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Modeling exchange rate -interest rate differential nexus in BRICS: The role asymmetry and structural breaks

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Abstract

This paper produces three new results for the interest rate differential – exchange rate nexus using data for the BRICS countries. One, it mostly validates the sticky price thesis which specifies negative relationship between interest rate differential and exchange rate in the countries. Two, further probe reveals that exchange rate predominantly responds asymmetrically to interest rate differential in four of the five countries. Three, the study reveals noteworthy result for China, showing that the nonlinearity in the nexus could be better captured with a threshold, rather than an asymmetric model.

Keywords: interest rate differential; asymmetry; structural breaks; BRICS
JEL Classification Codes: E43, F21, F31

1. Introduction

This study investigates the implications of interest rate differential for predicting exchange rate movements in BRICS countries. Previous evidences in support of the linkage are undeniable (see for example, Beng and Ying, 2010; Jackman et al., 2013; Moosa and Burns, 2014; Hacker et al., 2014; Ding and Yang, 2017; Galstyan and Velic, 2017). The theoretical motivation for the study is wrapped around the interest rate parity theory which accord significant role for non-zero interest rate differential to drive investment between the home and foreign economies and thereby serve as a predictor for exchange rate (see Auten, 1963, Hooper and Morton, 1982).[1] Further motivation for the research derives from its investment undertone particularly for emerging BRICS economies whose growth pursuits require stability in the goods and financial markets (see Wulandari, 2012; Beju and Ciupac-Ulici, 2015).

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[1] The more explicit theoretical models that define the nature of the relationship although differently are the sticky-price approach which specifies the (short run) relationship as negative and the flexible-price approach which outlines positive relationship.

The major contribution of this study is the consideration of asymmetry in the relationship in addition to its being a cross-country analysis. The theory emphasises nonlinearity in the relationship when it envisages different effects of positive and negative interest rate differential on exchange rate. The theory suggests a positive relationship (which leads to exchange rate appreciation) when interest rate differential favours the foreign country, and the reverse when it favours the home economy (see Auten, 1963). Several empirical evidences in our support indicate that exchange rates are better predicted within a nonlinear modelling framework (see Meese and Rogoff, 1983; Kilian and Taylor, 2003; Vygodina et al., 2008). Hence, we expect dissimilar response (i.e. asymmetric effects) of exchange rate to positive and negative interest rate differentials as well as possible differences in short and long run estimates (see Engel, 2016). We capture these asymmetric effects with a nonlinear autoregressive distributed lag (ARDL) technique[2] and return with interesting findings.

Following the introduction is the methodology section. Section 3 introduces the data and preliminary results. Section 4 discusses the main findings and Section 5 concludes the paper.

2. Methodology

The flexible/sticky-price monetary models (Hooper and Morton, 1982; Bilson, 1978; Frenkel, 1976; Dornbusch, 1976) in line with the assumption of interest rate parity are adequate for explaining the interest rate differential and exchange rate nexus. The synthesis of the models identifies the predictors of bilateral exchange rate to include relative differences in: short-term interest rate, prices, money growth, and output growth between the home country (each of the BRICS countries) and the foreign country (the US as the reference economy). This relation is true when the uncovered interest and purchasing power parities hold between the two economies (see Frenkel, 1979).

We reduce this theoretical construction into an Autoregressive Distributed Lag (ARDL) model:

$$\Delta e_t = c + \phi_1 e_{t-1} + \beta_1(\pi_{t-1} - \pi^*_{t-1}) + \delta_1(ms_{t-1} - ms^*_{t-1}) + \lambda_1(i_{t-1} - i^*_{t-1}) + \gamma_1(y_{t-1} - y^*_{t-1}) + \sum_{j=1}^{p}\phi_{2j}\Delta e_{t-j} + \sum_{i=0}^{q_1}\beta_{2i}\Delta(\pi_{t-i} - \pi^*_{t-i}) + \sum_{i=0}^{q_2}\delta_{2i}\Delta(ms_{t-i} - ms^*_{t-i}) + \sum_{i=0}^{q_3}\lambda_{2i}\Delta(i_{t-i} - i^*_{t-i}) + \sum_{i=0}^{q_4}\gamma_{2i}\Delta(y_{t-i} - y^*_{t-i}) + \varepsilon_t$$

(1)[3]

where e_t is the logarithm (log) of the bilateral exchange rate to the US\$ (domestic currency/\$); π_t is the inflation rate, ms_t is the log of the domestic nominal money supply, i_t is the interest rate, y_t is the log of domestic output, the variables denoted with asterisk are corresponding foreign variables (using US data), c is an arbitrary constant, and ε_t is a disturbance term.

