Testing the Expectations Hypothesis of the Term Structure of Interest Rates in BRICS Countries: A Multivariate Co-integration Approach

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Abstract: The BRICS is a group of major emerging economies in the world which have combined financial resources to form the New Development Bank in an effort to address economic challenges faced by these countries. Thus, the flow of funds among the BRICS countries are expected to increase and this has implication on interest rates changes in these countries. Employing monthly short and long term interest rates from June 2005 to June 2015, this study used a multivariate cointegration approach to test for the validity of the expectations hypothesis (EH) of the term structure of interest rates in BRICS countries. The results of the co-integration analysis revealed that the EH only holds in three of the five countries, namely China, India, and South Africa. Short and long term interest rates for these three countries converge to the long-run equilibrium at different speed, where the convergence was found to be quick in South Africa and slow in China. This study found no evidence of EH in Brazil and Russia. Findings of this study are relevant to current developments within BRICS financial markets and provide valuable information that can be used to forecast future changes in interest rates in BRICS countries.

Key words: Expectations hypothesis; term structure; interest rate; co-integration; BRICS

JEL Classification: E430; E470

1. Introduction

Monetary policy authorities and economists are constantly faced with the task of forecasting interest rate movements and in many cases, interest changes are induced by implantations of monetary policy. Changes in interest rates have implications for various market participants and understanding their dynamics becomes essential not only for economists and monetary policy, but also for risk management practices and for financial security valuations (Modena, 2008). Based on the market expectations regarding interest rates, participants are able to mitigate

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associated risks and maximise profits. Often when there is a downturn in an economy, interest rates are expected to fall and in such times investors are more likely to shift towards longer term maturity investments as they expect interest rates to fall (Rose & Hudgins, 2013). During times of economic prosperity, interest rates are expected to rise; investors thus expect a bullish market and are likely to shift to shorter term maturity investments as they may experience losses in longer term investments when interest rates are expected to rise (Rose & Hudgins, 2013). This can be explained by the expectations hypothesis (EH) which implies that investors are able to predict future changes in interest rates by simply observing the interest rate spread (Modena, 2008), that is, the difference between the short term and the long term interest rates (Guidolin & Tam, 2013). In addition to monetary policy conditions, a change in the outlook of interest rates in relation to current rates is thus reflected by changes in the expectations of market participants regarding future changes in interest rates (Shiller et al., 1983).

A common assumption made in macroeconomics regarding the EH is that the expectations of future short term interest rates shape the term structure of long interest rates (Beechey et al., 2008). This assumption proposes that long term rates reflect the expectations of future short term interest rates. A basic principle of the EH states that, under normal economic conditions, the long term rate is higher than the short term rate (Campbell & Shiller, 1991). The long term rate is therefore determined by the sum of current and future expected short term rates plus the risk premium (Campbell & Shiller, 1991). This then implies that the two rates will yield the same returns for the following year, even though the long term rate has a higher yield relative to the short term rate (Campbell & Shiller, 1991). The EH suggests that any two ways of transferring money across time, on average, ought to yield the same expected return provided that there are neutral traders in the market. This means that any difference between the two interest rates, in the long-run, may create arbitrage opportunities.

In the context of this paper, the EH is investigated within BRICS. BRICS is a group that consists of countries that are considered to be major emerging market economies. These are the economies of Brazil, Russia, India, China and South Africa that seek to enlarge influence among developed countries through combining financial resources (Shanming, 2013). The BRICS have set up a development bank which is now known as the New Development Bank (NDB) where the different countries intend to address the group's economic challenges with combined resources. Countries in the BRICS group have either undergone or are undergoing structural changes in their monetary policy frameworks (Shanming, 2013). The way in which interest rates in the different countries correlate is, to a certain extent, affected by structural changes. As emphasized by Shelile (2006), it becomes of great significance to consider not only the economic setting of the different countries, but to also consider the monetary policy regimes adopted by

each of these countries. This is important due to the possibility of the results being influenced by structural changes in these countries and also by the prevailing economic conditions.

With the slowdown in global economies due to the 2008/2009 financial crisis in the United States, Shanming (2013) asserts that financial cooperation is essential. Pointing to an observation made by Holmes et al. (2011) that proposes a compelling case for modelling domestic term structure at an international context. In recent times, domestic term structure is influenced mostly by external term structures and monetary policies due to the liberalization of international financial markets (Beechey et al., 2008) and this may be the case in BRICS. Thus, this paper aims to establish whether the expectations hypothesis of the term structure of interest rates holds in BRICS countries.

