional one year of average school time.

Conceptually, the MSME variable describes the capacity of the real sector in creating added value and job opportunities, while the DumQRIS variable represents the level of payment system digitalization that is expected to increase the efficiency of economic transactions after QRIS is massively used. Meanwhile, RLS is used as a proxy for the quality of human capital, while tourist visits (KW) function as a control variable that represents the contribution of the tourism sector to regional economic activities. With these specifications, the model is expected to be able to identify the role of payment system digitalization and MSME development in regional economic growth more comprehensively.

Model estimation was carried out using a panel data regression approach through three alternative models, namely Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), each of which assumes homogeneity of observation units, fixed individual effects between districts/cities, and random individual effects that do not correlate with independent variables. The selection of the best model is carried out in stages through specification tests. The Chow Test is used to determine the suitability of FEM to CEM, with a probability value smaller than the significance level indicating a rejection of the zero hypothesis.

so that FEM is more appropriately used. If the results of the Chow Test do not support the use of FEM, an LM Test is performed to determine the suitability of REM to CEM. Furthermore, the Hausman Test is used to choose between FEM and REM based on whether there is a correlation between individual effects and independent variables, where probability values smaller than the level of significance indicate FEM as a more consistent estimator, while larger values indicate REM is more efficient. Through the stages of Chow Test, Hausman Test, and LM Test, the estimation model used is the model that best suits the characteristics of the analyzed panel data.

In addition to model selection, data testing was also carried out through multicollinearity tests and heteroscedasticity tests. Multicollinearity tests were carried out through a correlation matrix between independent variables to ensure that there were no strong linear relationships between explanatory variables, while heteroscedasticity tests were carried out to test the similarity of residual variance so that the estimators obtained remained efficient and unbiased. The feasibility of the model was then evaluated through a determination coefficient (R^2), simultaneous test (F-statistic), and partial test (t-statistic) to assess the model's ability to explain the variation of dependent variables and the significance of the influence of each independent variable on regional economic growth.

The results of all these diagnostic tests are the basis for ensuring that the regression model used meets the empirical feasibility criteria, so that the interpretation of the estimation coefficient can be carried out more reliably and provides a solid basis in the preparation of policy implications.

IV. RESULTS AND DISCUSSION

Before interpreting the influence of each independent variable on regional economic growth, this study first evaluates the most suitable model specifications to estimate the panel data. The selection of the model is an important stage because the economic characteristics of each district/city in the Special Region of Yogyakarta have different socioeconomic conditions, economic structures, and levels of development. If this heterogeneity is not accommodated in the model, then the parameter estimation has the potential to be biased, reducing the validity of empirical inferences.

Tabel 1. Statistik Deskriptif

Variabel	N	Mean	Median	Maximum	Minimum	Std. Dev.
PDRB	55	2,24E+13	2,09E+13	4,01E+13	1,09E+13	8,52E+12
RLS	55	9,974000	9,920000	12,31000	7,080000	1,674110
UMKM	55	62.396,67	55.250,00	116.400,0	28.900,00	26.011,70
KW	55	3.837.000	3.880.000	8.780.000	820.000	2.204.611

Note: Source: The author's data processing results using EViews. The statistics include 55 balanced panel observations in 5 districts/cities during 2015–2025. DUMQRIS is not displayed in the descriptive statistics because it is not listed in the descriptive statistical output used.

The selection of the model was carried out through *the Chow Test* and *the Hausman Test*. The results of *the Chow Test* showed a probability value of 0.0000, so the null hypothesis that the *Common Effect Model* (CEM) is more appropriate than *the Fixed Effect Model* (FEM) was rejected. Furthermore, the *Hausman Test* also produces a probability of 0.0000, which indicates that *the Fixed Effect Model* is more consistent than *the Random Effect Model* (REM). Based on these two tests, all empirical analyses in this study use *the Fixed Effect Model* (FEM) as the main estimation model. This model was chosen because it is able to accommodate the specific characteristics of each district/city that are fixed (*time-invariant heterogeneity*), resulting in a more consistent estimate in explaining the relationship between payment system digitalization, MSME development, human capital quality, tourism activities, and regional economic growth.

