Examining the Linkage Dynamics and Diversification Opportunities of Equity and Bond Markets in India

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Abstract: *The seminal work of Markowitz (1952) has generated extensive literature in the area of portfolio diversification. Substantial literature, however, has focused on all equity portfolios. Extending the same philosophy of low correlations and assets with different risk factors, one can argue that a portfolio combining equity and bond assets may also provide minimum risk. This argument however may turn invalid in the event the two markets exhibit considerable degree of comovement in which case the developments in one market can impact the returns in the other market. Although it is well known that equity and bonds have distinct risk factors, the existing literature on the relationship between the two markets in several countries has indicated that there are conditions under which the markets exhibit comovement thus reducing the opportunities for diversification. The present paper therefore attempts to evaluate the linkages between stocks and bonds segments in Indian capital markets using vector autoregression methodology. It is concluded that while equity and bond prices in India do not show any significant comovement, the corporate bond prices are impacted by developments in government bond market.*

I. INTRODUCTION

Diversification of portfolios is a meaningful strategy for investors in capital markets. Across the spectrum of varied classes of investors ranging from domestic retail investors to international institutional investors, this strategy holds true and advisable. Therefore, a significant quantitative and qualitative analysis is undertaken by all types of investors to identify such assets and asset classes that will create a well diversified portfolio capable of offering an in-built compensation mechanism. The idea is basically to ensure inclusion of such assets in a portfolio that are impacted by different risk factors thus reducing the probability of erosion in investment capital on account of certain given risk factors. An approach followed by global investors in segregating these risk factors is to allocate their investment capital to different countries and particularly to those sharing insignificant correlations with home country. On the other hand domestic investors attempt sectoral diversification to minimize portfolio risk while dealing in equity markets. However, such a diversification is still happening within the common asset class of equity. Whereas, there might be a bigger opportunity for diversification in a portfolio that combines different assets classes that react differently to given risk factors. It is in this context that one can evaluate diversification opportunities by combining the asset classes of equity and debt. In fact, an important reason for within equity sectoral diversification particularly in emerging markets like India has been a limited interest of investors in debt market which further is an outcome of limited understanding of debt market dynamics. While development of debt market and increasing market participation therein is yet another policy issue to be researched, this paper empirically examines whether the theoretically propounded advantages of the two asset classes viz. equity and bonds can help in reducing the risk of portfolio that combines these assets.

Equity and fixed income securities markets are affected by some common and at the same time some distinct factors. Equities and bonds thrive under different market conditions. In a slowing economy, the profits contract and therefore stock prices may fall. However, an intervention such as reduction in interest rates may result in increase in prices of bonds. Thus, in a portfolio of stock and bond, the losses in stocks may be compensated by gains in bonds thereby reducing the overall portfolio risk. However, such advantage accrues as long as the stock and bonds do not exhibit significant correlation and comovement. Any change in this structure may nullify the diversification benefits. The relationship between these asset classes therefore must be evaluated empirically to assess the dynamics of their linkages and return comovement.

II. LITERATURE REVIEW

Ever since the significance of negative correlation across portfolio assets was highlighted by Markowitz (1952) for efficient portfolio diversification, academic and practitioners have laid equal emphasis on identifying such assets that share low correlations. Theoretically, one would assume low correlations between stocks and bonds and hence opportunity for diversification. Early studies in developed countries, in fact, have also revealed that stocks and bonds have weak correlations. Fama and Schwert (1977), for instance, found

negative correlation between stock and bond market returns for US market. Campbell and Ammer (1993) also studied the relationship between stocks and bond returns in US and concluded that excess stock and bond yields are nearly uncorrelated. Patoda and Jain (2012) after examining stock and bond returns relationship in India using regression model, concluded that these markets share negative and insignificant correlation during the period of economic recovery, although they also observed significant positive correlations between the two markets during the recession phase. Assuming that in crisis period, investors generally tend to shift asset allocation more in favour of less risky securities like bonds from risky assets like equities, there should be ideally a negative relationship between stock and bond prices. Gulko (2002), for instance, did find that such negative correlations exist between stock and bond prices in crisis period and therefore these assets do provide diversification benefits.

