

Structural Breaks and Focus Shifts: An Analysis of Growth Predictability of Yield Spread in India

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ABSTRACT

This paper, by covering data from Indian bond market over the period of 15 years (2000-2014), examined the growth predictive power of Treasury bond yield spread in India. Contrasting to the theoretical arguments as well as empirical evidences reported in the literature from other markets, this analysis found no significant granger causality or co-integration between the yield-spreads of securities with various maturities individually and GDP growth rates. But the common unobserved yield spread component in the linear combination of the spreads of various maturities, derived through principle component analysis, found statistically significant evidences of economic growth predictive power over the study period. The study also observed structural breaks and focus shifts in the information possession of yield spread about the future movement of economy in the Pre-crisis and Crisis period in the Indian market. In the light of these evidences, by considering the distinct features of yield spread-economic growth linkages in emerging economies, this study demands the need of exploring; the dynamic role of inflation, fiscal interventions and changes in both domestic as well as international interest rates upon the formation of yield curves; and nature of yield curve formation in such economies to substantiate the arguments of this study.

Key words: debt financing, bond yield spread, economic growth predictability, structural breaks, yield spread formation

JEL Classification: E32, E43, E44

1. Introduction

Every economy, particularly free enterprise economies are occasionally exposed to the phenomenon of cyclical booms and depressions, which is termed as business cycles in the economic parlance and are reflected through fluctuations in aggregate employment, income, output and price level. Economic recession or depression can revert economies many years in development and can cause to increase in unemployment, poverty, illegal ways of commerce, run on the banks and social instability. It may cause business firms to lay idle or disappear and it may burn the hands of investors as well. Hence, at this point of uncertainty, a reliable prediction of future course of economic activity, for better decision making, is demanded since an inapt decision may put an economy and economic agents either way into chaos or huge losses. It becomes crucial in case of governmental and monetary authorities in seeking right time of action to tackle macroeconomic issues and business firms; for making decisions regarding expansion, market entry, diversification, and acquisitions, and in the case of investors; for the proper selection of a portfolio of securities to invest in instruments of different maturities. The process of global integration of the economies, especially in the spheres of finance, production, consumption and distribution, has also increased the role of managerial approach to weigh the risk and return in decision making procedure.

Fisher (1907), (cited in Harvey, 1989), formalized the link between securities market and real economic activity, by proposing that in equilibrium one year interest rate reflects the marginal value of income today in relation to its marginal value next year. In the same lines, modern asset pricing theories also suggest a relation between expected asset returns and investors' expected consumption plans. By making an inter-temporal trading by investing in assets in good times to insure against the recession, investors get more benefit in recession period as same amount of currency will buy more in recession than in peak times. And the intensity of this trading is driven by investors' expectation about the future state of the economy and this in turn will be reflected in asset prices. Stock and Watson (1989), Friedman and Kuttner (1998), Bernanke (1990) Kasyap, Stein and Wilcox (1993), Harvey (1993) and many others ventured to examine the predictive content in the fixed income securities about the real economic activity. Government bonds market, being a yardstick for all other securities, has drawn exceptional attention in this regard in terms of yields to maturity. The bond yield curve becomes flatter or steeper based on investors' expectations. For example, if recession is expected in two years in future, there is an incentive to sacrifice today to buy a two year bond that pays off in the bad times. Thus, as the demand for the two year bond increases, its price will go up which finally will result in the fall of its yield and simultaneously to make this hedging possible investors will sell off the short term securities in their hold leading to a fall in their prices and a rise in their yields. These inter-temporal trading activities in turn will result in fall of yield spread (slope of the yield curve) and flattening of the yield curve.

In fact, there have been numerous research attempts, in analysing the relationship between yield spread and economic growth. Broadly, they put forward mainly the following arguments; changes in monetary policy transmit to term structure and thereby to real economic activity (Homer, 1968); changes in monetary policy affects short term rates and create fluctuations and structural breaks in term structure and bond yield spreads (Carr and Smith, 1972; Engsted and Taggaard, 1995; Smets and Tsatsaronis, 1997); properties of yield spread is influenced by factors besides monetary policy (Hegrefe, 2007; Feroli, 2004); yield spread is a significant predictor of economic

growth even when effects of variables such as stock market returns, lagged values of GDP, levels of interest rate, real money supply, the profit rate and inflation are separated (Harvey, 1989; Estrella and Hardouvelis, 1991; Estrella et al., 2003; Harvey, 1993; Cozier and Tkacz, 1994; Kozicki, 1997; Dotsey, 1998; Mody and Taylor, 2003; Kanagasabapathy and Goyal, 2002; Estrella, 2005; Ang et al., 2005; Mehl, 2009); expected future short rate and term premium having significant influence on the predictive power of the spread (Hamilton and Kim, 2002). All these studies support the predictive power of yield spread about the real economic activity and point out its varying predictive power as the countries and the economic systems differ.

