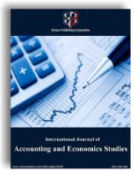
International Journal of Accounting and Economics Studies, 13 (2) (2026) 604-612

International Journal of Accounting and Economics Studies

Website: www.sciencepubco.com/index.php/IJAES
https://doi.org/10.14419/vtfx2k20
Research paper



The Impact of Financial Inclusion and Digitalization on Income Inequality: A Panel Data Analysis for ASEAN

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Received: January 8, 2026, Accepted: February 25, 2026, Published: April 14, 2026

Abstract

This study examines the impact of financial inclusion and digitalization on income inequality in selected ASEAN countries over the period 2011–2024 using panel data econometric techniques. Fixed Effects (FEM), Random Effects (REM), and Generalized Method of Moments (GMM) estimators are employed to capture both static and dynamic relationships while accounting for unobserved heterogeneity and potential endogeneity. Correlation analysis indicates that financial inclusion and digitalization are moderately associated with lower income equality. FEM results show that financial inclusion significantly reduces inequality, whereas digitalization initially increases inequality, suggesting uneven distributional benefits during the early stages of digital adoption. These mixed results reflect transitional digital divide im-pacts in early digitalization phases, where access and digital capabilities remain uneven. In contrast, REM and GMM estimates reveal that digitalization has a statistically significant inequality-reducing impact, highlighting its broader and dynamic role in expanding access to digital finance, employment opportunities, and entrepreneurial activity. Financial inclusion remains statistically insignificant in these models, indicating that its short-run distributional impact may be limited without inclusive outreach and effective utilization. Overall, the findings suggest that while digitalization contributes to inequality reduction over time, financial inclusion requires targeted and complementary policies to generate sustained distributive effects. The results provide relevant policy implications for promoting inclusive growth in ASEAN economies.

Keywords: *Financial Inclusion; Digitalization; Income Inequality; ASEAN; Panel Data.*

1. Introduction

Income inequality, the uneven distribution of wealth and resources within a society, poses a significant challenge to sustainable development and social cohesion. High levels of income inequality can hinder economic growth, exacerbate poverty, and fuel social unrest. Addressing this issue requires a multifaceted approach, and in recent years, the roles of financial inclusion and digitalization have gained increasing attention as potential drivers of greater equity. This research investigates the complex relationship between these two factors and income inequality, focusing specifically on the Association of Southeast Asian Nations (ASEAN).

ASEAN, a dynamic and diverse region comprising ten member states, has experienced rapid economic growth in recent decades. However, this growth has not always translated into equitable distribution of benefits, with income inequality remaining a persistent concern in many member countries. While some nations have made strides in poverty reduction, the gap between the rich and the poor continues to be a challenge. Understanding the factors that contribute to or mitigate income inequality within the ASEAN context is crucial for formulating effective policies that promote inclusive growth.

Financial inclusion, which refers to access to and usage of formal financial services by all segments of society, is increasingly recognized as a key tool for poverty reduction and economic empowerment. By providing access to savings accounts, credit, insurance, and other financial products, financial inclusion can enable individuals and businesses to participate more fully in the economy, potentially leading to increased income generation and reduced inequality. For example, access to credit can empower small entrepreneurs to start or expand their businesses, creating jobs and contributing to economic growth. Similarly, access to savings accounts can help individuals build assets and manage financial shocks, improving their economic security.

Complementing financial inclusion is the rapid rise of digitalization. The proliferation of internet access, mobile phones, and digital financial services has transformed the way people interact with the financial system. Digitalization can lower the costs of financial transactions, expand access to financial services, particularly in remote areas, and create new opportunities for economic participation. For instance, mobile banking allows individuals to manage their finances conveniently, while digital payment platforms facilitate e-commerce and create new avenues for income generation. The convergence of financial inclusion and digitalization has the potential to further amplify the positive impacts on income distribution.

However, the relationship between financial inclusion, digitalization, and income inequality is not straightforward. While these factors can potentially reduce inequality, they can also exacerbate existing disparities if not implemented thoughtfully. For example, if access to digital financial services is concentrated among the already wealthy or if digital literacy remains low among marginalized communities, the benefits of digitalization may accrue disproportionately to the privileged, widening the income gap. Furthermore, the expansion of financial services without adequate consumer protection mechanisms can lead to increased indebtedness and financial vulnerability, potentially worsening inequality.

Income inequality remains a critical challenge facing ASEAN countries, where economic growth has not been uniformly inclusive. Addressing this issue is essential for achieving sustainable development, social cohesion, and regional stability. This research is significant because it bridges a notable gap in the existing literature. While there is substantial research on financial inclusion (Beck et al., 2007) and digitalization (Ozili, 2022) separately, few studies have explored their combined impact on income inequality within the ASEAN context. By filling this gap, the study will provide a more comprehensive understanding of the factors influencing inequality in the region.

This research aims to address these complexities by examining the impact of financial inclusion and digitalization on income inequality in ASEAN countries using panel data analysis. The findings offer valuable insights for policymakers aiming to reduce income disparities. By identifying how financial inclusion and digitalization affect inequality, governments can design targeted policies and initiatives that leverage these factors to promote more equitable economic growth. Understanding the roles of financial inclusion and digitalization can help formulate strategies to integrate marginalized populations into the formal economy. This integration can lead to increased access to credit, savings, and investment opportunities, thereby stimulating economic activity and reducing poverty levels (Demirgüç-Kunt et al., 2018). Finally, the research aligns with global objectives such as the United Nations Sustainable Development Goals (SDGs), specifically those related to reducing inequality and fostering sustainable economic growth. By providing insights that help ASEAN countries meet their commitments, the study supports these international efforts.

