

# DO MACROECONOMIC VARIABLES AFFECT STOCK RETURNS IN BRICS MARKETS? AN ARDL APPROACH

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**Abstract** *The Arbitrage Pricing Theory (APT) propounded by Ross in 1976 argued for a variety of macroeconomic variables (sources of systematic risk) in explaining stock returns. In the same vein, this paper examines the relationship between macroeconomic variables (GDP, inflation, interest rate, exchange rate, money supply, and oil prices) and aggregate stock returns in BRICS markets over the period 1995-2014 using quarterly data. We have applied Auto Regressive Distributed Lag (ARDL) model to document such a relationship for individual countries as well as for panel data.*

*Contrary to general belief, we find that GDP and inflation are not found to be significantly affecting stock returns in most of BRICS markets mainly because Stock returns generally tend to lead rather than follow GDP and inflation. In line with the theory and literature, we find significant negative impact of interest rate, exchange rate and oil prices on stock returns and a positive impact of money supply.*

*This study would be a valuable addition to the growing body of empirical literature on the subject besides being useful to policy makers, regulators and investment community. Policy makers and regulator should watch out for impact of fluctuations in exchange rate, interest rate, money supply, and oil prices on volatility in their stock markets. Investor can search for arbitrage opportunities in BRICS markets on the basis of these variables but not the basis of GDP or inflation.*

**Keyword:** *Macroeconomic Variables, Stock Returns, BRICS, Auto Regressive Distributed Lag (ARDL), Panel Analysis*

## INTRODUCTION

BRICS is the group of five prominent emerging and developing economies of Brazil, Russia, India, China, and South Africa. They have large, fast-growing economies and now command significant political and economic influence at global level. In 2014, these BRICS economies together represented about 40% of world's population and 20% of world's nominal GDP.

Stock markets play a pivotal role in BRICS and other emerging economies by enabling optimal allocation of scarce financial resources to their most productive uses, capitalising businesses, serving as investment avenue for investors, sustaining economic growth, facilitating price discovery of financial assets, improving liquidity, providing risk management tools like derivatives and lowering transaction costs.

Owing to their increasing importance in overall financial system and role in economic development, the focus, has shifted to identifying prominent factors (particularly the

systematic risk factors) which determine and impact stock returns especially in emerging markets like BRICS. In this context, macroeconomic variables such as GDP, inflation, interest rate, exchange rate, money supply, and oil prices have long been hypothesised to significantly affect stock market performance.

According to Fama (1981) and Mukherjee and Naka (1995), an increase in GDP raises the level of economic activity (aggregate demand and consumption) thereby increasing corporate earnings and hence should positively affect stock returns. Inflation, on the other hand, reduces savings and investments, increases input costs, interest payments, demands pressures, and raises the cost of capital for the firm (as investors demand more returns to compensate them for inflation risk). All of these negatively impact stock returns.

A high interest rate scenario provides investors with other lucrative investment avenues (fixed income securities) (Aspremi, 1989). Like inflation, it raises firm's cost of capital and results in higher interest pay-outs causing share prices

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to fall (Mukherjee & Naka, 1995). Therefore interest rate is expected to have a negative relationship with stock returns.

On an average, export-oriented economies are favourably affected by a weaker domestic currency as this would increase their earnings (Maysami *et al.*, 2004). But, for a country with unfavourable trade balance, currency depreciation may have an adverse impact on domestic stock market by harming import-oriented firms. However, it may also influence overall stock returns favourably through gain for export-oriented companies and increased foreign portfolio capital inflows (Mukherjee & Naka, 1995). Hence, the literature is divided over whether there is positive or negative relationship between exchange rate and stock returns.

Money supply's net impact on stock returns is also debatable and can be positive or negative. An increase in money supply increases liquidity making more money available for consumption and investments and lowers interest rate in the economy favourably affecting corporate performance and stock returns (Mukherjee & Naka, 1995; Chaudhuri & Smiles, 2004). But, they also build up substantial inflationary pressure in the economy which could negatively impact stock returns. Increases in oil price will be beneficial to oil exporting countries as it would mean an increase in expected future cash flows for firms and exports for the economy as a whole. However, for an oil importing country, a high oil price would result in increased cost of production, inflation, reduced aggregate demand, and lower expected cash flows across all sectors of economy. This would unfavourably affect stock returns in oil importing nations.

Though a vast amount of literature exists on relationship between macroeconomic variables and stock returns for developed markets, the literature on this relationship for major developing markets is scant. Also, while the results are largely conclusive for advanced economies, there is lack of consensus for emerging economies both due to paucity of research and emergence of conflicting results. While there are some studies on the subject for developing markets which consider few macroeconomic variables or few economies, a single comprehensive study which considers major developing markets and multiple prominent macroeconomic variables simultaneously is conspicuous by its absence.

Our objective in this paper is to examine both the short term and long term relationship between BRICS stock returns and major macroeconomic variables, i.e., GDP, inflation, interest rate, exchange rate, money supply, and oil prices. We also seek to identify if any of the macroeconomic variables are useful in predicting BRICS stock returns. We further probe for the presence of any causal (lead-lag) relationship between BRICS stock returns and major macroeconomic variables in the short and long term. We first establish this relationship for these countries individually and then collectively using panel data.

This paper is relevant and has significant implications for policy makers, regulators, investment community, academicians and researchers which are discussed in detail in the last section. The rest of the paper is structured like this: second section gives an outline of concerned literature. Third section elucidates the data and methodology used. Fourth section discusses the empirical results. Fifth section reports the conclusions and implications of the study.

## REVIEW OF LITERATURE

Most of the earlier (1970s, 1980s, 1990s) studies have been conducted in case of developed markets and they have been mostly unanimous in their conclusion on relationship between various macroeconomic variables and stock returns. Prominent ones are discussed below. Fama (1981) declares that a strong relationship is present between stock returns and macroeconomic variables, notably, inflation, national output and industrial production. Chen, Roll and Ross (1986) found that industrial production, changes in the risk premium, twists in the yield curve significantly affect expected stock returns. Geske and Roll (1983) reported that US stock prices are negatively related with inflation and positively related to real economic activity. Aspren (1989) established positive relationship between stock prices and money supply but identified negative relationship of stock returns with inflation and interest rates for European markets. Chaudhuri and Smiles (2004) found evidence of a long-run relationship between real stock price and the measures of aggregate real activity including GDP, money, private consumption and oil price in real terms for the Australian market.

Since the relationship seemed to have been clearly established for developed markets and owing to growing clout of developing markets, the more recent studies have focused on probing this relationship for developing markets.

Gay (2008) found no significant relationship between stock indices of Brazil, Russia, India, and China (BRIC) markets and their exchange rates and oil prices. Rasiyah (2010) used cointegration test and the vector error correction model to demonstrate the evidence of positive long-run relationships between real stock returns and macroeconomic factors comprising industrial production, consumer price index, money supply, and real exchange rate for Malaysian stock market.

El-Nader and Alraimony (2012) stated that real money supply, consumer price index, real exchange rate, weighted average interest rates on loans and advances are negatively related with stock returns on Amman Stock Exchange (ASE) while, real gross domestic product is positively related with the ASE returns. Abdelbaki (2013) examined the relationship between macroeconomic variables and Bahraini stock market development using the Autoregressive Distributed

Lag (ARDL) model. He found that banking system development, income level, private capital flows, domestic investment and stock market liquidity are significant factors impacting stock market.

