

INFLATION, CREDIT MARKETS AND ECONOMIC GROWTH: THE CASE OF BRICS
COUNTRIES

By

BAVUYILE BARAYI

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Supervisor: Prof ANDREW PHIRI

DECLARATION

I, BAVUYILE BARAYI (215180518), hereby declare that the dissertation for Master of Economics to be awarded is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

B.B

Bavuyile Barayi

BBarayi
December 2021

ABSTRACT

The empirical study investigates the relationship between inflation, credit markets and economic growth in the context of Brazil, Russia, India, China and South Africa (BRICS) countries. The BRICS group consists of five emerging market economies and was first coined by Jim O'Neil of Goldman Sachs in 2001 whereby initially the bloc consisted of only Brazil, Russia, India, China, South Africa joined the BRICS group in 2010. The BRICS bloc was deemed to be the top fast-growing economies that showed great potential for growth.

Consequent to the 2008 global financial crisis, there has been a large change in economic thinking as policy-makers have struggled to overcome the economic misfortunes caused by the crisis. Amongst the emerging countries, the BRICS countries have in effect, established a New Development Bank to play the role of the credit facilitator the BRICS countries and other emerging countries as well. This BRICS New Development Bank was established in 2014 and already has identified and funded some projects within the BRICS countries. Moreover, the main objective of this bank is to provide credit to be utilised for infrastructure, climate change measures, as well as to ensure sustainable development. Against this backdrop, the current study investigates the role played by credit and the extent of development in credit markets on enhancing growth in the BRICS countries, particularly looking at the levels of inflation that are conducive to credit market development.

The study notes that in order for credit expansion to be successful, the credit received by a country must reflect positively on a country's economic growth. In other words, with more credit coming into a country, the expected result is that there will also be a rise in economic growth. Furthermore, seeing that inflation erodes the value of money, this credit or these funds that a country receives may not have the expected influence on growth. Therefore, the study finds it imperative to investigate the levels at which inflation allows for credit expansion to promote growth in a country.

Furthermore, central banks play an important role in credit markets via the interest rate channel and the study examines the role of monetary policy in credit markets of each of the BRICS countries by looking at the inflation targeting regime as well as the absence thereof within these countries. Moreover, BRICS central banks share more or less the same goal of maintaining price stability and low inflation through various monetary policy tools. Therefore, achieving this objective will allow a central bank to gain both investor and consumer confidence which

plays a role in a country's investment rates. Moreover, inflation that is not controlled results in uncertainty which makes investors hesitant and unwilling to embark on investments. Ha, Ivanova, Ohnsorge and Unsal (2019) associate a developed financial sector with low inflation, stating that stable inflation rates eliminate uncertainty and avoids the erosion of the value of money.

The current study used an Autoregressive Distributed Lag (ARDL) model to examine the linear co-integration and Non-linear Autoregressive Distributed Lag (NARDL) for the non-linear empirical analysis of the relationship between inflation, credit markets and economic growth in BRICS countries. The non-linearity of this relationship is important to study as there has been many debates on the nature of the inflation-growth relationships with some studies implying that it is positive, some say it is a negative relationship and some say it is non-linear. The annual data time series is extracted from the World Bank Indicators and the Penn State database covering the period 1960-2019. The main variables used in the study are Inflation (CPI), Credit (Domestic Credit to Private Sector) and Economic growth (GDP). The study conducted various regressions including the total of five linear regressions which were run individually for each country, the non-linear regressions consisted of three regressions for each country which were on 1) Only Inflation partitioned, (2) Only Credit partitioned and (3) both Inflation and Credit were partitioned. The partitioning of the variables is made possible by the NARDL model which allows variables to be partially decomposed into negative and positive sums to identify thresholds of variables which have various effects on other variables.

The overall findings of the study suggest that although inflation exerts various effects on growth, according to this study's results, it does not have a significant impact on credit for all the countries except for China whereby credit in general is conducive to economic growth and Brazil where growth is enhanced when credit is declining. The study revealed that generally, inflation exerts a negative impact on growth, therefore, authorities must focus on keeping inflation rates low particularly for Russia, India and South Africa as Brazil's results suggest that rising inflation is conducive to its economic growth in the long run. According to the findings of this study, credit does not have the significant impact on growth even under different inflation thresholds. Furthermore, this does not imply that the credit channel is a futile tool for authorities, the relationship between inflation, credit and growth particularly with the hypothesis that inflation enhances credit market development and therefore growth, is not significant.

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DEDICATION

To my late mother Lindiwe Ruth Solani, my late grandfather Mxabanisi Golden Ngalo and my late father Mphathi Ngalo.

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LIST OF ACRONYMS

ARDL	AUTOREGRESSIVE DISTRIBUTIVE LAG
NARDL	NON-LINEAR AUTOREGRESSIVE DISTRIBUTIVE LAG
BRICS	BRASIL RUSSIA INDIA CHINA SOUTH AFRICA
NDB	NEW DEVELOPMENT BANK
IMF	INTERNATIONAL MONETARY FUND
FIR	FOURTH INDUSTRIAL REVOLUTION
GDP	GROSS DOMESTIC PRODUCT
GFC	GLOBAL FINANCIAL CRISIS
SARB	SOUTH AFRICAN RESERVE BANK
TAR	THRESHOLD AUTOREGRESSIVE
PSTR	PANEL SMOOTH TRANSITION REGRESSION MODEL
GMM	GENERALIZED METHOD OF MOMENTS
CMN	NATIONAL MONETARY COUNCIL
CPI	CONSUMER PRICE INDEX
GFCF	GROSS FIXED CAPITAL FORMATION
OECD DEVELOPMENT	ORGANISATION FOR ECONOMIC CO-OPERATION AND
APEC	ASIA-PACIFIC ECONOMIC COOPERATION
SETAR	SECTOR-EXCITING THRESHOLD AUTOREGRESSIVE
WAMZ	WEST AFRICAN MONETARY ZONE
BTTC	BRICKS THINK TANK COUNCIL
PDS	PUBLIC DISTRIBUTION SYSTEM
RDP	RECONSTRUCTION AND DEVELOPMENT PROGRAMME
GEAR	GROWTH EMPLOYMENT AND REDISTRIBUTION
CAMP	CAPITAL ASSET PRICING MODEL
RBI	RESERVE BANK OF INDIA
CRR	CASH RESERVE RATIO
OMOS	OPEN MARKET OPERATIONS

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CHAPTER 1

1.1 INTRODUCTION

Following the 2008 US sub-prime crisis which had contagion spill-over effects on the global economy, there has been a major change in economic thinking as policy-makers have battled to overcome the economic adversities caused by the most detrimental financial crisis since the Great Depression. One of the most recent major success stories within the emerging markets was the formation of the Brazil, Russia, India, China and South Africa (BRICS) New Development Bank (NDB), which has been seen as an alternative to Western-dominated World Bank and International Monetary Fund (IMF) as a source of funding for infrastructure development projects in less developed economies. The NDB was established in 2014 as a multilateral finance institution aimed at facilitating credit not only among the BRICS countries, but other emerging countries as well. The primary objectives of the NDB include the development of infrastructure and tackling the issue of climate change, together with ensuring sustainable development.

As part of the NDB's mission to achieve its objectives, the Bank identified numerous projects within the BRICS countries that the NDB already has and will finance. The Bank approved the first financial assistance of USD 811 million to a set of projects which include, the Hohhot New Airport in China which was approved in November 2018 of which the loan amount from the NDB was RMB 4.4 billion; The Jiangxaki Natural Gas Transmission System Development Project also in China, with a loan amount of USD 400 million and was approved in November 2018 as well; The Mumbai Metro Rail Project costing the NDB USD 260 million was approved for India in November 2018; The Lesotho Highlands Water Project (Phase 2) with a loan cost of ZAR 1.15 billion approved in March 2019; The Environmental Protection Project for Medupi Thermal Power Plant in South Africa for USD 480 million was approved in March 2019; The Renewable Energy Sector Development Project which cost the Bank ZAR 1.15 billion, was approved also in March 2019. As can be seen from this list, the projects that the NDB has funded emphasise on infrastructure and factors in the dynamics of climate change.

Notably, central banks in BRICS countries share more or less the same goal of maintaining price stability and low inflation through various monetary policy tools as a measure of protecting that country's currency. Moreover, achieving this objective allows a central bank to gain both investor and consumer confidence which plays a role in a country's investment rates as investors and consumers adjust their expectations accordingly. In other words, inflation that is not controlled results in uncertainty which makes investors hesitant and unwilling to embark

on investments. Ha, Ivanova, Ohnsorge and Unsal (2019) associate a developed financial sector with low levels of inflation, stating that stable inflation rates eliminate uncertainty and avoids the erosion of the value of money. Furthermore, because BRICS countries, with the exception of China, have inflation targeting as a monetary policy framework, this study will also lend the necessary attention to the impact of inflation targeting practices on each country's inflation levels and the extent to which these levels are able to enhance economic growth. Furthermore, when looking at the inflation targeting monetary policy framework, the study further considers the transmission mechanism by exploring previous schools of thought surrounding the transmission mechanism used to control inflation.

Bernanke and Gertler (1995), Mishkin (1995) and Ireland (2005) all formally discussed the transmission mechanism through which monetary policy instrument is used to control inflation. One of the main transmission channels through which the central banks' monetary policy instruments can impact the economy is via credit markets or 'credit channel'. This mechanism simply implies that when a central bank increases interest rates, the bank rates also rise and therefore the credit decreases and consequently there will be a drop in output and will eventually affect prices and thus depress the economy. An opposite effect is when a central bank reduces interest rates, the implication would be the exact opposite of the previously mentioned process, in other words, the credit will increase which will ultimately increase output.

↓ Interest rates = ↓ Bank rates = ↑ Credit = ↑ Output = ↑ inflation or

↑ Interest rates = ↑ Bank rates = ↓ Credit = ↓ Output = ↓ inflation

Furthermore, as can be seen from above depiction, there is the notion that if there is an increase in credit, then output will also increase. This means that the stability of this financial system is important for further credit that is coming into the country as would be in the case of credit from the BRICS NDB into the BRICS countries.

1.2 BACKGROUND

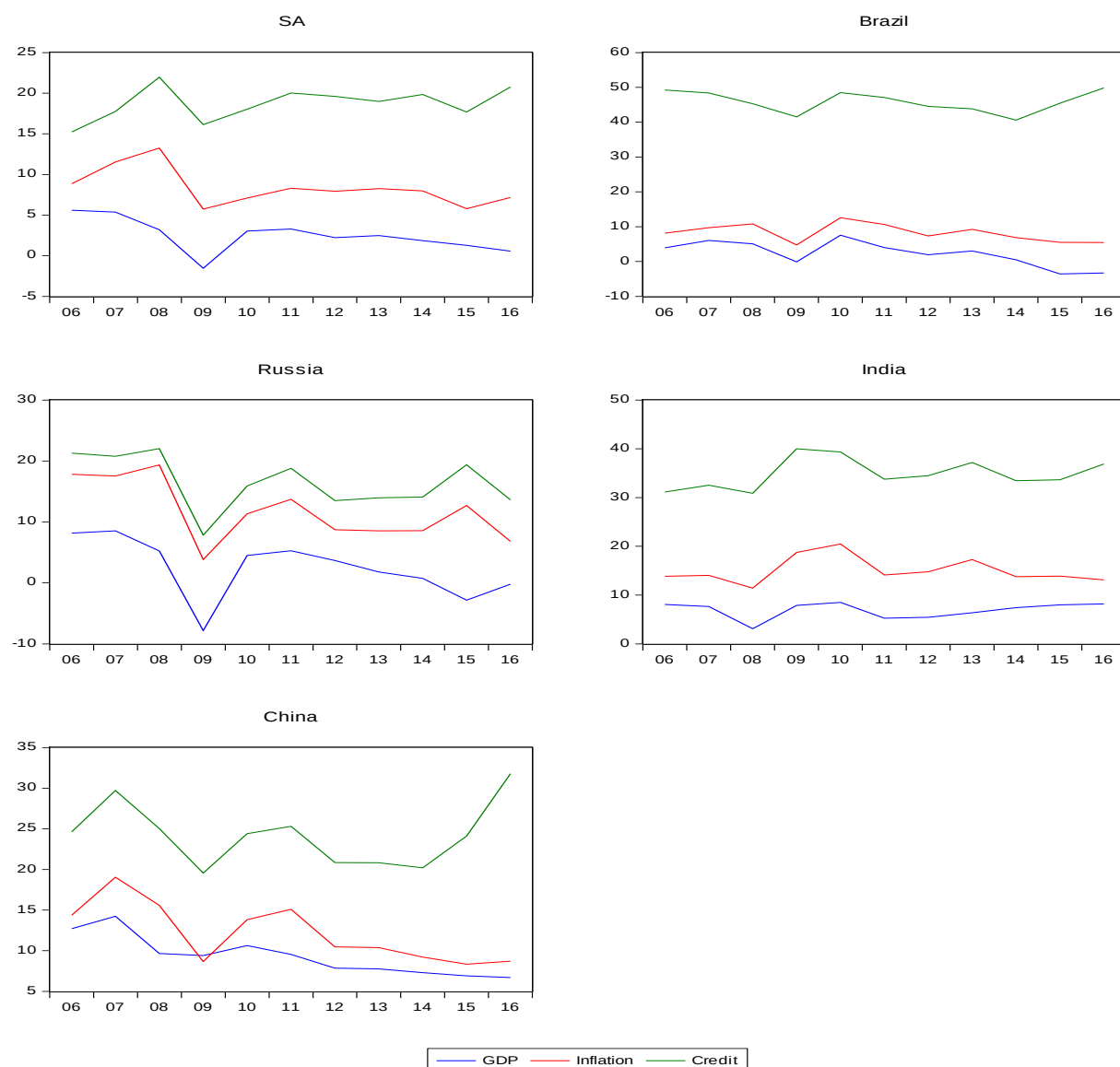
The study focuses on BRICS countries, which is a group that has been considered to be among the rapidly growing economies in the last decade. The study particularly focuses on how each country's monetary policy contributes to credit market development and economic growth and further investigates whether there is evidence of an optimal level of inflation for each of the countries at which credit market development and economic growth at simultaneously enhanced.

The acronym 'BRIC' was first devised by Jim O'Neil in 2001 of which the group initially consisted of only Brazil, Russia, India and China. The group was established in 2008 and South Africa was formerly introduced to the group in 2010 and thereafter the acronym became 'BRICS'. Jim O'Neil considered the BRIC countries to be amongst the rapidly growing economies worldwide and advocated that together, the group can have a big influence in the world economy. The BRICS was established mainly to facilitate financial assistance, promote development and support projects including infrastructure amongst the BRICS countries.

Moreover, BRICS countries commonly share similar monetary policy frameworks in the sense of inflation targeting or keeping inflation within a designated target. Although the goal of all five central banks is more or less the same, the BRICS countries operate under different monetary policy frameworks whereby from the group only Brazil, Russia, India and South Africa have adopted inflation targeting, with India adopting a flexible inflation targeting framework and South Africa adopting an inflation targeting range. China has not formally adopted inflation targeting and its monetary policy objectives consist of more than just achieving price stability (McMahon, Schipke and Li, 2018).

In order to gain understanding of the group's history as far as GDP, inflation and credit is concerned and how the 2008 global financial crisis has impacted these macroeconomic variables, Figure 1 provides graphical depictions of the trends of the variables from the year 2006 until 2016

Figure 1: Inflation, Credit and GDP in BRICS



Researcher's extraction from EViews

Like other developing countries, the GFC only had a major impact on Brazil's economy in 2009, although slight changes to GDP, inflation and credit were starting to show between 2007 and 2008. In 2007, GDP declined from 6.06 per cent to 5.09 per cent in 2008 and then drastically dropped to -0.12 in 2009, while credit was still fluctuating in the 30 per cent levels, it had declined from 41.08 per cent in 2006 and 38.68 per cent in 2007. Inflation levels kept increasing and deviating further from the 3.25 per cent target, where inflation rates increased from 3.64 per cent in 2007, to 6.63 in 2011 and 9.02 per cent in 2015. While GDP experienced a major increase from -0.12 in 2009 to 7.52 in 2010, it was anticipated that the country had

recovered remarkably from the crisis. However, since 2010 the GDP rates have been declining where the rates were at negative levels of -3.54 per cent in 2015 and -3.30 in 2016. Once more, while credit is showing to increase gradually each year, there is a downward trend in GDP.

As can be seen from the graph, Russia's inflation rates have always been at high levels until inflation decreased significantly in 2010 from 11.64 per cent in 2009 to 6.84 per cent in 2010. Inflation rates have been inconsistent between 2011 and 2016, reaching double-digits in 2015 of 15.53 per cent; Russia is yet to obtain its 4 per cent inflation target. In terms of GDP rates, Russia experienced a dramatic decrease from 5.24 per cent in 2008 to a staggering -7.82 per cent in 2009 and consequently, growth rates have been declining since. Moreover, with inflation well-beyond the target, growth rates were negative at -2.82 per cent in 2015 and -0.22 per cent in 2016 which managed to get back to a positive percentage of 1.64 per cent in 2017. Credit in Russia has been experiencing a steady increase over the years.

India has been growing as far as GDP is concerned, although the country has not managed to keep inflation rates within the long-term target of 4 per cent that is set by India's Reserve Bank. The growth rate has been steady and remarkable and the credit has been increasing since its drop from 21.27 per cent in 2009 to 18.86 per cent in 2010, with 23.76 per cent in 2016. Credit increased remarkably from 19.79 per cent in 2015 to 23.76 per cent in 2016 which can be argued to be as a result of the formation of the BRICS New Development Bank.

Furthermore, although China's GDP growth rates have been remarkable, there has been a gradual declining trend in GDP and following the GFC. The country experienced a significant drop from 14.23 per cent in 2007 to 9.65 per cent in 2008 after which the rates have been declining since, with the exception of 2010 where the GDP was 10.63 per cent. While the country's GDP is still around 6 per cent, it is significantly low compared to double-digit levels before the crisis in 2008. As far as the inflation rates are concerned, China does not have a formal inflation target, but unofficially aims to keep inflation around 3 per cent. For most of the period between 2006 and 2017, China has managed to achieve this goal, but not without some deviations where during 2009 inflation fell in the negative rates of -0.73. Credit in China showed a major increase from 2014 from 10.97 per cent to 15.75 per cent and again increased to 23.06 per cent in 2016.

From the period 2007 to 2009, South Africa experienced changes in GDP, Inflation and Credit. The effect of the Global Financial Crisis (GFC) was particularly visible in 2009, GDP fell from 5.36 in 2007 to 3.19 in 2008 and eventually hit negative levels in 2009 standing at -1.53 per

cent. Inflation increased from 6.17 in 2007 to 10.05 in 2008 and then dropped to 7.26 in 2009. With credit, there has been a gradual increase from 6.22 per cent in 2007 to 8.71 in 2008 and reached 10.40 per cent in 2009. Moreover, in 2010 South Africa showed improvements in all these macroeconomic variables, with GDP restoring back to the positives at 3.03 per cent, inflation started stabilising and what at 4.06 per cent, while credit continued with the gradual increase. This improvement in 2010 may arguably be due to South Africa's inclusion into the BRICS group as the country was formerly introduced in that year. Furthermore, although credit has been increasing, GDP rates are gradually declining while with the exception of the year 2016, inflation remained within the target of 3-6 per cent set by the SARB.

With the exception of Russia, there is a general trend evident from the graphs provided, which is that as credit increases, particularly the period after the formation of the BRICS New Development Bank, the GDP rates of Brazil, India, China as well as South Africa gradually declined. To reiterate the works of Mishkin (1995), Bernanke and Gertler (1995) and Ireland (2005) that suggest that when credit increases, so must output but seemingly, this is not the case with most of the BRICS countries.

1.3 PROBLEM STATEMENT

High inflation rates have an adverse effect on the efficiency of credit markets as central banks respond to these inflation variations by either increasing or decreasing interest rates. However, these changes in interest rates cause uncertainty among investors and therefore disrupt the credit market. The implication is that the output is affected as a result of the disruptions in the credit markets that potentially cause investments to decrease, which will consequently lead to a decreased or slow economic growth. Therefore, inflation should be kept at levels that will allow the development of credit markets and therefore promote economic growth. There has not been many studies examining these dynamics in the inflation-economic growth relationship, where the credit channel is factored in using the Non-linear ARDL modelling strategy.

One of the similar studies investigating the relationship between Credit markets, Inflation and Economic growth include that of Bose (2002) which focuses on the effect that inflation has on the behaviour of lenders as an important contributor to the inverse relationship between inflation and growth. Bose (2002) finds that inflation not only erodes the amount available for funding but rising inflation levels may negatively change the behaviour of lenders by focusing the equilibrium lending regime from screening to rationing or increasing the rationing incidence. Bose (2002) study however, does not provide explanation on the amount or percentage of credit that is needed or is sufficient to enhance economic growth under inflation.

Furthermore, studies such as those of Vazakidis and Adamopoulos (2009) investigate the relationship between bank lending, gross domestic product (GDP) and inflation rate using the Johansen co-integration analysis. Vazakidis and Adamopoulos (2009) study focuses on the effect that economic growth has on enhancing credit market development while taking into account the adverse effects that inflation has on credit market development. In the case of the current study and contrary to that of Vazakidis and Adamopoulos (2009), the focus is on the extent to which credit market development spurs economic growth considering the fact that inflation has a negative impact on credit market development.

Similar studies also include those of Arsene and Guy-Paulin (2013) who focus on the CEMAC area and that of Gillman, Kejak and Valentinyi (2004) who focus on OECD and APEC. Whereby Arsene *et al.* (2013) focus on the impact that economic growth has on credit and does not particularly look at how inflation affects credit and therefore economic growth. Furthermore, Arsene *et al.* (2013) study uses a Vector Autoregressive (VAR) model for their analysis and focus on only the period before and during the Global Financial Crisis, whereas

the current study factors in the years post the GFC to further study the importance of a developed credit market.

Moreover, the current study is unique from these previous studies firstly in the strategy of modelling chosen, which is the NARDL model and particularly on the countries chosen, specifically in the South African context. Considering that there has been a BRICS New Development Bank that has been established to make more funds available for development and infrastructure in these countries, it is useful to study how inflation affects the credit in these BRICS countries. Additionally, it is useful to study the levels of inflation that will not cause the credit markets harm and consequently allow growth in an economy through credit markets. This is the gap that the current study attempts to fill, in other words identifying the level of credit and credit market development that is needed to enhance economic growth as well as the level of inflation that will allow the credit market to have a positive impact on growth for the BRICS countries.

1.4 RESEARCH AIM: The aim of the study is to determine the levels of inflation that allows for credit markets to enhance economic growth in the BRICS countries.

1.5 OBJECTIVES:

1. To investigate the non-linear relationship between inflation, credit and growth in BRICS countries.
2. To determine the threshold level of inflation that allows for the credit market to enhance economic growth
3. To determine the extent of the effect that credit market development has on economic growth

1.6 HYPOTHESES:

H_0 : There is no long run non-linear relationship between inflation, credit and economic growth in Brazil.

H_1 : There is a long-run non-linear relationship between inflation, credit and economic growth in Brazil.

H_0 : There is no long run non-linear relationship between inflation, credit and economic growth in Russia.

H_1 : There is long run non-linear relationship between inflation, credit and economic growth in Russia.

H_0 : There is no long run non-linear relationship between inflation, credit and economic growth in India.

H_1 : There is long run non-linear relationship between inflation, credit and economic growth in India.

H_0 : There is no long run non-linear relationship between inflation, credit and economic growth in China.

H_1 : There is long run non-linear relationship between inflation, credit and economic growth in China.

H_0 : There is no long run non-linear relationship between inflation, credit and economic growth in South Africa.

H_1 : There is long run non-linear relationship between inflation, credit and economic growth in South Africa.

1.7 DATA AND METHODOLOGY

This study relies on annual data collected from World Bank Development Indicators as well as from the Penn State database from the period 1960-2019. The study is based on Brazil, Russia, India, China and South Africa (BRICS) and because the researcher presumes a non-linear relationship, the study employs the Non-linear ARDL (N-ARDL) model to examine the long run asymmetries between the variables. The presumption of a non-linear relationship is based on previous studies such as those of Das (2015), Eggoh (2014) and Fischer (1993) amongst others. The variables used in the study are Inflation (CPI), Credit (DCPS), Growth Domestic Product (GDP), Terms of Trade (TRADE), Labour (EMPL), Investment (GFCF) and Real Effective Exchange Rates (REER). Inflation, REER and Employment were transformed into their natural log values to moderate outliers and attempt to correct the problem of serial correlation.

The study uses endogenous growth theory to derive the empirical specification and makes use of a Non-linear ARDL (N-ARDL) model developed by Shin, Yu and Greenwood-Nimmo (2014). The advantage of employing the N-ARDL is that since the N-ARDL model is a Bounds test which depicts long run relationships and if the study finds evidence of co-integration amongst the variables and the effects of these relationships, then the study's objective will be achieved. The model introduces short- and long-run non-linearities through positive and negative partial sum decompositions of the explanatory variables. However, instead of following the conventional rule of the model of thresholds greater than or smaller than zero, this study will look at inflation that is greater than and less than the points of fluctuation at a certain point. Another advantage of the N-ARDL model is that it is capable of capturing the optimum point of inflation.

1.8 SIGNIFICANCE OF STUDY

This study will be the first to consider the N-ARDL model with threshold effects for this particular relationship and for the proposed countries. The expected outcome of this study is to establish the level of inflation that enhances credit development which is an important monetary policy finding to validate the suitability of the current inflation targets that the central banks have set for their respective countries. Thereby, identifying the inflation threshold that will allow for economic growth. The role of the credit channel as a monetary policy transmission has been debated extensively in literature, therefore, this research will bring the validation or otherwise that a highly efficient credit market can spur economic growth under certain inflation levels. This study will not only provide results for the inflation-growth nexus,

but also threshold levels of inflation and also bring light to the role played by credit market development in this relationship. Moreover, the study incorporates credit market development in exploring the relationship between inflation and growth using the ARDL model. This study brings two topics that have been extensively studied separately in literature, into one study that will provide recommendations not only to domestic monetary authorities in BRICS countries but also to heads of states and respectively policy-makers who head the BRICS summits.

CHAPTER 2

2.1 BRICS: AN OVERVIEW

The BRICS is an association of 5 major emerging market economies which initially consisted of only four countries and South Africa later joined the group in 2010. Jim O'Neil coined the BRIC acronym based on his perception that the group would have a remarkable influence on the global economy and that these countries are amongst those with rapidly growing economies. To date, the group is not only considered to be a major influencer in the global economy but is recognised for its advocacy of reform, shared prosperity, diversity and rights of developing countries. The BRICS as a group accounts for 43 per cent of the global population, with three countries from the group ranked in the top 10 economies based on GDP size with China being the second, India taking seventh place and Brazil at number nine (Maasdorp, 2019).

The primary purpose and objectives of the BRICS bloc is to provide financial assistance to member countries and eventually non-member countries to enhance sustainable development in emerging economies. Furthermore, the group's other objectives include supporting infrastructure projects and promoting cooperation for development within the group. The BRICS' long term strategy rests on the group's five pillars which are; promoting cooperation for economic growth and development; social justice, peace and security, sustainable development, and quality of life; political and economic governance; and progress through knowledge and innovation sharing.

Furthermore, the BRICS bloc gather once every year at the BRICS annual summits held each time at a different BRICS country and so far, the group has held eleven summits. The first summit was held in Yekateringburg, Russia on 16 June 2009 where it was only Brazil, Russia, India and China at that time. The second summit took place in Brasilia, Brazil on the 15th of April 2010 and this time, South Africa had joined the group; The third summit was held in Sanya, China on 14 April 2011; 29 March 2012 was the fourth summit held in New Delhi, India; the fifth summit was hosted in Durban, South Africa from 26-27 March 2013; 14-16 July 2014 was the sixth summit held in Fortaleza, Brasilia; Ufa, Russia hosted the seventh summit during 9-10 July 2015; the eighth summit took place during 15-16 October 2016 in Goa, India; Xiamen City, China held the ninth summit from 3-5 September 2017; the tenth summit was held in Johannesburg, South Africa in 2018 and in 2019, the eleventh summit was held in

Brasilia, Brazil. The group's twelfth summit is scheduled to be held in Saint Petersburg, Russia in July 2020.

Some of the topics and themes discussed in these summits include: Reform and International Financial Institutions; International Investment and Environment; Fight against poverty; Development; Climate Change; Strengthening Cooperation; BRICS NDB; Local currency extension facilitation agreement; Contingent Reserves Arrangements (BRICS policy center). Moreover, apart from the annual BRICS summits, the groups' senior government officials, ministers, academics amongst others, meet within the restrictions of the G-20, World Bank, United Nations and IMF meetings.

Furthermore, in an effort to achieving sustainable economic growth, the BRICS countries place emphasis on investments that are related to energy, new medical technologies, information telecommunications as well as the development of drugs in order to also ensure a diverse economy (Economic Commission for Africa, 2014). Evidence of BRICS' commitment to investment into a green economy can be seen from an agreement was concluded in the 5th BRICS summit where which two key agreements were concluded which mainly involves financing infrastructure and the green economy, namely The BRICS Multilateral Infrastructure Co-Financing Agreement for Sustainable Development (ECA, 2014). According to ECA (2014) the role of the first agreement is to create an environment that will allow the co-financial arrangements for infrastructure projects to be established across Africa and the latter agreement is premised around the establishment of bilateral agreements that involve the launch of co-financing agreements and cooperation in defined around green economy elements as well as sustainable development.

2.2 POLITICAL AND ECONOMIC OUTLOOK OF BRICS COUNTRIES

2.2.1 BRAZIL

Brazil is well-known for its major reforms which include social, institutional as well as political economic reforms which has been a trend since the 1980s. One of the beacons of reform in Brazil was during the 1990s whereby the country embarked on a range of reforms including trade liberalisation, opening up the economy to foreign investment, decentralised a number of state-owned enterprises and a new regulatory framework was gradually established, amongst other things. Brazil has been battling with achieving a steady economic growth trend as the country's economy has shown strong economic growth for many years with severe economic crises that follow. Therefore, the government in Brazil is known for its interventions in the country's economic development which is evident with the many reforms in Brazil. Brazilian government intervention includes the coordination of production decisions, financing both public and private investment as well as protecting certain sectors and setting prices.

Brazil is relatively new to democracy as the country experienced long periods of dictatorship between 1930-45 and 1964-85 of which this period of imperialism ended in the late 19th century. Brazil had a long and difficult process of developing its democracy and this resulted in a back-and-forth movement until the mid-1980s where the country finally obtained mass democracy. The ceding of the presidency to a civilian in 1985 by the military, followed by the enactment of a new constitution by the Constituent Assembly in 1988 as well as the direct popular elections for president that were held in 1989 for the first time since 1960 (Pinheiro, 2015), are arguably some of the indicators of the mass democracy that was established in Brazil.

Furthermore, the political economy of Brazil involves a substantial amount of corruption cases which ranging from the Collor's affair, the mismanagement of the national budget, federal government getting crop stocks from private warehouses, unlawful access to credits issued to public agents such as bureaucrats and politicians where which treasury requirements were not followed and last but not least, there was a case whereby the Federal Bureau of Control was tipped off on contracts of security guards where the salaries were heavily inflated substantially above the market salary.

As a result, Brazil has put in place a Federal control system in an attempt to monitor the behaviour of civil servants. Under this system there are six units in total that consist of: 1) The Federal Bureau of Control; 2) the Integrated System of Financial Management (SIAFI); 3) the

Federal General Advocacy; 4) the Federal Audit Court; 5) the Public Prosecutor and lastly; 6) the Federal Police. Although the success of these measures have not yielded the desired results, they are an indication of the acknowledgement of the corruption in the country and the attempt to counter it.

2.2.2 RUSSIA

The transformation of Russia from the Soviet central planned economy between the years 1991 and 1998 was a complex process and a possible exacerbation to the process was that this transition overlapped with most of President Boris Yelts' regime. As a result, the country's economy experienced some chaos shown by a significant drop in its real GDP accompanied by high inflation rates that reached over 2 000 per cent in 1992 before declining to 800 per cent in the following year. The high inflation rates took a toll on the value of the Ruble as it collapsed during that period, thereby forcing a sharp devaluation of the currency by Russia's government in January 1998.

Consequent to the transition from the Soviet system, between 1992 and 1998, Russia experienced an increasingly large foreign debt partly as a result of adopting the former Soviet Union's foreign debt as part of an arrangement amongst other Soviet states; there was also capital flight worth approximately \$150 billion, amongst other things. Furthermore the collapse of the economy which was a factor of the Soviet government as well as rapidly disintegrating a state-controlled, albeit guided by the communist party, economic system was what sustained economic problems even post-Soviet government. In this economic system, heavy emphasis on industry production was placed by the government regardless of the monetary consequences and the damage to other sectors such as the services and consumer industries as well as the agriculture sector. Cooper (2009) argues that the high inflation accompanied by the economic disorder during the 1990s played a major role in the political and social instability which the government consequently had to rule in wasteful spending in an attempt to control inflation and obtain stability.

Fortunately, Russia's economy improved from 1999 and maintained an impressive economic growth between 1999 and 2008 which unfortunately ended abruptly in the last quarter of 2008 when the Global Financial Crisis hit the global economy. The Russian economy before the crisis was growing impressively, however, the plunging of world oil prices had already impacted Russia's economy during mid-2008 which was problematic for the Russian economy as oil is a pivotal source of government funding and export revenue for the country.

2.2.3 INDIA

By 2009, the Indian economy has been growing impressively since 2003 with a steady per capita income. This progress may be attributed to various factors including some of the initiatives that were introduced during the time of Indira and Gandhi's governing between 1980 and 1989. These initiatives were premised around favouring established Indian producers, redirecting the Indian economic policy towards big business, albeit it was not a priority to obtain foreign direct investment during the 1980s and additionally, Indira's government reduced the strong anti-capital rhetoric that was deployed in the 1970s.

Furthermore, during the early 1970s, Indira Ghandi became prominent in the political platform with the Garibi hatao (end poverty) slogan for her election campaign of which some parts of the Monopolies and Trade practices were retired by the Congress government of the 1980s which resulted in the expansion of big businesses in key sectors such as chemicals and cement, being convoluted. With India being a relatively closed and protected economy between 1956 and 1974, the country's domestic private sector was gradually given some liberation during 1975-1990 which allowed the country's GDP to rise.

Compared to its counterparts and particularly China which adopted a rapid approach to reform, India is a state that has been infiltrated by social actors and was unable to adopt globalisation as well as eliminate private enterprise with the same pace as China as both these transformations would require the Indian state to have larger control over interest groups such as trade unions, industrialists and farmers. Moreover, enhancing economic growth eventually became unsustainable in India as large subsidies went in and out of the agricultural system which included cheap food going out of the Public Distribution System (PDS) and cheap water, power and fertiliser going into the PDS and this ultimately led to the spurring of the Indian economy and resulted in the 1991 fiscal and balance of payments crisis. In response to this crisis, Congress as well as the National Front (1989-91) governments were forced, due to the combination of limited tax concessions to big businesses and pervasive tax evasion, to increase revenues by borrowing more domestically and abroad, as well as through deficit financing and thus rendering this process unsustainable (Corbridge, 2009).

