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Nonlinear dynamics of the finance-inequality nexus in developing countries

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Abstract This study examines the dynamics of the finance-inequality nexus in 35 developing countries during the past two decades, using two data sets of income inequality: the University of Texas Inequality Project (UTIP) and the Standardized World Income Inequality Database (SWIID). The empirical results of this study, based on the dynamic panel models, provide new evidence that highlights the nonlinear U-shaped relationship between financial deepening and income distribution. It implies the narrowing of the income-inequality gap at the early stage of financial development of the countries. This improvement, however, will only be sustainable dynamically below a certain threshold level. Further deepening above that level will lead to a reverse effect, which deteriorates income inequality. This reflects the inefficiency of financial markets in improving economic inequality when the threshold level is overshot.

Keywords Financial deepening · Income inequality · Gini coefficient · Dynamic panel analysis

JEL Classification E0 · G0 · O15

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1 Introduction

Income inequality is a major concern in development and welfare economics, especially as it relates to developing countries. Such inequality can be interpreted as a sign of injustice, insider privilege, unequal opportunity, and social instability. In developing countries, income inequality is observed to be destructive and problematic to society and the economy. This inequality combined with underdeveloped markets and ineffective government programs can be a huge hindrance to economic growth and welfare development.

It is widely accepted that financial deepening constitutes a potentially important mechanism for sustaining long-term economic growth (see [1, 5, 8–12, 15, 18, 19, 22, 24], and many others).[1] Although the relationship is well documented, the same conclusion cannot be drawn regarding the direct link between financial deepening and income inequality. In view of this, researchers have begun to investigate the importance of financial deepening and, as a result, three influential hypotheses have emerged in the literature: the inequality-widening hypothesis, the inequality-narrowing hypothesis, and the inverted U-shaped hypothesis. The first two hypotheses were derived from the conceptual framework of Banerjee and Newman [3] and Galor and Zeira [14], while the third hypothesis was developed from the pioneering theoretical model of Greenwood and Jovanovic [16].

The inequality-widening hypothesis posits that financial deepening may benefit the rich and well connected, in particular when institutional quality in the society is weak. According to this hypothesis, the rich are able to offer collateral, and they are the people who have a high probability of repaying the loans. The poor, who do not meet the above criteria, might, therefore, find it difficult to obtain loans even when financial markets are well developed. Therefore, it might worsen income inequality, and we would expect to see a positive relationship between financial deepening and income inequality. The inequality-narrowing hypothesis, on the other hand, puts forward the idea that when the financial sector grows, the poor, who were previously excluded from obtaining loans, might gain access to it. In this respect, finance may be an equalizer for people with talent, ambition, and persistence. According to Jalilian and Kirkpatrick [17], financial sector development policy can contribute to achieving the goal of poverty reduction in developing countries. The third hypothesis, which predicts a hump or inverted U-shaped relationship between income inequality and financial factors, predicts a nonlinear relationship between financial development and income inequality during the process of economic deepening. At the early stages of development, only the rich can afford to access and profit from financial markets; thus, financial market development intensifies income inequality. At higher levels of economic development, financial development helps an increasing proportion of society.

Even though the finance-inequality theoretical framework was well developed in the 1900s, deficiencies in the data resulted in a lack of empirical evidence at that time. The empirical work on this issue only began when the data set of income inequalities was made available by Deininger and Squire [7]. Nonetheless, empirical studies on the relationship remained scarce until recently. Among the very few,

[1] Levine [19] provided an excellent overview of a large body of empirical literature that suggests that financial development can robustly explain differences in economic growth across countries.

Clarke et al. [6] examined the relationship between finance and income inequality in 83 countries, including both developed and developing countries, between 1960 and 1995 using ordinary panel data analysis. Their results demonstrated that inequality is reduced when the financial sector is deepened over the long run, which supports the finance-narrowing hypothesis. In another study, Liang [21] examined the relationship between financial deepening and income inequality in China, using Chinese provincial data over the period of 1991–2000. This has been the only empirical paper thus far that has employed the dynamic panel generalized method of moments (GMM) techniques to the finance-inequality relationship. The estimated results of this study indicated that financial development contributes significantly in stabilizing the income distribution in China. However, this finding only provided evidence to support the linear inequality-narrowing hypothesis, not the nonlinear hypothesis of an inverted U-shaped relationship.