At the same time, it has to be agreed that these correlations may not remain constant across various time periods. Several studies therefore, have also focused on examining the time-varying-correlation structure between stocks and bonds. Ilmanen (2003) and Saleem (2011) provided evidence that the assumption of constant correlation between stock and bond returns is not true and it is indeed time-varying. Besides, studies have also pointed out that many a times, the linkage dynamics between stocks and bonds tend to be country specific. For instance, studies by Li and Zou (2008), and Ahmed and Joher (2009), did not provide any evidence of significant negative correlation between stock and bond prices in China and Malaysia respectively during the crisis period. However, Gulko (2002) as stated earlier, did find contradictory evidence for US markets. Similarly, Gencer (2015) conclude that Turkish financial markets exhibit significant negative correlation between stocks and bonds. Ogum (2009) on the other hand suggests that the evidence of Gulko (2002) of decoupling between stock and bond does not hold true for South African markets. The author in fact proves that both the stock and bond markets are affected by common macroeconomic conditions and hence their return volatilities have positive correlation. Johansson (2010) also provides evidence of significant volatility spillover between stock and bond markets in nine emerging markets in Asia.

The findings from the literature reveal that a considerable degree of dynamics exists between stock and bond prices. For emerging markets in particular, there is a need to study the financial market linkages within domestic markets as most literature has attempted to focus on contagion effect across markets. Similarly, a gap in literature exists in terms of price comovement studies as several studies have attempted to examine volatility linkages across bond and stock markets. In the context of India in particular, with retail government and corporate bond market being available, it would be interesting to examine if stock and bond price comovements provide any scope for constructing an automatically hedged portfolio. It is also known that within the asset class of bonds, there exist different instruments of return, primarily, government bonds and corporate bonds. There is a possibility of stocks having different dynamics with different type of bonds. Further, it is important to understand the linkages and comovement between different categories of bonds as well. This will help in understanding the impact of innovations in one category of bonds on the other and thus provide useful inputs on portfolio construction. The evidence on these aspects is particularly limited in the literature and more so for Indian financial markets. The present paper attempts to fill this gap and evaluate relationship between not only stocks and bonds in Indian financial markets, but also between different categories of bonds.

III. DATA AND METHODOLOGY

The study evaluates aspect of dynamic linkages between stock and bond markets in India using daily data of popular stock market and bond market indices. The time series of daily prices of BSE Sensex, S&P BSE India Government Bond Index and S&P BSE India Corporate Bond Index are collected for the period from January 2014 to August 2017. The data period is so selected as the stated bond market indices were officially launched by Bombay Stock Exchange on December 31, 2013. While bond index data is available for above indices even for prior period, this data has not been considered as it is an estimated data and not actual data. The required data is collected from the websites of Bombay Stock Exchange and Asia Index.

For each of the indices, logarithmic returns have been computed as follows:

$$\ln R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

Where P is the daily closing price of given index.

The study applies methodology of Vector Autoregression (VAR) developed by Sims (1980). VAR model is ideal in this situation as it provides a multivariate framework where changes in particular variable are related to changes in its own lags and to changes in other variables and the lags of those variables. The model thus can help in identifying main channels of interactions and simulates the responses of a given market to innovations in other markets. The VAR model can be expressed in its standard form as:

$$\ln R_t = C + \sum_{k=0}^{p} A_k R_{t-k} + \varepsilon_t \quad (2)$$

where $\ln R_t$ is the m x 1 column vector of daily returns on indices at time t, C is the m x 1 column vector of constant terms, A_k are m x m matrices of coefficients such that the (i, j)th component of A_k

measures the effect of change in the jth market on the ith market after k periods, ε_t is an m x 1 column vector of unobserved disturbances assumed to satisfy the usual assumptions of the errors from an OLS regression. Eq. (2) assumes a return generating process where the return of each market (stocks, government bonds and corporate bonds) is a function of a constant term, its own lagged returns, the lagged returns of other variables in the system, plus an error term ε_{it}, which is serially uncorrelated but can be contemporaneously correlated. In other words, the returns of a market incorporate not only its own past information, but also the past information of other markets.