Khan and Yousuf (2013) concluded using cointegration analysis along with Vector Error Correction Model (VECM), that oil prices, money supply, and interest rates positively relate to stock prices while exchange rates negatively relate to stock prices, and inflation does not significantly impact stock prices in the long-run for Bangladesh. Rafay, Naz and Rubab (2014) reported the presence of strong positive relation between imports and Karachi Stock Exchange (KSE) index. Others macroeconomic variables did not have significant relationship with KSE 100 index. Tripathi and Seth (2014) conveyed a significant correlation among stock

market indicators and macroeconomic factors and identified inflation, interest rate, and exchange rate as three principal factors through Factor analysis. They also reported presence of five co-integrating relationships between stock market and macro-economic variables. Tripathi and Kumar (2015a & b) used granger causality and panel cointegration on BRICS market to conclude that while inflation rate may be significantly related to stock returns in the short run, they do not seem to move together in the long run.

Overall, it can be said that, the studies have comprehensively analysed the developed markets and arrived at some common ground. But for developing markets, the consensus is largely lacking as the researches on emerging markets report widely varying results for most macroeconomic variables.

**Table 1: Data Description (Macroeconomic Variables)**

S. No.	Country	Macroeconomic Variables	Operational Definition	Time Period	Source	Symbol
1.	Brazil	GDP	Fixed PPP, 2005 Prices	1996: Q1 -2014: Q3	OECD	BGDP
2.	Brazil	Inflation	Consumer Price Index, Base 2010	1995: Q1 -2014: Q4	OECD	BINF
3.	Brazil	Interest Rate	Brazil Selic Target Rate	1999: Q1 -2014: Q4	Bloomberg	BIR
4.	Brazil	Exchange Rate	1 USD in Brazilian Real(BRL)	1995: Q1 -2014: Q4	Bloomberg	BER
5.	Brazil	Money Supply	Broad Money Supply (M3)	1995: Q1 -2014: Q4	Central Bank of Brazil	BMS
6.	Russia	GDP	Fixed PPP, 2005 Prices	1995: Q1 -2014: Q3	OECD	RGDP
7.	Russia	Inflation	Consumer Price Index, Base 2010	1995: Q1 -2014: Q4	OECD	RINF
8.	Russia	Interest Rate	Russia Refinancing Rate	1995: Q1 -2014: Q4	Bloomberg	RIR
9.	Russia	Exchange Rate	1 USD in Russian Ruble (RUB)	1995: Q1 -2014: Q4	Bloomberg	RER
10.	Russia	Money Supply	Narrow Money Supply (M1)	2002: Q2 -2014: Q4	Bloomberg	RMS
11.	India	GDP	Fixed PPP, 2005 Prices	1996: Q2 -2014: Q4	OECD	IGDP
12.	India	Inflation	Consumer Price Index, Base 2010	1995: Q1 -2014: Q4	OECD	IINF
13.	India	Interest Rate	Weighted Average Call Money Rates	1995: Q1 -2014: Q4	RBI	IIR
14.	India	Exchange Rate	1 USD in Indian Rupees	1995: Q1 -2014: Q4	RBI	IER
15.	India	Money Supply	Broad Money (M3)	1995: Q1 -2014: Q4	RBI	IMS
16.	China	GDP	GDP at current prices	1995: Q1 -2014: Q3	National Bureau of Statistics	CGDP
17.	China	Inflation	Consumer Price Index, Base 2010	1995: Q1 -2014: Q4	OECD	CINF
18.	China	Interest Rate	1 Year Benchmark Lending Rates	1996: Q2 -2014: Q4	Bloomberg	CIR
19.	China	Exchange Rate	1 USD in Chinese Yuan (CNY)	1995: Q1 -2014: Q4	Bloomberg	CER
20.	China	Money Supply	Money Supply (M2)	1996: Q1 -2014: Q4	Bloomberg	CMS
21.	South Africa	GDP	Fixed PPP, 2005 Prices	2002: Q1 -2014: Q4	OECD	SAGDP
22.	South Africa	Inflation	Consumer Price Index, Base 2010	2002: Q1 -2014: Q4	OECD	SAINF
23.	South Africa	Interest Rate	AverageRepo Rate	2002: Q1 -2014: Q4	Bloomberg	SAIR
24.	South Africa	Exchange Rate	1 USD in South African Rand	2002: Q1 -2014: Q4	Bloomberg	SAER
25.	South Africa	Money Supply	Money Supply (M2)	2002: Q1 -2014: Q4	Bloomberg	SAMS
26.	International	Oil Price	Simple average of three spot prices: Dated Brent, West Texas Intermediate, and the Dubai Fateh.	1995: Q1 -2014: Q4	IndexMundi	OIL
27.	Panel	GDP	-	1995: Q1 -2014: Q4	-	PGDP
28.	Panel	Inflation	-	1995: Q1 -2014: Q4	-	PINF
29.	Panel	Interest Rate	-	1995: Q1 -2014: Q4	-	PIR
30.	Panel	Exchange Rate	-	1995: Q1 -2014: Q4	-	PER
31.	Panel	Money Supply	-	1995: Q1 -2014: Q4	-	PMS

## DATA AND METHODOLOGY

### Data

The period of present study is 1995: Q1 to 2014: Q4. Frequency of all data is quarterly. The data comprise macroeconomic variables and stock indices values for all BRICS nations and international oil prices. We have considered six prominent macroeconomic variables, i.e., GDP, Inflation, Interest Rate, Exchange Rate, Money Supply and Oil Prices. The operational definitions, time period of availability, source and symbol of each macroeconomic variable for each country is provided in Table 1. We have also constructed a panel data of BRICS stock indices and macroeconomic variables.

The detailed description of stock market variables of each country is given in Table 2.

### Methodology

#### Unit Root Test

If the mean, variance and auto-covariance of a time series data are time invariant, it is said to be stationary. Stationarity of a data is a prerequisite for applying most advanced econometric techniques. Augmented Dickey Fuller (ADF) unit root test has been used to test for presence of unit root. To apply ARDL model we need stationary series.

#### ARDL Model

The Autoregressive Distributed Lag (ARDL) approach was introduced by Pesaran *et al.* (1996). ARDL model has been used here for the analysis of both short-run dynamic and long run relationship between stock returns and macroeconomic

variables in BRICS markets.

An autoregressive distributed lag model is considered as

$$\text{ARDL (1, 1) model: } y_t = \mu + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + u_t$$

Where  $y_t$  and  $x_t$  are stationary variables, and  $u_t$  is a white noise.

The first differenced logarithmic values of all the macroeconomic and stock index variables of BRICS nations and of BRICS panel and international oil prices are found to be stationary according to ADF unit root test results. While, log of variables at level are non-stationary and have been used as long run coefficients. Before running ARDL model, we determine the optimal lag length as per Akaike Information Criteria (AIC) in VAR framework. Based on optimal lag length as per AIC, we have applied ARDL model for each country & panel.

Our ARDL model regresses stock index (dependent) variables on their own lagged values; on stationary (short run) contemporary and lagged values of macroeconomic (independent) variables of that country and international oil price; and on non-stationary (long run) values of macroeconomic variables.