This paper aims to extend the literature in three dimensions. First, linear and nonlinear dynamic panel data models are set up to test the linear and nonlinear inverted U-shaped finance inequality relationship across developing countries. This can be considered as one of the pioneering empirical works using the robust dynamic panel GMM approach to estimate the relationships, in particular the nonlinear ones. Second, the models are estimated based on the newly assembled income-equality measure developed by Galbraith and Kum [13] and Solt [23]. In addition, two sets of financial indicators are employed; the private credit and liquid liabilities of the banking sector, and the capitalization and total value traded in the stock market, are used to capture the various aspects of financial deepening. Third, a range of threshold values of financial deepening for the selected individual countries will be determined if either an inverted U- or a U-shaped finance-inequality relationship is detected for these countries. This threshold value is crucial in determining the responses of a country in terms of income inequality to financial fluctuations at different levels of financial development.

This paper is organized as follows. Section 2 describes the dynamic panel data models and the related hypotheses. Section 3 explains the econometric method and the data employed. Section 4 reports the estimated results and interprets the findings, and the final section concludes the discussion.

2 Dynamic panel data model and finance-inequality nexus

A linear dynamic panel data model is first set up to test the alternative linear hypotheses of inequality widening and inequality narrowing. The model can be represented in its log-linear form as follows:

$$G_{it} = \beta_0 + \gamma\, G_{it-1} + \beta_1\, FD_{it-1} + \beta_2\, RGDP_{it} + \beta_3\, \mathrm{COR}_{it} + \beta_4\, INF_{it} + \varepsilon_{it} \qquad (1)$$

where G is an indicator of income inequality, FD is the lagged financial deepening indicator,[2] $RGDP$ is real income, COR is the corruption index, and INF is the

[2]Since there are potential causal effects from income inequality to financial deepening, this study uses a lagged measure of financial deepening instead of a current financial deepening measure to deal with this kind of endogeneity.

inflation rate. A lagged dependent variable is included to allow for the partial adjustment of G to its long-term equilibrium value. Thus, all the beta coefficients represent short-term effects; the long-term effects can be derived by dividing each of the betas by 1–γ.

Equation 1 provides a test of the inequality-widening hypothesis and the inequality-narrowing hypothesis. If $\beta_1 > 0$ and is significant, then financial deepening will widen inequality. Nevertheless, if $\beta_1 < 0$ and is significant, then financial deepening will narrow the dispersion in income. In addition to the financial factors, we also include control variables for income inequality, specifically, income per capita, institutional quality, and inflation. Economic development as proxy to the income per capita might improve income inequality. The quality of institutions, which is proxy to the corruption index (measured on a scale of 0 to 10 with higher values indicating higher levels of corruption), might also have a negative impact on income distribution. Thus, the coefficients of β_2 and β_3 are expected to be negative. Last but not least, the reduction in inflation is expected to lower income inequality; therefore, the coefficient of β_4 is expected to be positive.

Although the relationship between financial factors and income inequality appears to be linear, the relationship may be generated by different mechanisms at different levels of financial deepening. It can therefore be nonlinear at a certain level of financial deepening. Greenwood and Jovanovic [16] demonstrated that the financial and economic deepening might give rise to an inverted U-shaped finance-inequality relationship. In other words, income inequality may first increase as the financial sector develops, but it later declines as more people gain access to the system. Therefore, the square term is entered separately into the regression and the resulting specification is as follows:

$$G_{it} = b_0 + \gamma\ G_{it-1} + \beta_1\ FD_{it-1} + \beta_2\ FD^2_{it-1} + \beta_3\ RGDP_{it} \\ +\beta_4\ COR_{it} + \beta_5\ INF_{it} + \varepsilon_{it} \quad (2)$$

The inverted U-shaped hypothesis predicts $\beta_1 > 0$ and $\beta_2 < 0$. In this case, the effect of financial deepening (positive or negative) on the Gini coefficient (*Git*), or income inequality, depends on a threshold level which can be obtained through partial derivatives of the Gini coefficient with respect to the financial deepening. The signs of β_1 and β_2, and the effects of financial deepening on income inequality will be the reverse if a U-shaped instead of an inverted U-shaped relationship is detected.

