Financial development and economic growth in Brazil: A Non-linear ARDL approach

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ABSTRACT

Financial intermediation through the banking system plays an important role in economic development through the allocation of savings, thus improving productivity, and ultimately increasing the rate of economic growth. This paper examines the interrelationships between financial development and economic growth using the Nonlinear Autoregressive Distributed Lag (NARDL) model for Brazil. The time component of the study's database is 1985 – 2015 inclusive. The study focused on the banking sector and stock market indicators of financial developments. The empirical results suggest that the banking sector measures of financial development have a negative relationship with economic growth while the financial development indicators representing stock market development are positively related to economic growth. The study also established an evidence of a long run and short run asymmetric relationship between financial development and growth. The empirical results open new insights for policy makers for long run and sustainable economic development.

JEL: C13;C22;G20;G21;

Keywords: Financial development, economic growth, Non-linear ARDL, Brazil

1 Introduction

The importance of financial development has received a lot of attention in developed, emerging and developing countries. Financial development is considered as one of the factors that plays a major role in promoting economic growth and development in many economies. Schumpeter (1911) argued that financial intermediation through the banking system played an important role in economic development through the allocation of savings, thus improving productivity, and ultimately increasing the rate of economic growth. Advanced economies have more developed financial markets compared to developing economies, hence, policy formulation is of importance to develop financial sector in order to promote economic growth.

Some studies in the literature established a positive relationship between financial development and economic growth (Hassan, Sanchez and Ya (2011), Nyasha and Odhiambo (2015), Estrada, Park and Ramayandi (2010), Gondo (2009), Madsen, Islam and Doucouligos (2011).On the other hand, other studies established a negative relationship and bidirectional relationship between financial development and economic growth (Robinson (1952), Kuznets (1955) and Demetriades and Hussein (1996) and Rousseau and Vuthipadadorn (2005) respectively. The reason for differences is attributable to different methodologies and study periods utilised.

According to Silva (2015), Brazil's financial sector is fairly developed with the total financial system credit operations reaching $3,026.4 billion in 2015, and the credit/GDP ratio increased to 58.6% from 22.5% in 2002. However, Brazil is currently suffering from political stability and a decrease in commodity prices which has negatively impacted on economic growth. GDP contracted by close to 4% in 2015 and 2016 and the IMF expected the country to growth by a modest 0.7% in 2017. Some banking sector development has been stagnant during that period while stock market development have been decreasing, hence the link between financial development and economic growth needs to be revisited.

The aim of the study is to examine the relationship between financial development and economic growth in Brazil over the period 1985-2015. The data for the study is sourced from the World Bank. Most studies investigating the link between financial development and economic growth utilise linear techniques, however, a number of relationships in finance are non-linear in nature. Therefore, the study utilises the Non- Linear Autoregressive Distributive Lag (NARDL) estimation technique proposed by Shin, Yu and Greenwood-Nimmo (2014) to examine the finance and growth nexus in Brazil.

The rest of the study is structured as follows: section two provides an overview of Brazil's financial sector development, section three provides literature review. Section four provides data and methodology, section five results. Section six concludes the study.

2 History of Brazil's financial sector development

Brazil initiated financial reforms in 1988 which involved providing financial institutions freedom to diversify and organise themselves as universal banks (de Carvalho 2008). The reforms included the abolishing of interest rate, capital and exchange controls, as well as privatisation of a number of financial institutions. Privatisation of financial institutions was vital in the face of stable bankruptcy due to high inflation rates. Universal banks increased the number of players in the market for public debt which was the safest and most profitable business.

High inflation rates in the years prior to 1995 prompted the implementation of the Real Stabilisation Plan in 1994 (Goldfajn, Hennings & Mori 2003). Despite the success of the Plan in reducing inflation rates and ensuring price stability, the banking sector suffered a number of problems. Banks were adapted to the period of high inflation where state securities were the most profitable assets. Inflation revenue from holding treasury operations accounted for 40% of revenues earned by banks before the Real Stabilisation Plan (de Carvalho 2008). When prices became stable, banks had to shift their operations to providing more credit to the private sector, however, due to limited skill in dealing with the private sector, a number of banks experienced problems in 1995.

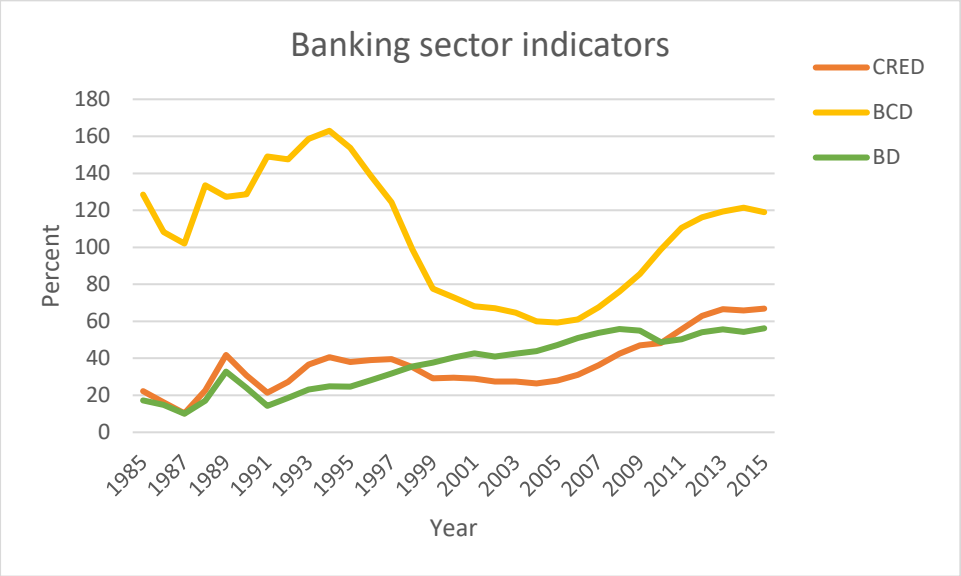
Fearing that a bank crisis would erupt, the authorities embarked on programmes known as PROER and PROES (Filho, Macahyba & Zeidan 2014). Under PROER, banks experiencing problems were absorbed by healthy ones through mergers and acquisitions. Furthermore, entry of foreign banks into the domestic banking sector was encouraged in order to prevent concentration in the banking sector increasing to high levels, as well as boosting competition and consolidation. PROES resulted in liquidation of the financially distressed banks by the central bank and focused on reducing state involvement in the banking sector (Goldfajn et al 2003). These two programmes were crucial in preventing a banking crisis from erupting in the 1990s.