All the more, an efficient environment in the economy is the precondition for the better transmission of information on investors' expectation of economic risk, proper pricing and return discoveries. It is observed that not many studies in these lines have been conducted in the Indian context. The study of Kanagasapathy and Goyal (2002), on the basis of quarterly data for four years from 1996-2000, revealed a significant positive relationship between the bond yield spread and industrial production in India. However, Indian bond market has become more efficient and transparent and the entire economic system, especially financial system, has gone through a lot of transformations over the period of time. Therefore the present study tries to revisit the yield spread-economic growth relationship in a deeper as well as longer span of time. This analysis, by covering a period of 15 years (2000-2014), specifically attempts to answer the following issues; 1) Does the yield spread of government securities has the predictive power of future economic growth in the Indian market; what is the nature of information accumulation of yield spread about future economic activity both in pre crisis and crisis periods.

This research paper is arranged in such a way that the second section reports the survey of literature; briefly reviewing the impact of monetary policies and yield curve formation and the relationship between yield curve formations and economic activity. It also highlights the justification for the present study. Details of data sources, methods of derivations, and temporal characteristics of data are covered in the third section, followed by fourth section presenting the results of empirical examination of the research issues. The results discussion and scope for further research initiatives are covered in the fifth section and the sixth section concludes the study.

2 Literature Review

The variations in the bond yields and after effects of them had captured the attention of fixed income security analysts of all the time. Earlier studies in this area were preoccupied with the transmission of monetary policy to term structure of interest rates and thereby to real economic activity (Homer, 1968; Carr and Smith, 1972; Engsted and Taggaard, 1995; Smets and Tsatsaronis, 1997; Hegrefe, 2007). Harvey (1989) made a comparative study about the economic growth forecasting power of stock market and bonds market. The results suggested that while yield curve measures were able to explain more than 30 percent of the variation in economic growth over the 1953-1989 the stock market variable explained only about 5 percent of the variation in the same. Thus this study set reliability for bond yields as a holder of information relevant for predicting the economic growth. Similarly, by refining his previous study, Harvey (1989) stated that the yield spread retaining its forecasting power, even when lagged GDP growth rates and inflation were considered as explanatory variables along with yield spread in the regression model, in varying degrees for different countries.

Substantiating these findings, Estrella and Hardouvelis (1991) provided the basic evidences about the predictability of future changes in output. The results

corroborated the presumption that a steeper slope implied faster future growth in real output. The study also revealed that even though the current monetary policy would have an influence on the yield curve, the yield spread remained as a significant factor predicting the presence or absence of recession with increase or decrease in the probability of recession in quarters ahead. In another analysis Estrella et al., (2003) also suggested that yield spread between long term bonds and Treasury bills as a good predictor of future economic growth.

Harvey (1993), in the study on term structure and economic growth, affirmed the explanatory power of yield spread by regressing the variance in the annual real GDP growth on the yield spread of five year treasury bond and three month bill yields. Further, Cozier and Tkacz (1994) also observed significant predictability of Canadian yield spread about the economic activity in the presence of number of variables such as, level of interest rate (bank rate), real money supply, stock prices, the profit rate and the US term structure. The examination of predictive power of term spread for components of output revealed that the spread was more closely related to consumption in shorter horizons while it is to investment in case of longer horizons. In shorter horizons, the middle-short spreads found to be contributing more to the predictive content while long-middle spreads maintained it throughout the time horizon. Kozicki (1997) observed a fall in the predictive power of yield spread as the time horizon increased and Dotsey (1998) in the examination of predictive content of the term spread about economic growth found that the predictive content of the spread on output growth being time variant over different sample periods. The study also revealed that spread containing information not contained in the past economic activity and it sustained even when tight monetary policy is considered. Similarly Mody and Taylor (2003) by estimating long horizon regression covering broadly three periods 1960s 1970s and 1980s and 1990s separately found variations in predictive power of yield spread of real economic activity across the periods. The study found that the high yield spread; the difference between Junk bond yield and government bond, contained a high predictive content of movements in economic activity compared to that of term spread.

