Linkage between Stock Volatility and Corporate Bond Yield Spread in Singapore

Nafis Alam

Abstract

This paper aims to analyse the correlation between stock volatility and the corporate bond yield spreads in the Singapore Bond Market. For analysis purpose and to substantiate the findings the paper will make use of the Real Estate and Banking Sector of Singapore bond market for period of year 2000 - 2010. To capture the effect of equity volatility, Singaporean government security (SGS) interest rate and credit rating on corporate bond yield spread, OLS regression analysis was performed. Our findings concluded that the stock volatility is significantly correlated with the bond yield spread with an overall positive relationship in the presence of the credit rating and SGS interest rate spread. The analysis also concludes that the stock volatility has the highest explaining power to the yield spreads. The findings indicated that the stock volatility is very much significant in explaining the bond yield spreads with a positive correlation and is also the most powerful determinant of the yield spread.

Keywords: Stock volatility, Corporate bond yield spread, Market risk

1. Introduction

Before 1998, the size of the bond market of Singapore was not that large or developed. Reason was being, the government running budget surpluses and being self-sufficient and not feeling the need to raise funds in the capital markets. Most of the Singapore Government Securities (SGSs) were lying with banks and insurance companies while not being actively traded and were usually issued to meet banks, statutory liquidity requirements.

Since there was no detailed bond market present, private borrowers were heavily dependent on bond borrowings and equity in order to meet their funding requirements. Even though Singapore market was the least affected market when compared to others during the Asian financial crises (1997-98), it highlighted the necessity of a greater number of funding sources.

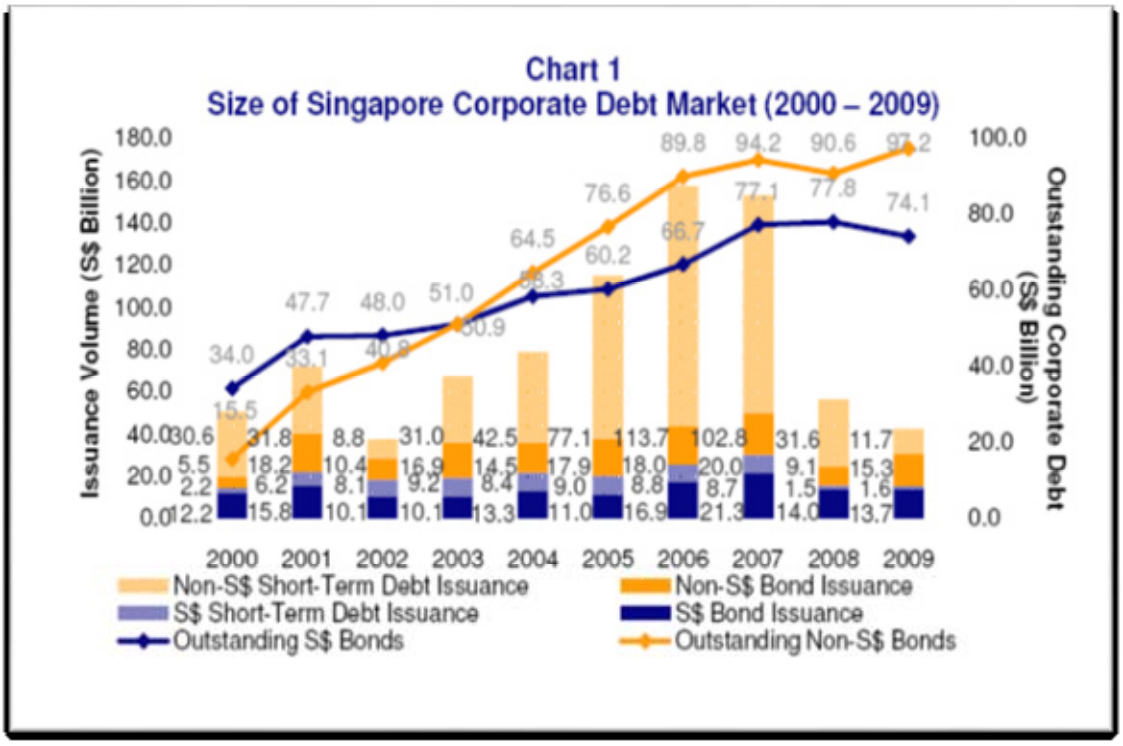
The Monetary Authority of Singapore (MAS) planned a corporate bond market development program with three basic goals: constructing a liquid government benchmark yield curve as a price discovery reference for the issuers and investors; promoting the development of a vigorous secondary market (for cash transactions and derivatives) in order to provide competent risk management and finally increasing the number of issuers and investors (both domestic and international) to participate in the Singapore debt market.