Against this backdrop, the study addresses the following research questions: (i) Does financial inclusion significantly impact income inequality in ASEAN economies? (ii) What is the impact of digitalization on income inequality, and does this impact differ between short-run and dynamic settings? (iii) To what extent do financial inclusion and digitalization jointly shape inequality outcomes when potential endogeneity and persistence effects are accounted for? This study contributes to the existing ASEAN literature by going beyond static panel estimations and incorporating a dynamic Generalized Method of Moments (GMM) framework to capture path dependence and mitigate endogeneity concerns. Unlike prior studies that rely primarily on cross-sectional or fixed-effects approaches, this analysis provides a more comprehensive assessment of both short-run and broader dynamic effects of financial inclusion and digitalization on income inequality. By adopting multiple estimation strategies and focusing on recent data, the study offers more robust and policy-relevant evidence on the distributional implications of financial and digital transformation in the ASEAN context.

2. Literature Review and Hypotheses Development

2.1. Theoretical framework

The nexus between financial inclusion, digitalization, and income inequality is examined through development and financial theories that explain how access to capital, technological diffusion, and institutional structures influence income distribution.

Financial Intermediation Theory posits that well-functioning financial systems mobilize savings, improve capital allocation, and enhance investment efficiency (McKinnon, 1973; Shaw, 1973). Expanded access to credit, savings, and insurance allows low-income households and micro, small, and medium enterprises (MSMEs) to participate more fully in productive activities, thereby contributing to long-run inequality reduction. However, during early stages of financial development, gains may accrue disproportionately to financially literate and higher-income groups, resulting in delayed distributive effects.

Access-to-Opportunities Theory emphasizes that inequality arises when individuals face unequal access to education, labor markets, technology, and productive resources (Becker, 1964; Sen, 1999). Digitalization reduces informational frictions, lowers transaction costs, expands labor market reach, and enables digital entrepreneurship. In this context, internet connectivity and digital access can promote inclusive development by broadening economic opportunities, particularly for rural and underserved populations.

Digital Financial Inclusion Integration Theory highlights that digitalization enhances the scalability and reach of financial services by reducing geographic and administrative barriers (Ozili, 2022; Sun et al., 2023). Digital platforms such as mobile wallets, online lending, and fintech applications facilitate access to financial services among previously excluded groups. In this sense, digitalization strengthens the transmission mechanism through which financial inclusion may affect inequality outcomes. Importantly, this interaction is conceptual in nature, reflecting complementary mechanisms rather than a direct econometric interaction effect estimated in the baseline models.

The Kuznets Curve Hypothesis further suggests that inequality may initially rise during early stages of financial and technological development before declining as access becomes more widespread (Kuznets, 1955). This framework helps reconcile mixed empirical findings by recognizing transitional phases in which digitalization and financial inclusion generate uneven short-run distributional effects.

Taken together, these theoretical perspectives suggest that financial inclusion and digitalization independently influence income inequality, while digitalization conceptually enhances the effectiveness of financial inclusion over time by improving access, usage, and scale.

2.2. Empirical evidence

Income inequality remains a critical issue across ASEAN. Over the past two decades, financial inclusion and digitalization have emerged as key strategies to reduce inequality by promoting economic participation and access.

2.2.1. Financial inclusion and income inequality

Empirical evidence from ASEAN countries generally supports the view that financial inclusion contributes to inequality reduction, although effects vary across countries and over time. Studies on the Philippines, Indonesia, Vietnam, and Malaysia highlight the role of microfinance expansion, account ownership, and mobile banking in improving access to financial services, particularly among low-income and rural populations (Demirgüç-Kunt et al., 2018; Isa & Ali, 2019; Uy, 2022). However, several studies note that limited financial literacy and uneven outreach can weaken the short-run distributional impact of inclusion initiatives.

Evidence from non-ASEAN economies provides complementary insights. Research from China, South Korea, and Japan suggests that credit access and savings systems can reduce inequality when supported by strong institutions and inclusive policies, but transitional

disparities may emerge during early reform phases (Huang & Zhang, 2020; Shirakawa, 2012). These findings reinforce the relevance of institutional context in shaping inequality outcomes.

2.2.2. Digitalization and income inequality

Within ASEAN, digitalization has increasingly been linked to improved financial access and income-generating opportunities. Studies from the Philippines, Malaysia, and Vietnam indicate that digital payment platforms and internet penetration have reduced urban–rural income gaps by enabling entrepreneurship and labor market participation (Ramos et al., 2021; Tan & Chan, 2022; Uy, 2022). Nevertheless, persistent digital divides—particularly in infrastructure and digital literacy—continue to limit inclusive gains in less-developed economies. Evidence from outside ASEAN similarly shows that digitalization can reduce inequality when access is broad-based, but may initially widen disparities in contexts characterized by unequal digital readiness (Liu et al., 2020; Ozili, 2022). These studies underscore the importance of complementary policies in realizing the equity-enhancing potential of digital transformation.

2.2.3. Combined effects and conceptual interaction

A growing body of literature emphasizes the complementary relationship between financial inclusion and digitalization. In ASEAN, the integration of fintech solutions with traditional financial services has expanded outreach and improved service efficiency, particularly for MSMEs and rural households (Isa & Ali, 2019; Tan & Chan, 2022). Similar patterns are observed in emerging Asian economies, where digital platforms amplify the reach and effectiveness of financial inclusion initiatives (Sun et al., 2023).
Rather than estimating a direct interaction term, this study treats the reinforcing role of digitalization as a conceptual mechanism through which financial inclusion may exert stronger distributional effects over time. This approach allows for a clearer interpretation of short-run versus dynamic impacts while maintaining econometric parsimony.

