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THE FINANCE-INEQUALITY NEXUS IN THE BRICS COUNTRIES: EVIDENCE FROM AN ARDL BOUND TESTING APPROACH

Wissem Boukraine*

ABSTRACT The aim of this paper is to investigate the long run relation between financial development and income inequality by exploring the shape of the curve that describes it for the BRICS countries namely Brazil, Russia, India, China and South Africa. We test the Greenwood and Jovanovich (1990) hypothesis by estimating an Autoregressive Distributed Lag (ARDL) model for the period 1980-2017. We consider three dimensions of financial development: depth, access and efficiency in both markets and institutions, while household income before taxes is the proxy for income inequality. Our findings confirm, except for South Africa, the existence of an inverted U-shaped curve relation in Brazil, Russia, India and China; which validates the Greenwood and Jovanovich (1990) hypothesis and the positive impact of financial development on income inequality. Our policy recommendation for South Africa is the necessity of improving its population's effective access, under regulation, to a range of formal financial services meeting their needs.

KEY WORDS: *Financial development, Income inequality, ARDL, BRICS*

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1. INTRODUCTION

Higher inequality slows down the accumulation of physical and human capital (Aghion et 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's web site "where we work" section, 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. BRICs economies implemented reforms to mobilize more savings, promote domestic investment and improve their attractiveness of foreign investment through modern financial regulations and policies (Chittedi, 2010). In fact, these countries not only reduced governmental intervention in the financial sector, but also privatized banks and enhanced market capitalization. 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 affect the poor more than the rich and widen the gap between these two classes (Beck et 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 et al. 2014), while others found a positive impact (Jauch and Watzka, 2016; Seven and

Coskun, 2016; Jaumotte et 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 et al. (2015) for Iran; Tiwari et al., (2013) for India and Destek et al (2020) for Turkey, among others. To our knowledge this technique was rarely applied for the case of the BRICS countries, what motivates us to fill this gap is its ability to distinguish long-run relationships from short-run dynamics. 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. Burgess and Pande (2005) found that financial inclusion reduced income inequality in India from 1977 to 1990. Clarke et al. (2006) using a panel data set of 83 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. Bittencourt (2007) found a positive impact of financial development on inequality in Brazil from 1980 to the first half of the 1990s. 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. 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. 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. 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. Zhang and Chen (2015) found evidence of an inverted U-shaped curve between financial development and inequality in china from 1978 to 2013. 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. 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. 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. 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. 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. 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 1995–2015. 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. Le et al., (2019) analyzed the impact of financial inclusion on income inequality in 22 transition economies from 2005 to 2015 and found a negative relationship. Through the literature many proxies for financial development were used: domestic credit to private sector–GDP ratio (Batuo et al., 2010; Law et 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's financial system stability assessment reports and the GINI index, developed by Gini (1913), 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:

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

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 as it measures the extent to which household's income distribution within an economy deviates from a perfectly equal distribution.

The gross domestic product (GDP per capita: Y) is a proxy for the impact of financial development on steady–state income distribution.

Inflation (INF) 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 (G) 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 (FD) covers depth, access and efficiency in both markets and institutions.

The square of financial development (FD^2) 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 variables should be integrated of same order (Perron, 1989, 1997; Kim et al., 2004). If not, this is when the Autoregressive Distributive Lag Model or ARDL bounds testing approach to cointegration, developed by Pesaran et al., (2001), comes in handy.

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

Where Δ and n are the difference operator and lag length, respectively. The hypothesis of no cointegration $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ is tested against the alternative hypothesis $H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$. If there is cointegration among variables, the long-run ARDL equation is estimated as follows:

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

Where p, q, r, s, τ, 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:

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

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.

3.2. 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	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). It is important to determine the exact number of lags to be included as regressors as too many lags increase the forecast error while omitting lags may result in an estimation bias.