As the predictive power of spread on real activity might depend on factors such as monetary policy reaction function or the relative importance of real and nominal shocks which might change over time, Estrella et al.,(2003) examined the stability of the relationship of spread with real growth and inflation using econometric techniques of break testing. Overall the results suggested that models that predict real activity were somewhat more stable than those that predict inflation. Feroli (2004) made a detailed analysis of this with other measures of monetary policy like the first difference of the federal funds rates, residual from an identified VAR (monetary innovations) and a narrative measure of monetary policy. But even the inclusion of these measures left yield spread with significant predictability. The study advocated that yield spread not merely picked information from monetary policy but absorbed the information from economic agents. Hamilton and Kim (2002), by decomposing the predictability contribution of spread into effect of expected future changes in the short rates and into the effect of the term premium, found that both the expected future short rate and term premium having significant influence on the predictive power of the spread but the effect of future short rates are much more important than the term premium for predicting GDP more than two years ahead.

Ang et al.,(2005), in a dynamic yield curve and GDP growth model by considering the information across the whole yield curve, found that the whole yield curve had significant predictive power and it varied with maturities of yields. The study used two factors from yield curve, the short rate expressed at a quarterly

frequency to proxy the level of yield curve and 5 year term spread to proxy the slope of the yield curve along with the quarterly GDP growth rate. The analysis revealed that the maximum maturity differences as the best measure of slope of yield curve to predict economic activity. Mehl (2009) observed that the yield curve in emerging economies having information content for future inflation and future industrial production growth in almost all countries considered. Analysis of international financial linkages of yield curve both in-sample and out of sample showed that the slope of the US and Euro yield curves having information content for future industrial production growth in all economies. The study on yield curve spill over suggested that the economies having deep closed domestic financial markets were scarcely affected by yield curve spill over from US and Euro yield curves.

2.1 Government Securities Market in India

Administered structure of interest rates and other statutes of restrictions were controlling the Indian financial system till early 1990s. Reserve Bank of India (RBI) have taken several measures to develop, to integrate and enhance efficiency in money and government securities markets. The auction system was introduced freeing interest rates on all monetary instruments and making the yield on the government securities to be determined by market forces. The introduction of primary dealers system, initiation of delivery versus payment system, active open market operations by RBI, setting up of STCI (Securities Trading Corporation of India), and opening of screen based trading by NSE and computerizing of SGL (Subsidiary General Ledger) operations and dissemination of information by RBI on secondary market trading, introduction of a Negotiated Dealing System etc enhanced considerable transparency in trading, liquidity and participation in money and governments securities. Since 1992, the deficit finance has relied increasingly on borrowing from the market rather than the previous policy of monetizing the deficit. In connection with this RBI annual policy remarked that the large market borrowing by the Government put pressure on the yields on government securities during 2009-10. The bond market, both government and corporate bonds, grew to only a more modest 40 percent by 2008 from 21.3 percent in 1996. The turnover ratio for government bonds in Indian market was lower than that in most markets in Emerging East Asia. The relative illiquidity of the government bond market was due to low level of traded bonds. Liquidity had been clearly concentrated in a few bonds and did not extend along the length of the yield curve, which has emerged to over a spectrum of 30 years. It was highly concentrated in 10 year issues and 5 year issues. Indian debt market is composed of 52% of Government securities, 21% of corporate bonds, 14% of State Development Bonds (SDL), 8% of Commercial papers and Certificate of Deposits and 5% of treasury bills as on March 31 2013. The ratio of Government securities to GDP rose from 4.8% in fiscal year 2004-05 to 7% in 2010-11 and declined to 5.9% in 2013-14. There was an increase in the annual amount of issuance, as well as average issue size over the years. Securities of 5-10 and 10-20 years of maturity accounted for 35% and 32% respectively in the total annual issuance in the primary market. The secondary market experienced a steady increase in the daily trade volume between 2009 and 2013. Trading in bonds of residual maturity 3 to 5 years accounted for 54% of the trade volume generated while 35% of the total trade volume was from the bonds of 5-10 years of residual maturity (Asian Development Bank (ADB), 2008; Credit Rating Information Services of India Ltd (CRISIL), 2013).