Thus, while the stationary contemporaneous and lagged values will determine the short run relationship between macroeconomic variables and stock returns, the non-stationary ones will establish the long run relationship. Optimal AIC lags and the corresponding ARDL models for each of the BRICS economies and Panel is shown in Table 3 below.

We use Breusch-Godfrey Serial Correlation Lagrange Multiplier test to check for autocorrelation errors in the model. The null hypothesis is that there is no serial correlation, which if accepted implies that the ARDL model is free from any serial correlation problem. To check for stability of coefficients of ARDL models, we use CUSUM

**Table 2: Data Description (Stock Market Variables)**

S.No.	Country	Stock Exchange	Stock Index	Time Period	Source	Symbol
1.	Brazil	Sao Paulo Stock Exchange	Ibovespa	1995: Q1 to 2014: Q4	Yahoo Finance	BINDEX
2.	Russia	Moscow Stock Exchange	RTSI INDEX	1995: Q3 to 2014: Q4	Yahoo Finance	RINDEX
3.	India	Bombay Stock Exchange	BSE SENSEX	1995: Q1 to 2014: Q4	Yahoo Finance	IINDEX
4.	China	Shanghai Stock Exchange	Shanghai SE Composite	1995: Q1 to 2014: Q4	Yahoo Finance	CINDEX
5.	South Africa	Johannesburg Stock Exchange	FTSE-JSE All Share Index	2002: Q1 to 2014: Q4	Yahoo Finance	SAINDEX
6.	Panel (Index)		-	1995: Q1 -2014: Q4	-	PIINDEX

Table 3: Optimal VAR (AIC) Lag Length &amp; ARDL Model

Country	Lag	ARDL Model
<b>Brazil</b>	1	$DLOG(BINDEX) = C(1) + C(2)*DLOG(BINDEX(-1)) + C(3)*DLOG(BGDP) + C(4)*DLOG(BGDP(-1)) + C(5)*DLOG(BINF) + C(6)*DLOG(BINF(-1)) + C(7)*DLOG(BIR) + C(8)*DLOG(BIR(-1)) + C(9)*DLOG(BER) + C(10)*DLOG(BER(-1)) + C(11)*DLOG(BMS) + C(12)*DLOG(BMS(-1)) + C(13)*DLOG(OIL) + C(14)*DLOG(OIL(-1)) + C(15)*LOG(BGDP) + C(16)*LOG(BINF) + C(17)*LOG(BIR) + C(18)*LOG(BER) + C(19)*LOG(BMS) + C(20)*LOG(OIL).$
<b>Russia</b>	4	$DLOG(RINDEX) = C(1) + C(2)*DLOG(RINDEX(-1)) + C(3)*DLOG(RINDEX(-2)) + C(4)*DLOG(RINDEX(-3)) + C(5)*DLOG(RINDEX(-4)) + C(6)*DLOG(RGDP) + C(7)*DLOG(RGDP(-1)) + C(8)*DLOG(RGDP(-2)) + C(9)*DLOG(RGDP(-3)) + C(10)*DLOG(RGDP(-4)) + C(11)*DLOG(RINF) + C(12)*DLOG(RINF(-1)) + C(13)*DLOG(RINF(-2)) + C(14)*DLOG(RINF(-3)) + C(15)*DLOG(RINF(-4)) + C(16)*DLOG(RIR) + C(17)*DLOG(RIR(-1)) + C(18)*DLOG(RIR(-2)) + C(19)*DLOG(RIR(-3)) + C(20)*DLOG(RIR(-4)) + C(21)*DLOG(RER) + C(22)*DLOG(RER(-1)) + C(23)*DLOG(RER(-2)) + C(24)*DLOG(RER(-3)) + C(25)*DLOG(RER(-4)) + C(26)*DLOG(RMS) + C(27)*DLOG(RMS(-1)) + C(28)*DLOG(RMS(-2)) + C(29)*DLOG(RMS(-3)) + C(30)*DLOG(RMS(-4)) + C(31)*DLOG(OIL) + C(32)*DLOG(OIL(-1)) + C(33)*DLOG(OIL(-2)) + C(34)*DLOG(OIL(-3)) + C(35)*DLOG(OIL(-4)) + C(36)*LOG(RGDP) + C(37)*LOG(RINF) + C(38)*LOG(RIR) + C(39)*LOG(RER) + C(40)*LOG(RMS) + C(41)*LOG(OIL).$
<b>India</b>	2	$DLOG(IINDEX) = C(1) + C(2)*DLOG(IINDEX(-1)) + C(3)*DLOG(IINDEX(-2)) + C(4)*DLOG(IGDP) + C(5)*DLOG(IGDP(-1)) + C(6)*DLOG(IGDP(-2)) + C(7)*DLOG(IINF) + C(8)*DLOG(IINF(-1)) + C(9)*DLOG(IINF(-2)) + C(10)*DLOG(IIR) + C(11)*DLOG(IIR(-1)) + C(12)*DLOG(IIR(-2)) + C(13)*DLOG(IER) + C(14)*DLOG(IER(-1)) + C(15)*DLOG(IER(-2)) + C(16)*DLOG(IMS) + C(17)*DLOG(IMS(-1)) + C(18)*DLOG(IMS(-2)) + C(19)*DLOG(OIL) + C(20)*DLOG(OIL(-1)) + C(21)*DLOG(OIL(-2)) + C(22)*LOG(IGDP) + C(23)*LOG(IINF) + C(24)*LOG(IIR) + C(25)*LOG(IER) + C(26)*LOG(IMS) + C(27)*LOG(OIL).$
<b>China</b>	2	$DLOG(CINDEX) = C(1) + C(2)*DLOG(CINDEX(-1)) + C(3)*DLOG(CINDEX(-2)) + C(4)*DLOG(CGDP) + C(5)*DLOG(CGDP(-1)) + C(6)*DLOG(CGDP(-2)) + C(7)*DLOG(CINF) + C(8)*DLOG(CINF(-1)) + C(9)*DLOG(CINF(-2)) + C(10)*DLOG(CIR) + C(11)*DLOG(CIR(-1)) + C(12)*DLOG(CIR(-2)) + C(13)*DLOG(CER) + C(14)*DLOG(CER(-1)) + C(15)*DLOG(CER(-2)) + C(16)*DLOG(CMS) + C(17)*DLOG(CMS(-1)) + C(18)*DLOG(CMS(-2)) + C(19)*DLOG(OIL) + C(20)*DLOG(OIL(-1)) + C(21)*DLOG(OIL(-2)) + C(22)*LOG(CGDP) + C(23)*LOG(CINF) + C(24)*LOG(CIR) + C(25)*LOG(CER) + C(26)*LOG(CMS) + C(27)*LOG(OIL).$
<b>South Africa</b>	1	$DLOG(SAINDEX) = C(1) + C(2)*DLOG(SAINDEX(-1)) + C(3)*DLOG(SAGDP) + C(4)*DLOG(SAGDP(-1)) + C(5)*DLOG(SAINF) + C(6)*DLOG(SAINF(-1)) + C(7)*DLOG(SAIR) + C(8)*DLOG(SAIR(-1)) + C(9)*DLOG(SAER) + C(10)*DLOG(SAER(-1)) + C(11)*DLOG(SAMS) + C(12)*DLOG(SAMS(-1)) + C(13)*DLOG(OIL) + C(14)*DLOG(OIL(-1)) + C(15)*LOG(SAGDP) + C(16)*LOG(SAINF) + C(17)*LOG(SAIR) + C(18)*LOG(SAER) + C(19)*LOG(SAMS) + C(20)*LOG(OIL).$
<b>Panel</b>	5	$DLOG(PINDEX) = C(1) + C(2)*DLOG(PINDEX(-1)) + C(3)*DLOG(PINDEX(-2)) + C(4)*DLOG(PINDEX(-3)) + C(5)*DLOG(PINDEX(-4)) + C(6)*DLOG(PINDEX(-5)) + C(7)*DLOG(PGDP) + C(8)*DLOG(PGDP(-1)) + C(9)*DLOG(PGDP(-2)) + C(10)*DLOG(PGDP(-3)) + C(11)*DLOG(PGDP(-4)) + C(12)*DLOG(PGDP(-5)) + C(13)*DLOG(PINF) + C(14)*DLOG(PINF(-1)) + C(15)*DLOG(PINF(-2)) + C(16)*DLOG(PINF(-3)) + C(17)*DLOG(PINF(-4)) + C(18)*DLOG(PINF(-5)) + C(19)*DLOG(PIR) + C(20)*DLOG(PIR(-1)) + C(21)*DLOG(PIR(-2)) + C(22)*DLOG(PIR(-3)) + C(23)*DLOG(PIR(-4)) + C(24)*DLOG(PIR(-5)) + C(25)*DLOG(PER) + C(26)*DLOG(PER(-1)) + C(27)*DLOG(PER(-2)) + C(28)*DLOG(PER(-3)) + C(29)*DLOG(PER(-4)) + C(30)*DLOG(PER(-5)) + C(31)*DLOG(PMS) + C(32)*DLOG(PMS(-1)) + C(33)*DLOG(PMS(-2)) + C(34)*DLOG(PMS(-3)) + C(35)*DLOG(PMS(-4)) + C(36)*DLOG(PMS(-5)) + C(37)*LOG(PGDP) + C(38)*LOG(PINF) + C(39)*LOG(PIR) + C(40)*LOG(PER) + C(41)*LOG(PMS).$

