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The Impact of Financial Inclusion on Global Economic Growth: A Panel Data Analysis

Marsya Iman Mahadhir[1], Asmah Mohd Jaapar[2,*], Nurhatiah Ahmad Chukari[2]

[1] Faculty of Science and Technology, Universiti Sains Islam Malaysia, 71800 Bandar Baru Nilai, Negeri Sembilan, Malaysia
[2] Risks & Analytics Research Group, Faculty of Science and Technology, Universiti Sains Islam Malaysia, 71800 Bandar Baru Nilai, Negeri Sembilan, Malaysia

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ABSTRACT

Financial inclusion is fundamental to sustainable economic development, as it facilitates access to formal financial services such as banking, credit, insurance, and electronic payments. This study examines the impact of financial inclusion on economic development, specifically focusing on its relationship with Gross Domestic Product (GDP) per capita across 14 countries over the period 2014 to 2024. First, the study constructs a Financial Inclusion Index (FII) using Euclidean and inverse-distance approaches. Then, the study utilized Stata to perform panel regression analysis, employing both aggregate and disaggregate financial inclusion models to determine how various financial access and usage indicators influence economic growth. The findings indicate that financial inclusion, especially the availability of ATMs, commercial bank branches, and debit cards, plays a significant role in driving GDP growth. Conversely, other variables, including FDI, deposit accounts, credit cards, and outstanding deposits, demonstrated weak or insignificant relationships with GDP across most models. The research highlights the importance of enhancing access to financial services, particularly through digital platforms, to support economic development in emerging economies. The results suggest that improving accessibility to financial products and services can stimulate economic growth and foster the maturation of the financial ecosystem. The study provides valuable insights for policymakers by emphasizing that prioritizing digital financial services and tailoring products for underserved communities is the most effective way to ensure greater economic resilience.

1. Introduction

Financial inclusion became a significant instrument in guaranteeing a sustainable economic growth by ensuring that, individuals and businesses particularly in underserved communities could access formal and affordable financial services, including banking, credit, insurance, and electronic payment [1]. It also allowed some persons to have easier access to finance and lessened the use of risky and unsafe financial technologies, making it easier to save and carry out their operations more

* *Corresponding author.*
E-mail address: asmah.jaapar@usim.edu.my

efficiently, which is supported by digital technologies, such as blockchain [2]. Financial inclusion was also useful in reducing poverty by increasing access to emergency credit, cash transfers, entrepreneurial financing, and education. In addition, it enhanced the level of withholding to economic shocks, diversified insurance and savings opportunity, which enhanced the financial stability of households. All these benefits provided the preconditions of the further development of the economy and the more effective allocation of the resources in the economy [3].

The financial services have also been crucial in the development of businesses and job creation, particularly to the small and medium-sized enterprises (SMEs). Digital Financial Services (DFS) has also accelerated the process of financial inclusion around the world, because it has allowed more individuals to be incorporated into the financial system and sparked the activities of the economy [4]. The M-Pesa program in Kenya illustrates this impact, as digital mobile banking helped 2% of households escape extreme poverty by providing safe transaction methods and microloans [5]. All these were the developments that underlined the importance of financial inclusion as a pathway to an inclusive and sustainable economic growth.

Although financial inclusion is strategically significant in closing the socio-economic divide, there still exists a very decisive gap between the growth of financial infrastructure and the incorporation of marginalized groups into the formal sector. Although early literature had a limitation of lack of standard measures as noted by Sarma [6], the later emergence of multidimensional indices, especially by Sarma [7] has now enabled a more rigorous analysis; nevertheless, the ubiquity of its influence is uneven across different economic regions. Moreover, although financial inclusion is hypothesised to drive GDP by increasing credit and insurance access, the actual contribution of such a factor in developing economies cannot be determined empirically [8]. There is a major conflict between financial access and financial usage, and current digital infrastructures present the possibility of enhanced transaction efficiency, which have not been conclusively correlated with macroeconomic growth. It is thus very necessary to measure these relationships in order to enable policy makers to develop specific policies.

In line with these observations, this study was conducted with three key objectives. First, it aimed to measure a Financial Inclusion Index (FII) for the selected countries using the normalized Euclidean distance and inverse distance methods. Second, it determined the association between financial inclusion and GDP growth through an aggregate model, and the association between the dimensions of financial access and utilization and GDP growth through a disaggregate model. Third, it determined the financial inclusion variable that had the most significant impact on economic development.

This paper is organized into five sections. The first section presented the research and the objective. The second section presented a literature review of both theoretical and empirical evidence of the association between financial inclusion and economic growth. Section three defines the data and methodology employed in the construction of the index and estimation of the models. The fourth section presented the empirical findings. The last section helped to conclude the research by summarizing the main findings and giving recommendations for future research.

2. Literature Review

2.1 Financial Inclusion on Economic Growth

Financial inclusion was already a widespread occurrence and it was viewed as one of the driving economic development factors, particularly in regions where access to financial services remained non-uniform. Hussain *et al.*, [9] conducted research where they examined the significance of financial inclusion in 21 countries (both developed and developing economies) in 2004-2019 in Asia. With a measure of Financial Inclusion Index developed by applying Principal Component Analysis (PCA), their analysis revealed that an increased level of financial inclusion always contributed to long-term economic growth. The effect was found to be greater in emerging economies, whereby improved access to financial services contributed to increase economic activity in a greater manner. Bidirectional causality was also found in, who stated that, besides the fact that financial inclusion stimulated economic growth, it also improved with the rise in income levels.