A number of institutional reforms were also introduced in the 1990s and 2000s to diversify the financial sector and boost economic growth (de Carvalho 2008). These included measures to promote the growth of capital/stock markets through restructuring and improving the

regulatory environment (Nyasha & Odhiambo 2017). Between July 1994 and December 1995, the National Monetary Council (CMN) implemented 154 resolutions which changed the operations of the financial market (Filho et al 2014).

The financial reforms resulted in an increase in the number of financial institutions from 111 in 1988 to 203 in 1994 (Goldfajn et al 2003). However, by 2002 the number had decreased to 171. The number of commercial banks in 2012 was 162 while in 2017 the number was 180 (International Monetary Fund 2012, Banco Central Do Brasil 2017). Over the last decade, the financial system has grown in size and diversification due to financial inclusion, the growth in securities and derivative market, and the involvement of institutional investors (International Monetary Fund 2012). Public banks still hold a significant proportion of the financial sector with foreign investors playing significant roles in capital and derivative markets. The reforms also went a long way in helping Brazil withstand the 2008/2009 global financial crisis (Filho et al 2014). Despite the stock market falling by close to 50%, the banking sector remained resilient.

Figure 1: Banking sector indicators

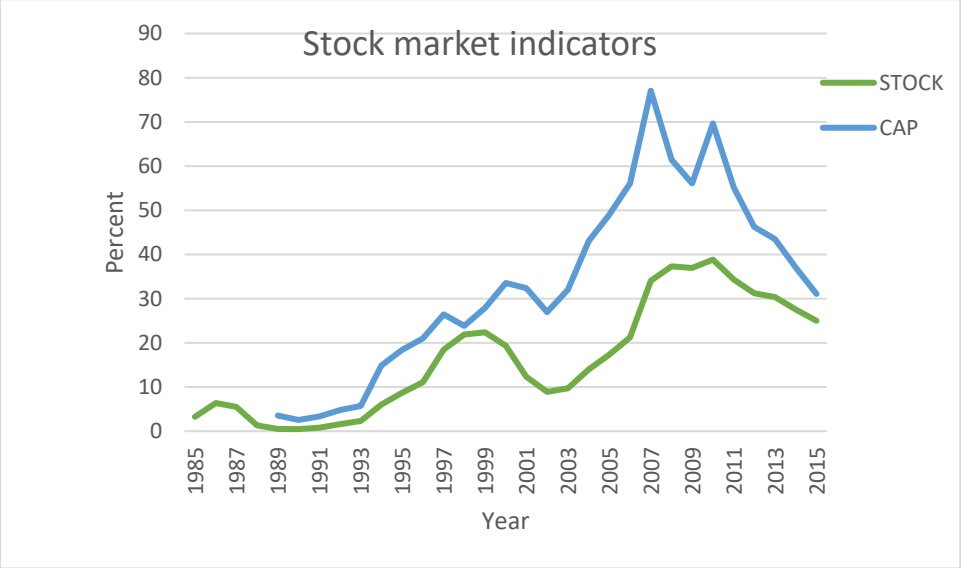


Source: Beck, Demirgüç-Kunt and Levine (2000), Beck, Demirgüç-Kunt and Levine (2009) and Čihák, Demirgüç-Kunt, Feyen and Levine (2012)

The trends in selected banking sector indicators shown on figure 1 indicate that bank deposits increased following financial reforms while private credit decreased from the mid-1990s till 2005. As a result, the ratio of bank credit to deposits reduced drastically during that period. A possible explanation could be the rise in bank deposits following reforms in interest rates and

a drop in private credit as banks had limited experience in dealing with the private sector. Since 2005 there has been an increase in the credit to deposit ratio as the growth in credit outpaced that of deposits. Stock market indicators presented on figure 2 show an upward trend from the early 90s till 2010 despite a decrease between 2000 and 2001. However, since 2010, stock market development has been on the decline which can be explained by the political instability in Brazil.

Figure 2: Stock market indicators



Source: Beck, Demirgüç-Kunt and Levine (2000), Beck, Demirgüç-Kunt and Levine (2009) and Čihák, Demirgüç-Kunt, Feyen and Levine (2012)

3 Literature review

The theoretical underpinnings of the relationship between economic growth and financial development can be traced back to the work of Levine (1997, 1999). He argues that financial markets play an important role in driving growth of many economies. Financial development has various functions in many economies. Sirri and Tufano (1995) establish that financial development mobilise savings from different investors to enable investment that facilitates in the accumulation of capital that promotes economic growth. Levine (1997) suggests that facilitation of risk management is essential as investment is associated with risk that arises due to imperfect information and exogenous events. Shen and Lee (2006) establish that financial systems serve as a base for allocating resources, improved monitoring systems; less information asymmetries thus improve levels of economic growth. Monitoring the performance

of managers and fostering the exchange of goods and services is another important function of financial development (Hermes and Lensink, 2003).

On the empirical front, there has been empirical evidence investigating the relationship between financial development and economic growth. Large number of studies reported that financial development has a positive impact on economic growth (see Hassan, Sanchez and Ya (2011), Nyasha and Odhiambo (2015), Estrada, Park and Ramayandi (2010), Gondo (2009), Madsen, Islam and Doucouligos (2011), Khan and Senhadji (2000), Djoumessi (2009), Jaliland and Feridun (2011), Seetanah, Ramessur and Rojid (2008) , Abida, Sghaier and Zghidi (2015) and Nyasha and Odhiambo (2017).