test. The null hypothesis is that the model is stable. If the ARDL model lies within the 5% significance limits, the null hypothesis is accepted and the ARDL model is stable.

## EMPIRICAL RESULTS AND DISCUSSION

### Brazil

The results are shown in Table 4. The R-square of this model is about 63%. Results reveal that Brazil stock returns are

significantly explained by its own lagged value, short run coefficient of money supply and long run coefficients of inflation, exchange rate, and oil prices. Brazil stock returns have a significant negative relationship with its lagged value, long run exchange rate and long run oil prices while it has a significant positive relationship with short run money supply and long run inflation.

Fig.1 shows the graphical representation of Brazil ARDL model. Here, we see that the fitted values of Brazil stock returns are close to actual values.

CUSUM stability test results of the model in Fig.2 show that, Brazil ARDL model lies well within the 5% significance limits shown by the red lines and thus the model is stable.

### Russia

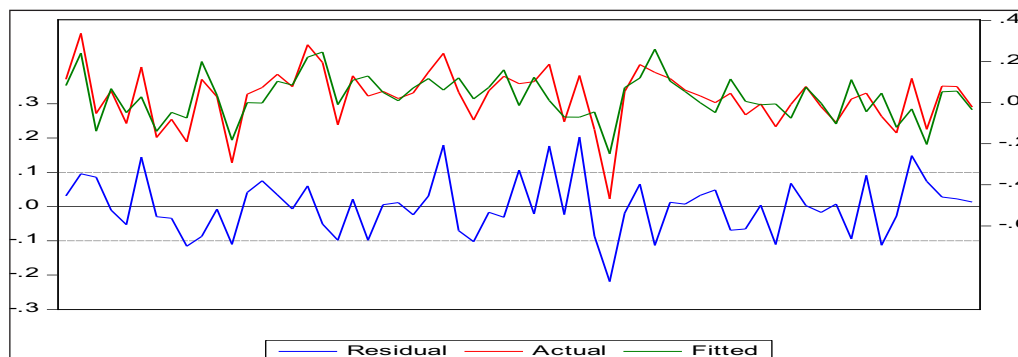
Russia ARDL Model results are provided in Table 5. The explanatory power of this model ( $R^2$ ) is very high, i.e., 98.5%. Russian stock returns have significant negatively relationship with past values of GDP and significant positive relationship with lagged values of money supply.

**Table 4: Brazil ARDL Model Results**

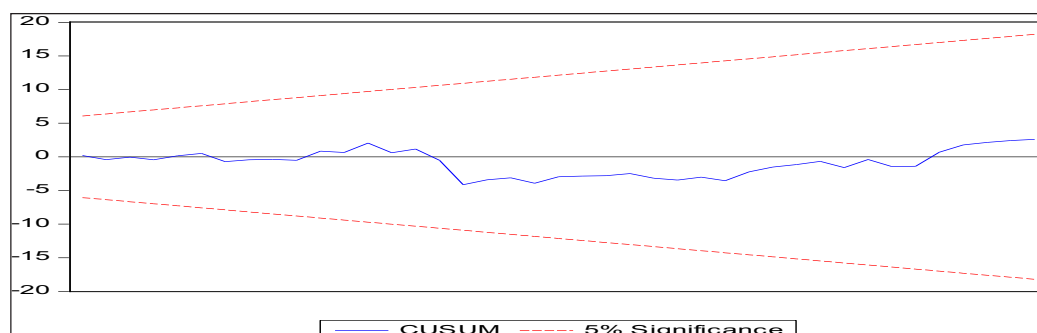
Variable	Coefficient	Std. Error	t-Statistic	Probability
C	45.03	24.24	1.86	0.07
DLOG(BINDEX(-1))	-0.35*	0.16	-2.13	0.04
DLOG(BGDP)	2.20	2.34	0.94	0.35
DLOG(BGDP(-1))	2.73	1.83	1.50	0.14
DLOG(BINF)	4.98	2.68	1.86	0.07
DLOG(BINF(-1))	-1.20	2.45	-0.49	0.63
DLOG(BIR)	-0.40	0.25	-1.61	0.11
DLOG(BIR(-1))	0.15	0.17	0.88	0.39
DLOG(BER)	-0.18	0.36	-0.51	0.61
DLOG(BER(-1))	0.45	0.29	1.55	0.13
DLOG(BMS)	3.24*	1.00	3.25	0.00
DLOG(BMS(-1))	-1.96	1.13	-1.74	0.09
DLOG(OIL)	0.22	0.13	1.68	0.10
DLOG(OIL(-1))	-0.04	0.12	-0.35	0.73
LOG(BGDP)	-3.76	2.04	-1.85	0.07
LOG(BINF)	2.22*	1.03	2.15	0.04
LOG(BIR)	-0.04	0.18	-0.23	0.82
LOG(BER)	-0.66*	0.31	-2.10	0.04
LOG(BMS)	0.12	0.46	0.26	0.80
LOG(OIL)	-0.32*	0.12	-2.59	0.01

\* Denotes Significant at 5% level.