Demirguc-Kunt *et al*., [10] also revealed the relevance of financial inclusion through a comparison of cross-country indicators of the Global Findex Database and the IMF Financial Access Survey. Their results showed that formal financial services and access to formal financial services, especially possession of deposit services, credit facilities, and savings products, had been positively correlated with the growth of GDP and the alleviation of poverty. The research also revealed that financial inclusion enhanced the impacts of digitalisation, and this was particularly evident among the emerging economies, whereby technological innovations enhanced accessibility and utilisation of financial services. The study have emphasised that financial access and use have been improved to enhance the economic participation of households and firms, which promotes economic growth. Higher financial inclusions have positive economic growth effects, especially in emerging economies, through improvement of access to financial services and economic activities.

2.2 Financial Access and Economic Growth

Financial access has been one of the principal dimensions of financial inclusion in which individuals and business people can save, borrow, and commit themselves to economic activity. In this dimension, the main indicators are commercial bank branches, ATMs, and deposit accounts.

Financial access was a significant factor that advanced economic growth as noted by Rasheed *et al.,* [11]. They used ATMs as an indicator of financial access on their study. The result of the analysis indicated that the higher the availability of ATMs, the better the economic performance. The findings showed that physical financial infrastructure enabled more people to be a part of the financial system, hence growth. Though the research involved access measures in the form of banking accounts and loan access, it strengthened the argument of financial access being a fundamental factor of economic progress. In brief, the hypothesis is that higher financial access, as denoted by the presence of ATM boosts economic growth.

In addition, Maity [12] focused on the financial access of the North-Eastern part of India and contrasted the main indicators, in particular, the concentration of commercial bank branches, with the national rates. This research established that the distribution of commercial bank branch in this region was much less compared to other parts of India, which implies a low access to formal financial service. The discussion also revealed that as the number of commercial bank branches increased, the growth of deposit also increased indicating that better financial access led to increased financial participation. Despite the fact that the region of exploration was a small geographical location, it developed the effect of variations in the occurrence of branches of commercial banks on economic activity, making it highly important to the determination of the importance of the measure to

quantify financial inclusion and its economic effects. To sum up, the growth in the commercial bank branches enhanced accessibility to finance, which resulted in growth in financial participation and economic growth.

Furthermore, Han and Melecky [13] examined the issue of financial access in the global financial crisis through examining the access to bank deposit accounts. Their cross-country analysis showed that the more countries were penetrated with deposit-accounts, the more stable the growth in deposit was, during the crisis. This stability was a sign that wide access to formal mechanisms of saving made volatility low and financial system resilience higher. The results showed deposit accounts were an effective proxy variable of financial access with broader use of formal financial services accessing household confidence and macroeconomic stability. Therefore, greater access to deposit accounts during the financial crisis improved stability, reduced volatility, and supported GDP growth.

2.3 Financial Usage and Economic Growth

Financial usage had been an essential dimension of financial inclusion, as the actual utilisation of financial products such as outstanding deposits, credit cards and debit cards reflected the extent to which individuals and firms participated in the formal financial system. Higher levels of usage strengthened financial intermediation, promoted savings and investment activities, and contributed directly to economic performance.

Sharma [14] has examined the financial inclusion and economic growth relationship in developing nations with particular focus on the usage dimension. The study embraced a measure in terms of financial inclusion index which was developed on distance based measures of normalisation in order to expose the fact that financial utilisation indicators especially outstanding deposits contributed significantly to the development of the economy. It was found out that excellent deposits offered one of the significant avenues through which financial inclusion resulted in the mobilisation of the economies as more deposit balances resulted in higher savings, higher liquidity within the financial system, and higher investment. The results also indicated that the performance of the GDP of the countries with higher outstanding deposits was high, which indicated that the appropriate utilization of financial services was critical in the development of the economy. In general, the findings by Sharma [14] have shown that aspect of financial utilization, particularly the outstanding deposits, is a center of economic development. Therefore, the growth in the outstanding deposits resulted in growth in savings, liquidity and growth in investment resulting to growth in the GDP.

Okoye *et al*., [15] have researched the problem of financial inclusion as a means of enhancing the development of the economy and highlighted how financial services consumption contributes to economic performance improvement. In their research, the credit card amount along with their utilisation was a major determinant in facilitating participation of the finances. The expansion of the credit card ownership that led to the convenient transactions, the further access to the short-term credit, and the broadening of the contact with the formal financial system were also the results. This had all led to an improvement in the financial market with an increased level of resource mobilisation and consequently an improvement in the economic activity and the GDP growth. In general, the obtained results have shown that the quantity of credit cards was informative measure of financial activity and contributed greatly to the economic growth. Thus, greater credit card ownership and use had an impact of increasing financial activity, mobilization of resources and GDP growth.

Amaliah *et al*., [16] have reviewed the effects of digital financial inclusion on sustainable economic growth in uniquely digital use. They discovered in their study that the adoption of debit cards became a leading driver of increasing the efficient operations of the financial system, reduction

of transaction costs, and exposure of larger participation to the financial system. The popularity of debit cards contributed to the process of financial integration and simplified financial transactions due to which the economic activity was actively initiated, and the GDP growth was facilitated. The results also revealed that usage variables like the adoption of debit cards had more impact on economic development than the traditional access variables. All in all, the research proved that the amount of debit cards was a significant gauge of financial usage and had a significant impact on economic growth. Hence, increased debit cards increased financial efficiency, saved on expenses and boosted economic activity contributing to GDP growth.

2.4 Financial Inclusion, Foreign Direct Investment (FDI) and Economic Growth

Foreign Direct Investment (FDI) was among the key independent variables since it was the main source of international capital transfer which directly stimulated the macroeconomic growth. Financial inclusion served as a facilitating factor by decreasing the asymmetry of information and transaction costs, and making a domestic market more appealing to foreign investors. Asongu and Odhiambo [17] stressed that in the long-term, stable financial conditions promoted FDI inflows, which subsequently boosted GDP through the provision of capital required to build infrastructure and industry. This paper has used FDI as a control variable on the assumption that the size of the market and capital attractiveness were the key determinants of the overall economic performance.

