

“Financial inclusion and social outcomes in the European Union: Evidence from time-series analysis”

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FINANCIAL INCLUSION AND SOCIAL OUTCOMES IN THE EUROPEAN UNION: EVIDENCE FROM TIME-SERIES ANALYSIS

Abstract

Financial inclusion has become increasingly central to the European Union's social policy agenda amid digital transformation, recurrent economic shocks, and persistent poverty and inequality concerns. This study aims to assess the impact of financial inclusion on poverty risk and income inequality in the European Union, with particular attention to non-linear and long-run effects. The analysis uses annual aggregate EU-level data for 2004–2023. It applies time-series econometric methods, including correlation analysis, unit root and Granger causality tests, linear and quadratic regressions, and Error-Correction Models. The results indicate that financial inclusion does not exert a uniform direct linear effect on social outcomes. Correlation analysis shows a strong association between digital financial use and income inequality (e.g., card transactions and the Gini coefficient: $r = -0.69$; internet banking use and the Gini coefficient: $r = -0.63$), while correlations with poverty risk remain weak. Regression results confirm that most financial inclusion indicators have no statistically significant linear effect on poverty risk. However, a significant non-linear (inverted U-shaped) relationship is identified between card payment transactions and poverty risk, indicating that poverty risk declines once digital payment usage exceeds a threshold. In contrast, income inequality is significantly and negatively associated with traditional financial access, as increases in bank branch density per 100,000 inhabitants reduce the Gini coefficient in both the short and long run. Overall, the findings show that the social effects of financial inclusion in the EU are outcome-specific and depend on the form and intensity of inclusion rather than access alone.

Keywords

financial inclusion, poverty risk, income inequality,
digital finance, European Union

JEL Classification

D31, G21, I32, O16

INTRODUCTION

Financial inclusion has become a central pillar of socio-economic policy in the European Union, reflecting its growing relevance for social cohesion, poverty alleviation, and economic resilience. Recent analytical reports by the World Bank emphasize that access to formal financial services, such as transaction accounts, savings instruments, credit, and insurance, plays a decisive role in shaping households' ability to smooth consumption, cope with shocks, and participate fully in economic life (Demirgüç-Kunt et al., 2021; World Bank, 2024). Although the EU displays comparatively high levels of financial development, significant inclusion gaps persist across income groups, age cohorts, migrants, and residents of peripheral or rural regions. These disparities have become particularly visible in the wake of successive crises, including the COVID-19 pandemic, the energy price shock, and war-related disruptions, which have disproportionately affected financially fragile households with limited access to formal financial mechanisms.

At the EU level, financial inclusion is increasingly framed as a key instrument for delivering broader social objectives. The European Commission has repeatedly stressed that inclusive access to affordable and safe financial services is essential to achieving the goals of the European Pillar of Social Rights, particularly those related to social inclusion, equal opportunities, and poverty protection (European Commission, 2021; Eurostat, 2023a). Policy initiatives linked to the Digital Finance Strategy and the Capital Markets Union further highlight that digitalization can either reduce or exacerbate social inequalities, depending on the accessibility of digital financial services and the level of financial and digital literacy. In this context, financial exclusion is increasingly viewed not only as an economic inefficiency but also as a structural barrier to social mobility, labor-market participation, and effective welfare delivery within the Union.

From a macro-financial perspective, assessments by the International Monetary Fund underline that financial inclusion has meaningful implications for inequality, social stability, and long-term growth, even in advanced economies. IMF evidence suggests that broader inclusion is associated with lower income inequality, improved resilience to income shocks, and more effective transmission of social and fiscal policies, provided that inclusion is supported by strong consumer protection frameworks and sound regulation (Sahay et al., 2015; IMF, 2018; 2023). Against this background, analyzing the relationship between financial inclusion and social outcomes in the European Union is particularly timely. Such analysis allows for an assessment of whether ongoing financial deepening and digital transformation translate into measurable social benefits, or whether institutional, regulatory, and socio-economic constraints continue to limit the EU's financial system's inclusive potential.