Given the focus of the study to tease out the nonlinear asymmetric response of exchange rate to interest rate differential, we specify the nonlinear ARDL variant that captures asymmetry in Eq. (2).

$$\Delta e_t = c + \phi_1 e_{t-1} + \beta_1(\pi_{t-1} - \pi^*_{t-1}) + \delta_1(m_{t-1} - m^*_{t-1}) + \lambda^+_1(i_{t-1} - i^*_{t-1})^+ + \lambda^-_1(i_{t-1} - i^*_{t-1})^- + \gamma_1(y_{t-1} - y^*_{t-1}) + \sum_{j=1}^{p}\phi_{2j}\Delta e_{t-j} + \sum_{i=0}^{q_1}\beta_{2i}\Delta(\pi_{t-i} - \pi^*_{t-i}) + \sum_{i=0}^{q_2}\delta_{2i}\Delta(m_{t-i} - m^*_{t-i}) + \sum_{i=0}^{q_3}\lambda^+_{2i}\Delta(i_{t-i} - i^*_{t-i})^+ + \sum_{i=0}^{q_4}\lambda^-_{2i}\Delta(i_{t-i} - i^*_{t-i})^- + \sum_{i=0}^{q_5}\gamma_{2i}\Delta(y_{t-i} - y^*_{t-i}) + \varepsilon_t$$

(2)

We follow the technique of Shin et al. (2014) in decomposing interest rate differential into positive and negative partial sums as $\left(i_{t-1} - i^*_{t-1}\right)^+$ and $\left(i_{t-1} - i^*_{t-1}\right)^-$:

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[2] Some of the remarkable features of the technique can be found in Fauzel (2017) and Woo and Lee (2018).

[3] The attractions for choosing ARDL model is consistent with the earlier stated objective of obtaining short run and long run estimates and the mixed order of integration of the underlying series.

$$(i_{t-1} - i^*_{t-1})^+ = \sum_{k=1}^{t} \Delta(i_{t-1} - i^*_{t-1})^+ = \sum_{k=1}^{t} max(\Delta(i_{t-1} - i^*_{t-1}), 0) \qquad (3)$$

$$(i_{t-1} - i^*_{t-1})^- = \sum_{k=1}^{t} \Delta(i_{t-1} - i^*_{t-1})^- = \sum_{k=1}^{t} min(\Delta(i_{t-1} - i^*_{t-1}), 0) \qquad (4)$$

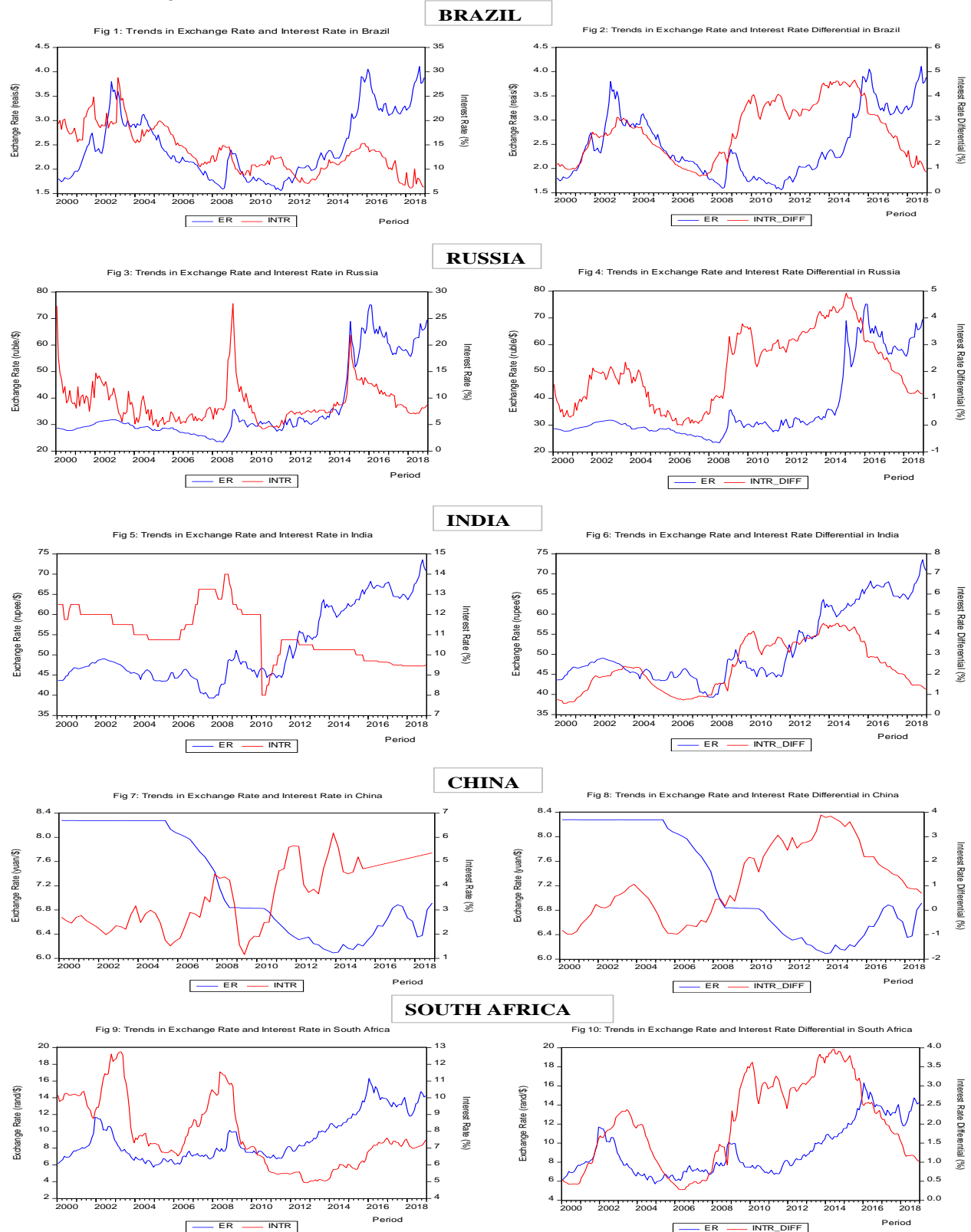*Figure 1.* Exchange rate, interest rate and interest rate differentials in the BRICS countries.