Hassan, Sanchez and Ya (2011) investigated the role of financial development on economic growth in low- and -middle income countries over the period 1980 and 2007 using the panel data analysis. The study found that financial development has a positive impact on economic growth in developing countries. Nyasha and Odhiambo (2015) investigated the impact of both bank-based and market-based financial development on economic growth in the United Kingdom over the period 1980 and 2012 using the ARDL bounds testing approach. The study found that market-based financial development has a positive impact on economic growth on the other hand, bank-based financial development has negative impact on economic growth in United Kingdom.

Estrada, Park and Ramayandi (2010) argue that financial development has a positive effect on economic growth, especially in developing countries over a period 1987 and 2008 using panel data analysis of 125 countries. Gondo (2009) reported that financial development drives economic growth in South Africa from the period 1970 to 1999 using robust standard error. Madsen, Islam and Doucouliagos (2011) reported that financial development promotes economic growth at advance levels in the Organization for Economic Cooperation and Development countries over the period 1870 and 2011using panel data. Khan and Senhadji (2000) argue that financial development has a positive effect on economic growth using a cross-section sample and panel data over the study period 1960 and 1999.

Djoumessi (2009) found that financial development has a positive and long-term relationship on economic growth in South Africa and in Cameroon between 1970 and 2006 using time methods. Likewise, Jaliland and Feriduri (2011) suggest a positive and significant relationship between financial development and economic growth in Pakistan from 1975 to 2008. Seetanah,

Ramessur and Rojid (2008) argue that financial development has a positive contribution on output on Island economies over a period of 22 years using Generalized Method of Moment (GMM) panel estimates. Abida, Sghaier and Zghidi (2015) suggest that there is a strong positive link between financial development and economic growth in the North Africa over the 1980 to 2012 period using Generalized Method of Moment (GMM) panel data. Nyasha and Odhiambo (2017) found that there is a positive relationship between market-based financial development and economic growth in Brazil in the long run, however not in the short run. The study also found that bank-based financial development does not have a positive effect on economic growth in Brazil using ARDL model.

Some studies established a negative relationship between financial development and economic growth (see, Robinson (1952), Kuznets (1955), Friedman and Schwartz (1963), Lucas (1988)]. On the other hand, Robinson (1952), Kuznets (1955), Demetriades and Hussein (1996) and Rousseau and Vuthipadadorn (2005) established a bidirectional relationship between financial development and economic growth.

4 Data and Methodology

Table 1: Description of the variables

Variable	Description of the variable
BCD	Bank credit to deposits ratio
BD	Bank deposits as a % of GDP
BM	Broad money as a % of GDP
CAP	Stock market capitalisation as a % of GDP
CRED	Private credit by deposit money banks as a % of GDP
DMBG	Deposit money bank assets as a % of GDP
LIQ	Liquid liabilities as a % of GDP
STOCK	Stock market total value traded as a % of GDP
GDP	GDP growth rate
TRADE	Exports plus imports as a % of GDP
INV	Investment as a % of GDP
INF	Consumer prices

Source: World Bank (2017), Beck, Demirgüç-Kunt and Levine (2000), Beck, Demirgüç-Kunt and Levine (2009) and Čihák, Demirgüç-Kunt, Feyen and Levine (2012)

The study employs time series data for Brazil over the period between 1985 and 2015. Economic growth is captured by GDP growth and is sourced from the World Bank (2017)' World Development Indicators. The financial development data is sourced from Beck, Demirgüç-Kunt and Levine (2000), Beck, Demirgüç-Kunt and Levine (2009) and Čihák, Demirgüç-Kunt, Feyen and Levine (2012). Table 1 presents the description of the data.

4.1 Descriptive statistics

Table 2 illustrates the descriptive statistics for the raw data. Bank credit to deposits rate averages 105% during the period of the study which is an indication of high levels of credit. Bank deposits and broad money average 40.3% and 62.7% respectively. The mean for stock market capitalisation is 33.4% while that for the stock market value traded is 18.2% which suggests low levels of stock market development. Private credit by deposit money banks averages 39.6% while the mean for deposit money bank assets is 66.5%. Liquid liabilities as a % of GDP averages close to 47%. Inflation averages 369% which is an indication of macroeconomic instability. The period from 1985 to 1995 was characterised by high inflation rates, however, from 1996 the inflation rate has been in single digits. Investment averages 19.2% while trade averages 22.3% which suggests low levels of openness. Standard deviations of the variables suggest the low levels of volatility except for inflation. According to the Jarque-Bera test, all the variables are normally distributed with the exception of inflation and investments.

Table 2: Descriptive statistics

	BCD	BD	BM	CAP	CRED	DMBG	GDP	INF	INV	LIQ	STO	TR
Mean	105	40.3	62.7	33.4	39.6	66.5	2.55	369	19.2	47.0	18.2	22.3
Median	111	42.5	60.4	32.0	36.7	61.6	3.05	6.87	18.6	45.1	18.5	22.6
Max	163	56.2	111	77.1	66.9	104	7.53	295	26.9	78.7	38.8	29.7
Min	59.3	14.3	30.4	2.54	21.4	29.9	-3.77	3.20	16.6	16.0	0.47	14.4
Std.Dev	34.4	12.9	22.2	20.9	13.4	20.6	2.67	788	2.12	18.4	12.6	4.69
Skew	0.12	-0.40	0.27	0.22	0.88	0.43	-0.52	2.10	1.83	0.23	0.11	-0.24
Kurtosis	1.65	1.91	2.10	2.25	2.66	2.35	3.04	6.22	7.45	1.98	1.77	1.69
JB	2.13	2.04	1.22	0.86	3.64	1.29	1.20	31.5***	37.4***	1.41	1.75	2.19
Sum	2834	1088	1693	902	1070	1798	68.87	9971	519.7	1268	492.7	601.6
Observations	27	27	27	27	27	27	27	27	27	27	27	27
Where: *** Indicates significance at the 1% level												