From 1996 to 2006, the Singapore corporate debt market experienced substantial growth. It grew more than five times. Corporate debts outstanding volume also increased

*Nafis Alam, Assistant Professor, Nottingham University Business School, Malaysian Campus, Malaysia.

over time; Total debt that was issued in Singapore in 2006 was S$157 billion which was 37% higher as compared to that of 2005. This included an issuance of S$ 123 billion in tenors of less than one year. The consequences of global economic meltdown of 2007-08 had negative impact on Singapore debt market with overall debt issuance decreased by 63% in 2008. This was the lowest volume of issuance observed since 2002. The SGD denominated and the Non-SGD denominated markets were both affected by the harsh market conditions in the last quarter of 2008. This caused the year-on-year drop of 48% and 67% respectively. Despite the global economic downturn, the outstanding volume of corporate debt increased by 2% to S$171 billion at the end of 2009. There was however a very large increase of 68% in the Non-SGD bond issuances. Short term debt issuances with maturities of less than one year fell sharply from S$ 33 billion to S$ 13 billion.

The size of Singapore bond market is shown in **Chart 1** below.



Source: MAS survey

In the recent times, Singapore real estate sector and banking sector has performed considerably well and contributed positively towards the nation GDP growth. The trading of most of the listed companies in real estate sector is at a greater price to earnings ratio which exhibits a high level of investors' confidence and interest in the Singapore property market and in the property stock sector. On the other hand due to the attractiveness of the Singapore financial market many multinational corporations which have set up their treasury and financial operations for the Southeast Asian region in Singapore have prompted the growth of Singaporean banking sector.

The objective of this study is to discover the correlation between stock volatility and the Singapore corporate bond yield spread in the real estate sector and the banking sector. The researcher has chosen these two sectors specially because there is very limited written researched evidence on these sectors in one of the most developed economy of South-east Asia. At the same time, there are only a few researches on Singapore markets about the determinant of corporate bond yield spread. In this paper, we will follow Campbell and Taksler (2003) methodology by applying OLS regression to investigate the relationship and linkage between stock volatility and corporate bond yield spread. Knowing this relationship could help investors when making decision on investment as well as providing empirical evidences of Merton (1974) theory in Singapore market.

The remainder of this paper is structured as follows. Section II shows the related literatures and theories including the findings of previous researchers on international and Singapore market. Next, section III explains the methodology and also gives details of the relevant explanatory variables. After that, section IV shows the empirical results and interpretations. Finally, section V reports conclusion and policy implications.

2. Literature Review

Relationship between stock and corporate bond had been studied by several researchers over the past 3 decades. Merton (1974) initiated the structure approach of contingent claim model in order to price the corporate bond. For other studies, Fama and French (1993) confirmed that stock return was linked to bond return. Followed by Kwan (1996), who found stock return and corporate bond yield are negatively correlated, which means that an increase in stock return will lead to the lessen corporate bond yield. Likewise, Kim and In (2007) had observed that changes in stock prices and bond yields do not move together in most G7 countries, except in Japan. Nevertheless, Treptow (2002) indicated that stock and bond of the same company tend to have positive correlation, which means that the underlying firm's value is the dominant factor when pricing both securities. He also discovered that stock market absorb information into price earlier than bond market. Even so, there are several researchers that study about the credit rating changes to stock return. For example, Pinches and Singleton (1978) examined whether bond rating changes impact to stock return and they found that no significant abnormal stock return appear after new rating announced. However, Griffin and Sanvicent (1982) and Dichev and Piotrosk (2001) explored that only bond downgrading has an effect on stock price, but not vice versa to bond upgrading.