Mukherji (2010) posits that it was only after the balance of payments crisis in 1991 that the country succeeded in substantially deregulating the economy to favour the private sector, a period which coincided with the aggressive industrial policies that favoured export promotion.

2.2.4 CHINA

It is a well-known fact that the Chinese economy soared after the 1978 economic reforms which were implemented over a 10-year period on a gradual approach over the period 1984-1994 which promoted the country's economy to rank higher-middle income. China implemented a spectrum of reforms such as price reform, institutional reform, the reform of state-owned enterprises (SOEs), opening up the economy to the world as well as allowing the market to access the private sector, which brought significant transformation in the Chinese economy. Although China has made significant progress with the promotion of entrepreneurialism, the impressive growth rates and the continuous integration into the global economy, these achievements have been met with overwhelming socio-economic issues pertaining to the displacement of people, environmental degradation and the income gap that keeps stretching in China.

Furthermore, China's reforms were concentrated more on economic reform rather than political development. Furthermore, as much as the new leadership that will be presented at the Seventh Party Congress, is noticeably different to their forerunners and the fact that they have included political reform in their agenda, the Chinese Communist Party maintains the preference of a one-party monopoly of power. As a result, the issues of human rights violation are still widespread particularly in the labour rights and public health as well as religious freedom areas.

Both Chinese leaders and their advisors have been open about the lagging behind of the country's political reform as compared to the economic and social reforms. The sluggish political reform could be attributed to most of the country's leaders being hesitant to this reform based on the perception that their interests and power would be undermined as a result of the public gaining oversight on these officials. In addition to official leaders' hesitation, members of the public may also be uncomfortable with the transition to democracy as it has been the Chinese culture that government officials are selected on merit together with the fact that the country has always selected bureaucrats over the years, therefore they may not trust and may lack the patience with elected politicians.

Moreover, as much as it may seem that the Chinese are resistant to political reform, one cannot discard the possibility that the CCP may actually follow through in pursuing political reform. In addition to this, dynamics within the global economy may force the country into the direction of such reforms, such as the desire for an improved global image of China, increase in public awareness of citizen rights and interests, the legitimacy of the one-party rule might incur a sharp decline, dispersion of democratic values and international norms as well as increasing

demands for the commercialisation of the media and freedom of the press, amongst other things (Li & Zhang, 2007).

China is a party state whereby the course of economic policy is established by the ruling party which is the Communist Party of China (CPC) and the government implements these policies based on their priorities which are also established by the CPC. Furthermore, China's decision-making system is based on a formal hierarchical structure of which the CPC's Politburo Standing Committee is at the core of this structure. It follows that the State council forms the state system under which various ministries and agencies form part of, this includes the People's Bank of China, the Ministry of Finance as well as the National Development and Reform Commission).

2.2.5 SOUTH AFRICA

The South African economy has been struggling against the backdrop of the Apartheid system which discriminated against black South Africans. The Apartheid regime consisted of a set of policies that categorised South Africans based on their race and that which excluded blacks between the year 1948 and 1994. This exclusion was aimed at placing black people at a disadvantage starting from education of which black people did not have access to the same level of education that the whites had and in addition to that, blacks were denied the skills development that their white counterparts had the privilege obtaining. The legacy that the Apartheid system left behind, resulted in alarming rates of unemployment, lack of skilled workers and poverty, which are issues that the government has been struggling to counter with socio-economic policies that prioritise the poor.

Thompson and Wissink (2018) acknowledge South Africa's attempts at transforming socio-political, economic and legislative system, however, they also argue that the country has only long-drawn-out spatial gaps in socio-economic development that exists to this day amongst different demographic groups, to show for such attempts at change. Faced with a spectrum of issues such as racial inequality, unemployment, a public bureaucracy that was established to favour mainly a minority group and as well as a sluggish economy that was a result of the Apartheid, South Africa implemented a range of reforms between 1994 and 2012 which included practical socio-economic policy as well as institutional and legislative reforms.

Moreover, some of the changes the ANC-led government has implemented over the years since they came into power include the publication of white paper, the publication of white papers as well as adopting policies that highlight fundamental rights as well as those that counter the

triple threat of inequality, poverty and unemployment. Furthermore, some of the national municipal and provincial socio-economic development framework consisted of the Reconstruction and Development Programme (RDP) (1994), the Growth, Employment and Redistribution (GEAR) (1996), the White Paper on Local Government (1998), the Expanded Public Works Programme (2004), Policy Guidelines for Implementing Local Economic Development in South Africa (2005), Accelerated Shared Growth Initiative of South Africa (2006), Department of Provincial and Local Government unveiled the Framework for Local Economic Development (2009), Medium Term Strategic Framework (2009-2014), New Growth Path (2010), the National Development Programme – 2030 which was adopted in 2012 and lastly, the Radical Economic Transformation (2016-17).

In addition, Coetzee, Daniel and Woolfrey (2012) describe the democratic South Africa's political institutions as possessing three spheres which consists of 1) the Executive; 2) the Legislative (where which three layers of local, regional and national government is established within the legislative sphere) and (3) the Judicial spheres. Furthermore, the Executive is comprised of the President, the Vice President as well as their Cabinet, whereby with the aim of separating powers, the President concludes his/her membership of parliament as soon as they take up office. The Legislative sphere which refers to the local governments consisting of representatives that are elected on the basis of a combination of constituency-based and proportional representation. The local government is responsible for issues such as building regulations, electricity and gas reticulation, air pollution, fire fighting services and municipal planning, amongst other things. Finally, the responsibility of the Judiciary is that once the laws that are formulated the executive have been passed by parliament, they are to enforce these laws to the public at large.

2.3 MONETARY POLICY: AN OVERVIEW

2.3.1 BRAZIL

Brazil is known for its long history of high interest rates accompanied by poor macroeconomic performance. Brazil's usual response to continuous external as well as internal crises is mainly through institutional reforms. The economic reforms implemented in Brazil involved the expansion of trade liberalisation through eliminating a wide range of trade barriers, privatisation of state-owned enterprises in the chemistry, railroads and telecommunications sectors. As part of these reforms, unsound institutions were liquidated, restructured or merged, representing the submission to fully-fledged reformation of the financial system. Furthermore, the *Real Plan* of 1994 is another example of such reforms where the main instruments of stabilisation were interest rates and the exchange rates, otherwise known as the monetary and exchange rate anchor. Unfortunately, under this reform, the Brazilian economy has been sluggish and the *Plan* has been virtuous in maintaining price stability amongst other things.

Unfortunately, these reforms eventually led to imbalances in the balance of payments despite the fact that they successfully brought Brazil's history of persistently high inflation to an end and consequently, a problem linked to monetary authorities' use of interest rates to influence foreign capital emerged (Arestis, Filho & Paula, 2008). Consequently, the use of interest rates to attract foreign capital ultimately led to economic performance and fiscal balance of payments weakening through increased public debt.

Furthermore, the economic reforms were unable to prevent the Brazilian economy from substantially slowing down, this was evident especially when the country's economic performance is compared to its counterparts as well as its own historical trend. The country's performance in other macroeconomic domestic indicators also declined or entered a concerning trajectory which involves the significant decline in investment behaviour with levels averaging at 17.2 per cent of GDP.

Like many other countries during the 1990s, Brazil adopted the Inflation Targeting Framework in 1999 at the abandonment of the exchange rate as a monetary policy anchor. Brazil targets inflation with a tolerance interval of ± 2 per cent annually, the inflation targets set by the BCB were 8 per cent for 1999; 6 per cent for 2000 and 4 per cent for 2001. Following Brazil's adoption of the IT regime, the so-called 'macroeconomic tripod' which is a combination of three fiscal and monetary policies, emerged shortly after – a transition that can be seen as a modernisation of Brazil's institutions.

Brazil adopted the inflation targeting regime, like many other countries, consequent to the failure of the exchange rate peg regime and in Brazil's case, this was accompanied by the deep financial crises during the 1990s. These crises involved the South East Asian and Russian crises as well as the international recession during 1997 to 1998. The abandonment of the crawling-peg exchange rate was primarily due to the Russian crisis, whereby Brazil was forced to adopt a floating exchange regime. However, the exchange rate subsequently depreciated and resulted in adverse consequences on the inflation front via pass-through effects (Arestis *et al.*, 2008). The BCB simultaneously increased the Selic rate in reaction to the currency-depreciation shock of which the currency rapidly appreciated and as a result, the inflation rate reached single figures despite the devaluation at the beginning of 1999. However, increasing the Selic rate became a primary tool to counter inflation which led to some opposing outcomes such as the fall in private investment, a rise in public debt spending and the current account imbalances.

Furthermore, Brazil has been struggling with long periods of high inflation rates since the 1960 where inflation reached a level around 100 per cent, despite the adoption of inflation targeting. Although during the period after this, inflation rates subdued, between 1980 and 1994 inflation once again rose beyond the 100 per cent as a result of the 1973 oil shock. Ayres, Garcia, Guillen and Kehoe (2019) credit the high inflation period between 1964 and 1994 to a combination of monetary policy that was passive, fiscal deficits and debt financing constraints which led to a period of low inflation during 1995-2016 although no significant improvement was reflected on economic growth. Furthermore, although during this period, Brazil's central bank's independence slightly increased, to this day, monetary authorities still lack greater access to debt financing and the central bank is not yet formally independent.

2.3.2 RUSSIA

Russia was the largest of 15 states that gained independence after the Soviet Union was dissolved in late 1991, each country with their own institutional structure and economic policies. Some of the changes/reforms that Russia implemented post-Soviet Union included privatising majority of the state-owned enterprises, liberalising prices in 1992 and in mid-1992 the rouble was made exchangeable. The Bank of Russia's initial function was a legacy of the Soviet system whereby the Bank of Russia was to provide directed credits to particular sectors and to finance government deficits. Subsequently, the role of the Bank of Russia became that of an independent body that is responsible for maintaining the stability of prices.

Unfortunately, a host of institutional factors hindered the CBR's effectiveness, with majority of banks being controlled by the state. Furthermore, Russia's economy under the Soviet system

was centrally planned prior 1987 with the state controlling over 90 per cent of production and investment. During this time, there were four financial institutions that existed including; the State Bank for Foreign Trade, the Savings Bank, the Gosbank and the Construction Bank, whereby the Gosbank was responsible for the monetary policy operations.

Furthermore, the Soviet planned economy began reform in 1987 through decentralisation and liberalisation aimed at improving the economy's efficiency. In addition, during 1997 and 1998, reforms in the financial sector were introduced which were essentially meant to create a dual banking system that separated three specialised banks from direct state control. Additionally, the decentralised system of 1987 led to the placement of ceilings on the aggregate credit granted by each specialised bank of which ultimately the credits were funded by the Gosbank that had the function of allocating credit to these banks.

Russia's history of economic reform is characterised by persistently high inflation and fluctuations in prices since the early 1990s. According to Ryttilä (1994), developments in the Soviet-Russian financial system can be divided into three sub-periods. The first period represented an era of a Soviet planned economy whereby under the government's control, the Gosbank's role was to act as an instrument of implementing the government's economic plan. The second period which was during 1987-1992 was one whereby the monobank system and independence in the country's financial developments were disbanded as a result of the Soviet banking system break-up. Finally, the years 1993-1994 represents the third period for the Russian financial system where the rouble was the single currency and the rouble zone appeared to have been abandoned. Furthermore, the need to strengthen the central bank's supervisory capacity came about as a result of rapid developments in the financial and banking system.

2.3.3 INDIA

The Reserve Bank of India was established in 1934 whereby its main functions was to operate the credit and currency system to the country's advantage, to control the issue of bank notes and maintaining reserves with the intent of maintaining monetary stability in India. Furthermore, monetary policy in India has undergone a number of amendments since, specifically the 2016 amendment to the RBI Act where the primary objective was to maintain price stability, with the growth being kept in consideration as well. Following this, RBI adopted a Flexible Inflation Target (FIT) as price stability was delineated in terms of inflation target based on CPI. Furthermore, the government in consultation with the RBI determined the

numerical value of the inflation target which was subsequently announced to be 4 per cent with a bank of +/- 2 per cent for 2016/17.

Furthermore, prior to the mid-1980s, India's monetary policy was characterised by credit planning, with the main objective being channelling credit at discounted administered rates and the public sector bank being the intermediaries to further the country's economic objectives. India's economy from 1990 to 2009 was financially repressed, with fiscal policy dominating, administered interest rates, high statutory pre-emption and sectoral credit targets. During this time, India negotiated some significant changes within the structure of the financial sector which led to the liberalisation of the banking sector, removal of interest rate regulations, reduction in fiscal dominance as well as the development in financial and money markets (Mohan & Ray, 2018). Consequently, India's financial sector became market-oriented.

India's monetary policy evolution can be divided into 6 phases (see Mohanty (2017) and Das (2020)):

1935-1949: Initial/Sterling Parity – The primary objective prior to independence was to maintain a fixed exchange rate which was the nominal anchor for monetary policy by regulating liquidity using 3 monetary policy tools which included the Cash Reserve Ratio (CRR), Open Market Operations (OMOs) and the Bank rate.

1949-1969: Developmental Years – This period was characterised by two distinct developments, the first one being the nationalisation of the RBI by the government in 1949, a move that was motivated by global trends. The second development refers to the representation of the Banking Regulation Act for comprehensive development of the banking sector. Furthermore, subsequent to the country's independence in 1949, the government followed a policy of planned economic development which showed a turning point in the country's monetary as well as financial policy.

1969-1985: Credit Planning – The primary focus of monetary policy during this period was credit planning and the main aim of the nationalisation of banks was to ensure that credit was made available to a wider range of people and activities. However, this led to a challenge faced by the RBI as more banks gained access to credit expansion, it became more challenging to maintain a balance between the sharp increases in money supply as a result of credit expansion. Moreover, a number of factors contributed to the inflationary pressures that were experienced during the 1970s which include the 1971 Indo-Pak war, Global oil price shocks in 1973 & 1979, Drought in 1973 as well as the collapse of the Bretton-woods system in 1973.

1985-1998: Monetary targeting – Based on the recommendations of Chakravarty Committee (1985), the main focus of monetary targeting was to manage inflation through controlling (limiting) the supply of money. Under the monetary targeting framework, the Reserve money was used as the operating target and the broad money (M3) was used as an intermediate target.

1998-2015: Multiple indicators approach – In 1997, as an approach to contend with the Southeast Asian crisis, the Indian economy had to raise the bank rate significantly to 11.1 per cent by 200 basis points in the attempt to counter capital outflows. Evidently, the period 1997/98 was the period where interest rates as a monetary policy tool was activated, whereby the bank rate was changed 7 times. Furthermore, the RBI adopted multiple indicators in April 1998 as a result of the efficacy of monetary targeting framework being undermined by financial innovations. This new approach possesses indicators such as output, inflation, credit, capital flows, trade, returns in different markets, exchange rates and fiscal performance.

2015 – onwards: The RBI decided to review its monetary policy framework subsequent to inflationary pressures, a new credible nominal anchor needed to be established considering the 6-year double digit inflation that India experienced. Following the Expert Committee's recommendations, a Flexible Inflation Targeting monetary policy framework agreement was signed between the RBI and the Government of India on February 2015. Following this agreement, a Flexible Inflation Targeting framework was formally adopted from the 2016/17 financial year of which the target was met.

2.3.4 CHINA

As mentioned previously in the text, China has not explicitly adopted IT as a monetary policy framework (China does not have a single obvious objective), however, maintaining price stability in the country's financial system is the PBoC mandate. The Chinese policy implementation's transformation dates back to the 1990s where it previously relied on quantity-based instruments, to having a mixture of price- as well as quantity-based instruments. The Chinese policy framework typically consists of implicit – final targets which refer to growth, inflation and financial stability, indicative or intermediate targets which include the banking system credit growth as well as the M2, implicit or operating targets which consists of overlooking short-term interbank interest rates and reserve money, policy instruments which include reserve requirements, open market operations (OMO), rediscount, re-lending, base lending and deposit interest rates.

Furthermore, some of China's policy instruments include commercial bank deposit and lending rates, OMOs through Central Bank bills and the reserve requirement ratio, administrative measures, window guidance which provide the financial institutions although without legal promise, direction on growth and credit sector allocation and the level of the renminbi exchange is influenced through foreign exchange interventions (He & Pauwels, 2008).

Although China has not formerly adopted inflation targeting, it has achieved remarkable stability (low inflation rate) throughout the years and therefore begs the question of what China does differently to the rest of the BRICS countries specifically with its monetary policy. Furthermore, out of the BRICS countries, China is the only country that has a dual mandate which is economic growth and price stability, unlike the rest of the countries whose mandate is targeting inflation. Furthermore, Giradin *et al.* (2017) suggest that a combination of historical transformations that could be attribute to China's rapidly evolving monetary policy;

1. The PBoC's role and responsibility that has been enhanced by the institutional reforms in the country.
2. As a result of China's rapid trade and financial liberalisation, the country is financially integrated into the global economy.
3. The increased sensitivity of consumption to the cost of capital and prices as well as investments could be attributed to the country's SOE reform during the 1990s including the swift development of and enhanced job creation by the private sector.

Initially, China's central bank primary instrument for controlling credit and money supply prior 1998, was the credit plan and the central bank only adjusted loans and interest rates on deposits on certain occasions. The Central bank of China only began conducting OMOs regularly in 1998 with the aim of sterilizing foreign exchange interventions and proceeded with the heavy use of RRR in late 2007 which was a result of the PBoCs perception that the RRR are more cost effective relative to the OMOs.

Furthermore, before the reforms, China's history was a closed, stagnant, substantially inefficient and poor economy which was centrally controlled which essentially isolated the Chinese economy from the rest of the world. Once China opened up to the global market and participated in free trade, investments and implanted free-market reforms in 1979, the economy began to experience remarkable performance. Since the reform, China has been among the fastest-growing economies, with a high real annual GDP growth average, being the world's

largest economy in manufacturer merchandise trader as well as being the largest holder of foreign exchange reserves.

Furthermore, China initially had an under-developed financial sector and therefore implemented gradual liberalisation for both bank and financial markets together with the gradual liberalisation of interest rates whereby first the short-term interbank rates were de-regulated in 1996 and 1997 and the long-term interest rates were de-regulated in 1988 and 1989 once national bond and policy financial bond prices were allowed to be determined by markets. However, Leung and Lu (2011) report that interest rates were not entirely liberalised as the fixing of the benchmark floor rate for bank loans and cap rates for deposits is still the responsibility of the PBoC. Consequently, China has two different instruments of action with the first one being that some instruments are not yet fully liberalised and instruments that transform the central bank's policy position through the interest rate channel of monetary transmission such as OMOs or minimum requirements.

2.3.5 SOUTH AFRICA

The main purpose of earlier Central Banks was to facilitate the development of banking systems and the provision of finances to government and served as the last resort lender in the attempt of protecting the stability of the banking system. Furthermore, during the years of The Great Depression and the rise of the Keynesian economics, the mandate of central banks included the promotion of full employment, monetary stability and maximum production, however, this changed during the 1960s and early 1970s when inflationary pressures became noticeable and thereafter the central banks shifted focus in terms of monetary policies pursued and focused on maintaining the domestic value of the currency. Consequently, during the 1980s, many central banks were given the mandate of protecting the currency was given to many central banks. Subsequently, there were contractions in monetary policies which were evident with the various increases in Bank rates in 1989, amongst the reasons for the tightening in monetary policy was that banks perceived rising inflation to hinder monetary stability; domestic expenditure which was financed by substantial increase in the money supply hindered economic growth sustainability.

According to Burger and Marinkov (2008), out of the 3 distinct monetary policy regimes in South Africa since 1980, improvement on SARB's performance was exhibited once they pursued low inflation rates which was considered an implicit objective during the second regime. During the third regime which was the beginning of the inflation targeting regime

(2000 – present) some slight progress in maintaining low inflation rates was experienced, although the ability to keep inflation rates within the official target was inhibited.

Furthermore, South Africa's monetary policy performance as well as its impact on inflation was indeed affected by the changes in monetary policy regimes since 1980. These changes include 3 different governors of the reserve bank between 1980 and 2002, liberalisation of financial markets, money supply (M3) targets set in place and the adoption of the ITR in 2000 which was the first target set for 2002.

Moreover, during the second regime and consequent to the actual pursuit of then objective which was to protect the internal and external value of the currency, inflation rates reached single-digits. Furthermore, the periods 1990s, 2001/2 and 2007/8 were periods where economies globally were affected by the Asian crisis, dot.com bubble burst as well as the global financial crisis whereby South Africa experienced both a depreciation in currency and increase in inflation.

The function of the SARB was to achieve monetary policy objectives which include money stability, defending the Rand currency, maintaining low inflation rates and most importantly to utilise the transmission mechanism to stabilise the general price level. Moreover, due to the complex, difficult to manage and time-consuming nature of the transmission mechanism, many monetary authorities established intermediate targets whereby the authorities use monetary policy instruments to influence these intermediate targets directly. Furthermore, the traditional and most popular intermediate targets include monetary aggregates (money supply) and the exchange rate. According to SARB (2011), in their monetary policy regime (framework) during the 1990s up until 1998, South Africa infused the use of money supply targets, an action which was based on the belief that inflation is a monetary phenomenon, where inflation is cured by the effective control of the money supply.

Following a hesitation for adopting inflation targeting as a monetary policy framework despite the global trend of central banks, the SARB eventually adopted the IT framework in 1998 whilst they already had an existing implicit inflation target that was in place before officially following the IT regime. This was the SARB's attempt to align the country's inflation rate with its competitor countries and major international trading partners' average inflation rates.

2.4 THE BRICS PROJECTS AND THE IMPACT OF THE 2007/8 GLOBAL FINANCIAL CRISIS

Since the establishment of the BRICS bloc, there has been many projects founded by the group that primarily seek to enhance the relationship, communication and development within the BRICS economies. Therefore, in an attempt to strengthen relations between the group's businesses, trade and investment the BRICS bloc established the BRICS Business Council which was launched in 2013. It was at this launch that the idea of instituting a BRICS New Development Bank (NDB) came about. The main objective around the establishment of the BRICS NDB was to allocate resources towards sustainable development and infrastructure within the BRICS countries. Furthermore, the formation of the BRICS NDB was a clear challenge of the international system status quo and an effort to redirect power from the industrialised countries to the emerging market economies. Another reason for the establishment of the bank was the evident gap in major financing-infrastructure in the countries, a gap which once minimised can lead to greater access to markets, a rise in productivity and eventually enhanced economic growth.

Amongst the many projects the BRICS group promotes, great priority is placed on knowledge and as such the group launched the BRICS Academic Forum in the attempt to harness partnership between the private sector, BRICS universities as well as BRICS governments. Included in the BRICS projects is the BRICS Think Tank (BTTC) which was formed in 2013 with the primary objective being to create a platform where think tanks, researchers and academia would be able to brainstorm ideas, for the purpose of policy recommendations as well as to offer guidance to be taken into consideration by the BRICS. Furthermore, the BTTC consists of a spectrum of institutions which include; the Institute for Applied Economic Research, National Committee for BRICS Research, the Observer Research Foundation, the China Centre for Contemporary World Studies and the National Institute for the Humanities and Social Sciences.

The next section will be discussing how each of the BRICS countries were impacted by the 2007/08 GFC.

2.4.1 BRAZIL

Brazil's initial recovery from the crisis led many to think that the country's economy would escape unscathed from the financial crisis and its growth would not suffer in years following the GFC. Moreover, Brazil's existing economic conditions during the time of the 2007/08 GFC

may be an explanation to how the country eventually recovered well from the crisis and was not hit as badly when compared to its emerging economy counterparts and even the developed countries. Brazil's economy during 2006 exhibited favourable conditions which consisted of low consumer debt, idle capacity and financially-sound companies in most sectors, short term consumer liabilities and strong prudential regulations that were implemented by the Central Bank of Brazil since the 1990s banking crisis. Furthermore, Brazil's Central bank maintained monetary policy conduct that targeted inflation and designed its fiscal policy to complement the country's Growth Acceleration Program which may have counted in the country's favour when it faced the global crisis.

The GFC began in September 2007 with the Lehman Brothers filing for bankruptcy, however, the impact on the Brazilian economy only became evident at the end of 2008 which was indicated by a substantial decline in exports of manufactured goods, a global decline in lending activity which adversely affected the country's domestic market operations and the US funding for exports suffered a severe blow. In the attempt to counter the global credit crunch, many companies used exchange rate derivatives to obtain credit through Brazilian operations in real and unfortunately, following the devaluation of the real during the end of 2008, these companies suffered and most of them went into bankruptcy.

The main areas where Brazil's economy was mainly impacted by the GFC are the capital and credit markets, as well as international trade. Fortunately, during the second quarter of 2009, the Brazilian economy began to recover which was shown by the revaluation of the Brazilian real and the improvement in the exports. In a further attempt to reverse the recessive economic trends following the initial impact of the GFC at the beginning of 2009, Brazil's monetary authorities implemented counter-cyclical economic measures which was the behaviour of monetary authorities across the globe to alleviate the effects of the GFC on the real economy. Some action that the Brazilian authorities took with its monetary policy involved reductions and changes in compulsory deposits that are required of small, medium and large banks in order to inject liquidity into the economy and reactivate credit markets. Furthermore, according to Filho (2011), Brazil's monetary policy was eventually eased whereby the Selic rate by was reduced by 5 per cent points from 13.75 per cent in 2008 to 8.7 per cent in September 2009, where the Selic rate reached its lowest level in over a decade at 4.3 per cent in December 2009. This action was followed by the enhanced liquidity in the interbank market which was conducted by the Monetary Policy Council (Copom) together with the Brazilian Central Bank

(BCB) through altering the requirements related to reserve ratios and which had an influence on the funds available for financial institutions to lend.

Additionally, other measures that played a pivotal role in the recovery of Brazil's economy included the operation of public banks on credit markets to counter the scarcity of funds which was a result of the private financial system's performance for liquidity. The BCB and the Federal Reserve Bank also provided and operated lines of external credit in order to cater for the private export sector's financing. Furthermore, with the initial aim of preventing the devaluation of the real from producing a pass-through effect and therefore jeopardising the inflation targets and later prevent any major exchange appreciation, interventions in the exchange rate market occurred occasionally.

2.4.2 RUSSIA

During the pre-crisis period, Russia's economic state demonstrated impressive macroeconomic indicators with rapid growth evident in gold and foreign currency reserves, a rapid increase in the M2 as well as budgetary funds accompanied by a current account surplus and a sustainable budget. It was perhaps this economic environment that gave many the confidence that Russia would escape the GFC unaffected. Unfortunately, contrary to this positive expectation, the country suffered a double shock stemming from the collapse of oil prices, declining of exports and the withdrawal of capital from the country. Accompanying the drop in oil prices, was the substantial fall in export volumes of metals which was a result of the abrupt slowing down of construction and other activities in Europe which led to the suspension of deliveries from Russia to England with the implication of prices further plummeting.

Furthermore, Russia took a gradual policy response approach to the impact of the GFC particularly with the devaluation of the rouble in November 2008 with the anticipation that the currency depreciation will become a continuous cycle leading to the currency being excessively depreciated. Against the backdrop of an overheating economy and strong financial inflows in 2007 and 2008, the Russian authorities decided to allow the real exchange rate to appreciate through high domestic inflation.

2.4.3 INDIA

India's banking and financial system is less associated with investments in structured financial instruments that emanate from subprime mortgages therefore, one would expect India to be able to avoid the adverse events in the global financial markets. On the contrary, the effects of the crisis were visible between 2008 and 2009 when the country started to experience a decline in economic growth. Before the crisis, India's policy conduct was primarily concerned with

the excessive capital inflows which steadily increased from 2005 and 2008 which led to foreign exchange reserves also increasing and therefore contributed to the expansion of money and ultimately encouraged liquidity growth. Furthermore, GFC seemed to have a positive influence on the Indian economy whereby during September 2007 to January 2008, the country received accelerated Foreign Institutional Investment (FII) flows. Unfortunately, as the impact of the GFC intensified across the globe particularly through capital and current account of balance of payments, FII rapidly sold equity states exchange rates which resulted in India's net portfolio inflows turning negative and liquidity had to be tightened.

India's monetary policy had to undergo some alterations in the attempt to counter the liquidity as well as the global credit crunch. Furthermore, the perception of the apparent link between inflationary expectations and monetary expansion, the RBI's policy stance in the first half of 2008 was premised around controlling monetary expansion and conducted a contractionary monetary response to the GFC by firstly increasing the repo rate and the Cash Reserve Ratio (CRR) in 2008 (Bajpai, 2011). These were efforts by the RBI to ensure adequate liquidity is available and to protect the country's banking system from being saturated by the global financial contagion. Fortunately, the Indian economy is showcasing satisfactory recovery with economic growth at 8.6 per cent during the 2010-11 fiscal year.

2.4.4 CHINA

Like many other emerging economies, China only felt the quake of the GFC after the US investment bank Lehman Brothers declared bankruptcy in September 2007. China has exhibited heavy dependence on exports as early as the 1970's and now has the highest export demand among other major global economies. With China's substantial reliance on exports, this is where the GFC hit the most whereby in 2008 the GFC led to a substantial decline in China's exports which ultimately impacted the country's GDP.

Furthermore, China's reliance on foreign trade and Foreign Direct Investment led to the country succumbing to the effects of the GFC even though the country did not endure as heavy a hit from the GFC as its counterparts. China started to experience the contagion effect from its major trading partners when the GFC began to affect their demand of goods and services, therefore, China's growth in foreign trade started to collapse and eventually a contraction in the economy. During pre-crisis, China's economy had been performing well indicated by a 13 per cent annual growth rate in 2007 and the inflation rates were maintained at low levels, however, the GFC in China became evident when the country's inflation rates started to reach

high levels and GDP gradually fell beginning of 2008 and even more rapid during the 3rd and 4th quarter especially following the bankruptcy of the Lehman Brothers

As mentioned in the previous paragraphs, the main area where which the GFC hit China was international/foreign trade whereby the fall in international demand in the Chinese export sector has been recorded to be one that took the hardest hit. Moreover, Zhang (2009) posits that the investment demand from the industrial sector was another source of external shock where the collapse of commodity markets during August combined with the rapid decline in inflationary pressure, resulted in the de-stocking of inventory by manufacturing firms.

In November 2008, the Chinese government responded to the impacts of the GFC through a combination of expansionary fiscal and monetary policy which included the Stimulus Package consisting of a RMB 4 trillion injection into the economy. The Stimulus Package was aimed at stimulating the demand through the enhancement of public expenditure whereby a substantial amount of the RMB 4 trillion was aimed to be channelled into public projects such as earthquake reconstructions, transportation network, rural infrastructure and other social works.

The PBoC conducted expansionary monetary as an additional measure to the fiscal policy expansion that was employed in November 2008 to counter the effect of the GFC on the Chinese economy. The expansionary monetary policy that China adopted was contrary to its contracted monetary policy conduct during the pre-crisis period and the new monetary policy consisted of a temporary elimination of quota control on lending by commercial banks, cutting interest rates to historically low levels and reducing the bank reserves requirement ratios which successfully resulted in increased liquidity being injected into the banking system.

Finally, during the first half of 2009 China's bank credit rose from RMB 3.18 billion in 2006 and 2007, to an amount above its official target of RMB 7.3 billion for the year and the combination of the high credit growth and increase in broad supply led to high volumes of liquidity in the inter-bank money market (Yu, 2009). China's banking system was newly transformed in the form of non-performing loans being written off and substantial amounts of capital being injected into the system.

2.4.5 SOUTH AFRICA

Although the GFC began in 2007, most emerging economies only felt the impact after the Lehman Brothers' declaration of bankruptcy and the same is true for South Africa. For the first time since 1992, the National Treasury of South Africa announced that the country's economy was in a recession in May 2009. Despite the backdrop of improved macroeconomic stability and years of steady economic growth, SA eventually succumbed to the impacts of the global recession when it experienced a decline in GDP growth for two consecutive quarters in 2009.

Attributable to this decline in GDP is the decline in the automobile components and motor industries, mining, wholesale and retail trade together with manufacturing industries in South Africa (Baxter, 2009). Furthermore, like many other emerging countries decreasing capital inflows such as FDI and portfolio investments started to adversely impact the country's growth and caused it decline. The limited exposure nature of SA's financial institutions to international structured financial products including the traditional financial regulations and risk management practices that SA has been subjected to, protected the South African economy from being directly affected by the GFC. Ultimately, SA's banking sector and financial institutions suffered collateral damage by the collapse of the developed world's share prices of financial institutions and banks.

Furthermore, industrial countries have been subjected to pressures to modify their monetary operations as a result of the GFC, an experience that SA was fortunate not to be faced with. Overall, SA's banking system coped well with the impact of GFC as a result of the country's housing market's relevant rand value held steady and thus avoided any substantial write-downs of the mortgage credit given by the banking system.

2.5 SUMMARY

This chapter provides a comparative analysis of the inflation and monetary regime of the different BRICS countries, the political economic history as well as each country's experience with the global financial crisis. The chapter details how the different central banks conduct monetary policy in effort to fight inflation as well as the different monetary policy tools and transmission that play a role in the process. The next chapter, Chapter 3, consists of the study's literature review which has been broken down into the Theoretical review as well as the Empirical review.

CHAPTER 3: LITERATURE REVIEW

3.1 INTRODUCTION

Chapter 3 consists of the literature review that the study is based on and includes the theoretical and empirical literature. The theoretical literature provides the different theories found in economic literature upon which most economic studies are based on. The theoretical literature includes sections on Keynesian economics, Classical economics, Neo-classical economics as well as Endogenous economic theory. Furthermore, the empirical literature consists of two sections of existing literature with a section for studies on inflation, credit and growth and a section on inflation and growth.

3.2 THEORETICAL LITERATURE

3.2.1 CLASSICAL ECONOMISTS

In the economics literature we find that the forerunners of the modern growth theory were Adam Smith, David Ricardo and Thomas Malthus. Moreover, the economic changes that were occurring during the 18th and 19th century spurred the classicists' interest in explaining these social and economic changes as well as the new economic system – the industrial revolution which was being introduced during that time. Furthermore, as a result of the industrial revolution, there were some developments within the society, therefore, it was important to determine the forces that either hindered or encouraged this progress.

The classicists argued that technological change and accumulating productive investment are the primary factors that promote economic growth. Therefore, the classical economists including Smith, Marx and Ricardo proposed a supply-side driven growth model to explain the relationship between inflation and growth. The classical economists assumed that supply is a function of capital, labour and land ($Y = f(L, K, T)$) and therefore as the population grows, economic growth rises as a result of productivity growth. Furthermore, technological change is expressed in the distribution of labour and variations in production methods.

Smith argued that economic growth is achieved through savings based on his assumption of increasing returns to scale, stating that investments rise or are created as a result of an increase in savings which ultimately leads to enhanced growth. Another assumption made by Smith is that instead of profit declining as a result of decreasing marginal product of labour, profits decline as a result of an increase in wages that is forced up by companies that bid on labour because of competition, thereby driving the wages up. Therefore, the main argument of the classical economists is that based on the higher wage cost, there is a negative relationship between inflation and growth. Furthermore, because Smith assumed that investment is created

through increased savings, he argued that one of the key determinants of the rate at which the economy grows is income distribution. Smith's main point is that the reduction in firms' profits as a result of higher wages, suggests that the inflation-growth relationship is negative.

Furthermore, the classical growth model is not without its criticisms and the most common criticism is that the economists took a general approach to the analysis of this phenomenon by viewing the economic system holistically and neglected to investigate and apply separate economic theory. Furthermore, the classicists wrongly assumed that the rest of the world would follow England's experience, therefore neglecting the disparities in economies, policies and outcomes of such policies.