1. LITERATURE REVIEW

The conceptual foundations of financial inclusion are rooted in the understanding that access to formal financial services constitutes a core mechanism through which economic development translates into social progress. Early theoretical and empirical contributions demonstrate that inclusive financial systems reduce income inequality, improve welfare distribution, and enhance opportunities for disadvantaged groups by easing access to savings, credit, and payment services (Beck et al., 2007; Sarma & Pais, 2011; Anderloni et al., 2007). These studies establish financial inclusion not merely as a financial-sector objective but as a multidimensional socio-economic phenomenon linked to poverty reduction, income distribution, and long-term development trajectories.

Measurement and global benchmarking of financial inclusion constitute a foundational pillar for time-series and comparative analysis. The development of harmonized indicators capturing account ownership, savings behavior, digital payments, and fintech penetration has enabled consistent tracking of inclusion dynamics over time and across regions (Demirgüç-Kunt et al., 2018; 2021). These data infrastructures are essential for

identifying structural breaks, crisis effects, and long-run trends in financial inclusion, particularly within advanced economies such as the European Union.

Subsequent empirical evidence confirms that financial inclusion significantly mitigates poverty and vulnerability by enabling households to smooth consumption, cope with shocks, and reduce exposure to financial distress. This relationship has been documented across diverse institutional contexts using multidimensional inclusion indicators and both micro- and macro-level data (Burgess & Pande, 2005; Koomson et al., 2020; Omar & Inaba, 2020; Adenike et al., 2025). These findings consistently show that savings mobilization, credit access, and formal banking penetration exert measurable effects on poverty alleviation and household resilience, reinforcing the relevance of inclusion for social outcomes.

The literature further highlights that financial inclusion interacts closely with income inequality and broader socio-economic structures, producing heterogeneous effects across regions and population groups. Empirical studies identify persistent disparities in income level, labor-market position, gender, migration status, and rural-urban di-

vides that moderate the social benefits of inclusion (Aleksić & Jovović, 2025; Eriqat et al., 2025; Kling et al., 2022; Dudek & Landmesser, 2025). Evidence from transition and post-transition economies suggests that financial inclusion reduces inequality only when supported by institutional quality, social policy alignment, and inclusive labor markets (Vasylieva et al., 2022; Bekbossinova et al., 2025; Zhanbozova et al., 2026).

A growing body of research underscores the transformative role of digitalization and fintech in expanding financial inclusion while simultaneously introducing new risks of exclusion. Digital finance is shown to lower transaction costs, expand outreach, and improve service efficiency, particularly for rural households, SMEs, women, and informal workers (Ozili, 2018; Maatallah, 2024; Ait Hbib & Makhrouf, 2025; Bani Atta, 2025). However, uneven digital infrastructure, limited digital literacy, and socio-demographic barriers may reinforce exclusion among older adults and vulnerable groups, thereby weakening the social inclusiveness of financial deepening (Ghorbanian Zolbin et al., 2025; Castro-Rojas et al., 2025; Ruthvika & Hedau, 2025).

The interaction between financial inclusion and financial system stability constitutes another important strand of the literature, particularly relevant for advanced and emerging economies. Empirical evidence indicates that broader inclusion can strengthen banking stability and governance when accompanied by sound regulation, transparency, and trust in financial intermediaries (Anton & Afloarei Nucu, 2024; Phan & Pham, 2025; Čihák et al., 2021). Conversely, weak institutional frameworks and unethical practices in financial intermediation may undermine inclusion efforts and generate social costs through trust erosion and informalisation (Brychko et al., 2021; Guennoune et al., 2025; Soussou & Hamrouni, 2025).

Social outcomes of financial inclusion extend beyond income and poverty indicators to encompass health, education, social protection, and public value creation. Empirical studies demonstrate links between financial access and healthcare affordability, life expectancy, public welfare provision, and resilience to crises, including pandemics

and war-related shocks (Bhowmik, 2025; Ukpe & Mohamadou, 2024; Megbowon & Zehirun, 2025; Kuzior et al., 2023). Complementary research highlights the role of financial literacy, education systems, and socialization processes in shaping inclusive financial behavior and long-term social sustainability (Johnson & Kasztelnik, 2024; Kuzior et al., 2022; Ruiz-Dotras et al., 2025).