3 Data and Methodology

The data required for this study are collected from the Hand book on Indian economy published by Reserve Bank of India. Data of GDP at factor cost at constant

price prices (base year 2004-05), Yields of SGL transactions in government dated securities for various maturities, and Treasury bill yield for 15-91 days maturity were drawn for a period spanning from 2000 to 2014. The GDP growth rates specifically for periods such as; one quarter (q1), two quarter (q2), four quarter (q4), eight quarter (q8), twelve quarter (q12) and sixteen quarters (q16) from the corresponding periods in the previous years were calculated by the equation;

$$G_{tq} = \{(G_{tq} - G_{(t-1)q}) / G_{(t-1)q}\} * 100$$

where G_{tq} stands for the GDP growth rate in period t for the q^{th} quarter. Similarly yields of securities for various maturities were deducted from the Treasury bill yield for 15-91 days maturity to calculate the yield spread for maturity periods such as; six month (ysp6m), one year (ysp1), two year (ysp2), three year (ysp3), five year (ysp5), eight years (ysp8) and ten years (ysp10).

$$S_t = R(n, t) - R(1, t)$$

Where S_t is the yield spread and $R(n, t)$ is the yield of a government dated security of n maturity period in time t while $R(1, t)$ is yield of treasury bill with maturity of 15 to 91 days in time period t . From the unit root analysis based on Philips-Perron test the variables q1, ysp6m, ysp1, ysp2, ysp3 and ysp5 were found to be stationary at level and variables q2, q4, q8, ysp8 and ysp10 were found to be first difference stationary. The variables q12 and q16 were found to be second difference stationary.

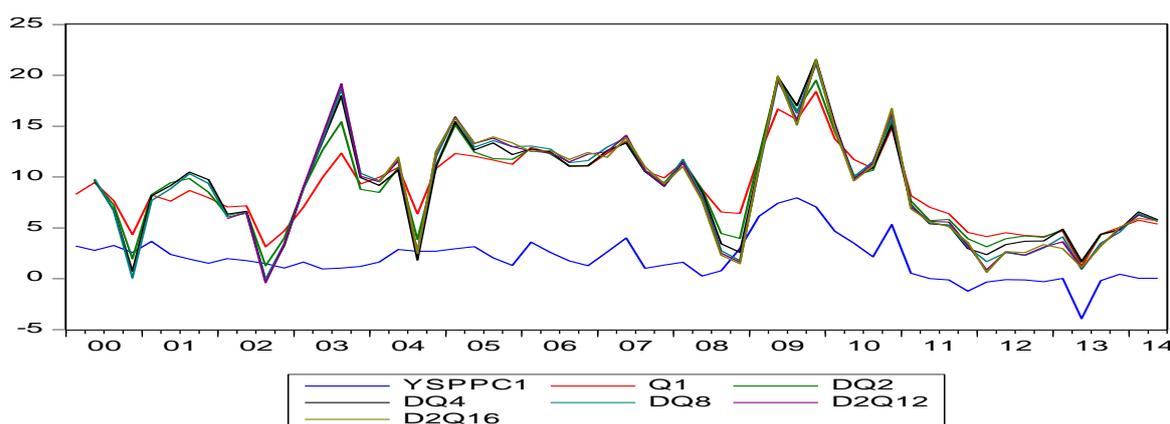
4 Results and Discussion

4.1 The Unobserved Yield Spread Component and Economic Activity

As a preliminary step, we examined; the granger causality between periodical economic growth rates with the yield spread of various maturities, after necessary transformations, as well as the possibility of co-integration among the variables using Johansen Co-integration tests. From the analysis, we observed no evidences of granger causality in either direction or possibility of long run relationship between variables. These findings confirm that yield spread of securities of various maturities individually does not possess sufficient information to predict future movements of economy over the period. But, since these evidences do not rule out the possibility that yield spreads collectively possess an unobservable component that has a bearing on predicting the future economic activity. Therefore, we culled out this common component in the yield spreads of various maturities based on principle component analysis. The results show that the first principle component explains around 91 percentage of the variability in the yield spreads of securities with various maturities.