3 Methodology and data

This study is conducted based on the dynamic panel GMM estimation. Under this approach, Eq. 1 is estimated using the two-step GMM estimator provided by Arellano and Bond [2]. This GMM estimator has been widely employed in recent empirical studies, particularly in finance and macroeconomics. Beck et al. [4] argued that the GMM panel estimator is good at exploiting the time series variation in data, accounting for unobserved individual specific effects, allowing for the inclusion of lagged dependent variables as regressors, and therefore providing better control for endogeneity of all the explanatory variables.

3.1 Dynamic panel GMM estimation

Under this approach, the econometric model can be rewritten as follows:

$$G_{i,t} = \gamma\ G_{i,t-1} + X'_{i,t}\ \beta + u_{it};\ \ i = 1, \ldots, N;\ \ t = 1, \ldots, T. \tag{3}$$

where $u_{it} = m_i + v_{it}$ with $m_i \sim \text{IID}\left(0, \sigma_\mu^2\right)$ and $v_{it} \sim IID\left(0, \sigma_v^2\right)$, independent of each other and among their own self. μ_i is the country-specific effect that captures the individual heterogeneity and v_{it} is the disturbance. $G_{i,t}$ is the Gini coefficient in the logarithm, and $X_{i,t}$ is the explanatory variable. To achieve a consistent estimate of γ as $N \to \infty$ with T fixed, Arellano and Bond [2] proposed the following difference equation:

$$G_{i,t} - G_{i,t-1} = \gamma(G_{i,t-1} - G_{i,t-2}) + (X_{i,t} - X_{i,t-1})'\beta + (v_{i,t} - v_{i,t-1}) \tag{4}$$

While differencing eliminates the country-specific effect, it also introduces a new bias by construction of the new error term, $(v_{i,t} - v_{i,t-1})$, which is correlated with the lagged dependent variable, $(G_{i,t-1} - G_{i,t-2})$. This assumes that (i) the error term, v, is not serially correlated and (ii) the explanatory variables, $X_i = \left[x'_{i1}, x'_{i2}, ..., x'_{iT}\right]$, are weakly exogenous and predetermined. These explanatory variables are assumed to be uncorrelated with future realizations of the error term, or $E(x_{it}v_{is}) = 0$ for $s > t$. Arellano and Bond [2] proposed the following moments conditions.

$$E\left[G_{i,t-s}.(v_{i,t} - v_{i,t-1})\right] = 0 \quad \text{for} \quad s \geq 2; t = 3, \ldots .T \tag{5}$$

$$E\left[X_{i,t-s}.(v_{i,t} - v_{i,t-1})\right] = 0 \quad \text{for} \quad s \geq 2; t = 3, ...T \tag{6}$$

Based on these moments conditions, the two-step GMM estimator could be established.

3.2 Data

To estimate the models, this study employs two data sets corresponding to the two different measures of financial development indicators: banking sector development and stock market development. The first measure of financial development contains two banking sector development indicators: private sector credit and liquid liabilities. Private sector credit is defined as the value of financial intermediary credits to the private sector. Beck et al. [4] and Levine et al. [20] have shown that growth is faster in countries where private credit is higher. Liquid liabilities measure the ability of banks to mobilize funds or the size of the banking system relative to the economy. These two banking sector development indicator samples are collected from 35 developing countries for the period of 1980–2000,[3] and the source is World Development Indicators (2008). The second measure of financial development comprises two stock market development indicators, stock market capitalization and total share value traded, where both data sets are quoted as a percentage of gross domestic product (GDP) of the respective countries. The data are gathered from Beck et al. [5] and are collected from 28 developing countries for the period of 1980–2000.

[3]We ended the sample period in 2000 because the Galbraith and Kum [13] income inequality data set is only available through 2000.

Two income-inequality, or Gini coefficients, indicators are utilized in the analysis, the measure provided by Galbraith and Kum [13] under the University of Texas Inequality Project (UTIP)[4] and the Standardized World Income Inequality Database (SWIID) created by Solt [23]. The Galbraith and Kum [13] data set provides comparable and consistent measures across space and through time that the earlier data set of Deininger and Squire [7] does not. It is based on the inequality of manufacturing wages obtained from the data collected by the United Nations Industrial Development Organization (UNIDO). Nevertheless, in some of the developing countries, only a very small fraction of people may actually be working in the manufacturing sector. Thus, to provide a sensitivity check, this study also uses the Gini coefficients provided by Solt [23], who used various techniques to estimate the ratios between different types of Gini coefficients—relying more on information about the ratio in the same country nearby in time—to increase the number of comparable observations.