Source: Researcher's own computations

Table 3: Correlation Analysis

Correlation	BCD	BD	BM	CAP	CRED	DMBG	GDP	INF	INV	LIQ	STO	TR
BCD	1.00											
BD	-0.55***	1.00										
BM	-0.09	0.60***	1.00									
CAP	-0.69***	0.85***	0.43**	1.00								
CRED	0.30	0.55***	0.58***	0.33*	1.00							
DMBG	-0.48**	0.96***	0.66***	0.84***	0.63***	1.00						
GDP	-0.12	0.03	0.09	0.35*	0.05	0.06	1.00					
INF	0.61***	-0.67***	-0.22	-0.79***	-0.21	-0.64***	-0.08	1.00				
INV	0.65***	-0.05	0.26	-0.16	0.66***	0.06	0.15	0.24	1.00			
LIQ	-0.50***	0.97***	0.63***	0.83***	0.60***	0.99***	0.03	-0.65***	0.01***	1.00		
STOCK	-0.43**	0.84***	0.49**	0.88***	0.58***	0.84***	0.16	-0.83***	0.02	0.84***	1.00	
TRADE	-0.75***	0.67***	0.33*	0.65***	-0.08	0.59***	0.17	-0.36*	-0.48**	0.64***	0.40**	1.00
Where: ***, **, * represents significance at the 1%, 5% and 10% levels respectively												

Table 3 illustrates the correlation between the variables. This will help in determining whether there is multicollinearity or not. Most of the correlations between GDP and the financial development indicators are insignificant except for stock market capitalisation which is positively correlated with GDP and significant at the 10% levels. Some of the correlation coefficients between the financial development indicators are above 0.8 which is an indication of severe multicollinearity (Gujarati and Porter, 2009). Therefore, the financial development measures are used in separate models in order to avoid the problem of severe multicollinearity. GDP is also positively correlated with investments and but negatively correlated with inflation. However, the correlations are insignificant.

4.2 Model Specification

A Production function has an inconclusive nature and encourages researchers to explore the linkage between financial development and economic growth. In doing so, studies employ different models and incorporate different intermittent variables. This study serves to explore the link between financial development and economic growth in Brazil covering the period from 1985 to 2015. Inflation, terms of trade and investments were incorporated as additional variables to deal with the issue of omitted variable bias. In investigating the relationship between the variables, the economic growth model is specified as follows:

$$\text{GDP} = \alpha + \beta_1 FD_t + \beta_2 INF_t + \beta_3 INV_t + \beta_4 TR_t + \mu_t \quad (1)$$

Where GDP represents economic growth, FD is financial development, INF represents inflation, INV and TR denote investment and trade, respectively. μ_t is an error term which is assumed to be normally distributed.

4.3 Non-liner ARDL co-integration test

The presence of asymmetries in gross domestic product and financial development propels this study to apply non-linear co-integration technique to explore the linkage between the variables. In doing so, the study adopts the non-linear ARDL (NARDL) co-integration technique which originated from Shin et al. (2014). This approach is an asymmetric extension of the ARDL model of Pesaran and Shin (1999) and Pesaran et al (2001), which is aimed at capturing both long run and short run asymmetries in a variable of interest. Following NARDL framework introduced by Shin et al (2014), the study specifies the following asymmetric long run equation of gross domestic product as follows:

$$\Delta GDP_{t=} \alpha_0 + \rho GDP_{t-1} + \theta_1^+ FD_{t-1}^+ + \theta_2^- FD_{t-1}^- + \theta_3 INF_{t-1} + \theta_4 INV_{t-1} + \theta_5 TR_{t-1} + \sum_{i=1}^{p} \propto_1 \Delta GDP_{t-i} + \sum_{i=0}^{q} \alpha_2 \Delta FD_{t-i}^+ + \sum_{i=0}^{q} \alpha_3 \Delta FD_{t-i}^- + \sum_{i=0}^{q} \alpha_4 \Delta INF_{t-i} + \sum_{i=0}^{q} \alpha_5 \Delta INV_{t-i} + \sum_{i=0}^{q} \alpha_6 \Delta TR_{t-i} + D_t + \mu_t \quad (2)$$

Where α denotes the short-run estimates in equation 2, while the long run estimates are indicated by θ_i with *i*=1-9. This implies that the immediate effects of the exogenous variables, financial development, inflation, investment and trade on the endogenous variable gross domestic product are determined by the short run analysis. The long run analysis focuses on the time reaction and speed of adjustment towards long run equilibrium. In order to determine the existence of asymmetries in the short run ($\alpha = \alpha^+ = \alpha^-$), the Wald test is applied. The Wald test is also employed to find the asymmetries in the long run ($\theta = \theta^+ = \theta^-$). $_p$ and $_q$ are employed to show the optimal lag length. To capture the structural breaks, a dummy variable D_t is included determined by Kim and Perron (2009) unit root test. $E_t^+ and\ E_t^-$ are achieved by partially summing of negative and changes in E_t, presented as follows;

$$E_t^+ = \sum_{j=1}^{t} \Delta E_j^+ = \sum_{j=1}^{t} \max(\Delta E_j, 0), \; E_t^- = \sum_{j=1}^{t} \Delta E_j^- = \sum_{j=1}^{t} \min(\Delta E_j, 0), \quad (3)$$

Where E represents the financial development indicators, FD_t

In order the determine the existence of long run co-integration between GDP, FD, INF, INV and TR while accommodating asymmetries, the study follows the bounds test by Shin et al. (2014) which is the joint test of all the lagged levels of regressor. The study employs the F-statistics test by Pesaran et al. (2001) as well as the t-statistics which was formulated by Banerjee et al. (1998). Commencing with the t-statistics, the null hypothesis: $\theta = 0$ is tested against the alternative hypothesis: $\theta < 0$, while with the F-statistics, the null hypothesis: $\theta^+ = \theta^- = \theta = 0$ is estimated. The rejection of the null hypothesis indicates that there is a long run relationship between economic growth, financial development, inflation, investment and trade. Finally, to estimate the asymmetric estimates for long run, the study follows $L_{m^+} = \theta^+/\rho$ and $L_{m^-} = \theta^-/\rho$.

4.4 Unit root test

Estimation by the NARDL model is preceded by unit root testing in order to ensure that there are no variables integrated of order two (I(2)). These variables result in invalid cointegration testing. The Augmented Dickey Fuller (ADF), Phillips and Perron (PP) and Dickey-Fuller Generalised Least Squares (DF-GLS) unit root tests will be used.