2. Literature Review

2.1. Conceptualisation of EH

Interest rates have a vital role in the economy, a movement up or down in interest rates has an impact on individual consumption, businesses and investment decisions, making it essential to understand the underlying dynamics of interest rates in an economy (Van der Merwe & Molletze, 2013). For years, economists have tried to determine the underlying variables of the term structure of interest rates; still, no consensus has been reached (Van der Merwe & Molletze, 2013). The EH is one of the theories that attempt to explain the relationship between interest rates of different maturities. According to Cox et al. (1985), the association between interest rates of different maturities has made it possible for market participants to forecast interest rate movements as well as how these movements would affect the term structure of interest rates.

The EH of the term structure of interest rates hypothesizes that the yield spread between the long term rate and the short term rate can be used to predict future changes in short term rates over the life of the longer maturity investment (Shivam & Jayadev, 2003). The EH suggests that long term interest rates are determined by current and expected short term rates; suggesting that the market's forecast of changes in rates is reflected by the slope of the term structure of interest rates, that is, the spread between long rates and short rates (Mankiw et al., 1986). Long term rates are, therefore, the average of the current and expected short term interest rates (Modena, 2008). According to the EH, monetary policy is able to affect the long term interest rates by influencing the short term interest rate and changing market expectations of future short term rates (Walsh, 2003). This suggests that short term interest rates are more volatile compared to the longer term interest rates, and the EH is able to clarify the reason for the variation in volatility (Van der Merwe &

Molletze, 2013). Individual components change faster than the average, and with long term interest rates being the average of current and expected future short term interest rates, then, they should be less volatile compared to short term interest rates (Van der Merwe & Molletze, 2013).

There are a few guidelines on how the term structure can be interpreted when used as a forecasting tool. According to Bonga-Bonga (2010), higher long term rates, in relation to short term rates, reflect the demand of higher risk premium on long term securities and this is an indication of normal economic conditions. Nel (1996) states the upward sloping yield curve is related to growth in the economy which is characterised by low short term rates to stimulate demand. Conversely, a negative or inverted yield curve reflects recession expectations, which are characterised by higher long term interest rates than the short term interest rates (Nel, 1996). These characteristics make the term structure beneficial in that it is able to forecast future economic developments (Van der Merwe & Molletze, 2013). Low short term rates become less appropriate in a debt fuelled demand; implying that, they lead to an increase in inflation and an expectation of an increase in short term rates is reflected by rising short term bond yield (Clay & Keeton, 2013). A positive relationship between the term structure of interest rates and economic activity thus exists. Hence, the behaviour of market participants is influenced by economic expectations, which in turn affect the term structure of interest rates (Modena, 2008). EH explains investor's aggressive maturity strategy of a shift to security investments of longer term maturity when there is an anticipated decline in interest rates in order to capitalise on the income potential of these securities when interest rates fall (Rose & Hudgins, 2013).

2.2. Empirical Literature Review

Over the years, studies on the EH of term structure of interest rates have been conducted using various methodologies to test whether EH would hold or not. Studies on EH have produced mixed results with some (e.g. Engle & Granger, 1987; Ghazali & Low, 2002; Shivam & Jayadev, 2003; Shelile, 2006; Guidolin & Thornton, 2008) providing empirical evidence to support the EH and its predictive ability; while other studies (Mankiw & Summers, 1984; Shiller et al.,1983; Taylor, 1992; Beechey et al., 2008) did not find any evidence to support it. With the use of co-integration methods to test for the validity of the EH, Engle & Granger (1987) highlight that the co-integration between yields of different maturities is a crucial condition for the validity of the expectations hypothesis if nominal interest rates are generated by a unit-root process. A stationary spread between yields is denoted by the expectations hypothesis if interest rates are integrated of order one, meaning that, the EH is valid after finding co-integration between long and short term rates (Engle & Granger, 1987). Guidolin & Thornton (2008) predicted short term rates and the EH of the term structure of interest rates and found empirical evidence supporting the validity of EH. Using five Indian money market benchmark rates,

Shivam & Jayadev (2003) assessed the operational efficiency of the Indian money market and examined its structure by testing the validity of the EH. Their results provide evidence that validates the EH in the Indian money market; implying that money market participants are able to predict changes in rates while choosing between various money market instruments (Shivam & Jayadev, 2003).