Within the European context, the literature increasingly focuses on institutional diversity, governance quality, and policy asymmetries as key determinants of financial inclusion outcomes. Measurement frameworks and composite indices reveal substantial cross-country heterogeneity within the EU, driven by regulatory structures, digital public-sector capacity, and welfare-state models (Korynski & Pytkowska, 2016; Valaskova et al., 2025). Studies addressing migration, solidarity economy mechanisms, ESG alignment, and public value management further emphasize that financial inclusion in Europe is deeply embedded in broader socio-economic and governance transformations (Kuzior et al., 2020; Gruodė et al., 2025; Sułkowski et al., 2025; Yeremenko et al., 2025).

An important extension of the literature connects financial inclusion with public finance effectiveness and welfare-oriented governance. Evidence suggests that inclusive financial systems enhance the efficiency of budget allocation, improve the financial performance of public institutions, and strengthen the welfare impact of fiscal policy, indicating indirect transmission channels from financial access to social outcomes (Adnan et al., 2025). These findings are relevant for the EU context, where public expenditure, redistribution mechanisms, and multi-level governance structures strongly mediate social outcomes. From the perspective of financial intermediaries, expanding financial access creates socioeconomic trade-offs that influence social outcomes through banking-sector performance and risk exposure. Broader access has been shown to improve outreach and performance while simultaneously revealing tensions related to credit risk, affordability, and financial vulnerability among newly included groups (Budhathoki et al., 2025). This evidence reinforces the argument that the social benefits of financial inclusion depend on institutional safeguards and sustainable financial intermediation.

Institutional and legal environments further condition the relationship between financial inclusion and social outcomes by shaping households' financial security and resilience. Legal safeguards, including temporary protective measures in civil and administrative proceedings, influence individuals' capacity to manage financial obligations and mitigate social vulnerability during periods of uncertainty (Einikienė & Stočkienė, 2025). Beyond financial markets and public institutions, organizational culture and human capital policies also play complementary roles in fostering inclusive development. Inclusion-oriented human resource practices and meritocratic organizational cultures strengthen social cohesion, labor-market participation, and equal opportunity, reinforcing the broader societal effects of financial inclusion (Ly & Mujtaba, 2025). Finally, integrative reviews of global financial inclusion research consolidate these diverse strands while identifying persistent gaps. Despite extensive empirical evidence linking financial inclusion to poverty reduction, inequality mitigation, and resilience, limited attention has been paid to long-run dynamics and advanced-economy contexts, underscoring the need for time-series approaches (Ozili, 2021).

At the macroeconomic level, recent contributions stress that financial inclusion evolves dynamically over time and interacts with economic cycles, crises, and structural reforms. Time-sensitive evidence indicates that inclusion affects countries' resistance to shocks, post-crisis restructuring, and sustainable growth pathways, particularly under conditions of digital transformation, demographic change, and geopolitical instability (Cull et al., 2014; Barajas et al., 2020; Saher et al., 2022; Shapoval, 2025; Raman et al., 2025; Tutar et al., 2025; Sartamorn et al., 2025; Yusuf et al., 2025; Ntuli et al., 2025).

The literature demonstrates that financial inclusion is a multidimensional and dynamic process with far-reaching social consequences, shaped by institutional quality, digitalization, and socio-economic context. While extensive cross-sectional and panel data confirm its role in poverty reduction, inequality mitigation, and social resilience, fewer studies explicitly examine the temporal dynamics through which inclusion influences social outcomes in advanced econo-

mies. This gap provides a strong justification for a time-series analysis of financial inclusion and social outcomes in the European Union, enabling a deeper understanding of long-term trajectories, structural breaks, and crisis-driven adjustments within an integrated yet heterogeneous economic area.

The aim of this study is to assess the impact of financial inclusion on poverty risk and income inequality in the European Union.

2. METHODOLOGY AND DATA

2.1. Research design and methods

This study employs quantitative research methods to assess the impact of financial inclusion on income inequality and poverty risk in the European Union. The empirical strategy combines descriptive graphical analysis, correlation analysis, unit-root and stationarity testing, and econometric modelling. Based on the data's statistical properties and identified relationships, both linear and non-linear regression models are applied. Where appropriate, Error Correction Models (ECM) are employed to distinguish between short-run dynamics and long-run equilibrium relationships between the variables (Čihák et al., 2021).