Table 4: Unit root tests: Intercept only option

	Levels			First difference		
Variables	**ADF**	**PP**	**DF-GLS**	**ADF**	**PP**	**DF-GLS**
BCD	-0.71	-1.38	-0.89	-3.57**	-3.80***	-3.49**
BD	-4.24**	-2.96	-4.25***	-8.12***	-7.54***	-7.56***
BM	-4.37***	-3.55*	-4.18***	-6.45***	-8.00***	-6.70***
CAP	-0.46	-0.70	-1.22	-4.17**	-5.09***	-4.23***
CRED	-2.19	-1.76	-2.34	-6.82***	-5.43***	-6.53***
DMBG	-3.79**	-2.68	-3.86***	-8.33***	-6.37***	-7.80***
GDP	-4.00**	-3.94**	-3.70**	-4.69***	-8.59***	-8.67***
INF	-3.39*	-3.48*	-3.39**	-7.31***	-12.33***	-3.47**
INV	-3.08	-3.17	-2.92*	-5.30***	-8.35***	-5.29***
LIQ	-3.56*	-2.87	-3.68**	-6.04***	-8.09***	-6.16***
STOCK	-3.48*	-2.16	-3.44**	-7.35***	-2.94**	-3.27**
TRADE	-2.21	-2.43	-2.10	-5.26***	-5.26***	-4.68***
Note: (***), (**) and (*) indicate significance at 1%, 5% and 10% levels respectively.						

Source: Researchers' own computations

Table 5: Unit root tests: Intercept and trend option

	Levels			**First difference**		
Variables	**ADF**	**PP**	**DF-GLS**	**ADF**	**PP**	**DF-GLS**
BCD	-1.07	-1.53	-1.02	-3.70***	-3.90***	-3.02***
BD	-1.18	-0.54	-0.71	-8.13***	-7.13***	-6.77***
BM	-3.28**	-3.10**	-2.42	-6.56***	-8.46***	-6.62***
CAP	-1.63	-1.52	-1.20	-3.57**	-4.69***	-3.54***
CRED	-1.25	-0.19	-1.18	-6.89***	-5.31***	-5.14***
DMBG	-0.72	0.58	-0.45	-8.33***	-6.34***	-5.83***
GDP	-4.07***	-3.99***	-3.42***	-4.88***	-8.76***	-8.82***
INF	-2.49	-2.85*	-2.54**	-4.14***	-12.25***	-4.00***
INV	-2.83*	-2.94*	-2.57**	-5.38***	-9.53***	-5.06***
LIQ	-0.38	-0.07	0.37	-6.13***	-7.64***	-5.86***
STOCK	-1.57	-1.31	-1.46	-2.69**	-2.99**	-2.71***
TRADE	-0.98	-1.10	-0.97	-5.37***	-5.37***	-3.95***
Note: (***), (**) and (*) indicate significance at 1%, 5% and 10% levels respectively.						

Source: Researchers' own computations

The unit root tests are estimated using two approaches, one with only an intercept and the other with an intercept and a trend. The results are presented on tables 4 and 5, and these suggest that all variables are either stationary (I(0)) or integrated of order one (I(1)). Therefore, NARDL model is appropriate for the analysis as there are no I(2) variables.

4.5 Diagnostic tests

Diagnostic tests for normality, serial correlation, heteroscedasticity and model misspecification are conducted on the estimated model. The serial correlation test selected is the Breusch-Godfrey LM developed by Breusch (1978) and Godfrey (1978). The null of the test is that there is no serial correlation. Heteroscedasticity is determined using the Breusch & Pagan (1979) test. The null that the variance of the error term is constant (homoscedasticity). The Ramsey (1969) test is estimated to ensure that the model is correctly specified. The null is that the model is correctly specified. Normality is tested using the Jarque-Bera test under the null that the residuals are normally distributed (Gujarati & Porter, 2009). Finally, the cumulative sum of recursive residuals (CUSUM) test is applied to test the stability of the coefficients.

5 Empirical results

The bounds test results presented on table 6 shows that cointegration is detected in all the models at 1% level of significance. Furthermore, as shown on table 7, all models pass the diagnostics tests which means that the residuals are normally distributed, not serially correlated and homoscedastic. Also, the Ramsey RESET test and the CUSUM[1] graphs indicate that the models are stable and show no hint of misspecification. The analysis may therefore proceed to estimating the NARDL long-run and short-run coefficients.

The long-run results are presented on table 8 and these indicate that the banking sector measures of financial development have negative coefficients while the financial development indicators representing stock market development have positive coefficients. The results confirm the findings of Nyasha and Odhiambo (2017) who found that banking sector growth is negatively related to growth while stock market development has a positive effect on growth in Brazil. Stock market development impact positively on economic growth by providing a means for companies to raise funds for investment purposes (Levine & Zervos, 1998). The negative association between banking sector development and economic growth is not in accordance with theoretical expectations as banking sector development is expected to boost

[1] These are shown in the appendix

economic growth through savings mobilisation and credit facilitation (Levine 1997). in the economy.

Table 6: Bounds testing

Variable	F-statistic	Conclusion
BCD	21.30	Cointegration
BD	16.04	Cointegration
BM	25.70	Cointegration
CAP	26.03	Cointegration
CRED	16.68	Cointegration
DMBG	7.95	Cointegration
LIQ	7.08	Cointegration
STOCK	10.29	Cointegration

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
1%	3.41	4.68

Source: Researchers' own computations. Critical value bounds taken from Pesaran et al (2001)