The annual data on real GDP per capita, converted to US dollars based on constant prices of the year 2000, and inflation are collected from the world development indicators. The corruption index is collected from the International Country Risk Guide (ICRG), which is a monthly publication of Political Risk Services (PRS). Higher values of the index indicate higher levels of corruption and vice versa.

4 Empirical results and findings

Table 1 presents the estimated results for the linear model (Eq. 1) under the dynamic panel GMM approach, where income inequality is measured using Galbraith and Kum's [13] University of Texas inequality data set. The financial deepening indicators employed in the estimations are either proxy to the banking indicators, such as the private sector credit and the liquid liability in Model 1(a), or the stock market indicators, such as the stock market capitalization and the total value traded in Model 1(b). In this estimation, the lagged dependent variable is statistically significant, which implies that the dynamic GMM is an appropriate estimator and the empirical results are reliable; hence, the statistical inference related to the hypothesis of interest can be performed.

The estimated results of Model 1(a) indicate that the lagged one period of private sector credit and liquid liability exert a significant negative effect on income inequality. This result supports the inequality-narrowing hypothesis, which implies that income inequality will be relatively lower in countries where the banking sector is more developed. To examine the extent to which the above findings may vary with different aspects of financial deepening, two stock market indicators are also considered (see Model 1(b)). These estimated results, however, demonstrate that neither the stock market capitalization nor the total value traded in the market influences income inequality significantly.

In addition to the financial deepening indictor, the real GDP per capita, corruption, and inflation are also statistically significant determinants of income inequality. The estimated coefficients of real GDP per capita are negative, whereas the

[4]The University of Texas Inequality Project (UTIP) is a research group working on measures and movements of inequality in wages and earnings and patterns of industrial change around the world.

Table 1 Financial factors and income inequality (linear model)

Variable	Model 1(a) - Linear		Model 1(b) - Linear	
	FD = Banking sector indicator (1980–2000)		FD = Stock market indicator (1988–2000)	
	Model 1(a) private sector credit	Model 1(b) liquid liability	Model 2(a) stock market capitalization	Model 2(b) total value traded
Constant	0.0018 (10.22)***	0.0018 (9.37)***	0.0012 (3.28)***	0.0011 (3.19)***
G_{it-1}	0.5145 (25.94)***	0.5525 (25.05)***	0.2618 (2.48)**	0.2633 (2.43)**
FD_{it-1}	−0.0055 (−3.28)***	−0.0061 (−4.81)***	−0.0011 (−0.91)	−0.0004 (−0.41)
$RGDP_{it}$	−0.0572 (−8.46)***	−0.0553 (−7.99)***	−0.0362 (−2.17)**	−0.0373 (−2.11)**
COR_{it}	0.0088 (7.75)***	0.0770 (6.73)***	0.0037 (2.47)**	0.0040 (2.52)**
INF_{it}	0.0013 (3.10)***	0.0013 (2.69)***	0.0008 (14.86)***	0.0008 (15.04)***
Sargan test (p value)	30.60 (0.7232)	27.64 (0.8399)	14.20 (0.1643)	13.67 (0.1886)
Autocovariance of order 1 (p-value)	0.0044	0.0039	0.0642	0.0678
Autocovariance of order 2 (p-value)	0.3882	0.3738	0.3159	0.3268
N	35	35	28	28
T	21	21	13	13
List of countries	35 countries: Algeria, Bangladesh, Bolivia, Cameroon, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Papua New Guinea, Senegal, South Africa, Sri Lanka, Syria, Thailand, Trinidad and Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.		28 countries: Bangladesh, Bolivia, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.	

Dependent variable: Gini coefficient (*University of Texas Inequality Dataset*; Linear model: testing for the inequality widening/inequality narrowing hypotheses). All models are estimated using the Arellano and Bond dynamic panel GMM estimations using a maximum of two lags of the dependent variables for use as instruments (Stata xtabond command). Figures in parentheses are t statistics

G Gini index; *FD* financial deepening indicator; *RGDP* real GDP per capita (in US dollars, 1995 prices); *COR* corruption index; *INF* inflation