Table 1. Summary Statistics.

BRAZIL	Mean	Std. Dev.	Skewness	Kurtosis	RUSSIA	Mean	Std. Dev.	Skewness	Kurtosis
NER	2.480	0.667	0.608	2.253	NER	36.728	13.932	1.359	3.238
INF	0.511	0.382	2.176	12.464	INF	0.008	0.006	1.359	5.598
INTR	13.384	4.739	0.306	3.316	INTR	8.901	3.522	1.739	7.817
IPIG	0.079	6.496	0.032	2.941	IPIG	0.310	6.879	-1.715	7.800
MS	56.337	38.838	0.514	1.894	MS	49.278	40.757	0.524	1.891
CHINA	Mean	Std. Dev.	Skewness	Kurtosis	INDIA	Mean	Std. Dev.	Skewness	Kurtosis
NER	7.201	0.839	0.229	1.374	NER	51.866	9.045	0.707	2.050
INF	0.537	1.048	0.301	2.918	INF	0.515	0.762	0.690	6.407
INTR	3.600	1.343	0.053	1.623	INTR	11.006	1.246	0.175	2.453
IPIG	-0.065	1.515	-0.068	6.188	IPIG	0.428	5.475	-0.399	3.642
MS	54.955	40.189	0.599	2.006	MS	55.363	38.326	0.522	1.911
S. AFRICA	Mean	Std. Dev.	Skewness	Kurtosis	Reference	Mean	Std. Dev.	Skewness	Kurtosis
NER	9.182	2.654	0.827	2.468	US_INF	0.175	0.382	-0.882	6.817
INF	0.432	0.440	0.297	3.831	US_INTR	1.953	1.962	0.987	2.691
INTR	7.730	2.028	0.683	2.516	US_IPIG	0.070	1.810	0.034	3.381
IPIG	99.877	2.414	-1.632	13.486	US_MS	73.274	23.879	0.396	1.903
MS	64.551	32.635	0.086	1.760					

Note: ER = Bilateral Exchange Rate; IPIG = Growth in Industrial Production Index; INTR = Inter-bank Interest Rate; INF = Inflation; MS = Money Supply.

3. Data and preliminary analysis

3.1. Data sources and description

The study sourced the required dataset for BRICS countries from the International Monetary Fund's International Financial Statistics and the Federal Reserve Bank Database. The data cover 2000M01 to 2018M12 for the countries except China only available at quarterly frequency. The data are presented in turn. NER: Nominal exchange rate which is the bilateral exchange rate of the domestic currency against the US Dollar; INF: Inflation rate computed as $100*\log(cpi/cpi(-1))$; INT: Interest rate which is the domestic lending rate; IPIG: Industrial Production index Growth derived from the computation of the IPI growth rate as $100*\log(IPI/IPI(-1))$; and MS: Money supply.

3.2. Preliminary Analyses

Following standard approach to time series modelling, we explore the statistical properties of the variables with descriptive statistics, graphical presentations and unit root tests. From Table 1, using the mean values, India and Russia record the most exchange rate depreciation while Brazil and China experienced it the least during the review period. Brazil with the least exchange rate depreciation, the least volatile exchange rate series (judging by the standard deviation figures) also record the highest interest rate differential. On the other hand, India and Russia with the highest exchange rate depreciation have the most volatile exchange rates and the lowest interest rate differentials. To complement the summary statistics, the co-movements between the series are reported in Figure 1. The figures show that there are negligible differences between the graphs of exchange rate and interest rate and those of exchange rate and interest rate differential.

Further time series analyses based on the Augmented Dickey Fuller (ADF) unit root tests (with and without structural breaks) as employed in Table 2 indicate evidence of mixed order of integration and therefore lend support to our choice of ARDL estimation technique. The preliminary results also show that the presence of structural breaks is real in the data and should be reflected in the main analysis. We also test for the presence of co-integration using the Bounds test approach (see Table 3). The test was conducted on four variants of the ARDL

models; linear ARDL, linear ARDL with structural breaks, nonlinear ARDL, and nonlinear ARDL with structural breaks. We are able to reject the null of no co-integration with the linear model in Brazil, linear model with structural breaks in the case of Russia, India and South Africa. The exception is China where we find no evidence of co-integration irrespective of the variant of ARDL model considered.

