

BRICS Export Performance: An ARDL Bounds Testing Empirical Investigation

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Summary

- **Aim:** To investigate the export performance of the BRICS countries: Brazil, Russia, India, China and South Africa.
- **Methodology:** ARDL Models - Bounds Testing Approach
- **Period:** January 2000 - December 2014
- **Variables:** exports, real effective exchange rate (level and volatility), world imports (proxy for foreign demand) and commodity prices

Results: Long Run

Export performance asymmetries:

- **Brazil:** foreign demand and commodity prices
- **Russia:** real exchange rate, foreign demand and commodity prices
- **India:** real exchange rate and commodity prices
- **China:** real exchange rate and foreign demand
- **South Africa:** foreign demand

Results: Short Run

Error Correction Model (ECM):

- **Brazil and China:** higher speed of adjustment
- **India:** intermediate speed of adjustment
- **Russia and South Africa:** lower speed of adjustment

BRICS: Empirical Studies

- Hooper and Kohlhagen (1978)
- Assery and Peel (1991)
- De Grauwe (1988)
- McKenzie (1999)
- Bahmani-Oskooee and Hegerty (2007)
- Arize et al. (2000)
- Huchet-Bourdon and Korinek (2011)
- Vieira and MacDonald (2016)
- Ekanayake et al. (2012)
- Srinivasan and Kalayvani (2013)
- Todani and Munyama (2005)
- De Grauwe (1988)
- Chit (2008)
- Bahmani-Oskooee and Hegerty (2007)
- Ying et al. (2015)
- Kocourek (2015)
- Bojnec et al. (2014)

BRICS: Empirical Studies - Brazil

- Aguirre et al. (2007):
 - Brazil ARDL model
- Cavalcanti and Ribeiro (1998)
- Neves et al. (2007)
- Markwald and Puga (2002)
- Vieira et al. (2014):
 - Panel Data for Brazilian States

Data and Econometric Approach

- **Period:** January 2000 to December 2014
- **Equations:**

$$LEXP_t = \beta_0 + \beta_1 VOLAT_t + \beta_2 LREER_t + \beta_3 LWIMP_t + \beta_4 LPCOM_t + \varepsilon_t$$

$$\begin{aligned} \Delta(LEXP)_t = & \mu + \alpha_1 t + \beta_1 (LEXP)_{t-1} + \beta_2 (LREER)_{t-1} + \beta_3 (VOLAT)_{t-1} + \beta_4 (LWIMP)_{t-1} + \\ & + \beta_5 (LPCOM)_{t-1} + \sum_{i=1}^p \beta_6 \Delta(LEXP)_{t-1} + \sum_{i=1}^q \beta_7 \Delta(LREER)_{t-1} + \\ & + \sum_{i=1}^r \beta_8 \Delta(VOLAT)_{t-1} + \sum_{i=1}^s \beta_9 \Delta(LWIMP)_{t-1} + \sum_{i=1}^v \beta_{10} \Delta(LPCOM)_{t-1} + u_t \end{aligned}$$

- **LEXP:** Log of Exports (US\$ Million) - (Source: DOTS).
- **LREER:** Log of Real Effective Exchange Rate (2005 = 100) - (Source: BIS).
- **VOLAT:** Real Effective Exchange Rate Volatility - (Source: BIS).
- **LWIMP:** Log of World Imports (US\$ Million) - (Source: DOTS).
- **LPCOM:** Log of Commodity Price Index – Emerging Economies (2010 = 100) (Source: The World Bank).

Unit Root Tests

		ADF	PP	KPSS	DF-GLS
Log of Commodity Price	Emerging	1.22	1.16	0.30**	-1.15
Log of World Imports	World	-2.35	-2.73	0.23**	-2.40
Log of REER	Brazil	-2.50	0.29	0.17*	-2.09
	China	1.11	1.40	0.35**	-1.22
	India	-2.39	-2.63	0.15*	-1.86
	Russia	-2.16	-2.69	0.35**	0.10
	S. Africa	-2.35	-2.26	0.10	-2.33
Log of Exports	Brazil	-3.30	-4.54**	0.27**	-2.76
	China	-1.59	-4.54**	0.35**	-1.35
	India	-1.76	-3.56**	0.22**	-2.00
	Russia	-2.23	-2.21	0.25**	-2.28
	S. Africa	-5.20**	-5.09**	0.23**	-2.68
REER Volatility	Brazil	-4.95**	-4.89**	0.053	-5.11**
	China	-3.76**	-3.80**	0.14	-3.09*
	India	-1.78	-1.86	0.34**	-1.57
	Russia	-4.40**	-4.34**	0.08	-4.30**
	S. Africa	-4.55**	-4.54**	0.07	-4.09