The estimation results show that the model has a *very high level of goodness of fit*. *The Adjusted R^2 value* of 0.9953 shows that around 99.53% of the variation in the Gross Regional Domestic Product (GDP) of districts/cities during the period 2015–2025 can be explained by a combination of independent variables used in the model, namely MSMEs, DumQRIS, average school length, and tourist visits, after considering the fixed effects of each region. Meanwhile, a Prob(F-statistic) value of 0.0000 shows that independent variables

simultaneously have a significant ability to explain changes in GDP. These results confirm that the built model has a high level of reliability to be used as the basis for the analysis of relationships between variables.

Table 2. Panel Data Model Estimation Results

Dependent Variable: Ln(PDRB)	Common Effect	Fixed Effect	Random Effect
Ln(KW)	0.0946*** (0.0260)	0.0784*** (0.0110)	0.0748*** (0.0130)
Ln(UMKM)	0.6600*** (0.0329)	0.2599*** (0.0519)	0.5065*** (0.0320)
RLS	0.1043*** (0.0067)	0.1370*** (0.0443)	0.1027*** (0.0096)
Dummy QRIS	-0.1144*** (0.0256)	0.0308 (0.0155)	-0.0400** (0.0163)
Constant	21.1062*** (0.3224)	25.2291*** (0.2996)	23.0048*** (0.2881)
Observations	55	55	55
R-squared	0.9645	0.9960	0.9159
Adjusted R-squared	0.9617	0.9953	0.9091
F-statistic	339.85***	1415.81***	136.06***
Prob (F-statistic)	0.0000	0.0000	0.0000
Chow Test (Prob.)		0.0000	
Hausman Test (Chi-square)		75.5733	
Prob > Chi-square		0.0000	

Source: Author's work *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Although the value of the determination coefficient obtained is very high, the condition can still be explained econometrically because the model uses a *cross-section fixed effects* approach. This approach controls for differences in *unobserved heterogeneity* in each district/city, such as institutional quality, economic structure, fiscal capacity, and relatively constant geographical characteristics during the study period. By accommodating these factors, the model is able to capture GDP variations more comprehensively than the panel model without fixed effects. Therefore, the high value of the determination coefficient does not only indicate a mechanical relationship, but also reflects the model's ability to isolate the influence of regional characteristics that cannot be directly observed.

Table 3. Multicollinearity Test – Correlation Matrix

Variabel	LPDRB	LKW	LUMKM	RLS	DUMQRIS
LPDRB	1,000000	0,719242	0,843570	0,595006	0,256549
LKW	0,719242	1,000000	0,565114	0,308414	-0,021475
LUMKM	0,843570	0,565114	1,000000	0,181685	0,452351
RLS	0,595006	0,308414	0,181685	1,000000	0,137022
DUMQRIS	0,256549	-0,021475	0,452351	0,137022	1,000000

Based on Table 3, the correlation between independent variables is relatively moderate. The highest correlation value is found between LKW and LUMKM at 0.565114, while the correlation between LUMKM and DUMQRIS is 0.452351. All correlations between independent variables are below 0.80. Thus, based on pairwise correlation examination, there is no strong indication of multicollinearity that can interfere with the estimation of the model coefficient. However, since the available output does not contain VIF, this conclusion is limited to the examination of the correlation matrix.

Table 4. Heteroscedasticity Test

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
LKW	0,113996	0,756612	0,150667	0,8809
LUMKM	0,283558	3,862991	0,073040	0,9418
RLS	3,248282	3,257627	0,997131	0,3239
DUMQRIS	-2,160789	1,017007	-2,124655	0,0390
Konstanta	-42,90327	20,22852	-2,120929	0,0393

Table 4 shows the results of the heteroscedasticity test by regressing the square residual logs against the independent variables. LKW, LUMKM, and RLS are not significant individually because each has a

probability of 0.8809; 0,9418; and 0.3239. In contrast, DUMQRIS has a probability of 0.0390 so it is significant at the level of 5 percent. These findings indicate heteroscedasticity in the test specifications. This condition is an important consideration in the estimation of the main model; therefore, the use of EGLS panels with *cross-section weights* in the FEM estimate helps to obtain a more appropriate estimate of the characteristics of variance between *cross-sections*.