Moreover, the Malthusian Law of population which is also often referred to as the exponential law, states that any and all population rises when there is a profusion of resources, in other words there is a rise in population growth in response to an increase wage that goes beyond subsistence. This theory argues that the actual growth of population is limited by the resources/wages available whereby once wages goes beyond subsistence level, the rate of population growth outpaces the rate of increase in wages which ultimately forces the wages back down to lower rates. Ultimately, the reliance on population growth for labour supply means that there would have to be an upper limit to the expansion of population growth beyond which accumulation would drive up the wage to an extent that continued accumulation would no longer be possible and this would ultimately hinder economic growth in the long run

3.2.2 KEYNESIAN ECONOMICS

Keynesian economics emanated from John Maynard Keynes's (1883-1946) economic principles and theories whereby his economic thinking became popular when he provided ground-breaking economic analysis during the 1930 Great Depression by exploring the causes of mass unemployment during this time. Keynes, was known for his advocacy of excessive government spending, inflationary money growth and budget deficits where he encouraged spending by governments and argued that it had significant impact on inflation, output and employment. Keynes is considered to be the father of modern macroeconomics with his most famous work including *The General Theory of Employment, Interest and Money* which was published in 1936.

Furthermore, Keynesian economics dominated economic theory after World War II and well into the 1970s, particularly during a time referred to as 'stagflation', whereby some advanced economies suffered from both slow growth and inflation. However, some of the criticisms of

his theory include the lack of suitable policy response to stagflation and contributed to his dominance in economic theory to decline. Additionally, Keynes also disregarded the consequences of inflation as far as his advocacy for expansionary measures to fight unemployment is concerned. Keynes's theories and principles came under attack for other reasons as well, such as the notion of ability of authorities to manipulate policy instruments with the goal of pegging real economic activity and interest rates at any level that is desirable, coupled with the flawed concept of a steady trade-off between inflation and unemployment (Humphrey, 1981). Furthermore, the heavy reliance on government, particularly during times of depression would leave the economy vulnerable to being centrally controlled with the government controlling and making all decisions in the economy.

In the Keynesian economics theory nominal shocks exert real effects as a result of frequent changes in nominal prices particularly when firms frequently adjust their prices as a response to rising average inflation rates so firms are able to keep up with increasing price levels. Ball, *et al.* (1998) posit that the implication of this is that prices adjust more rapidly to nominal shocks which means that the real effects created by the shocks are minor.

According to Ball *et al.* (1988) Keynesians believed that the rigidity in prices and wages are what causes changes in aggregate demand which was one of the Keynesian theories' downfall – the fact that these rigidities were not explained in detail but rather assumed. Moreover, Keynesians explain the rigidities mentioned in the Keynesian model by using 'menu costs' to discuss the costs attached to adjusting prices. The 'menu costs' refers to the costs of physically changing product prices, updating catalogues, employing people in charge of this change, the printing of new and updated menus, amongst other things.

This theory was challenged by the Classical whom argued that although these costs exist, they are minor and in actual economies these obstacles to nominal flexibility are not significant enough to support the basis of Keynesians' model. Moreover, the difference between the Keynesian model and other phenomena which speaks to rigidities in real prices and wages, whereas Keynesians rely on nominal wage and price rigidities and the flexibility of nominal prices is not hindered by real rigidities because changes in real price are not required for full adjustments to a nominal shock.

In addition, Blinder (2008) provides six principles that are at the core of Keynesian economics of which the first three relates to how the economy operates and the rest relates to economic policy. Firstly, Keynesians hold the belief that both private and public decisions have an

influence on aggregate demand. Secondly, the most significant impact of anticipated or unanticipated changes in demand, falls on employment and real output instead of prices. The third tenet relates to wage and price rigidity, Keynesians believe that there is a slow response from wages and prices to supply and demand changes which creates surpluses and shortages. The fourth point is that because the Keynesians believe that price adjustments are rigid and unemployment is affected by the impulse of aggregate demand, they do not consider the level of employment as ideal. The fifth principle relates to the Keynesians' advocacy of activist stabilization policies which are meant to counter the business cycle. Lastly, instead of focusing on combating inflation, many Keynesians focus on fighting unemployment due to their conclusion that the costs of inflation are minor.

The sum of household, government and business spending is a measure of aggregate demand and government spending was Keynes's main advocacy for the prosperity of an economy. Keynes advocated for government intervention that aimed at obtaining price stability and full employment by means of public policies. Moreover, Keynes argued against the Classical belief of a free market that has mechanisms that allow the economy to return to equilibrium on its own. Keynes argued that any of the four summed components representing an economy's output of goods and services given by Consumption, Investment, Government Spending and Net Exports (exports minus imports), should explain an increase in demand. However, demand is often impeded by strong forces during a recession as spending decreases as a result of a collapse in consumer confidence caused by economic downturns. Consequently the reduction in spending by consumers may result in lower demand for firms' products and therefore may lead to the decrease in investments by firms and ultimately leaves the burden of increasing output to the government.

Furthermore, the rise of the New Classical School in the mid-1970s came with criticisms of both Keynesian and monetarist theories and principles. Following the classicist beliefs, the new classicists were also against government intervention and argued that because individuals market participants are able to anticipate policy changes and therefore respond to those changes in advance, policymakers are thus ineffective and of no use. To counter this new classical stance, during the 1970s and 1980s a new generation of Keynesians acknowledged that individuals are in fact able to correctly anticipate changes in policy, overall markets may not clear instantly which may still allow fiscal policy to be effective in the short run.

3.2.3 NEO-CLASSICAL ECONOMISTS

The first economists to develop the neo-classical model of growth were Solow (1956) and Swan (1956), where the model assumed exogenously determined rates of population growth and savings as explaining the long-run levels of income per capita in market economy. The savings variable implies that a country experiences greater investment rates as a result of higher savings and therefore this makes a country rich; whereas, when population growth rates are increasing, the implication to this is a poor country as investment is now spread thinly across the population of workers. A Cobb-Douglas production function can be used to express aggregate growth in the Solow-Swan growth model;

$$Y(t) = Kt^{\alpha} (A(t)L(t))^{1-\alpha} \quad ; \quad 0 < \alpha < 1$$

Where Y represents income; K represents Physical capital; A represents Level of technology and L is Labour. The production function implies that the Solow-Swan growth model assumes that the level of per capita income is determined by technology, rates of savings and population growth as well as technological progress in steady state equilibrium.

There are two main implications of the model, the first being that there is a ‘catch-up’ effect of poorer countries to their rich counterparts. Secondly, the Solow-Swan model implies diminishing returns to capital investments in the long run, meaning that economic growth ultimately depends on technological progress and in the absence of this progress, growth diminishes and ultimately disappears and market economies start to stagnate.

Furthermore, the main critique of the Neo-classical model which has been raised substantially in literature, and the indiscretion lies on basing the model on the two variables which are exogenous. The main problem with this is that in the Solow-Swan model, these two variables are used to explain the model, however, it is known that exogenous variables are not explained within the model therefore, it is incorrect to say that the model explains the two factors which it claims to be the main driving force behind economic growth.

Furthermore, some of the early Neo-classical inflation-growth theories include the work of Tobin (1965) whose work became predominantly known as the ‘Tobin effect’, Sidrauski (1967) and Stockman (1981). These studies concluded three different and important theories in literature which was that (1) inflation has a positive (2) a negative and (3) no effect on economic growth. This study starts with Tobin (1965) who developed Mundell’s (1963) model and followed Solow (1956) and Swan’s (1956) argument of making money a store value. According to this model, individuals forego current consumption and store their money or acquire capital for future consumption. Tobin (1965) argued that capital intensity was created

as a result of people transitioning from money to interest earning assets due to inflation that ultimately erodes the value of money. To put Tobin's (1965) argument in perspective, in the event of an increase in inflation, people tend to move away from money as it now yields lower return and instead move to acquiring capital. Moreover, Tobin's (1965) framework suggests that a positive inflation-growth relationship in the sense that during periods of high inflation, economic growth increases as a result of people holding their asset in interest earning assets. This results in increased capital accumulation and hence economic growth.

In contrast to the Tobin (1965) model, the Stockman model suggests that an increase in inflation lowers the steady-state level of output. The Stockman (1981) study is based on the premise that as inflation increases; people tend to withdraw from spending cash on both goods and capital investments which ultimately leads to the decline in steady-state level of output. Thus, the Stockman (1981) effect posits that there is a cash-in-advance restriction on both consumption and capital purchases as a result of increased inflation rates. Stockman's (1981) model suggests that as inflation rises, people's welfare as well as the economy's steady-state level of output declines. Stockman (1981) suggests that the relationship between output and inflation is negative as the model assumes money to a complement to capital. This effect is premised around the fact that firms either make a cash investment directly to the financing package or it involves compensating balances.

Another important contribution in the economics literature was produced by Sidrauski (1967) where he introduced the hypothesis of superneutrality of money in the long run. Sidrauski (1967) suggests that attention be brought to the role played by real capital alternative assets in the neo-classical growth model. Furthermore, Sidrauski's 1976 paper attempts to incorporate the economy's monetary structure into the Solow-Swan model of economic growth. The reason that Sidrauski (1976) makes this attempt is based on his argument that an economy's ability to attain the Solow-Swan steady state capital stock is impeded for as long as outside money exists. Moreover, Sidrauski's (1967) theory suggests that money has a superneutral characteristic in that, the rate of change of money supply does not influence real variables and therefore there is no relationship between inflation and economic growth in the long run. Furthermore, it is important to note that according to Fischer (1979), Sidrauski's theory may hold in the long run but argues that inflation does have an influence on real variables in the short run.

3.2.4 ENDOGENOUS GROWTH THEORY

Endogenous growth theorists were the first to propose a non-linear relationship between inflation and growth in theory as well as to include credit in theoretical models. Moreover,

Gillman, Kejak and Valentinyi (2000) and Bose (2002) further introduce an endogenous growth with non-linear dynamics.

The indiscretions of the Solow-Swan growth model gave rise to the Endogenous growth model which attempts to remedy this problem of exogenous variables explaining this phenomenon. The main argument of the endogenous growth model is that economic growth relies on the rate of return to capital and argues against the diminishing returns to capital investment as implied by the Neo-classical growth model. The Endogenous growth theory endogenises technological progress and therefore augments the Solow growth model to include human capital.

Another criticism alleged by the endogenous theorists is that observed differences in per capita income across countries are not explained in the neo-classical model. Furthermore, a concern in this model is that of convergence, that is, whether or not there is a tendency toward convergence of per capita income levels across the countries (Knight, Loayza & Villanueva, 1993). Moreover, the Solow-Swan model predicts a conditional convergence after the determinants of the steady state have been controlled for. Upon finding evidence of conditional convergence, Mankiw, Romer and Weil (1992) confirm Solow-Swan's model predictions once cross-country differences in population growth rates and savings are considered.

Mankiw *et al.* (1992) explain that the Solow-Swan model adequately provides an explanation of cross-country data once augmented to include the accumulation of both physical and human capital. Furthermore, Mankiw *et al.* (1992) investigate the Solow model's implications on convergence whether poor countries grow faster than rich ones and find that the countries converge at approximately the rate predicted by the Solow model only when capital accumulation and population growth rates are held constant. Mankiw *et al.* (1992) support their inclusion of human capital by arguing that its exclusion leads the estimation of influences of saving and population growth to appear too large, therefore it is necessary to incorporate human capital. However, Mankiw *et al.* (1992) do not include inflation in their model.

Furthermore, Bose (2002) and Gillman *et al.* (2004) explored the negative non-linear relationship between inflation and growth by including credit in their investigation. Gillman *et al.* (2004) who were strong supporters of Tobin, investigated the inflation-growth relationship by extending the Gomme (1993) – type model which allows them to guide and interpret the estimation of the relationship comprehensively. Interestingly, Gillman *et al.* (2004) supported Tobin's work which argued that inflation exerts a positive impact on economic growth, and developed Gomme's 1993 model which inferred that there is a negative relationship.

Furthermore, instead of a cash-only economy, Gillman *et al.* (2004) extend the model to involve the exchange technology where the model now includes both money and credit which can be utilized for consumption goods. The model specifies the credit production function in an additional layer of 'micro-foundations' which allows the different results between OECD and APEC samples to be interpreted through the variations in the credit technology or financial development. The model is based on the premise that inflation diminishes the rate of return of both human and physical capital based on a parsimonious empirical theory. Gillman *et al.*'s (2004) perception of a non-linear relationship between inflation and growth is based on the premise that consumers use more money and only a little amount of credit when inflation rates are at low levels.

Chu, Cozzi, Furukawa and Liao (2017) also model non-linear effects of inflation on growth by presenting an endogenous growth model where they develop the Schumpeterian growth model with endogenous entry of heterogeneous firms to study the impact that monetary policy has on economic growth through cash-in-advance (CIA) constraint on Research and Development (R&D) investment. In addition, they consider lab-equipment innovation and entry processes that use final goods as the input as opposed to labour, they allow random quality improvements and include a fixed entry cost to create endogenous entry of heterogeneous firms. The implication of these amendments is that in the event that a firm creates a higher quality product, the magnitude of the increase in quality will be randomly drawn from a Pareto distribution. Therefore, only if the quality increase is large then the firm would be liable to pay the fixed entry cost in order to implement the invention to enter the market. In investigating the effects of monetary policy on economic growth, the authors found that inflation could have an inverted U-shaped effect on economic growth.

Furthermore, in studying the relationship between inflation and growth, Oikawa and Ueda (2018) construct an innovation-driven endogenous growth model by incorporating sticky prices which result from menu costs. The model joins the standard quality ladder model formulated by Grossman and Helpman (1991) with the standard menu cost model formulated by Sheshinski and Weiss (1997). Oikawa and Ueda (2018) argue that firms do not respond to developments in nominal wages by adjusting their prices and therefore the real profits are obstructed by inflation as well as deflation. This impacts primarily the potential entrants and thus takes away the incentive for innovation and consequently has a negative effect on economic growth. Considering this analysis, Oikawa and Ueda (2018) suggest that Central banks should set their inflation targets at the negative of a fundamental growth rate that is

obtained without price stickiness in order for them to maximise growth rates. The reason being that once this target is obtained, the nominal growth rate becomes zero and therefore eliminates the nominal rigidity which allows for economic growth and creative destruction to be maximised (Oikawa & Ueda, 2018)

Ultimately, the Endogenous growth model challenges the main features of the Neo-classical model which include; the absence of human capital, exogenous technological progress, diminishing returns to capital investment as well as perfect competition. The theory relates the rate of return to capital inversely to inflation due to the fact that inflation erodes the value of money and therefore decreases the rate of return to capital which ultimately leads to a reduction in capital accumulation and therefore a decrease in the growth rate. This theory posits that economic growth is determined by the factors that are within the production process which may include increasing returns or induced technological change and economies of scale.

Moreover, the endogenous growth theory focuses on one variable that it assumes growth is dependent on and that variable is the rate of return to capital which may be reduced by inflation and consequently leads to the decrease in capital accumulation, hence a reduction in the growth rate. Furthermore, the main distinction between the endogenous growth theory and the neo-classical theory is the assumption of decreasing returns on capital in the neo-classical economics, whereas in the endogenous growth theory it is stated that because the return on capital does not fall below a positive lower bound, there is a continued increase in per capita output.

3.3 EMPIRICAL REVIEW

3.3.1 INFLATION, CREDIT AND GROWTH STUDIES

Gillman, Kejak and Valentinyi (2004) analyse the relationship between inflation, growth and credit services by introducing a monetary growth model with an unambiguous credit service sector used to explain the observed magnitude. The study finds that inflation is negatively related to economic growth whereby this relationship becomes weaker as inflation increases. Furthermore, the study posits that inflation exerts a stronger effect on growth in the presence of a credit service sector than in a conventional monetary growth model.

Bose (2002) proposes a model that predicts a negative and non-linear relationship between the rate of inflation and the rate of growth. The model introduces an economy where credit market imperfections exist as a result of asymmetric information between lenders and borrowers. In this model, the influence inflation has on lenders' behaviour plays an important role in contributing to the inverse relationship between inflation and growth including the inflation threshold. The study finds that in addition to reducing the funds available for lending, a rise in inflation may change the behaviour of lenders that the unfavourable growth effect of inflation is magnified. Furthermore, the study suggests that as a result of a change in lending regime, a rise in inflation above a critical level may lead to a sharp decline in economic growth.

Analysing the link between credit to the private sector, inflation and growth Arsene and Guy-Paulin (2013) employ a Vector Autoregressive model which includes a system of three equations that test for causality amongst the variables using the VAR Granger causality block exogeneity Wald Tests. The study covers the period 1965-2010, focusing on the CEMAC area and finds that inflation is positively and significantly related to growth. Economic growth exerts a positive and significant impact on credit whereas inflation is negatively and significantly affected by credit to the economy. Inflation granger causes economic growth, economic growth granger causes credit to the private sector and credit to the private sector granger causes inflation.

Johnson (2015) found that inflation does not significantly impact economic credit. However, any economic growth improvement negatively influenced the economic credits, therefore validating the fact that Togolese economic growth carrier sectors benefited only a bit from the economic credits. For the period 1970-2010, the study utilised the production function of Cobb

Douglas with technological progress and used the Engel and Granger test and Johansen test for co-integration.

3.3.2 International studies

Over the years, the topic of the inflation and growth relationship has been controversial, with some authors arguing that the relationship is positive (see Mundell (1965, Tobin (1965) and those that argue that the relationship is negative, non-existent or non-linear (see, Fischer (1993), Kormendi and McGuire (1985), Ghosh and Phillips (1998), Burdekin (2000), Khan and Senhadji (2001), Eggoh & Khan (2014)). Moreover, although there have been controversies surrounding this relationship, it is also largely believed that high levels of inflation in general, inflicts a negative impact on economic growth. The inflation-growth relationship has been an ongoing debate between structuralists and monetarists where structuralists believe that inflation is needed for economic growth and monetarists argue that inflation is detrimental to economic growth.

A negative association between inflation and growth over the period 1950-1977 was found by Kormendi and Meguire (1985) where they investigated this relationship for 47 countries using a cross-section regression. This study made use of a few other determining factors of growth and the results showed a negative impact of inflation on growth mainly through the negative impact of changes in inflation on investments.

Fischer (1993) used spline functions to investigate the relationship between inflation and growth and used cross-sectional data for 93 countries where he presumed the relationship to be non-linear. Fischer (1993) uses a growth accounting framework in order to identify the channels through which inflation impacts growth. The study concludes that inflation reduces growth by decreasing investment as well as the rate of productivity growth. Fischer (1993) used spline functions with breaks at 15 and 40 per cent and found that the overall negative relationship between inflation, growth, capital accumulation and productivity growth is attributable to high inflation outliers. Moreover, the study posits that the relationship between the said variables is stronger when inflation is at low to moderate levels than it is when inflation is high. What the study basically concludes is that the relationship between the variables is negative.

Bruno and Easterly (1995) used spline regression functions and found an inflation threshold of 40 per cent where inflation levels above the 40 per cent represent high inflation crises. The study covers the period 1961-1992 and considers the inflation and growth relationship for 26

countries. The results show that with the exception of high inflation crises countries, there is no evidence of a consistent relationship. However, the study does find that during discrete high inflation crises, there is a sharp fall in growth and this fall during a crisis, as well as its recovery post-crisis, usually averages out close to zero and therefore the lack of a robust cross-section correlation. Moreover, the study concludes that it does not support the view that inflation, once reduced, carries significant short-to-medium run output costs. Ultimately the study finds that at the threshold of 40 per cent, inflation negatively impacts economic growth.

Sarel (1996) explored linear effects of inflation on economic growth with a fixed effect technique framework using a panel data sample of 87 countries during the period 1970-1990. The study found evidence of a structural break in the function that relates growth rates to inflation that is estimated to occur when the average annual inflation is 8 per cent. Furthermore, the findings imply that inflation above the 8 per cent inflation threshold is detrimental to growth. This means that above this level, there is significant negative impact of inflation on growth. Moreover, the findings show that inflation does not have a significant negative effect on growth at low levels but exudes a powerful negative effect on growth when inflation is high. The paper emphasises the importance of considering the existence of structural breaks and that once ignored, this existence may lead to the estimated effect of higher rates of inflation on growth to decrease by a factor of three.

Using the Granger methodology, Paul, Kearney and Chowdhury (1997) examined the direction as well as the pattern of causality between inflation and economic growth in 70 countries using data over the period 1960-89. The results show that the relationship is non-uniform across countries where 40 per cent of the countries studied reveal absence of causality, one third exhibit unidirectional causality and about one-fifth of countries show bidirectional causality. Additionally, the industrial group comprises largely of the majority of countries which show either uni- or bi-directional causality and lastly, the low inflation regime will on balance reallocate real growth opportunities benefit towards the industrialised countries.

Khan and Senhadji (2001) also examined the relationship between inflation and growth and found that at levels above an estimated 1 to 3 per cent, inflation significantly slows growth for industrial countries and for developing countries; the threshold level is 7-11 per cent. The study used a panel data set of 140 countries (both industrial and developing) covering the period 1960-1998 and employed non-linear least squares to take into account the non-linearity of the

relationship using new econometric techniques that provide procedures for estimation and inference for 140 developed and developing countries.

In an attempt to investigate the relationship between inflation and GDP for South Asian countries (Bangladesh, India, Pakistan and Sri Lanka), Mallik and Chowdhury (2001) utilise co-integration and error correction models. The use of these models is to determine the extent to which economic growth is related to inflation and vice versa. The study covers the period 1974-1997 for Bangladesh; India from 1961 to 1997; Pakistan 1957-1997 and Sri Lanka spans from 1966-1997 as the periods of study are determined by the availability of data. The results show evidence of a long-run positive relationship between GDP growth rate and inflation for all four countries with significant feedbacks between inflation and economic growth. Moreover, the study suggests that moderate inflation is conducive to growth but faster economic growth feeds back into inflation.

Sweidan (2004) established an inflation threshold of 2 per cent for Jordan beyond which the effect of inflation rates above this level turns to be negative on economic growth. The study covered the period 1970-2000 and utilised the Autoregressive Conditional Heteroskedasticity (ARCH) model to estimate the proxy to the inflation variability. The study also made use of a multiple regression model to confirm stylised effects about the determinants of economic growth. The variables tested include Annual growth rate of real GDP, Inflation as proxied by the consumer price index (CPI), Growth rate of money supply (M2), Annual growth rate of the real gross fixed capital formation, a dummy variable that takes the value of one when inflation is greater than the structural break rate and zero otherwise.

Furthermore, Burdekin, Denzau, Keil, Sitthiyot and Willet (2004) make use of a reduced-form model to investigate the effects of inflation on growth and follow a variant of Sarel's (1996) econometric procedure but consider the data for industrial and developing countries separately. The study also follows multiple thresholds using spline estimation techniques and discovers that the non-linearities are different for industrial countries than for developing countries. Following Sarel's finding, the study isolates a threshold of 8 per cent for industrial countries and estimate 3 per cent threshold for the developing countries. Furthermore, the findings suggest that below the 8 per cent threshold for the industrial countries, the effects of increasing inflation rates are statistically insignificant but are pre-dominantly negative. Additionally, the effect of inflation on growth for developing countries was estimated to be positive for levels below a 3 per cent inflation threshold whereby inflation then demonstrates negative effects on

growth at levels above the 3 per cent. This indicates that developing countries also feature the decreasing marginal costs of inflation as suggested by Fischer (1993).

By employing new econometric methods for estimation and inference in non-dynamic, fixed-effects, panel-data models, Drukker (2005) postulates that in the full sample of 138 countries covering the period 1950 to 2000, there exists an estimated threshold of 19.6 per cent. Furthermore, the study estimated two thresholds for the industrialized sample with threshold points of 2.57 per cent and 12.61 per cent. The study suggests that in the overall sample, if inflation exceeds the initial 19.6 per cent, then the growth will decline due to inflation in the long run, whereas, if the inflation rate is below this percentage then an increase in inflation will not have a statistically significant impact on growth.

Pollin and Zhu (2005) estimated cross-country non-linearities between the inflation and economic growth relationship which included 80 countries over the period 1961-2000. The study performs tests using the full sample of countries as well as sub-samples consisting of OECD countries, middle-income countries and low-income countries and considers the full sample of countries within the four separate decades between 1961 and 2000. The study finds that higher inflation is associated with moderate gains in GDP growth of up to approximately 15-18 per cent inflation threshold. However, the findings differ when the full data set is divided based on the income levels.

Using the econometric model developed by Khan and Senhadji (2001), Mubarik (2005) estimated the threshold level of inflation in Pakistan and established a 9 per cent inflation threshold level above which inflation is detrimental to economic growth. The study covered the period from 1973-2000.

Following the global inflation episode of 2007-08 and the concern that high inflation could undermine growth, Espinoza, Leon and Prasad (2010) studied the inflation-growth nexus using a panel of 165 countries over the period 1960-2007. To investigate the speed at which inflation beyond a threshold becomes detrimental to growth, the study employs a smooth transition model. The results show evidence of a 10 per cent threshold where which if inflation exceeds this percentage, it rapidly becomes harmful to growth for all the countries except the advanced countries.

In order to identify at what level inflation becomes harmful to economic growth in Ghana, Frimpong and Oteng-Abayie (2010) estimate the threshold effect of inflation for the period 1960-2008. The study uses threshold regression models designed to estimate inflation

thresholds and found evidence of an 11 per cent inflation threshold beyond which inflation becomes significantly harmful to Ghana's economic growth. Furthermore, for inflation rates below the 11 per cent threshold, it is likely that inflation will have a mild effect on economic activities. The study concludes that the current medium-term 6-9 per cent inflation target set by the Bank of Ghana and the Government is well below the 11 per cent.

By utilising the threshold model developed by Khan and Senhadji (2001), Salami and Kelikume (2010) examines the inflation threshold for Nigeria during the period 1970-2008. The study makes use of annual time series data spread over two periods 1970-2008 and 1980-2008 to determine the inflation threshold for Nigeria and to establish whether there is significant change in the threshold level for the two periods. The variables used in the study include Growth in the ratio of broad money supply to GDP ($GLM2/GDP$) and Growth in terms of trade ($GTOT$) and established an optimal inflation level of 8 per cent for Nigeria over the period 1970-2008. A different inflation threshold level of 7 per cent was established for the period 1980-2008, however this percentage failed the significance test.

Marbuah (2011) re-examined the relationship between inflation and growth to identify the existence of a threshold effect and if it proves to exist, he further investigated whether the estimated inflation threshold level is conducive for Ghana's economic growth. The study utilised a non-linear specification and found significant threshold effects of inflation on growth to have emerged. Furthermore, the study established that the failure to take structural break in the model into account, led to multiple inflation threshold of 6 and 10 per cent respectively. Moreover, when the study adjusted for structural breaks in the model, the threshold level of 10 per cent emerged which is robust with respect to sample size and estimation technique. The main findings of the study support the 7-11 per cent inflation target implemented by the Bank of Ghana.

Kremer, Bick and Nautz (2012) examine the inflation threshold for long-term economic growth for 124 countries (both industrialised and non-industrialised) by introducing a dynamic panel threshold model. The study advances on Hansen (1999), Caner and Hansen (2004) and presents a model that allows the estimation of threshold effects with panel data even in the case of endogenous regressors. The results confirmed inflation targets of about 2 per cent for industrialised countries, which is the target *already* set by many central banks. In the case of non-industrialised countries, the estimation is that inflation rates that exceed 17 per cent lead

to a decrease in economic growth. However, below this threshold, the correlation remains insignificant.

Tarawalie, Sissoho, Conte and Ahortor (2012) based his paper on the WAMZ member countries in investigating the threshold levels using the conditional least square technique. The study covers the period 1970-2010 for Ghana, Nigeria and Sierra Leone, and 1980-2010 for the Gambia and Guinea. The results show the existence of a statistically significant long-run negative relationship between inflation and economic growth for the countries. Moreover, the study estimated an optimal rate of inflation of 9 per cent for the WAMZ countries which means that inflation above this threshold exerts a negative effect on growth. The results show that WAMZ countries threshold inflation rates lie within the convergence criterion of maintaining inflation rates that do not exceed 10 per cent as this may help to maintain sustainable growth.

In an attempt to examine the existence of a threshold in the inflation-growth relationship for Ghana, Mireku (2012) studies the period 1970-2010 and employs standard econometric technique. The study established a 9 per cent inflation threshold for Ghana within the 6-10.5 per cent range end year inflation target but above the medium-term target of 6.5 per cent set by the Bank of Ghana. Furthermore, the study suggests that targeting an inflation rate that exceeds the 9 per cent threshold will be detrimental to economic growth.

Based on panel time-series data and analysis, Seleteng, Bittencourt, van Eyden (2013) found that inflation has had a detrimental effect to growth in the Southern African Development Community (SADC) region over the period between 1980 and 2009. Therefore, the study highlights the fact that inflation has offset the Mundell-Tobin effect (some inflation is conducive to growth) and consequently reduced economic activity in the region.

Danladi (2013) presents evidence using countries in the West African region including Burkina Faso, Ghana, Nigeria and Senegal for the period 1980-2009, to suggest the existence of a threshold level of 9 per cent. Using panel data analysis, the study estimates that inflation beyond the 9 per cent threshold a negative impact on growth.

Enu, Attah-Obeng and Hagan (2013) employed the methods of scatter plot, correlation analysis and simple linear regression estimated using OLS to determine the relationship between GDP growth rate and inflation rate in Ghana over the period of 1980 to 2012. The results to all three approaches gave evidence of a strong linear relationship between the two macroeconomic variables in Ghana. This means that for every 1 per cent increase in the rate of inflation, GDP will decrease by 0.0864724 per cent at 5 per cent level of significance. The study suggests that

policymakers should aim at keeping inflation at low levels in order to enhance stability and economic growth.

Ahiakpor (2014) investigated the relationship between inflation and economic growth in Ghana using quarterly data from 1986Q1 to 2012Q4 and found a negative relationship between the two macroeconomic variables. Using co-integration and error correction model, the results show that capital, government expenditure, labour force and money supply have a positive impact on GDP. Furthermore, inflation and interest rate decrease economic growth. The study recommends that inflation targeting is the best monetary policy.

Investigating the effect that inflation has on economic growth in South Asian countries, Behera (2014) established that within the context of these countries, there is a significant positive relationship between inflation and economic growth for all the countries. Furthermore, the co-integration results show that for Malaysia, there is evidence of a long run relationship whereas for the rest of the countries there is no long run relationship. The study used the time series data for the period 1980-2012 and employed the Error Correction and Granger causality test to examine the short run dynamics as well as the direction of causality and for the identification of short run dynamics between inflation and growth, the study employed unidirectional VAR analysis.

Inflationary thresholds in the finance-growth relationship were established by Iyke and Odhiambo (2016) both in Nigeria and Ghana for the periods between 1964-2011 for Ghana and 1961-2011 for Nigeria. The different time spans are owing to the lack of data availability. The study employed specific threshold regressions and found that the inflationary threshold range for Ghana is 10.73 -29.83 per cent and for Nigeria, the range lies between 10.07-19.25 per cent. The results showed that during low and moderate inflationary regimes, financial development had positive and significant effects on economic growth and insignificant effect on growth during high inflationary regimes for both countries. Moreover, when the rate of inflation is below the 10.73 per cent threshold in Ghana, growth is significantly impacted by financial development, however, it dissipates when inflation rate reaches and goes beyond the 29.83 per cent. Similar results are found in the case of Nigeria, where below the threshold of 10.07 per cent financial development exerts great impact on growth but dissipates when inflation rate reaches and exceeds the 19.25 per cent threshold.

In examining the non-linearities in the relationship between inflation and growth in Africa, Ndoricimba (2017) using a dynamic panel threshold regression which is aimed at accounting

for potential endogeneity bias in the model, provides evidence of the existence of these non-linearities. The study established an inflation threshold of 6.7 per cent for the whole sample, 9 per cent for sub-sample of low-income countries and 6.5 per cent for middle-income countries. Furthermore, the study suggests that inflation in the sub-sample of middle-income countries enhances growth but does not affect growth for the whole sample nor for the sub-sample of low-income countries. Moreover, inflation that is above the threshold level is harmful to economic growth for all the cases considered.

Eggoh and Muhammad (2018) present evidence using a large panel data that includes both developed and developing economies to validate that inflation-growth non-linearity is sensitive to financial development, investment ratio, trade openness and government expenditures. Employing the PSTR and dynamic GMM techniques, the study presents two aspects of the inflation and growth relationship which include the analysis of non-linearity and provision of thresholds for the global and income specific sub-samples. The second aspect is the identification of indirect channels effectual for inflation-growth non-linearity.

3.3.3 BRICS countries studies

Hodge (2006) investigates the inflation and growth relationship in South Africa for the period 1950-2002 over both medium to long term and short term using two base models to estimate the relationship. The study is focused on the direction and the magnitude of the relationship and the results show that there is a significant negative relationship between inflation and growth over the medium to long term. Moreover, contrary to other studies, the study suggests that a simple linear relationship gives the best fit to the South African data. However, the study finds evidence of a non-linear relationship between inflation and growth in South Africa over the medium to long term. The main finding is that over a 5-year period, the average annual inflation rate decreases the average annual growth rate when there is a one percentage point increase, by about a quarter percentage point. Furthermore, the study finds that the negative relationship between inflation and growth is stronger after the mid-1970s.

In examining the level of inflation which exerts least harm on the finance-growth activity for the South African economy, Phiri (2010) employed OLS technique and re-estimated the model using the two-stage least squares instrumental variable (2SLS-IV) method to check for robustness. The study estimates an inflation threshold in a non-linear finance-growth regression using quarterly data between the period 2000 and 2010. The study established two findings to the examination; the first showed inflation to have an adverse impact on finance-growth

activity at all levels of inflation. The second finding showed an estimate of 8 per cent level of inflation threshold below and above which real activity losses slowly begin to be expanded the further one moves from the threshold. The main findings show that the 3-6 per cent inflation target set by the South African Reserve Bank is restrictive to sustainable economic activity.

Phiri (2012) investigates the threshold effects in the persistence of South African aggregate inflation data using univariate threshold autoregressive (TAR) models over the period of 2000-2010. The results confirmed the existence of threshold effects in the persistence of all employed aggregate measures of inflation, whereas such disproportionate effects are unclear for disaggregated inflation measures. Although these authors were the first to explore the non-linearities in this relationship and proved that the effect that inflation has on growth differs at various levels inflation, the authors were unable to specify these exact levels.

Manamperi (2014) investigates the short and long run relationship between inflation and economic growth in BRICS countries using the Johansen co-integration and the ARDL bound test for the long run relationship and a VAR analysis for the short run dynamics. The time period spans from 1980-2012. The study established a positive long run relationship between the two macroeconomic variables for India, but no long run relationship was found for the rest of the country. Furthermore, the study found a significant negative short run relationship for Brazil, Russia, China, and South Africa whereas for India the short run relationship is found to be positive.

In the context of BRICS countries, a positive long run relationship was found only for China and South Africa at 5 per cent level of significance in a study on the inflation-growth nexus by Mishra and Behera (2016). The study covers the period from 1980 to 2012 using the VAR analysis. Furthermore, results show that a unidirectional causality between economic growth and inflation exists for India and bidirectional causality occurs in China's case. The results from the VAR analysis could not find any evidence of a consistent short run relationship between inflation and economic growth over ten years ahead for BRICS countries. The study recommends that policymakers should consider both the short run and long run relationship for China and South Africa, while considering only the short run relationship between inflation and economic growth.

