The finance-inequality nexus in the BRICS countries: evidence from an ARDL bound testing approach

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Abstract

Increasing inequality keeps any economy stuck in the middle-income group despite its strong growth. The largest of the middle-income economies are the BRICS countries (Brazil, Russia, India, China and South Africa). In this paper we intend to investigate the long run relation between financial development and income inequality and the shape of the curve that describes it for the BRICS countries. We will tests the Greenwood and Jovanovich (1990) hypothesis by estimating an Autoregressive Distributed Lag (ARDL) for the period 1980-2017. We found evidence for an inverted U-shaped curve relation in Brazil, Russia, India and China; which validate the GJ hypothesis.

Keywords: Financial development, Income inequality, ARDL, BRICS.

JEL classification: C13, G20, I30

1. Introduction

Higher inequality slows down the accumulation of physical and human capital (Aghion and al 1999), reduces labor productivity (Stiglitz 2012) and hampers poverty reduction (Ravallion 2004), which negatively affects the sustainability of economic growth. According to the World Bank site, the BRICS countries account for over a fifth of the global economy. These countries experienced a strong economic growth and an important financial development.

According to the World Bank, until 2014, Brazil knew a decade of economic and social progress as income inequality dropped by 6.6%. Russia, despite a modest annual GDP growth, intends to halve the poverty rate to 6.6% by 2024 through investment on education, health, and infrastructure. India, before 2015, succeeded in reducing extreme poverty from 46% to 13.4%. China is the world’s second largest economy; but the same does not apply to its income per capita as a quarter of the population is living below the upper-middle-income poverty line. Poverty declined in South Africa from 33.8% in 1996 to 18.8% in 2015, despite the weak economic growth the country experiences since the global financial crisis of 2008. According to the International Monetary Fund, 87% of the Brazilian population aged 15 and above are in contact with financial institutions in 2018, which makes the country hold one of the highest levels of bank account penetration, right behind South Africa and China, among emerging economies. Russia has a bank account penetration of 67.4% of adults, while India reached 65% in 2015.

The existence of a relation between financial development and inequality has been confirmed in theory but the empirical results are inconclusive, towards the nature of the impact, and can be categorized into three main hypotheses. Greenwood and Jovanovic (1990), proposed an inverted U-shaped hypothesis where income inequality increase at the early stage of financial development and then decrease. Galor and Zeira (1993) and Banerjee and Newman (1993) supported the finance–inequality narrowing hypothesis when financial markets are fully developed. Rajan and Zingales (2003) put forward the finance–inequality widening hypothesis where the development of financial sector increases income inequality. A developed financial system is supposed to reduce income inequality by providing funds, for the rich and for the poor, to invest (Galor and Moav, 2004); but financial imperfections affects the poor more than the rich and widen the gap between these two classes (Beck and al., 2007). Mixed empirical results characterize the finance-inequality nexus as several studies found a negative impact of financial development on_income inequality (Hamori and Hashiguchi 2012; Mookerjee and Kalipioni 2010; Law and al. 2014), while others found a positive impact (Jauch and Watzka 2016; Seven and Coskun 2016; Jaumotte and al. 2013).

In this paper we will apply the bound testing approach for cointegration through an Autoregressive Distributed Lag (ARDL) model. This technique was previously used by Shahbaz and Islam 2011 for Pakistan; Shahbaz and al. (2015) for Iran; Tiwari and al. (2013) for India and Destek and al (2020) for Turkey, among others. To our knowledge this technique was never applied for the case of the BRICS countries, which motivates us to fill this gap.

The rest of the paper is organized as follows. Section 2 presents the literature review. Section 3 details the data and the methodology, while Section 4 contains the empirical results. The final section is dedicated for the conclusion.