H0 rejection: *(5%); **(1%)

ARDL Models - Lags

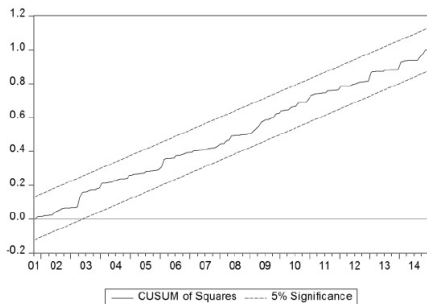
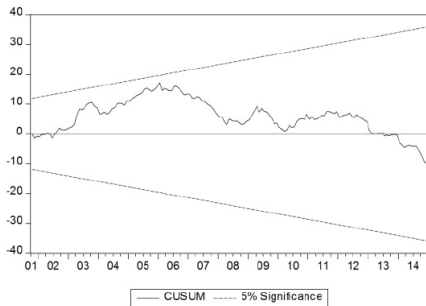
Country	ARDL Model (with const. and trend)	Autocorr. LM Test (Prob)
Brazil	(6, 0, 0, 1, 2)	0.737 (0.390)
Russia	(2, 0, 1, 6, 2)	2.355 (0.124)
India	(2, 5, 6, 3, 0)	0.774 (0.378)
China	(6, 1, 0, 6, 2)	0.203 (0.652)
South Africa	(3, 1, 0, 2, 2)*	2.094 (0.147)

Note: *(no constant, no trend)

Dependent Variable: Exports of each country

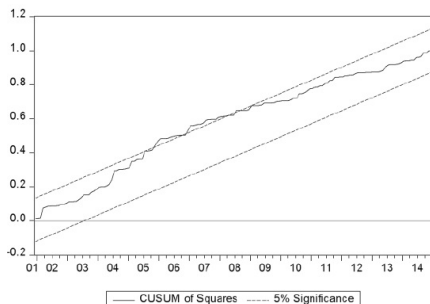
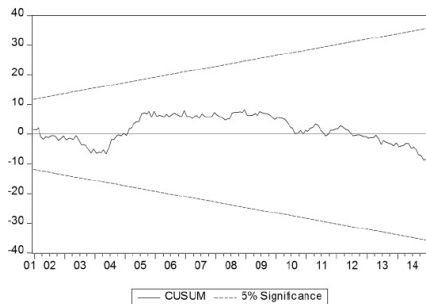
Stability Tests

Figure 1A: Brazil – CUSUM and CUSUMQ



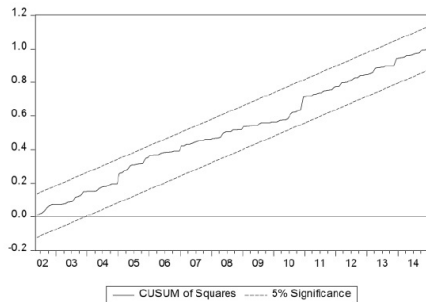
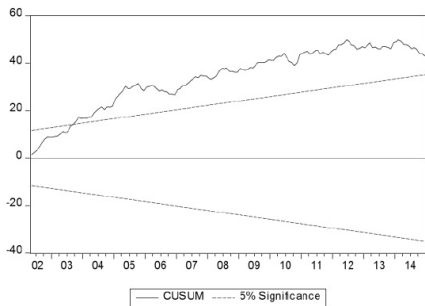
Stability Tests

Figure 1B: Russia – CUSUM and CUSUMQ



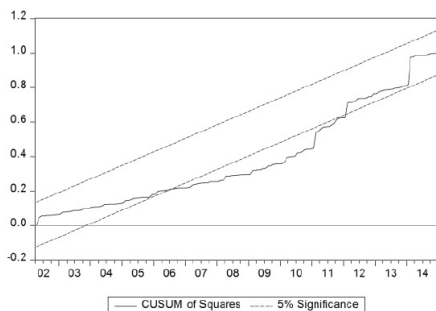
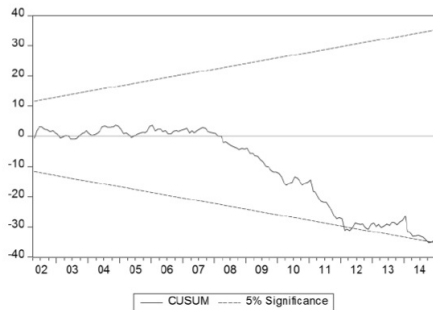
Stability Tests