In a study undertaken by Mavikela, Mhaka and Phiri (2018) for South Africa and Ghana, it was found that there is a positive relationship between inflation and growth in Ghana when inflation is at high levels. Whereas, during the post-crisis period, inflation exerts negative impact at all

levels of inflation for both countries with inflation having its least adverse effects at high levels for Ghana and at moderate levels for South Africa. The study utilises quantile regression method to study the relationship between inflation and economic growth for both Ghana and South Africa over the period 2001-2016.

Considering the empirical literature above, the study finds some gaps in this literature, namely, studies such as those of Fischer (1993) and Bruno and Easterly (1995) that use spline regression functions to study the proposed relationship failed to prove or provide a specific optimal threshold for inflation and thus their policy recommendations lack preciseness. Furthermore, studies such as that of Kormendi and Meguire (1998) may include periods of high inflation related to data from the 1970s which according to Phiri (2010) may influence the threshold estimates.

Fortunately, in remedy of the above-mentioned flaw by Fischer (1993) and Bruno and Easterly (1995), Sarel (1996) used sample-splitting econometric techniques to estimate the optimal level of inflation. The study successfully found a threshold level of 8 per cent and 11 per cent. However, there may be bias in the thresholds estimated in studies such as that of Sarel (1996) that group together industrialised and developing countries as inflation does not have the same impact across these countries or these two categories. Furthermore, some studies averaged more than 100 countries in examining this relationship (see Eggoh and Muhamad, 2018)); the argument against such studies is that the averaging of so many countries may give way to inconclusive or meaningless results.

A shortfall to studies such as those of Khan and Senhadji (2001) and that of Sarel (1996) is that although they provide the level of inflation threshold above which inflation has a negative effect on economic growth, they fail to advise what the implication is with levels below this threshold and importantly, they fail to show the lower percentage of inflation (percentage below which will have a certain effect on growth) and its effect on growth. However, there is some good news that the works of Leshoro (2012) address this shortfall and provide both the high and low levels of inflation that have impact on economic growth. Leshoro (2012) posits that inflation levels below 4 per cent exert a positive but insignificant relationship between inflation and growth. Whereas the study indicates that the relationship turns negative and significant at levels above the 4 per cent threshold. Furthermore, another study that fails to provide the precise levels of inflation rates that have an impact on growth is that of Mavikela *et al.* (2018).

A further area of improvement in the study of Khan and Senhadji (2001) is that in estimating the impact of inflation on growth, the study does not indicate through which channels inflation impacts growth. Additionally, the study may contain coefficient biasness as inflation is not an exogenous variable in the inflation-growth regression.

Additionally, the researcher identified two studies, that of Mishra and Behera (2016) and Manamperi (2014), which are based on the BRICS countries and of the relationship between inflation and economic growth. Mavikela, Mhaka and Phiri (2018) found that at high inflation rates, there is a positive relationship between inflation and economic growth, however, no percentage has been given to indicate at what level/rates this happens. Therefore, the study could have incorporated threshold effects estimates to give more clear results

Other studies in literature (see Phiri (2012) and Eggoh and Muhamad (2018)) rely on the TAR and STAR models. The shortfall of the TAR model is that it gives sharp turning points which are unrealistic in the real world as there are lag lengths that occur before an effect of a variable on another is reflected. In this regard, the STAR models are more realistic and give proper representation of real-life effects.

3.3.4 SUMMARY

Considering the studies mentioned above and to the researcher's knowledge, there is a gap in literature which is that there has not been a study that utilizes the NARDL model in investigating this relationship particularly with the inclusion of the credit market development factor and the specific choice of countries which is the BRICS bloc. The finding of this research is expected to follow those that find a negative/non-linear relationship between inflation and growth. Moreover, this paper will potentially allow for not only lenders to have information on investment under different inflation conditions as far as these countries are concerned, but the authorities to have an idea of how to structure the monetary in a way that will be conducive to economic growth.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

The current chapter provides discussion on the methods and procedures followed in the study to investigate the relationship between Inflation, Credit and Growth in the BRICS countries. The first section of the chapter begins with specifying the baseline model used to test the relationship during the period 1960-2019. In this chapter researcher provides a brief description of the variables used in the study as well the source from which the data has been extracted. Upon the identification and description of the variables used in the study, the second section provides a brief discussion of the unit root tests conducted. Once the study confirms the compatibility of the variables for the model, the researcher provides the third section of the chapter with the discussion of the main models including the linear ARDL model followed by the Non-linear ARDL model separately for each of the BRICS countries and examines the co-integration by making use of co-integration tests such as the Wald test and the F-statistic test.

Moreover, although the main objective of this study is to study the non-linear relationship between the proposed variables, the study does in addition, include a linear ARDL analysis for comparison purposes. This last section includes the diagnostic tests which are used to determine the robustness and reliability of the models. Separate regressions of each model will be used to test the relationship for each of the BRICS countries individually. The study makes use of the EViews statistical software to run all the regressions in the study.

4.2 DATA DESCRIPTION

The study investigates the period from 1960 to 2019 annual data for the BRICS countries. The study does not make use of dummy variables as the non-linearities take care of structural break problems in the data. The variables used in the study are Growth Domestic Product (GDP) to represent economic growth in the countries, Inflation (CPI), Credit market development (proxied by Domestic credit provided to private sector as a percentage of GDP), Terms of Trade (TRADE), Labour (Employment), Investment proxied by Gross Fixed Capital Formation (GFCF) and Real Effective Exchange Rates (REER). The variables Inflation, Credit and Growth are important to study as these are key macroeconomic variables that central banks often use as tools and as indicators to guide their monetary policy conduct which has a direct impact on a country's economic growth rate.

The study used the Aike Information Criterion (AIC) to select and determine the maximum lag length. The AIC was the criterion with the lowest value which will make for a better model and less degrees of freedom will be lost with low maximum lag lengths. Furthermore, too many

lags inflate the standard errors of coefficient estimates. The dependent variable has a lag length of 1 due to the error that occurred when adjusted for any lag length greater than 1. This could be attributed to the degrees of freedom that are lost when using a lag length greater than 1. Larger degrees of freedom means that the researcher will have a larger sample size which allows more power to reject a false null hypothesis and find a significant result.

Table 4.1 contains more description on the variables as well as its sources:

Table 4.1

Variable	Description	Source
GDP	Gross Domestic Product (Annual %)	World Bank Data Bank
LogInfl	Inflation (Consumer Price Index)	World Bank Data Bank
DCPS	Domestic Credit to Private Sector (percentage of GDP)	World Bank Data Bank
LogREER	Real Exchange Rates (Converted from current prices/ CPPP)	World Bank Data Bank
TRADE	Trade as a percentage of GDP	World Bank Data Bank
GFCF	Gross Fixed Capital Formation (Percentage of GDP)	World Bank Data Bank
LogEMPL	Employment (Number of persons engaged in millions)	Penn State Database

Researcher's own compilation

4.3 MODEL SPECIFICATION

The study follows the work of Gillman, Harris and Matyas (2004) in examining the relationship between Inflation, Credit and Growth. In the Gillman *et al.* (2004) model specification, the authors do not include inflation and credit, therefore, the current study formulates a specification that includes these two variables. The study presents the following baseline regressions:

Brazil

$$Y_t = \Phi_0 + \Phi_1 INFL_t + \Phi_2 DCPS_t + \Phi_3 GFCF_t + \Phi_4 REER_t + \Phi_5 TRADE_t + \Phi_6 EMPL_t + \varepsilon_t \quad (1)$$

Russia

$$Y_t = \Phi_0 + \Phi_1 INFL_t + \Phi_2 DCPS_t + \Phi_3 GFCF_t + \Phi_4 TRADE_t + \Phi_5 EMPL_t + \varepsilon_t \quad (2)$$

India

$$Y_t = \Phi_0 + \Phi_1 INFL_t + \Phi_2 DCPS_t + \Phi_3 GFCF_t + \Phi_4 TRADE_t + \Phi_5 EMPL_t + \varepsilon_t \quad (3)$$

China

$$Y_t = \Phi_0 + \Phi_1 INFL_t + \Phi_2 DCPS_t + \Phi_3 GFCF_t + \Phi_4 REER_t + \Phi_5 TRADE_t + \Phi_6 EMPL_t + \varepsilon_t \quad (4)$$

South Africa

$$Y_t = \Phi_0 + \Phi_1 INFL_t + \Phi_2 DCPS_t + \Phi_3 GFCF_t + \Phi_4 REER_t + \Phi_5 TRADE_t + \Phi_6 EMPL_t + \varepsilon_t \quad (5)$$

Where Y is GDP, INFL is inflation, DCPS is Credit, GFCF is Investment, REER is Real Effective Exchange Rate, TRADE is Terms of Trade and EMPL is Labour. The variable Real Exchange Rates (REER) was omitted in India's regression due to the lack of data on that variable for the period adopted in this study. The variable was omitted for Russia also to confront the problem of serial correlation.

4.4 DATA ANALYSIS

Once the first step which is to identify the suitable variables is done, the study tests for stationarity in each of the variables. Although the ARDL and NARDL model is applicable whether the variables are I(0) or I(1), it does not work with I(2) variables, therefore, the study employs unit root tests which include the Augmented Dickey Fuller (ADF) by Said and Dickey (1984), the Phillips-Perron (PP) by Phillips and Perron (1988) and Dickey Fuller GLS (ADF-GLS) test developed by Elliot, Rothenberg and Stock (ERS) (1992), to ensure the variables are compatible with the model. Furthermore, the general null hypothesis for stationarity testing is that the variable has a unit root and the alternative hypothesis states that there is no unit root present. Moreover, Panel data was not considered for the current study as panel data aggregates the data for all countries therefore one result would be applied to different countries. The disadvantage of this is that the different characteristics of each country would not be captured, thus the individual study was identified to be best suitable for the current study.

4.5 UNIT ROOT TESTS

4.5.1 Augmented Dickey-Fuller test

The ADF as modified by Said and Dickey (1984), adjusts the original Dickey-Fuller unit root test to allow for possible serial correlation in the error terms by adding the lagged difference terms of the regressand.

Furthermore, according to Brooks (2008), the ADF test can be expressed as:

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^{\rho} \alpha \Delta y_{t-i} + \mu_t \quad (6)$$

Where y_t is the value of y at period t (current period); y_{t-1} is the value of y at period $t-1$ (the previous period); $\Delta y_t = y_t - y_{t-1}$; and μ_t is the error term.

Junkin (2011) posits that the ADF tests the null hypothesis (represented in terms of ρ) of there being a unit root in the series, with the alternative being the absence of a unit root. Under the Augmented Dickey-Fuller test, if the variables are stationary at first difference of the order they are denoted as $I(1)$ and as $I(0)$ if they are stationary in levels.

The ADF unit root test are based on the following regressions:

$$1. \text{ Without constant and trend: } \Delta Y_t = \gamma Y_{t-1} + \varepsilon_t \quad (7)$$

$$2. \text{ With constant: } \Delta Y_t = a_0 + \gamma Y_{t-1} + \varepsilon_t \quad (8)$$

$$3. \text{ With constant and Trend: } \Delta Y_t = a_0 + \gamma Y_{t-1} + a_2 t + \varepsilon_t \quad (9)$$

The hypothesis is $H_0: \rho = 0$ (unit root): $H_1: \rho \neq 0$ (no unit root)

This study also expresses the simplest formula to test for a unit root and that is the ADF, considering an AR (1) process:

$$\Delta Y_t = \alpha + \beta_t + \theta Y_{t-1} + \theta_1 \Delta Y_{t-1} + \varepsilon_t \quad (10)$$

Where Y_t represents the time series, Y_{t-1} shows the value of Y_t in a one-period lag; the α denotes the constant; the β represents the coefficient and the ε_t denotes the error term. To interpret the ADF test we look at the T-statistic and associated p-value. Using the DF test statistic computed by: $DF_T = \frac{\gamma}{SE(\gamma)}$, we reject the null hypothesis of the presence of a unit root test if the calculated value is less than the critical value.

4.5.2 Dickey-Fuller GLS

Elliot, Rothenberg and Stock (1996) modified the original Dickey – Fuller test statistic using a generalized least squares (GLS) rationale. The DF-GLS test is an augmented DF, however, in this test the time series is transformed via a generalized least squares regression before performing the test – the explanatory variables are removed from the data prior to running the test. Elliot *et al.* (1996) showed that the new DF-GLS test possessed the best overall performance in terms of small-sample size and power, thus dominating the Dickey – Fuller

test. Furthermore, the authors also find that the DF-GLS test under the condition that an unknown mean or trend is present, has noticeably improved.

Essentially, the time series is transformed through a generalised least square (GLS) regression before performing the test. The DF-GLS tests series that include 1 to k lags of first differenced and detrended variables. Taking an ADF regression in the form of:

$$\Delta y_t = \alpha + \beta y_t + \phi_t + \delta_t \Delta y_{t-1} + \dots + \delta_k \Delta y_{t-k} + \varepsilon_t \quad (11)$$

The DF-GLS is similar to this regression, however, the GLS uses data that is detrended. An example of this detrended data is expressed as:

$$\Delta y_t^d = y_t - \beta'_\phi D_t \quad (12)$$

Using the GLS detrended data, we can estimate the following regression:

$$\Delta y_t^d = \alpha y_{t-1}^d \delta \Delta_{t-1}^d + \varepsilon_t \quad (13)$$

Where Δy is the locally detrended time series. The null hypotheses for the GLS test is, H_0 : Y_t is a random walk with a possible drift and for the alternative hypothesis, Elliot, Rothenberg and Stock (1995) provide two alternative hypotheses, firstly: H_1 : Y_t is stationary about the linear time trend and the second is that Y_t is stationary with a possibly nonzero mean with no linear time trend.

4.5.3 Phillips and Perron Unit root test

Furthermore, to test whether the time series is integrated of order one, the Phillips-Perron test is usually employed. The Phillips-Perron (1988) test is used because it allows for milder assumption on the distribution error. According to Brooks (2008), there is a similarity between the Phillips and Perron tests and the Augmented Dickey-Fuller test, the difference is that the PP tests incorporate an automatic correction to the DF procedure to allow for autocorrelated residuals. The equation for PP can be expressed as:

$$\Delta Y_t = \alpha + (\rho - 1)Y_{t-1} + \varepsilon_t \quad (14)$$

The null hypothesis of this tests is $H_0: \delta = 0$ and the alternative hypothesis is $H_1: \delta \neq 0$. The test statistic for the PP unit root test is expressed as follows:

$$\text{t-statistic: } t_\alpha = t_\alpha \left(\frac{y_0}{F_0} \right)^{1/2} - \frac{T(F_0 - Y_0)}{2f^{1/25}} \quad (15)$$

Where α represents the estimate, $t\alpha$ the t-ratio of α , $se(\alpha)$ is the coefficient standard error, s is the standard error of the test regression. Additionally, Y_0 represents the constant estimate of the error variance and F_0 is the residual band estimate at frequency zero.

The unit root tests are performed for each variable for every individual country, first in levels then in difference if not all of the variables are stationary in levels. Once the unit root tests have been performed and compatibility in the variables has been established, the study proceeds with the main models to test the proposed relationship. The procedure is demarcated into three sections, the first using the linear econometric model and the second, using the non-linear model to test for asymmetries when (1) Inflation is partitioned and (2) When Credit has been partitioned into negative and positive sum decompositions.

4.6 LINEAR ARDL ECONOMETRIC MODEL

The study relies on Perasan *et al.* (2001) ARDL model to investigate the co-integration between inflation, credit and growth. The study favours ARDL model to test for co-integration over the alternative co-integration tests such as the Johansen (1988) and the Engle and Granger (1987) conventional procedures for the following reasons;

The ARDL procedure in determining co-integration relation provides more statistically significant results (Ghatak & Siddiki, 2001). According to Perasan and Shin (1999), the ARDL model provides consistent estimations of long run coefficients that, regardless of the co-integration order (I(0) and/or I(1)), are asymptotically normal. Furthermore, Adebola, Yusoff and Dahalan (2011) posit that when compared to the Johansen co-integration method, the ARDL employs a single reduced form equation instead of a system of equations and includes lags for both the dependent and independent variables.

The study begins by running separate regressions for each country, and expresses the Unrestricted Error Correction Model per country as:

Brazil

$$\begin{aligned} \Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta INFL_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta DCPS_{t-1} + \\ & \sum_{i=1}^p \alpha_{4i} \Delta GFCF_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta REER_{t-1} + \sum_{i=1}^p \alpha_{6i} \Delta TRADE_{t-1} + \sum_{i=1}^p \alpha_{7i} \Delta EMPL_{t-1} + \\ & \beta_{1i} GDP_{t-1} + \beta_{2i} INFL_{t-1} + \beta_{3i} DCPS_{t-1} + \beta_{4i} GFCF_{t-1} + \beta_{5i} REER_{t-1} + \beta_{6i} TRADE_{t-1} + \\ & \beta_{7i} EMPL_{t-1} + \varepsilon_t \end{aligned} \quad (16)$$

Russia

$$\begin{aligned}\Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta INFL_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta DCPS_{t-1} + \\ & \sum_{i=1}^p \alpha_{4i} \Delta GFCF_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta TRADE_{t-1} + \sum_{i=1}^p \alpha_{6i} \Delta EMPL_{t-1} + \beta_{1i} GDP_{t-1} + \beta_{2i} INFL_{t-1} + \\ & \beta_{3i} DCPS_{t-1} + \beta_{4i} GFCF_{t-1} + \beta_{5i} TRADE_{t-1} + \beta_{6i} EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (17)$$

India

$$\begin{aligned}\Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta INFL_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta DCPS_{t-1} + \\ & \sum_{i=1}^p \alpha_{4i} \Delta GFCF_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta TRADE_{t-1} + \sum_{i=1}^p \alpha_{6i} \Delta EMPL_{t-1} + \beta_{1i} GDP_{t-1} + \beta_{2i} INFL_{t-1} + \\ & \beta_{3i} DCPS_{t-1} + \beta_{4i} GFCF_{t-1} + \beta_{5i} TRADE_{t-1} + \beta_{6i} EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (18)$$

China

$$\begin{aligned}\Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta INFL_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta DCPS_{t-1} + \\ & \sum_{i=1}^p \alpha_{4i} \Delta GFCF_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta REER_{t-1} + \sum_{i=1}^p \alpha_{6i} \Delta TRADE_{t-1} + \sum_{i=1}^p \alpha_{7i} \Delta EMPL_{t-1} + \\ & \beta_{1i} GDP_{t-1} + \beta_{2i} INFL_{t-1} + \beta_{3i} DCPS_{t-1} + \beta_{4i} GFCF_{t-1} + \beta_{5i} REER_{t-1} + \beta_{6i} TRADE_{t-1} + \\ & \beta_{7i} EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (19)$$

South Africa

$$\begin{aligned}\Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^p \alpha_{2i} \Delta INFL_{t-1} + \sum_{i=1}^p \alpha_{3i} \Delta DCPS_{t-1} + \\ & \sum_{i=1}^p \alpha_{4i} \Delta GFCF_{t-1} + \sum_{i=1}^p \alpha_{5i} \Delta REER_{t-1} + \sum_{i=1}^p \alpha_{6i} \Delta TRADE_{t-1} + \sum_{i=1}^p \alpha_{7i} \Delta EMPL_{t-1} + \\ & \beta_{1i} GDP_{t-1} + \beta_{2i} INFL_{t-1} + \beta_{3i} DCPS_{t-1} + \beta_{4i} GFCF_{t-1} + \beta_{5i} REER_{t-1} + \beta_{6i} TRADE_{t-1} + \\ & \beta_{7i} EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (20)$$

Where α_0 is the intercept, $\alpha_{1i}, \dots, \alpha_{7i}$ and $\beta_1, \dots, \beta_7$ are the parameters for short-run and long-run elasticities, and ε_t is the error-term. The error term must be statistically significantly negative and be between 0 and -1 whereby a negative error correction implies a long run causality between the time series.

Co-integration in the variables is examined using the Wald test and the F-statistic test. The Wald test is also referred to as the Wald Chi-Squared Test which is a test used to examine the significance of explanatory variables in a model. The F-test has an upper bound and a lower bound critical value which determines the status of cointegration within the variables. The upper bound assumes that the repressors are $I(1)$ and the lower bound assumes that they are

$I(0)$. Therefore, if the F-test has a value that is less than the lower bound critical value, the null hypothesis of no co-integration may not be rejected. Similarly, if the F-statistic is greater than the upper bound value, then the null hypothesis may be rejected. Co-integration is considered inconclusive for F-statistics values that fall between the lower and upper bounds of the critical values.

4.7 NON-LINEAR ARDL (NARDL) MODEL

The study follows the Non-linear ARDL (N-ARDL) model developed by Shin, Yu and Greenwood-Nimmo (2001) to investigate non-linear relationship between inflation, credit and growth for the BRICS countries. This is done by first partitioning the Inflation variable, secondly partitioning only the Credit and thirdly partitioning both the Inflation and Credit parameters into positive and negative partial sum processes. The use of an N-ARDL model is motivated by the researcher's presumption or expected result of a non-linear relationship between the proposed variables. The study runs 3 regressions for each NARDL model, namely; (i) The bounds test, (ii) The Long run and (iii) The short run test.

The study defines the negative and positive partial decompositions of inflation and credit as follows:

$$INFL_{it}^+ = \sum_{j=1}^i \max(\Delta infl)$$

$$INFL_{it}^- = \sum_{j=1}^i \min(\Delta infl)$$

$$DCPS_{it}^+ = \sum_{j=1}^i \max(\Delta dcps)$$

$$DCPS_{it}^- = \sum_{j=1}^i \min(\Delta dcps)$$

Considering the partial decompositions that have been expressed, the study then uses the model regression demonstrated by Shin *et al.* (2014) to investigate non-linearities and expresses the following model:

$$Y_t = \sum_{j=1}^p \phi_j Y_{t-j} + \sum_{j=0}^q (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \epsilon_t \quad (21)$$

Where x_t is a $K \times 1$ vector of multiple regressors defined such that $x_t = x_0 + x_t^+ + x_t^-$, ϕ_j is the autoregressive parameter, $\theta_j^+ & \theta_j^-$ are the asymmetric distributed lag parameters. ϵ_t is an iid process with zero mean and constant variance, δ_t^2 .

The above equation may then be transformed into the following Non-linear Error Correction representation for each of the BRICS countries:

The study uses below equation to estimate both the dynamics of long and short run non-linearities:

4.7.1 Inflation non-linearity:

Brazil

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{t=0}^4 \Phi_{4i} \Delta DCPS_{t-1} + \sum_{t=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{t=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{t=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\ & \sum_{t=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\ & \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (22)$$

Russia

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{t=0}^4 \Phi_{4i} \Delta DCPS_{t-1} + \sum_{t=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{t=0}^6 \Phi_{6i} \Delta TRADE_{t-1} + \\ & \sum_{t=0}^7 \Phi_{7i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\ & \theta_5 TRADE_{t-1} + \theta_6 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (23)$$

India

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{t=0}^4 \Phi_{4i} \Delta DCPS_{t-1} + \sum_{t=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{t=0}^6 \Phi_{6i} \Delta TRADE_{t-1} + \\ & \sum_{t=0}^7 \Phi_{7i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\ & \theta_5 TRADE_{t-1} + \theta_6 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (24)$$

China

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{t=0}^4 \Phi_{4i} \Delta DCPS_{t-1} + \sum_{t=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{t=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{t=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\ & \sum_{t=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\ & \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (24)$$

South Africa

$$\begin{aligned}
\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\
& \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\
& \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\
& \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t
\end{aligned} \tag{25}$$

4.7.2 Credit non-linearity:

Brazil

$$\begin{aligned}
\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta DCPS_{t-1}^- + \\
& \sum_{i=0}^4 \Phi_{4i} \Delta Infl_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\
& \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\
& \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t
\end{aligned} \tag{26}$$

Russia

$$\begin{aligned}
\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta DCPS_{t-1}^- + \\
& \sum_{i=0}^4 \Phi_{4i} \Delta Infl_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta TRADE_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta EMPL_{t-1} + \\
& \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \theta_5 TRADE_{t-1} + \\
& \theta_6 EMPL_{t-1} + \varepsilon_t
\end{aligned} \tag{27}$$

India

$$\begin{aligned}
\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta DCPS_{t-1}^- + \\
& \sum_{i=0}^4 \Phi_{4i} \Delta Infl_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta TRADE_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta EMPL_{t-1} + \\
& \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \theta_5 TRADE_{t-1} + \\
& \theta_6 EMPL_{t-1} + \varepsilon_t
\end{aligned} \tag{28}$$

China

$$\begin{aligned}
\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta DCPS_{t-1}^- + \\
& \sum_{i=0}^4 \Phi_{4i} \Delta Infl_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\
& \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\
& \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t
\end{aligned} \tag{29}$$

South Africa

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta DCPS_{t-1}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta Infl_{t-1} + \sum_{i=0}^5 \Phi_{5i} \Delta GFCF_{t-1} + \sum_{i=0}^6 \Phi_{6i} \Delta REER_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1} + \theta_4 GFCF_{t-1} + \\ & \theta_5 REER_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (30)$$

4.7.3 Both Inflation and Credit partitioned:

Brazil

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^5 \Phi_{5i} \Delta DCPS_{t-1}^- + \sum_{i=0}^6 \Phi_{6i} \Delta GFCF_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta REER_{t-1} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta TRADE_{t-1} + \sum_{i=0}^9 \Phi_{9i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \\ & \theta_3 DCPS_{t-1}^+ + \theta_4 DCPS_{t-1}^- + \theta_5 GFCF_{t-1} + \theta_6 REER_{t-1} + \theta_7 TRADE_{t-1} + \theta_8 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (31)$$

Russia

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^5 \Phi_{5i} \Delta DCPS_{t-1}^- + \sum_{i=0}^6 \Phi_{6i} \Delta GFCF_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-1} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \theta_3 DCPS_{t-1}^+ + \theta_4 DCPS_{t-1}^- + \\ & \theta_5 GFCF_{t-1} + \theta_6 TRADE_{t-1} + \theta_7 EMPL_{t-1} + \varepsilon_t\end{aligned}\quad (32)$$

India

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-i} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-i}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-i}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-i}^+ + \sum_{i=0}^5 \Phi_{5i} \Delta DCPS_{t-i}^- + \sum_{i=0}^6 \Phi_{6i} \Delta GFCF_{t-i} + \sum_{i=0}^7 \Phi_{7i} \Delta TRADE_{t-i} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta EMPL_{t-i} + \rho y_{t-i} + \theta_1 INFL_{t-i}^+ + \theta_2 INFL_{t-i}^- + \theta_3 DCPS_{t-i}^+ + \theta_4 DCPS_{t-i}^- + \\ & \theta_5 GFCF_{t-i} + \theta_6 TRADE_{t-i} + \theta_7 EMPL_{t-i} + \varepsilon_t\end{aligned}\quad (33)$$

China

$$\begin{aligned}\Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^5 \Phi_{5i} \Delta DCPS_{t-1}^- + \sum_{i=0}^6 \Phi_{6i} \Delta GFCF_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta REER_{t-1} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta TRADE_{t-1} + \sum_{i=0}^9 \Phi_{9i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- +\end{aligned}$$

$$\theta_3 DCPS_{t-1}^+ + \theta_4 DCPS_{t-1}^- + \theta_5 GFCF_{t-1} + \theta_6 REER_{t-1} + \theta_7 TRADE_{t-1} + \theta_8 EMPL_{t-1} + \varepsilon_t \quad (34)$$

South Africa

$$\begin{aligned} \Delta GDP_t = & \Phi_0 + \sum_{i=1}^1 \Phi_{1i} \Delta GDP_{t-1} + \sum_{i=0}^2 \Phi_{2i} \Delta Infl_{t-1}^+ + \sum_{i=0}^3 \Phi_{3i} \Delta Infl_{t-1}^- + \\ & \sum_{i=0}^4 \Phi_{4i} \Delta DCPS_{t-1}^+ + \sum_{i=0}^5 \Phi_{5i} \Delta DCPS_{t-1}^- + \sum_{i=0}^6 \Phi_{6i} \Delta GFCF_{t-1} + \sum_{i=0}^7 \Phi_{7i} \Delta REER_{t-1} + \\ & \sum_{i=0}^8 \Phi_{8i} \Delta TRADE_{t-1} + \sum_{i=0}^9 \Phi_{9i} \Delta EMPL_{t-1} + \rho y_{t-1} + \theta_1 INFL_{t-1}^+ + \theta_2 INFL_{t-1}^- + \\ & \theta_3 DCPS_{t-1}^+ + \theta_4 DCPS_{t-1}^- + \theta_5 GFCF_{t-1} + \theta_6 REER_{t-1} + \theta_7 TRADE_{t-1} + \theta_8 EMPL_{t-1} + \varepsilon_t \end{aligned} \quad (35)$$

The advantage of utilising the N-ARDL is that since the N-ARDL model is a co-integration model, therefore, if the study finds evidence of co-integration amongst the variables then the first objective will be achieved. The model introduces short- and long-run non-linearities through positive and negative partial sum decompositions of the explanatory variables. However, instead of following the conventional rule of the model of thresholds greater than or smaller than zero, this study will look at inflation that is greater than and less than the points of fluctuation at a certain point. Secondly, if the study finds a level of threshold inflation, then the second objective will also be achieved as another advantage of the N-ARDL model is that it is capable of capturing the optimum point of inflation. This model allows the researcher to capture both the short run and the long run asymmetries in the transmission by modelling the long run relationship and the pattern of dynamic adjustment simultaneously in a coherent manner.

Additionally, Shin *et al.* (2014) propose that in order to confirm non-linear effects in the N-ARDL model, further testing of three hypotheses should be done whereby the second and third hypothesis can be tested using the standard Wald test. To test for overall co-integration relations, Perasan *et al.* (2001) propose the extension of the non-standard bounds-based F-test given by:

$$HOI: \rho = \lambda = \lambda_2 = 0$$

Secondly, to test for long run non-linear effects with the null hypothesis of no long run non-linear effects, the hypothesis is expressed as:

$$HOI: \rho = \beta + = \beta -$$

The third hypothesis which tests for short run asymmetric effects with the null hypothesis of no short-run asymmetric effects is tested by:

$$H03: \delta = \delta_2$$

4.8 DIAGNOSTICS

Furthermore, to ensure the adequacy and the robustness of the models employed in the study, diagnostic tests were conducted by the researcher including the Jarque – Bera test for normality, Ramsey RESET test, Breusch – Godfrey (1978) LM test for auto (serial) correlation, and the Breusch and Pagan (1979) test of heteroscedasticity.

4.8.1 Normality

The Jarque – Bera (JB) normality test is an asymptotic test based on OLS residuals. The JB uses the following statistic:

$$JB = n \left[\frac{S^2}{6} + \frac{(K-3)^2}{24} \right]$$

Where: n is the number of observations, S is the skewness coefficient (3rd moments) and K is the kurtosis coefficient (4th moments).

The Skewness coefficient measures the extent to which a distribution is not symmetric about its mean value, whereas the Kurtosis coefficient measures how fat the tails of the distribution are. The JB tests computes the skewness and kurtosis measures of the OLS residuals first, then uses the statistic expressed above to test for normality. Furthermore, JB uses the property of a normally distributed random variable that the entire distribution is characterized by the mean and the variance. The statistic has a χ^2 distribution with 2 degrees of freedom under the null hypothesis of normally distributed errors (Brooks, 2008). If the residuals are normally distributed, the histogram should be bell-shaped and the Bera - Jarque statistic would not be significant.

4.8.2 Ramsey RESET test

The Ramsey RESET test identifies misspecification of functional form. The test is applied using terms of the fitted values that are of higher order, for example: $Y_t'^2, Y_t'^3$, in an auxiliary regression. The auxiliary regression is where the dependent variable Y_t , from the original equation is regressed on powers of the fitted values combined with the original explanatory variables. This can be expressed as follows:

$$Y_t = \varphi_t + \varphi_2 Y_t'^2 + \varphi_3 Y_t'^3 + \dots \varphi_p Y_t'^p + \sum \beta_i x_{it} + v_t \quad (36)$$

Moreover, a variety of non-linear relationships can be captured by higher orders of the fitted values of y as they represent higher powers and cross-products of the initial explanatory variables for example:

$$Y_t^2 = (\beta'_1 + \beta'_2 x_{2t} + \beta'_3 x_{3t} + \dots \beta'_k x_{kt})^2 \quad (37)$$

4.8.3 Breusch – Godfrey autocorrelation test

The Breusch – Godfrey (BG) test for autocorrelation is also referred to as the Lagrange Multiplier test. Gujarati and Porter (2009) posit that the BG, unlike Durbin's h test is statistically more powerful in the large samples, the finite and/or small samples, which is the reason for the choice of employing this test. Furthermore, the BG test allows in its general sense, for (1) nonstochastic regressors, i.e. the lagged values of the regressand, (2) higher-order autoregressive schemes, i.e. AR(1), AR(2), and (3) simple or higher-order moving averages of white noise error terms. Furthermore, the BG test involves three stages, namely:

1. The first step is to utilize OLS to estimate an equation where you obtain residuals (μ_t)
2. The next step is to regress the error term on all the regressors using the following regression: $\mu_t = \alpha_1 + \alpha_2 X_t + \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \dots \rho_r \mu_{t-r} + \mu_t$. This regression is then used to obtain R^2 (38)
3. If the sample size is large then: $(n - p)R^2 \sim X^2_p$

The null and alternative hypotheses are:

$$H_0: \rho_1 = 0, \rho_2 = 0 \dots \text{and } \rho_r = 0$$

$$H_1: \rho_1 \neq 0, \rho_2 \neq 0 \dots \text{or } \rho_r \neq 0$$

However, there is one potential limitation of Breusch – Godfrey which is in determining an appropriate value of r , the number of lags of the residuals, to use in computing the test.

4.8.4 Heteroscedasticity

According to Gujarati and Porter (2009), heteroscedasticity occurs when the errors do not have a constant variance. The detection of heteroscedasticity in a study is vital as the regression will be inadequate in the presence of heteroscedasticity (will not be able to use regression). This study utilizes the Breusch and Pagan (1979) test for heteroscedasticity because of its simplicity. The null hypothesis for this test states that there is equal variance in all the errors and the alternate hypothesis states that the variances in the errors are not equal, that they are a multiplicative function of one or more variables (Williams 2015). Furthermore, a small chi-

square value as well as a small p-value verifies the null hypothesis to be true. A distinct limitation of the test is that it assumes that error variances are caused by a linear function of explanatory variables in the model, thus it does not accommodate non-linear forms of heteroscedasticity. Another criticism of this test is that it depends heavily on the normality assumption of the disturbances.

4.9 SUMMARY

The methodology chapter presented an overview of the models to be utilized in the study, the data collection and the period to be studied. This chapter provided all unit root test to be utilized to test for stationarity and provided some advantages as well as limitations of these tests. The chapter further gave detail on the model utilized to examine a long run relationship between inflation, credit markets and economic growth. Finally, included in the chapter are the diagnostic tests which are used to examine the adequacy of the models. The next chapter discusses the analysis and findings from the tests described in the current chapter.

