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THE EFFECT OF INTEREST RATE VOLATILITY ON SOVEREIGN BOND YIELDS OF INDIA

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ABSTRACT

In this paper we tried to elicit the effect of interest rate volatility on Sovereign Bond Yields of India. We found that interest rate volatility is positively correlated related with sovereign bond yields and it is also found that effect of volatility decreases with increase in maturity period of Sovereign Bond Yields. In our study interest rate volatility explains 16.2% variations in one year Sovereign Bond Yields of India as compared to only 1.6% of variations in ten year Sovereign Bond Yields of India. Our results are entirely contradicting with the previous studies which found that there is negative relationship between interest rate volatility and bond yields in advanced countries. In our study interest rate volatility is simply defined as the standard deviation of the interest rates.

KEYWORDS : Sovereign bond yields, interest rate volatility, Regression analysis, India.

INTRODUCTION:

The determination of yields of both short term and long term sovereign bonds is of great interest to academicians, researchers, policy makers and investors. Interest rate volatility plays a vital role in sovereign bond yields, as it measures uncertainty of macroeconomic variables. It is vital because it affects interest rate, investment returns, and individual or firm investments decisions. (Ingersoll, Ross, 1992) As far as this study is concerned interest rate volatility is defined as standard deviation of

interest rate process. However it has been found that very less attention has been paid on the effects of interest rate volatility on sovereign bond yield of India. Very few studies have attempted that too in advanced countries to predict or identify the effects but overall findings are quite mixed. The objective of this study is to find effect of interest rate volatility on short term (one year) as well as long term (ten year) sovereign bond yields of India during 1999 till 2015. It is hypothesized that, because of the stochastic nature of interest rates and the implicit option associated with the government's ability to time its borrowings, there should be a negative relationship between interest rate volatility and Bond yields. Further, this negative relationship should be stronger for longer maturity bonds, since the option effect increases with maturity. This hypothesis is tested empirically, using bond yield data from the US Treasury market. The main empirical finding is that interest rate volatility does indeed have a significant negative effect on bond yields, and the significance is greater for 20-year bonds than for 10-year bonds, as hypothesized (Sudipto Sarkar, Mohamed Ariff, 2010)

REVIEW OF LITERATURE

Many authors have developed alternative theories of how interest rate volatilities affect bond yields. Veronesi (2010) and others derive expected default-free bond returns as a function of interest rate volatility. In a classic article, Heath et al. (1990) derive a bond pricing model where the drift in the short (forward) rate is, in fact, a function of the volatility of short rates. classic interest rate theories of Merton (19731) and Vasicek (1977) suggest that short rate volatility is independent of the level of interest rates while, in contrast, later models such as Cox et al. (1985), Black and Karasinski (1991), and Pearson and Sun (1994) maintain that the volatility of interest rates depends on the level of interest rates. Duffee (1998), in testing the Longstaff and Schwartz (1995) model on both callable and non callable bonds, found that a greater level of interest rates suggests a stronger growth in firm value and thus reduces the spread over U.S. Treasury bonds. Elton et al. (2001) find that expected default explains a smaller part of spreads than commonly assumed. Chen et al. (2007) find that default risk does not fully explain spreads and stress that liquidity explains a large part of corporate bond spreads. Bao et al. (2011) find that liquidity is a determinant of spreads. (Although Lin et al. (2011) do not address yield spreads; they do find that liquidity is an important determinant of expected bond returns.) However, these papers have not addressed the impact of interest rate volatility on yield spreads. Acharya and Carpenter (2002) also provide theoretical support for the positive effect of interest rate volatility on no callable bond spreads. Assuming that the firm has a single bond outstanding, they model a defaultable bond where its spread increases with the volatility of the difference between the host bond price and the firm value. The host bond is a coupon paying bond with no default risk and no call risk. The details of their model are given in the theory and hypotheses section.'

