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INVESTIGATING LONG AND SHORT RUN ASSOCIATION BETWEEN SOVEREIGN BOND YIELDS AND INTEREST RATE OF BRICS COUNTRIES

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Abstract: we examine empirical association of dated sovereign security *(15 year sovereign. bond index*) and interest rate of BRICS countries by using weekly data from 2001 to 2010. We used unit root test to check stationarity of data and it was found that one variable (bond) is stationary at level and other variable (interest) at 1st difference. In this case we used ARDL model, to see is there any short run and long run association between dated sovereign security and the interest rate of BRICS countries. We investigated the results by using Akaike info criterion (AIC) and Schwarz criterion (SIC).out of AIC and SIC we took lowest value for optimum lag selection. Breusch-Godfrey Serial Correlation LM Test was used to check long run association of Govt. dated security and interest rate of BRICS countries, stability diagnostic test was used to check the stability of the data. We also calculated the speed of adjustment or Error Correction Term (ECT) and again with ECT (-1) we checked short run causality by using LM Test, stability diagnostic test and finally we used Wald test to check short run causality of bond lag1, lag2, interest lag1, interest lag2 and it was found that there is short run causality also between bond lag1, lag2 and interest lag1, lag2.

Key words: ARDL model, BRICS countries, Error correction term, interest rate, sovereign bonds.

1. BACK GROUND OF THE STUDY

The economic indicator has predictive value for investors, it must be current, it must be forward-looking and it must discount current values according to future expectations. Meaningful statistics about the direction of the economy starts with the major market indices. The following are the main economic indicators to predict the country's economic growth viz. Stock and stock futures markets, Bond and mortgage interest rates and the yield curve, Foreign exchange rates, Commodity prices especially gold, grains, oil and metals.*(www.investopedia.com*) Many studies have been undertaken by taking stock market, commodity and foreign exchange rates to predict the growth of economy. But only few studies were conducted with bond market. No study has been conducted by taking BRICS economies as a group. Here we have taken bond market as economic indicator of BRICS countries to show the long run and short run association between dated sovereign security and interest rate of BRICS countries.

Brazil, Russia, India, China and S.Africa (BRICS) are fastest growing and emerging economies. They have potential to form a powerful economic bloc. BRICS have gained the attention of both investors as well as academia in this era of globalization. There are many reasons but common reason is lower labor and production cost that attracted many foreign companies and investors. The five economies vary in their structural characteristics, economic policies and geopolitical importance. India, China and S.Africa are economies with most population living in rural areas, and relatively closed and state-controlled capital markets. Their development strategy is export led, based on domestic industrialization for export markets. Here we are interested to see how one of the economic indicator bond index is influenced by interest rate during the globalized economic era whether both the variables are moving together in all the countries in the long run and short run or not. If both variables are moving together in long run and short run we can mark as all the member countries of BRICS are moving together and challenging the global economic conditions together or otherwise. This is our main focus of the study.

2. PREVIOUS DTUDY

Literature review: The vast majority of previous empirical studies which examined the role of financial markets on economic growth, have largely ignored the effect of bond markets on the economic growth process. Bond markets were ignored under the notion that what matters is the state of a country's overall financial development, and the differences in composition and institutions that make up a country's financial system are trivial so long as an economy has access to a well-functioning financial system (Levine, 1997; Merton, 1992). This is because a well-functioning financial market enables economic agents to not only reduce transaction costs through hedging, trading

and pooling risks, but also increase the liquidity and size of the capital market, all of which are essential for economic growth (Fry, 1995; Goldsmith, 1969; King & Levine, 1993a, 1993b; McKinnon, 1973; Wachtel, 2001) the ample studies have been undertaken in the finance to examine implications of various economic variables on bonds in developed countries like America but none of the study has been done on BRICS till now. **Fleming and Remolona** investigate macroeconomic announcement effects on the Treasury market. Fleming and Remolona _1997, 1999 apply 1 year of intra daily data on the 5-year Treasury note and they found that the largest changes in price and trading volume stem from macroeconomic announcements. Moreover, the most influential announcements are the employment and the PPI reports the unexpected component of the announcement is of importance for the reaction of the bond market. Immediately after macroeconomic announcements, the bond price changes sharply and the trading volume declines.