2. Literature review

There is an extensive recent literature on the finance-inequality nexus based on different estimation methods and proxies for financial development. Chen and Kinkyo, (2016) used the pooled mean group approach for 88 countries over the period 1961–2012 and found that financial development reduces inequality in the long-run. Using private credit to GDP as a proxy for financial development in a fixed-effect two-stage least-squares estimation over the period 1960–2008, Jauch and Watzka (2016) found that financial development reduces income inequality in 138 developed and developing countries. Azam and Raza (2018) using the same technique for the ASEAN-5 countries over the period 1989–2013, also found that financial development reduce inequality but only up to a certain level.

The investigation of the nonlinear dynamics of the finance inequality nexus was conducted by many authors. Seven and Coskun (2016) using dynamic panel data methods for 45 emerging countries over the period 1987-2011, found no significant impact of financial development on income inequality. Tan and Law (2012) used the dynamic panel generalized method of moment's estimation for 35 developing countries over the period 1980–2000 and found a U-shaped curve with the narrowing of income inequality at the early stage of financial development. Clarke and al. (2006) using a panel data set of 91 countries over the period

1960-1995, found a positive impact of financial development on income inequality but no sign of an Inverted-U shaped curve. Contrarily, Park and Shin (2017) found evidence for a U-shaped relationship between financial development and income inequality for 162 countries over the period 1960-2011. Kaidi and Mensi, (2016) found a positive impact of financial development on income inequality, in both linear and nonlinear context, for 138 countries over the period 1980-2012. They also detected an inverted U-shaped relationship in high income countries and a U-shaped relationship in the lower and middle income countries. Ali and Noor (2014) using the Generalized Method of Moments for 7 developed countries over the period 1961-2011 found a negative impact of financial development on income inequality with no evidence of an inverted U-shaped curve. Jalil and Feridun (2011) using an ARDL bounds testing approach to cointegration, in China over the period 1978-2006, found that financial development reduced income inequality. The ARDL bounds testing approach to cointegration was also applied by Giri and Sehrawat (2015) but for India over the period 1982-2012. They found that financial development worsens income inequality. Younsi and Bechtini (2018) found evidence of an inverted U-shaped curve with the generalized method of moment's estimation for the BRICS countries over the period 1990–2015. They used domestic credit provided by banking sector, domestic credit provided to private sector, broad money supply, and stock market capitalization as financial development indicators. Through the literature many proxies for financial development were used: domestic credit to private sector–GDP ratio (Batuo et al. 2010; Law and al. 2014); the share of market capitalization-to-GDP ratio (Sehrawat and Giri 2015; Park and Shin 2017); and the deposit money banks as a share of GDP (Kim and Lin 2011; Kappel 2010).

3. Data and methodology

3.1. Empirical model and data

All annual data used in this paper are from the World Bank except for the financial development index (Svirydzenka 2016) which have been provided by the International Monetary Fund and the GINI index from the Standardized World Income Inequality Database (SWIID). Our sample covers the period 1980-2017 for the BRICS countries (Brazil, Russia, India, China and South Africa). The empirical model is as follow:

$$\ln INE = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln INF_t + \alpha_3 \ln G_t + \alpha_4 \ln FD_t + \alpha_5 \ln FD_t^2 + \varepsilon_t \qquad (1)$$

where t and ε_t are the time period and residual term, respectively.

All data $\ln INE$, $\ln Y_t$, $\ln INF_t$, $\ln G_t$, $\ln FD_t$ and $\ln FD_t^2$ are in natural log and designate respectively the $GINI$ index, the real gross domestic product GDP per capita, the consumer price index as a proxy for inflation, government expenditure's share in GDP, the financial development indicator and its square.

The GINI index represents household's income before taxes and it is a proxy for income inequality. The GDP per capita is a proxy for the impact of financial development on steady–state income distribution. Inflation affects the purchasing power but its negative impact is stronger on the poor and middle income classes than on the wealthy that can access financial services easier (Easterly and Fisher, 2001). Government expenditure's share in GDP is a proxy for government size; these expenses are supposed to reduce inequality but in case of corruption, it worsens income inequality because the wealthy are able to secure their access to financial services with their political links. The financial development index covers depth, access and efficiency in both markets and institutions. The square of financial development describes the non-linear relationship between financial development and income inequality.