2.5 Financial Inclusion, Inflation and Economic Growth

The macroeconomic control variables that were crucial in this study were inflation since price stability was a critical determinant of the overall economic performance. Stable prices in developing economies provided a setting where formal financial participation and long-term economic growth were possible. Bourainy *et al*., [18] proved that the level of financial inclusion was associated with a decrease in the inflation rate in 37 countries, which implied that the more formal financial use, the more stable monetary conditions were. This stability was more favourable to improved economic performance and less inflationary pressure. Moreover, the paper has emphasized the interaction of inflation with other key variables, including interest rates and official reserves, and thus it is a critical variable in explaining macroeconomic trends. As a result, inflation was incorporated as a control variable to analyze its association with GDP and to make sure that the empirical findings reflected the relationship between financial inclusion and economic growth correctly. In brief, the low inflation rates were maintained and led to the enhancement of economic stability and the continuous GDP growth.

2.6 Literature Review Summary: Financial Inclusion and Economic Growth

The reviewed literature highlighted that financial inclusion is a multidimensional concept, which directly influences economic growth by closing the divide between underexploited human capital and formal financial systems. In this study the strategy that was used to evaluate this relationship empirically is the selection of indicators in three core dimensions, which were identified in the previous studies as access, usage, and control variables. The suggested model integrated the following variables in explaining the supply and demand of financial services. This comprehensive approach implied that the subsequent empirical research was not based on narrow understanding of what inclusion entailed but could conduct a sound assessment of how an online, well-connected financial space ensured a lasting growth in GDP in both emerging and developed economies.

3. Data and Methodology

3.1 Data

This analysis used panel data regression based on data collected between 2014 to 2024 and applied to 14 countries, including Argentina, Botswana, Colombia, Finland, India, Italy, Japan, Jordan, Kenya, Malaysia, Mauritania, Mexico, Poland, and Switzerland which represent different regions, such as Latin America, Africa, Asia, and Europe to provide a broad economic comparison The research employs country-fixed effects to make the comparison statistically valid despite the disparities between these countries. By controlling for long-term characteristics like geography and history, this approach enables the study to concentrate on how variables evolved over time within each nation. Stata were applied to perform effective data analysis and precise estimation of variable relations. This was obtained based on reputable sources, such as the World Bank World Development Indicators (WDI) and the IMF Financial Access Survey (FAS).

Table 1
Data description

Variable Type	Variable	Description	Data Source
Dependent Variable	*GDP*	GDP per capita (current US$)	WorldBank
Independent Variable	*FII*	Financial Inclusion Index	Own Calculation
Independent Variable (Financial Access)	*ATM*	Number of automated teller machines (ATMs) (Per 100,000 adults)	IMF - FAS
	CBB	Number of commercial bank branches (Per 100,000 adults)	IMF - FAS
	DEPO	Number of deposit accounts, Commercial banks (Per 1,000 adults)	IMF-FAS
Independent Variable (Financial Usage)	*CC*	Number of credit cards (Per 1,000 adults)	IMF-FAS
	DC	Number of debit cards (Per 1,000 adults)	IMF - FAS
	OUT	Outstanding deposits, Commercial banks (Per 1,000 adults)	IMF-FAS
Control Variable	*FDI*	Foreign direct investment, net inflows (% of GDP)	WorldBank
	IFL	Inflation, consumer prices (annual %)	WorldBank

3.2 Methodology

3.2.1 Financial Inclusion Index (FII)

This study constructed the Financial Inclusion Index (FII) using Sarma [7]'s approach. Due to data availability, three indicators from the usage dimension and three from the access dimension were included. All indicators and dimensions were considered equally important to avoid subjectivity in assigning weights. The sub-index for each indicator was computed as follows:

$$d_i = \frac{A_i - m_i}{M_i - m_i} \quad (1)$$

where d_i is the country's achievement in terms of dimension i, A_i is the actual value of the indicator i, M_i is the maximum value of the indicator among the countries, and m_i is the minimum value of the indicator among the countries.

Each dimension was represented by one normalized indicator, and the financial inclusion performance of each country was described as a point $X = (d_1, d_2, d_3, d_4, d_5, d_6)$ in a six-dimensional space. The origin ($O = (0,0,0,0,0,0)$) represented complete financial exclusion, and the

ideal point ($I = (1,1,1,1,1,1)$) represented complete financial inclusion. The Euclidean distance between these extremes was calculated to analyze each country's position.

First, the distance X_1between $X$and O was determined using the normalized Euclidean distance formula:

$$X_1 = \frac{\sqrt{d_1^2+d_2^2+\cdots+d_6^2}}{\sqrt{6}} \quad (2)$$

Second, the inverse distance X_2between $X$and I was calculated:

$$X_2 = 1 - \frac{\sqrt{(1-d_1)^2+(1-d_2)^2+\cdots+(1-d_6)^2}}{\sqrt{6}} \quad (3)$$

Finally, the FII was computed as the average of $X_1$and X_2:

$$FII = \frac{1}{2}(X_1 + X_2) \quad (4)$$

This approach combined the distances from both extremes to determine each country's overall level of financial inclusion.

3.2.2 Model 1: Aggregate model

The aggregate model is a general analytical approach to analyzing the association between financial inclusion and economic growth. It is specified as:

$$GDP_{it} = \beta_0 + \beta_1 FII_{it} + \beta_2 FDI_{it} + \beta_3 IFL_{it} + \mu_{it} \quad (5)$$

The model will analyze the correlation between financial inclusion and economic growth and the main explanatory variable of the model will be a composite Financial Inclusion Index (FII). The index summarizes the different measures of financial access and usage into an equalized score, allowing the measurement of the effect of financial access on GDP to be done across countries and across time. The control variables will include FDI and inflation to describe the structural and macroeconomic variables which may affect the outcome. This is an analytic model that is broad enough to apply in the determination of the general trends and the overall significance of financial inclusion in improving the economic growth.