2.2.4. Methodological approaches

Quantitative methods dominate the literature, with panel data regression and dynamic models frequently employed. In Malaysia, Tan and Chan (2022) used fixed effects models to examine the impact of digitalization on income inequality, while Isa and Ali (2019) applied structural equation modeling to assess financial inclusion policies. In the Philippines, Ramos et al. (2021) used Generalized Method of Moments (GMM) estimators to address endogeneity in analyzing digital finance's effects on rural entrepreneurship. Similarly, Nguyen and Nguyen (2019) used fixed effects and GMM models to study financial inclusion in Vietnam. In China, Huang & Zhang (2020) employed panel cointegration techniques to examine urban-rural income inequality.
Despite progress, gaps remain in the literature. Few studies offer cross-country comparisons within ASEAN or between ASEAN and East Asia. Additionally, the intersection of financial inclusion, digitalization, and other dimensions of inequality—such as gender and education—requires further exploration.
Emerging trends include the integration of artificial intelligence (AI) and blockchain technologies in digital finance. Ozili (2022) highlighted their potential to enhance transparency and reduce transaction costs. The COVID-19 pandemic accelerated digital adoption, creating opportunities to study its long-term impacts on financial inclusion and inequality.

2.3. Conceptual framework

Based on theoretical underpinnings and empirical evidence, this study conceptualizes income inequality as a function of financial inclusion and digitalization. Financial inclusion is expected to promote equitable access to financial services, which may empower low-income households and small businesses, thereby reducing income disparity. Digitalization is anticipated to facilitate the diffusion of financial technologies (FinTech), improve labor market participation, and enhance entrepreneurship, particularly in emerging economies such as those in ASEAN. Furthermore, digitalization is posited to enhance the efficiency and reach of financial inclusion, leading to stronger inequality-reducing effects.

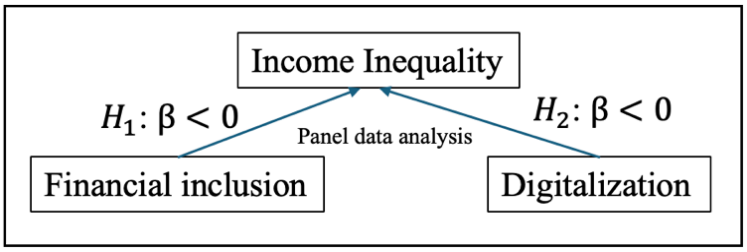

Fig. 1: Research Paradigm.

2.4. Hypotheses development

Income inequality remains a persistent challenge in ASEAN economies, where disparities in access to financial services and digital infrastructure limit inclusive participation in economic growth. Financial inclusion and digitalization have been widely recognized as key policy instruments for reducing inequality; however, their distributional effects may differ across countries and over time, particularly in developing and emerging market contexts.
Financial inclusion is expected to reduce income inequality by expanding access to formal financial services, such as savings, credit, and payment systems, especially for low-income households and micro, small, and medium enterprises. By enabling productive investment, risk management, and asset accumulation, broader financial access can contribute to more equitable income distribution. Accordingly, the first hypothesis is formulated as follows:
H_1: Financial inclusion hurts income inequality in ASEAN economies.
Digitalization, measured through internet usage and digital access, can lower transaction costs, improve labor market connectivity, and facilitate digital entrepreneurship. However, its distributional impact may vary depending on the stage of digital development and the level

of access inclusivity. While early stages of digital adoption may generate uneven benefits due to digital divides, broader and sustained digitalization is expected to promote inclusive economic participation. Therefore, the second hypothesis is stated as:
H_2: Digitalization hurts income inequality in ASEAN economies.
Beyond their independent effects, existing theory and prior empirical evidence suggest that digitalization enhances the reach, efficiency, and scalability of financial services, thereby potentially strengthening the inequality-reducing impact of financial inclusion. This complementary relationship represents a conceptual mechanism: digital technologies may expand access, improve service delivery, and increase the effective use of financial services over time. Importantly, this study does not estimate an econometric interaction term between financial inclusion and digitalization. Instead, the reinforcing role of digitalization is treated as an interpretive and theoretically grounded proposition that guides the discussion of empirical findings. Thus, Hypothesis 3 (H3) is formulated as a conceptual hypothesis rather than a statistically tested interaction effect, and it serves to frame the theoretical interpretation of the independent coefficient estimates rather than to test a multiplicative specification within the regression model:
H_3: The inequality-reducing impact of financial inclusion is conceptually enhanced in economies with higher levels of digitalization.