Using VAR model two important questions related to integration of two markets can be answered – one, how fast are the price movements in one market transmitted to other markets; two, how much of movements in one market can be explained by innovations in other market. The first question can be answered by generating impulse response functions (IRFs) which measure the response of different markets to shock of 1 standard error in a particular market; and the second by computing forecast error variance decompositions (FEVD). Before implementing VAR methodology it is necessary to test for stationarity of return variables to avoid the problem of spurious regression (Granger and Newbold, 1974; Phillips, 1986). The popular Augmented Dickey-Fuller (Dickey and Fuller, 1979) test is used to test the stationarity of the variables. If all the variables are stationary at levels, then VAR model is appropriate. However, if there are variables that become stationary at first difference, then testing of cointegration is required which if exists, a vector error correction model (VECM) would be more appropriate.

IV. RESULTS AND DISCUSSION

Test of stationarity

The results of ADF test on all the variables are presented in Table 1 below:

Table1: Results of Stationarity Test Using ADF Test

Variable	ADF Test Statistics			
	Without trend	P value	With Trend	P value
RLSEN(BSE Sensex)	-28.48425*	0.0000	-28.47646*	0.0000
RLGB(Government Bond)	-27.36965*	0.0000	-27.38208*	0.0000
RLCB(Corporate Bond)	-31.35681*	0.0000	-31.38313*	0.0000

Notes: (a) Lag selection for ADF test is automatic based on SIC (Schwartz Information Criterion)
(b) MacKinnon (1996) one-sided p values use for rejection of hypothesis of unit root.
(c) * indicated significance at 1% level.

The results of the ADF test indicate that all the variables are stationary at levels. Therefore, VAR model is suitable for this data.

Correlation Structure

The correlation structure across markets for different assets would provide a preliminary understanding of existing linkages. Table 2 below presents the results of Pearsons correlation for between the three variables under study.

Table2: Correlation between Selected Financial Assets

	RLSEN	RLGB	RLCB
RLSEN	1.00	0.12	0.09
RLGB	0.12	1.00	0.89
RLCB	0.09	0.89	1.00

The correlation between stock and bond markets is positive but extremely weak. The coefficient of correlation between stock returns and government bond market returns is 0.12 while that between stock returns and corporate bond market is 0.09. Interestingly, we observe that the coefficient of correlation between government bond market and corporate bond market is high at 0.89 indicating that there exist strong linkages between the two markets within the same asset class. At this preliminary level, there appears to be diversification opportunity to combine equity and bonds in Indian markets. However, the strong positive correlation between government bonds and corporate bonds is indicative of comovement between the two assets.

Analysis of Forecast Error Variance Decomposition (FEVD)

As stated earlier, FEVD analysis helps in evaluating contribution of one market to the variance in the other market. This enables in understanding the dependence structure between two markets and also in determining the direction of impact of shocks (innovations) across financial markets. The results of FEVD analysis are presented in Table 3 below.

Table3: Results of Forecast Error Variance Decomposition

Variance Decomposition of RLGB:				
Period	S.E.	RLGB	RLCB	RLSEN
1	0.001691	100.0000	0.000000	0.000000
2	0.001704	99.65545	0.187569	0.156980
3	0.001707	99.44411	0.369030	0.186855
4	0.001710	99.35613	0.376642	0.267226
5	0.001714	99.28254	0.399423	0.318035
6	0.001714	99.27311	0.408346	0.318539
7	0.001714	99.26807	0.413433	0.318497
8	0.001714	99.26701	0.414511	0.318477
9	0.001714	99.26557	0.415572	0.318857
10	0.001714	99.26526	0.415789	0.318953
Variance Decomposition of RLCB:				
Period	S.E.	RLGB	RLCB	RLSEN
1	0.001160	83.96404	16.03596	0.000000
2	0.001168	82.84297	16.90934	0.247694
3	0.001168	82.74931	16.99192	0.258765
4	0.001169	82.75778	16.97617	0.266052
5	0.001169	82.73909	16.99337	0.267541
6	0.001169	82.73483	16.99679	0.268375
7	0.001169	82.73540	16.99623	0.268371
8	0.001169	82.73514	16.99615	0.268706
9	0.001169	82.73496	16.99625	0.268792
10	0.001169	82.73491	16.99629	0.268796
Variance Decomposition of RLSEN:				
Period	S.E.	RLGB	RLCB	RLSEN
1	0.008474	1.247054	0.031674	98.72127
2	0.008553	2.613241	0.060699	97.32606
3	0.008563	2.607999	0.062754	97.32925
4	0.008573	2.602294	0.097405	97.30030
5	0.008582	2.599651	0.189166	97.21118
6	0.008583	2.605191	0.195148	97.19966
7	0.008583	2.605211	0.195362	97.19943
8	0.008583	2.605145	0.195397	97.19946
9	0.008583	2.606002	0.195550	97.19845
10	0.008583	2.606009	0.195726	97.19826
Cholesky Ordering: RLGB RLCB RLSEN				