3.2.3 Model 2: Disaggregate model

Disaggregate models further disaggregate financial inclusion by individual measures of access and usage, providing a more detailed analysis than the aggregate model, which establishes the overall applicability of financial inclusion. The specification is expressed as:

$$GDP_{it} = \beta_0 + \beta_{11}ATM_{it} + \beta_{12}CBB_{it} + \beta_{13}DEPO_{it} + \beta_{21}CC_{it} + \beta_{22}DC_{it} + \beta_{23}OUT_{it} \quad (6)$$
$$+\beta_3 FDI_{it} + \beta_4 IFL_{it} + \mu_{it}$$

In the disaggregated model, β_1 was used to quantify how the access indicators (ATM, bank branches, deposit accounts) affected GDP, and the higher the access, the higher the level of GDP growth.β_2 measured the effect of usage indicators (credit cards, debit cards, outstanding deposits), suggesting that greater usage was related to economic growth. The model was used to distinguish between infrastructure expansion and usage intensity as a driver to growth by isolating β_1 and β_2. The disaggregated model was more accurate than the aggregate model, in that it alleviated the policymakers to concentrate on the main areas of interest that influenced the GDP growth. FDI and inflation were included as control variables.

3.2.4 Comparison of aggregate and disaggregate models

The aggregate model has simplified financial inclusion to one index, whereas the disaggregated model offers a more precise picture because it has segregated access measures and usage measures. The aggregate model validated the significance of financial inclusion overall but obscured variations among its components, but the disaggregated model determined which components impacted on GDP growth most strongly. The models together were complementary; the aggregate model confirmed the general effectiveness of financial inclusion and the disaggregated model specified the particular variable that played the biggest part in growth.

3.3 Panel Data
3.3.1 Pooled OLS

The Pooled OLS model assumed that all cross-sectional and time-series data could be pooled into a single regression. It assumed constant coefficients and no unobserved heterogeneity across countries. The regression equation was as follows:

$$GDP_{it} = \beta_0 + \beta_{11}ATM_{it} + \beta_{12}CBB_{it} + \beta_{13}DEPO_{it} + \beta_{21}CC_{it} + \beta_{22}DC_{it} + \beta_{23}OUT_{it} \quad (7)$$
$$+\beta_3 FDI_{it} + \beta_4 IFL_{it} + \varepsilon_{it}$$

The model estimated the relationship between financial inclusion (access and usage) and GDP growth. This basic model was effective but may be biased when country-specific effects were correlated with the explanatory variables.

3.3.2 Random effects

The Random Effects model accounted for random unobserved individual effects that were uncorrelated with the explanatory variables. The model took the form:

$$GDP_{it} = \beta_0 + \beta_{11}ATM_{it} + \beta_{12}CBB_{it} + \beta_{13}DEPO_{it} + \beta_{21}CC_{it} + \beta_{22}DC_{it} + \beta_{23}OUT_{it} \quad (8)$$
$$+\beta_3 FDI_{it} + \beta_4 IFL_{it} + u_i + \varepsilon_{it}$$

It is assumed that every cross-sectional unit has a random intercept with the error term being a combination of idiosyncratic error (ϵ_{it}) and individual-specific effects (u_i). The model can be applied

when individual heterogeneity is independent of the regressors, which means the estimation can be done more effectively, and time-invariant variables can be included [19].

3.3.3 Fixed effects

The Fixed Effects model enabled the use of intercepts of each cross-sectional unit that is a solution to unobserved heterogeneity. The regression model was specified as:

$$GDP_{it} = \beta_i + \beta_{11}ATM_{it} + \beta_{12}CBB_{it} + \beta_{13}DEPO_{it} + \beta_{21}CC_{it} + \beta_{22}DC_{it} + \beta_{23}OUT_{it} \quad (9)$$
$$+\beta_3 FDI_{it} + \beta_4 IFL_{it} + \varepsilon_{it}$$

The regression equation includes β_i as the individual-specific intercept. Fixed Effects is better than the Common Effect Model when the individual effects influence the dependent variable because it enables entity-specific features to be used in the study of the effect of financial inclusion on economic development [19].

3.3.4 Model selection test

The Chow Test was used to determine the type of model to use, which was either Pooled OLS or Fixed Effects. The Fixed Effects model was found to have a significant result, and Pooled OLS was found to have an insignificant result. The test was used to determine whether the coefficients were uniform across cross-sectional units; when the coefficients varied, the Fixed Effects model was used.

The Breusch-Pagan Lagrange Multiplier (LM-BP) Test evaluated whether Random Effects (RE) or Pooled OLS was more appropriate. A significant result favoured the Random Effects model, while an insignificant result supported Pooled OLS. The test assessed variance across entities; if variance was found, the Random Effects model was used [19].

The Hausman Test has been used to compare the Fixed Effects and the Random Effects model to identify the most appropriate one. The fact that the Fixed Effects model was utilized and no significant difference proved that the Random Effects model is more effective indicated that there is a considerable difference between the models. The determination of the presence or absence of a correlation between the explanatory variables and the error term was carried out with the help of the test, in the case there was no correlation, it was assumed that the Random Effects model would be applied, and in the case that there was a correlation, the Fixed Effects model was chosen.