In testing the EH of the term structure in South Africa, Shelile (2006) employed the Generalized Method Moments technique between 1970 and 2004 to observe the ability of the term structure of interest rates to predict economic activity, and also effects of different monetary policy regimes on the predictive ability of the term structure. The author's findings were favourable, showing that economic activity was predicted by the term structure until the period of 2000 to 2004 (Shelile, 2006). South Africa went through different economic environments during the observed period; Shelile (2006) also finds that the term structure's ability to forecast economic activity improved after the liberalization of financial markets in the country. The predictive ability of the term structure of interest rates in future economic activities was also found by Ghazali & Low (2002) with the use of Malaysian rates.

A study by Beechey et al. (2008) made use of cointegration methods to test the EH of the term structure of interest rates in fourteen developed and developing countries. Ten of the 14 countries showed a co-integrating relationship between long and short interest rates, supporting the EH. However, Beechey et al. (2008) did not find evidence of the EH in emerging economies, which were India and South Africa in this case. According to Beechey et al. (2008), the likely reason for the absence of the EH in both countries is structural change. Post the apartheid era, interest rates in South Africa were accompanied by strong inflows of foreign capital and the shift to inflation targeting in 2000 and all of these changes are related to the decline in long term interest rates. The decline in long term interest rate over the life of the shorter term bond runs counter to the EH which insists that shorter term interest rates tend to rise over the life of the longer term interest rates (Campbell & Shiller, 1991). Thus, the ability of the term structure to anticipate future movements in short term rates depends on the level and the volatility of the term premia and this was confirmed by Fama (1984), Mishkin (1988) and Modena (2008) who provided evidence that the yield spread consists of valuable information that can be used to forecast future changes in interest rates.

Contrary to studies that conclude in favour of the EH, other studies (Mankiw & Summers, 1984; Shiller et al., 1983; Taylor, 1992) find inconsistencies in the EH of term structure and conclude that it can predict false information. Shiller et al. (1983) claim that the EH only becomes successful in forecasting interest rates; if there is a break in the historical interest rate pattern, without it, the EH does not hold. Shiller et al. (1983) compare the EH with an alternative model referred to as the "tail-wags-dog" theory where long term interest rates are said to react

excessively to information that is only applicable to short term interest rates. Their model, the "tail-wags-dog", does support their theory; suggesting that there may be a psychological theory superior to the expectations theory (Shiller et al., 1983).

3. Methodology

3.1. Data and Sample Period

The data used in this study consists of short and long term interest rates from BRICS countries, namely Brazil, Russia, India, China and South Africa. The sample period consists of a panel of 605 (121 for each country) monthly observations from June 2005 to June 2015. Data was obtained from the Central Banks of the different countries, the Organization for Economic Co-operation and Development (OECD), World Bank and Bloomberg. The selection of the sample period was based mainly on the availability of data. For all five countries, the Treasury bill rate is used as the short term rate; while the 10 year government bond rate represents the long term rate.

3.2. Modelling the EH Term Structure

The link between short and long term interest rates under the EH of the term structure is expressed by Campbell and Shiller (1991) as follows:

$$R_t^{(n)} = \frac{1}{q} \sum_{i=0}^{q-1} E_t \, R_{t+mi}^{(m)} + c \qquad (1)$$

Equation 1 illustrates that the relationship between the *n*-period of the long term interest rate, $R_t^{(n)}$, and an *m*-period of short term interest rate. $R_t^{(m)}$, is defined by the single linear relationship of EH of term structure where $n > m$. The EH states that the expected return from investing in an *n*-period rate will be equal to the expected return from investing in *m*-period rates up to $n - m$ periods in the future plus a constant risk premium, *c*, where $q = n/m$. Therefore, the longer-term interest rate, $R_t^{(n)}$, can be expressed as a weighted-average of current and expected short term rates, $R_t^{(m)}$, plus a risk premium, *c* (Brooks, 2014). Thus, by subtracting $R_t^{(m)}$ from both sides of Equation 1, we get:

$$R_t^{(n)} - R_t^{(m)} = \frac{1}{q} \sum_{i=0}^{q-1} \sum_{j=1}^{j=i} E_t \, [\Delta^{(m)} R_{t+jm}^{(m)}] + \mathrm{c} \qquad (2)$$