Substantively, the estimation results also show an interesting relationship pattern. The variables of MSME development, average school length, and tourist visits were proven to have a positive and significant influence on regional economic growth, while the DumQRIS variable showed a positive but not significant influence direction at a confidence level of 95 percent. This pattern indicates that the economic growth of districts/cities in the Special Region of Yogyakarta is still largely determined by the strengthening of the real sector and the quality of human capital, while digital transformation through the non-cash payment system plays a supporting factor that strengthens the efficiency of economic activities. These findings are the basis for discussion in the next section on the mechanism of how each variable contributes to the formation of regional economic growth.

Regression Results and Selected Model Discussion (FEM)

Table 5 presents the estimation results using *the Fixed Effect Model* (FEM) as the best model based on the results of the Chow and Hausman tests. Overall, the model shows very high explanatory ability with an *Adjusted R²* value of 0.9953 and a Prob (F-statistic) of 0.0000, which shows that the combination of independent variables is able to explain around 99.53 percent of the variation in the Gross Regional Domestic Product (GDP) of districts/cities in the Special Region of Yogyakarta during the period 2015–2025. The high value of the determination coefficient indicates that the model built has a strong explainer power on the dynamics of regional economic growth. However, the interpretation of the results of the study is not only based on the magnitude of the determination coefficient, but is more directed at how each variable explains the mechanism for the formation of regional economic growth.

Table 5 : Fixed Effect Model (FEM) Estimation Results

Variabel	Coefficient	Std. Error	t-Statistic	Prob.
Ln(KW)	0,078436***	0,010954	7,160413	0,0000
Ln(UMKM)	0,259923***	0,051937	5,010739	0,0000
RLS	0,136969***	0,044266	3,094239	0,0054
DUMQRIS	0,030815*	0,015544	1,982421	0,0534
C	25,22912***	0,299615	84,20517	0,0000
R-squared				0,995955
Adjusted R-squared				0,995252
Prob(F-statistic)				0,000000

Secara umum, hasil estimasi memperlihatkan pola yang menarik. Variabel perkembangan UMKM, kunjungan wisata, dan rata-rata lama sekolah terbukti berpengaruh positif dan signifikan terhadap PDRB. Temuan ini sejalan dengan Prasetyo et al. (2022) yang menunjukkan bahwa jumlah UMKM berpengaruh positif dan signifikan terhadap pertumbuhan ekonomi di Kabupaten Deli Serdang, serta dengan Budhi & Sanjaya (2024) dan Mukaffi & Haryanto (2022) yang mengonfirmasi bahwa kunjungan wisatawan mendorong pertumbuhan PDRB di Provinsi Bali dan Kabupaten Banyuwangi. Pengaruh positif rata-rata lama sekolah juga konsisten dengan Makarios (2025) yang menemukan RLS berpengaruh positif dan signifikan terhadap pertumbuhan ekonomi pada data panel 34 provinsi di Indonesia. Selain itu menurut Reavindo (2024) menunjukkan hasil serupa pada data panel kabupaten/kota di Sumatera Utara. Sebaliknya, variabel digitalisasi sistem pembayaran melalui QRIS menunjukkan koefisien positif, namun belum signifikan secara statistik pada tingkat kepercayaan 95 persen, hasil ini konsisten dengan Desfikasari et al. (2026) yang juga menemukan bahwa volume dan nominal transaksi QRIS belum berpengaruh signifikan terhadap pertumbuhan ekonomi nasional. Temuan tersebut mengindikasikan bahwa pertumbuhan ekonomi regional di Daerah Istimewa Yogyakarta masih lebih banyak ditentukan oleh penguatan sektor riil dibandingkan oleh akselerasi digitalisasi sistem pembayaran.