We further examined the nature of relationship between the yield spread component (YSPPC1), which is stationary at level, and periodical economic growth rates, after transforming them to stationary, using granger causality test. The variables DQ2, DQ4, and DQ8 are first differenced values of quarter 2, quarter 4 and quarter 8 GDP growth rates while D2Q12 and D2Q16 are the second difference values of quarter 12 and quarter 16 GDP growth values. But the causality results evinced statistically insignificant causal relationship between the variables in either direction throughout the analysis period. Therefore we explored the movements of the variables over the period graphically. The figure 1 depicts the movement of YSPPC1 and GDP growth rates over the period of time. It is observed that both the variables took totally opposite positions in their local optima until 2008 but this relationship was found to be discontinued over the time periods after 2008.

Figure 1: Movement of Yield Spread Component and Periodical GDP Growth Rates



The year 2008 has its significance for various reasons. It was in this year that the financial crisis in the developed economic regions started penetrating into other emerging economic regions and caused world economy to plunge into recession. Moreover, the period followed also witnessed the direct intervention of regulatory institutions, through various measures, in the domestic economies to insulate their economies from the global financial crisis.

4.2 Structural Breaks: Granger Causality and Chow Break Point Test

Being motivated by the observations from the graphical analysis (figure 1), we divided the entire data set into two periods; pre crisis period (2000:1 to 2008:4) and crisis period (2009:1 to 2014:2) and examined the granger causality between the variables. Table 1 presents only the results of the analysis which were found to be significant at 5% level of significance.

Table 1: Pairwise Granger Causality Tests (Lags 3)

	PRE-CRISIS PERIOD (2000:1 TO 2008:4)		CRISIS PERIOD (2009:1 TO 2014:2)	
	F-Statistic	Prob.	F-Statistic	Prob.
Null Hypothesis:				
Q1 does not Granger Cause YSPPC1	0.72677	0.5453	0.99248	0.423
YSPPC1 does not Granger Cause Q1	0.29045	0.8319	7.9076	0.0021
DQ2 does not Granger Cause YSPPC1	0.65953	0.5847	0.96638	0.4343
YSPPC1 does not Granger Cause DQ2	0.56149	0.6454	3.09023	0.059
D2Q16 does not Granger Cause YSPPC1	0.18575	0.9037	1.79653	0.191
YSPPC1 does not Granger Cause D2Q16	5.1143	0.0212	1.00736	0.4168

Note: q1 stands for 1 quarter ahead gdp growth rate, yspcc1 stands for yield spread component (index), dq2 is the first difference of 2 quarter ahead gdp, and d2q16 is the second differenced 16 quarter ahead gdp.

The test results evinced the presence of unidirectional causality from YSPPC1 to GDP growth rate or in other words the results confirms the predictive power in YSPPC1 about economic activity. But the interesting finding is that in the Pre-Crisis period YSPPC1 possessed the information about the long run economic activity which is evident from the significant result of YSPPC1 granger causing D2Q16 (three year ahead GDP growth movements). This causal relationship is found to be insignificant and discontinued in the Crisis period. But, the granger causality test results in the Crisis period evinced statistically significant causal relations from YSPPC1 to Q1. It means that in the Crisis period the nature of formation of yield spread is not based on the information about the long run expectation of economic activity rather it is the information about the short run expectation about the economic activity that form the basis of yield spread. In other words, yield spread component has predictive power about shorter horizon of economic activity in the crisis period.

On the basis of the findings of unidirectional relationships between yield spread component (YSPPC1) and GDP growth rates Q1 and Q16 (D2Q16), we specified three Vector autoregressive (VAR) equations to examine the nature and magnitude of predictive power of yield spread component about the GDP growth rates. The lag structure of the VAR system was identified based on Schwarz criterion. The equations were specified as below;

$$Q1 = C(1)*Q1(-1) + C(2)*Q1(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$$

(i)

$$D2Q16 = C(1)*D2Q16(-1) + C(2)*D2Q16(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$$

(ii)

Since we have assumed the structural break point based on graphical observation, we also attempted to verify the structural break in the linear relationship between the YSPPC1 and GDP growth rates based on Chow break point test. Chow test examines if the coefficients of a linear regression run on two sets of data of same variables in two different time periods are significantly different or not. In other words, this test is often used in time series analysis to examine if any structural break in the relationship between the variables has occurred over the period of time. Therefore, the analysis was carried out in two levels; one for the entire sample period (2000:1 to 2014:2); and the other, based on the Chow test results, for the sub periods in which granger causality was found significant. Table 2 presents the results of the Chow break point test.