The main objective of the study is to investigate the effects of interest rate volatility on long term and short term sovereign bond yields of India. The previous study suggests that interest rate volatility is negatively related with bond yields and significance of the effect of course depends upon several factors viz. maturity of sovereign bonds, size of bond market, liquidity and activity level of bond market etc. (Sudipto Sarkar, Mohamed Ariff, 2010).

HYPOTHESIS

H0: There is no effect of interest rate volatility on long term and short term sovereign bond yields of India.

DATA AND RESEARCH METHODOLOGY

The data of one year and ten year sovereign bond yields are collected from NSE of India and interest rate or prime lending rates are collected from Bloomberg data base, the data used in study is purely secondary and its frequency is monthly from 1999 to 2015. The total number of observations is 201. The following variables are used in the study:

Responsive Variables: One year and ten year sovereign bond yields of India.
Explanatory Variable: interest rate volatility or standard deviation of interest rate

TEST PROCEDURE

A direct approach is used to test the magnitude of interest rate volatility in explaining behavior of short term (one year) and long term (ten year) sovereign bond yields of India. The is performed by conventional means of regression analysis, with short run and long run yields as responsive variables and interest rate volatility as explanatory variable.

EMPIRICAL RESULTS AND DISCUSSION

The linear regression model is developed as follows using the output results (coefficients) shown in Table-1.

Table 1. Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.982	4.632		-.644	.000
	Interest_ volatility	23.542	3.809	.402	6.181	.000

a. Dependent Variable: 1Yrbond

From the table 1 above, the exact regression model that can be developed is thus Y=2.982+23.542X1. Where Y, X1 denote their usual meanings. The model is thus interpreted as follows:

The constant value of 2.982 is intercept which represents total yields of one year sovereign bond yields of India given that interest rate volatility is zero, all other variables being constant. And the coefficients of X1(interest rate volatility) of 23.542 implies how much or the magnitude by which one year sovereign bond yield will change when there will be one unit change in interest rate volatility (X1). This of course shows that there is a positive relationship between one year sovereign bond yield and interest rate volatility of India. This means that both one year sovereign bond yield and interest rate volatility move in same direction during study period.

Table 2.Model Summary of the other coefficients

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			Durbin-Watson
					R Square Change	F Change	Sig. F.C	
1	.402[a]	.162	.158	32.06096	.162	38.210	.000	.046

a. Predictors: (Constant), std_of_interest_ b. Dependent Variable: 1Yrbond

The model adequacy is checked by using the statistics in table 2. The R and R2 represent the multiple correlation and coefficients of determination respectively. The value of R (0.402) indicates that there is strong correlation between interest rate volatility and one year sovereign bond yield. It therefore indicates that interest rate volatility influence the sovereign bond yields of India as interest rate volatility rises, sovereign bond yields increases also. On the other hand the value of R2 (coefficient of determination) 0.162 or 16.2% of variations sovereign bond yields are explained by interest rate volatility. In other words interest rate volatility accounts 16.2% changes of sovereign bond yields.

Table 3. Analysis of variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39276.126	1	39276.126	38.210	.000[b]
	Residual	203525.172	198	1027.905		
	Total	242801.298	199			

a. Dependent Variable: @1Yrbond b. Predictors: (Constant), std_of_interest_

The analysis of variance table is used to test the overall significance of the model developed. The hypothesis that is tested here is:

H0: the overall model is not significant
H1: The overall model is significant.

Here the guide line is do not accept null hypothesis when significance value is less than 5%. The results in the above table shows that significance value (0.000) is less than 5%, so we fails to accept null hypothesis, rather we accept alternative hypothesis, means that the overall model is significant and good fitted.