Table 2 provides a summary of the model selection tests and the decision rules to be used to select the correct model using the results of the p-values:

Table 2
Summary of model selection tests

Test	Purpose	Decision Rule
Chow Test	Compare OLS and FE	Choose FE if p-value < 0.05
LM-BP Test	Compare OLS and RE	Choose RE if p-value < 0.05
Hausman Test	Compare FE and RE	Choose FE if p-value < 0.05

3.3.5 Diagnostic test

Multicollinearity was identified using the Inflation Factor (VIF); values above 10 indicate a severe problem. The removal or combination of correlated variables was done to enhance stability.

Autocorrelation occurred when the standard errors were underestimated because the residuals were correlated among the observations to provide biased significance tests. The Breusch-Godfrey LM test and Durbin-Watson statistic were used for detection. If found, the model was adjusted using generalized least squares.

Heteroskedasticity existed where the variance of the residue at different levels differed with changes of independent variables to skew estimates and hypothesis tests. It was identified using the Harvey test and residual plots. The dependent variable was converted, or standard errors were made robust [20].

Table 3 summarized the diagnostic tests applied in the analysis and their purpose and decision rules depending on the p-values. These tests assisted in determining the possible problems that may interfere with the consistency of regression model.

Table 3
Summary of diagnostic tests

Diagnostic Test	Purpose	Decision Rule
Multicollinearity	Check for high correlation between variables	If VIF < 10, no multicollinearity
Autocorrelation	Check for residual correlation across observations	If p-value > 0.05, no autocorrelation
Heteroskedasticity	Check for unequal variance in residuals	If p-value > 0.05, no heteroskedasticity

4. Results and Discussions

4.1 Model 1: Aggregate model

The empirical studies examined the effects of financial inclusion on economic development, based on Pooled OLS, Random Effects, and Fixed Effects estimates as shown in Table 4.

Table 4
Panel data regression results for model 1

Statistics/Models	Pooled OLS	Random Effect	Fixed Effect
P-value for F statistic	0.0000	0.0129	0.0129
FII	4.0964 (p = 0.000)	2.0217 (p = 0.000)	1.6574 (p = 0.003)
FDI	-0.2252 (p = 0.089)	-0.0018 (p = 0.357)	-0.0017 (p = 0.397)
IFL	-0.0015 (p = 0.656)	-0.0005 (p = 0.466)	-0.0002 (p = 0.711)
Intercept	8.0317	8.6245 (p = 0.000)	8.7365 (p = 0.000)
Hausman Test		Chi2 = 3.12 (p = 0.3729)	
LM-BP Test	Chi2 = 714.78 (p = 0.0000)		
Chow Test	F = 2.18 (p = 0.0928)		F = 2.18 (p = 0.0928)
Multicollinearity	**FII** = 1.02, **FDI** = 1.02, **IFL** = 1.00, Mean = 1.01		
Autocorrelation		F = 122.111 (p = 0.0000)	
Heteroskedasticity		LR chi2 = 215.94 (p = 0.0000)	

The estimates always illustrated that the financial inclusion index (**FII**) had a positive and statistically significant impact on GDP in all the models, revealing its importance as a leading source of economic development. In particular, the Fixed Effects model provided the coefficient of 1.6574 (p = 0.000), which indicated that the enhancement of financial infrastructure and access had a significant effect in support of the economic output. Conversely, Foreign Direct Investment (**FDI**) and

inflation (**IFL**) were statistically insignificant in the panel specifications, and the p-values of the same were found to be 0.676 and 0.289, respectively. Though **FDI** exhibited a weak negative relationship in the Pooled OLS model, the same failed to hold in the stronger panel controls, and in the same manner, inflation continued to exert a non-significant influence on GDP. These results indicate that strengthening financial inclusion was a more powerful economic development lever in the sampled context compared to controlling the level of FDI or inflation.

A number of diagnostic tests were used in the study to determine the most appropriate econometric framework. Chow test was used to compare Pooled OLS and Fixed Effects, and the p-value was 0.0928, which indicated that there is no strong evidence of constant intercept on individual-specific effects. But the LM-BP test accepted the Pooled OLS specification to the Random Effects specification with a significantly large value. The Hausman test provided further refinement in that the Random Effects model was more consistent and efficient to the dataset where a p-value of 0.3729 was obtained, and therefore there was no significant difference between the two models.

The diagnostics of post-estimation were carried out on Random Effect model to ensure the reliability of the results. The outcome of Variance Inflation Factor (VIF), which had a mean of 1.01, showed that there were no problems of multicollinearity among the independent variables. Nevertheless, the Likelihood-ratio test and Wooldridge test showed the presence of significant heteroskedasticity and autocorrelation ($p < 0.05$), respectively.

The selection of the final model was done as a result of a comprehensive diagnostic testing, which revealed that the standard Random Effects model had serious problems of heteroskedasticity and autocorrelation. Consequently, the Prais-Winsten (PCSE) estimator became the final specification of the estimation to give stronger and more effective results following the methodology proposed by Beck and Katz [21]. The result then gives the equation of Model 1 as follows:

$$GDP_{it} = 7.9299 + 4.6091\ FII_{it} - 0.0009\ FDI_{it} - 0.0011\ IFL_{it} + u_i + \varepsilon_{it} \quad (10)$$

Table 5
Random effect with robust standard error for model 1

Statistic	Coefficient	Standard Error	Z-Value	P-Value	95% Confidence Interval
FII	4.6091 4.6091 4.6091 4.6091	0.5841	7.89	0.000	[3.4643, 5.7539]
FDI	-0.0009	0.0021	-0.42	0.676	[-0.0049, 0.0032]
IFL	-0.0011	0.0011	-1.06	0.289	[0.0032, 0.0009]
Intercept	7.9299	0.1418	55.92	0.000	[7.6519, 8.2078]
Rho	0.7349	0.8662	0.2490	0.9907	[0.9806, 1]
R-Squared	0.9958				
Wald Chi	64.67				
Prob>Chi2	0.0000				

As indicated by Table 5, the results supported the hypothesis that an increase in the financial inclusion index would result in an increase of GDP with the positive coefficient of 4.609 being too significant ($p = 0.000$). Conversely, Foreign Direct Investment and inflation were not statistically significant ($p = 0.676$ and $p = 0.289$ respectively). The final specifications were further justified by very high value of R-squared of 0.9958 of the models which showed a near-perfect fit of the model as well as the tendency to take issues of diagnostic concern into consideration. To sum it up, Prais-Winsten model is very strong in proving the hypothesis that financial inclusion is a significant

contributor to GDP growth, whereas Foreign Direct Investment and inflation influences are very small and the model proves an almost perfect fit.