The impact of financial development on income inequality is determined by the sign and significance of α_4 and α_5. Inequality narrows if $\alpha_4 < 0$ while $\alpha_5 = 0$ and widens if $\alpha_4 > 0$ while $\alpha_5 = 0$. We observe a U-shaped curve relation between financial development and income inequality if $\alpha_4 < 0$ and $\alpha_5 > 0$ but in the opposite case when $\alpha_4 > 0$ and $\alpha_5 < 0$ we have an inverted U-shaped curve relation.

3.2. Empirical methodology

To avoid inefficiency in the predictive power of cointegration techniques, all variable should be integrated of same order (Perron, 1989, 1997; Kim and al. 2004). If not, this is when the Autoregressive Distributive Lag Model or ARDL bounds testing approach to cointegration, developed by Pesaran and al. (2001), comes in handy.

$$\Delta \ln INE_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1,i}\, \Delta lnINE_{t-i} + \sum_{i=0}^{n} \alpha_{2,i}\, \Delta lnY_{t-i} + \sum_{i=0}^{n} \alpha_{3,i}\, \Delta lnINF_{t-i} + \sum_{i=0}^{n} \alpha_{4,i}\, \Delta lnG_{t-i} + \sum_{i=0}^{n} \alpha_{5,i}\, \Delta lnFD_{t-i} + \sum_{i=0}^{n} \alpha_{6,i}\, \Delta lnFD_{t-i}^2 + \beta_1 lnINE_{t-1} + \beta_2 lnY_{t-1} + \beta_3 lnINF_{t-1} + \beta_4 lnG_{t-1} + \beta_5 lnFD_{t-1} + \beta_6 lnFD_{t-1}^2 + \varepsilon_t \quad (2)$$

Where Δ and n are the difference operator and lag length, respectively.

The hypothesis of no cointegration $H_0\colon \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ is tested against the alternative hypothesis $H_1\colon \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$. If there is cointegration among variables, the long-run ARDL equation is estimated as follows:

$$\ln INE_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1,i}\, \Delta lnINE_{t-i} + \sum_{i=0}^{q} \alpha_{2,i} lnY_{t-i} + \sum_{i=0}^{r} \alpha_{3,i}\, lnINF_{t-i} + \sum_{i=0}^{s} \alpha_{4,i}\, lnG_{t-i} + \sum_{i=0}^{t} \alpha_{5,i}\, lnFD_{t-i} + \sum_{i=0}^{v} \alpha_{6,i}\, lnFD_{t-i}^2 + \varepsilon_t \quad (3)$$

Where p, q, r, s, t, and v in equation (3) are the optimum lag for the series. The short-run coefficients of the variables are estimated with an error-correction model as follows:

$$\ln INE_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1,i}\, \Delta lnINE_{t-i} + \sum_{i=0}^{q} \alpha_{2,i} lnY_{t-i} + \sum_{i=0}^{r} \alpha_{3,i}\, lnINF_{t-i} + \sum_{i=0}^{s} \alpha_{4,i}\, lnG_{t-i} + \sum_{i=0}^{t} \alpha_{5,i}\, lnFD_{t-i} + \sum_{i=0}^{v} \alpha_{6,i}\, lnFD_{t-i}^2 + \gamma ECM_{t-1} + \varepsilon_t \quad (4)$$

Where the coefficient γ of the error-correction term ECM_{t-1} is the speed of adjustment parameter, the sign of this coefficient should be negative and statistically significant.

4. Empirical results

The ARDL approach does not require testing for stationarity, in fact the series can have different order of integration as long as it is not I(2) or higher.