For credit spread determinants, most of studies still appear in developed countries like USA, EU nations and Japan. For instance, in U.S. market, Longstaff and Schawartz (1995) discovered that credit spreads are inversely correlated with return on firm's asset (ROA) or equity (ROE), whereas, Campbell and Taksler (2003) argued that this spread could be explained by the idiosyncratic firm-level volatility. Moreover, Zhang et al (2005) had used the firm-level volatility and jump risks to explain the spread in credit default swaps. In contrast, Collin-Dufresne et al (2001) proposed that a change in credit spread was determined by aggregate factors more than firm specific factors.

The credit spread could be determine by the market return as well. Lamdin (2003), Van Lanschoot (2008) and Davies (2008) found the similar results that the return of S&P 500 play a vital role to explain the yield spreads. Davies (2008) claimed that when equity market rose, firms' leverage declined, thus, corporate bonds will have lower chance to default and the credit spread should be tightened. In addition, equity market also reflects expectation of future economy. Besides, he proposed that an increase in industrial production tends to increase asset value and leads to higher recovery rate. As a result, the price of corporate bond increases, while its yield declined and leads the yield spread to be tightened. Guha and Hiris (2002) found strong evidence that the credit spread performs counter-cyclically. They got a strong support that corporate bond spread is closely associated to the business cycle and have a tendency to increase during recession. Van Lanschoot (2008) observed the same result during recession in U.S. market, too.

The level and slope of interest rate also distress corporate bond spread; however, the signs of these variables are ambiguous. Longstaff and Schawartz(1995), Duffee (1998), Collin-Dufresne and Goldsein (2001), Van Lanschoot (2008) showed that credit spreads are robustly negative correlated with the level of interest rate. Nonetheless, Davie (2008) discovered the positive direction in his data set. For the slope of interest rate, he hinted that a shallow (steep) slope imply weaker (stronger) economic activities, decrease (increase) in firm's prospect and increase (decrease) default risk. This implied a higher (lower) yield on corporate bond and lead spread to widening (tighten). Van Lanschoot (2008) explored a significant result in both Euro and U.S. markets as well.

Looking at prior studies, it can be argued that the use of corporate bond yield spreads over corporate bond yields. Kwan (1996) got an adjusted R-squared of 60 percentage points after he regressed the variable of changes in investment-grade bond yields on changes in treasury yields and stock returns. On the other hand, Collin-Dufresne and Goldstein (2001) discovered that the adjusted R-squared value lowered by five percentage points when the dependent variable was 27 changed to changes in credit spread. This proved that there is very little learned concerning the determinants of changes in credit spread.

By looking in to the study, there was a common link between increasing idiosyncratic stock volatility and increasing yield spreads of corporate bonds relative to Treasury bonds. This indicates that the particular stock volatility and the cost of borrowing of corporate bond issuers are highly correlated. The data entails that volatility can clarify as much cross-sectional variation in yields as can credit ratings. Along with the credit ratings, stock volatility also helped in explaining during regression. Even when fixed effects were applied on each bond issuer, monthly time dummies and zero coupon spot rate with a dependent claims analysis were used, the findings matched with the ones as before. The effect of the reduced model seems to be stronger than it can be actually explained by Mertons' structured model.

Kwan (1996) found that it is the firm-specific information that drives the individual stocks and bonds at an individual firms' level and not the variance. The firm specific information is mostly linked with the mean reading of the firms' stock price. Along with the high correlation, Kwan (1996) discovered that latest bond yield changes were highly correlated to the past stock returns of the issuing firms. However he failed to find any correlation between the current stock return and the past values of the bond yield changes. This shows that specific information is more likely to be captured first in individual stock prices before looking into individual bond prices. Due to this reason the transmission of bond market of firm-specific information is led by the stock market.