Table 7: Diagnostic tests

Variables	Residual	Serial	Heteroscedasticity	Ramsey
BCD	4.34 (0.11)	2.52 (0.15)	0.67 (0.78)	0.27 (0.77)
BD	0.69 (0.71)	1.38 (0.28)	0.48 (0.91)	0.08 (0.79)
BM	1.04 (0.60)	0.90 (0.44)	0.53 (0.88)	0.41 (0.67)
CAP	0.73 (0.69)	0.03 (0.97)	0.79 (0.66)	0.05 (0.95)
CRED	2.06 (0.36)	0.54 (0.59)	0.20 (0.99)	0.32 (0.73)
DMBG	0.87 (0.64)	0.13 (0.88)	0.40 (0.95)	1.50 (0.18)
LIQ	0.47 (0.80)	2.54 (0.21)	1.70 (0.32)	3.46 (0.22)
STOCK	1.27 (0.53)	1.11 (0.38)	1.64 (0.21)	2.53 (0.14)

Source: Researchers' own computations

The negative association between banking sector measures of financial development and economic growth can be explained by a new strand of literature suggests that "too much" finance may not be growth enhancing in the long-run due rising debt levels which in turn result in banking crises. Studies by Beck, Georgiadis and Straub (2014), Law and Singh (2014) and Arcand, Berkes and Panizza (2015) suggest that financial development beyond a certain threshold may have a negative impact on economic growth. Furthermore, large financial sectors may hinder growth of productive sectors.

According to the results, a percentage point increase in banking sector development reduces economic growth by between 0.05 and 0.25 percentage points, however, the only significant coefficients are those of bank credit to deposits, bank deposits, broad money and private credit. A decrease in banking sector development levels enhances economic growth levels. The significant coefficients in this regard are bank deposits, broad money, private credit and deposit money bank assets. Therefore, there is a hint of asymmetry in the response of GDP to bank credit to deposits and deposit money bank assets.

A percentage point increase in stock market value traded enhances economic growth by 0.05 percentage points while a percentage point reduction decreases economic growth by 0.82 percentage points. The coefficients attached to the stock market capitalisation variable show an indication of asymmetry between the positive and negative long-run movements. An increase in stock market capitalisation is positively related to economic growth, however, the coefficient is insignificant. On the other hand, a reduction in stock market capitalisation has a negative impact on economic growth and the coefficient is significant at the 1% level.

Table 8: Long-run regression results

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
C	50.72*	4.85	-29.59**	-66.57***	-56.48***	9.92	3.69	-29.02**
BCD_P	-0.05***							
BCD_N	-0.01							
BD_P		-0.25***						
BD_N		-0.62***						
BM_P			-0.09***					
BM_N			-0.12***					
CAP_P				0.01				
CAP_N				0.10***				
CRED_P					-0.20***			
CRED_N					-0.59***			
DMBG_P						-0.09		
DMBG_N						-2.78**		
LIQ_P							-0.02	
LIQ_N							0.12	
STOCK_P								0.05***
STOCK_N								0.82***
INF	-0.01*	-0.001	0.002***	-0.001***	0.002***	0.003*	-0.002**	0.004
INV	-0.52	-1.03***	0.55*	1.74***	1.79***	-1.31**	0.22	0.52*
TRADE	-0.49***	0.48***	0.38***	0.28***	0.11	-0.07	0.08	0.74***
Note: (***), (**) and (*) indicate significance at 1%, 5% and 10% levels respectively.								

Source: Researchers' own computations

Table 9: Long-run asymmetry tests

Variable	F-Statistic	Conclusion
BCD	5.11**	Asymmetry
BD	15.19***	Asymmetry
BM	10.32***	Asymmetry
CAP	53.96***	Asymmetry
CRED	25.33***	Asymmetry
DMBG	6.24*	Asymmetry
LIQ	0.24	No Asymmetry
STOCK	18.65***	Asymmetry
Note: (***), (**) and (*) indicate significance at 1%, 5% and 10% levels respectively.		

Source: Researchers' own computations

Table 9 shows the results of the tests for long-run asymmetric response of GDP to financial development. The null of no asymmetry is rejected in all models with the exception of the model where liquid liabilities is used as a proxy. Therefore, there is evidence of a long-run asymmetric relationship between economic growth and financial development.

The association between inflation and economic growth is ambiguous to a large extent. However, the magnitude of the coefficients suggests a weak association between the variables. There is evidence that investment and trade have a positive impact on economic growth as most models have positive and significant coefficients, which supports theoretical expectations.

The results suggest that there is short-run relationship between financial development and economic growth as the all the indicators of financial development possess at least one significant coefficient. There is a hint of short-run adjustment asymmetry in most models due to the different number of lags of the positive and negative changes. Furthermore, asymmetry is indicated by different signs as well as the magnitude of the coefficients.

The short-run results suggest a negative relationship between inflation and economic growth despite the weak association. Trade is negatively associated with economic growth in the short-run while investment is positively related to economic growth.

Table 10: Short-run regression results

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
ΔBCD_P	-0.24***							
ΔBCD_P(-1)	-0.29***							
ΔBCD_P(-2)	0.39***							
ΔBCD_N	0.25*							
ΔBCD_N(-1)								
ΔBCD_N(-2)	0.37***							
ΔBD_P								
ΔBD_P(-1)		0.80***						
ΔBD_P(-2)								
ΔBD_N		-1.24***						
ΔBD_N(-1)		0.32						
ΔBD_N(-2)		-0.49**						
ΔBM_P			-0.21***					
ΔBM_P(-1)			-0.06					
ΔBM_P(-2)								
ΔBM_N								
ΔBM_N(-1)			-0.36***					
ΔBM_N(-2)								
ΔCAP_P				0.23***				
ΔCAP_P(-1)				0.37***				

ΔCAP_P(-2)								
ΔCAP_N				0.16				
ΔCAP_N(-1)								
ΔCAP_N(-2)								
ΔCRED_P					-0.35***			
ΔCRED_P(-1)								
ΔCRED_P(-2)								
ΔCRED_N					-0.59**			
ΔCRED_N(-1)								
ΔCRED_N(-2)								
ΔDMBG_P						-0.21		
ΔDMBG_P(-1)						0.20		
ΔDMBG_P(-2)						-0.47**		
ΔDMBG_N						-1.40***		
ΔDMBG_N(-1)						0.70***		
ΔDMBG_N(-2)						-0.63***		
ΔLIQ_P							-1.46**	
ΔLIQ_P(-1)							2.15**	
ΔLIQ_P(-2)							-0.35	
ΔLIQ_N							2.86	
ΔLIQ_N(-1)							-1.87	
ΔLIQ_N(-2)							-0.72	