3. RESEARCH DESIGN OF THE STUDY

3.1.1 Objective of the study

To find out the long run and short run association of dated sovereign security and interest rate of BRICS countries.

3.1.2 Hypothesis

$H0_1$: There is no long run and short run association of dated sovereign security and interest rate of BRICS countries.
$H0_2$: There is long run and short run association of dated sovereign security and interest rate of BRICS countries.

3.1.3 Variables used in the study

Hypothesis 1: bond, dbond (-1), dbond(-2), dbond(-3), dbond(-4), interest, dinterest(-1),d interest(-2), dinterest(-3), dinterest(-4)
Hypothesis 2: bond, dbond(-1), dbond(-2), dbond(-3), dbond(-4), interest, dinterest(-1),d interest(-2), dinterest(-3), dinterest(-4) ECT(-1)
Name of the model: ARDL model, unit root, optimum lag selection, LM and stability test, Wald test, and error correction term.

3.1.4 Data and research methodology

We investigate the association of dated sovereign security and interest rate of BRICS countries by looking at weekly data on bond index and interest rates. The data is secondary in nature. Our weekly data ranges from January 2001 to December 2010, collected from bloom berg database. Our study is important because of several reasons; despite the economic importance of Sovereign bonds, very little attention (compared to ordinary stock) has been paid to long run association of sovereign bonds and interest rates of BRICS countries. Secondly the study uses a fundamental economic variable i.e. interest rate to check its association with dated sovereign security *(15 year Govt. bond index*) of BRICS countries. Thirdly study is confined to only five fastest growing and emerging countries i.e. BRICS and finally the study is important because it is first time ARDL model is used to study the long run and short association of dated sovereign security and interest rate of BRICS countries.

4. RESULTS AND DISCUSSION

As mentioned above the main objective of study is to find out association of dated sovereign security and interest rate of BRICS countries. In order to get optimum lag which would be used for study? we used Bound Test i.e. [Bond =b1+b2*interest+…..*bn] and formula is d(bond) c (bond(-1)) d(bond(-2)) bond(-3)) d(bond(-4) interest(-1)) d(interest(-2)) dinterest (-3)) d(interest(-4) bond(-1) interest(-1).

4.1 Identification of Unit Root

Prior to do empirical analysis of data we should check whether the data is having unit root or not.

Table-4.1The Results of Unit Root Test

Method	Bond		Interest
	P.value at level	P. value at 1st diff.	P. value at level
Levin, Lin & Chu t	0.0759	0.0000	0.0364
ADF - Fisher Chi-sq.	0.0841	0.0000	0.0401
PP - Fisher Chi-sq.	0.1080	0.0000	0.0137

Panel co integration can be done by three methods one Johannsen co integration, Engel granger methods and third one is ARDL model . The ARDL model will be used when some variable are stationery at I (0) and some variables are at I (1) but none of the variables are not at I (2) For application of Engel granger and Johannsen integration methods, the variables must be stationery at the same levels. To comply with the above mentioned pre conditions our data suitable to do further analysis by using ARDL model. The table No.1 shows that the variables (bond and interest) used in the study are stationary at two different levels. Bond is significant at first difference and interest is significant at level. So ARDL model is used for further analysis.

4.2 Identification of Optimam Lag

In order to get optimum lags used for the study we calculated first four lags then two lags. Out of these two forms of techniques a technique which gets lowest value of Akaike info criterion (AIC) and Schwarz criterion (SIC) will be selected.

Table- 4.2 The Net Results of 4 lags and 2 lags

No. of lags	AIC	SIC	R Squared	Durbin Watson
4 lags	-0.916	-0.892	0.571111	2.001893
2 lags	-0.0913	-0.897	0.611354	1.991941

The result in the table no.4 reveals the Akaike info criterion and Schwarz criterion for four lags and two lags respectively. The ARDL model with two lags is having lowest AIC and SIC values. So ARDL model with two lags is suitable to do further analysis.