3. Research Methodology

This study adopts a quantitative research design using panel data econometric techniques to examine the impacts of financial inclusion and digitalization on income inequality in selected ASEAN economies. Panel data methods are particularly appropriate for this analysis as they allow the simultaneous exploitation of cross-country and time-series variation while controlling for unobserved heterogeneity across countries.
This study employs a quantitative panel data design to examine the effects of financial inclusion and digitalization on income inequality in selected ASEAN economies. Panel methods are appropriate because they exploit both cross-country and time-series variation while controlling for unobserved country-specific heterogeneity. The balanced panel includes five ASEAN countries—Indonesia, Malaysia, the Philippines, Thailand, and Vietnam—observed annually from 2011 to 2024. These countries were selected because they are the largest and most economically significant emerging economies in ASEAN, account for most of the region's GDP and digital activity, and exhibit meaningful variation in financial inclusion, digitalization, and inequality. Moreover, consistent and comparable data are available for this group, allowing a balanced panel specification. Although the cross-sectional dimension is small (N = 5), the time dimension (T = 14) is adequate for fixed-effects and dynamic panel estimation. In small-N settings, estimators remain consistent when T is moderate; however, inference must be interpreted cautiously. Accordingly, robust standard errors and specification checks are employed. The findings, therefore, provide internally valid evidence for the ASEAN-5 but should not be generalized to all ASEAN members without caution (Baltagi, 2008; Wooldridge, 2010).
Income inequality is measured using the natural logarithm of the Gini coefficient (lnGINI). Financial inclusion is proxied by the percentage of adults with an account at a formal financial institution or mobile money service provider. At the same time, digitalization is measured by the percentage of individuals using the internet. All variables are obtained from the World Bank's World Development Indicators and the Global Findex Database to ensure consistency and comparability across countries.

Table 1: Variable Notation and Description

Variable Name	Notation	Description	Measurement / Unit	Source
Financial Inclusion	FI	Percentage of adults (age 15+) with an account at a financial institution or through a mobile money service provider. This measures access to and usage of formal financial services.	% of population aged 15 and above	Global Findex Database
Digitalization	DIGI	Percentage of individuals using the Internet. This variable captures the level of digital adoption and access to information and communication technology.	% of total population	World Development Indicators
Income Inequality	GINI	The Gini Index represents the income inequality within a country. A higher value indicates greater inequality, while a lower value denotes a more equal income distribution.	Index (0 = perfect equality; 100 = perfect inequality)	World Development Indicators

3.1. Fixed effects and random effects models

To examine the baseline relationship between financial inclusion, digitalization, and income inequality, the following panel regression model is specified:

$$\ln(GINI_{it}) = \alpha_i+\beta_1 FI_{it}+\beta_2 DIGI_{it}+\varepsilon_{it} \quad (1)$$

Where ln(Giniit) denotes the natural logarithm of the Gini coefficient for country i at time t; FI_{it} represents financial inclusion; $DIGI_{it}$ denotes digitalization; α_i = captures unobserved, time-invariant country-specific effects; and ε_{it} is the idiosyncratic error term.
The Fixed Effects Model (FEM) is employed to control for unobserved heterogeneity that may be correlated with the explanatory variables, such as institutional characteristics, historical inequality patterns, and structural economic differences. Estimation is conducted using panel least squares with cross-section fixed effects, and heteroskedasticity-consistent standard errors are applied.
The Random Effects Model (REM) is specified as:

$$\ln(GINI_{it}) = \alpha+\beta_1 FI_{it}+\beta_2 DIGI_{it}+u_i+v_t+\varepsilon_{it} \quad (2)$$

Where u_i and v_t represent country-specific and time-specific random impacts, respectively. The REM assumes that these impacts are uncorrelated with the regressors, allowing for both within- and between-country variation to be exploited.
To determine the appropriate estimation strategy, the Hausman (1978) specification test is applied. Failure to reject the null hypothesis indicates that the REM provides consistent and efficient estimates and is therefore preferred.

3.2. Dynamic specification and generalized method of moments (GMM)

To address potential endogeneity, omitted variable bias, and the persistence of income inequality over time, a dynamic panel specification is estimated using the Generalized Method of Moments (GMM). The dynamic model is specified as:

$$\ln(GINI_{it}) = \gamma \ln(GINI_{it-1}) + \beta_1 FI_{it} + \beta_2 DIGI_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

Where $\ln(GINI_{it-1})$ captures the dynamic persistence of income inequality, and μ_i denotes unobserved country-specific impacts. The GMM estimator is suitable for panels with small N and moderate T, particularly when the model includes a lagged dependent variable that is correlated with the error term (Arellano & Bond, 1991). In this study, lagged levels of the dependent and explanatory variables are used as internal instruments to address simultaneity and reverse causality concerns.

Given the relatively small sample size, instrument proliferation is explicitly avoided. The instrument set is restricted to a limited number of lagged variables—$\ln(GINI_{it-1})$, FI_{it-1}, and $DIGI_{it-1}$—resulting in an instrument count that remains well below the number of cross-sectional units. This parsimonious instrument strategy ensures estimator stability and mitigates the risk of overfitting, which can bias GMM results in small samples.

Instrument validity is assessed using the J-statistic, where a non-significant result indicates that the instruments are uncorrelated with the error term. Heteroskedasticity and cross-sectional correlation are addressed using a White cross-section weighting matrix. Overall, the GMM framework provides robust dynamic estimates while remaining appropriate for the small-N ASEAN panel employed in this study.

3.3. Robustness checks

To ensure the robustness of the empirical findings, several diagnostic and sensitivity checks were conducted. First, alternative estimation strategies were compared by examining consistency in coefficient signs and statistical significance across the Fixed Effects, Random Effects, and GMM specifications. The persistence of key results—particularly the inequality-reducing effect of digitalization in the REM and GMM models—provides confidence in the stability of the estimates. Second, heteroskedasticity-robust standard errors were employed to mitigate potential bias arising from non-constant error variances. Third, instrument validity in the GMM estimation was assessed using the J-statistic, with non-rejection of the null hypothesis indicating appropriate instrument exogeneity. Finally, model diagnostics, including the Durbin–Watson statistic and residual variance components, were examined to ensure the absence of severe autocorrelation and to confirm that the model specifications adequately capture the underlying data-generating process. Collectively, these robustness checks support the reliability of the empirical results and the policy inferences drawn from the analysis.