**Fig. 1: Brazil ARDL Model Graph**



**Fig. 2: Brazil ARDL Model (CUSUM Stability Test Results)**



**Table 5: Russia ARDL Model Results**

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-529.31	228.27	-2.32	0.08
DLOG(RINDEX(-1))	-0.31	0.39	-0.79	0.47
DLOG(RINDEX(-2))	-0.01	0.30	-0.04	0.97
DLOG(RINDEX(-3))	0.06	0.21	0.28	0.80
DLOG(RINDEX(-4))	-0.29	0.21	-1.34	0.25
DLOG(RGDP)	-26.92	16.27	-1.65	0.17
DLOG(RGDP(-1))	-5.35	11.86	-0.45	0.68
DLOG(RGDP(-2))	-16.39	9.14	-1.79	0.15
DLOG(RGDP(-3))	-24.94*	9.28	-2.69	0.05
DLOG(RGDP(-4))	-6.25	10.38	-0.60	0.58
DLOG(RINF)	-11.03	10.37	-1.06	0.35
DLOG(RINF(-1))	-21.06	12.14	-1.73	0.16
DLOG(RINF(-2))	-13.36	15.09	-0.89	0.43
DLOG(RINF(-3))	-8.58	8.06	-1.06	0.35
DLOG(RINF(-4))	-12.56	11.05	-1.14	0.32
DLOG(RIR)	4.64	2.30	2.02	0.11
DLOG(RIR(-1))	4.49	2.01	2.23	0.09
DLOG(RIR(-2))	3.51	1.94	1.81	0.14
DLOG(RIR(-3))	3.14	1.98	1.58	0.19
DLOG(RIR(-4))	0.29	1.66	0.18	0.87
DLOG(RER)	-5.28	3.81	-1.39	0.24
DLOG(RER(-1))	-3.99	2.69	-1.48	0.21
DLOG(RER(-2))	-1.78	2.19	-0.82	0.46
DLOG(RER(-3))	-0.62	1.24	-0.50	0.64
DLOG(RER(-4))	-1.25	1.05	-1.19	0.30
DLOG(RMS)	8.34	5.02	1.66	0.17
DLOG(RMS(-1))	6.22	3.86	1.61	0.18
DLOG(RMS(-2))	4.96*	1.83	2.72	0.05
DLOG(RMS(-3))	4.02	2.10	1.91	0.13
DLOG(RMS(-4))	1.21	1.47	0.82	0.46
DLOG(OIL)	2.11	1.79	1.18	0.30

Variable	Coefficient	Std. Error	t-Statistic	Probability
DLOG(OIL(-1))	1.31	1.41	0.93	0.41
DLOG(OIL(-2))	0.62	0.99	0.63	0.56
DLOG(OIL(-3))	1.10	0.75	1.47	0.22
DLOG(OIL(-4))	0.48	0.48	1.00	0.37
LOG(RGDP)	35.58	14.94	2.38	0.08
LOG(RINF)	7.00	9.34	0.75	0.50
LOG(RIR)	-1.91	2.13	-0.89	0.42
LOG(RER)	3.98	4.14	0.96	0.39
LOG(RMS)	-10.70	5.48	-1.95	0.12
LOG(OIL)	-2.37	2.09	-1.13	0.32

\* Denotes Significant at 5% level.

The graphical representation of Russian ARDL model is provided in Fig. 3. It shows that model is approximately exact fit as fitted and actual values almost coincide.

CUSUM stability diagnostics test reveals in Fig. 4 that Russian ARDL model is stable.

### India

Next, the Indian ARDL model is executed. Results are provided in Table 6. Model's explanatory power is 70%. The results indicate that Indian stock returns are negatively related with their own lagged values; lagged values of domestic interest rate and long run money supply. However, they are positively linked to contemporaneous GDP values.

Fig. 3: Russia ARDL Model Graph

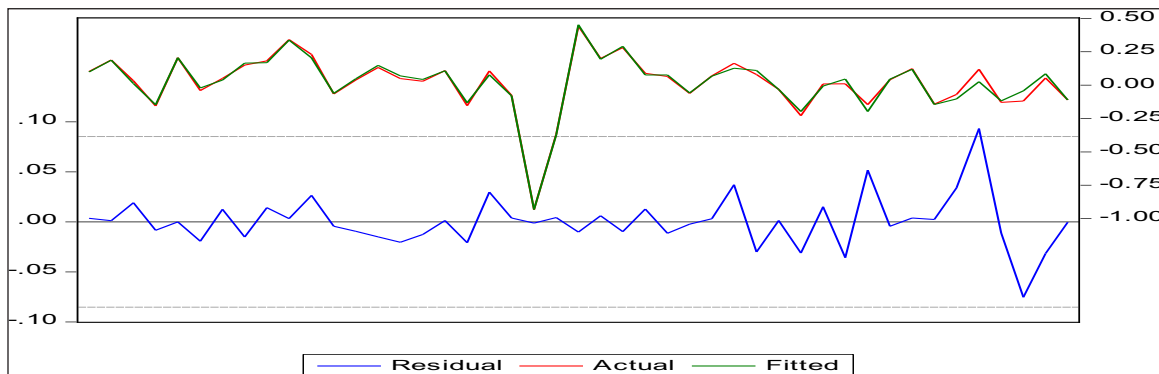
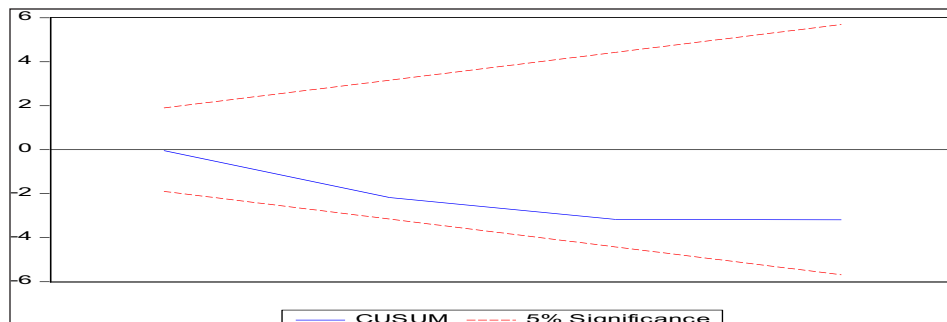


Fig. 4: Russia ARDL Model (CUSUM Stability Test Results)



**Table 6: India ARDL Model Results**

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-19.31	13.20	-1.46	0.15
DLOG(IINDEX(-1))	-0.19	0.13	-1.45	0.15
DLOG(IINDEX(-2))	-0.27*	0.12	-2.23	0.03
DLOG(IGDP)	4.38*	1.89	2.32	0.03
DLOG(IGDP(-1))	2.79	1.99	1.40	0.17
DLOG(IGDP(-2))	1.25	1.44	0.87	0.39
DLOG(IINF)	-1.71	1.10	-1.56	0.13
DLOG(IINF(-1))	-1.37	0.94	-1.45	0.15
DLOG(IINF(-2))	-1.21	0.89	-1.35	0.18
DLOG(IIR)	-0.01	0.07	-0.14	0.89
DLOG(IIR(-1))	-0.11	0.07	-1.58	0.12
DLOG(IIR(-2))	-0.13*	0.05	-2.40	0.02
DLOG(IER)	-0.69	0.42	-1.65	0.11
DLOG(IER(-1))	0.51	0.45	1.13	0.26
DLOG(IER(-2))	0.45	0.42	1.05	0.30
DLOG(IMS)	0.40	0.95	0.42	0.68
DLOG(IMS(-1))	-1.49	1.02	-1.46	0.15
DLOG(IMS(-2))	1.12	0.91	1.22	0.23
DLOG(OIL)	0.18	0.11	1.60	0.12
DLOG(OIL(-1))	-0.01	0.10	-0.14	0.89
DLOG(OIL(-2))	0.05	0.10	0.51	0.61
LOG(IGDP)	1.78	1.18	1.51	0.14
LOG(IINF)	0.06	0.60	0.10	0.92
LOG(IIR)	-0.14	0.08	-1.85	0.07
LOG(IER)	0.20	0.34	0.59	0.56
LOG(IMS)	-0.79*	0.36	-2.22	0.03
LOG(OIL)	-0.05	0.11	-0.45	0.66

\* Denotes Significant at 5% level.

