MANCHESTER 1824
The University of Manchester

Economics

Discussion Paper

Series

EDP-2311

Does Financial Development Relieve or Exacerbate Income Inequality? A Quantile Regression Approach

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December 2023

Economics

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Abstract

This paper probes deeper into the finance-inequality nexus to explore whether the impact of the multi-dimensional aspects of financial development on income inequality varies across countries at different stages of the inequality spectrum. Using an instrumental variable quantile regressions approach for a panel dataset of 91 countries from 1980 to 2014, the findings suggest that the impact of financial development in terms of banking and stock market development on income inequality for countries at the higher end of the inequality spectrum differs from those with lower or moderate inequality levels. Furthermore, the variation observed in the magnitude of the impact at different quantiles of the conditional distribution of income inequality depends on the specific measure used to capture a different aspect of financial development, i.e., depth, efficiency and stability of banking sector and stock market development. The results are robust to several alternative specifications and have important policy implications for countries with different inequality levels.

Keywords: income inequality; financial development; financial systems; quantile regressions
JEL codes: D63, O16, G00, P00.

1. Introduction

The pervasive and persistent phenomenon of rising income inequality has raised serious and fundamental issues of concern amongst researchers and policymakers in recent years. Several studies emphasise the strong repercussions of income disparities between the rich and poor, particularly on economic opportunity and welfare outcomes (Piketty, 2015; Ravallion, 2014; Stiglitz, 2012; Perotti, 1996). At the same time, the emergence of recent developments, complexities, and interrelatedness of modern financial systems, along with the aftermath of the global financial crisis of 2007-08, have spurred new debates on the role and implications of financial development on income inequality (Spratt, 2008).

Financial development - regarded as the "brain of the economy" (Stiglitz, 1997, p.14) performs several functions including facilitating resource allocation, mobilising and encouraging savings, and allowing better risk management, capital formation, corporate governance and firm monitoring (Levine, 2005). Existing theory shows that these functions allow households and firms to have greater access to credit and invest in productive activities by reducing their dependency on inherited wealth or informal sources of finance (Galor and Zeira, 1993). Several empirical studies have also attempted to unpack the finance-inequality nexus – albeit producing highly diverse and conflicting results on the impact of finance on inequality. For example, one strand of the literature suggests that greater financial development relieves income inequality, whereas another strand provides evidence for inequality-widening impact. To reconcile these conflicting effects, some studies explore the non-linear dynamics between financial development and income inequality. This paper contributes to this particular strand in the existing literature that relates to the non-linearity in the finance-inequality nexus – more specifically, this paper contributes to the existing literature by going beyond the mean effects and exploring the quantile-specific effects for different aspects of financial sector development on income inequality.

The conventional approach in the prevalent literature tends to estimate the impact of financial development on summary indices of income inequality, such as the Gini coefficient, which describes the mean effects at the centre of the income distribution (Atkinson, 1970; Clarke et al., 2006). Most empirical studies focus on conditional mean estimations that produce constant slope coefficients across heterogeneous countries in a panel dataset. However, given the complexities of the finance-inequality dynamics, there is a strong motivation to explore the full distributional impact of financial development on income inequality since the effects may not be the same at the upper tails or lower tails of the distribution as the mean – and to identify

which aspects of financial development has an impact on inequality for countries at different levels of the inequality spectrum. In other words, the heterogeneity in the impact of financial development on income inequality could be associated with whether a country has lower, moderate, or higher inequality levels. Moreover, the differences in institutional quality and financial structures across countries with different inequality levels may condition the impact of financial development on income inequality (Claessens and Perotti, 2007).[1]

To address the gaps in the existing literature, particularly on the quantile-specific effects of the multi-dimensional aspects of financial development, this paper attempts to systematically unpack the finance-inequality relationship by exploring whether the distributional effects of financial development vary according to the level of inequality across countries, such as the lower, middle and upper end of the inequality distribution.[2] This paper is intended to fill this void in the current literature. Furthermore, there is no single precise measure that can capture the different functions performed by banking systems and stock markets and this paper uses a multi-dimensional approach to capture the different dimensions of financial development related to the depth, efficiency and stability of the banking sector and stock market development. This paper is intended to fill this void in the current literature.

Given the complex and multi-faceted nature of the finance-inequality nexus, using a quantile regressions approach allows us to obtain a series of robust inferences and new insights to identify the effects of financial development on income inequality for countries at different levels of the inequality spectrum. This is further motivated by the skewed distribution of income inequality.[3] Unlike traditional approaches, the quantile regressions methodology offers to capture the distributional heterogeneity of the impact of financial development on income inequality across countries with low, moderate or high inequality levels.

The remainder of the paper is organised as follows. Section 2 reviews the existing literature on the finance and inequality nexus. Section 3 discusses the data, and Section 4 presents the econometric methodology. Section 5 discusses the results. Finally, Section 6 concludes the paper.

[1] Some studies suggest that richer countries with lower income inequality tend to have larger, more active and more efficient financial systems (Demirgüç-Kunt and Levine, 1999)

[2] A few studies in the growth literature explore the quantile-specific effects of economic growth on income inequality at different inequality levels (Lin et al., 2007; Sbaouelgi, 2017) and the impact of a financial stimulus on economic growth across different quantiles of the growth distribution (Andini and Andini, 2014). However, there is much scope in the finance-inequality literature to examine the impact of finance on income inequality across different inequality levels.

[3] The quantile plot (see Figure 1 below) shows that the data for income inequality is skewed and does not follow a normal distribution.

2. Literature on the Finance-Inequality Nexus

Ever since the seminal contributions by Goldsmith (1969), McKinnon (1973) and Shaw (1973) on the critical role of finance, several strands of literature related to financial development have emerged over the years, including the finance-growth and finance-poverty links, and more recently, finance-inequality nexus. Several studies on the finance-growth links indicate that an efficient, well-functioning financial system is necessary for long-term economic growth (King and Levine, 1993; De Gregorio and Guidotti, 1993; Arestis and Demetriades 1997; Banerjee and Duflo, 2003; Calderón and Liu, 2003). On the finance-poverty front, several studies find that financial development lowers poverty through various channels and the poor benefit from greater banking sector development and saving opportunities (Jeanneney and Kpodar, 2011; Jalilian and Kirkpatrick (2005).