CHAPTER 5: EMPIRICAL ANALYSIS

5.1 INTRODUCTION

In investigating the co-integration between inflation, credit markets and economic growth in BRICS countries, the study undertakes a series of tests to address the objectives of the study. The chapter provided information on these different tests, including how they are conducted and their significance to this study. The current chapter (5) consists of the analysis and discussions of these estimations. The results include the Summary statistics, Correlation matrix, Descriptive statistics, Unit root tests, Linear and Non-linear Co-integration tests and diagnostics tests for each of the five countries. The Chapter ends with the summary and conclusion of the estimation results.

5.2 DESCRIPTIVE ANALYSIS AND CORRELATION MATRIX

Table 5.2.1 Summary statistics

	mean	min	max	sd	jb	p-value
Panel A: Brazil						
infl	1.480365	0.504481	3.469488	0.971277	5.048233	0.080129
DCPS	52.76354	27.68567	134.1136	25.43513	31.98930	0.000000
ToT	21.85089	14.39088	29.67825	4.441031	2.401915	0.300906
EMPL	1.897821	1.709213	2.022658	0.090533	1.617316	0.445455
GFCF	19.29795	14.63039	26.90279	2.612051	2.207814	0.331573
REER	1.925019	1.760381	2.059053	0.080490	1.535403	0.464079
Panel B: Russia						
Infl	0.985736	0.566241	1.331974	0.195750	0.375996	0.828616
DCPS	38.48670	16.83777	55.95202	13.17770	1.392041	0.498566
ToT	51.98950	46.28715	61.11086	5.081386	1.728203	0.421430
GFCF	22.32493	18.92638	25.50122	1.819288	0.558386	0.756394
EMPL	1.827712	1.811086	1.838315	0.008051	1.081831	0.582215
REER						
Panel C: India						
Infl	0.845663	0.229224	1.456347	0.240175	0.673089	0.714234
DCPS	26.90385	8.516176	52.38571	14.04592	4.510615	0.104841
ToT	23.42473	7.661769	55.79372	15.16988	8.079343	0.017603
GFCF	25.74423	14.37692	41.93083	7.723436	3.585643	0.166490
EMPL	2.532132	2.296711	2.730649	0.141646	4.572793	0.101632
REER						
Panel D: China						
Infl	0.568734	-0.458663	1.384837	0.454088	0.162571	0.921931
DCPS	109.4224	73.98362	156.2299	24.56083	1.607642	0.447615
ToT	41.70188	24.27313	64.47888	12.32415	1.705414	0.426259
EMPL	-0.633428	-0.825784	-0.425969	0.145357	2.887021	0.236098

GFCF	40.42383	33.57303	46.66012	3.944561	1.075518	0.584056
REER	1.993067	1.848325	2.134531	0.070745	0.711110	0.700784
Panel E: South Africa						
Infl	0.912266	0.314468	1.270794	0.224093	1.131290	0.567994
DCPS	111.3867	53.96717	160.1248	34.77517	3.592995	0.165879
ToT	53.23886	37.48746	72.86539	8.131812	0.434770	0.804620
EMPL	1.094478	0.918958	1.257178	0.104149	2.523523	0.283155
GFCF	20.66262	15.16232	34.11518	4.233062	17.83606	0.000134
REER	2.038379	1.847392	2.257106	0.109979	1.153864	0.561619

Extracted from EViews

Table 5.2.1 consists of the summary of the statistical descriptions of the variables used in the study. The summary statistics show that Brazil out of all the five countries has had the highest maximum of inflation with the value of 3.47, with the minimum being 0.22 for India. These numbers of inflation particularly for Brazil, prove the existing literature that Brazil is a country that has been and still struggling with high inflation rates. Furthermore, China recorded disinflation for its minimum inflation value of -0.46. When it comes to Credit in the countries, South Africa records the highest value with an average of 111.39 and India with the lowest average of 26.90. Furthermore, for all the variables, the JB statistics are high which allows the researcher to reject the null hypothesis of normality at any level of significance.

When the study performed a serial correlation test it was determined that the variable REER in Russia's regression should be omitted to confront the problem of serial correlation.

Table 5.2.2: Correlation matrix

	infl	DCPS	ToT	REER	GFCF	EMPL
Pan el A: Bra zil						
infl	1	0.3415	-0.5143	0.0706	0.1919	-0.6927
DC PS	0.3415	1	-0.2431	0.1854	0.4429	0.0753
To T	-0.5143	-0.2431	1	-0.6501	-0.2540	0.7003
RE ER	0.070588235 29411766	0.185434173 6694678	- 0.650140056 0224091	1	0.396918767 5070029	- 0.199159663 8655462
GF CF	0.191876750 7002802	0.442857142 8571429	- 0.254061624 64986	0.396918767 5070029	1	- 0.143137254 9019608
EM PL	- 0.692717086 834734	0.075350140 05602243	0.700280112 0448181	- 0.199159663 8655462	- 0.143137254 9019608	1

Panel B: Russia						
Infl	1	-0.5661764705882354	0.8137254901960787		-0.5343137254901963	-0.5539215686274511
DC PS	-0.5661764705882354	1	-0.8774509803921571		0.3848039215686275	0.8774509803921571
To T	0.8137254901960787	-0.8774509803921571	1		-0.556372549019608	-0.8186274509803925
GF CF	-0.5343137254901963	0.3848039215686275	-0.556372549019608		1	0.6691176470588238
EM PL	-0.5539215686274511	0.8774509803921571	-0.8186274509803925		0.6691176470588238	1
RE ER						
Panel C: India						
Infl	1	-0.0530	-0.0118		-0.0142	-0.04422
DC PS	-0.0530	1	0.9001		0.9211	0.9550
To T	-0.0118	0.9001	1		0.9499	0.9500
GF CF	-0.0142	0.9211	0.9499		1	0.9499
EM PL	-0.0442	0.9550	0.9500		0.9499	1
RE ER						
Panel D: China						
Infl	1	-0.72831	-0.4621	-0.2008	-0.0574	-0.5818
DC PS	-0.7283	1	0.6258	0.3608	0.6642	0.9219
To T	-0.4621	0.6258	1	-0.1545	0.5708	0.6783
RE ER	-0.2008	0.3608	-0.1545	1	0.3022	0.3901
GF CF	-0.0574	0.6642	0.5708	0.3022	1	0.7271
EM PL	-0.5818	0.9219	0.6783	0.3901	0.7271	1

Panel E: SA						
Infl	1	-0.8198	-0.3753	0.6631	0.3952	-0.7954
DCPS	-0.8198	1	0.5123	-0.8470	-0.2918	0.9393
ToT	-0.3753	0.5123	1	-0.6346	0.3584	0.5531
REER	0.6631	-0.8470	-0.6346	1	0.2804	-0.9201
GF CF	0.3952	-0.2918	0.3584	0.2804	1	-0.3323
EMPL	-0.7954	0.9393	0.5531	-0.9201	-0.3323	1

Extracted from EViews

The correlation matrix in table 5.2.2 allows us to analyse the statistical association or dependence between variables in other words, it shows us the degree to which a variable is related to another. There are values of ones in the diagonal of the table as these cells measure the relation of a variable to itself. For example, from the table we can see that for Brazil, there is a weak but positive correlation between Inflation and Credit. For Russia, India, China and South Africa, the table shows that Inflation and Credit are weakly negatively correlated meaning that more Credit is associated with less Inflation rates. Moreover, there is very little correlation between Inflation and Credit for India with the value of -0.05.

5.3 UNIT ROOT TESTS

The summary of the results of the three unit root tests (ADF, PP and ADF-GLS) conducted in the study are displayed in table 5.3.1 (variables in levels). The results show that for some of the variables, the study rejects the null hypothesis of the existence of a unit root in some of the variables in levels at significance levels of at least 10 per cent. Although the ARDL/ NARDL does not require the series to be of the same order, it is always best to confirm that the variables are either I(0) or I(1) and not integrated at I(2) as the ARDL does not work with I(2) variables.

Table 5.3.1: Unit root test results (levels)

	ADF		PP		DF-GLS	
	int	Int+trend	int	Int+trend	int	Int+trend
Panel A: Brazil						
infl	-1.013354	-1.924072	-1.013354	-1.924072	-0.934725	-1.827769
DCPS	-4.502460** *	-2.009288	-3.279374**	-3.658778**	-1.954086**	-2.386430

ToT	-1.696927	-3.769893**	-1.481325	-3.784307**	-1.328846	- 3.732263** *
EMP L	-2.643492*	-0.378374	-2.438045	-0.544500	-0.408840	-0.896073
GFCF	-2.869706**	-3.357631*	-2.945378**	-3.391382*	- 2.901124** *	-3.302833**
REER	-2.247369	-2.289032	-2.457066	-2.500672	-2.285369**	-2.365950
Panel B: Russi a						
Infl	-3.385866** (0.0210)	-3.724347** (0.0385)	- 4.331208** * (0.0023)	- 7.686874** * (0.0000)	-1.396494 (0.1748)	- 2.869127** * (0.0083)
DCPS	-1.703590 (0.4108)	-2.395747 (0.3681)	-1.830486 (0.3549)	-0.749604 (0.9520)	-1.133919 (0.2746)	- 2.842105** * (0.0124)
ToT	- 4.710026** * (0.0007)	-3.435082* (0.0684)	- 4.670298** * (0.0008)	- 5.807091** * (0.0002)	- 4.464966** * (0.0001)	- 4.367990** * (0.0002)
EMP L	- 3.961105** * (0.0060)	- 6.213114** * (0.0002)	-2.797795* (0.0719)	-3.206648 (0.1042)	-2.414370** (0.0255)	- 3.085353** * (0.0058)
GFCF	-1.991225 (0.2889)	-2.058218 (0.5478)	-1.973433 (0.2963)	-2.058218 (0.5478)	-1.912007* (0.0655)	-2.151015** (0.0397)
REER	-2.289459 (0.1828)	-2.094196 (0.5239)	-2.289459 (0.1828)	-2.094196 (0.5239)	-1.559304 (0.1320)	-2.116251** (0.0449)
Panel C: India						
Infl	- 4.592919** * (0.0004)	- 4.550067** * (0.0031)	- 4.592919** * (0.0004)	- 4.550067** * (0.0031)	-2.186126** (0.0333)	- 3.256949** * (0.0020)
DCPS	-0.425488 (0.8973)	-2.848150 (0.1870)	-0.203314 (0.9318)	-1.919155 (0.6320)	0.238311 (0.8125)	- 2.742026** * (0.0084)
ToT	-0.429679 (0.8967)	-1.781419 (0.7012)	-0.575551 (0.8677)	-1.992721 (0.5931)	0.015531 (0.9877)	-1.416348 (0.1620)
EMP L	-1.431957 (0.5601)	-2.203655 (0.4782)	-0.854847 (0.7953)	-1.004116 (0.9351)	-0.020876 (0.9834)	-2.369816** (0.0214)
GFCF	-1.309951 (0.6194)	-1.914141 (0.6346)	-1.299645 (0.6242)	-2.146240 (0.5098)	-0.654012 (0.5157)	-2.058987** (0.0440)
REER						
Panel D: China						

Infl	-2.315657 (0.1765)	-3.223515 (0.1068)	-2.602055 (0.1058)	-3.308355* (0.0879)	-1.656203 (0.1125)	- 4.544298** * (0.0003)
DCPS	0.121439 (0.9637)	-2.490391 (0.3311)	0.466249 (0.9835)	-2.490391 (0.3311)	1.191339 (0.2404)	- 2.578303** * (0.0136)
ToT	-1.254401 (0.6448)	-1.526747 (0.8089)	-1.106797 (0.7076)	-1.452652 (0.8345)	-0.784817 (0.4359)	-1.710223* (0.0928)
EMP L	-0.612015 (0.8555)	-2.469378 (0.3404)	-0.335261 (0.9098)	-1.901988 (0.6334)	0.118705 (0.9062)	- 2.558097** * (0.0152)
GFCF	-1.836736 (0.3595)	- 4.724577** * (0.0018)	-1.901792 (0.3293)	- 5.453632** * (0.0002)	-1.801038* (0.0770)	- 3.694097** * (0.0005)
REER	-3.338363** (0.0206)	-2.042914 (0.5603)	-3.014400** (0.0423)	-3.825257** (0.0256)	-1.075413 (0.2890)	-1.212472 (0.2328)
Panel E: South Africa						
Infl	-3.068488** (0.0347)	-2.860163 (0.1830)	-3.074382** (0.0342)	-2.904654 (0.1688)	-1.132855 (0.2622)	-1.603613 (0.1145)
DCPS	-0.450014 (0.8921)	-1.947552 (0.6152)	-0.226321 (0.9280)	-1.664351 (0.7525)	-0.129476 (0.8975)	-1.559194 (0.1254)
ToT	-2.151325 (0.2260)	-2.614905 (0.2755)	-2.126672 (0.2352)	-2.591127 (0.2858)	-2.161610** (0.0348)	- 2.452061** * (0.0172)
EMP L	1.200307 (0.9978)	-1.976118 (0.6015)	1.048533 (0.9966)	-2.067886 (0.5521)	1.018122 (0.3133)	-1.333830 (0.1877)
GFCF	-1.628584 (0.4618)	-2.584209 (0.2888)	-1.513194 (0.5201)	-2.451240 (0.3505)	-1.662199 (0.1019)	-2.227599** (0.0298)
REER	-1.231154 (0.6515)	- 4.223221** * (0.0097)	-0.899406 (0.7782)	-3.152406 (0.1086)	-0.729300 (0.4702)	- 4.334669** * (0.0001)

Extracted from EViews

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

Table 5.3.1 contains a summary of the stationarity tests in levels. The table shows that some of the variables are stationary in levels therefore, the study may reject the null hypothesis of the existence of unit root and because the ARDL and NARDL model is compatible with variables that are either I(0) or I(1), the study can commence with the Bounds test.

5.4.1 LINEAR COINTEGRATION AND DIAGNOSTICS TESTS

Table 5.4.1 provides the linear co-integration and diagnostic test of the study. There are two tests in the literature which can be used to test for significant long run co-integration which includes the F-statistic bounds testing that was introduced by Perasan *et al.* (2001), denoted by F_{PSS} . The bounds testing tests for the null hypothesis that there is no co-integration $H_0 = 0$, against the alternative which implies the existence of co-integration. The second co-integration test that the study utilises is one introduced by Banerjee, Dolado and Mestre (1998) which is denoted by T_{BDM} , which tests the null hypothesis on the t-statistic of $\theta = 0$ against $\theta < 0$ which is the alternative hypothesis. These two tests are found in Panel A of Table 5.4.1.

In panel A, the results indicate the existence of a long run relationship between the variables for all the countries with the results showing that the F-statistics for all BRICS countries are greater than their upper bounds. To simplify the results further, All the BRICS countries show that there is a long run relationship between the variables for some countries at 1% and 10% level of significance.

The T_{BDM} value for Brazil has a t-statistic value of -9.488957 significant at one per cent level of significance. For Russia, the t-statistic for the T_{BDM} test is -5.414168 at one per cent level of significance. Furthermore, all the T_{BDM} tests for India (-7.808252), China (-5.192367) and South Africa (-6.675146), shows evidence of a long run relationship for all the countries at one per cent level of significance.

Table 5.4.1: Linear Co-integration and Diagnostic tests

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Cointegration tests					
F_{PSS}	10.01149*** (0.0000)	11.65719*** (0.0012)	11.65538*** (0.0000)	3.420197* (0.043547)	7.115763*** (0.0000)
t_{BDM}	-9.488957*** (0.0000)	-5.414168*** (0.0004)	-7.808252*** (0.0000)	-5.192367*** (0.0000)	-6.675146*** (0.0000)
Panel B: Diagnostics tests					
χ^2_{NOR}	3.876343 (0.143967)	1.188897 (0.551867)	4.650970 (0.097736)	0.378319 (0.827655)	3.703585 (0.156956)
χ^2_{SC}	0.138347 (0.7930)	1.862765** (0.0522)	7.389462*** (0.0010)	1.632086** (0.0357)	14.13031 (0.0000)
χ^2_{HET}	0.969392	1.575306	2.491001**	1.287267	1.761428

	(0.4349)	(0.2278)	(0.0355)	(0.3032)	(0.1365)
χ^2_{FF}	2.292372 (0.1449)	25.65903 (0.0039)	0.084543 (0.7726)	0.426167 (0.5302)	0.002731 (0.9588)
CUSUM	S	S	U	S	U
CUSUMSQ	S	S	U	S	S

Extracted from EViews

X^2_{NOR} , X^2_{SC} , X^2_{HET} , X^2_{FF} denote Jarque Bera statistics for normality, Breusch Godfrey statistics for serial correlation, Breusch-Pagan-Godfrey statistics for heteroscedasticity and Ramsey RESET statistics for functional form, respectively.

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

Panel B of Table 5.4.1 exhibits the diagnostic tests which consists of the Jacque-Bera normality test (X^2_{NOR}), the Breusch-Godfrey Serial Correlation Lagrange Multiplier (LM) test (X^2_{SC}), the Breusch-Pagan-Godfrey Heteroskedasticity test (X^2_{HET}), the Ramsey Reset Test for functional form (X^2_{FF}), Cumulative Sum of Recursive Residuals (CUSUM) as well as the CUSUM of squared residuals (CUSUMSQ) stability test where the 'S' denotes that the model is stable and the 'U' denotes instability in the model.

It is important to note that although the existence of a long-run relationship is proven by both the co-integration tests utilized in this study, issues of serial correlation and heteroscedasticity are unfortunately unyielding in some instances. Moreover, although proven to be futile, the researcher adjusted the number of lags in the attempt to remedy heteroscedasticity and serial correlation issues as will be discussed in the next sections to follow.

The Jacque-Bera statistic is the most frequently used to test whether data is normally distributed or not. The null hypothesis of the Jacque-Bera statistic is that the data is normally distributed at probability value that is less than five per cent, against the alternative hypothesis of non-normal distribution which indicates that there is not a normal distribution in the residuals of a series. Taking into consideration the JB statistics found in Panel B, Table 5.4.1, the study deduces that the null hypothesis of normality amongst the residuals, can be rejected as the probability values for all the BRICS countries JB statistics are greater than 5 per cent. This means that the residuals in all five of the countries' normality tests follow a non-normal distribution.

The second residual test conducted in the study is the Breusch-Godfrey Serial Correlation LM test. This test establishes whether variables are related to themselves over a period and whether they revert to the mean or not. The null hypothesis for this test is that there is no serial correlation in the residuals and the alternative being that there is. The LM statistic tests for serial correlation in the number of residuals with the lag order being specified by the researcher

of which the maximum number of lags this study was able to impose without losing degrees of freedom was 2.

The results for Brazil show that the study is unable to reject the null hypothesis of no serial correlation with the probability value of 0.7930, whereas for the rest of the countries, the study accepted the null hypothesis of no serial correlation.

Furthermore, the Breusch-Pagan heteroscedasticity test is conducted with the null hypothesis that the error variations are all equal against the alternative hypothesis that the error variations are a multiplicative function of one or more variables. The determining rule is that if the test has a p-value below 0.05 then the null hypothesis of homoscedasticity is rejected and therefore, it can be concluded that there is evidence of heteroscedasticity. Panel A shows that for all the countries, the null hypothesis can be accepted as the values are all above five per cent except for India which has a value of 0.0355 and thus proves the existence of heteroscedasticity for this country. Unfortunately, there is quite a few consequences that emanate from the existence of heteroscedasticity of which include the violation of B.L.U.E (Best Linear Unbiased Estimates), invalid F – and T- statistics as well as LM tests, incorrect standard errors, to name a few.

The advantages of employing an ARDL model includes the model not requiring the series to be of the same order, in other words, to be integrated of order zero $I(0)$ or order one $I(1)$ which means that it does not depend on unit root testing, the model uses a single reduced form of equation unlike the Johansen co-integration test which uses a system of equations.

The ARDL regression can be conducted whether or not the variables are of $I(0)$ or $I(1)$, which was established in the previous sub-section on unit root tests which validate that the researcher may now commence with the ARDL test. Before presenting the main findings, the study initially runs a basic linear ARDL regression on the proposed variables for the BRICS countries to which the summary of the results is found in table 5.4.2.

The variable Real Exchange Rates (REER) was omitted in India's regression due to the lack of data on that variable for the period adopted in this study. The variable was omitted for Russia also to confront the problem of serial correlation. Furthermore, the choice of variables is broadly consistent with existing literature which includes the works of Kormendi and Meguire (1985), Fischer (1993), Bruno and Easterly (1998), Khan and Senhadji (2001), Phiri (2010), Manamperi (2014), Mishra and Behera (2016) and Iyke and Odhiambo (2009) to mention a

few, whereby all of these studies made use of one or more of the variables utilized in the current study. These variables are Gross Domestic Product as an indicator of Economic Growth, Inflation as proxied by Consumer Price Index (CPI), Domestic Credit to Private Sector as a measure of Credit Market Development, Employment as a proxy for Labour, Investment modelled by Gross Fixed Capital Formation and lastly Real Exchange Rates. In this paper, Inflation, REER and Employment were transformed into their natural log values to moderate outliers and attempt to correct the problem of serial correlation.

The linear ARDL results for the BDM long run test found evidence of long run relationships for all the countries at least at five per cent level of significance. The second test which is the bounds test of F-statistics, validates this finding at least at five per cent level of significance.

The long run findings showed that in Brazil's case, the association between inflation and growth is positive, while in India and South Africa it showed to be negative. In other words, increasing inflation is conducive to Brazil's growth, it results in an increase in the country's economic growth. In India, when inflation decreases, the economy experiences some growth in the economy, similar results are also evident for South Africa when inflation decreases. Whereas, for Russia and China, inflation does not have a significant impact on economic growth. Furthermore, the results also show that DCPS does not have a significant impact on economic growth in any of the countries in the long run.

In the short run results, inflation positively and significantly impacts economic growth when declining in Brazil, India and South Africa, whereby the opposite is true for Russia and China with the results being insignificant.

Furthermore, the error correction term showed a long-run relationship in all the countries' variables. This is indicated by the negative and statistically significant coefficient of the error term, meaning there is a long-run causal relationship.

A summary of the linear ARDL regression is found in Table 5.4.2

Table 5.4.2: Linear ARDL estimates

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Long-run estimates					
infl	1.127969*	-4.816276	-1.689578**	0.423123	-6.428337**

	(0.0902)	(0.4065)	(0.0599)	(0.8216)	(0.0278)
DCPS	0.008807 (0.6758)	-0.479630 (0.1080)	0.036098 (0.5232)	-0.081266 (0.1294)	0.010307 (0.7979)
ToT	0.573894*** (0.0021)	-0.399539 (0.4524)	-0.073876 (0.1557)	-0.022487 (0.7070)	-0.011043 (0.9413)
EMPL	-9.192007 (0.2541)	175.695430 (0.5755)	8.252189** (0.0399)	20.799779* (0.0750)	-23.318603 (0.1598)
GFCF	-0.310639 (0.1764)	-0.465529 (0.4253)	0.077700 (0.3562)	-0.105767 (0.5533)	0.124019 (0.6652)
REER	21.193447*** (0.0080)			- 27.363511*** (0.0020)	-10.449836 (0.5221)
Panel B: Short-run estimates					
ΔGDP(-1)				0.843854*** (0.0026)	
ΔInfl	-2.548292*** (0.0135)	-3.649760 (0.3246)	-3.149738* (0.0805)	2.738677 (0.1681)	-5.448706** (0.0237)
ΔDCPS	0.007380 (0.6713)	-0.133039 (0.4387)	0.067294 (0.5274)	0.047175 (0.4929)	0.008737 (0.7977)
Δ ToT	0.480887*** (0.0012)	0.076964 (0.7931)	-0.137720 (0.1690)	0.291009** (0.0460)	0.271711** (0.0042)
ΔEMPL	136.827322*** (0.0027)	133.141499 (0.6173)	- 250.913600** (0.0234)	21.400727** (0.0473)	-19.765019 (0.1503)
ΔGFCF	0.752349*** (0.0001)	1.012151*** (0.0087)	0.144850 (0.3650)	-0.685481** (0.0394)	0.400310** (0.0544)
ΔREER	23.695931*** (0.0010)			- 28.154098*** (0.0002)	10.611143 (0.2985)
ECT(-1)	-0.837937*** (0.0000)	-0.757797** (0.0132)	-1.864217*** (0.0000)	-1.028892*** (0.0004)	-0.847607*** (0.0000)

Extracted from EViews

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

5.5.1 MAIN FINDINGS: NON-LINEAR ARDL ESTIMATIONS

The following section involves the study's diagnostic tests and the main findings which are non-linear ARDL estimations with regressions done on the proposed variables for the different countries. This analysis excludes the variable REER for both Russia and India for the same reasons that were stated in the previous section and transforms the values of Inflation, Employment and REER into their natural logs. Table 5.5.2 can be found containing the summary of the long run non-linear estimations. The main non-linear findings of the study have been broken down into three main estimations, whereby the researcher conducted regressions where (1) Only Inflation is partitioned, (2) Only Credit is partitioned and lastly, (3) Where both

Inflation and Credit are partitioned. These results will be given by their relative order and the results show that the relationship for some countries is insignificant, negative or positive.

5.5.2 NON-LINEAR INFLATION

5.5.2.1 Diagnostics tests

The summary of the diagnostic test results is found on table 5.5.2.1 panel A. The results show that for all the countries' bounds testing, there is evidence of a long run relationship which is shown by the F-statistic values which are all significant at one per cent level of significance. The F-statistics are given by their probability values. Furthermore, the BDM test also shows that there is evidence of co-integration with all the values being significant at one per cent level of significance with a negative coefficient. The study further employed the Wald test to test for a long run as well as a short run relationship between the dependent variable and the variable inflation, of which the results confirmed that such a relationship exists for all BRICS countries except Russia which has a probability value of 0.1759. The short run results could not be computed as the Wald test removed any results that had probability values of more than ten per cent.

Panel B in table 5.5.2.1 offers the diagnostic chi-square statistics. From the table, the researcher can reject the null hypothesis of normality at five per cent as the probability values of all five regressions show values above five per cent. This means that the residuals of these five regressions do not follow a normal distribution. Furthermore, the study fails to detect evidence of serial correlation for Brazil, Russia, India and China but shows evidence of serial correlation for South Africa at one per cent level of significance. The chi-square values for heteroscedasticity show that the study does not detect heteroscedasticity in the residuals as all the statistics are larger than five per cent. However, the Ramsey Reset functional form statistics for Russia and China suggest that these countries' models suffer from incorrect functional form and therefore may be unreliable. Whereas the model for Brazil, India and South Africa appear to be reliable and not suffering from incorrect functional form. The models of all BRICS countries show stability as illustrated by the CUSUM and CUSUMSQ results, with only India's CUSUMSQ showing instability.

Table 5.5.2.1

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A:					

Cointegration tests					
F_{SS}	6.549487*** (0.0000)	9.331476*** (0.0026)	8.717899*** (0.0000)	4.549698*** (0.0086)	4.978078*** (0.0000)
t_{BDM}	-9.451219*** (0.0000)	-6.437898*** (0.0001)	-7.853776*** (0.0000)	-4.940086*** (0.0000)	-4.925654*** (0.0000)
W_{LR}	13.61388*** (0.0000)	1.648282 (0.1759)	26.59729*** (0.0000)	10.65789*** (0.0000)	14.72016*** (0.0000)
W_{SR}					
Panel B: Diagnostics tests					
χ^2_{NOR}	0.794139 (0.672287)	1.078005 (0.583330)	4.271409 (0.118161)	0.328048 (0.848722)	1.097349 (0.577715)
χ^2_{SC}	0.106618 (0.8243)	1.806319 (0.0554)	2.455881 (0.0597)	1.814183 (0.0769)	3.484833 (0.0135)
χ^2_{HET}	1.344741 (0.2562)	1.714443 (0.2053)	2.125058 (0.0589)	2.124174 (0.1214)	1.205389 (0.3051)
χ^2_{FF}	0.664955 (0.4249)	5.983035 (0.0402)	0.492976 (0.4863)	6.407236 (0.0230)	0.065380 (0.9484)
CUSUM	S	S	S	S	S
CUSUMSQ	S	S	U	S	S

Extracted from EVIEWS

$X^2_{NOR}, X^2_{SC}, X^2_{HET}, X^2_{FF}$ denote Jarque Bera statistics for normality, Breusch Godfrey statistics for serial correlation, Breush-Pagan-Godfrey statistics for heteroscedasticity and Ramsey RESET statistics for functional form.

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

5.5.2.2 Long and short run asymmetries

The results for the regression on Inflation being the only variable being partitioned show that Brazil and China's positive inflation does not have a significant impact on economic growth, a result that is consistent with a study by Gillman *et al.* (2004) which finds that low levels of positive inflation has an insignificant impact on growth. From the table we can also see that for all the BRICS countries, negative or declining inflation yields an insignificant impact on economic growth. The insignificant findings for Brazil and China concerning the inflation-growth relationship was previously determined by Bruno and Easterly (1995) and Burdekin *et al.* (2004). Where Bruno and Easterly (1995) apart from high inflation crises countries, found no evidence of a consistent relationship between inflation and growth. Burdekin *et al.* (2004) found that below an 8 per cent threshold, increasing inflation rates are insignificant to growth but are predominantly negative.

On the other hand, positive inflation appears to have a significant negative impact on economic growth for Russia, India and South Africa in the long run. Whereby, when inflation increases,

economic growth declines in these countries. These results are consistent to those found by, Kormendi and Meguire (1985), Ahiakpor (2014), Manamperi (2014), whereby all these studies find a negative significant relationship between inflation and growth, where rising inflation rates harm the growth of the countries of these studies. Furthermore, Khan and Senhadji (2001) study, shows that inflation slows economic growth in industrial countries when the rates are between one and three per cent and developing countries between seven and eleven per cent. Additionally, although the study does not detect a significant relation between negative inflation and economic growth for any of the countries, the coefficients show that declining inflation for Russia, India and South Africa would have a positive impact on growth as it would cause growth to increase while it declines.

Credit for all the countries is insignificant and primarily negative, meaning the study fails to prove a long run significant effect between credit and economic growth for the BRICS countries and as insignificant the relationship is, declining credit is not conducive to economic growth in any of the countries.

In the short run, a significant negative relationship between positive inflation and economic growth is detected for Russia, India and South Africa which indicates that increasing levels of inflation are detrimental to economic growth in these countries. For China however, neither positive nor negative inflation influences the country's growth. Whereas, for Brazil, declining inflation is conducive to growth meaning that when there is a decrease in negative inflation, the country experiences growth in the economy. The significant negative effect that inflation has on economic growth is consistent with the studies of Vazakidis and Adamopoulos (2009), Gillman and Harris (2004) and that of Bose (2002) who found that economic growth is very sensitive to rising inflation.

Table 5.5.2.2: Inflation partitioned

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Long-run estimates					
Infl_pos	1.454668 (0.1171)	-14.179504* (0.0852)	-2.473230** (0.0348)	-1.249120 (0.7068)	-5.480160*** (0.0014)
Infl_neg	0.521977 (0.3296)	-8.460822 (0.1806)	-1.372476 (0.2473)	2.620795 (0.1178)	-2.922217 (0.3123)
DCPS	0.001502 (0.9233)	-0.178351 (0.4215)	0.039709 (0.5031)	0.000687 (0.9838)	0.036420 (0.1977)
TRADE	0.652904*** (0.0001)	0.630599 (0.2033)	-0.072124 (0.2083)	0.015475 (0.5539)	0.034991 (0.7652)

EMPL	-26.279722** (0.0290)	331.556952 (0.1378)	17.095617 (0.2677)	30.867219 (0.1538)	-4.640536 (0.7998)
GFCF	-0.051560 (0.7847)	0.919992** (0.0232)	0.059804 (0.4748)	-0.047184 (0.7316)	0.355583* (0.0680)
REER	24.550559*** (0.0002)			- 46.537749*** (0.0029)	-11.880069 (0.2983)
Panel B: Short-run estimates					
Δ Infl_pos	1.486710 (0.1189)	-15.982719** (0.0550)	-4.605509** (0.0480)	0.821020 (0.7483)	-6.246361*** (0.0044)
Δ Infl_neg	-3.255511*** (0.0042)	-9.536789 (0.1306)	-2.555746 (0.2659)	2.618191 (0.1506)	-3.330783 (0.2642)
Δ DCPS	0.001535 (0.9232)	-0.201032 (0.4393)	0.073945 (0.5064)	0.157776*** (0.0093)	0.041512 (0.1963)
Δ TRADE	0.365940** (0.0265)	0.710793 (0.1674)	-0.134304 (0.2151)	0.015459 (0.5699)	0.340452*** (0.0007)
Δ EMPL	141.038335*** (0.0014)	297.453478 (0.1106)	- 260.893736** (0.0358)	30.836549* (0.0712)	-5.289346 (0.7947)
Δ GFCF	0.866238*** (0.0000)	1.036987	0.111363 (0.4799)	-0.305098 (0.1787)	0.405299** (0.0515)
Δ REER	25.091324*** (0.0001)			- 46.491509*** (0.0000)	14.786098 (0.1464)
ECT(-1)	-1.022027*** (0.0000)	-1.127171*** (0.0001)	-1.862143*** (0.0000)	-0.999006*** (0.0001)	-1.139814*** (0.0000)

Extracted from EViews

5.5.3 NON-LINEAR CREDIT

5.5.3.1 Diagnostic tests

The co-integration results for regressions conducted with only DCPS as a non-linear variable are found in table 5.5.3.1. The results for the BDM t-test and bounds F-tests for asymmetric co-integration effects show that all the countries' statistics are greater than their upper bound critical values at one per cent level of significance which indicates significant evidence of co-integration. Furthermore, the long run non-linear Wald test statistics show that only Russia lacks evidence of a long run relationship between GDP and credit with a probability value of 0.3473, whereas, for the rest of the countries, the study detects a long run relationship between the variables at one per cent level of significance.

Panel B presents results whereby for the JB normality test, Brazil's statistic accepts the null hypothesis of normal distribution at one per cent level of significance, unlike Russia, India, China and South Africa where the null hypothesis is rejected and therefore showing evidence that the residuals are following a non-normal distribution. Serial correlation has been detected for Russia, India and South Africa at least at five per cent level of significance and

heteroscedasticity has been detected for Russia and India. Additionally, all the CUSUM and CUSUMSQ for all the countries except for India and South Africa's CUSUM test, the results show that the models are stable.

Table 5.5.3.1

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Cointegration tests					
F_{SS}	10.04876*** (0.0000)	8.505322*** (0.0088)	9.998647*** (0.0000)	5.308749*** (0.0078)	4.554065*** (0.0000)
t_{BDM}	-7.232380*** (0.0000)	-4.890177*** (0.0018)	-7.741055*** (0.0000)	-5.050529*** (0.0015)	-5.390643*** (0.0000)
W_{LR}	20.71641*** (0.0000)	1.100851 (0.3473)	19.22174*** (0.0000)	7.737472*** (0.0000)	13.93540*** (0.0000)
W_{SR}					
Panel B: Diagnostics tests					
χ^2_{NOR}	11.89912 (0.002607)	1.406962 (0.494860)	4.508096 (0.104973)	0.167693 (0.919573)	2.012448 (0.365597)
χ^2_{SC}	1.662912 (0.0854)	1.272359 (0.0673)	7.428612 (0.0009)	1.113527 (0.0289)	7.764664 (0.0005)
χ^2_{HET}	0.732311 (0.6202)	0.853123 (0.4434)	2.423368 (0.0371)	1.205761 (0.3444)	1.161032 (0.3277)
χ^2_{FF}	3.023294 (0.0961)	5.120114 (0.0714)			
CUSUM	S	S	U	S	U
CUSUMSQ	S	S	U	S	S

Extracted from EViews

$\chi^2_{NOR}, \chi^2_{SC}, \chi^2_{HET}, \chi^2_{FF}$ denote Jarque Bera statistics for normality, Breusch Godfrey statistics for serial correlation, Breush-Pagan-Godfrey statistics for heteroscedasticity and Ramsey RESET statistics for functional form, respectively.