The graphical representation of Indian ARDL model in Fig. 5 shows that the model's fitted values are close to the actual values.

CUSUM stability test for Indian ARDL model is provided in Fig. 6. It shows that Indian ARDL model is within the upper 5% significance level bounds and hence is stable.

## China

The ARDL model result of China is provided in Table 7. The explanatory power of this model is about 44%. Neither the lagged values of Chinese stock returns, nor the present and past values of any macroeconomic variables are significant in explaining present Chinese stock returns. This is also true for long run coefficients of macroeconomic variables.

Fig. 5: India ARDL Model Graph

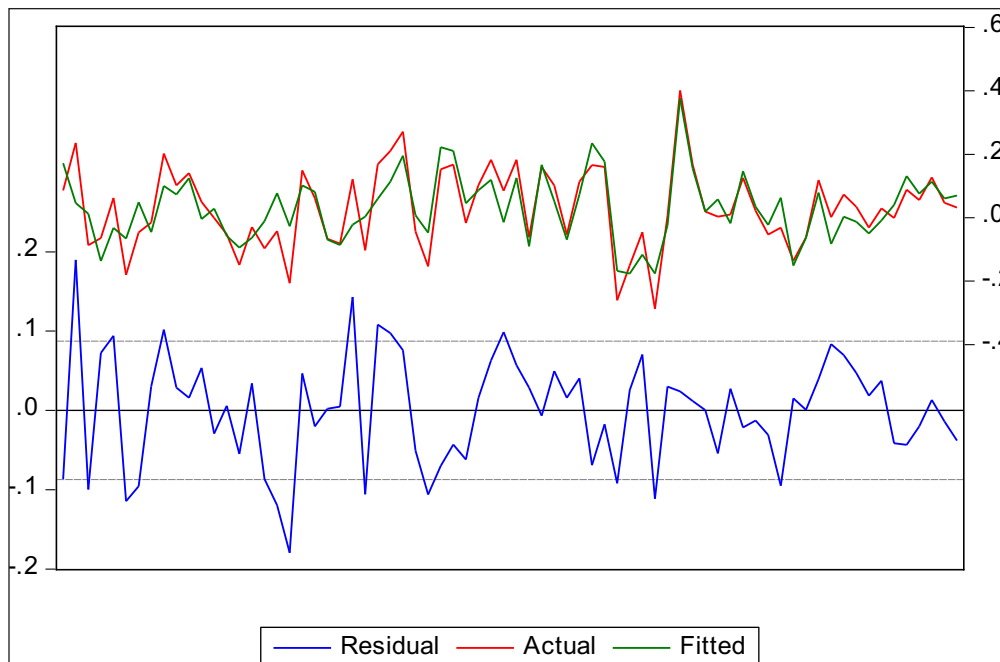


Fig. 6: India ARDL Model (CUSUM Stability Test Results)

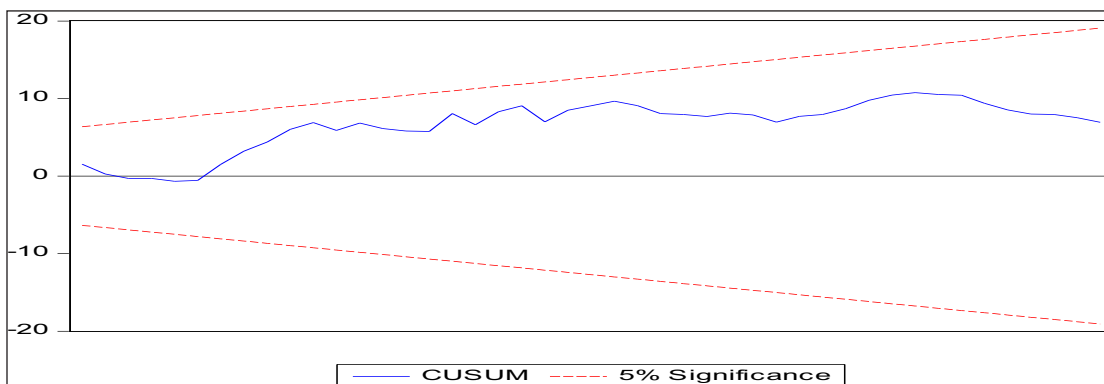


Table 7: China ARDL Model Results

Variable	Coefficient	Std. Error	t-Statistic	Probability
	-3.65	13.34	-0.27	0.79
DLOG(CINDEX(-1))	0.10	0.16	0.62	0.54
DLOG(CINDEX(-2))	0.16	0.16	0.99	0.33
DLOG(CGDP)	-1.24	1.06	-1.17	0.25
DLOG(CGDP(-1))	-0.87	0.72	-1.20	0.23
DLOG(CGDP(-2))	-0.42	0.37	-1.15	0.26
DLOG(CINF)	2.66	4.31	0.62	0.54
DLOG(CINF(-1))	-4.27	3.75	-1.14	0.26
DLOG(CINF(-2))	-4.11	3.83	-1.08	0.29
DLOG(CIR)	-0.23	0.66	-0.35	0.73
DLOG(CIR(-1))	0.43	0.63	0.69	0.50

DLOG(CIR(-2))	-0.07	0.56	-0.12	0.90
DLOG(CER)	0.17	3.50	0.05	0.96
DLOG(CER(-1))	1.40	3.58	0.39	0.70
DLOG(CER(-2))	6.42	3.34	1.92	0.06
DLOG(CMS)	0.13	1.81	0.07	0.94
DLOG(CMS(-1))	0.31	1.65	0.19	0.85
DLOG(CMS(-2))	-0.63	1.54	-0.41	0.68
DLOG(OIL)	-0.14	0.17	-0.80	0.43
DLOG(OIL(-1))	-0.18	0.15	-1.19	0.24
DLOG(OIL(-2))	-0.21	0.15	-1.42	0.16
LOG(CGDP)	1.58	1.42	1.11	0.27
LOG(CINF)	-0.83	3.11	-0.27	0.79
LOG(CIR)	-0.19	0.53	-0.35	0.73
LOG(CER)	0.72	1.50	0.48	0.63
LOG(CMS)	-1.20	1.08	-1.11	0.27
LOG(OIL)	0.16	0.16	1.03	0.31