Table 2. Unit Root Test Results**.**

BRAZIL						
VARIABLE	*WOSB*	*I(d)*	*VARIABLE*	*WSB*	*I(d)*	*BREAK DATE*
log(cpi)	-7.112638 [0][a,#]	I(1)	log(cpi)	-8.836730 [0][a,^]	I(1)	2002M11
log(er)	-9.914049 [1][a,^]	I(1)	log(er)	-10.95940 [0][a,#]	I(1)	2002M10
log(ipi)	-4.522002[15][a,#]	I(1)	log(ipi)	-18.69667[0][a,^]	I(1)	2000M12
log(ms)	-4.216928[4][a,#]	I(1)	log(ms)	-8.273656[0][a,#]	I(1)	2000M6
log(intr)	-17.65643[0][a,^]	I(1)	log(intr)	-19,36568[0][a,^]	I(1)	2018M06
RUSSIA						
VARIABLE	*WOSB*	*I(d)*	*VARIABLE*	*WSB*	*I(d)*	*BREAK DATE*
log(cpi)	-3.900243 [12][a,#]	I(1)	log(cpi)	-7.974782 [0][a,#]	I(1)	2001M06
log(er)	-11.35222 [0][a,#]	I(1)	log(er)	-12,81438 [0][a,#]	I(1)	2015M01
log(ipi)	-3.821090 [11][a,#]	I(1)	log(ipi)	-19.75439 [0][a,^]	I(1)	2000M05
log(ms)	-4.949349 [4][a,#]	I(1)	log(ms)	-7.782428 [0][a,#]	I(1)	2000M01
log(intr)	-8.783821 [3][a,^]	I(1)	log(intr)	-18.24219 [0][a,^]	I(1)	2004M01
INDIA						
VARIABLE	*WOSB*	*I(d)*	*VARIABLE*	*WSB*	*I(d)*	*BREAK DATE*
log(cpi)	-12.619[10][a]	I(2)	log(cpi)	-11.731[0]a,^	I(1)	2000M12
log(er)	-10.512[0][a,^]	I(1)	log(er)	-11.072[0]a,^	I(1)	2008M10
og(ipi)	-3.466[12][b,#]	I(1)	log(ipi)	-29.323[0]a,^	I(1)	2000M12
log(ms)	-3.340[6][c,#]	I(1)	log(ms)	-29.323[0],#	I(1)	2000m08
log(intr)	-14.532[0][a]	I(1)	log(intr)	-14.897[0]a,#	I(1)	2010M10
CHINA						
VARIABLE	*WOSB*	*I(d)*	*VARIABLE*	*WSB*	*I(d)*	*BREAK DATE*
log(cpi)	-4.862[5][a,^]	I(1)	log(cpi)	-8.393[0][a,#]	I(1)	2003 Q3
log(er)	-5.405 [0][a,#]	I(1)	log(er)	-6.869 [0][a,#]	I(1)	2018 Q1
log(ipi)	-6.081[3][a,#]	I(1)	log(ipi)	-10.548[0][a,^]	I(1)	2009 Q4
log(ms)	-4.982[0][a,#]	I(1)	log(ms)	-5.761[0][a,#]	I(1)	2009 Q1
log(intr)	-3.884[1][a,#]	I(0)	log(intr)	-8.074[0][a,^]	I(1)	2009 Q1
SOUTH AFRICA						
VARIABLE	*WOSB*	*I(d)*	*VARIABLE*	*WSB*	*I(d)*	*BREAK DATE*
log(cpi)	-9.768 [0]a,^	I(1)	log(cpi)	-10.467 [0]a,#	I(1)	2002M10
log(er)	-10.986 [0]a,^	I(1)	log(er)	-12.294 [0]a,#	I(1)	2001M12
log(ipi)	-4.558[2]a,#	I(1)	log(ipi)	-13.004[0]a,^	I(1)	2001M05
log(ms)	-4.285[6]a,#	I(1)	log(ms)	-7.640[0]a,^	I(1)	2000M05
log(intr)	-8.918[0]a,#	I(0)	log(intr)	-9.642[0]a,^	I(1)	2003M10
Reference Country (US)						
log(us_cpi)	-9.851845[1][a,#]	I(1)	log(us_cpi)	-10.99778[1][a,^]	I(1)	2008M11
log(us_ipi)	-4.522002[15][a,#]	I(1)	log(us_ipi)	-24.30762[0][a,^]	I(1)	2000M06
log(us_ms)	-12.14529[0][a,#]	I(1)	log(us_ms)	-13.32207[0][a,#]	I(1)	2000M06

Note: a, b and c denote 1%, 5% and 10% level of statistical significance; WOSB = without structural breaks; WSB = with structural breaks; ^ represents test with intercept; # represents test with trend and intercept.

Table 3. Summary of Cointegration test results.