Table-2 Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
Brazil						
2	94.666	5.634*	2.920*	-7.623*	-7.278*	-7.536*
Russia						
1	55.789	15.917*	0.000*	-6.224*	-5.934*	-6.209*
India						
2	125.19	10.396*	2.240*	-7.874*	-7.552*	-7.775*
China						
1	87.928	74.185*	6.410*	-6.827*	-6.533*	-6.749*
South Africa						
1	99.637	44.545*	7.970*	-8.918*	-8.619*	-8.853*

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

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CUSUM	stable	stable	stable	stable	stable
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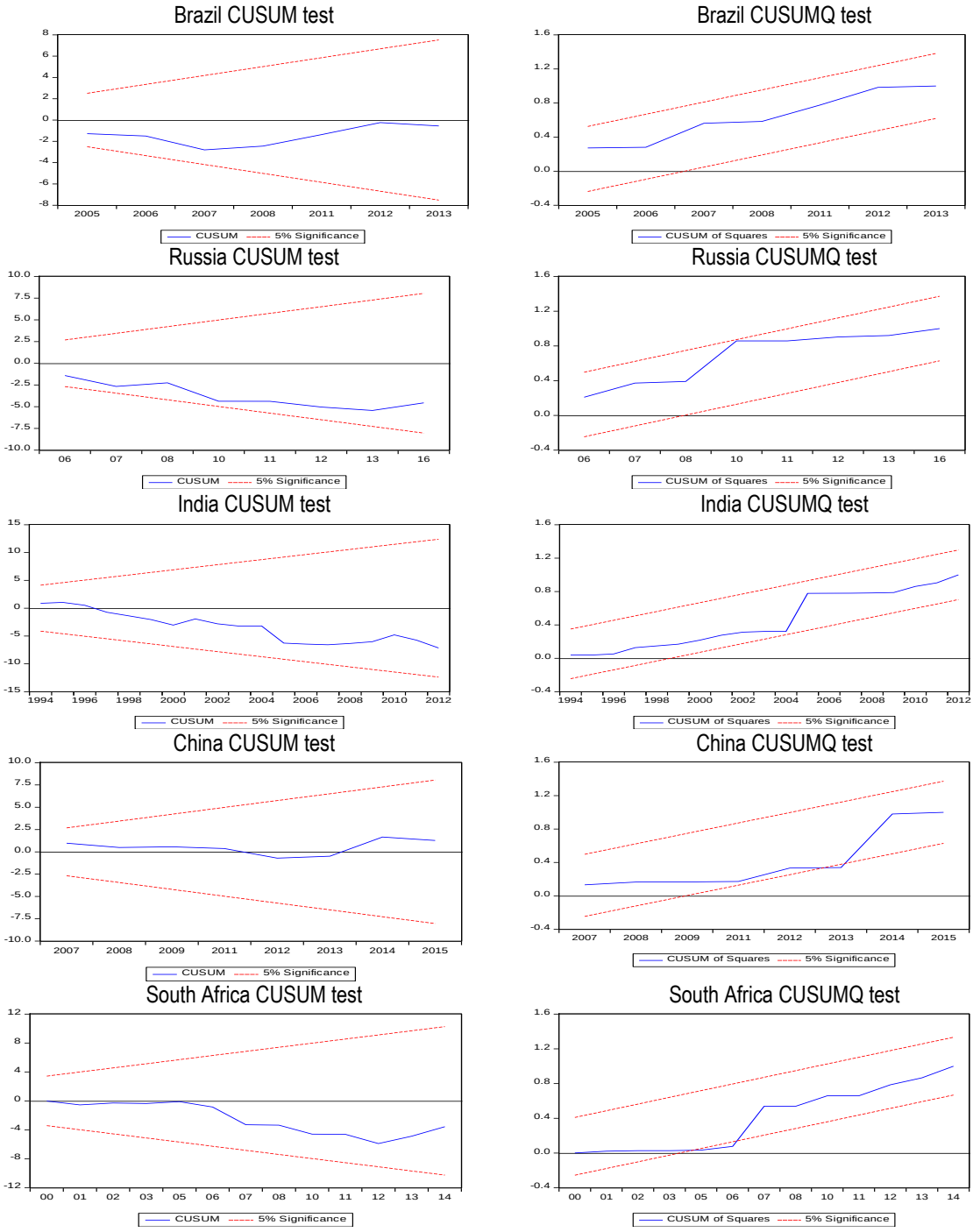
Diagnostic tests in Table 3 indicate the absence of serial correlation or heteroskedasticity in the residuals with the Breusch–Godfrey LM test and the ARCH test, also the result of the Jarque–Berra statistic confirms the normality behavior. The correct functional form is supported by the Ramsey–Reset 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-run and long-run effects of income, inflation, government size and financial development on income inequality. In the short run, GDP per capita (Y) has a positive impact on Russia and a negative one in India, government expenditure (G) has a negative impact in both Brazil and