From the results of FEVD in Table 3 above, a clear dependency structure between the three markets is evident. It can be observed that the Indian stock market is fairly independent from the shocks in bond markets. On day 1, the innovations in bond markets contribute to the forecast error variance in stock market only to the extent of 1.28% (both the categories of bonds collectively) whereas, more than 98% of variance in stock market is explained by shocks originating in the stock market itself. The percentage contribution of innovations in bond markets improves marginally to 2.67% on day 2 and attains a maximum level of 2.79% on day 10. A substantial contribution to error variance in stock market comes from within the market that remains at above 97% levels even on day 10.

Further, it can be observed that the innovations in government bond market are more pronounced in explaining error variance in India's equity market as compared to innovations originating in Indian corporate bond market. The innovations in government bond market contribute to more than 2% of error variance in equity market over different time periods. On the other hand, the percentage contribution of innovations in corporate bond market remains negligible at 0.19% over different time periods.

It is also observed that the innovations in equity market have negligible explanatory power in explaining error variance in bond markets. And this is true for both the categories of bond markets. On day 1, the innovations in equity market explain nothing of error variance in government bond market. In fact, it can be seen that 100% of error variance in government bond market is caused by the innovations in that market itself. Even upto 10 days, the innovations in equity market explain only 0.31% of error variance in government bond market. This thus indicates that the changes in price of government bonds are affected by other macroeconomic

factor and not by shocks originating in equity markets. For the corporate bond market also, the innovations in equity market do not have any contribution to error variance in bond market. The maximum contribution here reaches to 0.27% on day 10. In fact for rest of the days as well the same percentage contribution remains more or less applicable.

We also evaluate the dependency structure between government bond market and corporate bond market. Analysing the forecast error variance decomposition of government bond market, it can be observed that the government bond market is significantly affected by its own shocks and contribution of shocks originating in corporate bond market is miniscule. On day 1, innovations in corporate bond market do not explain any part of error variance in government bond market. For rest of the days, the there is a negligible increase in this contribution which ranges from 0.18% on day 2 to 0.41% on day 10.

On the other hand, we do find a significant impact of government bond market on the Indian corporate bond market. The analysis of variance decomposition of corporate bond market reveal that the innovations in government bond market contribute more than 80% of error variance in corporate bond market. On day 1, this contribution is 83.96% and only 16.03% of error variance in corporate bond market is explained by shock originating in that market itself. The impact remains rather consistent for other days included in analysis. In fact, the government bond market explains more than 82% of forecast error variance in corporate market for day 2 to 10. The results are indicative of one sided dependency between the two categories of bond markets in India.

Analysis of Impulse Response Functions

While FEVD analysis explains the contribution of innovations in one market to the error variance in other market, impulse response functions (IRFs) detail on the quantum of response that one market shows to the shocks originating in the other market. Besides, it also describes as to how long such response lasts in the market that gets affected by shocks from other market. This information is useful to traders in deciding timings of entry and exit and also in evaluating holding period for a particular asset.

The IRFs for cross-market impact between government bond market and equity market are presented graphically in Fig.1. The results indicate clearly indicate that both, the government bond market as well as equity market in India respond to significantly to their own shocks. On day 1, the response of government bond market to shocks originating in the same market is 0.0016 in comparison to its response to shocks originating in equity market which is 0 on day 1 and with extremely negligible variations, remains zero till 6 days. The response of government bond market to its own shocks tapers off by day 3, though with minor variations is reduced totally to zero by day 6. Similarly, the response of equity market (RLSEN) to its own shocks is tremendous at more than 0.008 in comparison to its response to shocks originating in government bond market (RLGB) which is 0.001 on day 1 and with extremely negligible variations, tapers to zero on day 3.