4. Results and Discussion

This section presents and discusses the empirical findings in relation to the study's hypotheses. Hypotheses H1 and H2 are evaluated using econometric evidence from the Fixed Effects Model (FEM), Random Effects Model (REM), and Generalized Method of Moments (GMM). Hypothesis H3 is treated as a conceptual mechanism, guiding the interpretation of how digitalization influences the effectiveness of financial inclusion rather than as a directly estimated interaction effect. This structure allows for a clear distinction between statistically tested relationships and theoretically motivated complementarities.

Table 2: Descriptive Statistics

Variable	Notation	Mean	Minimum	Maximum	Standard Deviation
Income Inequality	GINI	39.00	35.00	46.00	3.42
Financial Inclusion	FI	58.00	20.00	96.00	24.54
Digitalization	DIGI	59.00	12.00	98.00	24.94

Table 2 presents the summary statistics for the key variables used in the panel data analysis, covering five ASEAN countries—Indonesia, Malaysia, the Philippines, Thailand, and Vietnam—from 2011 to 2024. The variables include Financial Inclusion (FI), Digitalization (DIGI), and Income Inequality (GINI). The results indicate that Gini Index (GINI), representing income inequality, exhibits an average value of 39, with a range between 35 and 46 and a standard deviation of 3.42. This relatively narrow variation indicates that income inequality levels among the five selected ASEAN countries remain moderately stable over time, with only slight fluctuations across periods. Financial inclusion (FI) has a mean value of 58 percent, with values ranging from 20 percent to 96 percent. This wide range suggests substantial variation in access to formal financial services among the selected countries and across time. Economies such as Malaysia and Thailand exhibit relatively high levels of financial inclusion, while countries like Indonesia and Vietnam show comparatively lower levels in earlier years. The digitalization (DIGI) variable has an average of 59 percent, with a minimum of 12 percent and a maximum of 98 percent, reflecting significant disparities in internet usage rates across the five selected ASEAN economies. The increasing mean value over time suggests progressive digital transformation in the region, although unequal access to technology persists. Overall, the descriptive statistics reveal notable differences in financial inclusion and digitalization across countries, while income inequality appears relatively consistent. These initial observations provide a foundation for the subsequent panel regression analysis to determine how variations in financial inclusion and digitalization influence income inequality in the ASEAN region.

Table 3: Correlation Matrix

Variable	GINI
Financial Inclusion (FI)	-0.68
Digitalization (DIGI)	-0.59
Income Inequality (GINI)	1.00

Table 3 presents the correlation coefficients among the variables used in the study. The correlation between financial inclusion (FI) and income inequality (GINI) is negative and moderate ($r = –0.68$), indicating that greater access to financial services is generally associated with lower levels of inequality. This empirical result aligns with the literature asserting that financial inclusion enhances economic participation among low-income groups, thereby contributing to more equitable income distribution (Demirgüç-Kunt et al., 2018). Likewise, digitalization (DIGI) is negatively correlated with income inequality ($r = –0.59$), suggesting that increased digital connectivity may help

reduce income disparities, consistent with the findings of Tan and Chan (2022) in Malaysia and Uy (2022) in the Philippines, where digital financial services expanded access to financial tools and entrepreneurial opportunities for marginalized sectors. However, as noted by Ozili (2022), the inequality-reducing impact of digitalization may depend on the inclusiveness of digital adoption; in contexts where digital literacy and infrastructure remain uneven, digitalization may reinforce existing disparities instead of mitigating them.

Table 4: Fixed Effects Model (FEM): Short-Run, Within-Country Effects

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant (C)	3.5608	0.0248	143.5147	0.0000
Financial Inclusion (FI)	-0.0012	0.0004	-2.8093	0.0484
Digitalization (DIGI)	0.0029	0.0008	3.8266	0.0187
R-squared	0.2616			
Adj. R-squared	0.0155	F-statistics		1.0629
Durbin-Watson	1.7462	Probability (F-statistic)		0.4198

Table 4 reports the Fixed Effects Model (FEM) estimation results examining the impact of financial inclusion and digitalization on income inequality (lnGINI) in selected ASEAN economies from 2011 to 2024. By controlling for unobserved, time-invariant country-specific characteristics—such as institutional quality, cultural norms, and structural income distribution patterns—the FEM isolates within-country, short-run impacts, which are directly relevant for evaluating Hypotheses H_1 and H_2 in a static context.

Financial inclusion exhibits a negative and statistically significant coefficient ($\beta = -0.0012$, $p < 0.05$), indicating that improvements in access to formal financial services are associated with reductions in income inequality within countries over time. This finding supports H_1 in the short run, suggesting that expanded financial access enables low-income households and small enterprises to engage more effectively in productive activities. The result is consistent with empirical evidence from ASEAN economies such as Malaysia and the Philippines (Isa & Ali, 2019; Uy, 2022), as well as comparable findings from other emerging economies (Huang & Zhang, 2020).

In contrast, digitalization displays a positive and statistically significant coefficient ($\beta = 0.0029$, $p < 0.05$), implying that higher levels of digital adoption are initially associated with increased income inequality. This result does not support H_2 in the short-run FEM framework and reflects transitional digital divide effects, where early benefits of digitalization accrue disproportionately to individuals and firms with greater digital skills, connectivity, and resources. Similar short-run inequality-widening patterns have been documented in developing economies experiencing uneven digital readiness (Ozili, 2022; Liu et al., 2020). These findings are consistent with Kuznets-type dynamics, where technological progress initially amplifies inequality before broader diffusion generates inclusive outcomes.