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively.

5.5.3.2 Long and short run asymmetries

Inflation in Brazil, Russia and China shows that the relationship between inflation and growth is insignificant which is once again in alignment with the studies mentioned in the previous paragraphs. In this instance, inflation is negatively related to economic growth for India and China, meaning that inflation causes a decline in India's economic growth but is insignificant in China's case. Furthermore, negative and positive DCPS does not show evidence of a significant impact on economic growth in the long run, except for China's negative/declining credit which shows that as the variable declines, the country's economy increases. China's results are similar to those of Duican and Pop (2015), Hassan, Sanchez and Yuc (2011) for East

Asia and the Pacific and Leita0 (2010), Olowofeso *et al.* (2015) where the relation between credit and economic growth is positive.

In the short run, inflation inflicts a negative impact on economic growth for Brazil, India and South Africa. In the case of Russia, inflation has no significant effect on growth and China's economic growth on the other hand is positively affected by negative inflation. In this case, Credit has no significant impact on the countries' growth except for China whereby the effect is positive whether credit is declining or increasing and for Brazil where declining credit has a positive impact on the country's economic growth. The positive relation results are consistent to those found by Duican and Pop (2015), Hassan *et al.* (2011) for East Asia and the Pacific and Leita0 (2010) whereby these studies established that the correlation between credit and economic growth is one that is positive.

Table 5.5.3.2

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Long-run estimates					
INFL	1.211200 (0.1546)	-8.294235 (0.3456)	-1.629973* (0.0762)	1.370018 (0.3003)	-5.215150*** (0.0180)
DCPS_pos	0.021188 (0.5000)	-0.219377 (0.4413)	0.045340 (0.4645)	-0.052081 (0.1780)	-0.005549 (0.8612)
DCPS neg	0.012868 (0.5618)	-0.155798 (0.8595)	-0.027531 (0.8770)	-0.742449** (0.0381)	0.049457 (0.1979)
TRADE	0.459008** (0.0435)	0.776418 (0.2666)	-0.089549 (0.1810)	-0.013609 (0.7786)	0.114372 (0.3079)
EMPL	-11.022192 (0.3897)	191.150851 (0.5990)	6.313002 (0.3308)	-67.140368* (0.0839)	-2.518412 (0.8483)
GFCF	-0.295024 (0.3599)	1.013715 (0.1714)	0.094587 (0.3240)	-0.250204 (0.1333)	0.142196 (0.4708)
REER	14.287228 (0.1297)	12.211813 (0.6440)		5.436349 (0.6529)	-5.284406 (0.6321)
Panel B: Short-run estimates					
ΔGDP(-1)					
ΔInfl_	-2.650025** (0.0369)	-8.995997 (0.3154)	-3.044781* (0.0978)	4.123102* (0.0960)	-5.902255*** (0.0115)
ΔDCPS pos	0.015869 (0.4909)	-0.237938 (0.4707)	0.084696 (0.4696)	0.326745** (0.0373)	-0.006280 (0.8617)
ΔDCPS neg	0.009638 (0.5512)	-0.168980 (0.8590)	-0.051427 (0.8769)	-0.643624* (0.0697)	0.055973 (0.2347)
ΔTRADE	0.152703 (0.4258)	0.842109 (0.2167)	-0.167278 (0.1922)	0.211168 (0.1764)	0.321474*** (0.0013)
ΔEMPL	127.451552** (0.0235)	207.323811 (0.6133)	- 245.273941**	-23.392878 (0.6357)	-2.850217 (0.8457)

			(0.0295)		
$\Delta GFCF$	0.767614*** (0.0004)	1.099484 (0.1520)	0.176689 (0.3330)	-0.345711 (0.1391)	0.377227** (0.0495)
$\Delta REER$	10.700532 (0.1011)	13.245034 (0.6427)		- 29.155461*** (0.0132)	12.596663 (0.2071)
$ECT(-1)$	-0.748958*** (0.0000)	-1.084608*** (0.0018)	-1.867995*** (0.0000)	-1.381717*** (0.0015)	-1.131752*** (0.0000)

Extracted from EViews

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

5.5.4 NON-LINEAR CREDIT AND INFLATION

5.5.4.1 Diagnostic tests

Co-integration has been detected for all the countries at one per cent level of significance as shown by the bounds F-statistic and the BDM t-statistic that show to be above their corresponding critical upper bound values. Furthermore, Russia's Wald test statistics shows the country to be the only one to fail to detect a long run non-linear relationship between GDP, Inflation and DCPS with a probability value of 0.3697, whereas the rest of the countries show evidence of a long run asymmetric relationship amongst the variables, all having significant probability values of 0.0000.

Furthermore, the residuals of all the countries' regressions follow a non-normal distribution with probability values above five per cent. Unfortunately, the problem of serial correlation has been detected for Brazil, China and South Africa even after the researcher attempted to remedy this problem by changing the number of lags and omitting some variables. The study fails to detect heteroscedasticity as well as incorrect functional form in all the models of the countries, which in part, may allow the researcher to rely on these models. The CUSUM and CUSUMSQ results shows that for all the countries the models are stable, except for India's CUSUMSQ.

Table 5.5.4.1

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A: Cointegration tests					
F_{SS}	7.340819*** (0.0000)	7.489715*** (0.01221)	7.802260*** (0.0000)	3.982626*** (0.0101)	4.144397*** (0.0000)
t_{BDM}	-6.916229*** (0.0000)	-4.816859*** (0.0019)	-7.797938*** (0.0000)	-5.311014*** (0.0001)	-4.999512*** (0.0000)
W_{LR}	13.81701*** (0.0000)	1.069557 (0.3697)	16.61004*** (0.0000)	7.767747*** (0.0000)	8.653664*** (0.0000)

W_{SR}					
Panel B: Diagnostics tests					
χ^2_{NOR}	2.347021 (0.309279)	0.284960 (0.867205)	4.344803 (0.113904)	0.826554 (0.661479)	3.823481 (0.147823)
χ^2_{SC}	1.944418 (0.0301)	1.231885 (0.0713)	0.150747 (0.6611)	7.418013 (0.0005)	5.589112 (0.0008)
χ^2_{HET}	1.754462 (0.1541)	1.512588 (0.2556)	2.033776 (0.0662)	3.230707 (0.8387)	0.904189 (0.4877)
χ^2_{FF}	2.924142 (0.1035)	1.162978 (0.3223)	0.443390 (0.5090)	0.037543 (0.8488)	0.006315 (0.9373)
CUSUM	S	S	S	S	S
CUSUMSQ	S	S	U	S	S

Extracted from EViews

$\chi^2_{NOR}, \chi^2_{SC}, \chi^2_{HET}, \chi^2_{FF}$,denote Jarque Bera statistics for normality, Breusch Godfrey statistics for serial correlation, Breush-Pagan-Godfrey statistics for heteroscedasticity and Ramsey RESET statistics for functional form, respectively.

Notes, ***, **, * denote the 10%, 5% and 1% significance levels respectively

5.5.4.2 Long run and short run asymmetries

The study has now partitioned both inflation and credit to determine the nature of these variables to economic growth. From the table we see evidence of a significant long run relationship between the variables for Brazil, India and South Africa. Whilst the relationship between positive inflation and economic growth for Russia and China is negative and insignificant. Declining inflation does not have a significant impact on growth for Brazil, Russia, India and South Africa. In contrast, negative inflation, although weak, is significantly related to China's economic growth. As inflation in China decreases, the economy grows.

Once again, the study fails to prove evidence of a relationship between positive DCPS and economic growth for all five countries, shown by the insignificant coefficients. However, Brazil is the only country where declining credit has an impact on the country's growth. The table shows that when credit is declining in Brazil, the result is a growth in the economy.

The short run results show that increasing inflation results in a negative impact on Brazil, India and South Africa's economic growth as per Hassan *et al.* (2015), Vazakidis and Adamopoulos (2009), Gillman and Harris (2004). Both positive and negative inflation for Russia is insignificant and China's declining inflation has a negative impact on the country's growth.

Table 5.5.4.2

	Brazil	Russia	India	China	South Africa
	(1)	(2)	(3)	(4)	(5)
Panel A:					

Long-run estimates					
Infl_pos	-8.069799** (0.0418)	-32.944381 (0.1060)	-2.313748** (0.0584)	-1.818573 (0.4815)	-6.417118*** (0.0102)
Infl_neg	1.455721 (0.1073)	5.712324 (0.6473)	-1.467862 (0.2237)	3.030647* (0.0634)	-1.734769 (0.6048)
DCPS_pos	0.034828 (0.1949)	0.164026 (0.6634)	0.049140 (0.4338)	0.013810 (0.7017)	0.053584 (0.1224)
DCPS_neg	-0.065180* (0.0994)	-3.272672 (0.2115)	-0.045789 (0.8096)	-0.172257 (0.1617)	0.018243 (0.6982)
TRADE	0.423982*** (0.0171)	1.191687 (0.1351)	-0.089107 (0.1899)	-0.010717 (0.7076)	0.069734 (0.5325)
EMPL	38.337251 (0.1838)	683.094483 (0.1814)	12.105990 (0.5155)	10.395648 (0.6193)	-1.345110 (0.9311)
GFCF	0.072163 (0.7780)	0.411408 (0.5701)	0.081970 (0.3936)	-0.086935 (0.5227)	0.186654 (0.3469)
REER	8.368203 (0.2581)			- 32.523513*** (0.0102)	-5.111928 (0.6323)
Panel B: Short-run estimates					
ΔGDP(-1)					
ΔInfl_pos	-8.016666* (0.0715)	-31.787851** (0.0488)	-4.331265* (0.0729)	-2.088850 (0.4431)	-7.400929** (0.0209)
ΔInfl_neg	-2.215720 (0.1583)	5.511790 (0.6403)	-2.747793 (0.2433)	3.481064* (0.0709)	-2.000727 (0.5874)
ΔDCPS_pos	0.095407 (0.1071)	0.158267 (0.6444)	0.091988 (0.4384)	0.217613*** (0.0116)	0.061799 (0.1327)
ΔDCPS_neg	-0.064751 (0.1362)	-3.157783 (0.1542)	-0.085716 (0.8097)	-0.197858 (0.2143)	0.021040 (0.6975)
ΔTRADE	0.047871 (0.8020)	1.149852* (0.0677)	-0.166805 (0.1980)	-0.012310 (0.7068)	0.308310*** (0.0018)
ΔEMPL	144.073156*** (0.0112)	659.114105 (0.1706)	- 263.041531** (0.0362)	51.795611* (0.0875)	-1.551330 (0.9304)
ΔGFCF	0.946261 (0.0000)	0.396965 (0.5795)	0.153445 (0.4008)	-0.099855 (0.5309)	0.415268** (0.0332)
ΔREER	8.313105 (0.2283)			- 37.357172*** (0.0004)	15.493704 (0.1117)
ECT(-1)	-0.993416*** (0.0000)	-0.964894*** (0.0019)	-1.871970*** (0.0000)	-1.148620*** (0.0001)	-1.153310*** (0.0000)

Extracted from EViews

***Significant at 1%, ** Significant at 5%, * Significant at 10%

5.6 SUMMARY

Using the ARDL and NARDL models, the study investigated the linear and non-linear long run and short run co-integration between the proposed variables, specifically examining the nexus between Inflation, Credit and Economic Growth in the BRICS countries. From the analysis, the study estimated various relations between inflation and growth, inflation and

credit as well as Credit and growth and found that for the different countries the relationship is unique. For example, the study estimated an insignificant, negative and positive relationship between the variables for the different countries.

CHAPTER 6: CONCLUSION

6.1 INTRODUCTION

The goal of this paper is to explore the relationship between three important macroeconomic variables, inflation, credit and economic growth. The study makes use of the Autoregressive Distributive Lag (ARDL) and the Non-linear ARDL technique (NARDL) to facilitate the attainment of this goal. The empirical analysis concerns the period 1960 to 2019. This chapter comprises of a summary of the empirical results which includes a discussion of the study's analysis, it provides policy recommendations and lastly the chapter includes a discussion of recommendations for further research.

6.2 SUMMARY OF RESULTS

The N-ARDL model allows the researcher to determine thresholds of inflation that has a positive or a negative impact on economic growth. The NARDL model was further broken down into three sections, namely; regressing non-linear inflation on economic growth, regressing non-linear DCPS (credit) on economic growth, and lastly, regressing both inflation and DCPS as non-linear variables on economic growth. By making the variables non-linear, the researcher refers to partial decomposition of those variables into negative and positive.

The investigation of the group, BRICS, specifically was motivated by the potential that literature states the group has in terms of growth as emerging markets. It was interesting to study this bloc as they are all different and different characteristics, history, as well as that they have been drastically differently affected by the GFC 2007/8. The aftermath of the global financial crisis of 2007/8 has lingered over the global economy since its impact became evident within financial markets. More specifically, this study has investigated not only the impact of this crisis on BRICS countries but has attempted to answer the main question of the role played by inflation in credit market development in order to enhance economic growth in the BRICS countries. Furthermore, the role of the NDB is reviewed in terms of the credit that is made available to a country for infrastructural purposes and how these projects have helped the BRICS grow and develop their economy.

The research question/objective of how and at what levels inflation impacts economic growth and the role it plays in the development of credit markets to enhance economic growth, has been answered by the study to some extent. Moreover, the results are generally in alignment with economic theory which commonly suggests that inflation, particularly high levels or rising inflation, exerts a negative impact on economic growth. A significant negative long run

relationship has been detected by the study particularly for the countries Brazil, India and South Africa, with Russia and China having mostly insignificant results.

The period under study spans from 1960-2019, with some exceptions such as Russia which lacks the data starting from 1990. The variables used in the study include GDP which is a proxy for Economic Growth, Inflation as proxied by Consumer Price Index (CPI), Credit as proxied by Domestic Credit to Private Sector, TRADE as a proxy for Term of Trade, Investment as proxied by Gross Capital Formation (GFCF), Labour as proxied by Employment rates (EMPL) and lastly, REER which is a proxy for Real Effective Exchange Rates. The variables Inflation, Employment and REER have been transformed into their natural log values.

Although both ARDL and N-NARDL models do not require a series to be in the same order, the study conducted unit root testing to ensure robustness in the models and due to the fact that the model is not compatible with $I(2)$ variables. The unit root tests show that no unit roots were detected both at levels and at first difference. The study also employed an unrestricted VAR to determine the optimal lag length, which identified two lags as the optimal level. However, for the purposes of attempting to remedy the issues of heteroskedasticity and autocorrelation amongst others, the lags were altered accordingly.

The study finds that there are three common outcomes for various countries which include that there is a positive inflation and growth association, another models a negative association and lastly, the relationship is insignificant. Firstly, the linear findings for the study show that there is a positive long run co-integration between inflation and growth for Brazil when inflation is increasing at a 1.23 per cent level. In contrast, the short run results for Brazil indicate that inflation exerts a significant impact on growth when it is declining. The long run results for India, Russia and South Africa show that inflation is conducive to these economies when it is declining for India at least by 1 per cent and South Africa by 6 per cent. Furthermore, Russia and China's results suggest that inflation does not have a significant impact on growth in the long run with. The short run results for India and South Africa yield similar results to the long run, inflation is conducive to growth when it is decreasing and China and Russia are once again not significantly impacted by inflation in the short run.

Furthermore, the main findings were conducted on three regressions, one where only inflation is partitioned, the second when credit has been partitioned and thirdly, when both credit and inflation have been partitioned. The relationship between inflation and growth for Brazil and China yield insignificant results and the rest of the countries which include Russia, India and

South Africa, there is a significant negative association when inflation is at positive levels or is increasing. The results also suggest that negative inflation in the long run has no significant association with growth for all the BRICS countries. In the case of the short run, positive inflation exerts a negative impact on economic growth for Russia, India and South Africa's economy. China's economy is insignificantly impacted by both increasing and decreasing inflation, whereas, Brazil in the short run shows evidence that its economy grows with decreasing inflation.

Lastly, the study partitions both credit and inflation and finds that in the long run there is a positive association between inflation and credit for Brazil, India and South Africa. Russia and China's results suggests that the association between positive inflation and growth is insignificant. Furthermore, decreasing inflation in the case of Brazil, Russia, India and South Africa does not have a significant influence on growth, whereas in China's case, this relationship is positive for the Chinese economy. The credit variable in the long run has not shown significant association with economic growth.

The regression with both Inflation and Credit being partitioned indicated threshold levels of inflation that have a significant impact on economic growth. The study finds a threshold level for Brazil of between 1 and 8 per cent whereby both in the short- and long-run inflation exerts a significant impact on growth and at inflation levels of around 8 per cent in the short run, growth is negatively impacted. Russia is found to have an inflation threshold between 5 and 32 per cent whereby in the long run there is no significant impact and in the short run, inflation negatively and significantly impacts growth at 32 per cent. In the case of India, the inflation threshold identified is between 1 and 4 per cent whereby in the long run an inflation level of 2 per cent significantly impacts growth and levels above 4 per cent in the short run will negatively impact growth. China showed an inflation threshold of 1 to 3 per cent with 3 per cent in the long run having an impact on growth. In South Africa's case, the threshold level is 1 to 7 per cent and in the long run 6 per cent exerts an impact on growth and in the short run 7 per cent exerts an impact on growth. South Africa should keep its levels below 7 per cent as levels above that exerts a negative impact on growth.

Furthermore, inflation in Brazil and China has a weak and insignificant positive association with credit. In Russia's case, increasing inflation in the long run negatively and significantly affects credit and causes it to decline and when inflation is significantly increasing, it exerts a negative impact on credit at high levels of inflation. The impact that inflation has on India and

South Africa's credit is positive but insignificant meaning that it causes an insignificant increase in credit for these countries.

The study revealed that generally, inflation exerts a negative impact on growth, therefore, authorities must focus on keeping inflation rates low particularly for Russia, India and South Africa as Brazil's results suggest that rising inflation is conducive to its economic growth in the long run. According to the findings of this study, credit does not have the significant impact on growth even under different inflation thresholds. Furthermore, this does not imply that the credit channel is a futile tool for authorities, the relationship between inflation, credit and growth particularly with the hypothesis that inflation enhances credit market development and therefore growth, is not significant.

In summary, the co-integration results for both the ARDL and NARDL regressions indicate that there is evidence of a long run relationship between the variables inflation and economic growth. This validates that the study was able to verify the hypotheses and found that there is a non-linear long run relationship between inflation, credit and growth for the BRICS countries. These results predominantly consist of rising inflation having a negative relation to economic growth for most of the countries both in the long run as well as the short run. The use of the NARDL model has allowed the researcher to determine the impact that inflation has on both credit and growth at various levels, the study was able to deduct the kind of impact that increasing inflation has as well as when inflation is increasing (positive) is decreasing (negative). The results confirm previous literature of significant negative impact that inflation has on growth

6.3 POLICY RECOMMENDATIONS

A vast literature exists on the inflation-growth relationship however, only few studies include credit in the investigation and in addition, however, the study did not find the Credit variable to be significant except in China where it was found to have a negative impact on economic growth. According to common economic theory, inflation is bad for the economy especially when it is rising or is at high levels. A question that many studies have been asking and attempting to answer, considering that some level of inflation is necessary, is which levels of inflation allows for the growth of an economy or alternatively, does not bring detrimental impact on the economy. The study investigates the impact that inflation has on credit market development following literature that suggests that there exists a relationship between these variables which ultimately affects economic growth.

The conventional direct transmission tool used by authorities is the interest rates. The credit channel is usually used in conjunction with the interest rate channel and are tools used by monetary policy authorities to indirectly influence the real economy by controlling the amount of credit that is available in the economy. Therefore, by identifying the magnitude of the effect of inflation, the results of this relationship will provide a guide on how to use the credit channel to inflict an impact on the real economy under different levels of inflation rates. In other words, whether to increase or decrease the amount of credit available at specific levels of inflation and how that will impact the economy.

In doing so, this will provide direction whether or not the credit market is at a level that is compatible with the authority's conduct or if it needs to be developed still. Furthermore, authorities will be able to identify if inflation poses a hindrance on the development of credit markets. Answering the question of inflation is not only important for investment purposes but also for how the authorities decide to structure its monetary policy operations.

Additionally, the research conducted in this paper may help policymakers firstly to identify which from these macroeconomic variables have a significant effect on economic growth of the BRICS countries. Ultimately, the study brings meaningful insight on the operations of BRICS monetary policy, its tools and the channels to focus on in order to conduct monetary policy that will be conducive to economic growth for each of these countries individually.

Furthermore, the study reveals that inflation plays a significant role in a country's economic growth, therefore, these countries should emphasise their monetary policy conduct on maintaining price stability. Particularly, authorities of Brazil, India and South Africa need to adopt policies that will ensure or at least attempt to keep inflation at low levels. The study supports these countries' adoption of inflation targeting as a monetary policy framework and validates the regime's importance in these countries, especially with the results that were obtained from the study's regressions. In addition, the study supports China's hesitation of adopting Inflation Targeting as a monetary policy framework as the investigation proved that for this country, it is not a matter of urgency or an area that requires emphasis.

Finally, with the Credit variable not being significant, the study fails to support economic theory that credit market as monetary policy channel, enhances economic growth and thus would suggest that Brazil, Russia, India and South Africa explore other monetary policy channels to enhance monetary policy operations that will be conducive to growth in these countries' economies.

6.4 AVENUES FOR FUTURE RESEARCH

Building on the finding of this research, future researchers may add more explanatory variables that will enhance the representation of inflation and particularly credit as the study uses only one proxy of credit. Furthermore, the current study focused on the positive (increasing) and negative (decreasing) inflation thresholds, future research may conduct this analysis focusing on specifically different percentages of inflation to realise what the impact of inflation is on both credit and growth at different rates. It is maintained in literature that low inflation rates are associated with central bank independence and that the credibility of a central bank relies on its level of independence. Therefore, the study envisages that the level of central bank independence in terms of conducting monetary policy is explored which may bring light to the progress that these countries have with maintaining price stability and being able to translate credit into growth. This may be done by investigating Central Bank Independence and its impact on variables such as Inflation, Stock Markets and Growth. Future studies should also explore the financial sectors of the different BRICS countries more to gain understanding of how the credit resource is allocated.

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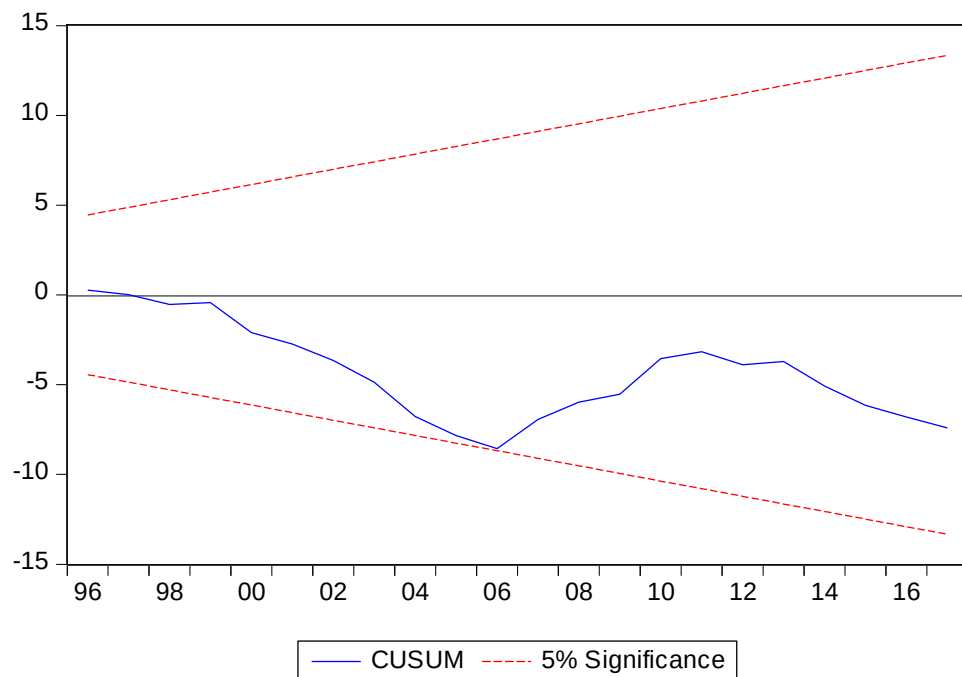
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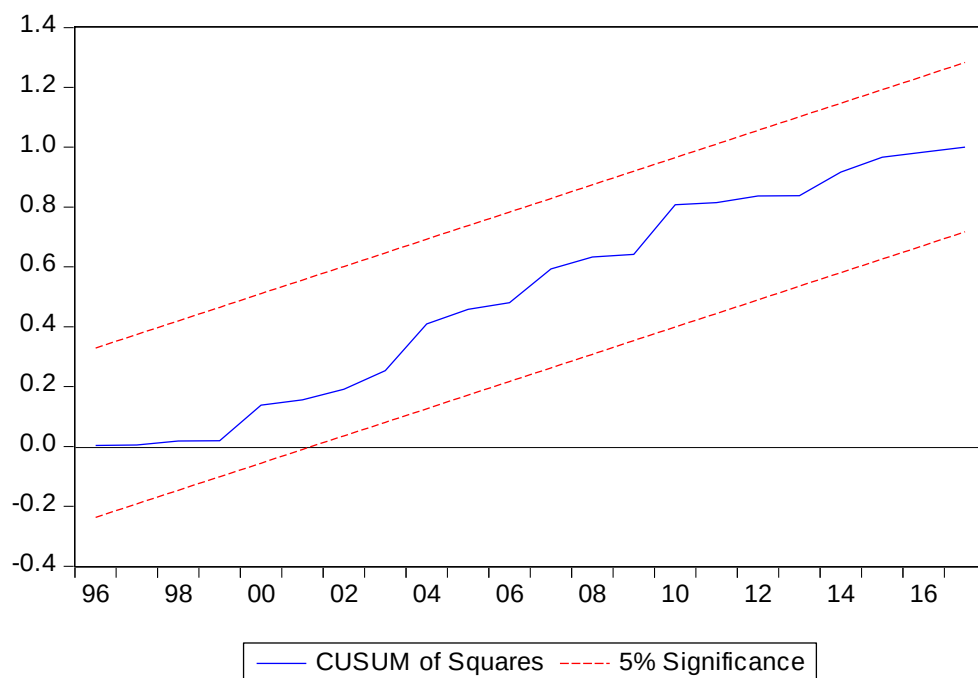
APPENDIX

ARDL (LINEAR) CUSUM

BRAZIL

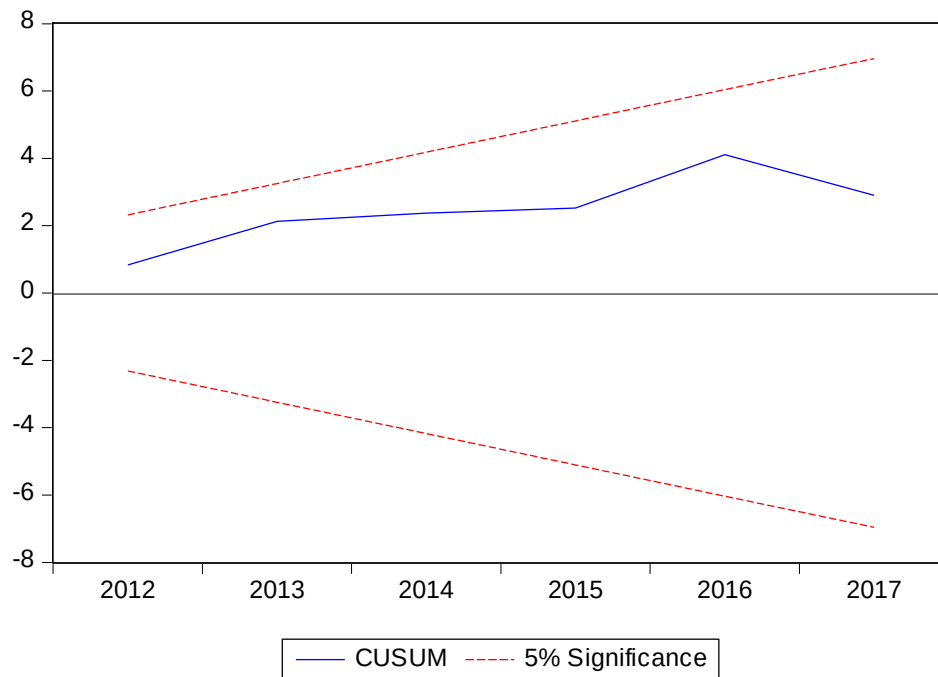


ARDL CUSUMSQ

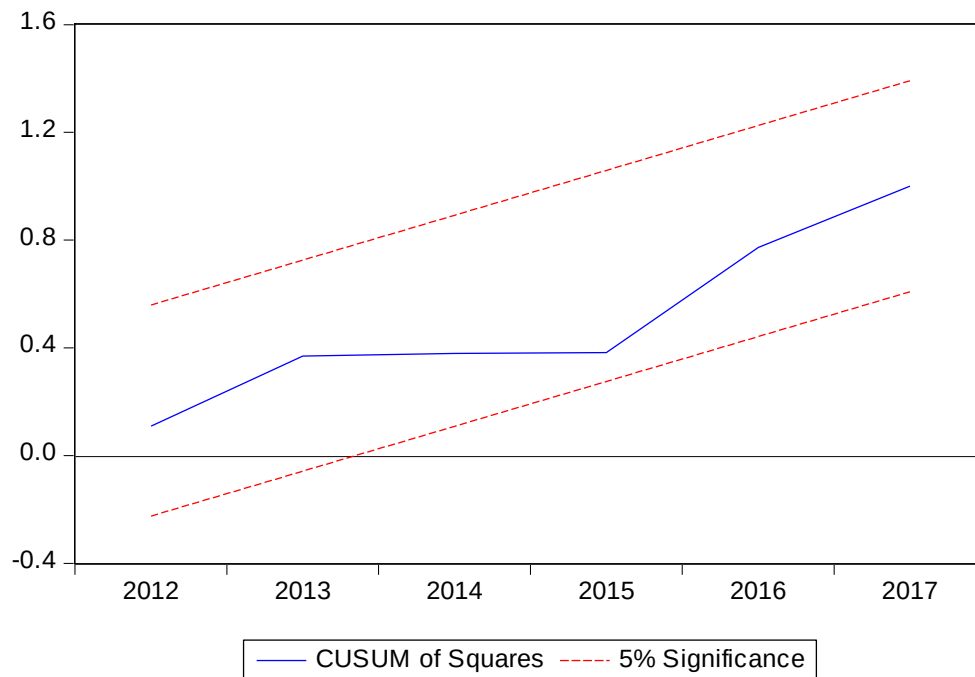


RUSSIA

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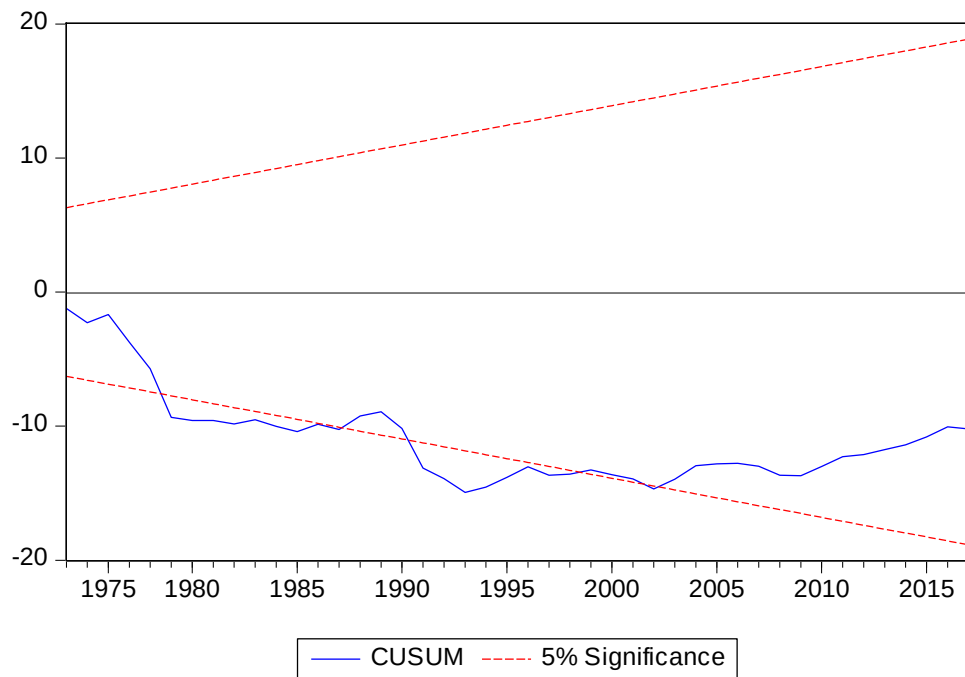


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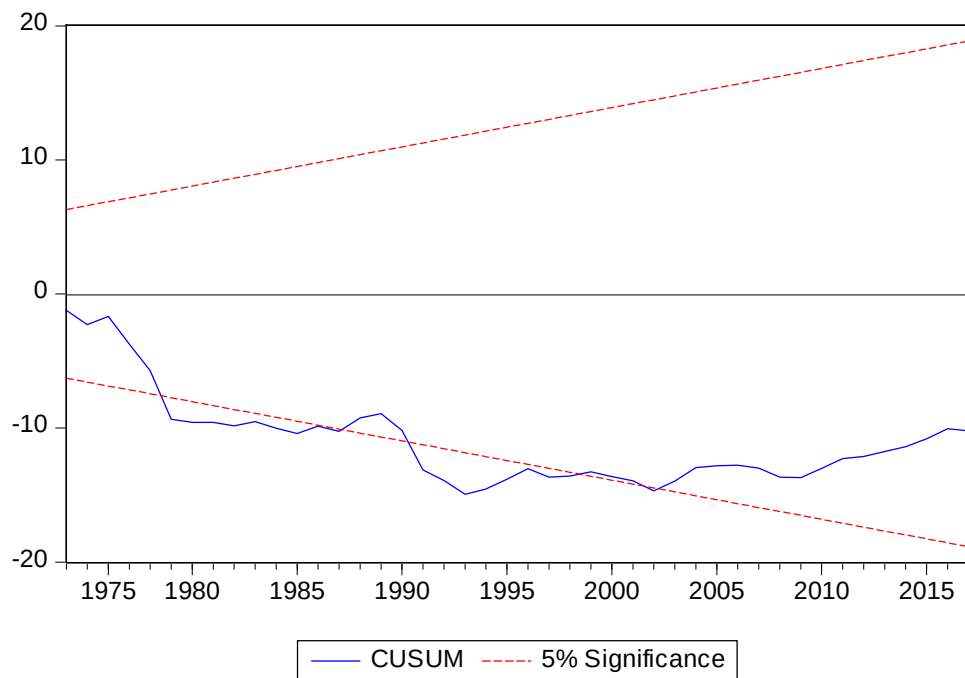