$^{*}p = 5\%$ significance level, $^{**}p = 1\%$ significance level

coefficients of corruption and inflation are both positive. These results are consistent with the theory that high income per capita helps to narrow the gap, while high corruption and inflation induce widening of the gap. The estimated model is not misspecified, as all the three diagnostic statistics are found to be satisfactory. The Sargan test statistics, as reported in Table 1, do not reject the over-identification restrictions. As expected, the null hypothesis of absence of first-order autocovariance is rejected, but the null hypothesis of absence of second-order autocovariance is not rejected. These diagnostic test results are acceptable in the context of an Arellano-Bond GMM regression, which is run on first differences. The presence of AR(1) in first-differenced residuals is expected, as both $\Delta u_{i,t}$ and $\Delta u_{i,t-1}$ contain $\Delta u_{i,t-1}$. As a consequence, the Arellano-Bond AR(1) test result is usually ignored. The AR(2) test on the first-differenced residuals is used to detect AR(1) in the underlying level variables, and therefore the null hypothesis should not be rejected.

Since the nonlinear relationship between financial deepening and income inequality may be important in these countries, we proceed to examine the inverted U-shaped hypothesis by estimating the nonlinear models, Models 2(a) and 2(b), from Eq. 2. In this equation, an additional squared term for financial deepening is included in the estimation to allow for the formation of the U-shaped or inverted U-shaped movements. Similar to Models 1(a) and 1(b), Model 2(a) considers banking sector indicators as proxies for financial deepening, whereas Model 2(b) considers stock market indicators as proxies for financial deepening.

The empirical results, reported in Table 2, reveal that the lagged one period of financial development indicator is an insignificant determinant of income inequality, regardless of whether it is proxy to a banking sector or stock market indicator. In addition, the square term of financial development indicator, proxy to four different financial variables, respectively, in Models 2(a) and 2(b), also does not appear to be a statistically significant determinant of income inequality. This finding suggests that neither the inverted U-shaped hypothesis nor the U-shaped hypothesis on the nexus between financial development and income inequality is supported in these developing countries based on the University of Texas inequality data set provided by Galbraith and Kum [13].

The coefficients on real GDP per capita, corruption, and inflation are consistent with those reported in Table 1. The estimated coefficient of real GDP per capita is significantly positive, whereas the estimated coefficients of corruption and inflation are both significantly negative in Models 2(a) and 2(b). This supports the argument that economic growth improves income inequality but corruption and inflation worsen this inequality. In this estimation, similar to those of Model 1, the three diagnostic statistics—the Sargan test and the first order and second order of covariance tests—are found to be satisfactory.

Because the Gini coefficient indicator in the above data set is calculated based on manufacturing wages but people in many of these developing countries do not work in the manufacturing sector, we repeated the analysis by employing an alternative data set, the SWIID. The results of this analysis are reported in Tables 3 and 4.

Likewise, Models 1(a) and 1(b) in Table 3 show the estimations for the linear model with different financial development proxies. One can see that the estimated coefficient for private sector credit and stock market capitalization are negative; thus, they are statistically significant determinants of income inequality. This finding also suggests that development of the banking sector and stock market is crucial

Table 2 Financial factors and income inequality (nonlinear model)

Variable	Model 2(a): Nonlinear		Model 2(b): Nonlinear	
	FD = Banking sector indicator (1980–2000)		FD = Stock market indicator (1988–2000)	
	Model 1(a) private sector credit	Model 1(b) liquid liability	Model 2(a) stock market capitalization	Model 2(b) total value traded
Constant	0.0018 (10.50)***	0.0018 (9.41)***	0.0014 (3.68)***	0.0013 (2.89)***
G_{it-1}	0.5229 (19.61)***	0.5345 (24.66)***	0.2612 (2.62)***	0.2745 (2.33)**
$FD_{\mathrm{it}-1}$	−0.0004 (−0.04)	−0.0026 (−1.03)	0.0024 (0.90)	0.0021 (1.75)
FD_{it-1}^2	0.0007 (1.38)	−0.0009 (−1.05)	−0.0007 (−1.40)	0.0003 (1.50)
$RGDP_{\mathrm{it}}$	−0.0612 (−6.99)***	−0.0526 (−7.79)***	−0.0283(−1.61)**	−0.0404 (−2.08)**
COR_{it}	0.0085 (5.54)***	0.0081 (7.42)***	0.0040 (1.63)	0.0035 (1.32)
INF_{it}	0.0012 (2.84)***	0.0013 (2.35)**	0.0008 (15.38)***	0.0008 (13.61)***
Sargan test (p-value)	29.54 (0.7681)	28.04 (0.8257)	11.92 (0.2907)	13.12 (0.2171)
Autocovariance of order 1 (p-value)	0.0040	0.0038	0.0633	0.0668
Autocovariance of order 2 (p-value)	0.3822	0.3800	0.3337	0.2741
N	35	35	28	28
T	21	21	13	13
List of countries	35 countries: Algeria, Bangladesh, Bolivia, Cameroon, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Papua New Guinea, Senegal, South Africa, Sri Lanka, Syria, Thailand, Trinidad and Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.		28 countries: Bangladesh, Bolivia, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.	