Table 1 Unit-Root Estimation

Countries	Variables	Intercept and trend			
		Level		**1st Difference**	
		Adj. t-Stat	Prob	Adj. t-Stat	Prob
Brazil	$LINE$	-0.959835	0.2950	-2.400071	0.0178**
	LY	-3.586369	0.0639*	-10.36730	0.0001
	$LINF$	-1.918301	0.6244	-4.471802	0.0057***
	LG	-1.516246	0.8058	-6.617051	0.0000***
	LFD	-2.836456	0.1941	-6.399406	0.0000***
	LFD^2	-2.966276	0.1549*	-6.444773	0.0000***
Russia	$LINE$	0.854953	0.8893	-1.681426	0.0871*
	LY	-6.352472	0.0012**	-2.878175	0.2111
	$LINF$	-6.256598	0.0002***	-7.305483	0.0000
	LG	-2.839959	0.1963	-6.584223	0.0001***
	LFD	-1.850618	0.6569	-6.116768	0.0001***
	LFD^2	-1.563781	0.7856	-5.920481	0.0002***
India	$LINE$	3.121451	0.9992	-1.674884	0.0883*
	LY	-9.021188	0.0000***	-31.74640	0.0000
	$LINF$	-2.651611	0.2614	-7.243394	0.0000***
	LG	-2.457524	0.3460	-4.119422	0.0133**
	LFD	-1.949206	0.6089	-5.014307	0.0013***
	LFD^2	-1.919012	0.6246	-4.980686	0.0015***
China	$LINE$	-1.995296	0.2874	-5.151061	0.0002***
	LY	-2.581294	0.2904	-6.903964	0.0000***
	$LINF$	-3.192195	0.1115	-4.009413	0.0282**
	LG	-2.385150	0.3808	-3.577944	0.0461**
	LFD	-2.120228	0.5171	-5.948175	0.0001***
	LFD^2	-2.018175	0.5714	-6.027681	0.0001***
South Africa	$LINE$	-1.768075	0.6985	-4.630248	0.0039**
	LY	-0.720159	0.9550	-7.641970	0.0002***
	$LINF$	-4.644021	0.0037**	-7.508038	0.0000
	LG	-4.336440	0.0076**	-6.470784	0.0000
	LFD	-2.979424	0.1513	-5.702546	0.0002***
	LFD^2	-2.970740	0.1537	-5.679135	0.0002***

*, **, *** denotes significance at 10%, 5% and 1%level, respectively.

The results of the Phillips-Perron (1988) unit root test reported in Table 1 show that income is stationary in level for Brazil, Russia and India, inflation is stationary in level for Russia and South Africa; while government size is stationary in level only in South Africa. The other series are integrated of order one for all BRICS countries.

Before applying the ARDL bounds testing approach, first we check optimal lag order for each country with the final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ).

Table 2 Lag Length Selection

	Lag	LogL	LR	FPE	AIC	SC	HQ
Brazil							
	2	94.66607	5.634316*	2.92e-05*	-7.623137*	-7.277552*	-7.536223*
Russia							
	1	55.78940	15.91713*	0.000121*	-6.223675*	-5.933954*	-6.208839*
India							
	2	125.1908	10.39564*	2.24e-05*	-7.879384*	-7.552437*	-7.774791*
China							
	1	87.92803	74.18514*	6.41e-05*	-6.827336*	-6.532822*	-6.749201*
South Africa							
	1	99.63714	44.54542*	7.97e-06*	-8.917823*	-8.619388*	-8.853055*