This multi-stage methodological approach enables a robust assessment of financial inclusion effects while accounting for time-series features and macroeconomic conditions.

2.2. Data sources and sample

The empirical analysis is based on annual aggregate data for the European Union covering the period 2004–2023. Data were obtained from the European Central Bank (ECB, n.d.), Eurostat (2023b; 2023c), and the World Bank (n.d.), ensuring high reliability and cross-country comparability. The use of aggregated EU-level data enables the analysis of the European Union as an integrated economic region rather than as a collection of individual countries.

The selection of financial inclusion indicators is grounded in the existing literature, which highlights the importance of both traditional financial infrastructure and digital financial services for comprehensive financial inclusion (Demirgüç-Kunt et al., 2021; Barajas et al., 2020). Moreover, this approach allows capturing long-run macro-social dynamics that may be obscured in country-level panel analyses.

2.3. Variables

Dependent variables

Two dependent variables are used to capture social outcomes:

- *GINI* – income inequality, measured by the Gini coefficient;
- *POV* – poverty risk, measured as the share of the population living below the at-risk-of-poverty threshold.

Independent variables – financial inclusion indicators

Financial inclusion is proxied by the following indicators:

- *ATM* – number of ATMs per 100,000 inhabitants;
- *BRANCH* – number of bank branches per 100,000 inhabitants;
- *ONLINE* – share of adults using internet banking (%);
- *CARD* – number of payment cards in circulation;
- *PAY* – total number of card transactions.

Control variables

To isolate the effect of financial inclusion from broader macroeconomic trends, two control variables are included:

- *GDPpc* – real GDP per capita;
- *UNEMP* – unemployment rate (%).

Previous studies indicate that higher income levels are generally associated with lower poverty risk, while unemployment increases the likelihood of social exclusion (Muhammad et al., 2018).

2.4. Econometric models

Two baseline models are specified. The first model examines the impact of financial inclusion on income inequality, while the second focuses on poverty risk.

Model 1: Financial inclusion and income inequality

The first model assesses the relationship between financial inclusion indicators and income inequality, measured by the Gini coefficient. Depending on stationarity and cointegration properties, either an Error Correction Model or regression analysis is applied to identify both short-run and long-run effects:

$$\begin{aligned} GINI_{it} = & \alpha + \beta_1 ATM_{it} + \beta_2 BRANCH_{it} \\ & + \beta_3 ONLINE_{it} + \beta_4 CARD_{it} + \beta_5 PAY_{it} \\ & + \gamma_1 GDPpc_{it} + \gamma_2 UNEMP_{it} + \varepsilon_{it}. \end{aligned} \quad (1)$$

Model 2: Financial inclusion and poverty risk

The second model evaluates the effect of financial inclusion indicators on poverty risk using the same econometric framework:

$$\begin{aligned} POV_{it} = & \alpha + \beta_1 ATM_{it} + \beta_2 BRANCH_{it} \\ & + \beta_3 ONLINE_{it} + \beta_4 CARD_{it} + \beta_5 PAY_{it} \\ & + \gamma_1 GDPpc_{it} + \gamma_2 UNEMP_{it} + \varepsilon_{it}, \end{aligned} \quad (2)$$

where i denotes the region, t denotes time, and ε represents the error term.

Additional specifications

When cointegration is detected among first-difference stationary variables, an Error Correction Model of the following form is estimated:

$$\Delta Y_{it} = \alpha + \sum \beta_j \Delta X_{jit} + \lambda ECT_{it-1} + \varepsilon_{it}, \quad (3)$$

where Δ denotes first differences, and the error-correction term (*ECT*) captures deviations from long-run equilibrium.

To account for potential non-linear relationships, quadratic regression specifications are also employed:

$$GINI_{it} = \alpha + \beta_1 CARD_{it}^2 + \gamma_1 GDPpc_{it} + \varepsilon_{it}, \quad (4)$$

$$POV_{it} = \alpha + \beta_1 ONLINE_{it}^3 + \gamma_1 UNEMP_{it} + \varepsilon_{it}. \quad (5)$$

Model selection is guided by correlation analysis, causality testing, and cointegration results. This methodological framework enables a comprehensive evaluation of both short-term and long-term effects of financial inclusion on income inequality and poverty risk at the EU level.