Country	F-test Statistics	ARDL(p,q,q,q,q)	Remark
Brazil	5.38	(2,0,0,0,3)	Cointegration @5%
Russia	7.00	(2,0,1,0,4)	Cointegration @1%
India	5.80	(2,1,0,0,0)	Cointegration @5%
China	2.08	(2,0,0,0,0,0)	No Cointegration @10%
South Africa	3.80	(2,0,0,0,0)	Cointegration @10%

Note. The null hypothesis of no Cointegration are evaluated for 1%, 5% and 10% significance levels as indicated in the remarks.

4. Discussion of results

In Table 4, we present the comprehensive results of the four variants of the ARDL models yielding the short and long-run estimates for the interest rate differential-exchange rate relationship for each of the BRICS countries. Starting with the linear ARDL model (with and without structural breaks) which assumes symmetric response of exchange rate to interest rate differential, we find that changes in exchange rate can be explained by the differential in interest rate in the short-run in India and South Africa and in the long run in Brazil. As expected of a country with a fixed exchange rate regime, we find no evidence of significant relationship between the China-US exchange rate and interest rate differential in both the short and long-run. The coefficients return with negative signs (supporting the sticky-price model) in most of the cases except in Russia.

Motivated by the argument that exchange rate could respond asymmetrically to interest rate differential, we further account for non-linearity in the ARDL framework. We address this in the two variants of linear ARDL models; the one without and the one with structural breaks. Results confirm our surmise that exchange rate movement indeed respond asymmetrically to interest rate differential in most of the economies (four out of the five BRICS countries). In Brazil, with and without structural breaks in the nonlinear model estimated, asymmetry matters in both short and the long run; in China, asymmetry is evident in both time horizons without accounting for structural breaks. However, accounting for asymmetry only matters in the short run response of exchange rate to interest differential in India and South Africa. In Russia however, bearing statistical insignificance, there is also dissimilar impacts of negative and positive changes of interest rate differential on exchange rate whether we consider specification with or without structural breaks.

As a step forward, we construct the graphs of dynamic multipliers from the asymmetric models with a view to tease out the contributions of each of the regressors to the variations in the regressand (exchange rate) and also show the asymmetry more clearly (Huettner and Sunder, 2011 provided the necessary guide). Since we are more concerned with the asymmetric effects of interest rate differential on exchange rate movements, we limit our discussion to the graphs in the first quadrants in Figure 2. These show the asymmetric response of exchange rate to interest rate differential in four countries (Brazil, Russia, China and South Africa). Importantly, the asymmetry shown in China may be better captured with a threshold model. This may explain the result of no Cointegration reported for China for all the ARDL variants considered.

In all, we establish that interest rate differential is a major determinant of exchange rate movements in the BRICS countries. Beyond that, we show that the nexus is not monotonic but reflect asymmetry and the effect of structural breaks in the data.

Table 4. ARDL and NARDL regression results.

BRAZIL	ARDL_WOSB (2,0,0,0,3)	ARDL_WSB (2,0,0,1,0)	NARDL_WOSB (2,0,0,0,0)	NARDL_WSB (2,0,0,0,0)
		Long-Run		
INTR	0.1245[b](0.0626)	-0.0066(0.1084)	-	-
INTR+	-	-	0.1129[b](0.0562)	0.0233[a](0.0785)
INTR-	-	-	-0.1244(0.0925)	-0.0982[c] (0.0562)
Control Variables	YES	YES	YES	YES
		Short-Run		
ΔINTR	-0.0227 (0.0154)	-0.0002(0.0031)	-	-
ΔINTR+	-	-	0.0063[c](0.0043)	0.0191[a](0.0057)
ΔINTR-	-	-	-0.0070[c](0.0037)	-0.0080[b](0.0037)
Control Variables	YES	YES	YES	YES
ECT	-0.0537[a] (0.0103)	-0.0283[a](0.0141)	-0.0559[a](0.0168)	-0.0817[a](0.0186)
		Residual Diagnostics		
Q-Stat (10)	12.051	13.183	10.642	9.977
Q^2-Stat (10)	17.761[b]	36.300[a]	30.070[a]	29.406[a]
		ARCH LM		
ARCH LM (5)	0.3764	0.3976	0.7042	0.3912
ARCH LM (10)	1.3594	1.5323	1.1381	1.3251
		Model Diagnostics		
Adj R^2	0.98	0.98	0.98	0.98
F-Statistic	1292.83[a]	1482.24[a]	1717.67[a]	1551.08[a]
SIC	-3.7108	-3.6587	-3.6918	-3.7033
AIC	-3.9778	-3.7950	-3.8129	-3.8396
RUSSIA	ARDL_WOSB (2,0,1,0,4)	ARDL_WSB (2,0,1,0,4)	NARDL_WOSB (2,0,0,1,4,4)	NARDL_WSB (2,0,0,1,0,4)
		Long-Run		
INTR	0.0084(0.0337)	-0.0072(0.0172)	-	-
INTR+	-	-	-0.0232(0.0032)	0.0511 (0.0574)
INTR-	-	-	-0.0279(0.0327)	-0.0033 (0.0220)
Control Variable	YES	YES	YES	YES
		Short-Run		
ΔINTR	0.0006(0.0022)	-0.0012(0.0027)	-	-
ΔINTR+	-	-	-0.0023(0.0031)	0.0078(0.0081)
ΔINTR-	-	-	-0.00270(0.0032)	-0.0005 (0.0034)
Control Variable	YES	YES	YES	YES
ECT	- 0.0652[a](0.0188)	-0.1612[a](0.0270)	-0.0978[a](0.0207)	-0.1531[a](0.0253)
		Residual Diagnostics		
Q-Stat (10)	14.051	16.501[c]	16.007[c]	15.376
Q^2-Stat (10)	77.817[a]	55.230[a]	56.506[a]	50.316[a]
ARCH LM (5)	2.6617[b]	1.8311	1.1974	1.4011
ARCH LM (10)	2.2159	2.0143[b]	1.9861[b]	1.8498[c]
		Model Diagnostics		
Adj R^2	0.99	0.99	0.99	0.99
F-Statistics	1591.68[a]	1751.91[a]	1485.09[a]	1633.25[a]
SIC	-3.9369	-3.8377	-3.7674	-3.8171
AIC	-4.0352	-4.0661	-4.0264	-4.0608
INDIA	ARDL_WOSB (2,1,0,0,0)	ARDL_WSB (2, 1, 0, 0, 0)	NARDL_WOSB (2, 1, 0, 0, 0)	NARDL_WSB (2, 1, 0, 0, 0)
		Long-Run		
INTR	-8.29E-05(0.0143)	-0.0289[c](0.0165)		
INTR+			0.0059(0.0380)	-0.0229 (0.0376)
INTR-			-0.0100(0.0233)	-0.0261(0.0220)
Control Variable	YES	YES	YES	YES
		Short-Run		
ΔINTR	-0.0206[b](0.0084)	-0.0024[c](0.0013)		
ΔINTR(-1)	0.0205[b] (0.0085)			
ΔINTR+			0.0005(0.0033)	-0.0022(0.0035)
ΔINTR-			-0.03634[b](0.0143)	
Control Variable	YES	YES	YES	YES
ECT	-0.0779[a](0.0174)	-0.0826[a](0.0152)	-0.0865[a](0.0177)	-0.0939[a](0.0171)
		Residual Diagnostics		
Q-Stat (10)	15.058	11.821	14.010	11.606