INDIA

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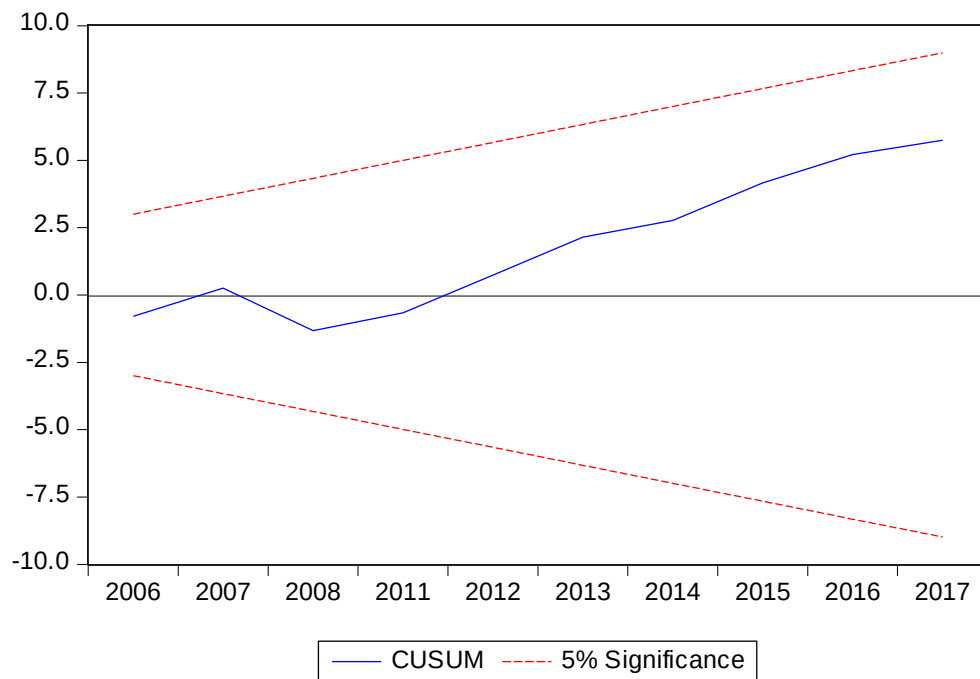


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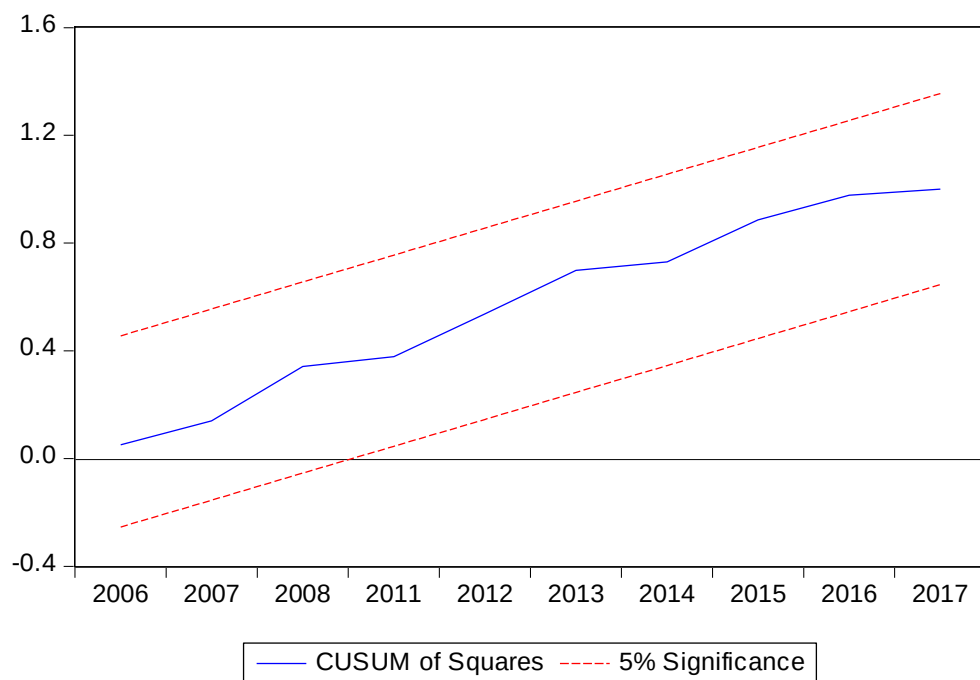


CHINA

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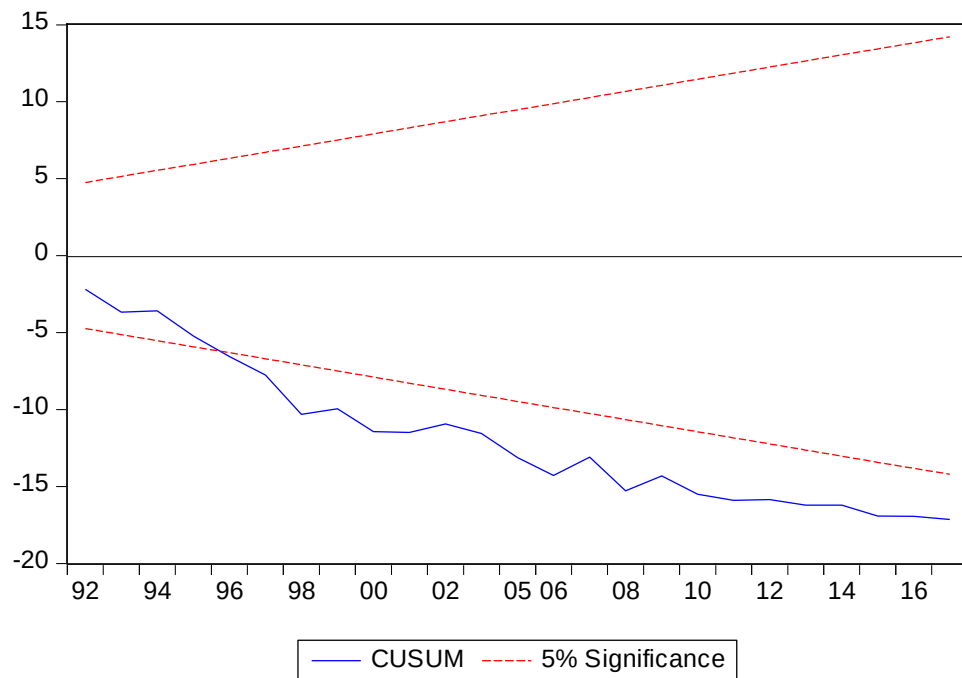


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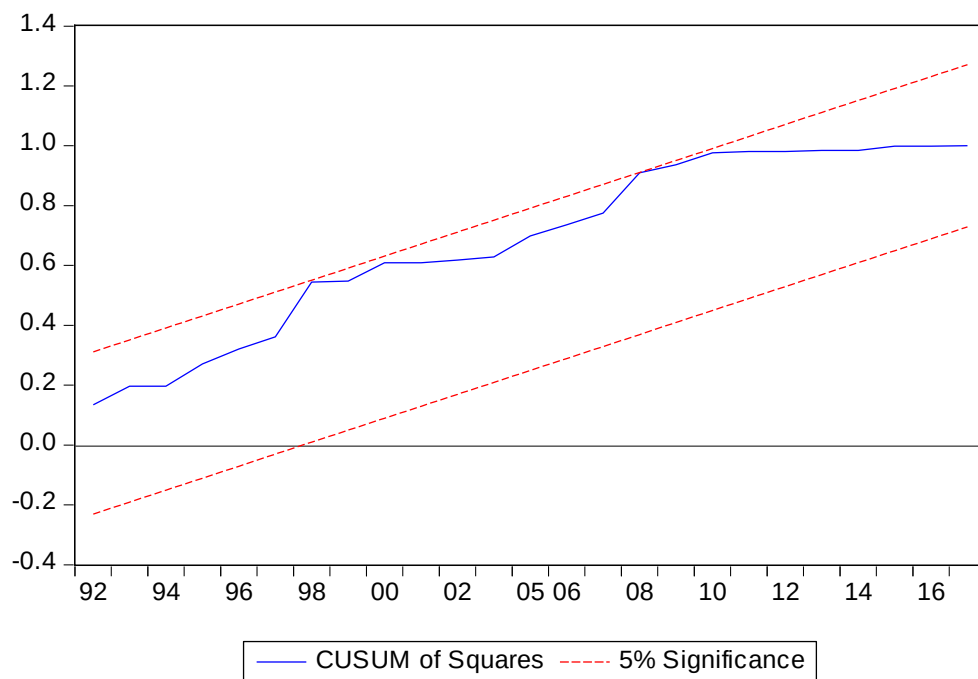


SOUTH AFRICA

ARDL CUSUM



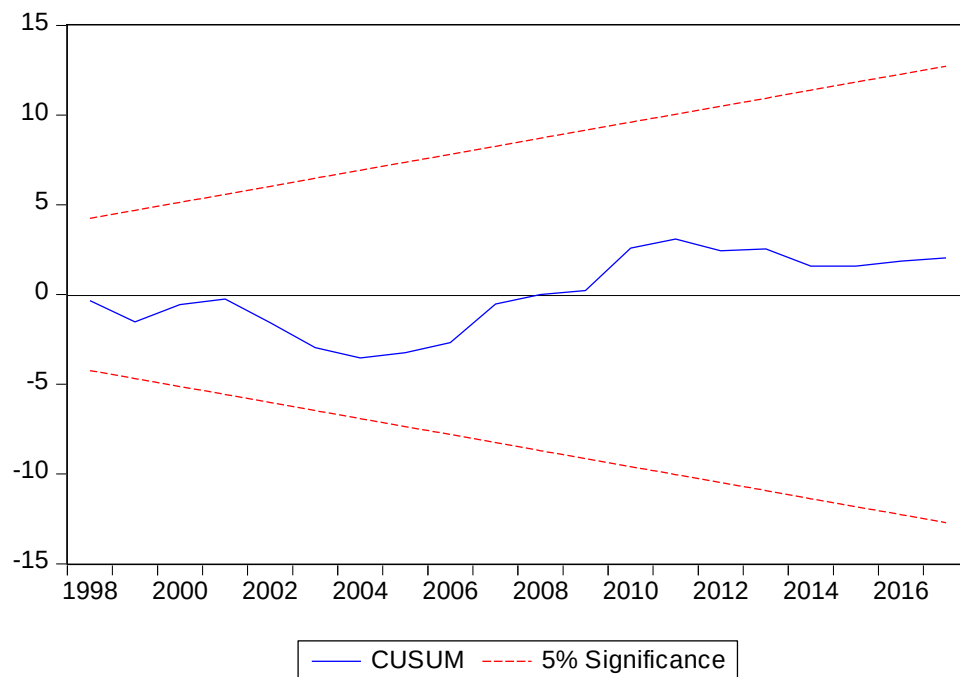
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NARDL : INFLATION PARTITIONED

BRAZIL

CUSUM

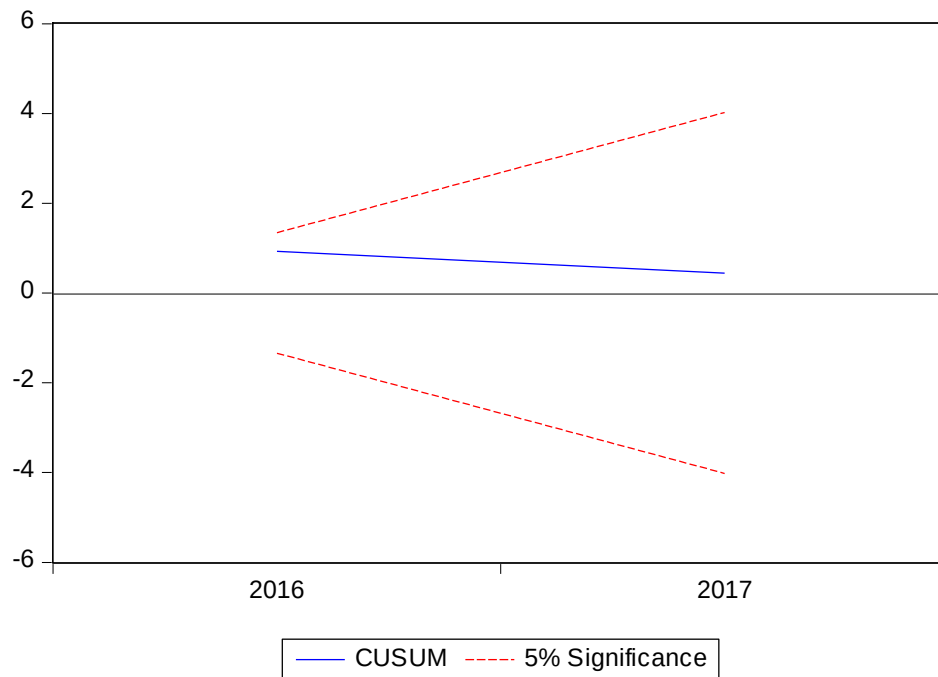


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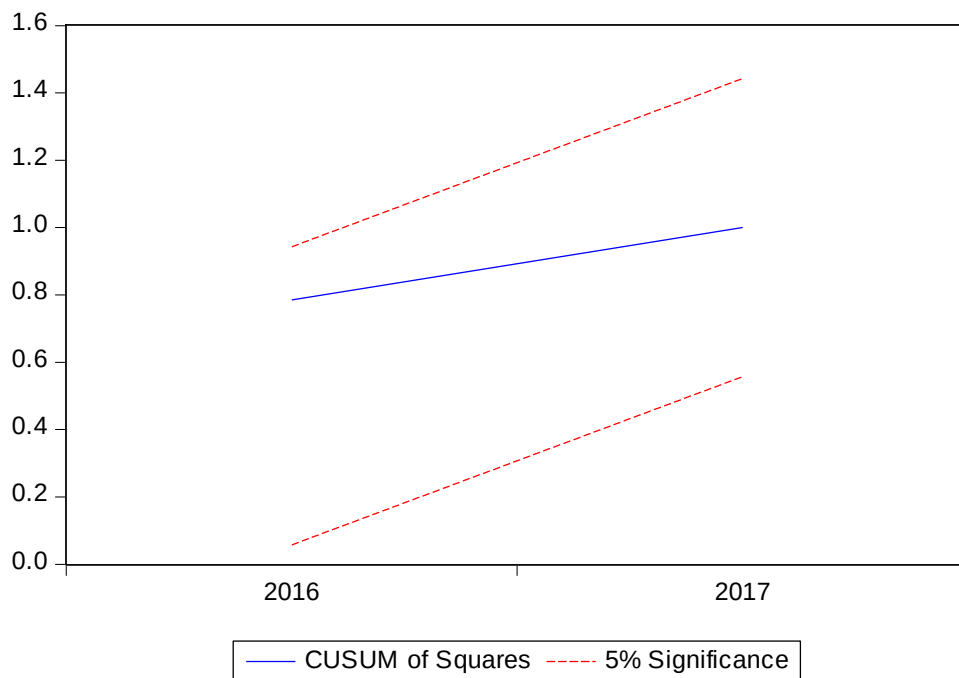


RUSSIA

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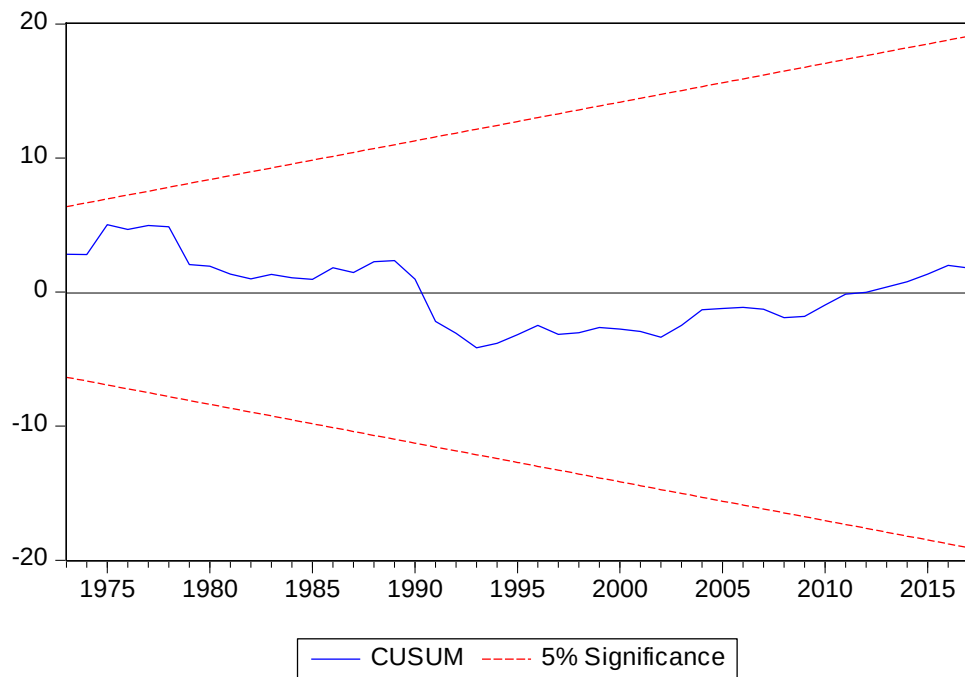


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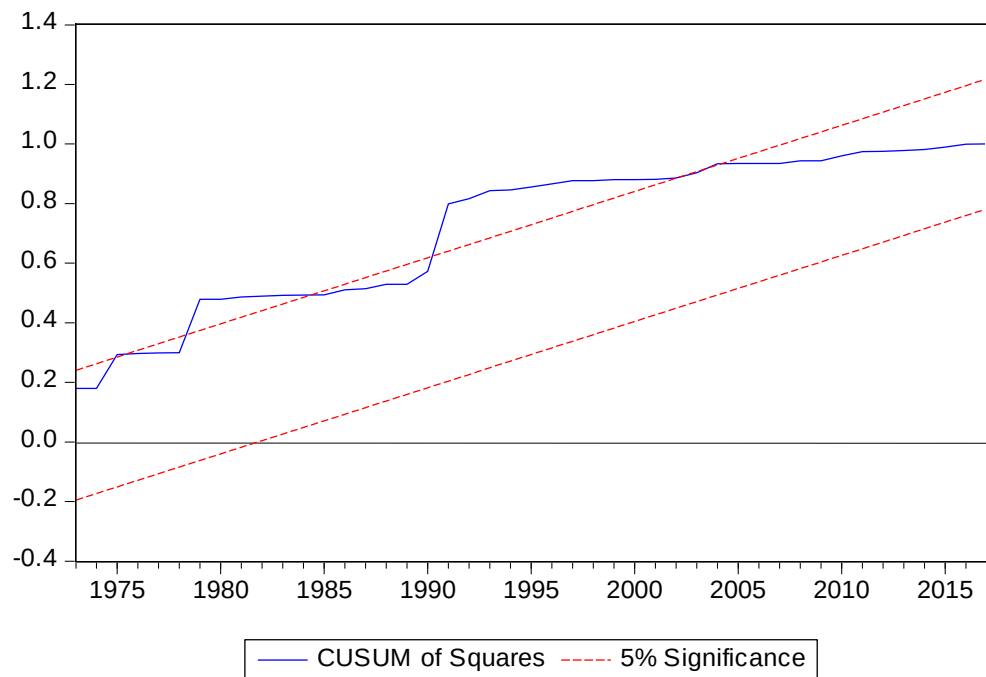


INDIA

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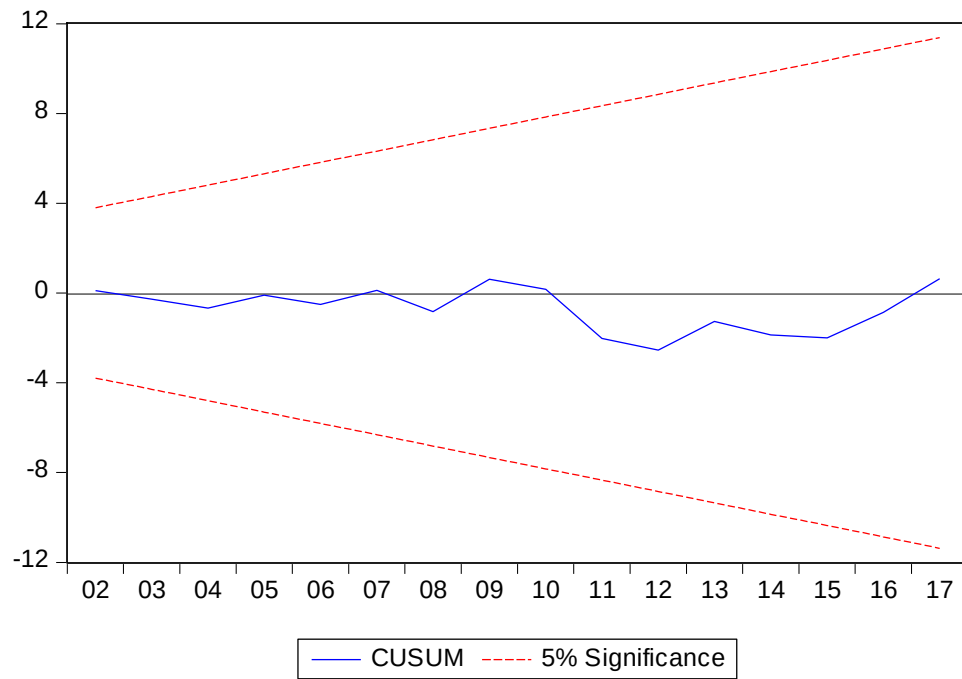


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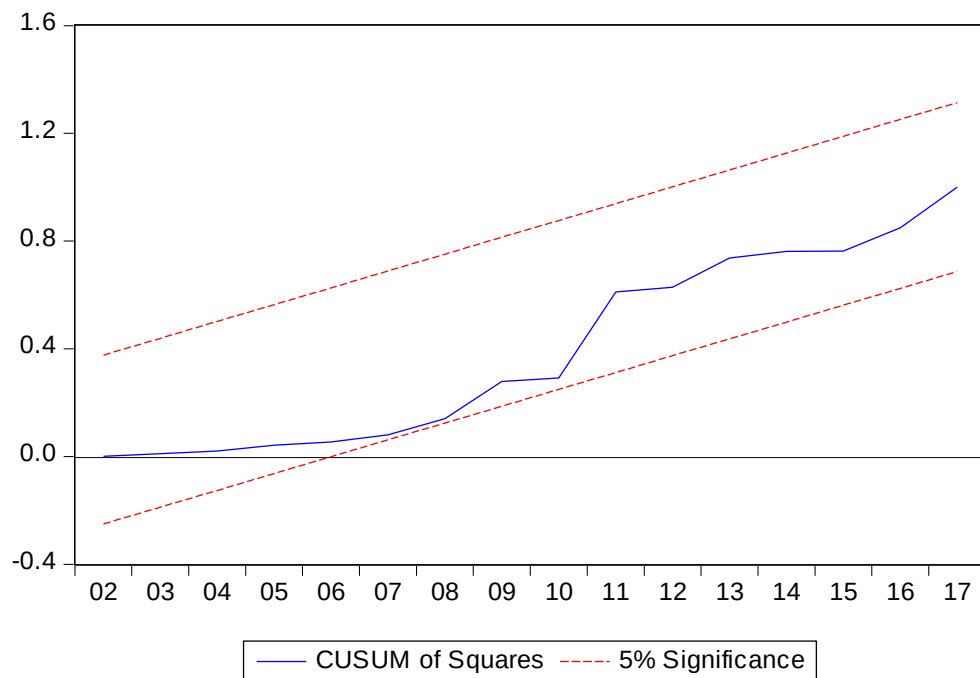


CHINA

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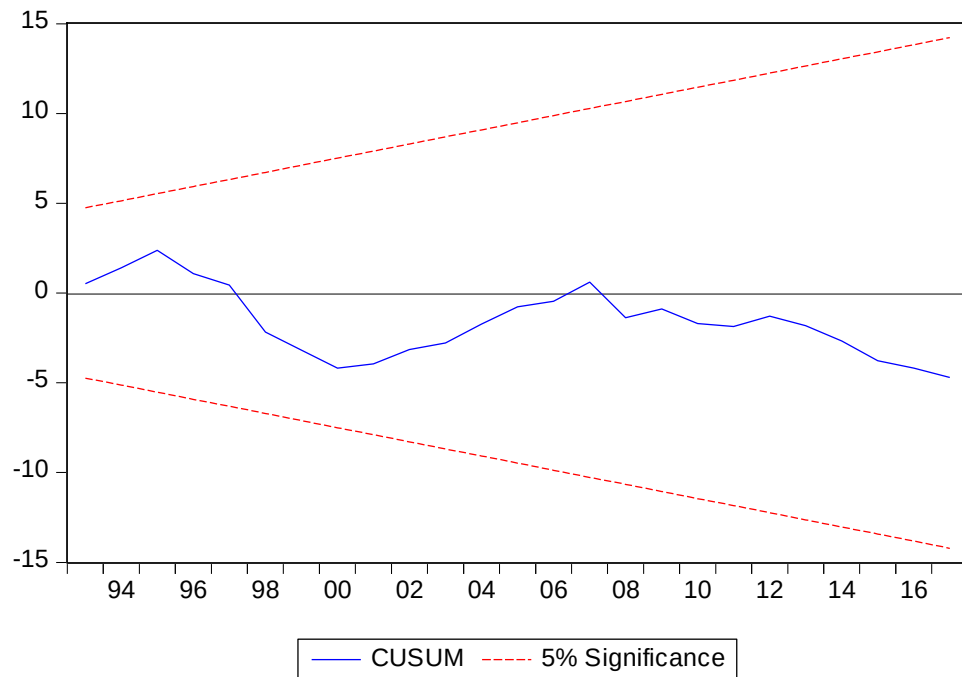


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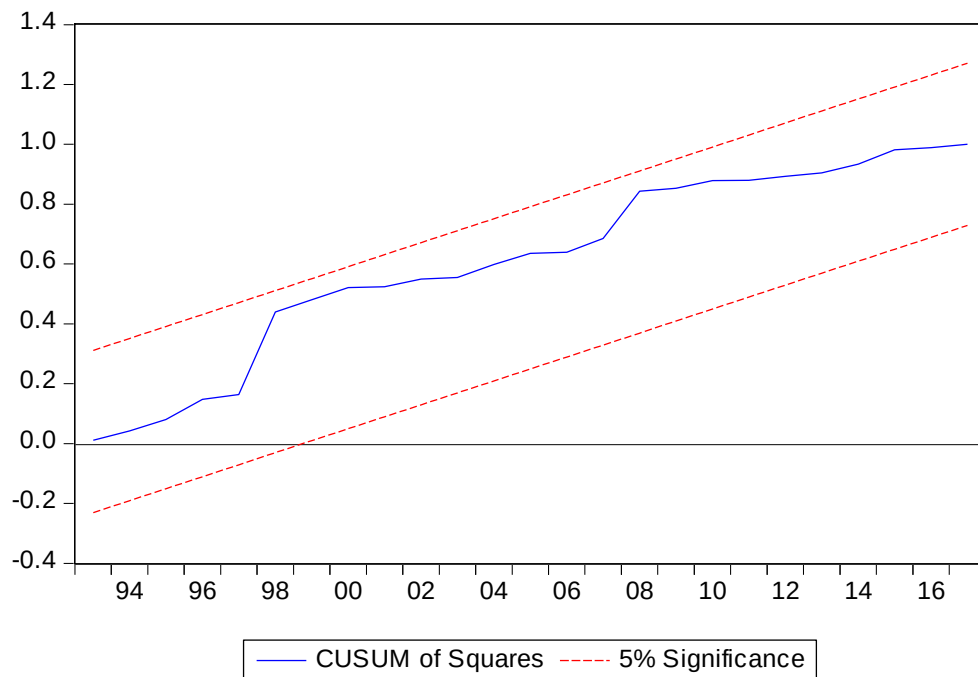


SOUTH AFRICA

CUSUM



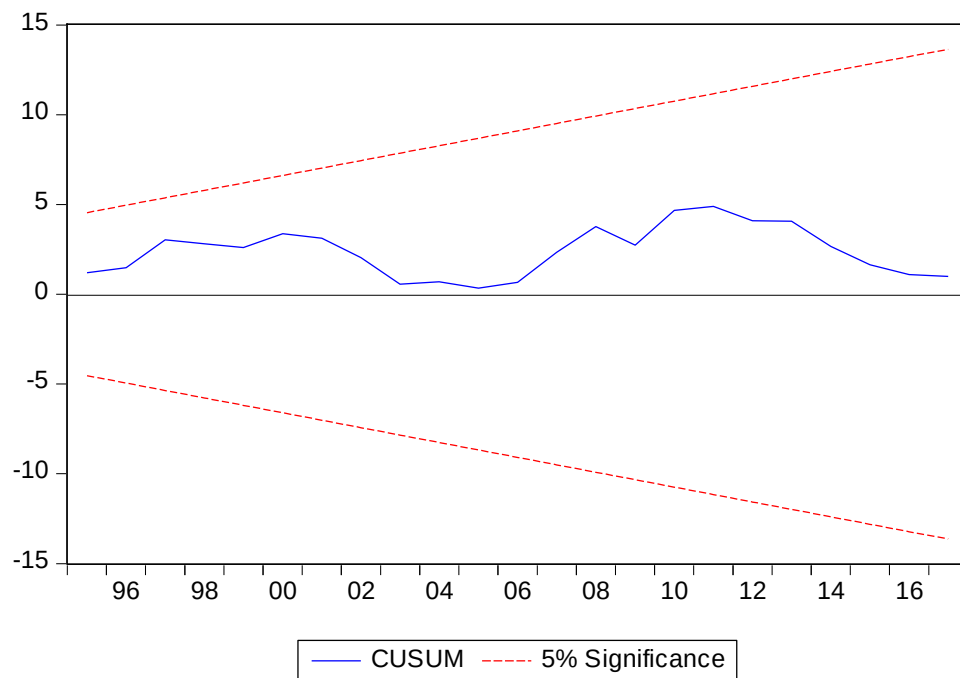
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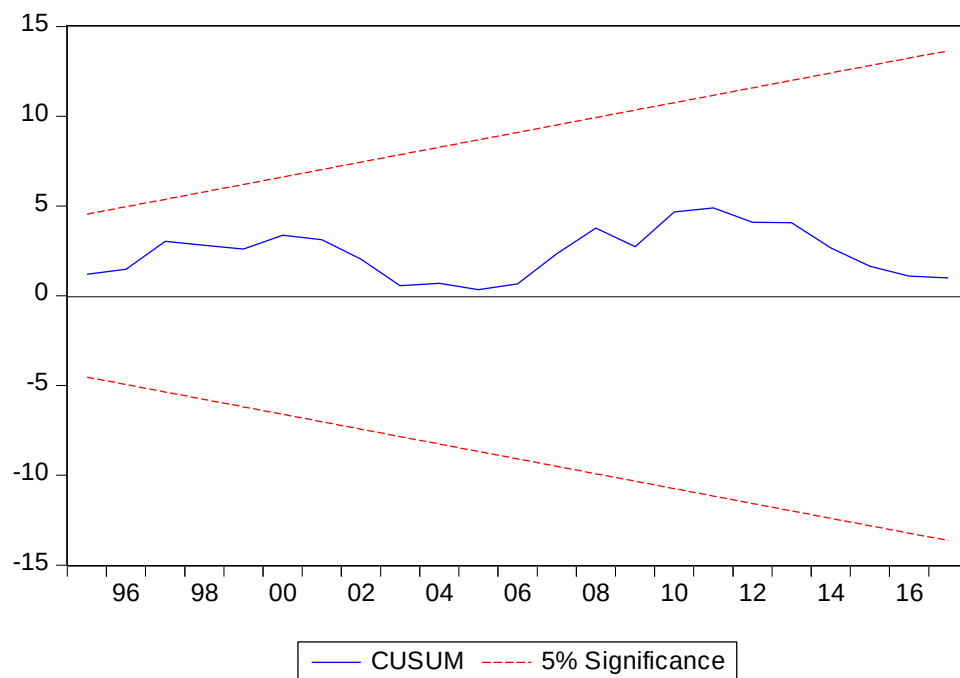
NARDL: DCPS PARTITIONED