3. RESULTS

3.1. Data overview and descriptive statistics

This empirical study investigates the relationship between financial inclusion and social outcomes in the European Union over the period 2004–2023. Financial inclusion is captured through indicators reflecting both traditional financial infrastructure and digital financial services. Social outcomes are measured using the poverty risk rate and income inequality, proxied by the Gini coefficient. To account for the broader macroeconomic environment, real GDP per capita and the unemployment rate are included as control variables.

Table 1 reports descriptive statistics for the variables employed in the empirical analysis at the EU aggregate level over the period 2004–2023. The distribution of the dependent variables indicates comparatively limited variation in income inequality and poverty risk, suggesting that changes in social outcomes at the EU level have been gradual rather than abrupt. This relative stability contrasts with the pronounced dynamics observed in financial inclusion indicators.

In particular, indicators capturing the usage and digital dimensions of financial inclusion exhibit substantial dispersion over time. The rapid growth in card transactions, internet banking usage, and the number of payment cards in circulation reflects the structural transformation of the EU financial system towards digital and cashless payment mechanisms. These developments point to potentially non-linear, threshold-dependent effects of financial inclusion that purely linear specifications may not adequately capture.

By contrast, traditional access indicators, such as the density of bank branches and ATMs, display more moderate variability, consistent with the gradual consolidation of physical banking infrastructure in advanced economies. The divergence between dynamic digital indicators and relatively stable social outcomes underscores the importance of applying time-series techniques that account for structural change and long-run relationships.

Table 1. Descriptive statistics of key variables (EU, 2004–2023)

Variable	Mean	Std. Dev.	Min	Max
Poverty risk (%)	16.6	0.8	15.4	17.8
Gini coefficient	30.3	0.6	29.5	31.2
Card transactions (bn)	55.4	23.7	21.3	92.4
Internet banking usage (%)	46.8	14.1	18.0	72.0
Bank branches (per 100,000)	34.2	6.5	22.1	47.3
ATMs (per 100,000)	68.7	9.4	52.0	82.1
Number of payment cards in circulation (million)	667.6	52.9	609	720.6
Real GDP per capita (EUR, th.)	28.4	1.8	25.3	31.0
Unemployment rate (%)	8.1	2.1	6.1	11.6

The descriptive statistics provide preliminary evidence that financial inclusion in the European Union has increasingly shifted from physical access to digital usage, thereby justifying the subsequent econometric approach that explicitly considers non-linear effects and long-term equilibrium dynamics in the relationship between financial inclusion, income inequality, and poverty risk.

3.2. Correlation analysis

To obtain preliminary insights into the relationships between financial inclusion indicators and social outcomes, a Pearson correlation analysis was conducted. Given the strong intercorrelations among

Table 2. Selected correlation matrix

Variable	1	2	3	4	5
1. Poverty risk	1.00				
2. Gini coefficient	0.25*	1.00			
3. Card transactions	0.14	−0.69***	1.00		
4. Internet banking usage	0.20	−0.63***	0.95***	1.00	
5. Unemployment rate	0.45**	0.73***	−0.51**	−0.47**	1.00

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

several financial inclusion indicators, only a selected correlation matrix is reported to avoid redundancy and multicollinearity.

The correlation results suggest that financial inclusion variables exhibit heterogeneous associations with the analyzed social outcomes. Indicators of access to and use of financial services – such as bank branch density, payment card use, and internet banking adoption – show moderate correlations with income inequality. In contrast, their correlations with poverty risk are generally weak or statistically insignificant. This pattern suggests that financial inclusion is more closely related to distributional outcomes than to poverty dynamics at the aggregate EU level.

By contrast, the control variables display strong correlations with both income inequality and poverty risk. In particular, real GDP per capita is negatively correlated with poverty risk. At the same time, the unemployment rate shows a strong positive association, highlighting the dominant role of labor market conditions and overall economic performance in shaping social outcomes.

These correlation patterns are consistent with the subsequent regression results, which indicate that financial inclusion does not exert a robust direct linear effect on poverty risk. At the same time, its relationship with social outcomes appears conditional and potentially non-linear. The strong correlations observed among the control variables further justify their inclusion in the econometric models to isolate the independent effects of financial inclusion and obtain economically meaningful estimates.