Q^2-Stat (10)	50.034[a]	46.976	50.829[a]	50.993
ARCH LM (5)	6.1635[a]	6.1254[a]	6.4662[a]	6.7972[a]
ARCH LM (10)	3.6114[a]	4.2303[a]	3.7053[a]	4.3059[a]
		Model Diagnostics		
R-squared	0.992212	0.992536	0.992232	0.247759
Adjusted R-squared	0.991962	0.992225	0.991945	0.230663
AIC	-5.528421	-5.553187	-5.522043	-5.577399
SIC	-5.407340	-5.401836	-5.385827	-5.486589

CHINA	**ARDL_WOSB** **(2,0,0,0,0)**	**ARDL_WSB** **(2, 0, 0, 0, 0)**	**NARDL_WOSB**	**NARDL_WSB**
		Long-Run		
INTR	-0.0275 (0.026)	-0.0345 (0.019)		
INTR+		-	0.0471(0.0380)	0.0331(0.0308)
INTR-	-	-	-0.0915[a](0.0329)	-0.0497(0.0369)
Control Variable	YES	YES	YES	YES
		Short-Run		
ΔINTR	-0.0019 (0.002)	-0.003(0.002)		
ΔINTR+			0.0058(0.0037)	0.00478(0.0038)
ΔINTR-			-0.0112[b](0.0042)	-0.0072 (0.0053)
Control Variable	YES	YES	YES	YES
ECT	-0.068[b] (0.028)	-0.096[b] (0.042)	-0.1225a(0.0335)	-0.1447[b](0.0437)
		Residual Diagnostics		
Q-Stat (10)	9.491	9.022	10.325	11.101
Q^2-Stat (10)	12.471	13.715	21.404[b]	19.365[b]
ARCH LM (5)	17.505[a]	28.041[a]	35.0882[a]	31.312[a]
ARCH LM (10)	7.962[a]	12.529[a]	16.4860[a]	14.015[a]
		Model Diagnostics		
R-squared	0.988482	0.989084	0.989527	0.989758
Adjusted r-squared	0.987451	0.987926	0.988416	0.988497
AIC	-5.771689	-5.798325	-5.839696	-5.834983
SIC	-5.553737	-5.549237	-5.590608	-5.554758