There is much less scrutiny put forward to unpack the distributive effects of financial development on income inequality. The existing literature on the finance-inequality nexus can be divided into three main strands, albeit conflicting. The first strand and the most empirically investigated– "the inequality-narrowing hypothesis" - proposes that greater financial development disproportionately benefits the poor and reduces income inequality by lowering credit constraints and dependency on inherited wealth as a primary source of capital (Galor and Zeira, 1993; Banerjee and Newman, 1993). Such financial constraints, including information and transaction costs, are particularly binding on the poor who lack collateral, credit histories and connections. The proponents of the inequality-narrowing hypothesis argue that a well-developed financial system plays an important role in reducing income inequality by facilitating the mobilisation of resources, encouraging savings into productive activities, and facilitating transactions, entrepreneurial activities, and trade (Levine, 1997; Claessens and Perotti, 2007; Ang, 2010). This hypothesis is supported by several empirical studies (Li et al., 1998; Clarke et al., 2006; Beck et al., 2007; Jeanneney and Kpodar, 2011). For example, a recent study by Coccorese and Dell'Anno (2022) examines the banking-inequality nexus to find that a higher banking development reduces income inequality.

Conversely, the second strand proposed an "inequality-widening hypothesis" – that is, financial development disproportionately benefits the rich and well-connected economic agents through greater availability of external finance (Claessens and Perotti, 2007; Mookherjee and Ray, 2003). The proponents of this view claim that it is difficult for poor individuals and firms to access financial services and obtain loans due to several reasons, including a lack of democratised access to the financial sector with barriers to entry erected by

insiders and political incumbents (Seven and Coskun, 2016; Rajan and Zingales, 2003). This tends to exclude the poor and widens the income disparities between the rich and the poor. Several empirical studies find that greater financial development may exacerbate income inequality (Jaumotte et al., 2013; Cournède and Denk, 2015; Jauch and Watzka, 2016).

Reconciling these conflicting views, a third strand of theoretical and empirical studies has emerged, which argues for nonlinearity in the relationship between financial development and inequality. These studies suggest that the impact of financial development on income inequality tends to vary depending on certain structural conditions, such as the stages of economic and financial development (Greenwood and Jovanovic, 1990; Aghion and Bolton, 1997) and the type of institutions an economy adopts (Acemoglu et al., 2005; Perotti and Volpin, 2007). This view has been supported by some recent empirical evidence of nonlinearity between financial development and inequality (Kim and Lin, 2011; Tan and Law, 2012; Altunbaş and Thornton, 2019).

While the current literature provides noteworthy insights into the role of financial development, several research gaps are worth investigating. First, the prevalent literature remains scant on the quantile-specific effects of finance on inequality, that is, whether the effects of the multi-dimensional aspects of financial development on income inequality vary across countries with different inequality levels. Second, most studies have only focused on a narrow approach when defining and measuring financial development by mainly looking at the banking sector depth measured by private credit or M2/GDP. To address the above-mentioned gaps, this paper investigates whether the impact of financial development on income inequality changes depending on the multi-dimensional aspects of financial development and across different intervals along the inequality distribution.

3. Data and Variables

3.1. Measure of income inequality

As the dependent variable, the Gini index of disposable (net) income inequality from the Standardised World Income Inequality Database (SWIID) is used to measure income inequality. The net Gini coefficient (post-tax, post-transfer) incorporates income redistribution via the system of taxes and transfers. The SWIID maximises the available data in terms of coverage and for which the underlying data sources and welfare definitions are known – drawing on the Luxembourg Income Study (LIS), the World Income Inequality Database

(WIID), regional sources, national statistical offices, and the academic literature, which is then used for imputation of any missing country/year cells (Ferreira et al., 2015). The SWIID is widely considered a credible effort to address the issues of data comparability and quality while maintaining the widest possible coverage across countries and over time (Tan and Law, 2012; Ostry, Berg & Tsangarides, 2014; Solt, 2016; Jauch and Watzka, 2016; De Haan and Sturn, 2017; Altunbas and Thornton, 2019). It is regarded as one of "the most comprehensive database and allows comparison across countries because it standardises income" (De Haan and Sturm, 2017; p. 314) and "the most comparable data possible for the broadest sample of countries and years of any cross-national income-inequality dataset" (Solt, 2015; p. 690).[4]

3.2 Measures of Financial Development

This paper employs six different measures of financial development related to the depth, efficiency and stability of banking systems and stock markets. The source of this data is the Global Financial Development Database (GFDD), which is an extensive dataset of financial system characteristics for 203 economies from 1960 till 2015 (Čihák et al., 2012). The following financial development measures are used in this study:

(i) private sector credit as a measure of the depth of banking systems;
(ii) total value of stocks traded as a measure of the depth of stock markets;
(iii) bank lending-deposit spread (cost of intermediating credit) as a measure of the inefficiency of banking systems (greater spread signals lower efficiency);
(iv) turnover ratio as a measure of stock market efficiency;
(v) volatility of credit growth as a measure of banking instability; and
(vi) volatility of the stock price index as a measure of stock market instability.

A few studies have combined some of these indicators to obtain a singular index (e.g., using the principal components approach). However, while this approach has some merit, this may hide the individual effects of the various proxies for financial development. Also, from a policy perspective, it would be useful to identify which aspect of financial development could yield a greater impact on lowering inequality. To mitigate potential multicollinearity issues, these measures of financial sector development are separately examined to gauge their significance.

[4] The WIDER (2019) dataset was also considered for this paper. However, it reduces the sample size considerably and has not been implemented for this empirical study.

3.3 Control variables

Following existing empirical literature on the finance-inequality nexus, a standard set of control variables is used to account for other potential determinants of income inequality (Beck, Demirgüç-Kunt and Levine, 2007; Jeanneney and Kpodar 2011; Jauch and Watzka, 2016). These include macroeconomic variables such as real GDP per capita and government spending, institutional variables such as democracy, and other variables related to international trade, human capital, and agricultural employment.[5]

4. Empirical Strategy

4.1 Quantile regression

This paper uses a quantile regression approach to investigate whether the effects of the different aspects of financial development on income inequality vary according to the level of inequality across countries. This technique, pioneered by Koenker and Bassett (1978), estimates the impact of a covariate at different points along the entire distribution of the outcome variable, not merely its conditional mean. In other words, the conditional distribution of the dependent variable is divided into various intervals, where the 50^{th} quantile represents the median.

The motivations for the application of quantile regressions to unpack the finance-inequality nexus are two-fold. First, it allows a richer characterisation of the data due to the possibility of estimating different slopes for different points in the entire distribution of the dependent variable (i.e., the Gini index). The conventional estimation methods generate coefficient estimates at the conditional mean that solely addresses the central effects of the covariates. However, the mean effects can provide a partial view of the relationship between the regressors and the outcome variable based on the conditional mean function (Chernozhukov and Hansen, 2008). On the other hand, the quantile regressions approach characterises the full distributional effects of financial development on income inequality for different levels of the inequality spectrum, which, in turn, allows the assessment of policy reactions over the conditional distribution of income inequality.

Second, the quantile regressions technique is more robust to outliers and heteroscedasticity, including non-normal errors in many real-world applications (Cameron and

[5] The control variables used in this study are extracted from the Quality of Government Standard Dataset (Teorell et al., 2021).