3.3. Stationarity tests

Prior to estimating regression models, the time-series properties of the variables were examined using Augmented Dickey–Fuller (ADF) tests. The results indicate that all variables are non-station-

ary in levels but become stationary after first differencing. Accordingly, all variables are treated as integrated of order one, $I(1)$, and the regression analysis is conducted using first-differenced series.

3.4. Granger causality tests

To further examine the dynamic relationships between financial inclusion and social outcomes, Granger causality tests were conducted. The results indicate no strong evidence of Granger causality running from financial inclusion indicators to poverty risk at the EU aggregate level. This suggests that changes in financial inclusion do not systematically precede changes in poverty risk within the analyzed time horizon.

By contrast, selected financial inclusion indicators exhibit Granger-causal relationships with income inequality, indicating that past values of financial inclusion help predict subsequent changes in income distribution. This finding is consistent with the observed moderate correlations and regression results, which point to a closer association between financial inclusion and income inequality than with poverty risk.

In addition, the tests reveal strong Granger causality from macroeconomic control variables – particularly unemployment – to poverty risk, underscoring the dominant role of labor market dynamics in shaping poverty outcomes. These results reinforce the importance of controlling for broader economic conditions when assessing the social effects of financial inclusion.

The Granger causality analysis supports the view that financial inclusion is not an immediate driver of poverty reduction in the European Union but may influence distributional outcomes over time, while poverty dynamics remain primarily driven by macroeconomic and labor market factors.

3.5. Regression results: Financial inclusion and poverty risk

Table 3 summarizes the key regression results examining the relationship between financial inclusion indicators and poverty risk in the European Union over the period 2004–2023. To ensure clarity and comparability, the table reports the preferred functional form for each indicator together with the direction and statistical significance of the estimated relationship. This presentation complements the detailed regression outputs provided in the appendix and focuses on the substantive empirical findings rather than on individual coefficient values.

The results reported in Table 3 clearly distinguish between access-based and usage-based measures of financial inclusion. Traditional indicators reflecting physical access to financial services, as well as basic digital access, do not show statistically significant effects on poverty risk. In contrast, a robust non-linear relationship is identified for card payment transactions, highlighting the importance of actual financial behavior rather than mere access or availability. This finding provides empirical support for the argument that the social benefits of financial inclusion materialize only when digital financial services are widely and intensively used.

While several financial inclusion indicators exhibit notable correlations with poverty risk, these

associations weaken once dynamic and non-linear relationships are accounted for in the regression analysis, highlighting the importance of appropriate econometric modelling.

3.6. Regression results: Financial inclusion and income inequality

Table 4 summarizes the key empirical findings regarding the relationship between financial inclusion indicators and income inequality, measured by the Gini coefficient, in the European Union over the period 2004–2023. The table consolidates the results from causality tests, cointegration analysis, and regression models, highlighting only statistically robust relationships.

The results reported in Table 4 indicate that, among all financial inclusion indicators considered, only the density of bank branches exhibits a statistically significant relationship with income inequality in the European Union. Both Granger causality tests and cointegration analysis provide evidence of a long-run equilibrium relationship between bank branch availability and the Gini coefficient. The estimated Error Correction Model further confirms a statistically significant short-run effect, with deviations from long-run equilibrium corrected at a relatively rapid pace.

The negative signs of the estimated coefficients in both the ECM and the long-run regression

Table 3. Summary of regression results: financial inclusion and poverty risk in the EU

Financial inclusion indicator	Model specification	Direction of the relationship	Statistical significance	Main empirical interpretation
Bank branches (per 100,000 inhabitants)	Linear and non-linear	None	Not significant	Physical banking infrastructure is not systematically related to poverty risk at the EU aggregate level.
ATMs (per 100,000 inhabitants)	Linear and non-linear	None	Not significant	Variations in ATM density do not explain changes in poverty risk.
Internet banking usage (%)	Linear and non-linear	None	Not significant	Digital access alone does not translate into measurable poverty reduction.
Number of payment cards in circulation	Non-linear	Weak/unstable	Not robust	Availability of payment instruments is insufficient to affect poverty outcomes.
Card payment transactions (total number)	Quadratic	Inverted U-shape	Significant	Poverty risk initially increases but declines after a threshold level of card payment usage is reached.
Real GDP per capita (control)	Linear and non-linear	None	Not significant	Aggregate income growth does not directly explain poverty dynamics.
Unemployment rate (control)	Linear	None	Not significant	Labor market effects are not statistically significant at the EU aggregate level.