ΔSTOCK_P								0.15**
ΔSTOCK_P(-1)								-0.19***
ΔSTOCK_P(-2)								-0.13**
ΔSTOCK_N								0.74**
ΔSTOCK_N(-								
ΔSTOCK_N(-								-0.43
ΔINF	-0.01**	-0.004	0.01**	0.001		-0.003***	-0.01***	
ΔINF(-1)	0.002	-0.002**	-0.001	0.001	-0.002**	-0.002**	-0.001	
ΔINF(-2)	0.002	-0.001**			-0.002**		-0.003**	
ΔINV	2.19***	1.06***	2.58***	1.45***	2.33***	0.72**	0.95**	0.97**
ΔINV(-1)	0.52*	1.32***	1.34***	-0.50**		1.00**	-0.62	-0.65**
ΔINV(-2)	0.52*	1.11***				1.05**	2.75**	
ΔTRADE		0.45**	0.40**			0.51**	-0.90*	1.34**
ΔTRADE(-1)		-0.25*	-0.47***		-0.38**		-0.30*	-0.44
ΔTRADE(-2)		-0.43**	-0.55***		-0.36**		-1.10**	-0.66**
Note: (***), (**) and (*) indicate significance at 1%, 5% and 10% levels respectively.								

Source: Researchers' own computations

6 Conclusion

The existence of a long run relationship between financial development and economic is detrimental for governments and policy makers in constructing sustainable development policy implications. These empirical findings are diverse because different researchers focused on different countries, using data and data sample as well as the different econometrical techniques. The objective of this study was to use the production function in investigating the linkage between economic growth and financial development taking into consider the different measures of financial development. We commenced by determining whether the variables integrated at $I(0)$ or $I(1)$ by employing the Augmented Dickey Fuller, Phillips and Perron and Dickey-Fuller Generalised Least Squares. Being aware of the asymmetries that exist in time series, this study employed the Nonlinear ARDL testing approach to examine the asymmetric impact of financial development on economic growth in Brazil. The time span of the data used in this study covers the period between 1985 and 2015.

The Nonlinear ARDL bounds test of co-integration revealed that there is a long run relationship among the variables. The findings further indicated that the banking sector measures of financial development are negatively related to economic growth while the financial development indicators representing stock market development have a positive impact on economic growth. There is an evidence of a long and short run asymmetry in the relationship between financial development and economic growth.

Understanding the linkage between financial development and economic growth is crucial for governments and policy makers. This study established that there is a negative relationship between economic growth and banking sector financial measures, and therefore it is recommended that caution be taken with regards to further development of the banking sector in Brazil. Financial development measures such as bank credit or credit to the private sector, may be hinder economic growth through a rise in bad debts which in turn cause financial crises. Therefore, authorities should implement a sound and effective regulatory framework to monitor bank operations such as lending in order to prevent financial crises. Focus should be aimed at measures that will strengthen the quality of the banking sector rather than its size. The study also indicated that stock market has a positive impact on economic growth. Therefore, it is recommended that authorities should create an environment conducive for the development of the stock market by ensuring macroeconomic stability.

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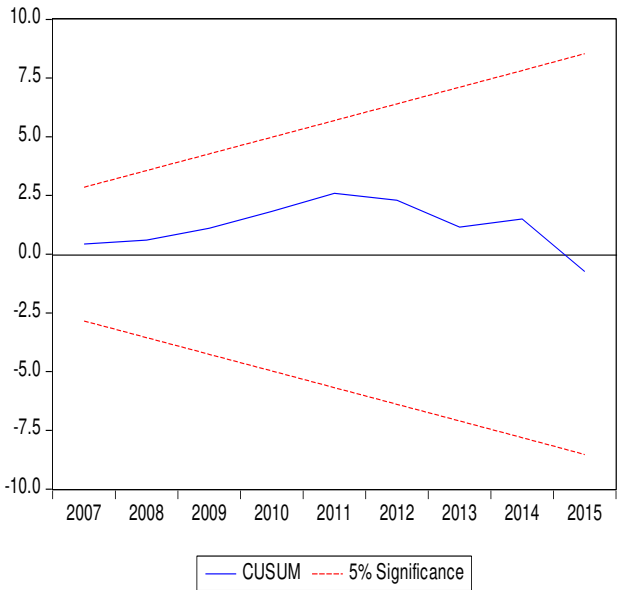
Appendix: CUSUM TESTS