Trivedi, 2005). Any observations outside the overall distribution pattern can arise due to the heterogeneity of countries in panel data analysis. Although it is relatively straightforward to detect outliers in simple regression via scatterplots, it can be difficult in multivariate regressions with a large number of observations. Simply considering the conditional mean of the Gini index may not be as informative or robust if the findings are driven by some highly unequal countries. A possible solution to the issue of outliers is using the quantile regressions technique since it estimates the impact at the median and the tails of the distribution, thereby reducing the influence of outliers in driving the estimated results. This provides greater flexibility to empirically investigate the heterogeneous effects of financial development on income inequality at different inequality levels in the presence of outliers and captures important features of the data that might be neglected by traditional estimation methods.

Furthermore, endogeneity can arise due to simultaneity bias, measurement error, sample selection or relevant omitted variables. To mitigate such endogeneity concerns, a series of researchers have developed an instrumental variables quantile regressions (IVQR) approach (Chernozhukov and Hansen, 2006, 2008, 2013), computation of IVQR-GMM estimators (Chen and Lee, 2018), and the dynamic panel IVQR models with lagged regressors as instruments (Galvao and Montes-Rojas, 2010; Galvao, 2011). The IVQR and IVQR-GMM estimators are discussed in the following sub-sections.

It is also worth noting that the quantile regressions approach differs from applying OLS to different subsets obtained by dividing the entire dataset into different quantiles of the outcome variable, which may result in an incomplete use of the entire dataset. On the other hand, quantile regressions use the entire dataset to obtain estimates for each conditional quantile considered - some observations are given more weight than others depending on the conditional quantile considered. In other words, an estimation of the quantile regression function for a low quantile, say $\tau = 0.25$, for examining the effect of financial development on income inequality in the lower tail of the income inequality distribution is different from estimating a mean regression when the data is conditioned on the lower tail of the distribution.

Therefore, the quantile regressions approach offers a comprehensive strategy for completing the regression picture by generating quantile-specific effects that describe the full distributional impact of covariates along the tails of the distribution (Koenker and Hallock, 2001). Given the existing data limitations in current literature and that the impact of different measures of financial development is likely to differ over the conditional distribution of income inequality, there is a strong need to extend this flexibility to facilitate a robust empirical

investigation of the finance-inequality nexus across different intervals of the income distribution.

4.2 Instrumental Variable Quantile Regression (IVQR)

This paper implements the instrumental variable quantile regression (IVQR) to address endogeneity concerns when estimating the finance-inequality nexus. The basic assumptions and structure of the model are discussed in detail by Chernozhukov and Hansen (2006, 2008, 2013) and summarised here. This model proposes a robust inference approach using IVQR that applies to endogenous variables and instruments and is robust to weak identification, partial identification, and non-identification. To allow endogenous variables and to better describe the effects of financial development on inequality at different levels of income inequality, this paper considers the following IVQR model for the τ–quantile of the outcome variable Y which is conditional on the variable, d, and a vector of controls, x:

$$Y_\tau = \alpha_\tau d + \beta_\tau x' + \mu$$
$$d = f(x, z, v) \quad \mu | x, z \sim uniform\ (0,1) \qquad (1)$$

Equation (1) estimates the quantile-specific effects on the outcome variable Y where τ denotes selected quantiles (0.25, 0.5 and 0.75) and μ represents an error term. Due to the omitted variable problem, d is allowed to be endogenous and is a function of x, z, and v, where z is an instrumental variable and v is an error term affecting d. Time-specific dummy variables are also included to control for structural differences across periods. The implementation of the IVQR estimator is based on the three-step procedure as outlined in Kwak (2010): (i) estimate the first stage using least squares; (ii) estimate the τ^{th} quantile of Y using predicted values of the treatment variable, d; (iii) conduct a grid search around those estimated values to find estimates that minimise the objective functions of both stages at τ. [6] Chernozhukov and Hansen (2008) propose a dual inference method, which is robust to weaker or irrelevant instrumental variables. This method is based on the Wald statistic, which can be constructed from the test of the null hypothesis that the coefficients of the instruments are zero. However, the

[6] To implement the quantile regressions approach, it is important to clean the dataset to remove observations with missing values and to avoid the computational burden of a higher dimensional grid search, the number of endogenous treatment variables should be limited to two, and the number of instruments should be at least as much as endogenous independent variables (Kwak, 2010).

implementation of this method is yet to be developed for practical use. To address this limitation, Galvao (2011), Galvao and Montes-Rojas (2010) and Chen and Lee (2018) recommend using lagged regressors as suitable instruments for implementing IVQR technique.[7]

4.3 IVQR-GMM

For robustness purposes, the IVQR-GMM estimation of Chen and Lee (2018) is implemented as an alternative technique to check the sensitivity of the results to the choice of econometric method used. To complement the previous work on quantile regressions using instrumental variables (Chernozhukov and Hansen, 2006, 2008), the IVQR-GMM technique proposed by Chen and Lee (2018) uses a computational algorithm based on the method of mixed integer optimisation (MIO) to compute the IVQR estimates within the classical generalised method of moments (GMM) framework. More specifically, they show that the GMM estimation problem in IVQR models can be equivalently formulated as a mixed-integer quadratic programming (MIQP) problem, which allows exact computation of the GMM estimators for the IVQR models. It is operationalised using MATLAB and Gurobi Optimisation.

While the IVQR model developed by Chernozhukov and Hansen (2006) is not directly a GMM estimator, Chen and Lee (2018) suggest that it can be shown to be asymptotically similar to the IVQR-GMM estimator. Furthermore, Chen and Lee (2018; p. 533) point out that the IVQR model of Chernozhukov and Hansen (2006) "admits conditional moment restrictions, which can be used to construct the estimating equations for the GMM estimation of the model parameters. However, the sample counterparts of the IVQR estimating equations are discontinuous in the parameters so that the resulting GMM estimation problem becomes a nonconvex and computationally nontrivial optimisation problem". To estimate the IVQR model within the GMM framework, the IVQR-GMM model of Chen and Lee (2018) estimates for linear-in-parameters IVQR models using mixed integer quadratic programming (MIQP). However, it is computationally demanding, requiring a super-fast computing environment or high-spec equipment.[8]

[7] This study uses lagged regressors as instruments for the IVQR framework of Chernozhukov and Hansen (2006, 2008) and then carries out a series of robustness tests to check the results. It can also be noted that some studies in the finance-inequality literature use external instruments such as legal origin, ethnic fractionalisation and religious composition of countries, which are heavily criticised as weak instruments for financial development (Jauch and Watzka, 2016).