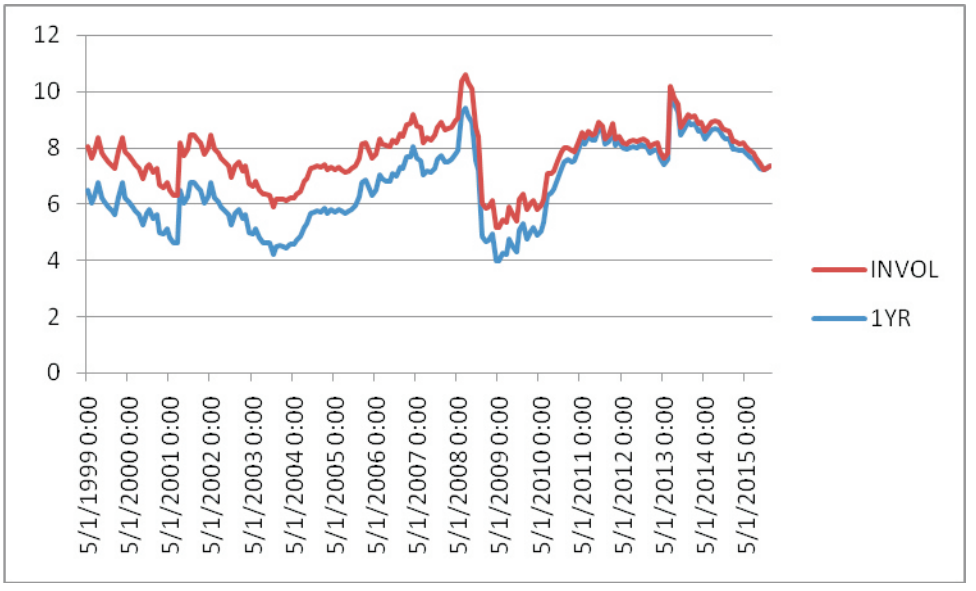

Figure 1: Line graph of interest rate volatility and one year sovereign bond yield of India from 1999 to 2015

The graph clears indicates that interest rate volatility and one year sovereign bond yields are positively related with each other as both are moving in same direction. Whenever there is fluctuation in interest rate volatility, it leads to fluctuations in one year sovereign bond yields too. In 2001, 2008, 2014, the interest rate volatility reaches its highest points and one year bond yield also touches its highest points.

Table 4. Regression Coefficients of int.volatility and 10 year bond yield

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.806	.256		30.447	.000
	std_of_interest_	.429	.211	.143	2.037	.043

a. Dependent Variable: @10yrbond

The model is interpreted as follows:

The constant value of 7.806 is intercepts which represents total yields of ten year sovereign bond yields of India given that interest rate volatility is zero, all other variables being constant. And the coefficients of X1(interest rate volatility) of 0.429 implies how much or the magnitude by which ten year sovereign bond yield will change when there will be one unit change in interest rate volatility (X1). This of course shows that ten year sovereign bond yield is positively related with interest rate volatility but the relationship is weak. This means that both ten year sovereign bond yield and interest rate volatility move in same direction during study period.

Table 5.Model Summary of the other coefficients

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.143[a]	.021	.016	1.77433	.021	4.150	1	198	.043	.030

a. Predictors: (Constant), std_of_interest_ b. Dependent Variable: @10yrbond

The model adequacy is checked by using the statistics in table 5. The R and R2 represent the multiple correlation and coefficients of determination respectively. The value of R (0.143) indicates that there is weak correlation between interest rate volatility and ten year sovereign bond yield. It therefore indicates that interest rate volatility are having very less influence on the sovereign bond yields of India as interest rate volatility rises, sovereign bond yields increases also. On the other hand the value of R2 (coefficient of determination) is 0. 016 or 1.6% of variations of sovereign bond yields are explained by interest rate volatility. In other words interest rate volatility accounts 1.6% changes of ten year sovereign bond yields.

Table 6. Analysis of variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.066	1	13.066	4.150	.043[b]
	Residual	623.351	198	3.148		
	Total	636.417	199			

a. Dependent Variable: @10yrbond, b. Predictors: (Constant), std_of_interest_

As it is above mentioned that analysis of variance (ANOVA) table is used to test the overall significance of the model developed. The hypothesis that is tested here is:

H0: the overall model is not significant
H1: The overall model is significant.