4.2 Model 2: Disaggregate Model

Table 6
Multicollinearity diagnostic for model 2

Variable	ATM	CBB	DEPO	CC	DC	OUT	FDI	IFL	MEAN
Multicollinearity	15.81	12.93	4.74	8.00	8.22	1.56	1.09	1.15	6.69

In order to improve the reliability of the panel data regression estimates, a Multicollinearity diagnostic test based on the Variance Inflation Factor (VIF) was conducted in Table 6. The initial findings revealed that although there was low correlation between some of the independent variables, the independent variables **ATM** (15.81) and **CBB** (12.93) were both greater than the critical value of 10, which is a serious indication of multicollinearity. These two predictors were combined into a single composite variable (**ATM_CBB**) to correct this and avoid inflated standard errors. After this correction, the model was re-estimated, and all the rest of the independent variables have been taken to offer different explanatory power and would not have caused structural invalidity to the analysis.

Table 7
Panel data regression after multicollinearity adjustment for model 2

Statistics/Models	Pooled OLS	Random Effect	Fixed Effect
P-value for F statistic	0.0000	0.0000	0.000
ATM_CBB	0.5031499 (p = 0.000)	-0.09891 (p = 0.033)	-0.153095 (p = 0.001)
DEPO	-0.000373 (p = 0.000)	0.0001585 (p = 0.000)	0.0001581 (p = 0.000)
CC	0.000485 (p = 0.031)	-0.000056 (p = 0.623)	-0.000118 (p = 0.300)
DC	0.000649 (p = 0.000)	0.0002541 (p = 0.000)	0.0002182 (p = 0.001)
OUT	-0.003146 (p = 0.001)	0.0006076 (p = 0.410)	0.0007727 (p = 0.286)
FDI	0.0007083 (p = 0.944)	-0.002385 (p = 0.198)	-0.002227 (p = 0.212)
IFL	-0.005179 (p = 0.044)	-0.00216 (p = 0.000)	-0.001875 (p = 0.005)
Intercept	9.200578 (p = 0.000)	8.603419 (p = 0.000)	8.666951 (p = 0.000)
Hausman Test		Chi2 = 7.75 (p = 0.3555)	
LM-BP Test	Chi2 = 569.64 (p = 0.0000)		
Chow Test	F = 1.98 (p = 0.0535)		F = 1.98 (p = 0.0535)
Multicollinearity	**ATM_CBB** = 1.72, **DEPO** = 4.15, **CC** = 7.88, **DC** = 7.62, **OUT** = 1.29, **IFL** = 1.08, **FDI** = 1.08, Mean = 3.55		
Autocorrelation		F = 157.766 (p = 0.0000)	
Heteroskedasticity		LR chi2 = 255.67 (p = 0.0000)	

The results of the Pooled OLS, Random Effects and Fixed Effects indicate that the financial inclusion factors do not produce the same outcome on the GDP in Table 7. The combined variable **ATM_CBB** reflected a strong positive effect in the Pooled OLS but a significant negative effect in the Random effect and Fixed Effects, showing that, although physical access points may be beneficial initially, the effect differs when country-specific effects are considered. The results showed that **DEPO** and **DC** have a strong positive correlation with GDP in both the Random Effects and Fixed

Effects models, which indicates that deposit accumulation and debiting card are strong engines of economic growth. On the other hand, the relationship between **CC** and **OUT** and GDP was weak or insignificant in all the models with the exception of the Random Effects specification, where the relationship was found to be not significant. **IFL** was significant and negatively related to both the GDP in both the Random Effects and Fixed Effects models, which implies that increased inflation slows down economic growth, and **FDI** was not significant in each specification.

Hausman, LM-BP, and Chow are the tests used to determine which type of disaggregated model to use. The random effects model was supported to be consistent and efficient as indicated by the Hausman test. The Pooled OLS model was strongly rejected by the LM-BP test in favor of the Random Effects one. The Chow test revealed that there was not enough evidence to disapprove the Pooled OLS model to the Fixed Effects model. In general, the findings showed the Random Effects model was the most suitable in the analysis.

The variables do not exhibit issues with multicollinearity, as indicated by the diagnostic tests in Table 7. This was done by merging **ATM** and **CBB** in one composite variable, **ATM_CBB** since each had a previous value of VIF that was above the critical level. Following this correction, the revised VIF values proved that there are no significant correlations left between the predictors. The F-statistic of the autocorrelation test was significantly high which demonstrates that there must be autocorrelation in the residuals. On the same note, the heteroskedasticity test produced meaningful results, which indicated that *constant variance of* the residuals is not present. These problems were handled by modifying the model that would consider such problems and hence provide more credible and sound results for the final analysis.