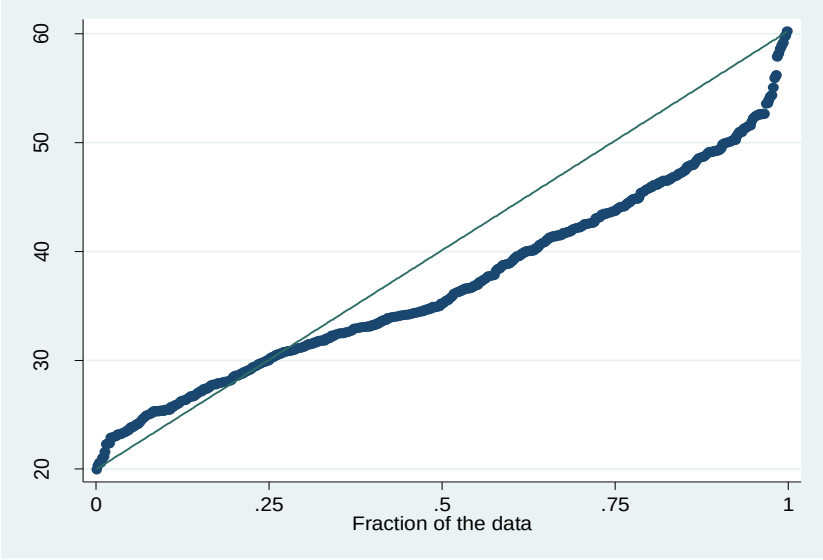
[8] For further details on the MIQP formulation of the IVQR-GMM estimation, please refer to Chen and Lee (2018).

4.4 Exploratory data analysis

This section outlines the data compilation process and provides some exploratory analysis. This paper uses a sample of 91 countries from 1980 to 2014 with five-year averages. To further motivate the choice of the quantile regressions approach, this section also presents some exploratory data analysis, such as quantile plots and scatterplots, to examine the overall shape of the data for important features, including symmetry and departures from normality assumptions. Figure 1 illustrates the quantile plot for the outcome variable using the panel dataset of developed and developing countries. The solid diagonal line represents the reference line indicating symmetry points for distribution. It can be observed that the distribution of income inequality is non-symmetrical and heavily skewed since the points of the outcome variable (income inequality measured by the disposable Gini index) stray further from the reference line.

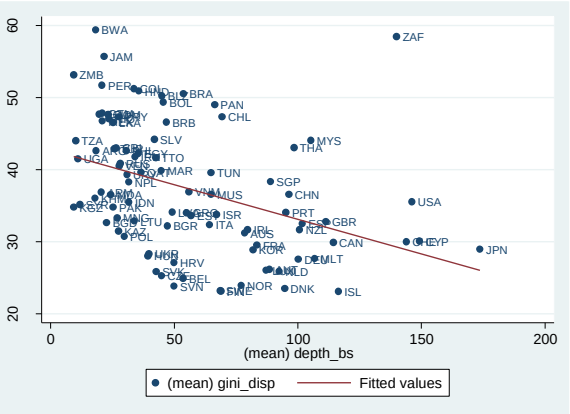
Since the panel dataset contains a heterogeneous group of countries, outliers are quite likely. The scatterplots (Figures 2-7) and the correlation matrix in Table 1 indicate the relationship between the different measures of financial development and income inequality. Some data points can be observed as lying away from the estimated line of best fit. Therefore, the evidence of the non-symmetric nature of the data and skewness further motivates the need for quantile regression since the average impact is likely to be influenced by some highly unequal countries, and the results may be sensitive to the presence of outliers.

Figure 1: Quantile plot of income inequality

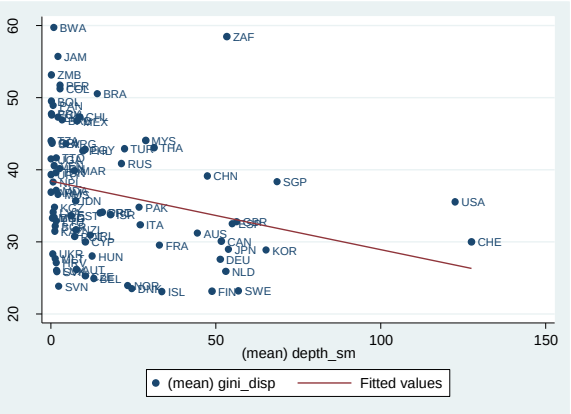


Source: Author's construction based on the SWIID database.

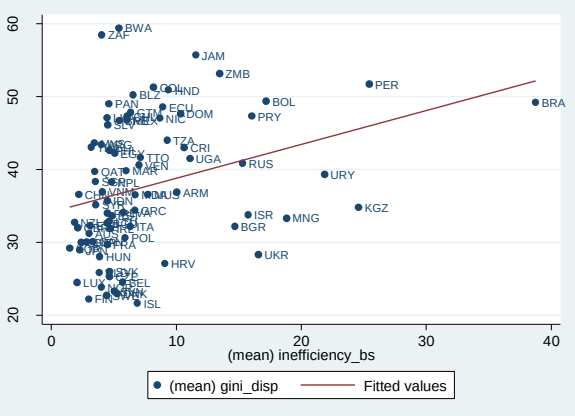
Figure 2: Scatterplots for different aspects of financial development and inequality