BRAZIL

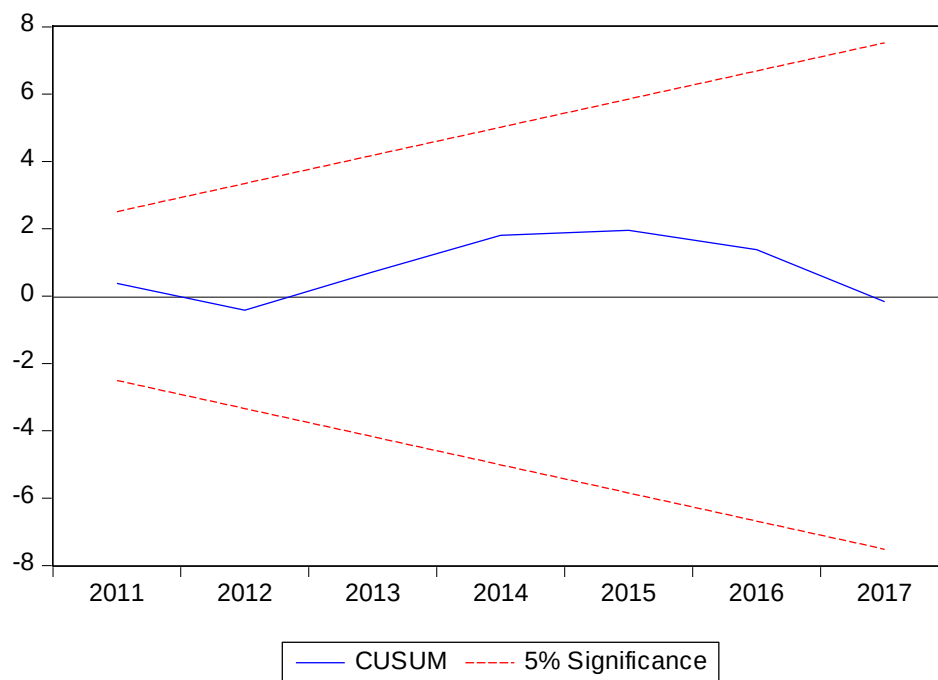
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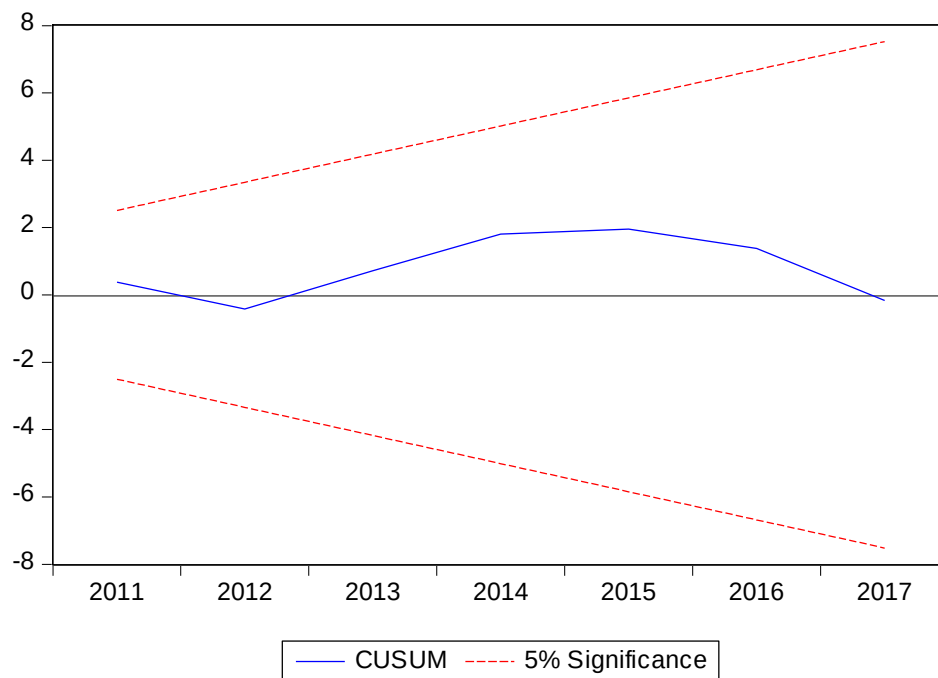
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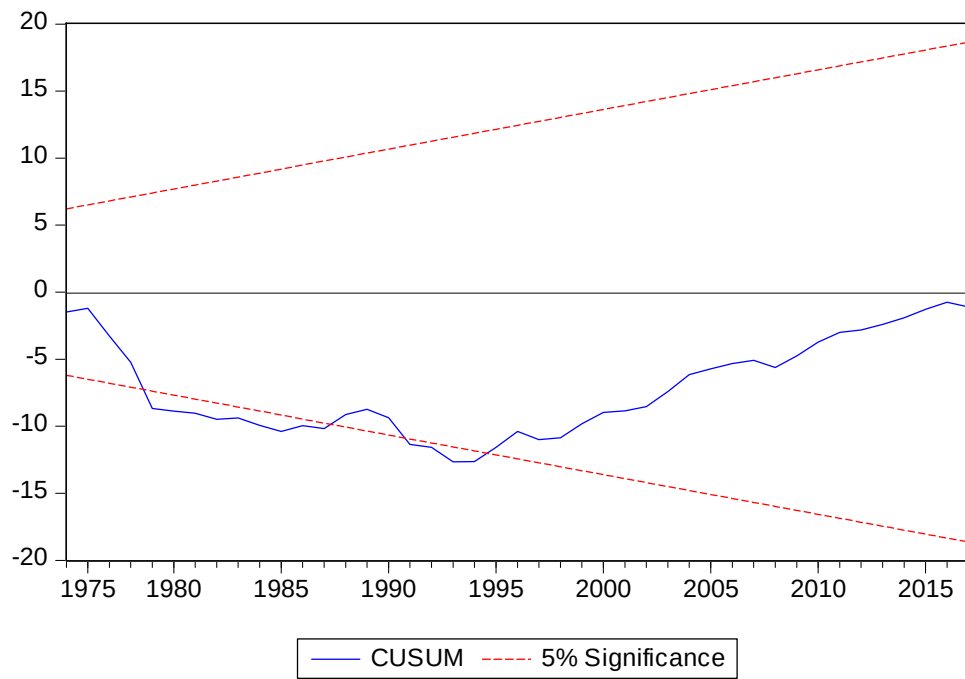
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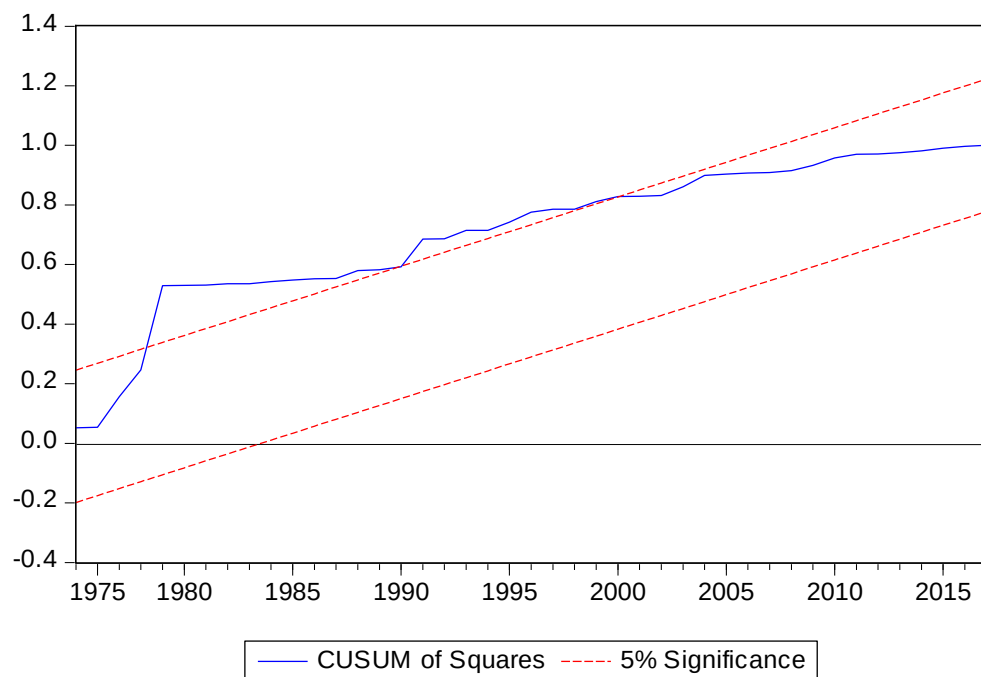
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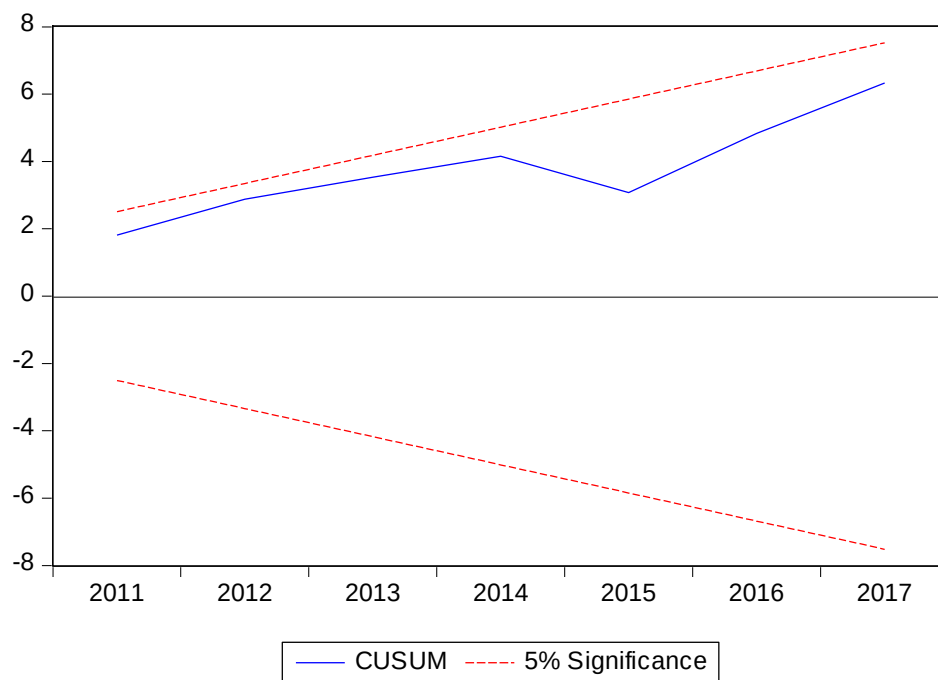
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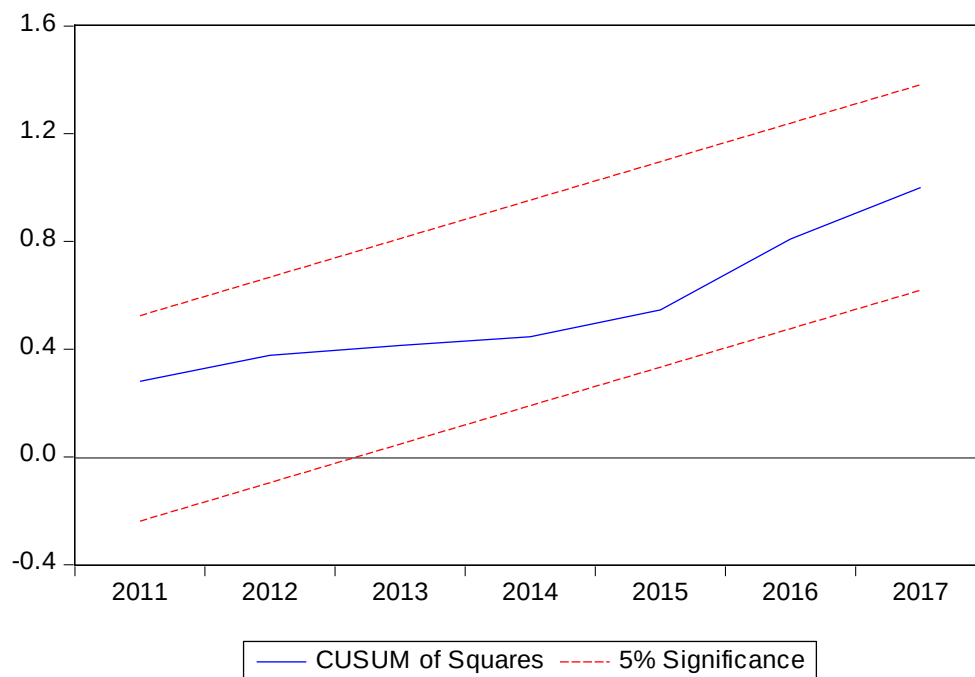
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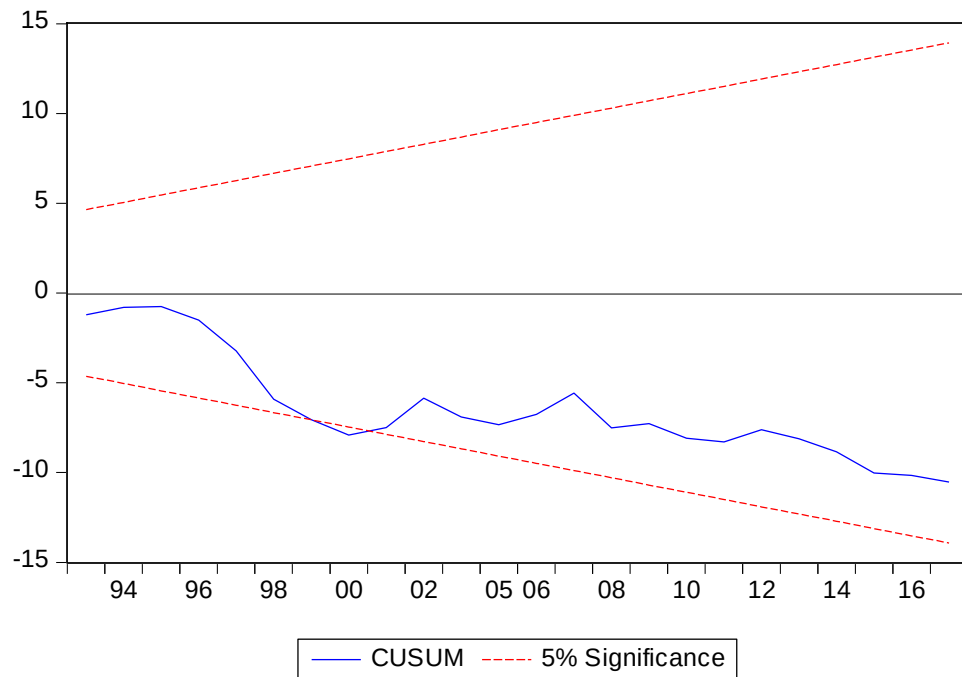


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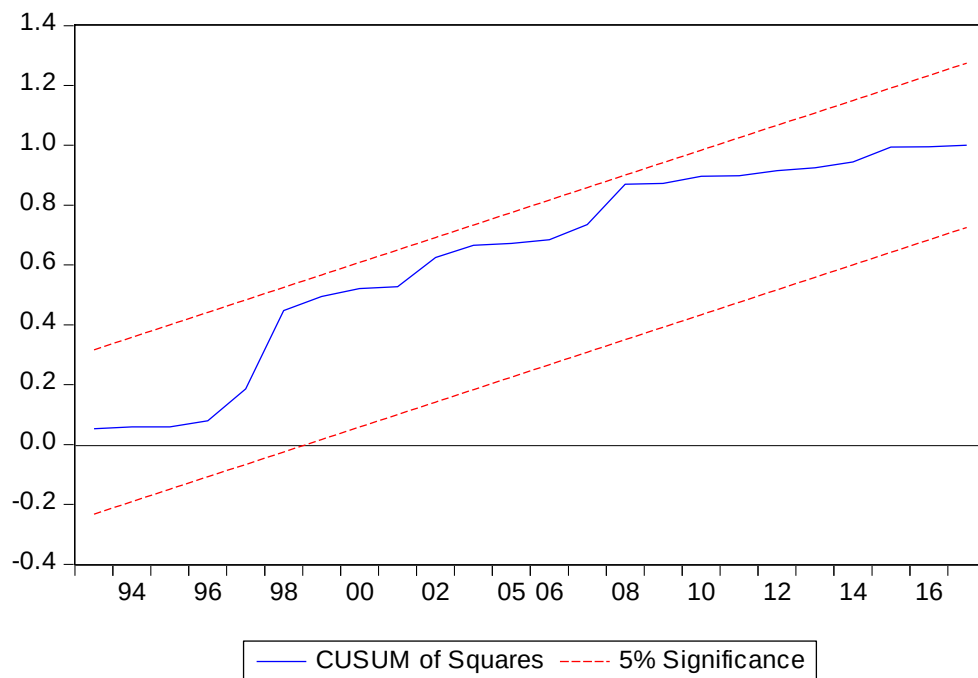


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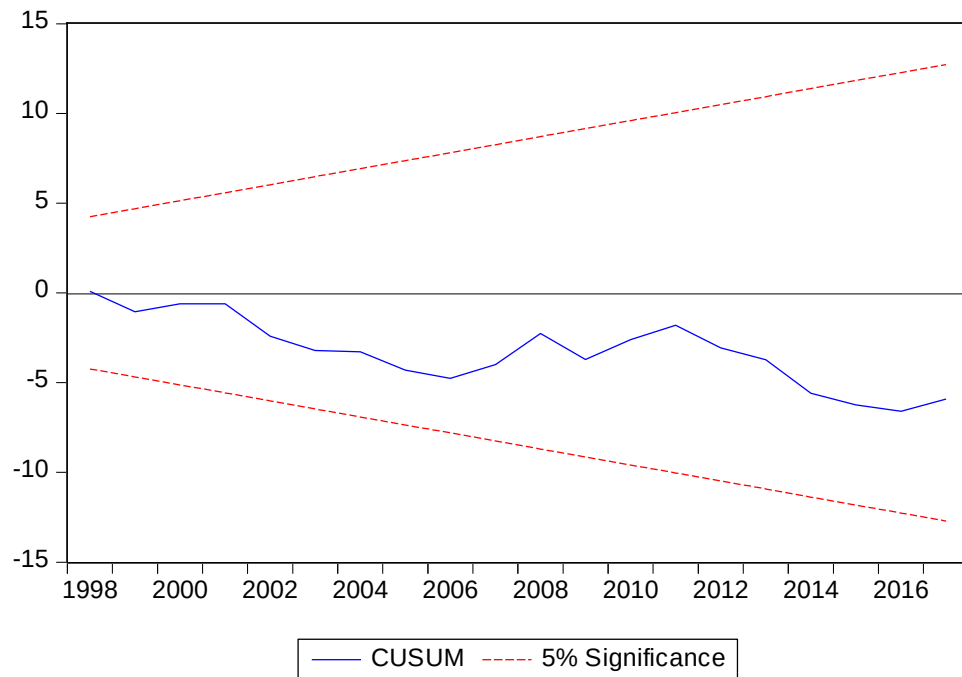


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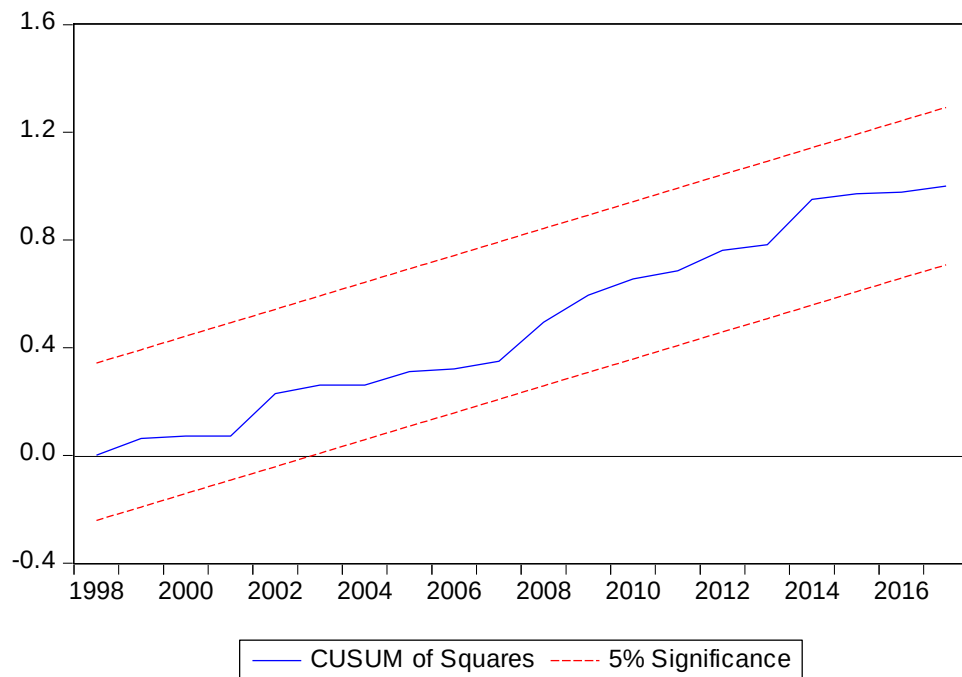


NARDL: INFLATION AND DCPS PARTITIONED

CUSUM

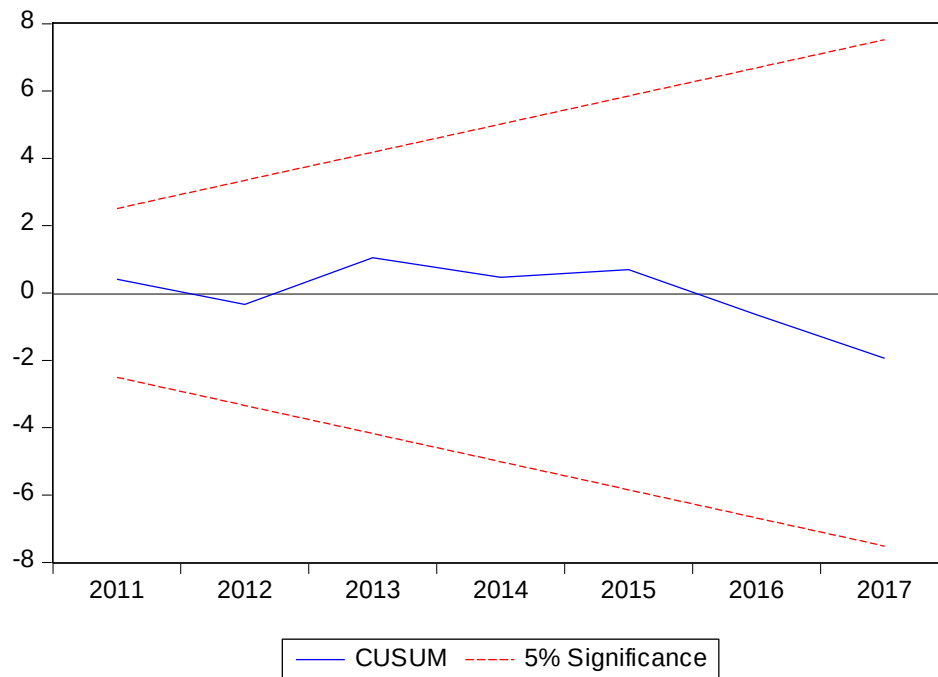


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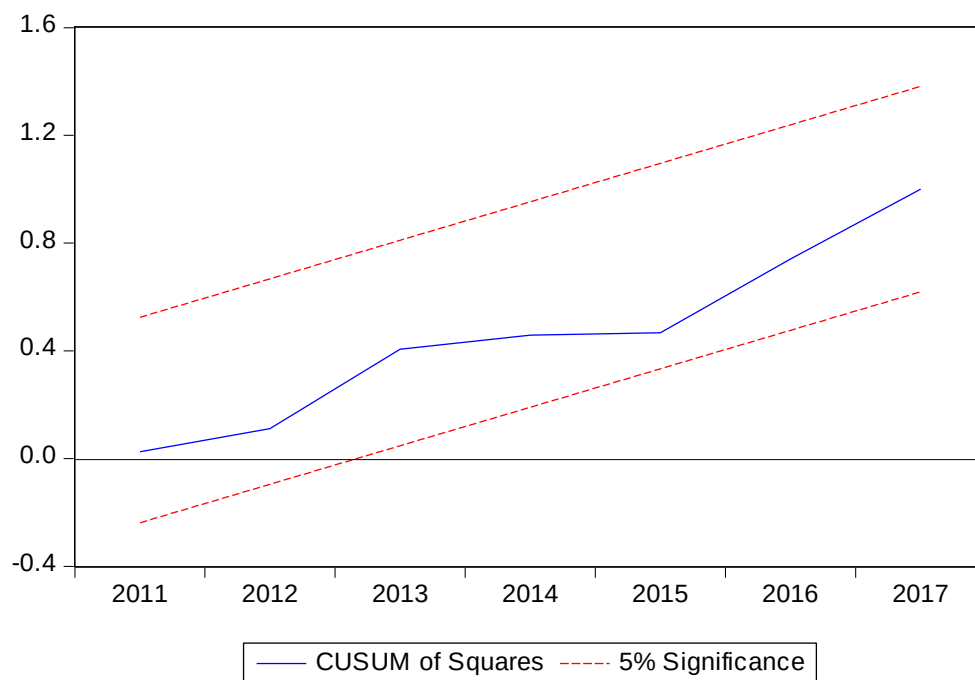


RUSSIA

CUSUM

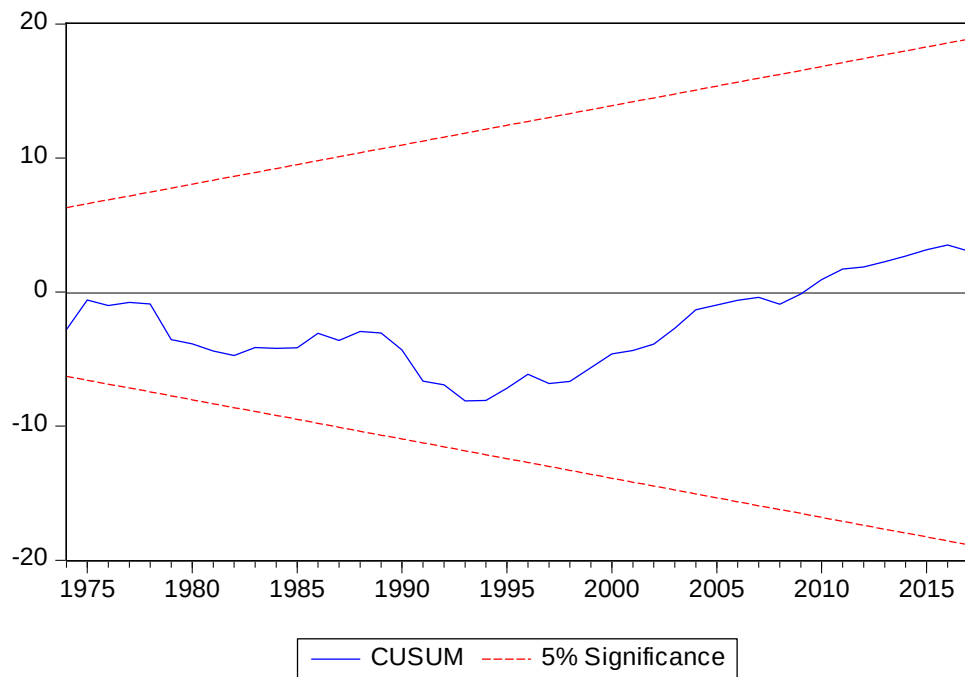


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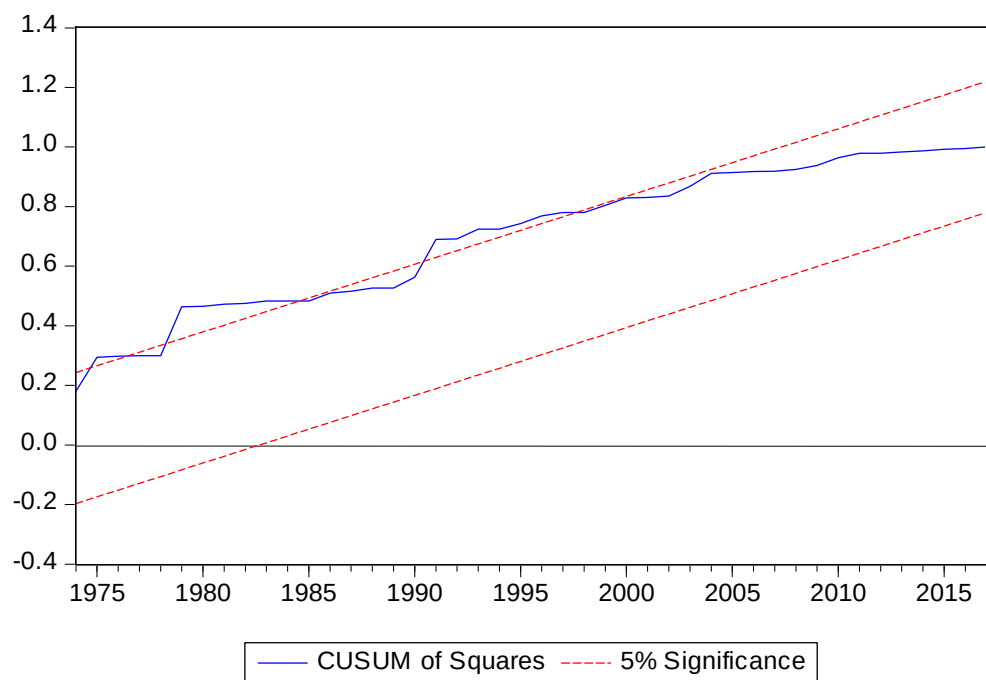


INDIA

CUSUM

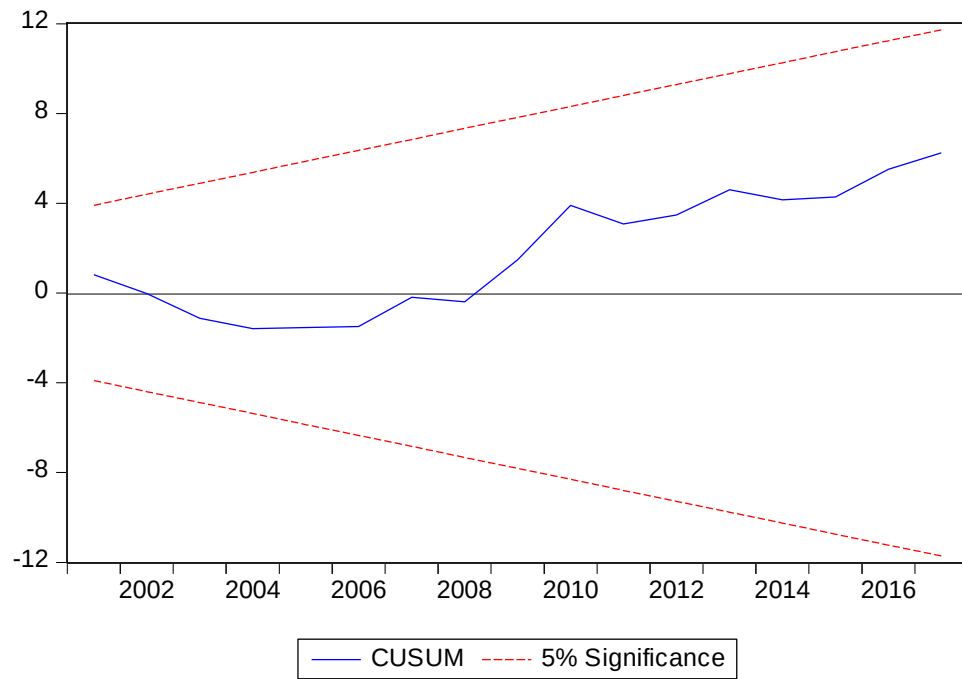


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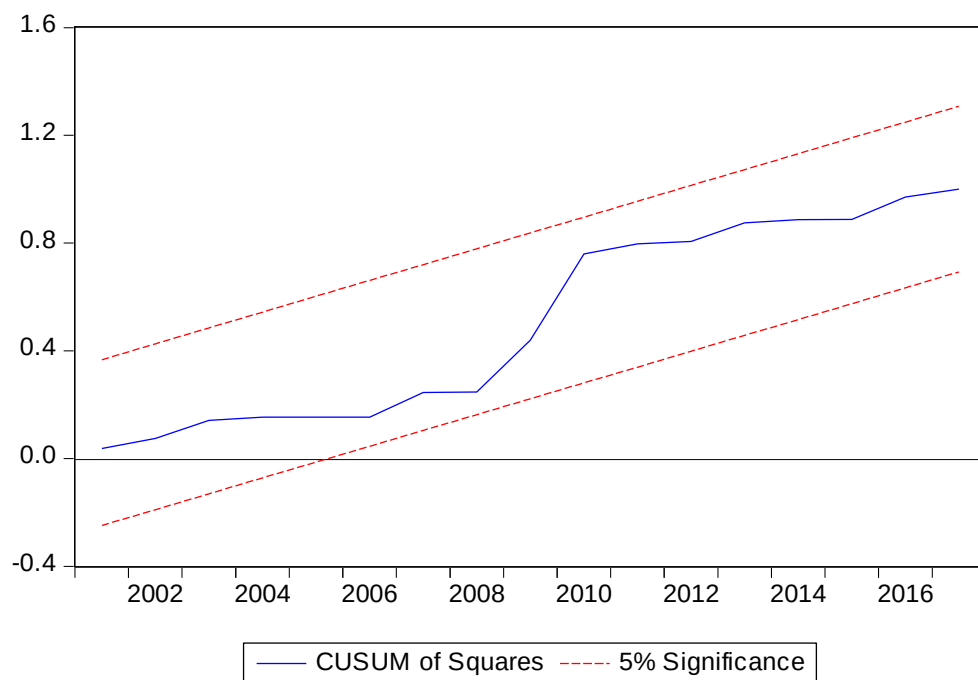


CHINA

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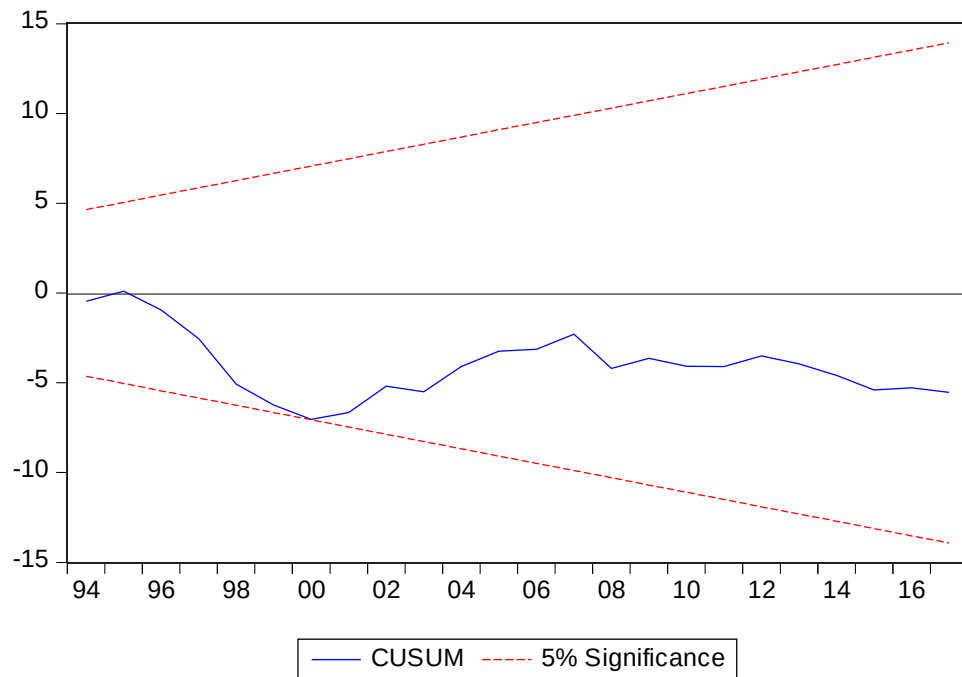


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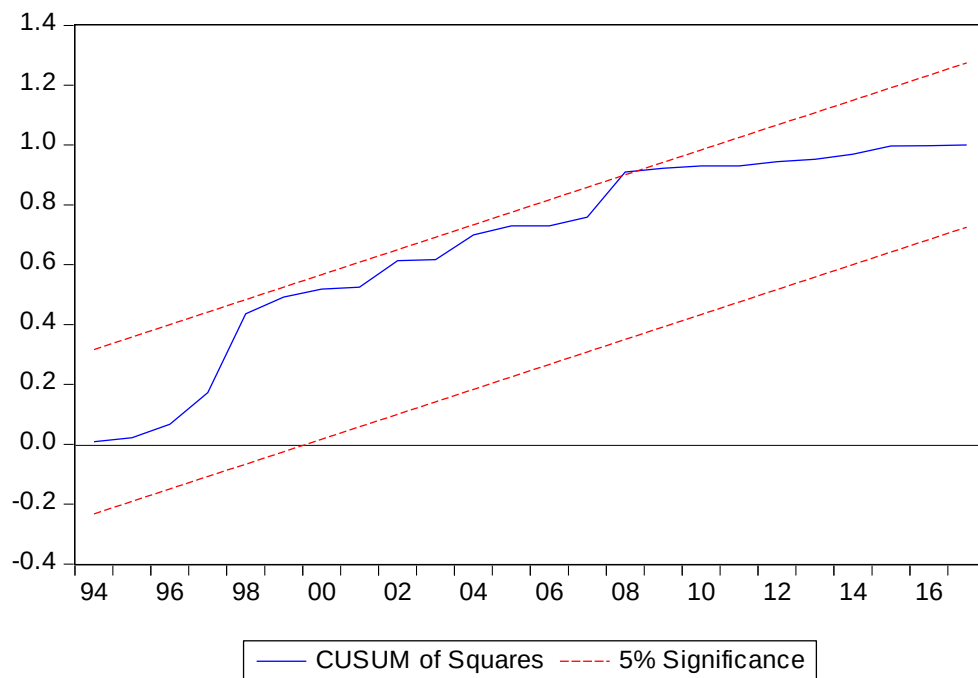


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