The diagnostic statistics indicate modest explanatory power ($R^2 = 0.2616$; Adjusted $R^2 = 0.0155$), suggesting that financial inclusion and digitalization explain only a limited share of short-run inequality variation, while broader macroeconomic and institutional factors remain influential. The Durbin–Watson statistic (1.7462) indicates no serious autocorrelation concern. Overall, the FEM results support H_1 but not H_2 in the short run, highlighting the importance of moving beyond static frameworks to assess longer-term distributional effects.

Table 5: Random Effects Model (REM): Broader Regional Effects

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant (C)	3.7292	0.0514	72.5975	0.0000
Financial Inclusion (FI)	-0.0001	0.0007	-0.2282	0.8184
Digitalization (DIGI)	-0.0002	0.0007	-2.8922	0.0386
R-squared (Weighted)		0.5665	F-statistic	12.2791
Adjusted R-squared (Weighted)		0.5209	Prob(F-statistic)	0.0002
Idiosyncratic Error S.D.		0.0053	Period Random Effect S.D.	0.0000
Cross-section Random Effect S.D.		0.0000		

Table 5 presents the Random Effects Model (REM) results, which account for both within- and between-country variation and are therefore more suitable for evaluating H_1 and H_2 from a broader regional perspective. The Hausman test results reported in Table 6 fail to reject the null hypothesis, confirming that the REM provides consistent and efficient estimates for the data structure used.

Table 6: Hausman Test Results

Effect Comparison	Chi-Sq Statistic	df	p-value	Decision
Cross-section random	1.3794	2	0.5027	Fail to reject H_0
Period random	0.0293	2	0.9869	Fail to reject H_0
Cross-section & period random	1.6038	2	0.4168	Fail to reject H_0

Financial inclusion retains a negative but statistically insignificant coefficient ($\beta = -0.0001$, $p = 0.8184$), indicating that, once cross-country heterogeneity is considered, financial inclusion does not exert an independent and immediate inequality-reducing impact. This finding suggests that access-based measures of financial inclusion may be insufficient on their own to generate measurable distributional gains in the short to medium term, thereby providing only partial support for H_1. Implementation gaps, limited usage, and financial literacy constraints likely weaken its aggregate impact across ASEAN economies.

Conversely, digitalization displays a negative and statistically significant coefficient ($\beta = -0.0002$, $p < 0.05$), indicating that higher internet usage contributes to lower income inequality across countries. This result supports H_2 in the REM framework and suggests that, beyond early transitional phases, digitalization facilitates broader access to economic opportunities through digital finance, labor market integration, and entrepreneurial platforms. Evidence from the Philippines, Malaysia, and Vietnam similarly highlights the inclusive role of digital ecosystems once access becomes more widespread (Ramos et al., 2021; Tan & Chan, 2022; Uy, 2022).

The model exhibits strong explanatory power (weighted $R^2 = 0.5665$), and the joint significance of the regressors (F-statistic $p < 0.01$) confirms their relevance in explaining inequality dynamics. Figure 2 further reinforces these results by demonstrating greater precision and stability for the digitalization coefficient relative to financial inclusion. Collectively, the REM findings indicate that digitalization plays a more immediate and robust role in reducing inequality at the regional level, while financial inclusion requires complementary conditions to become effective.

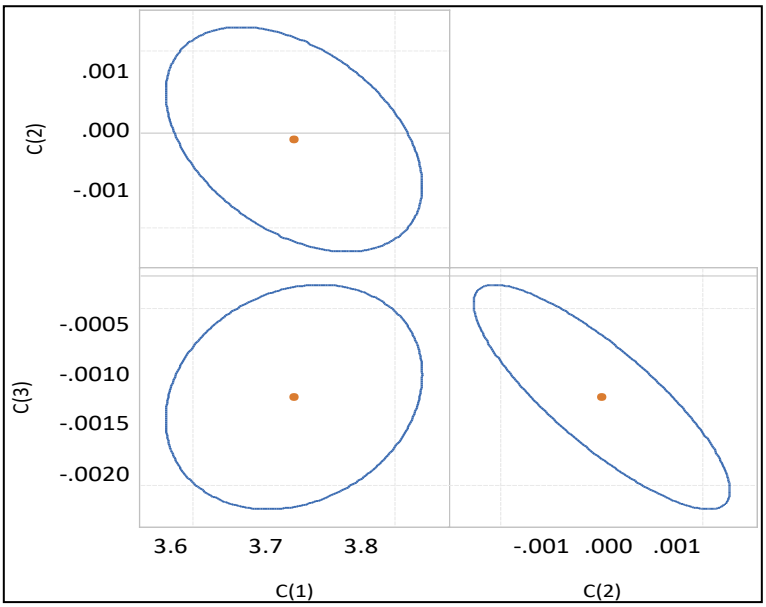

Fig. 2: Confidence Ellipse for REM.

Table 7 reports the GMM estimation results, which account for dynamic persistence and potential endogeneity in income inequality. This framework is particularly relevant for assessing the dynamic validity of H_1 and H_2 while informing the conceptual mechanism underlying H3.

Financial inclusion remains statistically insignificant ($\beta = 0.0002$, $p = 0.1766$), indicating that increases in basic account ownership do not generate immediate inequality-reducing impacts once lag dependence and endogeneity are controlled for. This result suggests that H_1 is not supported in the short-run dynamic setting, reinforcing the interpretation that financial inclusion alone—without effective usage, digital integration, and institutional support—has limited immediate distributive impact. Similar delayed effects have been documented in ASEAN economies where inclusion initiatives matured only after complementary reforms (Ramos et al., 2021).