Fig. 7: China ARDL Model Graph

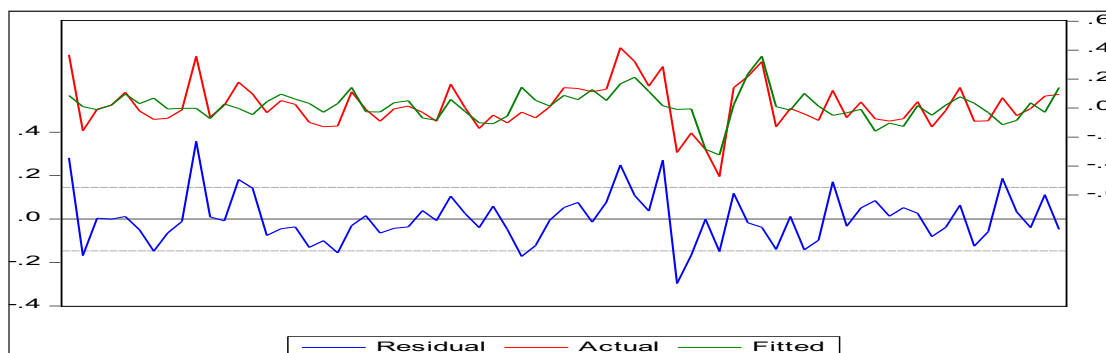


Fig. 8: China ARDL Model (CUSUM Stability Test Results)

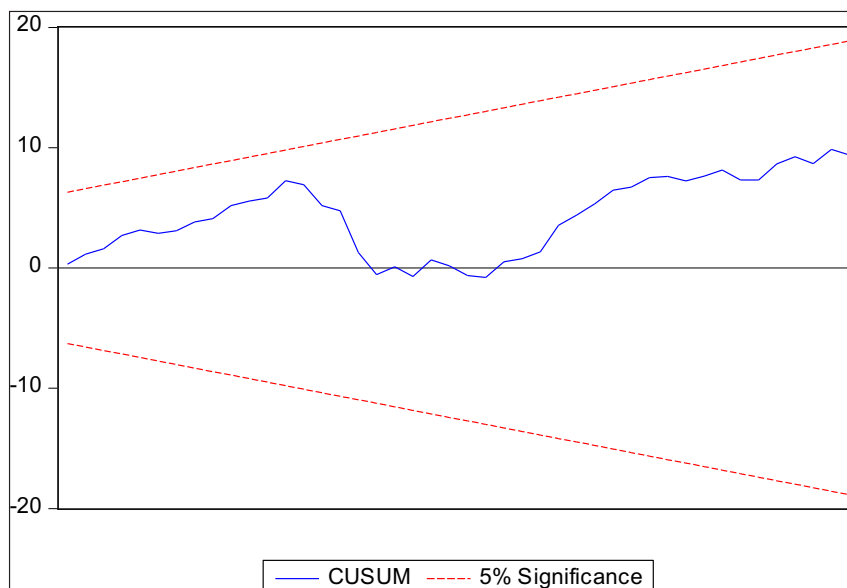


Fig. 7 shows that fitted values from China ARDL model are not very close to actual values.

CUSUM test results for Chinese ARDL model indicate stability of coefficients in the model.

## South Africa

ARDL model results for South Africa are provided in Table 8. R-Square of this model is 72.5%. We find that South African

stock returns have significant negative relationship with current inflation, current exchange rate, long run inflation and long run interest rate.

Graphical form of South African ARDL model shown in Fig. 9 reveals that the fitted values are close to their actual counterparts.

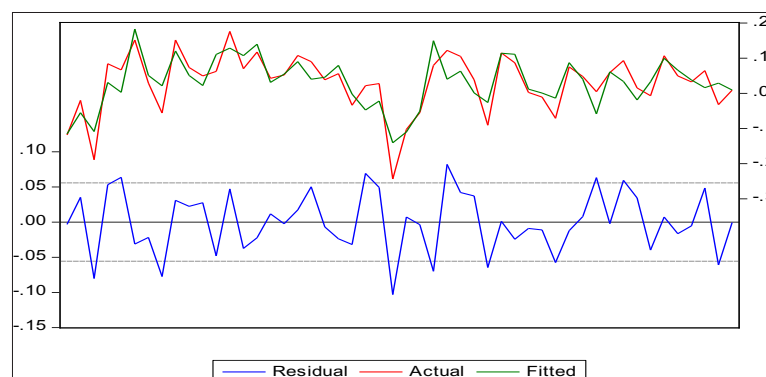
CUSUM Stability test results indicate stability of South African ARDL model.

**Table 8: South Africa ARDL Model Results**

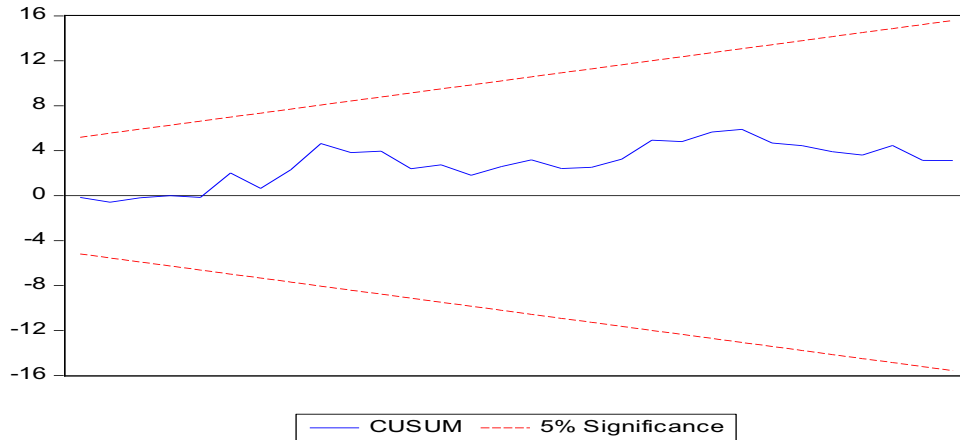
Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-4.37	15.31	-0.29	0.78
DLOG(SAINDEX(-1))	-0.33	0.18	-1.85	0.07
DLOG(SAGDP)	-2.75	2.99	-0.92	0.36
DLOG(SAGDP(-1))	-1.22	2.58	-0.47	0.64
DLOG(SAINF)	-6.01*	2.30	-2.62	0.01
DLOG(SAINF(-1))	-1.63	1.93	-0.85	0.40
DLOG(SAIR)	0.10	0.21	0.46	0.65
DLOG(SAIR(-1))	0.14	0.21	0.66	0.51
DLOG(SAER)	-0.46*	0.19	-2.50	0.02
DLOG(SAER(-1))	-0.09	0.17	-0.51	0.61
DLOG(SAMS)	0.82	0.48	1.71	0.10
DLOG(SAMS(-1))	-0.22	0.46	-0.47	0.64
DLOG(OIL)	0.15	0.10	1.48	0.15
DLOG(OIL(-1))	0.20	0.10	2.05	0.05
LOG(SAGDP)	0.42	1.59	0.26	0.79
LOG(SAINF)	-1.01*	0.31	-3.25	0.00
LOG(SAIR)	-0.21*	0.09	-2.34	0.03
LOG(SAER)	0.29	0.15	1.86	0.07
LOG(SAMS)	0.23	0.41	0.57	0.57
LOG(OIL)	0.02	0.12	0.17	0.87

\* Denotes significant at 5% level.

**Fig. 9: South Africa ARDL Model Graph**



**Fig. 10: South Africa ARDL Model (CUSUM Stability Test Results)**



We also check all the above ARDL models for serial correlation through Breusch-Godfrey Lagrange Multiplier (LM) Test. Results shown in Table 9 indicate that the null hypothesis of no serial correlation is accepted in all cases at 5% significance level. Thus, all the five ARDL models are free from serial correlation.

