International Journal of Financial Management and Economics

P-ISSN: 2617-9210
E-ISSN: 2617-9229
IJFME 2023; 6(2): 69-76
www.theeconomicsjournal.com
Received: 12-06-2023
Accepted: 15-07-2023

Dr. Pritpal Singh Bhullar
Assistant Professor, University Business School, Maharaja Ranjit Singh Punjab Technical University, Bathinda, Punjab, India

Dr. Dyal Bhatnagar
Associate Professor, Department of business Studies, Punjabi University, Guru Kashi Campus, Talwandi Sabo, Punjab, India

Corresponding Author:
Dr. Pritpal Singh Bhullar
Assistant Professor, University Business School, Maharaja Ranjit Singh Punjab Technical University, Bathinda, Punjab, India

Impact of bond profile on bond volatility: Evidence from India

Dr. Pritpal Singh Bhullar and Dr. Dyal Bhatnagar

DOI: https://doi.org/10.33545/26179210.2023.v6.i2.225

Abstract
The main aim of this study is to investigate the relationship between bond profile and bond volatility in the Indian capital market. The dataset pertaining to the bond market has been gathered during a decade-long timeframe, spanning from 2012 to 2022. The researchers employed regression analysis, a statistical technique, to evaluate the potential influence of bond profile on bond volatility. The research findings suggest that the duration of bonds is the primary factor influencing their volatility, irrespective of their individual qualities. The findings reveal that the coupon rate does not exert a substantial influence on the conditional volatility of unsecured bonds. The empirical evidence supports a strong association between the duration of bonds and the volatility shown by unsecured bonds. Additionally, the research suggest that the evaluation of bond ratings does not have a significant impact on their conditional volatility.

Keywords: Indian capital market, bond profile, bond volatility, coupon rate, duration

Introduction
The focus surrounding the fragility of financial markets has been spiked substantial, especially followed by the recent economic crisis. The aforementioned stipulation resulted in a decline in financial stability and an erosion in investor confidence, thereby causing a dearth of funding options. Making predictions about the volatility of financial assets is regarded as a crucial undertaking. The current unforeseen turbulence amid fragile global economic environment has sparked significant interest towards an investigation of how the fixed income market responds to the recent vulnerability in the financial markets (Zhou, 2021). The global community has observed the occurrence of sovereign defaults in several emerging countries, such as Greece and Sri Lanka. These defaults have resulted in a decline in the creditworthiness of these nations and have posed challenges to their government bond issuance. Comprehending the risks associated with government bonds is crucial for policy makers, as these bonds have the potential to reduce the government's borrowing expenses, as seen by fluctuations in government bond yields. In addition, it is necessary for investors to engage in the practise of predicting long-term interest rates and valuing corporate securities and other financial instruments (Nguyen and Nguyen, 2020) [18]. Bonds, which are considered as extended financial instruments, provide a contractual obligation for the borrower to fulfil the bondholders' requirements for both interest and principal repayments within a predetermined future timeframe (Nguyen and Nguyen, 2022) [17]. Security market growth might ease monetary policy implementation. Government securities allow shock-adjusted consumption and investment. Thus, the government's borrowing costs and financial risk drop. Government securities market development improves financial stability and financial intermediaries in microeconomics. The government worries about factors affecting government bond yields, which signal its borrowing cost. Investors in the bond market face the risk that the issuing firm may not meet its obligations to repay the principal amount of the bond and make the required interest payments. Hence, it is imperative to comprehend the complexities of the corporate debt market, including the dynamics of bond volatility and the factors that influence it.
When confronted with market uncertainty, investors seeking a secure investment option may consider bonds as an alternate investing option.

Risk-averse investors exhibit a preference for allocating their capital towards established enterprises that has a proven track record of consistently earning profits. When evaluating risk mitigation strategies, having a thorough understanding of bond volatility offers substantial advantages (Guo *et al.*, 2007) [6]. By comparing and contrasting different categories of bonds, such as secured and unsecured bonds, as well as convertible and nonconvertible bonds, it is plausible for investors to better analyse their bond investments. This, in turn, enables them to mitigate risk exposure, enhance productivity, and contribute to economic expansion. In the existing body of literature, numerous authors have examined bond volatility and have made comparisons between the volatility of stocks and bonds (Pham, 2016; Chang *et al.*, 2012) [14, 4]. Based on our current understanding, there is a limited body of research examining the monthly volatility of convertible and non-convertible bonds, as well as secured and unsecured bonds. The impact of bond grading, length, and coupon rate on bond volatility has been identified as a potential area of research. However, a comprehensive review of existing literature did not yield any specific studies that have examined these factors in relation to bond volatility. The majority of scholars have limited the scope of their research to developed countries exclusively. The importance of this crucial issue among developing countries was overlooked by the previous researchers.