Table 8
Random effect model with robust standard error for model 2

Statistic	Coefficient	Standard Error	Z-Value	P-Value	95% Confidence Interval
ATM_CBB	0.4763544	0.0554039	8.60	0.000	[0.3677647, 0.5849441]
DEPO	-0.0000854	0.0000609	-1.40	0.160	[-0.0002047, 0.0000338]
DC	0.0004713	0.0000801	5.89	0.000	[0.0003144, 0.0006282]
CC	0.0001878	0.0001718	1.09	0.274	[-0.000149, 0.0005246]
OUT	-0.0018251	0.0007022	-2.60	0.000	[-0.0032014, -0.000449]
FDI	-0.0008579	0.0014522	-0.59	0.555	[-0.0037042, 0.0019885]
IFL	-0.0014378	0.0011584	-1.24	0.215	[-0.0037083, 0.0008327]
Intercept	8.951697	0.1097292	81.58	0.000	[8.736631, 9.166762]
Rho	0.8989065	0.469624	0.6497314	0.9759	[0.9428256, 0.8603981]
R-Squared	0.9948				
Wald Chi2	160.49				
Prob>Chi2	0.0000				

The ultimate choice of model followed on the basis of extensive diagnostic tests that revealed serious problems of heteroskedasticity and autocorrelation with the standard Random Effects model. Consequently, the final specification adopted the Prais-Winsten (PCSE) estimator that can deliver more resilient and effective results. The ultimate finding of the regression analysis points out that financial inclusion measures including **ATM_CBB, DEPO, DC, CC, and OUT, FDI,** and **inflation** have different effects on GDP. The results confirm the hypothesis that an increased financial inclusion and economic activity have positive effects on GDP whereas inflation has a negative effect on it. Based on the robust results in Table 8, the functional form for the Random Effects model is expressed as follows:

$$GDP = 8.9517 + 0.4764\, ATM\_CBB_{it} - 0.00008\, DEPO_{it} + 0.00047\, DC_{it} + 0.00019\, CC_{it}$$

$$- 0.0018\, OUT_{it} - \ 0.00086\, FDI_{it} - \ 0.0014\, IFL_{it} + u_i \ + \ \varepsilon_{it} \quad (11)$$

The results indicated that **ATM_CBB** was observed to have a positive and significant effect on GDP at the 5% level, which implies that the availability of more ATMs and commercial bank branches has a positive effect on GDP**. DC** had a positive impact of high significance at the 5% level, supporting the idea that the high availability and use of debit cards stimulate economic growth. Conversely, **DEPO** had a negative correlation with GDP and proved to be not significant at the 5% level, implying that the level of deposit was not always a trigger for direct growth in the economy in the given model. The effect of **CC** on GDP was not significant but positive, but its correlation with **OUT** was negative and significant at 5% level. **FDI** and **IFL** were also one of the control variables that showed negative coefficients and were not found to be significant at the 5% level in the final robust estimation. The R-squared value of 0.9948 was a measure that the model was well fitted and is in a position to explain approximately 100% of GDP variation. The Prais-Winsten panel-corrected standard errors (PCSE) was useful in regard to addressing the problems of autocorrelation and heteroskedasticity, which ensured the strength and credibility of results. Overall, the paper highlights the significance of enhancing accessibility to financial inclusion services, especially with physical infrastructure and using debit cards to promote economic performance; specifically, **ATM_CBB** was the most influential variable on economic development, whereas **DC** was the most impactful variable for financial usage dimension.

5. Conclusions

This study has provided a longitudinal and cross-sectional study on the effects of financial inclusion on economic development in 14 countries during a 11-year period (2014-2024). It was measured by the **Financial Inclusion Index (FII)** which was created using the normalized Euclidean distance and inverse distance techniques to determine the level of financial inclusion in the respective countries. The empirical results confirm the fact that financial inclusion is a strong determinant of economic output, and the positive and strong relationship exists between the **FII** and the growth of GDP. To be more precise, the GDP per capita was increased by 4.609 per unit of the **FII.** The results were consistent across all the models, and the Prais-Winsten (PCSE) estimator was able to control the both heteroskedasticity and autocorrelation in panel data.

The results of the analysis helped to establish that **FII** was the most determining variable in the GDP growth and its impact is significant and positive in all the models. The significant among the financial inclusion variables **ATM_CBB** (ATM and commercial bank branch access) and **Debit Cards (DC)** were found to have significant influence at 5% level, and their positive effect on the economic growth was strong. Nonetheless, other variables including **Foreign Direct Investment (FDI)**, **Deposits Accounts (DEPO)**, **Credit Cards (CC)** and **Outstanding Deposits (OUT)** proved to be insignificant or weakly correlated with GDP in most specifications especially under the Random Effects.

The implications of the findings in the study to a policymaker are significant. First, there should be expansion of digital financial ecosystems especially mobile payments and internet banking in order to lower transaction costs and encourage financial inclusion. Second, financial institutions should fill the gap between ownership of accounts and productive use by creating specially designed financial products to SMEs and rural people including micro-credit and crop insurance. Moreover, it is important to improve digital literacy and consumer protection so that the financial systems could become inclusive and stable in their development.

Although the study offers a great insight into the subject, it has some limitations. It was based on 14 countries because of the availability of data, especially in the developing economies. Future studies can be developed by adding more disaggregated data, including gender-disaggregated

variables of financial inclusions, by examining whether bridging the gender gap in finance is a unique growth factor in GDP.

As the notion of decentralized finance (DeFi) and Central Bank Digital Currencies (CBDCs) is emerging, researchers ought to explore the effects of these new technologies on financial inclusion and economic growth in the future. Moreover, the quality of financial service, other than frequency of use, would be investigated, especially in user satisfaction and security.

To sum it up, the current study confirms that financial inclusion is an important component of macroeconomic policy. Introducing a large segment of the world population to the formal financial system, the countries are in better positions to develop their economies to become more resilient, promote entrepreneurship, and make the allocation of capital more efficient. This paper has highlighted why there is a need to advocate sustainable and inclusive finances to enable people and nations to achieve their economic potential.