4.3 Identification of Serial Correlation and Stability

In order to find out whether there is serial correlation among dated sovereign security and interest rate we used the **serial correlation Lm test**.

H0: There is no serial correlation between the dated sovereign security and interest rate of BRICS countries.

Ha: There is serial correlation between the dated sovereign security and interest rate of BRICS countries.

Table-4.3 shows Breusch-Godfrey Serial Correlation LM Test

F-statistic	2.976683	**Prob. F(2,510)**		0.0518
Obs*R-squared	5.988520	**Prob. Chi-Square(2)**		0.0501
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.527395	0.533102	0.989294	0.3230
D(BOND(-1))	-2.678680	3.185362	-0.840934	0.4008
D(BOND(-2))	-0.856793	0.403043	-2.125810	0.0340
D(INTEREST(-1))	-0.002861	0.011813	-0.242199	0.8087
D(INTEREST(-2))	-0.052854	0.061802	-0.855215	0.3928
BOND(-1)	-0.062206	0.063325	-0.982333	0.3264
INTEREST(-1)	0.000977	0.004071	0.240013	0.8104
RESID(-1)	2.741706	3.251177	0.843297	0.3995
RESID(-2)	1.276140	0.817424	1.561171	0.1191
R-squared	0.511539	**Akaike info criterion**		0.514885
		Schwarz criterion		-0.441153
		Durbin-Watson stat		1.993878

The result in the table fails to reject null hypothesis rather accept null hypothesis (P< 0.05) meaning that variables are not serially correlated. Now we would like to check whether there is stability among 2 lag variables. For that purpose we used stability diagnostic test. The results are shown in the figure. No.1

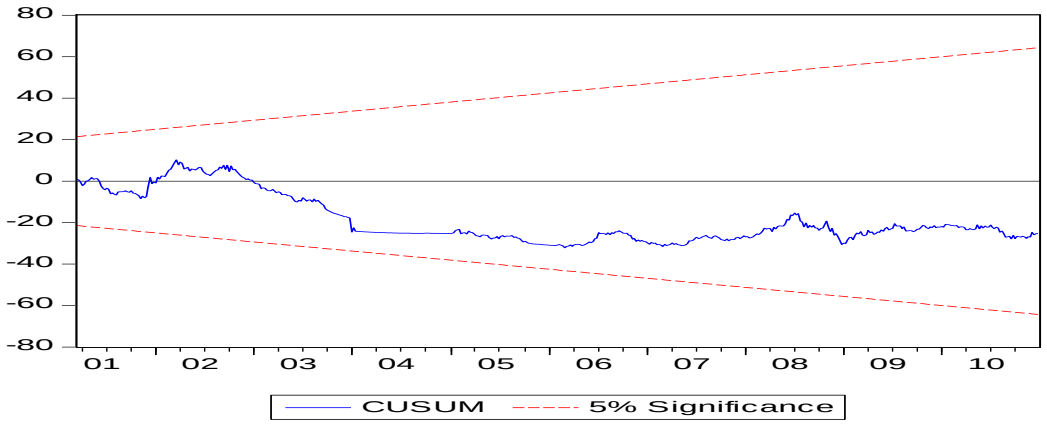

Fig. 4.1 Stability Test

The graph reveals that the blue line lies in between the two red lines stating that the model is stable and there is stability in data used for study. Here the model satisfies both criteria viz. no serial correlation and having stability. Now we can go for bound testing to see the weather the interest rate and dated securities have long run association or not .

4.4 Identification of Long Run Association

In order to know whether there is long run association between the dated sovereign securityand interest rate of BRICS countries we used Wald test. The formula for long run coefficient is $\beta 1 = -\frac{\theta i}{\theta 0}$ where

β1= coefficient of lag dependent variable i.e.2 lag of dated sovereign security.