The objective of this study is to examine the correlation between the Bond's profile and its level of volatility within the Indian stock market. The present study encompasses a sample of 56 Indian companies, spanning the time period from 2012 to 2022. The variables of duration, grading, and coupon rate have been employed as indicators or proxies for assessing the attributes of a bond. Conditional volatility and unconditional volatility have been utilised as a measure to approximate the level of volatility in bond markets. Based on the study's findings, it is evident that the duration of a bond is the sole determinant of its volatility, irrespective of its bond type. This finding illustrates a positive correlation between longer time periods and increased levels of volatility. Hence, it is imperative for prospective bond investors to conduct a thorough examination of the bond's duration prior to engaging in any transactions.

The rest of the paper is structured as follows: Section 2 demonstrates the extant literature in the field of bond volatility. Research design has been discussed in section 3. Section 4 explains the data analysis. Section 5 highlights the discussion of the results. The concluding remarks and implications of the paper have been presented in section 6.

Review of Literature and Hypothesis Development

Kim *et al.* (2021) [12] examined the relationship between corporate bond yield spread volatility and other factors, such as interest rate volatility, equity volatility, and rating. The same sources as in Kim and Stock were used to acquire data (2014). To conduct the analysis, multiple GARCH techniques will be used to assess the volatility of corporate bond yield spreads. This is the first study to look at the volatility of interest rate spreads. This article utilised both normal GARCH and asymmetric GARCH models, including E-GARCH, T-GARCH, P-GARCH, Q-GARCH, and I-GARCH models. According to AIC, the analysis selects the best fitting models for the noncallable (callable) scenario, and Q-GARCH (T-GARCH) emerges as the most robust model. The study concluded that selected explanatory variables are statistically significant at the 1% level when the best fitted models are utilised. In addition, the results showed that there were obvious differences. Investors and practitioners alike can benefit from research findings. Helwege and Wang (2021) [9] conducted an analysis of larger bonds, finding that they provide better liquidity, which should result in lower yields. The information was gathered between January 2003 and June 2016. Selling bonds with a large face value is a simple approach for businesses to reduce their financing expenses. According to this research, mega-bonds have a higher level of liquidity than smaller bonds. Despite this, the yield spreads on High bonds are not smaller and are actually larger than the spreads on bonds issued by similar entities in the market. The discount applied to big new issuance is consistent with price pressure effects that are also reflected in the secondary market pricing of the issuing firm's current bonds, according to the literature. The findings of the investigation indicated that there is a hidden cost associated with issuing highly liquid bonds. Gupta (2021) [7] discovered how macro-risk factors affect the credit spread in India's debt market. The difference between the yields on corporate and government bonds with equal maturities is known as the credit spread. Various factors have an impact on the spread both directly and indirectly. It was determined in this manuscript that there is a relationship between these components, and it was also explored which factors explain credit spread. Through the use of a regression model, this study investigates the relevance of linear dependence of credit spread on a variety of deferent parameters. The parameters under consideration are market risk factors, such as GDP growth and inflation, as well as liquidity factors such as the repo rate. The study's findings revealed whether the null hypothesis, which claims that these factors have no effect on the credit spread, was accepted or rejected, and whether the study accepted the null hypothesis, which states that these factors have no effect on the credit spread. Meyer and Hassan (2020) [15] investigated the influence of exchange rate volatility on the South African bond market and the country's economic performance. Monthly time series data were collected for variables such as the exchange rate, bond rates, real GDP, and the Consumer Price Index (CPI) between January 2000 and December 2018. The data analysis was carried out using the GARCH and Johansen cointegration methods. The results of the Johansen cointegration test revealed that the variables are associated over a lengthy period of time. Also revealed by the results of the VECM study is that volatility in the external value of interest payments on government bonds deters investment in the South African bond market. It has also been discovered that economic progress has a negative impact on bond yield. After everything was said and done, the research determined that exchange rate volatility is one of the most important factors restricting the potential of the bond market by discouraging international investment in the sector. Trinh *et al.* (2020) [18] studied Vietnam, a developing country, for the relationship between fiscal and financial macroeconomic factors and the variance of government bond borrowing costs From July 2006 through December 2019, monthly data was collected and analysed using a sample of 1-year, 3-year, and 5-year government bonds. Bond yield volatility can be studied using the GARCH model and its derivatives such as EGARCH and TGARCH, which are applied to the specified