Pembayaran Digital dan Pertumbuhan Ekonomi Daerah

The estimation results showed that the DumQRIS variable had a coefficient of 0.0308 with a probability value of 0.0534. The positive coefficient showed that, *ceteris paribus*, the GDP level in the period after the implementation of QRIS tended to be higher than the period before the implementation of QRIS. Thus, the results of the study show that there is a positive direction of the relationship, but do not provide strong evidence of the relationship between the implementation of QRIS and regional economic growth.

Economically, these findings can be explained through the concept of *transaction efficiency versus production capacity*. QRIS has the potential to reduce transaction costs, speed up the payment process, improve transaction security, and expand public access to digital payment systems. However, increasing transaction efficiency does not automatically increase production capacity if economic actors do not respond to it through expanding business scale, increasing productivity, or new investment. Therefore, the economic benefits of payment digitalization are highly dependent on the ability of the real sector to transform transaction efficiency into increased production activities.

The economic characteristics of the Special Region of Yogyakarta also provide relevant context for these findings. The economic structure of Yogyakarta is dominated by the trade, services, education, tourism, creative economy, and MSME sectors, which mostly consist of micro and small-scale businesses. In this context, the increase in the use of QRIS is likely to reflect more changes in payment instruments than the creation of new economic activities in the early stages. Consumers who previously made payments in cash can switch to using QRIS without having to increase the amount of consumption, while business actors can accept payments digitally without directly increasing their production capacity. This condition can be understood as the payment substitution effect, which is a change in payment methods from cash to digital that has not directly changed the amount of economic output.

These findings support the view that the digitalization of the payment system is more appropriately positioned as *an enabling infrastructure* rather than *a driving force* for economic growth. Digital payment infrastructure provides the foundation for the formation of a more efficient economic ecosystem, but its impact on economic growth can be indirect and dependent on real sector conditions. Birigozzi et al. (2025) show that digital payments can support economic growth through lowering transaction costs and changing people's economic behavior. Meanwhile, Aguilar et al. (2024) show that the benefits of digital payments are influenced by institutional conditions, productivity, and the level of technology adoption. Thus, payment digitalization has the potential to have a greater economic impact when accompanied by increasing production capacity, productivity, and the ability of business actors to utilize digital technology.

Furthermore, the relationship between QRIS and economic growth is likely to work through *an indirect transmission mechanism*. The implementation of QRIS in the MSME sector, for example, can first improve operational efficiency, the quality of transaction recording, consumer convenience and confidence, and access to markets and financial services. These changes then have the potential to improve business performance and in the next stage contribute to regional economic activity. The gradual mechanism may explain why the direct relationship between the period of implementation of QRIS and GDP in this study has not shown strong results, even though the coefficient has a positive direction.

The estimated results show that the development of MSMEs has the largest coefficient, which is $\beta = 0.2599$, compared to other independent variables, and has a positive and significant effect on GDP. This means that every increase in the number of MSMEs by 1 percent is followed by an increase in GDP of around 0.26 percent, assuming that other variables are constant. These findings show that the economic growth of Yogyakarta is still strongly supported by the dynamics of the real sector, especially MSME activities which play a role in expanding production activities, trade, labor absorption, and community income creation. This positive influence also reflects that the increase in the number of MSMEs not only increases regional production capacity, but also strengthens economic linkages between sectors through trade, distribution, and public consumption activities.