Table 2: Yield Spread Component (YSPPC1) and GDP Growth Rates: Structural Breaks

$Q1 = C(1)*Q1(-1) + C(2)*Q1(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$			
Null Hypothesis: No breaks at specified breakpoints			
Chow Breakpoint Test: 2008Q3			
Equation Sample: 1998Q1 2014Q2			
F-statistic	2.520425	Prob. F(5,58)	0.0393
Log likelihood ratio	13.36997	Prob. Chi-Square(5)	0.0201
Wald Statistic	12.60213	Prob. Chi-Square(5)	0.0274
$DQ16 = C(1)*DQ16(-1) + C(2)*DQ16(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$			
Null Hypothesis: No breaks at specified breakpoints			
Chow Breakpoint Test: 2008Q4			
Equation Sample: 2000Q1 2014Q2			
F-statistic	4.140933	Prob. F(5,31)	0.0054
Log likelihood ratio	20.97399	Prob. Chi-Square(5)	0.0008
Wald Statistic	20.70467	Prob. Chi-Square(5)	0.0009

The confirmation of structural break in the yield spread- economic growth relationship from the Chow test and the granger causality results motivated us to proceed to examine the nature and magnitude of the relationship between variables as specified in the VAR system generated linear equations (equation i and ii) under two regimes.

4.3 Predictive Power of Yield Spread Component about Economic Growth

The previous analysis of Granger causality has identified yield spread component granger causing three year ahead growth rate in the pre-crisis period and one quarter ahead growth rate in the Crisis period. Therefore, we estimated the coefficients

of the equations (i, ii) using Ordinary Least Square Method. Tables 3 and 4 present the results of the regression analysis together with that of Breusch-Godfrey Serial Correlation test, White Heteroskedasticity test and Normality test. Both the models were also found to be stable over the period based on CUSUM test results (not reported).

Table 3: Yield Spread Component (YSPPC1) and Three Year GDP Growth Rate (D2Q16) relation in the Pre-Crisis Period

$D2Q16 = C(1)*D2Q16(-1) + C(2)*D2Q16(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$					
	C(1)	C(2)	C(3)	C(4)	C(5)
Coefficient	0.092	-0.175	0.117	0.132	-0.54
Std. Error	0.219	0.209	0.051	0.068	0.174
t-Statistic	0.419	-0.836	2.31	1.948	-3.13
Prob.	0.682	0.42	0.039	0.075	0.009
R-squared	0.598		Adjusted R-squared		0.464
Breusch-Godfrey Serial Correlation LM Test:					
F-statistic	0.425	Probability			0.665
Obs*R-squared	1.331	Probability			0.514
White Heteroskedasticity Test:				Normality test of residuals	
F-statistic	0.325	Probability	0.933	Jarque-Bera	0.512
Obs*R-squared	4.166	Probability	0.841	Probability	0.773

Corroborating with the granger causality test results we could find that in the pre-crisis period yield spread component possessed information about the long term growth movements in the economy. It is evident from the results given in table 3 that the two period lagged values of yield spread components are significant in predicting the three year ahead economic growth rate. The reliability of the model is clear from the satisfactory results of serial correlation, hetroskedasticity and normality test results. But the relationship was found significant only in the pre-crisis period.

Table 4: Yield Spread Component (YSPPC1) and One Quarter ahead GDP Growth Rate (Q1) relation in the Crisis Period

$Q1 = C(1)*Q1(-1) + C(2)*Q1(-2) + C(3)*YSPPC1(-1) + C(4)*YSPPC1(-2) + C(5)$					
	C(1)	C(2)	C(3)	C(4)	C(5)
Coefficient	0.068	0.005	0.295	0.286	4.867
Std. Error	0.210	0.156	0.126	0.160	1.101
t-Statistic	0.327	0.033	2.341	1.787	4.419
Prob.	0.747	0.974	0.030	0.090	0.000
R-squared	0.767	Adjusted R-squared			0.718
Breusch-Godfrey Serial Correlation LM Test:					
F-statistic	0.392	Probability			0.682
Obs*R-squared	1.058	Probability			0.589
White Heteroskedasticity Test:				Normality test of residuals	
F-statistic	0.739	Probability	0.658	Jarque-Bera	0.291
Obs*R-squared	6.782	Probability	0.560	Probability	0.864

Conversely, in the crisis period, it is found that the yield spread component has significant predictive power only about one quarter ahead GDP growth rates. The coefficients of one period and two period lagged spread components were found to be significantly possessing information about the one quarter ahead growth movements which was statistically insignificant in the pre-crisis period.