dataset. The term structure of interest rates is consistent with the volatility in Vietnam government bond yields, according to the study's findings. It was shown that a portion of the fluctuation in yields on Vietnamese government bonds can be related to the preceding period's rates, international rates, stock market returns, fiscal deficits and public debt. The findings of this study can be used by macroeconomic policymakers and investors to better predict the volatility of bond yields. According to research conducted by Holtemoller and Mallick (2016) [10], supply shocks are a common cause of inflation in India. This is in contrast to the experience of more developed countries, in which inflation has traditionally been seen as a demand-driven issue. A further significant conclusion of the study is that, in contrast to other measures of uncertainty shock, the interest rate uncertainty (bond volatility) shock causes an increase in interest rates (loan rates). According to the findings of state-dependent panel local predictions, the increase in interest rate that is caused by a shock to the interest rate uncertainty is likely to be greater in nations that have large levels of public borrowing and a current account deficit.

Research Objectives

- To measure the effect of variables pertaining to the profile of bonds on bond volatility.
- To measure the effect of macroeconomic variables on bond volatility.

Research Design

The present study utilised data collected from a total of 56 distinct companies. The study encompassed an 11-year timeframe spanning from 2012 to 2022. Given that the majority of previous research has relied on the BSE as their primary data source, we made the deliberate decision to gather our sample exclusively from companies registered on the NSE. The rationale for choosing the time frame of 2012-2022 is to enhance the level of certainty in the results. The data was extracted from the Prowess database of the Centre for Monitoring the Indian Economy (CMIE). The rationale for choosing the time frame of 2012-2022 is to enhance the level of certainty in the results. The examination of data from the year 2008 is primarily motivated by the occurrence of a financial crisis during that period, which significantly impacted income levels due to heightened susceptibility to market volatility. Initially, a comprehensive examination was conducted on the entire cohort of 500 companies listed on the Nifty stock exchange in order to ascertain the presence of the requisite information. In order to obtain the ultimate sample, the initial step was the exclusion of the 149 entities from the NIFTY 500 that had not engaged in bond issuance. Subsequently, the evaluation of the given criteria was conducted based on the data availability, in accordance with the standards outlined in this study. The businesses that had a consistent pattern of financial statements were selected from the remaining businesses. After the implementation of these limits, the total number of firms available for obtaining our final figures was reduced to 56.

Research Variables

Dependent variable

Bond volatility has been taken as dependent variable. Conditional volatility and unconditional volatility have been taken as dependent variables in the study. Conditional volatility is the volatility of a random variable given some extra information. It was calculated with GARCH model. It is used as dependent variable for the examine the impact of macro-economic variables on the bond volatility.

On the other side, Unconditional volatility is the general volatility of a random variable when there is no extra information. Variance was used to find the unconditional volatility. It is employed as dependent variable while investigating the probable impact of proxies of bond profile on bond volatility.

Independent variables

To measure the effect of variables pertaining to the profile of bonds on unconditional bond volatility the following proxies of bond profile were considered and ANOVA was used to examine this relationship.

Grading of bonds: The grades are given to a bond by a rating administration that shows its credit quality. The following grades have been assigned to various categories of bonds by the rating agencies.

- AAA and AA: High credit-quality investment grade.
- AA and BBB: Medium credit-quality investment grade.
- BB, B, CCC, CC, C: Low credit-quality (non-investment grade), or “junk bonds”.
- D: Bonds in default for non-payment of principal and /or interest.

Duration: Duration of bond is expressed in the form of the number of years and measures a bond’s sensitivity to change the interest rates. It is the weighted average of maturities of cash payments.

Duration formula

$$D = \frac{\sum_{t=1}^{n} \frac{t(CF_t)}{(1+k)^t}}{B_o}$$

B_O = Price of the bond
CF = Cash flow
K = interest rate
T = maturity period

Coupon Rate: The coupon rate is the interest fee paid on a bond by its guarantor for the term of the security. Once set at the issuance date, a bond's coupon rate stays unaltered and holders of the bond get fixed interest payments at a foreordained time or recurrence. (Viceira, 2011) [20]. To measure the effect of macroeconomic variables on conditional bond volatility following proxies were used for macroeconomic variables and OLS regression has been used to explore this relationship.

Inflation: Inflation is a condition of the economy when the cost of goods and services rise and consequently purchasing power of money falls. Data regarding inflation has been taken from the website RBI, money control. Inflation rate is positively related to money growth rate (Fame, 1981), (Bhullar and Bhatnagar, 2020) [3].

Money supply: Money supply is the total stock of money and other liquid instrument circulating in a country’s economy at a particular time. Data has been taken from the

website of RBI. Various researchers found a positive relationship between share price and money supply (Cheng, 1995, Dhakal *et al.*, 1993) [21, 22].