**Table 9: Breusch-Godfrey Serial Correlation Lagrange Multiplier (LM) Test**

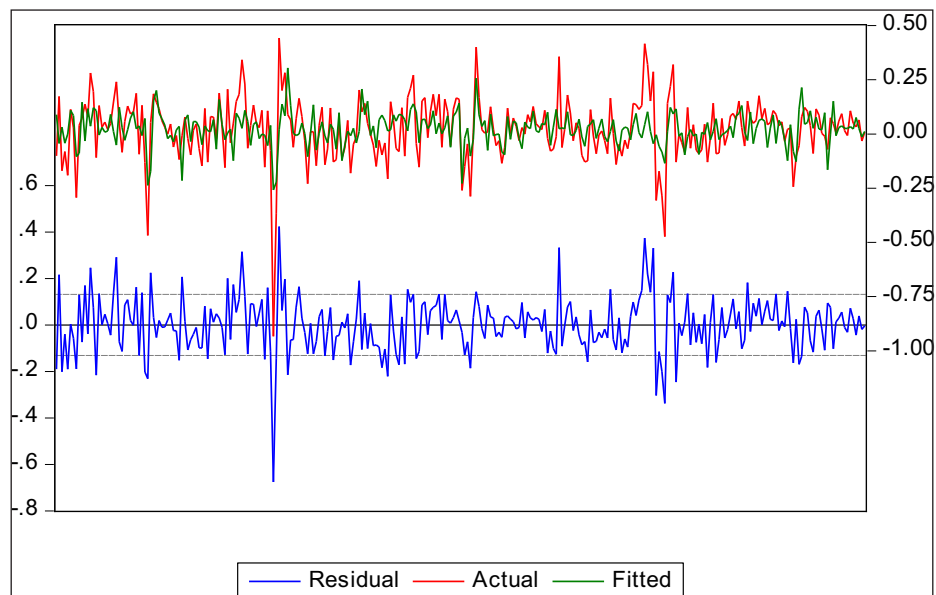
ARDL Model	F-statistic	Probability (F-Statistic)
Brazil	0.19	0.83
Russia	0.07	0.93
India	0.33	0.72
China	0.77	0.47
South Africa	3.03	0.06

### Panel Data Results

Finally, we run the Panel ARDL model to see the short and long run relationships between stock returns and macroeconomic variables of these five emerging economies as one collective group. This model explains about 27.5% of variation in the panel of BRICS stock returns. We find that while current BRICS stock returns are negatively linked to current exchange rate and past values of money supply; they are positively linked to their own lagged values and those of the exchange rate.

Fig. 11 presents graphic representation of actual, fitted & residuals of Panel ARDL Model.

**Fig. 11: Panel ARDL Model Graph**



**Table 10: Panel ARDL Model Results**

Variable	Coefficient	Std. Error	t-Statistic	Probability
	0.18	0.26	0.69	0.49
DLOG(PINDEX(-1))	0.20*	0.071	2.74	0.01
DLOG(PINDEX(-2))	-0.04	0.072	-0.56	0.58
DLOG(PINDEX(-3))	0.05	0.069	0.74	0.46
DLOG(PINDEX(-4))	-0.09	0.068	-1.39	0.17
DLOG(PINDEX(-5))	0.00	0.07	0.05	0.96
DLOG(PGDP)	0.11	0.57	0.20	0.84
DLOG(PGDP(-1))	-0.31	0.56	-0.54	0.59
DLOG(PGDP(-2))	-0.06	0.30	-0.19	0.85
DLOG(PGDP(-3))	-0.10	0.30	-0.34	0.74
DLOG(PGDP(-4))	-0.24	0.58	-0.41	0.68
DLOG(PGDP(-5))	0.22	0.57	0.38	0.71
DLOG(PINF)	-0.68	0.88	-0.78	0.44
DLOG(PINF(-1))	-1.53	0.90	-1.69	0.09
DLOG(PINF(-2))	0.56	0.89	0.63	0.53
DLOG(PINF(-3))	-0.67	0.87	-0.77	0.44
DLOG(PINF(-4))	0.72	0.92	0.78	0.43
DLOG(PINF(-5))	0.79	0.86	0.91	0.36
DLOG(PIR)	-0.03	0.07	-0.46	0.65
DLOG(PIR(-1))	-0.04	0.07	-0.66	0.51
DLOG(PIR(-2))	-0.09	0.06	-1.41	0.16
DLOG(PIR(-3))	0.07	0.06	1.10	0.27
DLOG(PIR(-4))	-0.03	0.06	-0.57	0.57
DLOG(PIR(-5))	-0.06	0.05	-1.19	0.24
DLOG(PER)	-0.65*	0.15	-4.30	0.00
DLOG(PER(-1))	0.34*	0.16	2.11	0.04
DLOG(PER(-2))	0.16	0.16	0.96	0.34
DLOG(PER(-3))	-0.03	0.16	-0.17	0.87
DLOG(PER(-4))	0.13	0.16	0.79	0.43
DLOG(PER(-5))	0.19	0.15	1.22	0.22
DLOG(PMS)	0.00	0.40	-0.01	0.99
DLOG(PMS(-1))	-0.34	0.39	-0.88	0.38
DLOG(PMS(-2))	0.81*	0.36	2.26	0.02
DLOG(PMS(-3))	-0.36	0.36	-1.02	0.31
DLOG(PMS(-4))	-0.75*	0.37	-2.02	0.04
DLOG(PMS(-5))	0.31	0.37	0.85	0.40
LOG(PGDP)	0.00	0.01	0.42	0.67
LOG(PINF)	-0.04	0.04	-1.02	0.31
LOG(PIR)	-0.01	0.04	-0.27	0.79
LOG(PER)	0.00	0.02	0.09	0.93
LOG(PMS)	0.00	0.00	0.13	0.90

\* Denotes significant at 5% level.

## CONCLUSION AND IMPLICATIONS

This paper examined the interesting issue of whether macroeconomic factors influence stock returns in BRICS markets. By applying Auto Regressive Distributed Lag (ARDL) model on macroeconomic and stock return data for the period from 1995-2014, we tested for both short run and long run dynamic relationship. On the basis of extensive literature review and data availability, we identified six prominent macroeconomic variables, viz. GDP, inflation, interest rate, exchange rate, money supply, and international oil prices. The leading representative market stock indices of these countries are used to calculate stock returns. Contrary to general belief, we could find a significant impact of GDP only in India and Russia. While, Inflation had a significant influence on stock returns in Brazil and South Africa only. A very strong reason for this is that stock markets already discount the GDP and inflation data and hence security prices reflect these expectations. In other words, stock returns tend to lead rather than follow GDP and Inflation. As expected in theory, interest rate, exchange rate, and oil prices are found to have a negative and significant impact on stock returns in both short and long run. Also, in line with the literature we find a positive influence of short run money supply on stock returns in these markets.

This study would be a valuable addition to the growing body of empirical literature on relationship between macroeconomic variables and stock returns in emerging markets besides being useful to policy makers, regulators and investment community. Policy makers and regulator should watch out for impact of fluctuations in exchange rate, interest rate, money supply and oil prices on volatility in their stock markets. Investor can search for presence of exploitable arbitrage opportunities in BRICS markets to earn above normal returns on the basis of these variables but not the basis of GDP or inflation.

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