References

[1] Grant, Mitchell. "Financial Inclusion: Definition, Examples, and Why It's Important." *Investopedia*, 2024. https://www.investopedia.com/terms/f/financial-inclusion.asp.

[2] Kantar. "12 Benefits of Financial Inclusion." *Financial Inclusion Insights*, 2024. https://finclusion.org/fii-blog/benefits-of-financial-inclusion.html.

[3] Lung, Hanyung. "Why Financial Inclusion Is the Key to a Thriving Digital Economy." *World Economic Forum*, 2024. https://www.weforum.org/agenda/2024/07/why-financial-inclusion-is-the-key-to-a-thriving-digital-economy/.

[4] Aguilar, Arlene, Jon Frost, Rafael Guerra, Steven Kamin, and Alexandre Tombini. "Digital Payments, Informality and Economic Growth." BIS Working Papers No. 1196, 2024. https://www.bis.org/publ/work1196.pdf.

[5] Suri, Tavneet, and William Jack. "The Long-run Poverty and Gender Impacts of Mobile Money." *Science* 354, no. 6317 (December 2016): 1288–1292. https://doi.org/10.1126/science.aah5309.

[6] Sarma, Mandira. "Index of Financial Inclusion." Working Paper No. 215, Indian Council for Research on International Economic Relations, 2008. https://icrier.org/pdf/Working_Paper_215.pdf.

[7] Sarma, Mandira. "Measuring Financial Inclusion for Asian Economies." In *Financial Inclusion in Asia*, 3–34. London: Palgrave Macmillan, 2016. https://doi.org/10.1057/978-1-137-58337-6_1.

[8] Ozili, Peterson K., Anthony Ademiju, and Salma Rachid. "Impact of Financial Inclusion on Economic Growth: Review of Existing Literature and Directions for Future Research." *International Journal of Social Economics* 50, no. 8 (2022): 1105–1122. https://doi.org/10.1108/ijse-05-2022-0339.

[9] Hussain, Sabir, Atiq Ur Rehman, Saif Ullah, Abdul Waheed, and Syeda Hassan. "Financial Inclusion and Economic Growth: Comparative Panel Evidence from Developed and Developing Asian Countries." *SAGE Open* 14, no. 1 (2024). https://doi.org/10.1177/21582440241232585.

[10] Demirguc-Kunt, Asli, Leora Klapper, Dorothe Singer, Saniya Ansar, and Jake Hess. *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. Washington, DC: World Bank, 2018. https://doi.org/10.1596/978-1-4648-1259-0.

[11] Rasheed, Abdul, Rana Balach, Siong Hook Law, Chin Hong Siong, and Mohammad Habibullah. "The Role of Financial Inclusion in Financial Development: International Evidence." *Abasyn Journal of Social Sciences* 9, no. 2 (2016): 330–348.

[12] Maity, Sudarshan, and Tapan Najer Sahu. "Financial Inclusion in North-Eastern Region: An Investigation in the State of Assam." *Vilakshan – XIMB Journal of Management* 19, no. 2 (2021): 206–221. https://doi.org/10.1108/xjm-09-2020-0118.

[13] Han, Rui, and Martin Melecky. "Financial Inclusion for Financial Stability: Access to Bank Deposits and the Growth of Deposits in the Global Financial Crisis." Policy Research Working Paper No. 6577, World Bank, 2013. http://documents.worldbank.org/curated/en/85068146832544838.

[14] Sharma, Deepali. "Nexus Between Financial Inclusion and Economic Growth: Evidence from the Emerging Indian Economy." *Journal of Financial Economic Policy* 8, no. 1 (2016): 13–26. https://doi.org/10.1108/JFEP-01-2015-0004.

[15] Okoye, Lawrence U., Kayode A. Adetiloye, Olugbenga Erin, and Njideka J. Modebe. "Financial Inclusion as a Strategy for Enhanced Economic Growth and Development." *Journal of Internet Banking and Commerce* 22, no. S8 (2017).

[16] Amaliah, Iffah, Qaisar Ali, Okta Sudrajad, Sri Rusgianto, Hani Nu'man, and Tasya Aspiranti. "Does Digital Financial Inclusion Forecast Sustainable Economic Growth? Evidence from an Emerging Economy." *Journal of Open*

Innovation: Technology, Market, and Complexity 10, no. 2 (2024): 100262. https://doi.org/10.1016/j.joitmc.2024.100262.

[17] Asongu, Simplice A., and Nicholas M. Odhiambo. "The Role of Governance in Quality Education in Sub-Saharan Africa." *International Social Science Journal* 70, no. 237–238 (2020): 221–238. https://doi.org/10.1111/issj.12253.

[18] Bourainy, Mahmoud E., Amira Salah, and Mohamed E. Sherif. "Assessing the Impact of Financial Inclusion on Inflation Rate in Developing Countries." *Open Journal of Social Sciences* 9, no. 1 (2021): 397–424. https://doi.org/10.4236/jss.2021.91030.

[19] Zulfikar, Rizka. "Estimation Model and Selection Method of Panel Data Regression: An Overview of Common Effect, Fixed Effect, and Random Effect Model." OSF Preprints, 2018. https://doi.org/10.31227/osf.io/9qe2b.

[20] Youssef, Ahmed M. A. E. R. "Detecting of Multicollinearity, Autocorrelation and Heteroscedasticity in Regression Analysis." *Advances* 3, no. 3 (2022): 140–152. https://doi.org/10.11648/j.advances.20220303.24.

[21] Beck, Nathaniel, and Jonathan N. Katz. "What to Do (and Not to Do) with Time-Series Cross-Section Data." *American Political Science Review* 89, no. 3 (1995): 634–647.