India; and a positive one in Russia, while an increase in financial development (FD) affects income inequality negatively in Russia.

Table-4 The results of the short run and long run

	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
Short-run results					
$\Delta LINE_{t-i}$	0.563 (0.001)	-	0.508 (0.000)	-	-
ΔLY_{t-i}	-	0.030 (0.003)	-0.003 (0.006)	-	-
$\Delta LINF_{t-i}$	-	-	-	-	-
ΔLG_{t-i}	-0.024 (0.033)	0.252 (0.006)	-0.053 (0.035)	-	-
ΔLFD_{t-i}	-	-	-	-	-
ΔLFD^2_{t-i}	-	-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					
$LINE_t$	-	-	-	-	-
LY_t	0.080 (0.365)	-0.003 (0.850)	-0.181 (0.129)	0.052 (0.243)	-
$LINF_t$	-0.016 (0.605)	-0.026 (0.249)	0.015 (0.829)	-0.077 (0.063)	-
LG_t	0.258 (0.490)	0.581 (0.044)	0.384 (0.363)	0.124 (0.821)	-
LFD_t	2.587 (0.000)	1.205 (0.007)	1.484 (0.020)	2.419 (0.052)	-
LFD^2_t	-0.462 (0.008)	-0.173 (0.004)	-0.166 (0.081)	-0.396 (0.080)	-

On the long run, economic growth GDP per capita (Y) has a positive impact on income inequality in Brazil and China but not in Russia and India. Inflation (INF) affects negatively income inequality (INE) in Brazil, Russia and China. On the other hand Inflation affects positively India Government expenditure (G) reduces income inequality in all countries as expected except South Africa. Financial development (FD) 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 (FD) and the square of the financial development (FD^2) 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 which is the existence of a non-linear relationship between financial development and income inequality. Therefore income inequality

increases at the early stage of financial development and then decrease. Our results are similar to those of Younsi and Bechtini (2018) who used a different approach.

5. CONCLUSION

Increasing inequality not only raise social pressure but it also keep any economy stuck in the middle-income group despite its strong economic growth. The largest of the middle-income economies are the BRICS countries (Brazil, Russia, India, China and South Africa). In this paper, we investigated the finance-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 (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 confirm 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; this validates the GJ hypothesis. Our results are in line with previous works like Younsi and Bechtini (2018) even thou we used a different empirical approach based on both short-run and long-run relationships.

But since financial imperfections affect the poor more than the rich and widen the gap between them, financial exclusion should be reduced in order for financial development to boost economic growth without raising inequality. This can be achieved first by promoting financial literacy on one hand and developing customized financial products provided through a robust and efficient digital network on the other hand. Secondly, by developing a partially pro-poor financial system to reduce income inequality which can be achieved with relaxed interest on micro credits for example.

DISCLOSURE OF CONFLICT

The author declares that he has no conflicts of interest.

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