Exchange rate: The exchange rate is the rate at which values of different country's currency is equal at different prices. Data has been taken from the website of RBI. Previous research shows significant relationship between returns and exchange rates. (Bhullar *et al.*, 2018) [2].

Industrial production: Industrial production is a measure of output of the industrial sector of the economy. Data has been taken from the website of money control, various other companies' websites. Industrial production is likely to have a positive relation with bond prices through its effect on expected future cash flows. (Geske & Roll, 1983) [23] depicted a positive relationship between industrial production and stock returns.

Market interest rate: Market interest rate (treasury rate) is the rate that the government pays to lend money for various time allotments. Data has been taken from the website of RBI.

Garch Model: In this study to measure the bond volatility GRACH model has been used. GARCH (Generalized Autoregressive Conditional Heteroskedasticity) is a statistical model that has various applications for the analysis of various types of time series data in finance and economics. The GARCH model is the extension of the model of ARCH (Autoregressive Conditional Heteroskedasticity) model. ARCH is a method that distinctly models the change in variance over time in a time series (Bhullar et al., 2022; Kirby & Ostdiek, 2012) [1, 13].

"The ARCH process introduced by (Engle and Sokalska, 2012) explicitly recognizes the difference between the unconditional and the conditional variance allowing the latter to change over time as a function of past errors." Mainly, this model contains lag variance terms along with lag residual error from the mean process. It helps to model the volatility or variance which depends on past residual squared observation and past variance of series. This model explains a new parameter "p" that explain the number of lag variance terms.

P: The number of lag variances to include in the GARCH model.

Q: The number of lag residual errors to include in the GARCH model.

GARCH model is to specify the GARCH () function with the *p* and *q* parameters GARCH (p, q); following is the example of GRACH (1, 1).

$$\sigma_t^2 = \omega + \alpha^1 \epsilon^2{}_{t-}{}^1 + \cdots\cdots + + \alpha\varepsilon^2{}_{t-} + \beta_1 \sigma^2{}_{t-1} + \cdots\cdots + + \beta_p \sigma^2{}_{t-p} = \quad = \omega + \sum_{i=1} \alpha_1 \epsilon^2{}_{t-1} + \sum^{P}{}_{i=1} \beta_1 \sigma^2{}_{t=i}$$

$\sigma^2{}_t$ = Current day variance or volatility

ω = Omega or constant

$\epsilon^2{}_{t-1}$ = Previous squared residual, which is known as the ARCH term.

$\sigma^2{}_{t-1}$ = Yesterday variance or volatility, which is known as the GARCH term.

Data Analysis: The analysis pertaining to relationship among conditional and unconditional bond volatility with macroeconomic variables and bond profile variables respectively have been depicted in ensuing paragraphs.

Table 1: Descriptive Statistics

Bond Profile		Secured Bond			Unsecured Bonds			Convertible Bonds			Non-Convertible Bonds		
		N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Coupon Rate	5-7	2	2.5210	2.74904	2	0.7092	0.33436	1	4.4649	5.567	3	0.9509	0.48077
	7-9	5	10.9047	13.20290	5	4.7690	3.69393	3	16.6448	15.00205	7	4.0620	3.24938
	9-11	15	6.6182	6.98164	13	5.9849	7.46799	10	4.9603	5.67766	18	5.7434	6.61101
	11-13	6	2.6716	3.46469	7	9.4983	12.74857	4	10.5694	15.14057	9	4.4712	7.02720
	Total	28	6.2453	7.84633	27	6.2798	8.42665	18	8.1267	10.24168	37	4.7272	5.93229
Grading	AAA	5	2.9644	2.96423	5	5.6809	5.20506	3	3.9306	3.69037	7	4.4906	4.72704
	AA	16	7.0827	7.79934	18	5.8970	7.52284	10	6.0232	7.75753	24	5.6667	6.68661
	A	5	8.5484	12.03338	4	8.7514	15.77865	5	14.8512	14.92608	4	0.8729	0.52988
	B	2	1.9899	2.76974	NA	NA	NA	NA	NA	NA	2	1.9899	2.76974
	Total	28	6.2453	7.84633	27	6.2798	8.42665	18	8.1267	10.24168	37	4.7272	5.93229
Duration	0-2	15	9.9097	8.95826	15	10.7506	9.13065	10	13.9805	10.55087	20	7.3725	6.70831
	2-3	10	2.5373	3.20952	7	0.5962	0.37640	5	1.2929	1.33550	12	1.8746	3.04339
	>3	3	0.2828	0.48392	5	0.8248	0.93207	3	0.0033	0.00122	5	0.9925	0.81541
	Total	28	6.2453	7.84633	27	6.2798	8.42665	18	8.1267	10.24168	37	4.7272	5.93229

Source: Author's calculation

The statistics for secured bonds depicts statistically significant movement in the volatility of secured bonds due to the change in bond profile. The results are showing difference in the conditional volatility of secured bonds of coupon rate from 5-7 (2.5210±0.2.7490) from the coupon rate of 7-9 (10.9047±13.2090) and 9-11(6.618±6.981). It is shown that mean values of all coupon rate are positive. The similar trend can be seen among all the categories of bond grading and bond duration. All have positive mean values.