Considering the broad acceptance that interest rates are well described at as I(1) processes (Campbell & Shiller, 1998), Equation 2 introduces interesting restrictions of stationarity. If the interest rates under analysis are I(1) series, then, by definition, $\Delta R_t^{(n)}$ and $\Delta R_t^{(m)}$ should be stationary, I(0). Moreover, since *c* is constant, then by definition it is a stationary series. Accordingly, if the EH is to hold, given that *c* and $\Delta R_t^{(m)}$ are I(0), the RHS of Equation 2 is stationary, then

$R_t^{(n)} - R_t^{(m)}$ should by definition be stationary, failing that, there will be an inconsistency in the order of integration between the relationship of the RHS and the LHS of Equation 2.

$R_t^{(n)} - R_t^{(m)}$ is generally known as the spread between the *n*-period and the *m*-period rates, represented by $S_t^{(n,m)}$, which gives an indication of the slope of the term structure. For that reason, if EH is to hold, then the spread will be found stationary, thus $R_t^{(n)}$ and $R_t^{(m)}$ will co-integrate with a co-integrating vector of (1, –1) for $[R_t^{(n)}, R_t^{(m)}]$. Consequently, the integrating process driving the individual rates is common to both interest rates and hence it can be said that the rates have a common stochastic trend (Brooks, 2014). As the EH predicts that each interest rate series will co-integrate with the one period interest rate, it then should be true that the stochastic process driving all the rates is the same as that driving the one period rate (Brooks, 2014).

Equation 2 suggest testing the relationship between long term (n) and short term (m) interest rates using a single-equation standard regression would lead to the high chance of spurious regression as standard regression methods are unable to handle non-stationary variables (Brooks, 2014). Thus, the first step of test for the EH is to check if series are stationary. The augmented Dickey Fuller (ADF) unit root test was used to test for stationarity of the data. If variables are found to be not stationary at level, then the first difference is used to make them stationary. If the variables become stationary at the first difference I(1), it means that there is a possibility that such variables are co-integrated. Thus, the next step would be to conduct a co-integration test. In the context of this study the co-integration results would indicate whether the EH hold or not. A multivariate Johansen co-integration approach was used to test for a long run relationship between short- and long term interest rates in each of the countries of BRICS. The use of Johansen co-integration approach was based on other studies such as Diebold and Li (2006), Shelile (2006),and Koukouritakis (2010), which used a multivariate cointegration approach to test for the EH.

3.3. Johansen Co-integration Test

The Johansen's (1988 and 1991) multivariate co-integrating is derived from a VAR model as follows:

Considering unrestricted VAR model: $Z_t = \sum_{i=1}^{k} A_i Z_{t-i} + e_t$

(3)

Where: $Z_t = \begin{bmatrix} X_{1t} \\ X_{2t} \\ . \\ . \\ X_{nt} \end{bmatrix}$ is column vector of observations X_{1t} to X_{nt}; and,

e_t = a column vector of random errors which are usually assumed to be contemporaneously correlated but not auto-correlated. Assuming that all variables are co-integrated in the same order, the VAR model in Equation 3 can be presented as follows:

$$\Delta Z_t = \Pi Z_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + e_t \text{, for k} \geq 2 \qquad (4)$$

Where: $\Pi = -(I - A_1 - A_2 - \ldots A_k)$; and, $\Gamma_i = -(A_{i+1} + A_{i+2} + \ldots + A_k)$, i = 1,…, k-1

According to Johansen and Juselius (1990), the matrix Π can be expressed as a product of two matrices:

$\Pi = \alpha\beta'$ where α and β' are both the same since Π is a square matrix.
(5)

The matrix β' gives the co-integrating vectors (a matrix of long run coefficients), while α stand for the adjustment of parameters that shows the level of speed with which the system responds to last period's deviations from the equilibrium (Brooks, 2014). Therefore, Johansen co-integration is based on the examination of the Π matrix. The test for co-integration is conducted by looking at the rank (r) of the Π matrix with the use of the *trace* and the *maximum eigenvalue* tests.