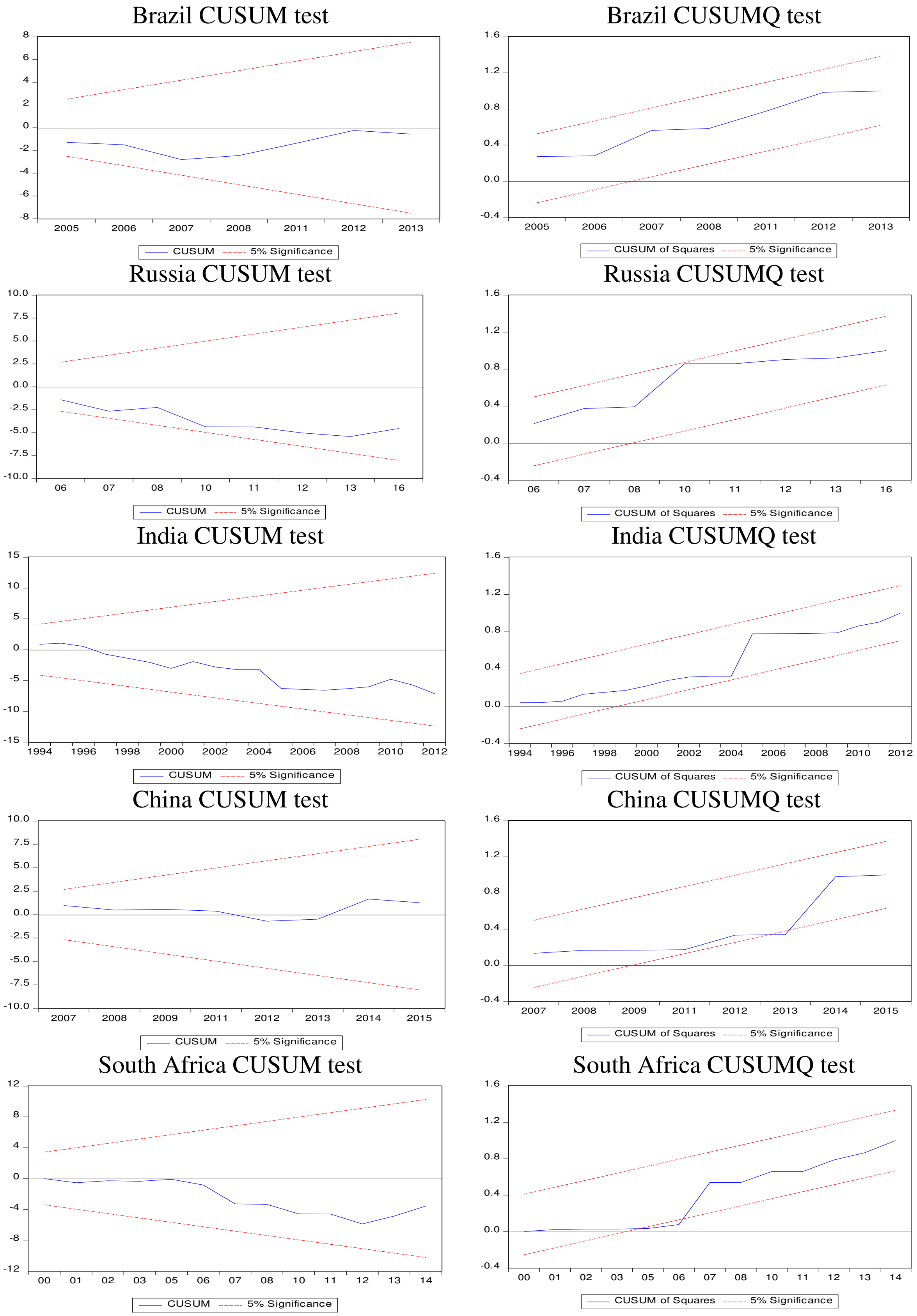
The results in the table above indicate the optimal choice is one lag for Russia, China and South Africa, while it is two lags for Brazil and India. Next, we apply the ARDL cointegration bound test to check the existence of long run relationship.

Table 3 Results of the ARDL cointegration and diagnostic tests

	Brazil	Russia	India	China	South Africa
Lag order	(2,1,0,1,0,0)	(1,1,0,1,0,1)	(2,1,0,2,0,0)	(1.0.0.0.0.0)	(1.0.0.1.0.0)
F-stat	2.97	3.43	2.08	19.34	1.26
Critical values	10%	5%	10%	1%	-
Lower bound	1.81	2.14	1.81	2.82	-
Upper bound	2.93	3.34	2.93	4.21	-
χ^2NORMAL	1.152 (0.562)	0,046 (0.977)	0,725 (0,696)	5.846 (0.054)	0.020 (0.990)
χ^2SERIAL	1.044 (0.418)	0.052 (0.841)	0.029 (0.971)	0.766 (0.394)	0.818 (0.380)
χ^2ARCH	0.831 (0.516)	0.434 (0.528)	0.710 (0.503)	4.126 (0.057)	0.449 (0.515)
χ^2RAMSEY	0.729362 (0.5273)	0.291279 (0.6435)	3.573045 (0.0558)	0.227109 (0.6397)	0.164386 (0.6909)
CUSUM	stable	stable	stable	stable	stable
CUSUMQ	stable	stable	stable	stable	stable