The results of this study are consistent with the findings of Senja and Setiawan (2016) which showed that the number of MSME units had a positive and significant effect on Indonesia's economic growth based on panel data regression analysis. The findings were strengthened by the research of Luviana et al. (2019) which

proved that the number of MSMEs had a positive and significant effect on economic growth in 34 provinces in Indonesia. The consistency of results was also seen in Bima's (2024) research which used regency/city data in Yogyakarta for the 2017–2022 period with a Fixed Effect Model approach and found that the number of MSMEs had a positive and significant effect on Yogyakarta economic growth. The similarity of these results confirms that MSMEs are an important base in local economic activities because they have a direct relationship with production, trade, community income, and labor absorption. Therefore, strengthening the capacity of MSMEs, including through the use of payment digitalization, is an important part in encouraging an increase in GDP and expanding economic inclusion in Yogyakarta.

The findings of the study show that the average length of school (RLS) has a positive and significant effect on GDP with a coefficient of $\beta = 0.1370$ and a probability of 0.0054. Thus, an increase in RLS of 1 percent is related to an increase in GDP of around 0.137 percent, assuming that other variables are constant. These positive and significant influences show that education is a form of human capital investment that can increase labor productivity, adaptability to technological changes, and people's capacity to generate economic added value. The longer the population receives education, the greater the chance of forming a workforce that has better knowledge and skills so that they are able to work in economic activities with higher productivity.

The results of this study are in line with Sari (2022) who used panel data from 34 provinces in Indonesia during the period 2006–2019. The study found that the average length of school has a positive and significant effect on the formation of GDP, so that improving education contributes to increasing economic output. The findings are also consistent with Kustanto (2020) who used the *Fixed Effect Model* in 34 provinces in Indonesia and found that *mean years of schooling* have an effect on regional economic growth. The education variable is even one of the important determinants along with health infrastructure, electricity, and trade openness.

More specific results in the context of DIY are shown by Yusuf et al. (2023), who analyzed five districts/cities in Yogyakarta during the period 2015–2020 with RLS as one of the educational proxies in explaining economic growth. Thus, the results of this study strengthen the argument that the increase in RLS in Yogyakarta not only reflects the success of educational development, but also increases the capacity of human capital in supporting productivity, technology adoption, and the creation of added value in the regional economy.

Furthermore, tourist visits (KW) also show a positive and significant influence on GDP with a coefficient of $\beta = 0.0784$ and a probability of 0.0000. This means that an increase in the number of tourist visits by 1 percent is related to an increase in GDP of around 0.078 percent, assuming that other variables are constant. This influence can be explained through the tourism multiplier mechanism. The increase in the number of tourists creates additional demand for various goods and services, such as accommodation, food and beverages, transportation, trade, travel services, creative economy, and MSME products.

The increase in visits shows the increasing economic demand entering the DIY area. This condition provides space for sectors related to tourism to increase their production and income. Thus, the growth of tourist visits not only has an impact on the accommodation and travel services sector, but also has the potential to expand economic activities through linkages with trade, transportation, culinary, creative economy, and MSMEs.

The findings of this study are in line with Pitoyo (2018) who specifically analyzed the influence of the tourism sector on the growth of DIY GDP using panel data from five districts/cities during the period 2012–2016. These results were strengthened by Azizurrohman et al. (2021) who used panel data and *Fixed Effect Model* in 33 provinces in Indonesia during the period 2006–2016. The study found that the arrival of foreign tourists had a positive and significant effect on economic growth.

Furthermore, Simatupang (2024) through a panel study of provinces in Indonesia found that tourism income has a positive and significant effect on regional GDP. The study also shows that domestic tourist spending and the availability of accommodation have a positive effect on tourism income. Therefore, the results of this study strengthen the evidence that tourism is one of the sources of economic activity that is able

to produce a multiplier effect on GDP, especially through increasing demand, business income, employment opportunities, and inter-sector linkages in the region.

Overall, this study contributes to the development of the digital economy literature by showing that the relationship between payment digitalization and economic growth is complementary, not substitutive. Payment digitalization does not automatically result in economic growth, but increases the efficiency of the economic ecosystem which further allows the real sector to develop more productively. Thus, the success of digital transformation should not only be measured based on the level of QRIS adoption, but also on the extent to which digitalization is able to strengthen the productivity of MSMEs, improve the quality of human capital, and expand regional economic activities. In this context, the research findings reinforce the endogenous growth theory that places technology as a factor supporting productivity, not as a stand-alone source of growth.