The trace test tests the hypothesis that there are at most r co-integrating vectors and is as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$$
(6)

λ_{trace} is a joint test where:

H_0: the number of co-integrating vectors ≤ r and

H_a: the number of co-integrating vectors > r.

The maximum eigenvalue test tests the hypothesis that there are r+1 co-integrating vectors against the hypothesis that there are r co-integrating vectors and is a follows:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (7)$$

Where: r is the number of co-integrating vectors under the null hypothesis, $\hat{\lambda}_i$ is the estimated value for i[th] ordered eigenvalue from the Π matrix and T is the number of usable observations. λ_{max} conducts a separate test on each eigenvalue in sequence as follows:

H_0: r = 0 versus H_1: 0 < r ≤ n

H_0: r = 1 versus H_1: 1 < r ≤ n

H_0: r = 2 versus H_1: 2 < r ≤ n

… … ...

H_0: r = n-1 versus H_1: r = n

The first test involves a H_0 of non-co-integrating vectors (corresponding to Π having zero rank). If the H_0 is not rejected, it would indicate that there are no co-integrating vectors and the cointegration test would be completed. Contrary, if the H_0 for r = 0 is rejected; the H_0 for r = 1 will be tested and so on. Hence, the value of r is repeatedly increased until the H_0 is no longer rejected. Since there are only two variables in each country's equation, the results are expected to have at most one co-integrating equation.

3.4. Optimal Lag Selection and Diagnostic Tests

To identify the number of optimum lags, this study used the information criteria namely, the Schwarz's Bayesian information criterion (SBIC), Akaike's information criterion (AIC), and Hannan–Quinn criterion (HQIC) (Brooks, 2014). Various diagnostic tests were conducted test the models used met the econometric assumptions. Tests conducted include autocorrelation, heteroscedasticity, parameter stability and normality tests.

4. Empirical Results

4.1. Preliminary Investigation

A graphical analysis is conducted (graphs are not reported on this paper) for preliminary investigation of long and short term rates in the five different BRICS countries. Between 2005 and 2009, Brazil and Russia reflect recession expectations for quite significant periods, as indicated by the long term rate that is lower than

the short term rate. While for South Africa, the recession expectation only begins in late 2006, with the actual recession beginning in 2008/09 (Venter, 2011). The spread between the interest rates' tends to widen, particularly after 2008 and 2009 when the world was hit by a financial crisis and most emerging market countries were faced with a depression (Venter, 2011). With a dampened demand for goods by developed countries from emerging market economies, an observation of a fall in short term rates relative to long term rates during the 2008-09 period in Brazil, India, and South Africa is made. In addition, these three countries illustrate fluctuating and persistent shocks in their rates during and shortly post the 2008-09 period. The fall in short term rates was possibly due to an attempt by monetary policy authorities in BRICS to stimulate market activities in their respective economies. Moreover, short term rates are left unchanged for relatively long periods; this is evident in countries like China, Russia and South Africa post 2009.

4.2. Testing for Unit Root

The results for ADF unit root test, with intercept and no trend, for each of the BRICS countries are summarised in Table 1. For both short and long term interest rates, the null hypothesis for a unit root is not rejected at levels for each country, implying that the two interest rates are not stationary at levels. At first differences, the H_0 for a unit root is rejected at the 1 percent level of significance; implying that both interest rates are I(1) as they become stationary after first differencing. This suggests that there is possibility that the two interest rates are co-integrated. Hence, the next step is to conduct the co-integration test.

Table 1. ADF Unit Root test results

Variable	At Level		First Difference		Order of Integration
	T-Stat	P-value	T-Stat	P-value	
Brazil-ST	0.789	0.3729	3.956	0.0001	I (1)
Brazil-LT	0.007	0.6783	11.557	0.0000	I(1)
Russia-ST	0.417	0.5311	8.875	0.0000	I (1)
Russia-LT	0.002	0.6815	9.164	0.0000	I (1)
India-ST	0.152	0.6293	10.620	0.0000	I (1)
India-LT	0.075	0.6556	11.615	0.0000	I (1)
China-ST	1.144	0.2290	10.530	0.0000	I (1)
China-LT	0.454	0.5161	7.442	0.0000	I (1)
South Africa-ST	0.662	0.4281	2.953	0.0034	I (1)
South Africa-LT	0.058	0.6613	8.196	0.0000	I (1)

$\boldsymbol{H_0}$**:** A series has a unit root and $\boldsymbol{H_a}$**:** A series has no unit root, stationary.