Figure 1C: India – CUSUM and CUSUMQ



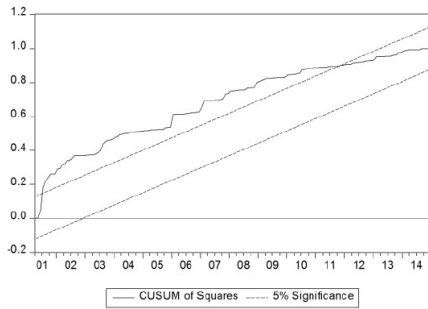
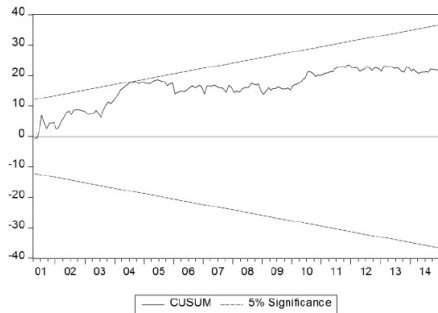
Stability Tests

Figure 1D: China – CUSUM and CUSUMQ



Stability Tests

Figure 1E South Africa – CUSUM and CUSUMQ



Cointegration Tests

Cointegration Test (ARDL Bounds Testing Approach)

Country	F-Statistics	Critical Values				Long Run Cointegration
		I(0) Bound		I(1) Bound		
		10%	5%	10%	5%	
Brazil	12.783	2.68	3.05	3.53	3.97	Yes
Russia	4.336	2.68	3.05	3.53	3.97	Yes
India	10.193	2.68	3.05	3.53	3.97	Yes
China	8.512	2.68	3.05	3.53	3.97	Yes
South Africa	3.396	1.90	2.26	3.01	3.48	Yes at 10%; Inconclusive at 5%

Notes: H_0 (no long-run relationship)

Long Run: Asymmetries in Export Performance

ARDL Models: Long Run Coefficients					
(Dependent Variable: Log of Exports)					
Country, (Lags)	Brazil (6, 0, 0, 1, 2)	Russia (2, 0, 1, 6, 2)	India (2, 5, 6, 3, 0)	China (6, 1, 0, 6, 2)	S. Africa (3, 1, 0, 2, 2)
Variables	Coeffic. (Prob.)	Coeffic. (Prob.)	Coeffic. (Prob.)	Coeffic. (Prob.)	Coeffic. (Prob.)
REER	0.059 (0.521)	1.228* (0.006)	0.508** (0.093)	-1.168* (0.000)	0.224 (0.256)
REER Volatility	7.761 (0.631)	195.530* (0.018)	-683.751* (0.048)	491.079 (0.190)	-27.844 (0.519)
World Imports	0.649* (0.000)	2.158* (0.000)	0.175 (0.236)	0.881* (0.000)	1.089* (0.000)
Commodity Price	0.370* (0.000)	-0.569* (0.030)	0.665* (0.000)	0.034 (0.698)	-0.011 (0.959)
Trend	0.002 (0.009)	-0.004* (0.008)	0.007* (0.000)	0.009* (0.000)	-

Results: Long Run

Export performance asymmetries:

- **Brazil:** foreign demand and commodity prices
- **Russia:** real exchange rate, foreign demand and commodity prices
- **India:** real exchange rate and commodity prices
- **China:** real exchange rate and foreign demand
- **South Africa:** foreign demand

Results: Error Correction - Short Run Dynamics

Error Correction Model		
Country (Lags)	ECM(-1)	Prob.
Brazil (6, 0, 0, 1, 2)	-0.818	0.000
Russia (2, 0, 1, 6, 2)	-0.295	0.000
India (2, 5, 6, 3, 0)	-0.582	0.000
China (6, 1, 0, 6, 2)	-0.871	0.000
South Africa (3, 1, 0, 2, 2)	-0.236	0.000
Average	-0.560	

- On average, 56% of the shock is corrected after the first month.
- **Brazil and China:** higher speed of adjustment
- **India:** intermediate speed of adjustment
- **Russia and South Africa:** lower speed of adjustment

Conclusion

Cointegration among the variables used in our empirical analysis.

Asymmetries in long run export performance:

- Real effective exchange rate (level and volatility) and foreign demand (China and Russia).
- Foreign demand and commodity prices (Brazil).
- Real effective exchange rate and commodity prices (India).
- Foreign demand (South Africa).

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