Notes: Statistical significance refers to conventional levels ($p < 0.10$; $*p < 0.05$; $**p < 0.01$). The quadratic specification is selected based on model fit diagnostics and residual tests. Detailed regression coefficients and diagnostics are available upon request or in supplementary materials.

Table 4. Summary of regression and causality results: financial inclusion and income inequality (Gini coefficient)

Financial inclusion indicator	Method applied	Direction of the relationship	Statistical significance	Main empirical interpretation
Bank branches (per 100,000 inhabitants)	Granger causality, ECM, long-run regression	Negative	Significant (short- and long-run)	Greater physical access to banking reduces income inequality over time.
ATMs (per 100,000 inhabitants)	Granger causality, PTR	None	Not significant	ATM density is not systematically related to income inequality.
Internet banking usage (%)	Granger causality, PTR	None	Not significant	Digital banking adoption alone does not affect income distribution.
Number of payment cards in circulation	Granger causality	None	Not significant	Availability of cards does not translate into lower inequality.
Card payment transactions (total)	Granger causality, PTR	None	Not significant	Usage intensity does not explain the dynamics of income inequality.
Real GDP per capita (control)	PTR	None	Not significant	Aggregate income growth does not directly reduce inequality.
Unemployment rate (control)	PTR	None	Not significant	Labor market conditions are not significant at the EU aggregate level.

model suggest that greater physical access to banking services is associated with lower income inequality. Specifically, increases in the number of bank branches per 100,000 inhabitants are associated with reductions in the Gini coefficient in both the short- and long-run, indicating that traditional banking infrastructure continues to play a redistributive role even in a highly developed financial environment.

In contrast, no statistically significant relationships are identified for other financial inclusion indicators, including ATM density, internet banking usage, payment card availability, and card payment transactions. These findings imply that, at the EU aggregate level, digital and usage-based financial inclusion measures do not directly affect income distribution. Similarly, macroeconomic control variables such as real GDP per capita and the unemployment rate fail to explain variations in income inequality over the period analyzed.

The results suggest a clear asymmetry between different dimensions of financial inclusion. While usage-based digital indicators are relevant for poverty risk, as shown in the previous subsection, income inequality appears to be more strongly associated with traditional forms of financial access. This distinction highlights the multidimensional nature of financial inclusion and underscores the importance of considering different social outcomes separately.

4. DISCUSSION

The empirical findings of this study provide macro-level evidence that helps reconcile the mixed and sometimes contradictory results reported in the existing financial inclusion literature. The absence of a robust direct linear relationship between most financial inclusion indicators and poverty risk at the EU aggregate level contrasts with a large body of micro- and country-level evidence documenting poverty-reducing effects of financial access in developing and emerging economies. Studies based on household or regional data typically find that access to savings and credit instruments improves consumption smoothing and reduces vulnerability (Burgess & Pande, 2005; Koomson et al., 2020; Omar & Inaba, 2020; Adenike et al., 2025). The present results suggest that, in a highly developed and institutionally dense environment such as the European Union, these effects are not automatic and may be absorbed or overshadowed by broader welfare systems, labor-market institutions, and redistributive policies, which play a dominant role in shaping aggregate poverty dynamics.

A key contribution of this study is the identification of a statistically significant non-linear relationship between card payment usage and poverty risk, indicating that the poverty-reducing effects of digital financial inclusion emerge only after a threshold of adoption is reached. This finding aligns with the growing literature emphasizing that digital finance is not inherently inclusive

but becomes socially effective only when usage is widespread and embedded in everyday economic behavior (Ozili, 2018; Maatallah, 2024; Phan & Pham, 2025). It also complements recent studies highlighting digital divides related to age, skills, and socio-economic status, which may delay or weaken the social benefits of digitalization in advanced economies (Ghorbanian Zolbin et al., 2025; Ruthvika & Hedau, 2025). In this sense, the results help explain why previous EU-focused studies often report weak or insignificant average effects of digital financial access on poverty outcomes.