Yield spreads of high rated bonds are linked with macroeconomic factors such as interest rates and not with the stocks issued by the firm. The yield spreads of low rated bonds and no relationship with interest rates; however they are highly correlated with their issuing firms' stocks. His conclusions specify that an AAA rated bond is nearly as good as a riskless treasury bond as compared to a risky bond. On the other hand, a speculative grade bond is more similar to equity security than a fixed income security.

3. Data and Methodology

The data has been extracted from the Singapore Stock Exchange (SGX) database and the Bloomberg financial database. Both of these databases include variables which are issuer-specific such as equity prices, corporate bond yield spreads, credit ratings and the Singapore government securities (SGS) rates.

Our sample in this study has only been restricted to the (SGD) corporate bonds from the Real Estate and the Banking sector. As mentioned earlier, these sectors are chosen because there is very little published evidence regarding these two sectors. Also these sectors have shown substantial growth in the recent past. There are a total of 18 corporations as an aggregate of the two sectors. However, we have included only 10 of them in our analysis. This is because there were no corporate bonds issued by the rest of the 8 companies which have been excluded. The firms are as follows:

Table 1 List of Firms

HBAN	*Huntington Bancshares Incorporated*	*Banks*
KEY	KeyBank/Key Corp	Banks
WFC	Wells Fargo & Company	Banks
HCN	Health Care REIT, Inc.	Real Estate Investment Trusts
HCP	Health Care Property Investors	Real Estate Investment Trusts
HST	Host Hotels and Resorts INC	Real Estate Investment Trusts
KIM	KimCo Realty Corp NY	Real Estate Investment Trusts
PCL	Plum Creek Timber Co. Inc.	Real Estate Investment Trusts
SPG	Simon Property Group, Inc	Real Estate Investment Trusts
VNO	Vornado Realty Trust	Real Estate Investment Trusts

The total number of corporate bonds in these 10 corporations is 45 whereas the total observations were 2766 (for the 10 year sample period from 2000 until 2010).

The econometrics model incorporated in this research was the OLS regression model. The independent variables which was used in the regression model are: equity volatility, credit ratings and the SGS rates (interest rate spread). The dependent variable used were the corporate bond yield spread.

We used the last traded yield spreads for the regression test. This is because considering the stale yield spreads can endanger the analysis by corrupting our regression

results. We have used the SGX and the Bloomberg financial data base to extract the corporate bonds related data. We have incorporated quotes of the corporate bonds of all the publicly traded companies from the real estate and banking sector in Singapore. Along with equity volatility, this research also considers the impact of different macroeconomic variables on the bond yield spreads for the bonds issued from 1st January 2000 to 31st December 2010. The time span that was used for equities and the interest rate spread was the daily data from 1st January 2000 to 31st December 2010. However, the bond yield spreads varied for every bond since they have different issuing dates and maturities. The interest rate spread that has been used is the difference between the 2-years and the 10-years rate. The yield spread in our study has been defined as the difference between the yield to maturity of a corporate bond and the yield to maturity of a T-bond of the same maturity.

In this study we have selected to apply the OLS regression as our main test on a few plausible variables to analyse and see all or either one of them have the capability to explain the corporate bond yield spreads. Now let's consider the determinants of the yield spreads on the returns which are offered on corporate bonds relative to returns by the government bonds. As the variables of regression, we have used equity volatilities, credit ratings and macroeconomic variable (interest rate spread). We make an attempt to discover each variable based on theoretical concept of what conclusions they may possibly lead to.

(i) Stock Volatility:

If we follow the theory then we have seen that the implied volatilities of a firm's publicly traded options can be used instead of the firm's volatility (it can act as a proxy). But since most of the corporations that we have considered in our study do not have publicly traded options, we therefore use the firm's standard deviation of the daily returns. The standard deviation is used as a simplified proxy for volatility.