By contrast, digitalization continues to exhibit a negative and statistically significant coefficient ($\beta = -0.0002$, $p < 0.05$), providing robust support for H_2 in the dynamic context. This finding indicates that digitalization contributes to inequality reduction by lowering entry barriers to economic participation and expanding access to digital financial services and markets over time. The validity of the instruments is confirmed by the non-significant J-statistic, reinforcing the reliability of the GMM estimates.

Table 7: Generalized Method of Moments (GMM) Estimation Results

Predictor	Coefficient	Std. Error	t	p-value
Constant (C)	3.6580	0.0796	45.7332	0.0000
Financial Inclusion (FI)	0.0002	0.0002	1.4098	0.1766
Digitalization (DIGI)	-0.0002	0.0001	-2.3812	0.0292
R-squared	0.2950	J-statistic		0.9170
Adjusted R-squared	0.2120	Prob(J-statistic)		0.3382
Durbin-Watson	1.8062	Instrument Rank		4
Estimation Method: Panel GMM-EGLS (Two-way random effects)				
Weighting Matrix: White cross-section (cross-section correlation)				
Instrument Specification: LOG(GINI(-1)), FI(-1), DIGI(-1), C				

Although no econometric interaction term is estimated, the combined evidence from FEM, REM, and GMM provides conceptual support for H_3. The results indicate that financial inclusion is more likely to generate inequality-reducing effects in environments characterized by higher digital readiness. While financial inclusion alone shows weak short-run effects, digitalization consistently demonstrates a robust and dynamic impact on inequality reduction. This pattern implies that digital infrastructure and digital access enhance the effectiveness, reach, and scalability of financial services over time.

Accordingly, H_3 is supported at the conceptual level, reinforcing the view that digitalization acts as an enabling mechanism through which financial inclusion can translate into sustained distributive gains. This interpretation is consistent with digital financial inclusion integration theory and recent empirical evidence emphasizing coordinated financial and digital development strategies (Sun et al., 2023).

5. Conclusion and Policy Implications

This study examined the impact of financial inclusion and digitalization on income inequality in selected ASEAN economies over the period 2011–2024 using panel data econometric techniques. By employing Fixed Effects, Random Effects, and Generalized Method of Moments estimators, the analysis distinguished between short-run, static relationships and broader dynamic effects while accounting for unobserved heterogeneity and potential endogeneity. The findings yield several important policy-relevant insights for inclusive growth strategies in the region.

With respect to Hypothesis H_1, the results provide partial support. Financial inclusion demonstrates a statistically significant inequality-reducing impact only in the Fixed Effects Model, indicating that expanded access to formal financial services can lower income inequality within countries in the short run. However, the absence of significance in the Random Effects and dynamic GMM estimations suggests that access-based financial inclusion alone is insufficient to generate immediate or sustained distributive gains at the regional level. From a policy standpoint, this underscores the need for ASEAN governments and financial regulators to move beyond account ownership targets toward usage-oriented financial inclusion policies, including financial literacy programs, consumer protection frameworks, and products tailored to the needs of low-income households and micro-enterprises.

Regarding Hypothesis H_2, the findings reveal a clear distinction between short-run and dynamic effects. In the Fixed Effects framework, digitalization is initially associated with higher income inequality, reflecting transitional digital divide effects during early stages of digital adoption. In contrast, both the Random Effects and GMM results consistently show that digitalization significantly reduces income inequality, providing strong support for H2 in broader and dynamic contexts. These results imply that digitalization becomes an effective equalizing force once access to digital infrastructure and capabilities reaches a sufficiently broad segment of the population. Consequently, policies aimed at expanding affordable internet access, nationwide broadband infrastructure, and digital skills development are critical to ensuring that digital transformation translates into inclusive economic participation rather than exacerbating inequality.

Although Hypothesis H_3 was not tested through an explicit econometric interaction, the combined empirical evidence provides strong conceptual support for the complementary role of digitalization in enhancing the effectiveness of financial inclusion. The results suggest that digitalization creates the enabling environment through which financial inclusion initiatives can yield more durable and equitable outcomes. In digitally prepared economies, financial services can be delivered more efficiently, reach underserved populations at lower cost, and support sustained participation in formal economic activities. This highlights the importance of integrated digital–financial policy frameworks, where financial inclusion strategies are embedded within broader digital development agendas.

Taken together, the findings emphasize that financial inclusion and digitalization should be treated as interdependent policy instruments rather than isolated interventions. For ASEAN economies, effective inequality reduction requires coordinated policies that combine financial access with digital infrastructure investment, digital and financial literacy programs, and inclusive fintech regulation. Strengthening regulatory oversight of digital financial services, promoting interoperability among digital platforms, and supporting innovation that targets marginalized groups—such as rural households, informal workers, and small enterprises—are essential for translating technological progress into inclusive growth.

Finally, this study contributes to the literature by providing dynamic and regionally focused evidence on the distributional effects of financial inclusion and digitalization in ASEAN economies. Future research may expand the measurement of financial inclusion beyond account ownership to better capture its multidimensional nature. While the percentage of adults with an account at a formal financial institution or mobile money provider reflects basic access, it does not fully account for usage intensity, service depth, or financial quality. Subsequent studies may incorporate alternative or complementary indicators such as deposit accounts per 1,000 adults, domestic credit to the private sector (% of GDP), ATM and bank branch density, frequency of digital payments, and formal savings or borrowing behavior. Employing composite indices or multiple proxies may provide a more comprehensive assessment of financial inclusion and allow researchers to examine whether empirical findings remain robust across different dimensions of financial access and usage. Future research may also extend this analysis by incorporating explicit interaction terms, alternative measures of inequality, or disaggregated household-level data to further examine the channels through which financial and digital development shape income distribution and to inform more targeted policy interventions.