Here the guide line is do not accept null hypothesis when significance value is less than 5%. The results in the above table shows that significance value (0.043) is less than 5%, so we fails to accept null hypothesis, rather we accept alternative hypothesis, means that the overall model is significant and good fitted.

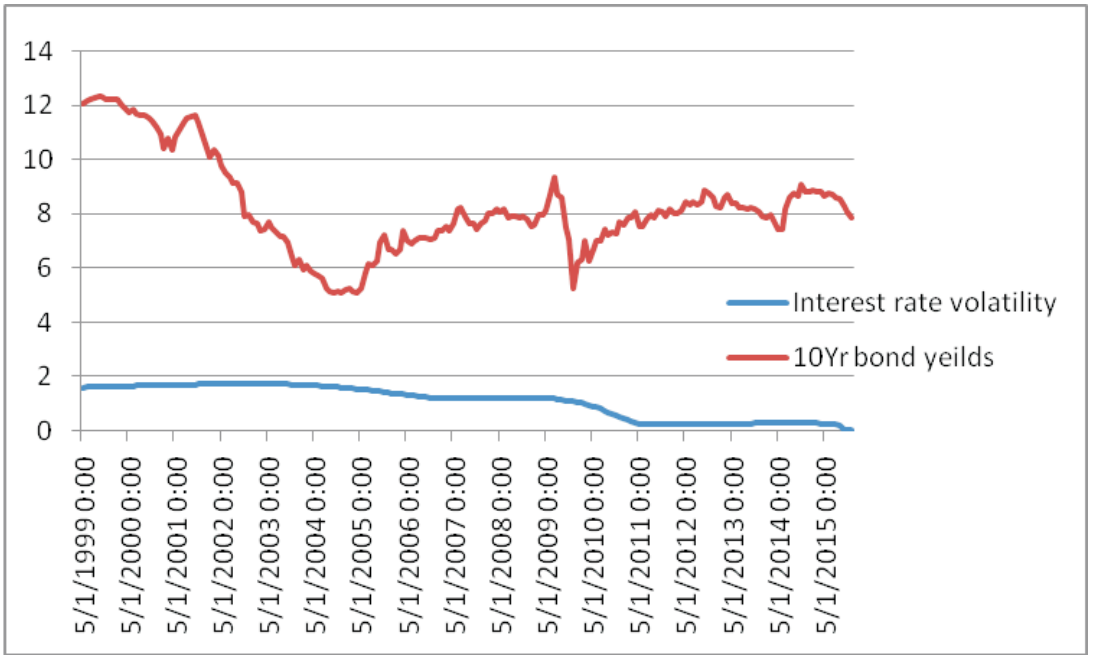

Figure 2: Line graph of interest rate volatility and ten year sovereign bond yield of India from 1999 to 2015

The graph clears indicates that interest rate volatility and ten year sovereign bond yields are positively related with each other as both are moving in same direction. But are weakly correlated to each other whenever there is fluctuation in ten year sovereign bond yields, there are very minute or no fluctuations in interest rate volatility. In 200, 2009, 2014, there are fluctuations in sovereign bond yields but interest rate volatility shows fluctuations only in 2011.

CONCLUSION

The major finding of this paper is that interest rate volatility seems to have positively related with sovereign bond yields of India, this positive effects decreases with time maturity of sovereign bond yields. Interest rate volatility highly affects one year sovereign bond yields (16.2%) as compared to ten year sovereign bond yields (1.6%) of India.. The results revealed by this study are quite opposite to the previous studies done in developed countries like America by Sudipto Sarkar, Mohamed Ariff, in 2010. Although lot of research is to be done before the phenomenon is completely and satisfactorily documented. This study is quite preliminary in nature, because other factors in interest rate determination are not controlled. It could be considered first step in this area, in order to explore the entire phenomenon especially in India.

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