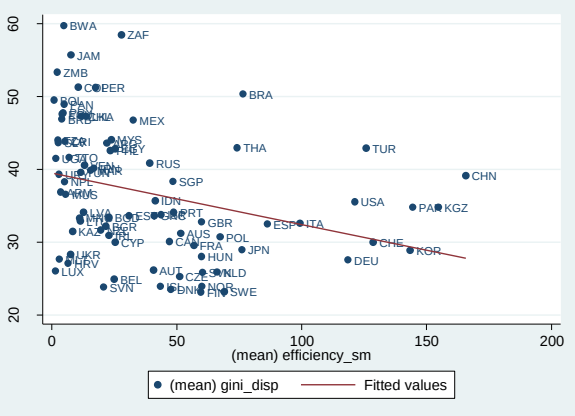
(i) Depth of banking sector



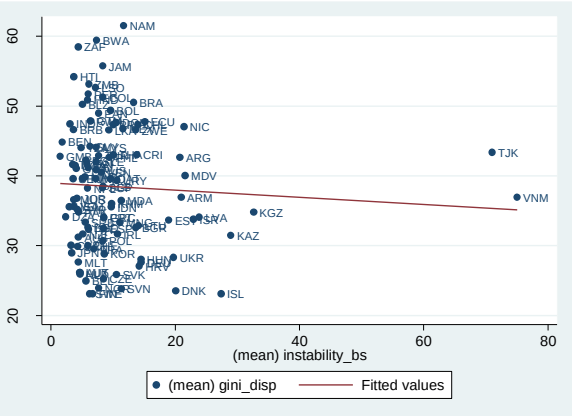
(ii) Depth of stock market



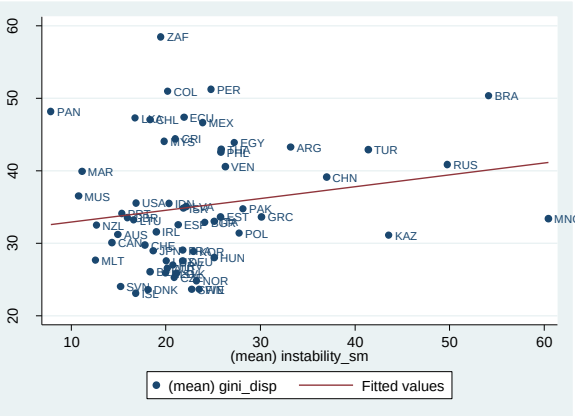
(iii) Inefficiency of banking sector



(iv) Efficiency of stock market



(v) Instability of banking sector



(vi) Instability of stock market

5. Results and Discussion

This section presents the empirical results related to whether the impact of different aspects of financial development on income inequality is specific to certain inequality levels, such as the lower (*q25*), middle (*q50*) and higher (*q75*) quantiles. The quantile-specific effects of the finance-inequality nexus for each aspect of the financial sector considered are discussed below.

5.1. Depth of Banking Systems

Starting with financial depth related to banking systems (measured by private credit), Table 1 shows that the estimated coefficients are negative and significant at 1% level for all quantiles. However, some variation can be observed in the magnitude of the impact at different quantiles of the conditional distribution of income inequality. The results indicate that across the distribution from lower (q25) to higher (q75) quantiles of income inequality, the magnitude of the impact is slightly greater for countries with higher inequality levels. In other words, although greater private credit yields substantial benefits on income inequality at all levels of the inequality distribution, it tends to yield greater benefits for countries at the higher end of the spectrum.

The following underlying mechanisms help to shed light on the differences in the magnitude of the impact across different quantiles. First, the results are consistent with the existing theory, which points out the structural differences in financial systems across countries with different inequality levels. Several studies indicate that countries with higher levels of inequality tend to have less-developed financial sectors consisting of predominantly bank-based financial systems while stock markets are underdeveloped or nonexistent (Jeanneney and Kpodar, 2011; Singh, 1999). Furthermore, in the context of countries with higher inequality countries, financing constraints tend to impose greater difficulty for entrepreneurs to access credit and for existing businesses to expand, particularly small businesses, which comprise the main source of employment in such countries (Freedman and Click, 2006; Beck et al., 2005; Demirgüc-Kunt and Maksimovic, 1998). These studies argue that bank-based development in countries with higher inequality levels tends to be more impactful in alleviating income inequality by easing credit constraints and disproportionately benefiting the poor. In other words, an improvement in the depth of the banking sector in terms of greater private credit benefits a greater proportion of the population in higher-inequality countries, thereby reducing income inequality by a greater magnitude. Thus, the bank-based financial structure that

primarily exists in higher-inequality countries may help explain why the impact of private credit is slightly greater in countries with higher inequality levels.

Table 1: IVQR estimation of Banking Depth and Income Inequality

	q25	q50	q75
VARIABLES	gini_disp	gini_disp	gini_disp
Depth of BS	-0.156***	-0.162***	-0.181***
	(0.0563)	(0.0277)	(0.0219)
Log of Real GDP	0.868	0.856	2.113***
	(0.716)	(0.683)	(0.755)
Trade openness	0.00553	0.0118**	-0.00127
	(0.0106)	(0.00595)	(0.00575)
Agri. employment	-0.0261	0.00105	-0.00924
	(0.0279)	(0.0239)	(0.0290)
Govt expenditure	-18.60***	-21.14***	-13.19*
	(5.820)	(7.577)	(6.785)
Human capital	-0.303	0.853**	0.0520
	(0.268)	(0.433)	(0.492)
Democracy	0.104	0.101	-0.0990
	(0.160)	(0.155)	(0.220)
Constant	0.537	2.993	-3.502
	(7.376)	(6.095)	(6.596)
Number of countries	91	91	91
Observations	492	492	492

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 per cent levels, respectively.*

Second, the type of financing extended to households and firms tends to vary across countries with different inequality levels. For example, the banking sector in higher-inequality countries tends to extend more credit to low-risk, labour-intensive, traditional sectors such as agriculture, which has greater potential for generating employment opportunities and reducing income inequality on a wider scale (Allen and Santomero, 1997). These results highlight the impact of greater depth of banking systems across lower, middle and higher intervals of the income distribution. While the direction and significance of the coefficients remain consistent (i.e., negative and statistically significant) across different quantiles, there is an increasing magnitude of the impact across the distribution as private sector credit reduces income inequality to a greater extent in higher-inequality countries.

5.2. Depth of Stock Markets

The quantile-specific effects of stock market depth measured by the total value of shares traded on income inequality at different inequality levels is provided in Table 2, which shows that the coefficient estimates are positive and significant at 1% level across the quantiles, with some variation in the magnitude of the impact. The results indicate that the gains from the increasing value of stocks traded are disproportionately distributed to the rich minority rather than the poor, thereby aggravating income inequality. Several studies suggest that stock markets tend to be more accessible for well-connected, established operators, leaving the poor behind, who are more vulnerable to earning risk (Rajan and Zingales, 2003). Greater stock market depth tends to disproportionately benefit rich individuals and large/mature firms since they are more likely to engage in stock markets, thereby extracting a greater share of capital gains and stock market wealth from the increased value of stocks traded (Blau, 2018). Consequently, stock market depth has an adverse and statistically significant impact on income inequality at all levels of the distribution.

Table 2: IVQR estimation of Stock Market Depth and Income Inequality

	q25	q50	q75
VARIABLES	gini_disp	gini_disp	gini_disp
Depth of SM	0.226***	0.204***	0.194***
	(0.0482)	(0.0620)	(0.0396)
Log of Real GDP	-6.484***	-4.327***	-2.514**
	(1.038)	(1.213)	(1.159)
Trade openness	0.0114	0.00505	0.0129
	(0.00904)	(0.00619)	(0.00943)
Agri. employment	-0.151***	-0.0950**	-0.0538
	(0.0382)	(0.0399)	(0.0489)
Govt expenditure	-22.24**	-20.05***	14.60
	(11.11)	(6.418)	(9.620)
Human capital	-1.820***	-1.038***	-0.989*
	(0.690)	(0.328)	(0.547)
Democracy	0.608**	0.431**	0.0757
	(0.263)	(0.192)	(0.280)
Constant	61.83***	39.57***	26.64***
	(8.334)	(11.53)	(9.936)
Number of countries	82	82	82
Observations	428	428	428

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 per cent levels, respectively.*

Across the distribution, the results indicate that the magnitude of the worsening impact on income inequality is greater for lower-inequality countries. Several studies suggest that lower-inequality countries tend to have a stock market-based financial structure, while countries with higher inequality levels tend to be predominantly bank-based with under-developed or non-existent stock markets (Jeanneney and Kpodar, 2011; Singh, 1999). These studies point out that as economies prosper and reach lower inequality levels, specialised financial intermediaries and equity markets become more evolved (Demirgüç-Kunt and Levine, 1996). The theoretical model of Boyd and Smith (1996) shows that richer countries tend to use more equity (financing from stock markets) and less debt finance (financing from banks) due to increasing monitoring costs whereas at low levels of economic development, agents do not use equity markets and only begin to use stock markets once the economy attains a critical level of real capita per income. Given that the rich are more likely to participate in stock markets, it is therefore intuitive to predict that greater stock market deepening disproportionately benefits the rich to a greater extent in lower inequality countries (Blau, 2018; p. 130).