SOUTH AFRICA	**ARDL_WOSB** **(2,0,0,0,1)**	**ARDL_WSB** **(2,0,0,0,1)**	**NARDL_WOSB** **(2,0,0,0,0,0)**	**NARDL_WSB** **(2,0,0,0,0,0,)**
		Long-Run		
INTR	-0.7031 (2.2860)			
INTR+	-		0.31504 (0.3157)	0.05852 (0.1265)
INTR--	-		-0.4975 (0.4214)	-0.1288 (0.0990)
Control Variable	YES	YES	YES	YES
		Short-Run		
ΔINTR	-0.0053[C] (0.0028)			
ΔINTR+			0.0092 (0.0063)	0.0049 (0.0107)
ΔINTR-			-0.0146[b] (0.0057)	-0.0109 (0.0072)
Control Variable	YES	YES	YES	YES
ECT	-0.0075[a](0.0025)		-0.029262[a] (0.0087)	-0.0842[a](0.0187)
		Serial Correlation		
Q-Stat (10)	11.455		10.634	10.568
Q^2-Stat (10)	7.3472		8.0781	5.9679
ARCH LM (5)	0.0421		0.0770	0.0807
ARCH LM (10)	0.6508			0.5158
		Model Diagnostics		
R-Squared	0.9829		0.9827	0.9834
Adjusted R-squared	0.9823		0.9821	0.9827
AIC	-3.7706		-3.761250	-3.7794
SIC	-3.649553		-3.6402	-3.6129