V. CONCLUSION

This study analyzes the role of payment system digitalization through QRIS and the development of MSMEs on the GDP of districts/cities in the Special Region of Yogyakarta for the period 2015–2025, with the quality of human capital (RLS) and tourism activities as control variables, using the *Fixed Effect Model* (FEM) approach chosen based on the Chow and Hausman tests. The model constructed has a very strong ability to explain the variation in GDP (Adjusted $R^2 = 0.9953$), while confirming that the dynamics of regional economic growth are the result of the interaction between digital factors, the real sector, the quality of human resources, and the economic characteristics of the region. The estimation results show a consistent pattern: QRIS has a positive but not significant effect on GDP, while MSMEs, RLS, and tourist visits are proven to have a positive and significant effect, with MSMEs as the largest influencing factor in the model.

These findings confirm that payment digitalization in Yogyakarta has not worked as a *direct driving force* for economic growth, but rather as an *enabling infrastructure* that strengthens transaction efficiency and the digital economy ecosystem, with effectiveness highly dependent on the ability of the real sector to translate these efficiencies into productivity and real added value. On the contrary, the development of MSMEs, the quality of human capital, and tourism activities have consistently been the main drivers of the formation of GDP — MSMEs affirm the role of the productive business sector as the backbone of the regional economy, RLS reflects the importance of long-term investment in human capital, and the contribution of tourism shows that the DIY economic structure based on services, culture, and creative economy remains strategic for inclusive growth. Conceptually, this study enriches the digital economy literature by showing that the influence of QRIS is complementary, not substitutive, to the real sector — digital transformation acts as a catalyst for development, not a substitute for economic fundamentals such as productivity and real sector capacity.

From a policy perspective, these findings imply that digital economy development strategies should not be solely oriented towards increasing QRIS adoption, but need to be integrated with strengthening MSMEs, improving the quality of education, and developing the tourism sector as a complementary ecosystem. For Bank Indonesia, the success of QRIS implementation needs to be measured not only by transaction adoption indicators, but also by the extent to which digitalization drives business productivity and economic added value at the regional level; for local governments, investment in education, MSME empowerment, and the development of creative economy-based tourist destinations is a complementary strategy to maximize the benefits of digital transformation.

This research has a number of limitations that open up space for further research: digitalization measurement that is still based on dummy variables during the QRIS adoption period and does not include other dimensions of the digital economy (*mobile banking, electronic money, fintech*); limited regional coverage of five districts/cities of Yogyakarta so that generalizations are still limited; the non-inclusion of regional fiscal capacity variables as additional determinants; and mediation and moderation mechanisms (financial inclusion, institutional quality, MSME productivity) that have not been explicitly tested. In the end, this study emphasizes that digital transformation is not the ultimate goal of economic development, but an instrument to strengthen productivity whose results will be optimal if it goes hand in hand with strengthening the real sector, improving the quality of human capital, and developing an innovative and inclusive economic ecosystem.

The findings that QRIS has a positive but not significant effect on GDP suggests that payment digitalization is likely to work as an *enabling factor* through indirect mechanisms, so further research needs to develop mediation and moderation models by considering MSME productivity, financial inclusion, operational efficiency, digital literacy, institutional quality, and digital infrastructure readiness. To improve generalization and capture the dynamics and linkages between regions, future research can also expand the scope of regions and use approaches such as *Spatial Panel Regression*, *Spatial Durbin Model*, *System-GMM*, or *Panel Vector Autoregression (PVAR)*. In addition, digitalization measurement needs to be expanded from QRIS to a digital transformation index that includes *electronic money*, *mobile banking*, *internet banking*, and *fintech*, as well as integrating the perspectives of *endogenous growth*, *digital economy*, *financial inclusion*, and *regional innovation systems* in order to gain a more comprehensive understanding of digital transformation mechanisms in driving inclusive, productive, and sustainable economic growth.

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