Since the rich minority tends to hold a higher concentration of stock ownership (Kennickell, 2009), existing literature identifies greater stock market depth as one of the main factors to explain the emerging super-rich and the greater disparity between the rich and poor. Greater stock market deepening may further widen the income gap by facilitating the rise of the "super-rich" with "superstar" income (Keister, 2000, 2005; Dumenil and Levy, 2004; Tomaskovic-Devey and Lin, 2011). Furthermore, the differences in the regulatory practices, such as insider abuse following stock market deepening and reforms, allow the expropriation of minority shareholders by insiders (Claessens and Perotti, 2007; La Porta et al., 2000; Claessens et al., 2002).

Therefore, stock market deepening disproportionately benefits the rich to extract greater capital gains since high-income individuals and firms are more likely to engage in stock markets than the poor who lack connections and initial wealth. The magnitude of the impact is relatively greater for lower inequality countries, which tend to have larger and more advanced stock markets that may facilitate the rise of the super-rich.

5.3. Inefficiency of Banking Systems

Table 3 summarises the main results related to the impact of banking inefficiency. The estimated coefficients of banking inefficiency measured by bank lending to deposit spread are positive and statistically significant across the inequality groups. However, it is worth noting

that the size of the estimate tends to increase when moving from lower inequality to higher income inequality. More specifically, the estimate goes from 2.647 (25th quantile) to 3.453 (50th quantile) and then 5.267 (75th quantile). This implies that in countries with higher income inequality, the effect of banking inefficiency is magnified, nearly twice the size of the low inequality group.

Table 3: IVQR estimation of Banking Inefficiency and Income Inequality

	q25	q50	q75
VARIABLES	gini_disp	gini_disp	gini_disp
Inefficiency of BS	2.647**	3.453***	5.627***
	(1.060)	(0.434)	(0.847)
Log of Real GDP	4.021	5.053***	4.301*
	(3.644)	(1.924)	(2.563)
Trade openness	-0.00738	0.00483	-0.0101
	(0.0119)	(0.00879)	(0.0135)
Agri. employment	0.00220	0.139	0.0990
	(0.133)	(0.0968)	(0.137)
Govt expenditure	-55.69**	-13.02	-22.87
	(22.23)	(11.61)	(16.37)
Human capital	-0.552	0.126	1.485
	(2.031)	(0.805)	(1.185)
Democracy	-1.108**	-0.884***	-1.249***
	(0.497)	(0.275)	(0.369)
Constant	-9.526	-41.58*	-30.67
	(37.63)	(21.41)	(27.65)
Number of countries	81	81	81
Observations	394	394	394

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 per cent levels, respectively.*

To explain such differences in the magnitude across quantiles, the following mechanisms are presented. First, the level of competition in the financial sector, both among banks and from stock markets, matters significantly for the banks to adjust the interest rates optimally and speedily for deposits and loans (Gropp et al., 2007). There tends to be less competition in banking systems in higher-inequality countries, both among banks and particularly from stock markets, resulting in lower deposit rates, obstructing savings, particularly for the poor and worsening income inequality (Boyd and De Nicolo, 2005). Existing studies also indicate that economic agents in higher-inequality countries tend to rely largely on debt finance from banks

rather than equity from stock markets as the main source of financing for investments (Demirgüç-Kunt and Levine, 1996).

Furthermore, as banks raise interest rates on loans, they are likely to attract more risky borrowers who are willing to incur higher interest rates because their probability of default is relatively high (Stiglitz and Weiss, 1981). Therefore, the greater cost of intermediating credit is linked with a higher probability of default on loans and increased monitoring costs (Levine, 1999). On the other hand, the magnitude of the adverse impact on income distribution is relatively less for lower-inequality countries where financial competition and intermediation tend to be more advanced.

5.4. Efficiency of Stock Markets

The results for stock market efficiency (measured by the stock market turnover ratio) are shown in Table 4, which indicates that greater stock market efficiency is negatively associated with income inequality for countries at different intervals of income inequality. Similar to previous results, some variation can be observed across different inequality groups since the magnitude of the impact is slightly greater for countries with lower inequality.

More specifically, the countries at the lower end of the spectrum yield greater benefits in terms of the inequality-narrowing impact of stock market efficiency. As pointed out earlier, lower-inequality countries tend to have a stock market-based financial structure where more economic agents, including the poor, are likely to participate due to greater access and ease of stock market transactions (Allen and Santomero, 1997). On the other hand, countries with higher inequality levels tend to be more bank-based and have not yet experienced such an increase in the breadth and depth of stock markets. As such, higher-inequality countries with smaller but efficient stock markets may not benefit from lower transaction costs to the same extent as lower-inequality countries with more advanced stock markets. Existing literature also suggest that the differences in the legal, regulatory, tax systems and political economy factors may condition the impact of stock market efficiency on income inequality (Rajan and Zingales, 2003; Law, Tan & Azman-Saini, 2014).

Table 4: IVQR estimation of Stock Market Efficiency and Income Inequality

VARIABLES	q25 gini_disp	q50 gini_disp	q75 gini_disp
Efficiency of SM	-0.428**	-0.352***	-0.336***
	(0.186)	(0.0854)	(0.0545)
Log of Real GDP	3.416	7.419*	5.095***
	(3.226)	(3.889)	(1.785)
Trade openness	-0.0651*	-0.0696***	-0.0658***
	(0.0333)	(0.0249)	(0.0197)
Agri. employment	0.0115	0.154	0.0863
	(0.0812)	(0.127)	(0.0719)
Govt expenditure	-11.45	-14.94	-28.66**
	(10.51)	(10.52)	(12.93)
Human capital	0.0686	0.584	1.496
	(0.798)	(1.047)	(1.279)
Democracy	-0.455	-1.703***	-2.115**
	(0.449)	(0.654)	(1.006)
Constant	-1.370	-34.50	4.527
	(25.34)	(31.77)	(16.45)
No. of countries	81	81	81
Observations	415	415	415

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 percent levels, respectively.*

5.5. Instability of Banking Systems

Moving to the instability of banking systems measured by the volatility of credit growth rate, Table 5 shows that the coefficients on the measure of bank instability are positive and significant for all selected quantiles, with some variation in the magnitude across the distribution. While greater volatility in banking systems disproportionately hurts the poor and exacerbates income inequality, the results are more revealing in terms of the variation in the magnitude of the impact across countries with different inequality levels.