θi= coefficient of2 lag independent variable i.e. 2lag of interest.

Θ0 =coefficient of dependent variable i.e.2 lag of dated sovereign security

Table-4.4 Results of Wald Test

Test Statistic	**Value**	**df**	**Probability**
F-statistic	3.454544	(2, 512)	0.0323
Chi-square	6.909088	**2**	0.0316
Null Hypothesis Summary:			
Normalized Restriction (= 0)		**Value**	**Std. Err.**
C(6)		-0.015588	0.005931
C(7)		0.000241	0.003685

The results of F. statistic should be compared with Pesaran critical value at 5 percent . our model is unrestricted intercept and our model is having no trend. The Pesaran critical value at 5 percent upper bound value is 3-34 and lower bound value is 2.14. Our F.statistic value is 3.4545, it is just above to the upper bound value of Pesaran. Therefore The result fails to accept null hypothesis rather it accepts alternate hypothesis indicating that there is a long run association between dated sovereign security and interest rate of BRICS countries. In other words it can conclude that both the securities are moving together in the long run. Since these two variables have long run association we also tried to check the short run association.

From the equation Bond=b1+b2* interest, we can take the residuals called it as ECT and again we run our model with two lags.

4.5 Identification of Short Run Relationship

To know **the speed of adjustment** we calculated error correction term (ECT)
By using formula d(bond) c d(bond(-1)) d(bond(-2)) d(interest(-1)) d(interest(-2)) ECT(-1)

Table-4.5 Result of Error Correction Term

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000483	0.008529	0.056669	0.9548
D(BOND(-1))	1.224659	0.355112	3.448653	0.0006
D(BOND(-2))	-0.177503	0.063920	-2.776958	0.0057
D(INTEREST(-1))	-0.019009	0.011575	-1.642304	0.1011
D(INTEREST(-2))	0.026364	0.013185	1.999515	0.0461
ECT(-1)	-1.730409	0.357846	-3.083471	0.0022
R-squared	0.042144	**Akaike info criterion**		-0.518104
		Schwarz criterion		-0.468877
		Durbin-Watson stat		1.993108

Here the pre-condition is the ECT (-1) should be negative and the probability value must be significant. The results in the table shows that ECT (-1) value is negative and its probability value also significant meaning that the whole system of dated sovereign security index and interest rates of BRICS countries gets back in short run equilibrium at the speed of 73%. Since our model shows short run equilibrium then we can check whether there is serial correlation among variables (dated sovereign security, interest) with ECT(-1) are not. Hence we again tested the serial correlation, LM test and stability test.

4.6 Identification of Serial Correlation & Stability for Short Run Equilibrium.

Table-4.6 Results of LM Test

Breusch-Godfrey Serial Correlation LM Test				
F-statistic	0.931056	Prob. F(2,510)		0.3948
Obs*R-squared	1.884440	Prob. Chi-Square(2)		0.3898
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-7.00E-06	0.008638	-0.000810	0.9994
D(BOND(-1))	0.193839	0.384447	0.504201	0.6143
D(BOND(-2))	-0.187353	0.252831	-0.741020	0.4590
D(INTEREST(-1))	-0.000888	0.011600	-0.076543	0.9390
D(INTEREST(-2))	0.002894	0.013356	0.216661	0.8286
ECT(-1)	-1.143060	1.180834	-0.968011	0.3335
RESID(-1)	0.952867	1.056318	0.902065	0.3674
RESID(-2)	0.168587	0.240197	0.701872	0.4831
R-squared	0.673638	**Akaike info criterion**		-0.514027
		Schwarz criterion		-0.448390
		Durbin-Watson stat		1.991357

The F. statistic is very low (0.93) and p> 0.05 indicates that the result in the table fails to reject null hypothesis rather it accepts null hypothesis meaning that there is no serial correlation between interest rate and dated sovereign security after checking the short run causality with (ECT). We found that there is no serial correlation between dated sovereign security and interest rate with error correction term (ECT) we would like to check the stability of variables with ECT. For that purpose we used stability test.