Diagnostic tests in Table 3 indicate the absence of serial correlation or Heteroskedasticity in the residuals with the Breusch–Godfrey LM test and the ARCH test, also the result of the Jarque–Berra statistic confirm the normality behavior. The correct functional form is supported by the Ramsey–Reset test, while the stability properties are examined with CUSUM and CUSUMQ tests shown in Figure 1. In addition, as shown in Table 3, the F-statistic exceeds the upper bound for Brazil, Russia and China at 10%, 5% and 1% respectively, while it falls between the lower and upper bound for India at 10%. Therefore, we conclude that there is a long-run relationship between variables for all BRICS countries except South Africa, where the F-statistic is below the lower bound for all critical values.

Figure 1 the cumulative sum and the cumulative sum of the squares of recursive residuals



Next, we examined the short- and long-run effects of income, inflation, government size and financial development on income inequality. On the short run, income has a positive impact in Russia and a negative one in India, government size has a positive impact in both Brazil and India; and a negative one in Russia, while an increase in financial development affect income inequality negatively in Russia.

Table 4 The results of the short run and long run

	Brazil	Russia	India	China	South Africa
Short-run results					
$LINE$	0.563 (0.001)	-	0.508 (0.000)	-	-
LY	-	0.030 (0.003)	-0.003 (0.006)	-	-
$LINF$	-	-	-	-	-
LG	-0.024 (0.033)	0.252 (0.006)	-0.053 (0.035)	-	-
LFD	-	-	-	-	-
LFD^2	-	-0.165 (0.005)	-	-	-
ECT (-1)	-0.035 (0.000)	-0.906 (0.005)	-0.035 (0.000)	-0.058 (0.000)	-
Long-run results					
$LINE$	-	-	-	-	-
LY	0.080 (0.365)	-0.003 (0.850)	-0.181 (0.129)	0.052 (0.243)	-
$LINF$	-0.016 (0.605)	-0.026 (0.249)	0.015 (0.829)	-0.077 (-0.063)	-
LG	0.258 (0.490)	0.581 (0.044)	0.384 (0.363)	0.124 (0.821)	-
LFD	2.587 (0.000)	1.205 (0.007)	1.484 (0.020)	2.419 (0.052)	-
LFD^2	-0.462 (0.008)	-0.173 (0.004)	-0.166 (0.081)	-0.396 (0.080)	-

On the long run, economic growth has a positive impact on income inequality in Brazil and China but not in Russia and India. Inflation affects negatively income inequality in Brazil, Russia and China. Government spending reduces income inequality as expected. Financial development has a positive impact on income inequality in Brazil, Russia, India and China. For the case of South Africa no long run relationship has been found. The coefficients signs of financial development and the square of the financial development suggest the existence of an inverted U-shaped curve relation in Brazil, Russia, India and China and it confirm the validity of the GJ hypothesis. Our results are similar to those of Younsi and Bechtini (2018) who used a different approach.

5. Conclusion

Higher inequality threatens the sustainability of economic growth and tends to raise social pressure. In this paper we investigated the financial-inequality nexus and the shape of the curve that describes it for the BRICS countries by applying the bound testing approach for cointegration through an Autoregressive Distributed Lag (ARDL) model. The bound testing approach for cointegration was useful to assess for the existence of long run relation since we used small samples. Our results for the period 1980-2017 confirms the existence of a long run relationship for all BRICS countries except South Africa and the existence of an inverted U-shaped curve relation in Brazil, Russia, India and China; which validate the GJ hypothesis for these countries.

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