In contrast to poverty risk, income inequality in the European Union is more closely associated with traditional forms of financial access, particularly bank branch density. This result is consistent with theoretical and empirical contributions arguing that physical banking infrastructure continues to play a redistributive role by facilitating access to financial services for lower-income and peripheral populations, even in digitally advanced economies (Beck et al., 2007; Sarma & Pais, 2011; Kling et al., 2022). The finding also echoes evidence from transition and post-transition contexts, where inclusive access to formal banking remains critical for mitigating structural inequalities, provided that it is supported by appropriate institutional quality and governance frameworks (Vasylieva et al., 2022; Eriqat et al., 2025; Aleksić & Jovović, 2025).

More broadly, the results reinforce recent arguments that financial inclusion should be treated as a multidimensional, outcome-specific phenomenon rather than a uniform policy instrument. While usage-based digital indicators appear more relevant for poverty dynamics under non-linear conditions,

distributional outcomes such as income inequality respond primarily to access-based, institutionalized forms of inclusion. This asymmetry helps clarify why the literature reports heterogeneous effects across social outcomes, countries, and methodological approaches (Barajas et al., 2020; Čihák et al., 2021; Ozili, 2021). By adopting a time-series perspective at the EU level, this study adds to the literature by demonstrating that the social impact of financial inclusion depends not only on the type of inclusion and the outcome considered, but also on long-run dynamics, threshold effects, and the broader socio-institutional environment in which financial systems operate.

This study is subject to several limitations that should be considered when interpreting the findings. First, the analysis relies on aggregated EU-level annual data, which masks substantial cross-country heterogeneity and prevents identification of distributional effects within individual Member States or population groups. Second, the use of macro-level indicators limits the ability to capture behavioral, institutional, and policy-specific mechanisms through which financial inclusion affects social outcomes, particularly in relation to welfare systems and labor-market dynamics. Third, although time-series techniques allow for the identification of long-run relationships and non-linear effects, the relatively short time span and the presence of overlapping structural shocks may constrain the robustness of causal inference. Finally, the selected indicators primarily reflect access to and usage of formal financial services and do not fully capture qualitative aspects such as financial literacy, trust, or consumer protection, which may play a critical role in translating financial inclusion into tangible social benefits.

CONCLUSIONS

The aim of this study was to assess the impact of financial inclusion on key social outcomes, poverty risk, and income inequality in the European Union, with particular attention to whether different dimensions of financial inclusion exert linear or non-linear effects over time. By focusing on the EU as an integrated economic area, the research sought to clarify why previous empirical studies report mixed evidence on the social effectiveness of financial inclusion in advanced economies.

The results indicate that financial inclusion does not exert a uniform direct linear effect on social outcomes at the EU aggregate level. No statistically significant linear relationship is found between most financial inclusion indicators and poverty risk. However, a significant non-linear relationship is identified between card payment transactions and poverty risk, following an inverted U-shaped pattern,

suggesting that poverty risk initially increases but then declines once digital payment usage surpasses a threshold. In contrast, income inequality is significantly and negatively associated with traditional financial access, particularly bank branch density. The Error Correction Model confirms both short- and long-run effects, indicating that increases in the number of bank branches per 100,000 inhabitants are associated with reductions in the Gini coefficient. In contrast, digital and usage-based indicators do not exhibit statistically robust effects on income distribution.

From a policy perspective, these findings imply that financial inclusion strategies in the European Union should be explicitly differentiated by social objective and the targeted inclusion dimension. Policies aimed at poverty reduction should prioritize not only access to digital financial services but also their effective and widespread usage, supported by investments in digital skills, consumer protection, and inclusive payment ecosystems. At the same time, policies addressing income inequality should not neglect traditional banking infrastructure, particularly in peripheral, rural, and socially vulnerable areas, where physical access to financial services continues to play a redistributive role. A balanced policy mix that combines digital innovation with inclusive institutional frameworks appears essential to translating financial inclusion into sustainable, socially equitable outcomes in the European Union.

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