5 Summary of the Findings

The examination of the predictive element in yield spread of government securities of various maturities about the future economic growth rates observed following findings;

- The yield spreads of the securities for various maturities individually does not possess sufficient information to significantly predict the future period economic growth movements; no Granger causality or co-integration was found between these yield spreads and economic growth rates in Indian economy.
- There is a common unobserved component in the yield spread which explains more than 91% of the variations in the vector of yield spread of government bonds with various maturities.
- Graphical analysis of the yield spread component - economic growth relationship evinced possibility of structural breaks in their relationships. Both the variables took totally opposite positions in their local optima until 2008 which was found to be discontinued in the later periods.
- This observation of discontinuity in the relationship was confirmed by the Chow break point test results.
- Granger causality test of yield spread component- economic growth relationship in the Pre-crisis period found significant evidences of Yield spread possessing information about three year economic growth movements in the Pre-crisis period which was found to be insignificant in the Crisis period.
- The Crisis period experienced a shift in the information possession of yield spread component about economic growth rates. The yield spread component was found to be granger causing short period (one quarter ahead) economic growth rates in this period.
- The analysis through VAR specifications of yield spread component- economic growth relationship also found significant growth predictive power of spread components and shift in their predictive ability between Pre-crisis and Crisis periods.

6 Research Implications and Scope for Further Research

The first question this study raise is about the inability of yield spreads various maturities individually fail to possess significant information about the future economic activity. It can possibly have a bearing on the nature of government securities market and the interest rate changes in India. Government securities market in India witnessed many reforms in the post reform period, with removal of restrictions, introduction of auction system and freeing of interest rates scenario, and thereby the interest rate risk and market risk increased along with the possibility of competitive pricing and substitution. But, though government bond market constitutes more than 50% of the

total debt market composition in India, there are significant differences in the new issuances and trading concentrations across bonds of various maturities. Securities of 5-10 years maturity accounted for 35% of annual issuance in the period from 2004 to 2013. The share of bonds with maturity period less than 5 years was significantly low over this time period. Though the trade volume in the secondary market increased over 300% between 2009 and 2013, the bonds of maturity up to 5 years found to be dominating in the periods of rising yield periods while the bonds with maturity above 5 years dominated in the yield falling periods. Bonds of maturity up to 3 years accounted for less than 5% of total trade volume generated while bonds with 3-5 years of maturity and 5-10 years accounted for above 41% and 50% of the trade volume in the year 2013. In short, illiquidity and concentration of trading in specific segments can be considered as the reason for the disproportionate information possession of the yield spreads of bonds with various maturities.

RBI annual policy remarked that the large market interventions by the Government put pressure on the yields on government securities during 2009-10. The continued efforts of the monetary as well as political institutions, through various mechanisms, to insulate the economy from the shocks of global financial crisis can be attributed to structural breaks in the yield spread- economic growth relationship during the crisis period. The interest rate was at its decadal lowest level in the year 2010. The share of scheduled commercial banks in the ownership of government bonds have declined from 71% to 54% in the period between 2004 and 2011. The Crisis period also experienced an emergence of inverted yield curve in the Indian market, indicating a shadow of recession expectation in the future. If recession is expected in the future the demand long maturity bond would increase resulting in its price to rise and fall in its yield. This would lead to selling of the short term securities and rise in their yields. To sum up, the development of inverted yield curve, changes in the pattern of holding of bonds by market participants, uncertainty about the further shocks in the international market and increased risk premium of world economy could be considered as the reasons for the shifts in the information possession of yield spread component in the Crisis period.

The sphere of this analysis was limited to yield spread- economic growth relationship. But an examination of; dynamic role of inflation, fiscal interventions and changes in both domestic as well as international interest rates upon the formation of yield curves; growth predictive power of yield spreads in an endogenous system of all these variables; nature of yield curve formation in an emerging debt market are some of the areas which would substantiate the findings of this study.

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