In terms of the variation in magnitude, the results show that the estimated coefficient of banking volatility is relatively larger in the lower quantile (0.553) compared to the higher quantile (0.268). This suggests that although banking instability worsens income inequality across different intervals along the inequality distribution, the magnitude of the inequality-widening impact is greater for lower inequality countries. One reason to explain why banking volatility seems to have a larger impact on countries with lower levels of income inequality is

that such countries tend to be more financially integrated compared to countries with higher inequality levels (Ravallion, 2009; Jeanneney and Kpodar, 2011). As such, a volatile banking system in the context of such financially integrated economies tends to exert a greater inequality-widening impact since it is likely to affect a wider section of society, particularly the poor who are more vulnerable to the adverse effects of instability. Furthermore, existing studies suggest that there are more financially dependent industries in lower-inequality countries, which experience slower growth and reduced real activity, investment and output due to banking instability (Dell'Ariccia, Detragiache & Rajan, 2008).

Table 5: IVQR estimation of Banking Instability and Income Inequality

	q25	q50	q75
VARIABLES	gini_disp	gini_disp	gini_disp
Instability of BS	0.553***	0.303***	0.268***
	(0.0443)	(0.0396)	(0.0399)
Log of Real GDP	-4.109***	-4.240***	-5.828***
	(0.952)	(0.861)	(0.866)
Trade openness	-0.00752	0.00194	-0.0111
	(0.0112)	(0.0101)	(0.0102)
Agri. employment	-0.154***	-0.134***	-0.180***
	(0.0502)	(0.0448)	(0.0452)
Govt expenditure	-34.91***	-40.01***	-28.02***
	(9.103)	(8.258)	(8.338)
Human capital	-2.227***	-1.805***	-2.311***
	(0.573)	(0.539)	(0.549)
Democracy	-0.509*	-0.0557	-0.787***
	(0.280)	(0.250)	(0.252)
Constant	89.27***	82.65***	114.3***
	(9.054)	(8.117)	(8.185)
Number of countries	90	90	90
Observations	476	476	476

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 percent levels, respectively.*

Interestingly, the magnitude of the inequality-widening impact of banking instability is relatively lower for countries with higher inequality countries. This suggests that not all of the poor in such countries will be adversely affected due to financial volatility. One interpretation of this result is that at the 75^{th} quantile, the countries with higher inequality tend to have less integrated financial systems. Ironically, many poor people who are not able to engage with or have access to banking systems will be protected from the adverse effects of banking instability

by the same things that have kept them poor in the first place, such as geographical isolation and poor connectivity with national and global markets (Ravallion, 2009).

5.6. Instability of Stock Markets

Finally, this section examines the quantile-specific estimates for the impact of stock market instability, measured by the volatility of the stock price index, on income inequality across countries with different levels of inequality. As reported in Table 6, the results indicate that stock market volatility increases income inequality for all selected quantiles, with a decreasing magnitude across lower to higher intervals.

Table 5: IVQR estimation of Stock Market Instability and Income Inequality

	q25	q50	q75
VARIABLES	gini_disp	gini_disp	gini_disp
Instability of SM	4.803***	4.448***	3.112***
	(1.514)	(1.578)	(1.046)
Log of Real GDP	-25.67	-15.80**	-18.03**
	(16.07)	(7.327)	(8.686)
Trade openness	0.0885	0.0505	0.0747*
	(0.0584)	(0.0465)	(0.0435)
Agri. employment	-1.399	-0.870*	-0.553
	(0.997)	(0.472)	(0.449)
Govt expenditure	-32.14**	-14.37*	-13.30
	(15.99)	(8.352)	(8.474)
Human capital	4.879	3.006	2.595
	(5.498)	(2.899)	(2.560)
Democracy	6.967	2.668	1.885
	(4.598)	(1.865)	(1.849)
Constant	31.71	62.60	101.7
	(121.2)	(52.97)	(84.53)
No. of countries	61	61	61
Observations	290	290	290

*Note: Bootstrapped standard errors with 200 replications in parenthesis. *, **, and *** represent statistical significance of 10, 5 and 1 percent levels, respectively.*

Across the distribution, the results indicate that the magnitude is slightly greater for lower-inequality countries. Existing studies suggest that countries with lower inequality levels have a greater concentration of income invested in stock markets (Blau, 2018). As such, an unstable and malfunctioning stock market would wreak more havoc on income inequality by widening the inequality gap between the rich and poor.

Furthermore, several studies find that the poor are less likely to participate and invest their savings to the high risks of stock markets (Blau, 2018; Owyang and Shell, 2016). Consequently, an increase in stock market instability in the context of countries with higher inequality countries has a lower magnitude of the worsening impact on inequality. On the other hand, in the context of lower intervals where countries generally have highly advanced stock markets and a greater proportion of the population participates and invests in stock markets, an increase in the volatility of the stock price index tends to significantly increase inequality.

5.7. Robustness checks

To check the validity of the main empirical results in Tables 1-6, a series of robustness checks are conducted, including (i) model specification change; (ii) different sub-sample; (iii) alternative econometric technique using an IVQR-GMM estimation.

(i) Alternative model specification

As part of the robustness checks against specification change, the quantile regressions are re-estimated using three control variables with the highest number of observations (i.e., log of real GDP, government expenditure and democracy). As mentioned earlier, the implementation of the IVQR technique requires data cleaning to remove observations with missing values (Kwak, 2010). Re-estimating the IVQR technique using three control variables with the highest number of observations enables maximising the sample size and checking the sensitivity of the main empirical results against specification change.

The results in the Appendix (see Table A1-A6) are consistent with the main empirical results above. For example, Table A1 (similar to results in Table 1) indicates a negative, significant sign on the coefficient for private sector credit across all quantiles, where the higher-inequality countries seem to benefit more from a greater depth of banking systems. Table A2 shows a positive, significant sign for the coefficients of stock market depth, with a greater magnitude of impact for lower-inequality countries. Table A3 presents a positive, significant relationship between banking inefficiency and income inequality across all quantiles, with the impact significantly greater for the higher-inequality countries. The coefficients in Table A4 are negative and significant across all quantiles, with some variation in the magnitude. Table A5 shows that greater banking volatility increases income inequality across all quantiles, with a greater magnitude of impact for lower and middle-inequality countries. Finally, the results in

Table A6 show that greater stock market volatility exacerbates income inequality across all quantiles, with greater magnitude for the middle quantile. In short, the results remain unchanged, thus indicating that the main finding is not driven by choice of specification.