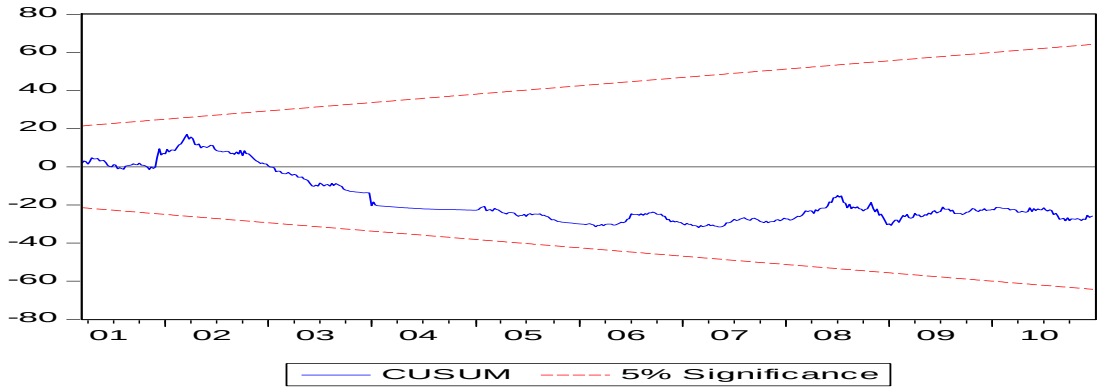

Fig. 4.2 Stability Test for Short Run Relationship

The graph reveals that the blue line lies between the two red lines stating that the model has stability in short run.

4.7 Identification Short Run Relationship

H0:C(2)=C(3)=0 where C(2)=d(bond(-1)),C(3)=d(bond(-2))

H1: C(2)=C(3) ≠0 where C(2)=d(bond(-1)),C(3)=d(bond(-2))

Table- 4.7 Results of Wald Test

Test Statistic	Value	df	Probability
F-statistic	3.302401	(2, 512)	0.0376
Chi-square	6.604803	2	0.0368
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(4)		-0.019009	0.011575
C(5)		0.026364	0.013185
Restrictions are linear in coefficients.			

The result in the above table fails to accept null hypothesis rather it accepts alternate hypothesis means that there is short run causality between dated sovereign security index and interest rate of BRICS countries.

H0:C(4)=C(5)=0 where C(4)=d(interest(-1)),C(5)=d(interest(-2))

H1: C(4)=C(5) ≠0 where C(4)=d(interest(-1)),C(5)=d(interest(-2))

Table- 4.8 Results of Wald Test

Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	6.012918	(2, 512)	0.0026
Chi-square	12.02584	2	0.0024
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		1.224659	0.355112
C(3)		-0.177503	0.063920
Restrictions are linear in coefficients.			

The results in the above table are significant at 5% which fails to accept null hypothesis rather accepts alternate hypothesis means that C4 and C5 are not equal to zero, therefore there is short run causality between interest lag1 and interest lag2. Similarly results in the table No. 9 shows that there is short run causality between bond lag1 and bond lag2. Therefore it could be concluded that lags of both bond and interest rates are showing short run causality. This means that there is short run association bond and interest rate of BRICS countries.

CONCLUSION AND FINDINGS

The study has been undertaken with the help of dated sovereign security index and interest rate of BRICS countries. There are three techniques available for using co integration for panel data. Here we used ARDL model. Since the two variables have no unit root at different levels. This paper is contributing to the literature by exploring the long run and short run association between dated sovereign security index and interest rate of BRICS countries. Our results in the analysis fail to accept null hypothesis rather accepts alternative hypothesis means that there is long run as well as short run association between the dated sovereign security index and interest rate of BRICS countries. The result in the analysis conveys that all countries in the group are having almost similar monetary policies and are moving together to face the global economic challenges. Hence our study corroborates with the existed literature that there is association between dated sovereign security index and interest rate tested.

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