Dependent variable: Gini coefficient (*University of Texas Inequality Dataset*; Nonlinear model: testing for the inverted U-shaped hypothesis). All models are estimated using the Arellano and Bond dynamic panel GMM estimations using a maximum of one lag of the dependent variables for use as instruments (Stata xtabond command). Figures in parentheses are t-statistics

G Gini index; *FD* financial deepening indicator; *RGDP* real GDP per capita (in US dollars, 1995 prices); *COR* corruption index; *INF* inflation

$^{*}p = 5\%$ significance level, $^{**}p = 1\%$ significance level

Table 3 Financial factors and income inequality (linear model)

Variable	Model 1(a) - Linear		Model 1(b) - Linear	
	FD = Banking sector indicator (1980–2000)		FD = Stock market indicator (1988–2000)	
	Model 1(a) private sector credit	Model 1(b) liquid liability	Model 2(a) stock market capitalization	Model 2(b) total value traded
Constant	0.0001 (−0.49)	0.0001 (−0.57)	−0.0017 (−2.40)**	−0.0014 (−2.01)**
G_{it-1}	0.7590 (162.70)***	0.7615 (165.83)***	1.2083 (7.58)***	1.2262 (5.68)***
$FD_{\mathrm{it}-1}$	−0.0051 (−2.56)***	−0.0012 (−0.54)	−0.0030 (−3.42)***	−0.0026 (−1.08)
$RGDP_{\mathrm{it}}$	−0.0006 (−0.07)	−0.0050 (−0.64)	−0.0138 (−0.72)	−0.0071 (−0.29)
COR_{it}	0.0077 (7.76)***	0.0073 (7.16)***	0.0046 (2.45)**	0.0054 (2.40)**
INF_{it}	0.0003 (2.91)***	0.0002 (2.34)**	0.0002 (3.18)***	0.0002 (2.93)***
Sargan test (*p*-value)	26.72 (0.8697)	27.49 (0.8447)	3.77 (0.9570)	3.95 (0.9496)
Autocovariance of order 1 (*p*-value)	0.0223	0.0211	0.0478	0.0483
Autocovariance of order 2 (*p*-value)	0.0875	0.0855	0.0889	0.0897
N	33	35	28	28
N × T	520	520	283	283
List of countries	33 countries: Algeria, Bangladesh, Bolivia, Cameroon, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Senegal, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.		28 countries: Bangladesh, Bolivia, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.	

Dependent variable: Gini coefficient (*Standardized World Income Inequality Database*; Linear model: testing for the inequality widening/inequality narrowing hypotheses). All models are estimated using the Arellano and Bond dynamic panel GMM estimations using a maximum of two lags of the dependent variables for use as instruments (Stata xtabond command). Figures in parentheses are *t*-statistics

G Gini index; *FD* financial deepening indicator; *RGDP* real GDP per capita (in US dollars, 1995 prices); *COR* corruption index; *INF* inflation

$^{*}p = 5\%$ significance level, $^{**}p = 1\%$ significance level

Table 4 Financial factors and income inequality (nonlinear model)