Figure1 Impulse Response Results for Government Bond Market and Equity Market in India

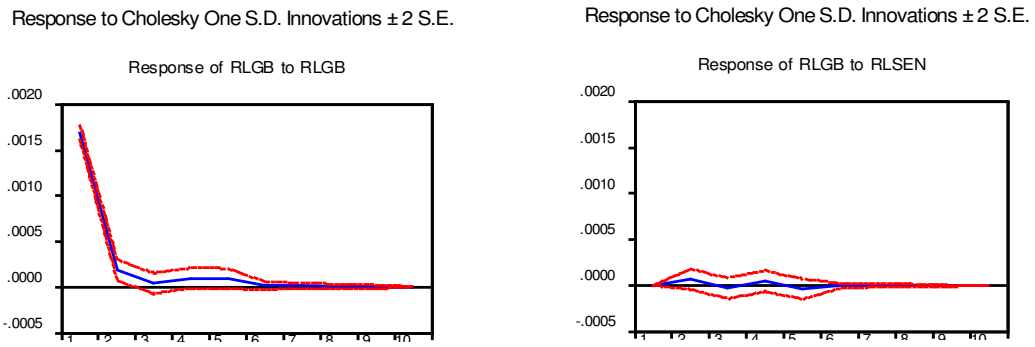


Figure2 provides graphical presentation of impulse response functions of corporate bond market and equity market.

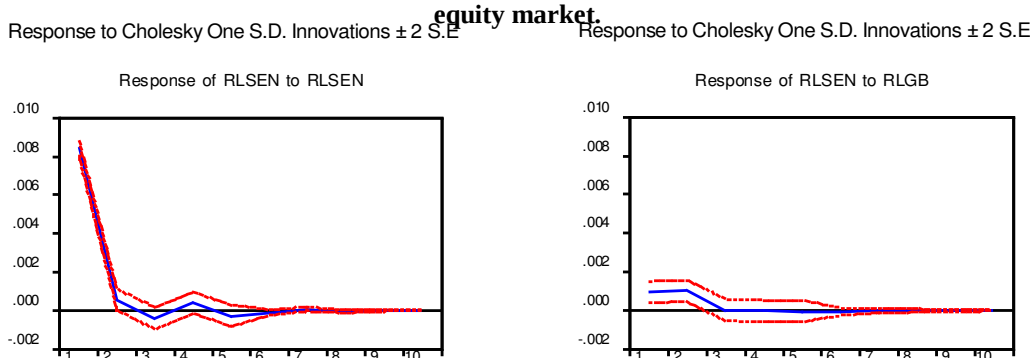
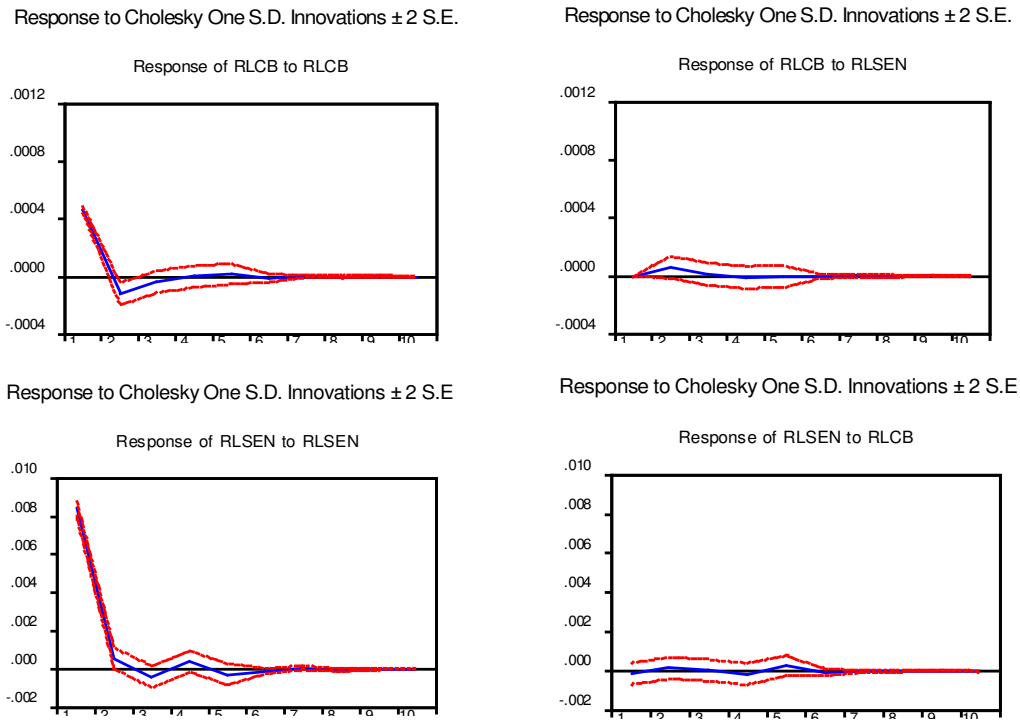