Note: ARDL = Autoregressive Distributed Lag Model; NARDL = Nonlinear ARDL; WOSB = Without Structural Break; WSB = With Structural Break; ECT = Error Correction Term; ARCH LM = Autoregressive Conditional Heteroscedasticity Lagrangian Multiplier test; AIC = Akaike Information Criterion; SIC = Schwartz Information Criterion; Q-Stat = Ljung-Box Residual Statistic; Q^2-Stat = Ljung-Box Squared Residual Statistic.
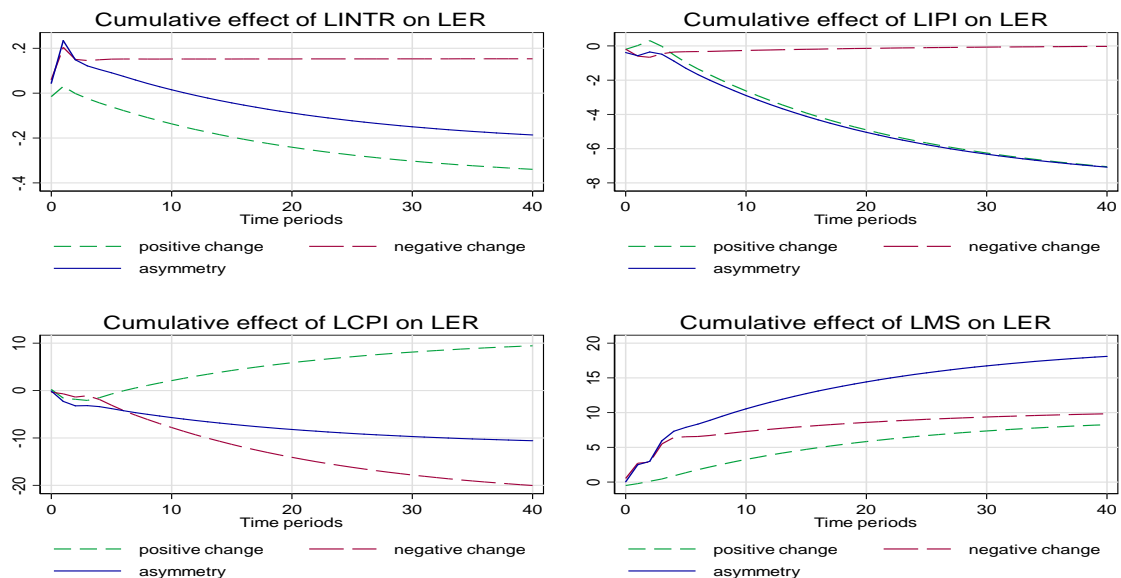
Figure 2: The graphs of dynamic multipliers
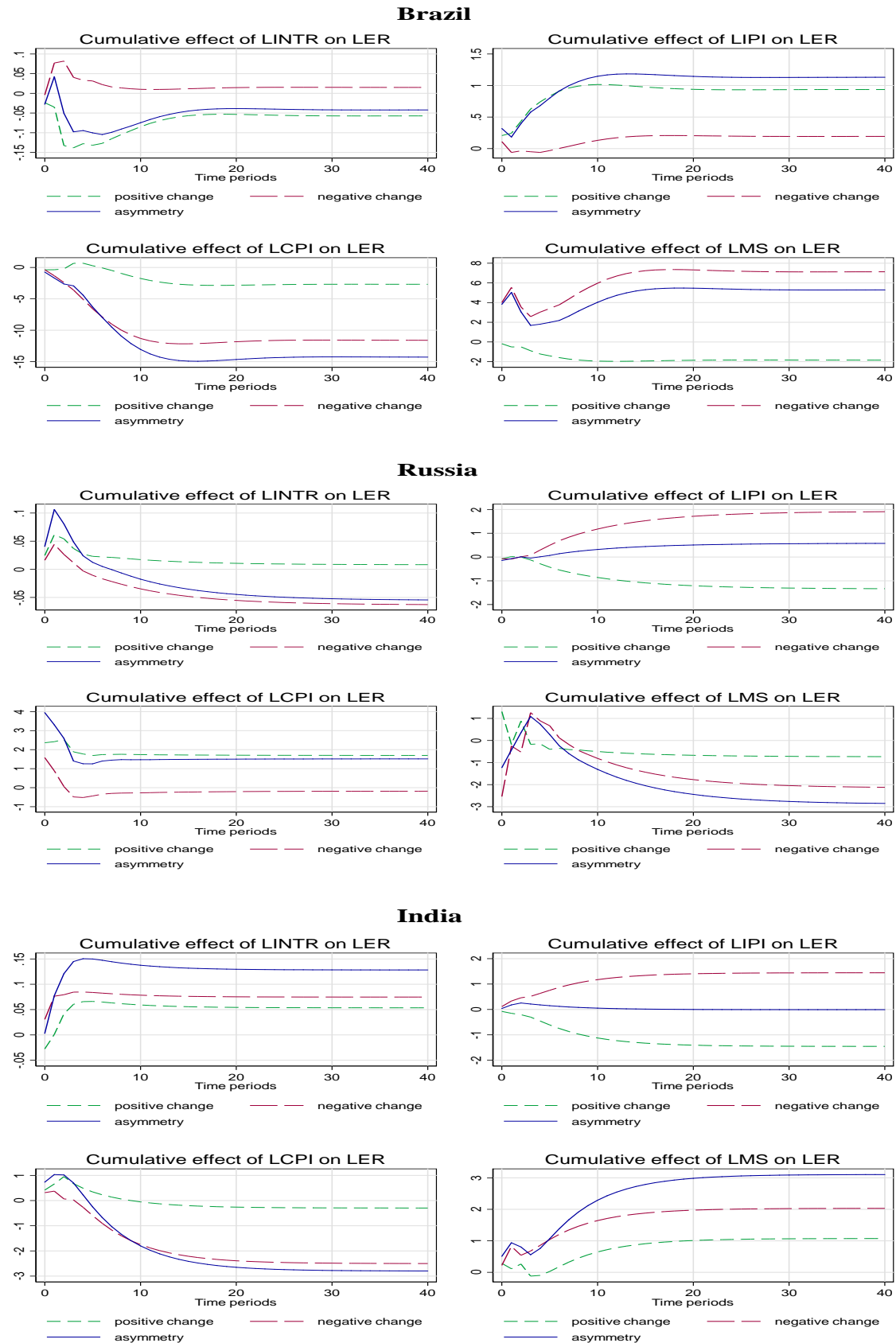
China
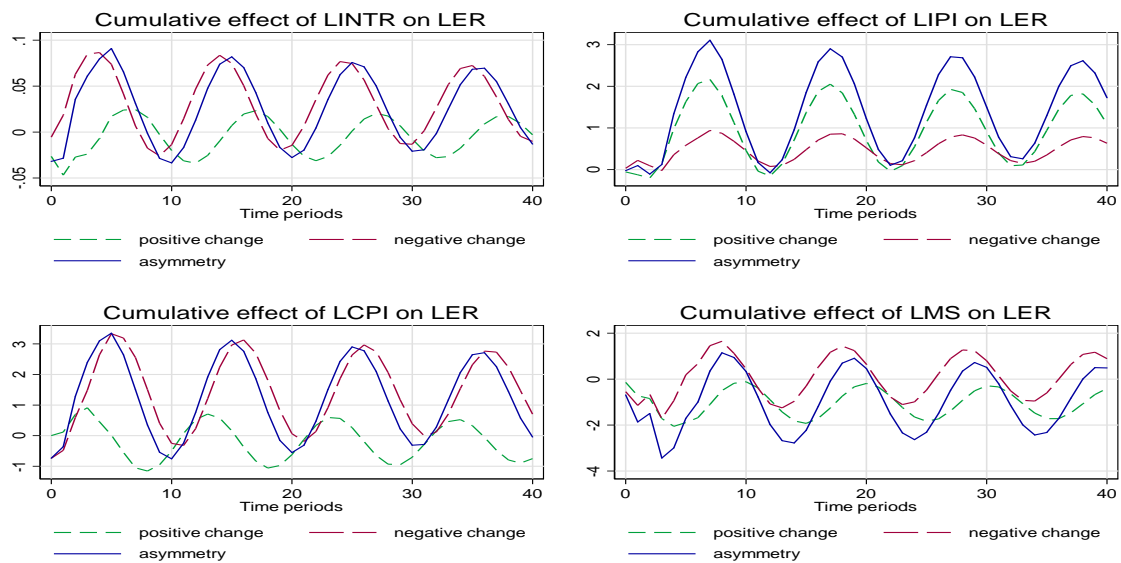
South Africa

5. Conclusion

The study examines the interest rate differential and exchange rate nexus in the BRICS countries, studying the asymmetric relationship and accounting for structural breaks evident in the data. Consequently, we adopt four ARDL variants namely; the linear ARDL model (with and without structural break); and the nonlinear ARDL with and without structural breaks. In the end, the study shows that asymmetry and structural break matter in the largely negative relationships. These are clear in four out of five countries studied. Further results obtained from the graphs of dynamic multipliers clearly show that the nexus between interest rate differential and exchange rate is nonlinear but that of China is of threshold-type, rather than asymmetry-type (i.e. positive and negative asymmetries).

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