(ii) Alternative sub-sample

In the main results presented in Sections 5.1-5.6, the IVQR estimation was conducted on the entire sample of developed and developing countries at different intervals of the income distribution (that is, lower, moderate and higher quantiles). It is interesting to note that there is a natural split in the entire sample of countries across the upper and lower ends of the spectrum according to the development categories of the countries. More specifically, the higher quantile of income inequality consists of developing countries, whereas the lower quantile consists of mostly developed countries that have lower inequality levels. However, there are some outliers in the sample. For example, it is observed that a few developing countries were categorised in the lower inequality interval, such as Korea, Ukraine, Mongolia and Kazakhstan. The above countries (outliers) are then removed from the sample.

A sub-sample is constructed where the lower quantile strictly comprises developed countries, and the higher quantile contains developing countries (the middle quantile contains both developed and developing countries). This allows us to check the robustness of different subsamples based on the level of development and to disentangle whether cross-group differences in financial development impact on income inequality are associated with group-specific economic development or from differences in the distribution of common characteristics or covariates in one group as compared to the other. The IVQR estimation results for the subsample in Tables B1-B6 (provided in the Appendix) further confirm the robustness of the main empirical results.

(iii) Alternative estimation technique

For further robustness checks, this study conducts the IVQR-GMM estimation of Chen and Lee (2017) on MATLAB using the Gurobi optimisation, which estimates linear-in-parameters IVQR models using mixed integer quadratic programming. However, it is computationally demanding and slow with additional covariates, requiring super-fast and high-spec equipment. For this reason, the results are presented using the baseline model augmented with time

dummies. As shown in Tables C1-C6 in the Appendix, the estimated coefficients using the IVQR-GMM technique are similar to the main set of results using the IVQR technique.

6. Summary of Results

This section summarises the main empirical findings related to whether the impact of the multi-dimensional aspects of financial development on income inequality varies across countries with different inequality levels. These results are summarised in Table 7 below. Starting with financial depth, the empirical findings reveal that while greater depth of banking systems reduces income inequality for all selected quantiles, other aspects such as inefficiency and instability of banks tend to aggravate it, albeit with variation in the magnitude of the impact across quantiles.

Table 6: Summary of results for the quantile-specific impact

	q25	**q50**	**q75**
FSD_1	(-) (a)	(-) (b)	(-) (c)
FSD_2	(+) (c)	(+) (b)	(+) (a)
FSD_3	(+) (a)	(+) (b)	(+) (c)
FSD_4	(-) (c)	(-) (b)	(-) (a)
FSD_5	(+) (c)	(+) (b)	(+) (a)
FSD_6	(+) (c)	(+) (b)	(+) (a)

Note: FSD_1 = private credit; FSD_2 = stock value traded; FSD_3 = bank lending-deposit spread; FSD_4 = stock market turnover ratio; FSD_5 = volatility of credit growth; FSD_6 = volatility of stock price index.
(+) denotes positive relationship (inequality-widening impact), (-) indicates a negative relationship (inequality-narrowing impact). (a), (b) and (c) indicate the magnitude of the impact where (c)>(b)>(a).

The magnitude of the impact for both depth and inefficiency of banking systems tends to be relatively greater for higher-inequality countries. This suggests the beneficial impact of financial development in terms of greater depth and lower inefficiency of banking systems to tackle income inequality, particularly for higher-inequality countries. Financial development in terms of greater private credit reduces inequality across countries with different levels of inequality, albeit with a greater magnitude of impact for countries with higher inequality levels. This implies that private credit tends to be more impactful in alleviating income inequality in countries with higher inequality countries. In other words, private credit lowers inequality in developing countries, which generally tend to have higher inequality levels and bank-based financial structures (Jeanneney and Kpodar, 2011).

Interestingly, the results highlight that the extent of the adverse impact of greater banking volatility is lower for higher-inequality countries, implying that not all of the poor will be adversely affected due to financial volatility. Ironically, the same factors driving the vicious cycle of poverty, such as restricted access to finance, geographical isolation, and poor connectivity with national and global markets (Ravallion, 2009) may protect many poor people in higher-inequality countries from the dangerous impact of financial volatility. Furthermore, existing studies suggest that there are more financially dependent industries in lower-inequality countries, which experience slower growth and reduced real activity, investment and output due to banking instability (Dell'Ariccia et al., 2008).

For stock market development, the empirical results indicate that greater depth and volatility aggravate income inequality, whereas enhanced stock market efficiency reduces it. The quantile-specific estimates show that the magnitude of stock market measures on income inequality tends to be greater for lower-inequality countries. Since lower-inequality countries have more advanced stock markets and rely more on equity financing, it is intuitive to predict that the magnitude of the impact of stock market development is relatively greater for such countries. Furthermore, existing literature also indicates that countries with higher inequality levels tend to be predominantly bank-based with under-developed or non-existent stock markets (Jeanneney and Kpodar, 2011); however, as economies develop and reach lower inequality levels, specialised financial intermediaries and equity markets are more evolved (Demirgüç-Kunt and Levine, 1996). As mentioned previously, it is possible that some measures with no statistically significant mean effect can exert a meaningful impact at a specific level of inequality distribution. These results shed more light on the impact of stock market development on inequality by going beyond the mean effects to indicate that stock market depth worsens inequality across different intervals of inequality distribution.

7. Conclusion

The main objective of this paper was to explore whether the distributional impact of financial development varies across different levels of income inequality. Depending on the measure of financial development used, there can be considerable differences in the size, significance and even the sign of the estimated parameters at different intervals of the inequality distribution. Furthermore, the different aspects of financial development may not yield the same effect for countries with higher inequality compared to countries with lower inequality levels. Therefore, to further unpack the complex and multi-layered dynamics between financial development and income inequality, this paper scrutinises the heterogeneity of the impact of different aspects of

financial development on income inequality across countries with different inequality levels. To address this research question, an instrumental variable quantile regression technique is adopted to obtain a series of robust inferences and new insights related to quantile-specific estimates. This approach allows capturing the full distributional impact pertaining to not only the centre but also the upper and lower ends of the spectrum, which are not available using traditional approaches based on the conditional mean function.

The empirical findings reveal that the different aspects of financial development may not yield the same effect for countries with higher inequality levels compared to countries with lower inequality levels. While it remains vital for researchers to not simply rely on a narrow definition of financial development, it is also imperative to probe deeper by going beyond the mean effects to uncover the full distributional impact on income inequality. At the same time, this research provides valuable insights for policymakers towards implementing effective and well-informed decisions by targeting the inequality-reducing aspects of financial development in the context of countries with high, moderate, or low levels of income inequality. Thus, this research sheds meaningful light on which aspects of banking systems and stock markets exacerbate or alleviate income inequality in the context of countries with high-, moderate- or low-income inequality, thereby aiding policymakers to devise and implement effectual policy decisions.

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