The results of descriptive statistics of unsecured bonds, the

results show the highest mean of among all the categories of coupon rate was 9.4983 in range of 11-13. About 50 percent of the bonds fall under this range. In case of grading, 66% of bonds comes under AA grading with mean value of 5.897±7.522. In context of duration, 60% of total bonds sample fall under 0-2 years duration categories. The mean values of all the categories are positive among all bond profile parameters. It shows that bond volatility moves in the same direction of bond profiles.

In context of convertible bonds, total 18 convertible bonds were considered out which 55% bonds fall under coupon rate of 11-13, 55% bonds fall under AA grading and same percentage of bonds were considered under duration of 0-2 years. Rest of the bonds comes under other categories of other understudy bond profile categories. In coupon rate maximum mean value movement was noticed under 11-13 rage with 10.5694+15.46, in case of grading profile of bonds, it was noticed under A grade with movement of 14.8512±14.926 and in duration, it was 13.980±10.550 under the category of 0-2 years.

For non-convertible bonds, all the mean values were positive under coupon rate, Grading and Duration. Total 37 bonds fall under non-convertible bond category. The maximum bonds fall under coupon rate were 52% in 9-11% category, under grading maximum were 65% under AA grading and in case of duration, 54% were fall under 0-2 years duration with maximum mean value movement of 7.3725±6.708.

Relationship between Bond Profile and Unconditional Volatility of Bonds

Table 2: Relationship between bond profile and unconditional volatility of bonds

	Convertible Bonds			Non-Convertible Bonds			Secured Bonds			Unsecured Bonds		
	Levene's	**ANOVA**	**Welch**	**Levene's**	**ANOVA**	**Welch**	**Levene's**	**ANOVA**	**Welch**	**Levene's**	**ANOVA**	**Welch**
	[Levene Stat] (Sign.)	[ANOVA Stat] (Sign.)	[Welch Stat] (Sign.)	[Levene Stat] (Sign.)	[ANOVA Stat] (Sign.)	[Welch Stat] (Sign.)	[Levene Stat] (Sign.)	[ANOVA Stat] (Sign.)	[Welch Stat] (Sign.)	[Levene Stat] (Sign.)	[ANOVA Stat] (Sign.)	[Welch Stat] (Sign.)
Coupon rate	[3.186]* (0.072)	[1.161] (0.360)	[0.834] (0.492)	[2.524]* (0.045)	[0.595] (0.622)	[5.082]* (0.013)	[5.492]* (0.005)	[1.188] (0.335)	[1.324] (0.358)	[4.210]* (0.016)	[0.664] (0.583)	[0.953] (0.411)
Grading	[7.698]* (0.005)	[1.660] (0.223)	[1.165] (0.364)	[0.902] (0.451)	[0.902] (0.451)	[4.27] (0.099)	[1.996] (0.142)	[0.661] (0.581)	[1.299] (0.366)	[3.674]* (0.041)	[0.191] (0.828)	[0.063] (0.940)
Duration	[6.371]* (0.010)	[5.75] (0.014)	[10.186]* (0.008)	[5.886]* (0.006)	[5.445]* (0.009)	[21.54]* (0.002)	[6.991]* (0.004)	[4.578]* (0.001)	[10.131]* (0.001)	[7.201]* (0.002)	[6.912]* (0.004)	[8.740]* (0.007)

Source: Author's calculations
*significant at 5% level

As can be seen from the table, all of the bond profiles (Coupon rate, Grading, and Duration) have a significant value that is less than 0.05, indicating that they are convertible bonds. This means that the Welch test is the correct one to use when examining the mean difference. Bond duration has a considerable impact on bond volatility for convertible bonds, as indicated by the Welch statistics (Welch0.05 (2, 7.38) = 10.186, P = 0.008). In this example, we reject the null hypothesis because the significance level is below 0.05. Since the p value is greater than 0.05, it can be concluded that bond quality and coupon rate have no statistically significant impact on the volatility of unsecured bonds. Hence when it comes to coupon rates and grades, the null hypothesis is not rejected.