6. Policy Implications for ASEAN

The findings of this study carry important policy implications for ASEAN economies, particularly those undergoing rapid digital and financial transformation, such as Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. First, while financial inclusion demonstrates short-run inequality-reducing effects, access alone is insufficient to generate sustained distributive gains. Policymakers should therefore move beyond account ownership targets toward usage-driven financial inclusion strategies that emphasize savings mobilization, responsible credit expansion, microinsurance development, and tailored financial products for low-income households and MSMEs. Strengthening financial literacy, consumer protection frameworks, and responsible digital lending standards is equally critical to ensure that increased access translates into meaningful economic participation rather than financial vulnerability.

Second, the results indicate that digitalization may initially widen income inequality before producing equalizing effects over time, reflecting transitional digital divide dynamics. This underscores the need for ASEAN governments to accelerate inclusive digital infrastructure development, particularly through expanded broadband connectivity in rural and underserved areas, affordable internet access programs, and large-scale digital skills training initiatives. Without deliberate intervention, early digital adoption may disproportionately benefit higher-income groups, thereby exacerbating inequality before broader diffusion occurs.

Third, the combined evidence suggests that digitalization enhances the long-run effectiveness of financial inclusion, highlighting the importance of integrated digital–financial policy frameworks. Financial inclusion strategies should be embedded within broader digital development agendas, including interoperable payment systems, digital identification infrastructure, fintech regulatory sandboxes, and cross-border digital finance standards. Coordinated regional efforts under the Association of Southeast Asian Nations can further promote harmonization of fintech regulation, digital payment interoperability, and inclusive innovation strategies that benefit marginalized populations.

Overall, inequality reduction in ASEAN requires a coordinated and sequenced approach in which digital infrastructure expansion, digital capability development, and inclusive financial deepening operate as complementary policy instruments. Treating financial inclusion and digitalization as interdependent rather than isolated reforms will be essential for ensuring that technological transformation translates into sustained and equitable economic growth across the region.

Acknowledgement

This research received no specific grant from any funding agency in public, commercial, or not-for-profit sectors.

Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

[1] Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58(2), 277–297. https://doi.org/10.2307/2297968.

[2] Baltagi, B. H. (2008). *Econometric analysis of panel data* (4th ed.). Wiley.

[3] Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality, and the poor. *Journal of Economic Growth*, 12(1), 27–49. https://doi.org/10.1007/s10887-007-9010-6.
[4] Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.
[5] Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution*. World Bank. https://doi.org/10.1596/978-1-4648-1259-0.
[6] Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271. https://doi.org/10.2307/1913827.
[7] Huang, Y., & Zhang, Y. (2020). Financial inclusion and urban–rural income inequality: Long-run and short-run relationships. *Emerging Markets Finance and Trade*, *56*(2), 457–471. https://doi.org/10.1080/1540496X.2018.1562896.
[8] Isa, F. M., & Ali, R. (2019). Financial inclusion policies and rural income inequality in Malaysia. *Asian Development Policy Review*, 7(1), 1–15.
[9] Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, 45(1), 1–28.
[10] Lee, J. W., & Lee, S. M. (2022). Digital transformation and inequality in South Korea. *Asian Economic Policy Review*, 17(3), 450–472. https://doi.org/10.1111/aepr.12385.
[11] Liu, X., Zhang, Y., & Chen, L. (2020). Urban–rural digital divide and income inequality in China. *China Economic Review*, 62, 101120.
[12] McKinnon, R. I. (1973). *Money and capital in economic development*. Brookings Institution.
[13] Ozili, P. K. (2022). Digital financial inclusion. In K. Sood, R. K. Dhanaraj, B. Balusamy, S. Grima, & R. U. Maheshwari (Eds.), *Big data: A game changer for the insurance industry* (pp. xx–xx). Emerald Publishing Limited.
[14] Ramos, G. D., Uy, C. M., & Tan, J. L. (2021). Digital finance and rural entrepreneurship in the Philippines. *Journal of Development Policy*, 15(2), 143–158.
[15] Sen, A. (1999). *Development as freedom*. Oxford University Press.
[16] Shaw, E. S. (1973). *Financial deepening in economic development*. Oxford University Press.
[17] Shirakawa, M. (2012). Financial inclusion and inequality: Lessons from Japan. *Bank of Japan Economic Review*, 45(4), 25–41.
[18] Stiglitz, J. E. (2012). *The price of inequality: How today's divided society endangers our future*. W. W. Norton & Company.
[19] Sun, Y., Chen, Z., & Wang, F. (2023). Digital financial inclusion, entrepreneurial activity, and rural income inequality. *Emerging Markets Finance and Trade*, 59(2), 267–283.
[20] Tan, C. H., & Chan, W. Y. (2022). Digitalization and financial inclusion: Evidence from Malaysia. *ASEAN Economic Bulletin*, 39(2), 178–192.
[21] Uy, C. M. (2022). Mobile banking and income inequality in the Philippines. *Asian Banking Review*, 10(3), 50–68.
[22] Wooldridge, J. M. (2010). *Econometric analysis of cross-section and panel data* (2nd ed.). MIT Press.