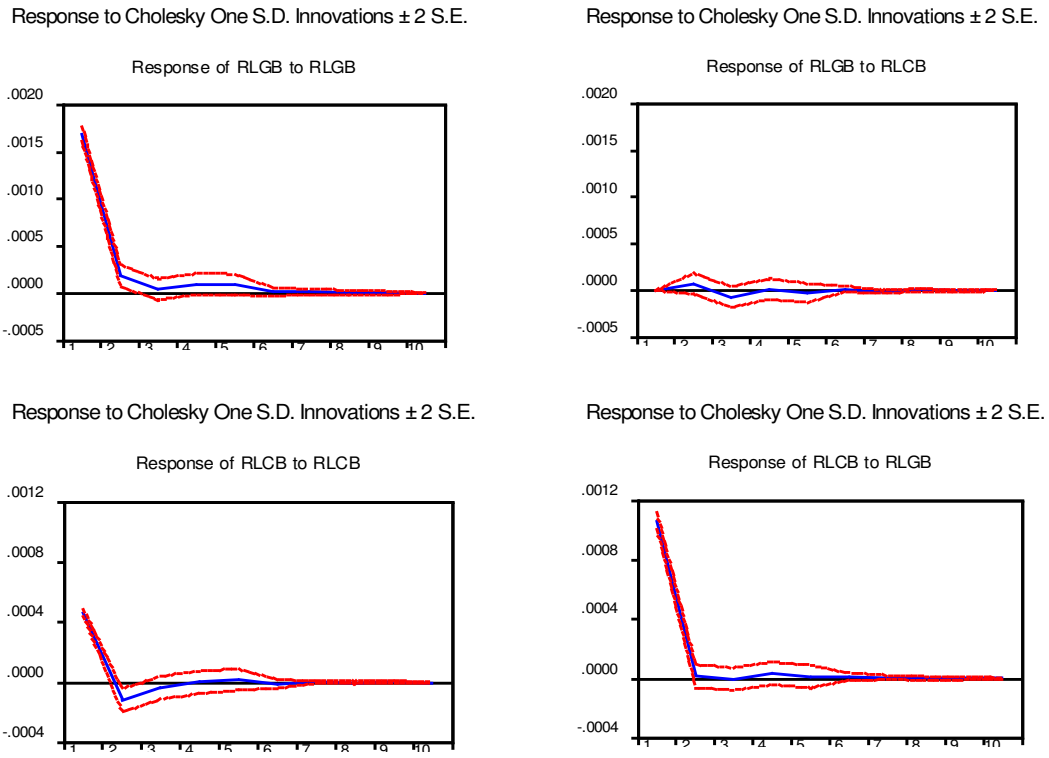
Figure2: Impulse Response Results for Corporate Bond Market and Equity Market in India



From the above figure, it can be observed that the cross-market shock relationship between Indian corporate bond market and equity market is similar to that between Indian government bond market and equity market. The corporate bond market (RLCB) responds to its own shock significantly at 0.004 on day 1 in comparison to no response to shocks in equity market on the same day. Similarly, the equity market does not respond to the shocks originating in corporate bond market in any significant manner. The response is almost zero for all the time periods in short run.

The impulse response function analysis for cross-market relationship between government bond market and corporate bond market as given in Fig.3, however, provide significant response relationship between these two markets.

Figure3: Impulse Response Results for Government Bond Market and Corporate Bond Market in India



As can be seen from the above figure, the government bond market does not respond to shocks originating in corporate bond market to any significant extent. However, the corporate bond market responds to the shocks originating in government bond market significantly. The response of corporate bond market to shocks in own market is 0.0004 on day 1 which is less than the magnitude of response of corporate bond market to shocks originating in government bond market which is close to 0.0012 on day 1. This response lasts till second trading day when it effectively becomes zero.