In the event of non-convertible bonds, Levene's test shows that the Welch test is appropriate for examining the mean difference because the significant value is less than 0.05 for all bond profiles (Coupon rate, Grading, and Duration). For non-convertible bonds, the Welch statistics (Welch 0.05 (2, 21.54) = 8.434, P = 0.002) for coupon rate and duration demonstrates a substantial effect of Bond duration on bond volatility. In this example, we reject the null hypothesis because the significance level is below 0.05. Since the p value is greater than 0.05, it can be concluded that bond quality and coupon rate have no statistically significant impact on the volatility of unsecured bonds. As a result, the null hypothesis is not rejected for purposes of evaluation.

The results of the ANOVA and Welch test for secured bonds are shown in the above table. Statistics show that the coupon rate has a Levene p-value lower than 0.05. Thus, the hypothesis of no effect is rejected. The Welch test was used for the correlation analysis. The Welch test for the coupon rate was not statistically significant at the 5% level of significance (Welch0.05 (3, 24) = 3.098, P = 0.028). This finding suggests the coupon rate has no material impact on the conditioned volatility of secured bonds. The analysis of variance (ANOVA) was utilised for case grading based on the results of Levene's test. An analysis of variance at the 5% level of significance revealed no significant results (Anova 0.05 (3, 24) = 0.666, P = 0.581). Time is measured using Welch, which is derived from the Levene distribution. Welch test results at the 5% level of significance (Welch0.05 (2, 15.763) = 10.131, P = 0.001) were significant. It demonstrates the enormous impact that bond duration has on the conditioned volatility of secured bonds.

The Levene's statistical value for secured bonds is lower than 0.05 for coupon rate. Hence null hypothesis is rejected. For analyzing the relationship, Welch test was applied. For coupon rate, Welch test ($Welch_{0.05}$ (3, 24) = 3.098, P = 0.028) were found to be non-significant at 5% level of significance. It implies of no significant effect of coupon rate on conditional volatility of secured bonds. In case grading, on the basis of Levene's test, ANOVA was used. ANOVA test ($ANOVA_{0.05}$ (3, 24) = 0.666, P = 0.581) were found to be non-significant at 5% level of significance. For duration, based on the Levene's statistics, Welch is applied. Welch test ($Welch_{0.05}$ (2, 15.763) = 10.131, P = 0.001) were found to be significant at 5% level of significance. It shows the significant effect of bond duration on conditional volatility of secured Bonds. While considering unsecured bonds, in all three bond categories (coupon rate, grade, and duration), the value of p is less than 0.05. Welch was found to be a valid method of examining the mean difference. Welch test for coupon rate yielded insignificant results at the 5% level of significance (Welch0.05 (2, 12.632) = 0.411, P = 0.411). This finding suggests that the coupon rate

does not have a major role in the conditional volatility of unsecured bonds. In the case of longevity, however, the opposite was discovered. At the 5% level of significance (Welch0.05 (2, 9.74) = 8.740, P = 0.007), we find that duration significantly affects the volatility of unsecured bonds. The p value for the Welch test was greater than 0.05, making it insignificant for grading purposes. Conditional volatility of bonds is shown to be unaffected by grading.

Table 3: Post Hoc Analysis

(I) Duration_cat		(J) Duration_cat		Secured Bonds		Unsecured Bonds		Convertible Bonds		Non-Convertible Bonds	
				Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Dimension 2	0-2	Dimension 3	2-3	7.3724*	0.02	10.1544*	0.00	12.6875*	0.01	5.4979*	0.01
			>3	9.6269*	0.00	9.9258*	0.00	13.9772*	0.01	6.3800*	0.00
	2-3	Dimension 3	0-2	-7.3724*	0.02	-10.1544*	0.00	-12.6875*	0.01	-5.4979*	0.01
			>3	2.2544	0.13	-0.2286	0.86	1.2896	0.19	0.8821	0.63
	>3	Dimension 3	0-2	-9.6269*	0.00	-9.9258*	0.00	-13.9772*	0.01	-6.3800*	0.00
			2-3	-2.2544	0.13	0.2286	0.86	-1.2896	0.19	-0.8821	0.63

Source: Author's calculation, SPSS Post-hoc test outcome, *significant at 5% level

In the above table, we can see the results of the Games Howel test for all four different kinds of bonds. Specifically, the results show that the conditional volatility of convertible bonds has a large difference between the 0-2 and 2-3 duration bands. Volatility also varies with time, with the lowest volatility occurring between 0 and 2 years and the highest occurring between 3 and 5 years. For non-convertible bond, the results reveal that the mean differences between bond maturities of 0-2 and 2-3 and 0-2 and > 3 are statistically significant, with the significant value for the former being less than 0.05 and the latter being greater than 3. Therefore, the degree of risk associated with unsecured bonds varies depending on their tenure, which ranges from 0-2 to 2-3 and 0-2 to > 3.