BCD



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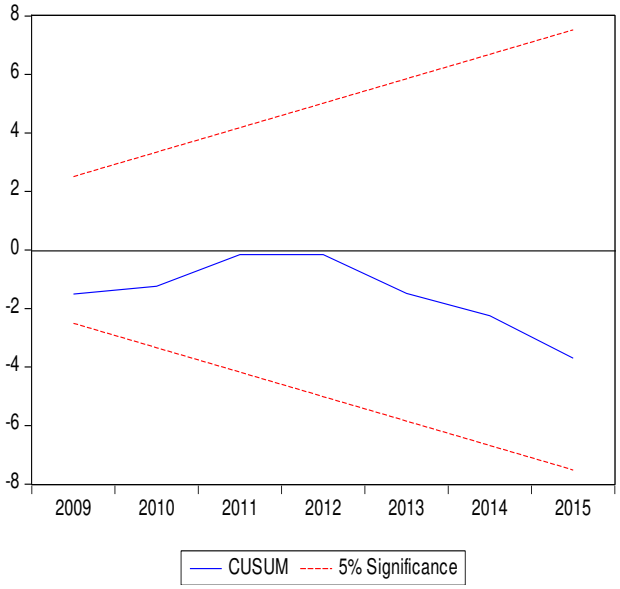
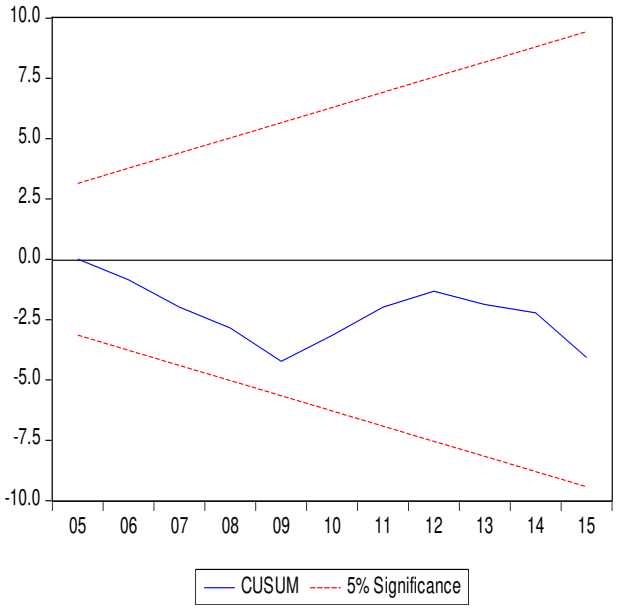
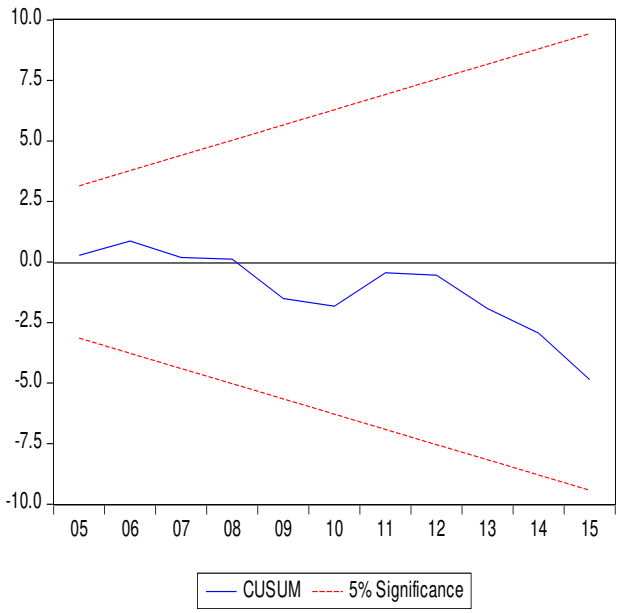


BM



CAP



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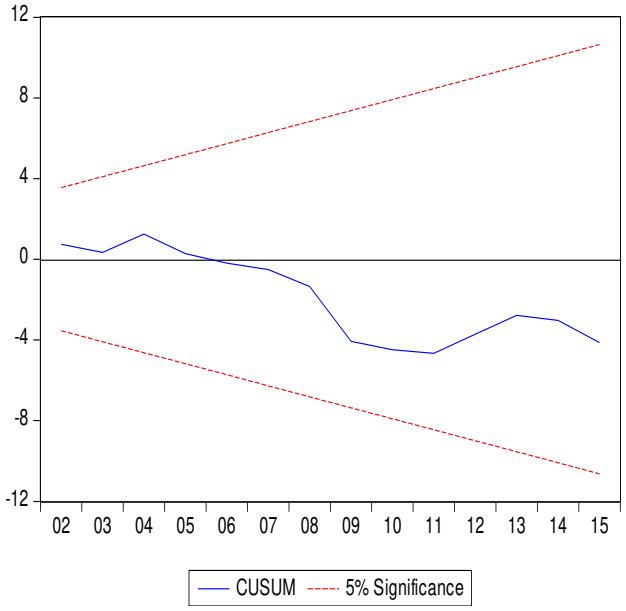
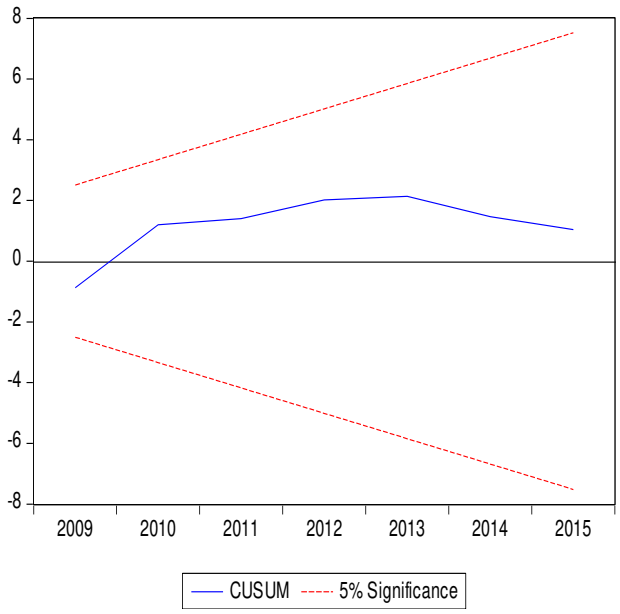
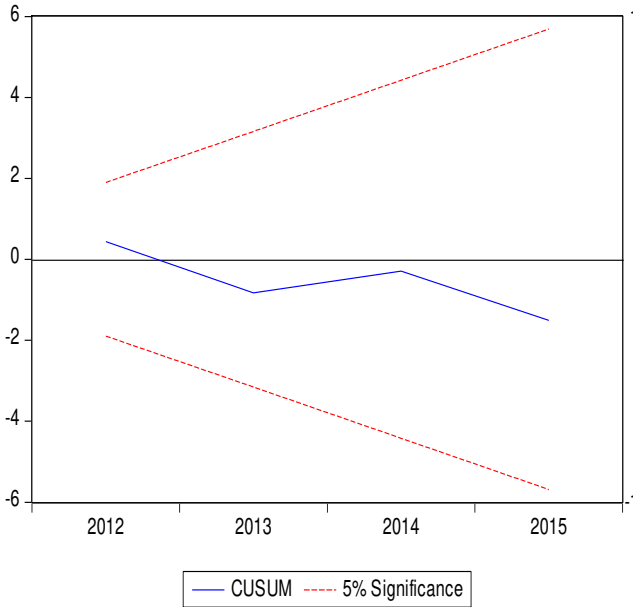


DMBG



LIQ



STOCK