4.4. Co-integration Test Results

The Johansen co-integration test requires the indication of number of lags in the models. The number of optimal lags was selected using the three criteria of lag selection (AIC, SIC and HQC). For the VAR model of each of the countries the number of lags are depicted on Table 2.

Table 2. Summary of number of lags selected for each country

	Brazil	*Russia*	*India*	*China*	*South Africa*
No. of Lags	4	3	4	2	3

Using the number of lags from Table 2, the Johansen co-integration test was conducted with intercept and no trend and results are in Table 3. The null hypothesis of no co-integration equation is compared against the alternative hypothesis of one co-integration equation for each country. For Brazil and Russia, the null hypothesis, for no co-integrating equations, is not rejected at the 5 percent level of significance; meaning that, in these two countries, short and long term interest rates are not co-integrated. For the remainder of the countries, Trace and Max-Eigen statistics show that the null hypothesis of no co-integration is rejected at the 5percent level of significance, implying that there is at most one co-integrating equation. For China, India and South Africa there is a long-run relationship between short and long term interest rates and this provides evidence of the validity of EH in these countries.

Table 3. Summary of results for Johansen co-integration test

	Trace Statistic		**P-value**		**Max-Eigen**		**P-value**		**Conclusion**
	None	Most 1	None	Most 1	None	Most 1	None	Most 1	
B	12.329	2.30	0.141	0.129	10.026	2.302	0.210	0.129	No Co-integration
R	9.859	2.516	0.291	0.112	7.342	2.516	0.449	0.112	No Co-integration
I	20.534	3.418	0.008	0.064	17.115	3.418	0.017	0.064	T & E 1 Co-integrating
C	17.003	2.860	0.029	0.090	14.143	2.860	0.052	0.090	Trace, 1 Co-integrating
S	20.142	3.808	0.009	0.051	16.334	3.808	0.023	0.051	T & E 1 Co-integrating

*B = Brazil, R = Russia, I = India, C = China, S = South Africa.

The long-run equations for the three countries, with co-integrating equations, are in Equations 8, 9 and 10. For China, short term rates negatively influence long term rates, in the long run, an increase of short term rates by 1 percent will lead to a decrease of long term rates by 10.9 percent. Indian and South African short term rates positively influence the long term rate. Equation 9 indicates that a percentage change in short term rates will result in an increase in the long term rate by 21.1

percent in India. In South Africa, a percentage increase in the short term rate will lead to an increase of 12.7 percent in the long term rate.

$$China_{LT} = 3.786 - 0.109China_{ST} \quad (8)$$

$$India_{LT} = 6.285 + 0.211India_{ST} \quad (9)$$

$$South\ Africa_{LT} = 7.360 + 0.127South\ Africa_{ST} \quad (10)$$

4.4. Vector Error Correction Model (VECM)

Table 4 reports the error correction terms (ECT), from the VECM, for the three countries. The ECT coefficients for these countries are negative and statistically significant at the 0.05 significance level. For China, the ECT coefficient of -0.10242 implies that about 10.24 percent of the disequilibrium in the model is corrected every month. Thus, changes in the short term interest rate take approximately 9.77 months to have a full effect on the long term interest rate. For India, the ECT coefficient of -0.16340 implies that about 16.34 percent of the disequilibrium in the model is corrected every month. Changes in the short term interest take roughly 6.12 months to have a full effect on the long term interest rate in India. Lastly, the ECT coefficient of -0.20447 for South Africa suggests about 20.45 percent of the disequilibrium in the model is corrected every month; implying that any changes in the short term interest rate take approximately 4.49 months to have a full effect on the long term interest rate. Therefore, both short and long term interest rates for these countries converge to the long-run equilibrium. However, the discrepancy between the two rates is corrected at different speeds, where it seems to be quick in South Africa and slow in China. These findings are consistent with Modena (2008), Shiller and Campbell (1991) who found that the two interest rates yield the same returns at some point in the future.