Convertible bonds exhibit different levels of volatility between 0-2, 1-3, and 0-2-3 years, according to the data. For convertible bonds, the p-value (> 0.05) indicates that there is no difference in volatility between terms of 2-3 years and terms of > 3 years. Non-convertible bond volatility is shown to vary between bond maturities of 0-2 and 2-3 and 0-2 and > 3. Furthermore, it is determined using a p-value analysis (p>0.05) that there is no statistically significant difference between the volatility of non-convertible bonds with maturities of 2-3 years and those with maturities of > 3 years.

Relationship between Macroeconomic Variables and Conditional Bonds Volatility

Regression Equation

AVS = 4.643*Exchange rate + 0.847*Average industrial production + 0.261*Market interest rate – 4.755*IMS + 28.721

Table 4: Regression Co-efficient

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	28.721	3.700		7.763	.000		
	Exchange Rate	4.643	.563	1.291	8.241	.000	.118	8.479
	Avg. Industrial Production	.847	.243	.246	3.493	.001	.585	1.710
	Market Interest Rate	.261	.135	.122	1.938	.055	.726	1.378
	IMS	-4.755	.463	-1.722	-10.273	.000	.103	9.714

a. Dependent Variable: AV

Source: Author's calculation

The above table demonstrate the regression analysis outcome of the overall model. The results reject the null hypothesis for all the understudy variables as their significant value is lower than 0.05. This implies that all the understudy variables have significant effect on the average volatility of bonds. The VIF values of all the variables are lower than 10. Hence no multi-collinearity exists among the variables. The co-efficient of variable IMS (Inflation and Money Supply) is negative. It shows that with increase in variable, the volatility of bond decrease.

The table presented above displays the statistical results obtained from the regression analysis. The table presents an r-square value of 0.633, indicating that 63.35% of the variation in average volatility can be attributed to the independent variables being examined. The F-statistic holds substantial significance in rejecting the Null hypothesis, when its value falls below the critical threshold of 0.05. This suggests that the model holds significance and demonstrates reliability. The Durbin-Watson statistic has a value of 1.867, which is in close proximity to 2. This finding suggests the absence of multicollinearity among the independent variables.

Table 5: Regression Results

R-Square	0.633
Adjusted R-Square	0.621
F-Statistics	54.65
Sig. Value	0.000
Durbin Watson	1.867

Source: SPSS Regression output

Discussions

The primary objective of the present study is to ascertain the correlation between the bond profile and bond volatility within the Indian capital market. The dataset relevant to the bond market has been collected over a period of ten years, from 2012 to 2022. The researchers utilised regression analysis as a statistical method to assess the potential impact

of bond profile on bond volatility. The study's findings indicate that the volatility of bonds is influenced solely by their duration, regardless of their specific characteristics. As the term increases, so does the volatility. The findings indicate that there is a temporal variation in volatility, with the minimum volatility observed within the 0 to 2-year timeframe, and the maximum volatility observed throughout the 3 to 5-year timeframe. The level of risk connected with unsecured bonds exhibits variability based on their respective tenures, which encompass durations spanning from 0-2 to 2-3, as well as from 0-2 to greater than 3. Prior to making investments in bonds, investors have the option to assess the length of said bonds. The coupon rate is the factor that has the most important influence on the degree to which non-convertible bonds are volatile. There is an increase in the price of the bond whenever the coupon rate is higher than the interest rate that is currently being offered. Conversely, if the coupon rate is lower than the market interest rate, the bond's price experiences a decline. Based on the empirical evidence, it can be concluded that the coupon rate does not have a significant impact on the conditional volatility of unsecured bonds. The study presents evidence of a significant correlation between bond duration and the volatility of unsecured bonds. Moreover, the statistical results of the study indicate that the assessment of bond ratings does not exert a substantial influence on their conditional volatility.

Future directions

In the realm of future research endeavours, the prediction of the Indian market can be facilitated through the comparative analysis of returns derived from futures contracts and bonds. Based on the aforementioned findings, it is conceivable that researchers can put forth a novel categorization framework for bonds, which incorporates different temporal perspectives and the potential occurrence of a worldwide economic restructuring. Further investigation can be conducted to examine the relationship between bond volatility and the phenomenon of seasonality. Under what circumstances might the strategic implementation of hedging techniques lead to a reduction in bond volatility? In subsequent periods, it would be prudent to investigate the potential relationship between macroeconomic news and the resultant impact on bond implied volatility. The potential correlation between the volatility of Indian and international bond markets might be examined in order to ascertain whether they exhibit parallel movements. Future researchers may conduct an examination on the effective application of hedging techniques to mitigate prospective bond volatility under specific scenarios. Further research can be conducted in the future to explore the correlation between macroeconomic announcements and their influence on the implied volatility of bonds. Scholars may also strive to investigate the potential synchronisation between bond volatility in the Indian market and overseas markets.