Variable	Model 2(a): Nonlinear		Model 2(b): Nonlinear	
	FD = Banking sector indicator (1980–2000)		FD = Stock market indicator (1988–2000)	
	Model 1(a) private sector credit	Model 1(b) liquid liability	Model 2(a) stock market capitalization	Model 2(b) total value traded
Constant	−0.0001 (−0.62)	0.0001 (0.13)	−0.0009 (−5.46)**	−0.0009 (−6.76)***
G_{it-1}	0.7766 (32.72)***	0.7554 (26.42)***	0.7793 (19.69)***	0.8358 (26.75)***
FD_{it-1}	−0.0033 (−2.10)**	−0.0033 (−0.49)	−0.0019 (−2.27)**	−0.0011 (−1.96)**
FD^2_{it-1}	−0.0003 (−0.27)	−0.0031 (−1.60)	0.0006 (3.91)***	0.0012 (6.00)***
$RGDP_{it}$	0.0036 (0.40)	−0.0044 (−0.51)	0.0131 (1.47)	0.0283 (1.77)
COR_{it}	0.0075 (7.39)***	0.0072 (6.69)***	0.0051 (5.92)***	0.0051 (4.03)***
INF_{it}	0.0002 (0.53)	0.0002 (0.37)	0.0001 (1.01)	0.0001 (0.62)
Sargan test (p-value)	25.34 (0.9076)	27.30 (0.8513)	24.42 (0.2246)	23.67 (0.2569)
Autocovariance of order 1 (p-value)	0.0207	0.0218	0.0420	0.0425
Autocovariance of order 2 (p-value)	0.0846	0.0860	0.0791	0.0811
N	33	33	28	28
N × T	520	520	283	283
List of countries	33 countries: Algeria, Bangladesh, Bolivia, Cameroon, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Senegal, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.		28 countries: Bangladesh, Bolivia, Chile, Colombia, Ecuador, Egypt, Ghana, Guatemala, India, Indonesia, Jamaica, Jordan, Kenya, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Thailand, Trinidad & Tobago, Turkey, Uruguay, Venezuela, Zimbabwe.	

Dependent variable: Gini coefficient (*Standardized World Income Inequality Database*; Nonlinear model: testing for the inverted U-shaped hypothesis). All models are estimated using the Arellano and Bond dynamic panel GMM estimations using a maximum of one lag of the dependent variables for use as instruments (Stata xtabond command).

G Gini index; *FD* financial deepening indicator; *RGDP* real GDP per capita (in US dollars, 1995 prices); *COR* corruption index; *INF* inflation

* $p = 5\%$ significance level, ** $p = 1\%$ significance level

in reducing the income-inequality gap in developing countries. The inflation and corruption indicators remain significant factors that widen the gap. Real GDP per capita, however, is found to be insignificant in this estimation. Again, the results of the diagnostic tests suggest that all models are relatively well specified.

Table 4 presents the results of the nonlinear model, with the square term of financial development included in the model specification. The empirical results demonstrate that the coefficients on both stock market development indicators and their squared terms are statistically significant, as shown in Model 2(b). The signs for the stock market development indicators and their squared terms are negative and positive, respectively. This rejects the inverted U-shaped hypothesis and suggests a U-shaped finance-inequality relationship. As with the other estimations, the results of the diagnostic tests suggest that all these models are relatively well specified.

5 Conclusions

This study examines the role of financial factors in influencing income inequality in 35 developing countries. Although the theory of financial deepening has been gaining popularity in recent years, especially in enhancing economic growth, only limited econometric evidence traces the link between the deepening and income inequality, in particular in developing countries. As financial and economic integration becomes a reality for an increasing number of developing economies, it is important to understand how the role of financial development affects the income distribution.

Using the dynamic GMM estimation and two income inequality data sets, the empirical results suggest that financial deepening significantly reduces income inequality, which provides support to the inequality-narrowing hypothesis in general. The results also indicate that income inequality responds differently to different aspects of financial deepening. When the University of Texas inequality data set is employed as a proxy for income inequality, the finance-inequality relationship is positive and significant only for the banking sector development indicators. The stock market indicators, on the other hand, do not show any significant influence on income inequality. Nevertheless, when the SWIID is utilized, the empirical results indicate that both banking sector and stock market development indicators (as represented by private sector credit and stock market capitalization, respectively) are significant determinants that narrow income inequality.

A new empirical finding to highlight from this study is the nonlinear U-shaped relationship between financial deepening and income distribution that is identified in these countries when the newly assembled income inequality measure provided by Solt [23] is employed in the analysis. This is a different finding from the theoretically established inverted U-shaped relationship of Greenwood and Jovanovic [16]. It implies that financial deepening narrows income inequality even at the early stages of development. In other words, not only the rich, but also the poor, in the countries can afford to access and profit from financial markets in the early stages of development. Unfortunately, a threshold exists for these countries, implying that the improvement in the finance-inequality nexus can only be sustained until a certain level is reached. Further financial deepening above this threshold will lead to an upturn in income inequality, reflecting an increase in financial market inefficiency above the threshold.

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