Table 4. VECM Error Correction Terms

Variables	Coefficients	Standard Error	T-Statistic
China (LT)	-0.10242	0.03433	-2.98350
India (LT)	-0.16340	0.06253	-2.61302
South Africa (LT)	-0.20447	0.05261	-3.88661

5. Discussion of Results

An observation made in the preliminary investigation is the relative decline in short term rates in China, Russia and SA from the year 2009. As emerging market economies were severely affected by the global recession after the 2008 financial crisis. Low short term interest rates are possibly a result of cautious lending activities due to lessened demand in the various economic activities. Moreover, it could be that monetary policy intervenes to stimulate demand in a dampened

economy by reducing interest rates in that way encouraging borrowing and spending. Although the two interest rates in India and Brazil were found to follow each other quite closely, after 2009; India was found to be the only country that seems to have relatively normal economic conditions, reflected by the long term rate that is higher than the short term rate, from 2005 to 2008. During the same period, long term rates were lower than short term rates for the other four countries signalling recession expectations which did occur in Brazil, Russia and SA (BIS, 2015). These findings agree with previous studies of Beechey et al. (2008), Bonga-Bonga (2010), Estrella and Hardouvelis (1991), and Nel (1996) on the EH.

An essential condition for the validity of the EH is co-integration between the long term and short term interest rates, as highlighted by Engle and Granger (1987). The Johansen co-integration test finds co-integration in three of the five countries namely, China, India and SA; thereby providing evidence of the expectations hypothesis for each of the three countries. This implies that market participants are able to forecast future interest rate movements and this makes the EH quite fundamental for clarifying monetary policy effectiveness. These findings are in line with those of previous studies (Beechey et al. (2008); Guidolin & Thornton (2008); Shivam & Jayadev, (2003) which found a co-integrating relationship between short and long term interest rates. The expectations about the direction of the of future short term interest rates and their association with long term interest rates guide market participants on long term interest rates' response to the central bank policies.

Findings have quite significant implications for investors especially after the establishment of the New Development Bank in BRICS countries. For investors, these findings are significant for investment decisions, particularly decisions involving longer term maturity investments, as the pricing of capital assets is normally done based on long term interest rates (Ghazali & Low, 2002). The existence of EH also means that central banks are able to influence long term interest rates using monetary policy through changes in short term rates, thereby influencing capital asset prices and investment decisions (Guney, 2013; Panigrahi, 1997; Walsh, 2003). Moreover, the EH gives the central bank and market participants the ability to predict recession and phases in the business cycle.

The absence of the EH in Brazil and Russia means that participants in the respective markets are unable to predict the movement of the short term rate, possibly due to structural changes in financial and economic conditions in the case of Russia (Bank for International Settlements, 2015). These findings on Brazil and Russia are in line with those of studies by Beechey et al. (2008) and Shiller et al. (1983). It is not surprising to find no long run relationship for Russian interest rates due to the weaknesses of the monetary policy stance highlighted in 2008 (Mohanty, 2011). In addition, Brazil and Russia interest rates fail to support the expectations hypothesis due to the times of high volatility, resulting in large deviations between

the expected and the actual spread. This is consistent with previous studies such as Beechey et al. (2008) and Shiller et al. (1983) which found that the EH did not hold in developing countries due to high volatility interest rates. However, in light of what the BRICS group is trying to accomplish with the New Development Bank, the absence of co-integration between the short and long term interest rates in Brazil and Russia could have substantial implications for the BRICS market, consequently creating arbitrage opportunities.

6. Conclusions

Variations in interest rates have implications for market participants, understanding interest rate dynamics becomes essential for economists, monetary policy, and also for risk management practices and for financial security valuations. Participants are able to mitigate risks associated with market's expectations of interest rates and hence maximise profits. This study employed monthly short and long term interest rates from June 2005 to June 2015 to test the validity of the EH within the block of emerging modern world economies known as BRICS countries. The results of a multivariate co-integration analysis indicate that the EH only holds in three of the five countries, namely China, India, and South Africa. Both short and long term interest rates for these three countries converge to the long-run equilibrium at different speed, where the convergence was found to be quick in South Africa and slow in China. This study found no evidence of EH in Brazil and Russia due to the times of high volatility, resulting in large deviations between the expected and the actual spread. The absence of EH in these two countries is also linked with change in monetary policies, experienced by these counties. Findings of this study are relevant to current developments within BRICS financial markets as they provide valuable information that can be used to forecast future changes in interest rates in BRICS countries. Hence, it is concluded that arbitrage opportunities may arise from the gaps among interest rates in BRICS countries.

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