References

1. Bhullar P Gupta, P, Bhatnagar D. Impact of COVID-19 on volatility of BSE Sensex Stock Index. International Journal of Electronic Finance. 2022;11(2):175-187.
2. Bhullar P, Gupta, P, Bhatnagar D. Impact of Buyback of Shares on Firm Value: An Empirical Evidence from India. Iranian Journal of Management Studies. 2018;11(3):425-436
3. Bhullar P, Bhatnagar D. Bitcoins as a determinant of stock market movements: A comparison of Indian and Chinese Stock Markets. Theoretical and Applied Economics. 2020;XVII3(624):193-202
4. Chang CE, WA Nelson, HD Witte. Do Green Mutual Funds Perform Well?, Management Research Review. 2012;35(8):693-708.
5. Engle RF, Sokalska ME. Forecasting Intraday Volatility in the US Equity Market. Multiplicative Component GARCH. Journal of Financial Econometrics. 2012;10:54-83.
6. Guo H, Wu G, Xiao Z. An analysis of risk for default able bond portfolios, Journal of Risk Finance. 2007;8(2):166-185.
7. Gupta P. Factors Affecting Credit Spread in Indian Debt Market. IT in industry. 2021;9(2):333-337.
8. Harford J, Uysal VB. Bond Market Access and Investment. Journal of Financial Economics. 2014;112(2):147-163.
9. Helwege J, Liying Wang L. Liquidity and price pressure in the corporate bond market: Evidence from mega-bonds, Journal of Financial Intermediation. 2021;48:100922. https://doi.org/10.1016/j.jfi.2021.100922
10. Holtemoller O, Mallick S. Global food prices and monetary policy in an emerging market economy: The case of India, Asian Journal of Economics. 2016;46:56-70.
11. Joslin S, Konchitchki Y. Interest rate Volatility, the yield curve and macro economy, Journal of Financial Economics. 2018;128:344-362.
12. Jong-Min Kim, Dong, Jung, Hojin. Applications of machine learning for corporate bond yield spread forecasting. The North American Journal of Economics and Finance. 2021;58:101540. 10.1016/j.najef.2021.101540.
13. Kirby C, Ostdiek B. It's all in the timing: Simple active portfolio strategies that outperform naïve Diversification. Journal of Financial and Quantitative Analysis. 2012;47(2):437-467. DOI: 10.1017/S0022109012000117
14. Linh Pham. Is it risky to go green? A volatility analysis of the green bond market, Journal of Sustainable Finance & Investment; c2016. p. 1-31 DOI:10.1080/20430795.2016.1237244
15. Meyer DF, Hassan AS. Analysis of the impact of exchange rate volatility on the South African Government Bond Market, International Journal of Economics and Finance Studies. 2020;12(2):271-289. DOI: 10.34109/ijefs.202012202
16. Malešević Perović L. The impact of fiscal positions on government bond yields in CEE countries. Economic Systems. 2015;39(2):301-316.
17. Nguyen, Hoang, Nguyen, Phuong Anh. The impacts of fiscal and macroeconomic factors on Vietnam Government Bond Yield. International Journal of Economics and Finance. 2022;14:23. 10.5539/ijef.v14n8p23.
18. Trinh QT, Nguyen AP, Nguyen HA, Ngo PT. Determinants of Vietnam government bond yield volatility: A GARCH approach. Journal of Asian Finance, Economics and Business. 2020;7(7):15-25. https://doi.org/10.13106/jafeb.2020.vol7.no7.015
19. Zhou S. Macroeconomic determinants of long-term

sovereign bond yields in South Africa. Cogent Economics and Finance. 2021;9:1. https://doi.org/10.1080/23322039.2021.1929678
20. Pflueger CE, Viceira LM. Inflation-indexed bonds and the expectations hypothesis. Annu. Rev. Financ. Econ. 2011 Dec 5;3(1):139-58.
21. Cheng Y. Mean shift, mode seeking, and clustering. IEEE transactions on pattern analysis and machine intelligence. 1995 Aug;17(8):790-9.
22. Dhakal D, Kandil M, Sharma SC. Causality between the money supply and share prices: a VAR investigation. Quarterly Journal of Business and Economics. 1993 Jul 1:52-74.
23. Geske R, Roll R. The fiscal and monetary linkage between stock returns and inflation. The journal of Finance. 1983 Mar;38(1):1-33.