V. CONCLUSION

This paper examined the linkage dynamics between three categories of financial markets, viz. government bond market, corporate bond market and equity market in India in order to determine if significant linkages and comovement exists between various pairs of these markets. Existence of any such comovement results in reduction of portfolio diversification benefits due to impact of one market on the returns in other market. From the above discussion, it can be concluded that there is no evidence of comovement between bond market and equity market prices in India. The existence of extremely week correlations and co-movements between these markets indicates that there is a significant diversification benefit opportunity available to create a portfolio that combines the two asset classes of bond and equity. However, the prices in the government and corporate bond markets show considerable degree of linkages and comovement. Particularly, it is found that Indian corporate bond market is significantly impacted by the innovations in government bond market whereas reverse is not true. The investors trading in Indian corporate bond market therefore need to monitor the developments in government bond market and should ideally avoid creating an asset mix of both the categories of bonds in a single portfolio in order to reduce risk. A portfolio that combines equity and corporate bond market will have to be monitored by taking into account the developments in government bond market and macro fundamentals since there will be direct implications of such developments and shocks on the portfolio due to existence of responding asset viz. corporate bonds.

VI. REFERENCES

[1] *Ahmed, A. and Joher, H. (2009), The Equilibrium Relations between Stock Index and Bond Index: Evidence from Bursa Malaysia, International Research Journal of Finance and Economics, 30, 7-17.*
[2] *Baur, D.G. and Lucey, B. M. (2009), Flights and Contagion - An Empirical Analysis of Stock Bond Correlations, Journal of Financial Stability, 4, 339-352.*
[3] *Boyer, Brian, Tomomi K. and Kathy Yuan, (2006) How Do Crises Spread? Evidence from Accessible and Inaccessible Stock Indices. Journal of Finance 61, 957–1003.*
[4] *C. A. Sims (1980), Macroeconomics and Reality, Econometrica, 48, 1-48.*
[5] *C.W.J. Granger and P. Newbold (1974), Spurious Regressions in Econom terics, Journal of Econometrics, 2, 111-120.*
[6] *Campbell, J.Y. & Ammer, J. (1993), What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns, Journal of Finance, 48, 3-37.*
[7] *D. A Dickey and W. A. Fuller (1979), Distribution of the Estimators for Autoregressive Time Series with Unit Root, Journal of the American Statistical Association, 427-431.*
[8] *Fama, F. Eugene and William G. Schwert (1977), Asset Returns and Inflation, Journal of Financial Economics, 5(2), 115-146.*
[9] *Gencer, H. (2015), Flight-to-Quality or Contagion Effect? An Analysis From the Turkish and the US Financial Markets, Financial Theory and Practice, 39 (3), 325-340.*
[10] *Gulko, L. (2002), Decoupling, The Journal of Portfolio Management Spring 2002, 28(3), 59-66.*
[11] *Ilmanen, A. (2003), Stock-Bond Correlations, Journal of Fixed Income, 13, 55-66.*
[12] *Johansson, A. (2010), Stock and Bond Relationships in Asia, CERC Working Paper, available at http://swopec.hhs.se/hacerc/ papers/hacerc2010-014.pdf*
[13] *Li, Xiao-Ming and Li-Ping Zou (2008), How Do Policy and Information Shocks Impact Comovements of China's T-bond and Stock Markets?, Journal of Banking and Finance 32, 347–359.*
[14] *Markowitz, H. (1952), Portfolio Selection, The journal of finance 7(1), 77-91.*
[15] *Ogum, G. (2009), The Dynamic Integration of Stock and Bond Returns in an Emerging Market: Evidence From the South African Financial Markets, International Journal of Business Research, 9(4), 78.*
[16] *P. C. B. Phillips (1986), Understanding Spurious Regressions in Econometrics, Journal of Econometrics, 33, 311-340.*
[17] *Patoda, R. and Jain, K. (2012), Assimilation between Bond Market and Stock Market, Global Journal of Management and Business Research, 12(20).*
[18] *Saleem, K. (2011), Time Varying Correlations between Stock and Bond Returns: Empirical Evidence from Russia, Asian Journal of Finance & Accounting, 3(1).*