The equity volatility (independent variable) was obtained by using the prices of equities of each company on the SGX. The prices were used to obtain the returns and then the returns were in turn used to generate the volatility. The returns were calculated by taking the logarithm of the current price divided by the price on the day before. Thus the daily returns were calculated for the entire sample period. The following formula was used:

$$R_t = \ln (P_t / P_t - 1)$$

The next step was to calculate the volatility which was done by using the following formula:

$$DV = \sqrt{\frac{(R_t - \bar{R})^2}{T}}$$

Where, DV = Daily volatility (Daily standard deviation of the daily SGX stock price index)

R_t = Daily returns of the SGX price index

□= Daily average returns of SGX stock price index obtained by dividing the sum of daily returns for the whole sample period by T which is the total number of days in the sample period

T = total number of days in the sample period (i.e. 2766).

Note that the summation symbol (□) is ignored in the formula because the purpose is not to find a single value for volatility for all 2766 days, but rather to find the daily volatility over the sample period of 2766 days.

Theoretically speaking, according to our expectations, the impact of standard deviation of daily excess returns on the yield spreads should be positive. When Campbell and Taksler 92003) and Collin-Dufresne et al. (2001) researched, they discovered that amongst all variables, volatility is the most powerful one in explaining the bond yield spreads.

If we base our study on Kwan's (1996) findings then our expectations will be different from that of Campbell & Taksler (2003). Kwan (1996) says that the historical stock returns have a negative effect on the bond yield spreads. But regardless of the sign of volatility's effect on the bond yield spreads, both Kwan (1996) and Campbell & Taksler (2003) agreed that the mean historical stock returns was the variable with the greatest explaining power to the bond yield spreads.

The equity prices of all the firms were extracted from the Bloomberg. In our tests, each bond's daily yield spreads are regressed against the respective firm's equity mean daily returns volatility.

(ii) Credit ratings

A concern for managers is about credit ratings the accurate costs (benefits) linked with different ratings levels in regards to credit ratings (Kisgen,2006). For example, when financial investor groups want to invest in bonds

it is the credit rating affect which affects the decision if they should invest or not, if yes what level of exposure is given to the investor groups in reference to capital requirements restrictions for making an investing in these types of bonds.

It has been tested that bond prices change because of new information found before and after the change in credit ratings, this was done by studying bond, stock, and option prices (Kliger and Sarig, 2000). It is said credit rating information is important because the concerned firm disclose information to rating agencies without disclosing any sort financial information to the general public. It has been found that a negative disclosure by rating agencies causes a detrimental movement in the market where as on the other hand when a positive disclosure is made it shows a minor response or no response at all from the market (Ederington, Yawitz, and Roberts, 1984, 1987).

For our sample, bonds ratings range from AA- to BB-. Therefore, in order to observe the impact of credit rating changes on the bond yield spreads, we create 2 dummy variables, one for the A category bonds (for AA- and A-) and the second dummy variable if for the B category bonds (BBB+, BBB- , BB- and BBB).

(iii) Interest rate spread

Credit spreads are strongly negatively related to the rate of interest, it is further said that changes in interest rates explain the alteration in credit spreads. Another important finding in relation to this is that credit spreads for firms with comparable default risk substantially differ if the assets of the firm have different interrelation with the changes in interest rates. This can better explain why bonds which have comparable credit ratings across various industries have differing credit spreads.

The sign on the level of interest rates are expected to be negative, as the drift of the risk-neutral process for the value of the firm increases (Campbell and Taksler, 2003; Longstaff and Schwartz, 1995). An increase in the drift shows that there is a decrease in likelihood of default therefore it decreases the corporate bond yield spread. It is also stated that bonds with a high grade are less sensitive to the changes that take place in the Treasury bond's term structure as compared to bonds of a lower grade (Duffee, 1998).

To calculate the level and the slope of the term structure the closest benchmark is used which is the SGS rate. The data regarding the SGS yield has been taken from Bloomberg database.

For this study, Ordinary Least Square model has been employed as the main econometric model. This is because the type of data being used is time series. Subject to meeting certain conditions, the OLS is considered most efficient in estimating time series data (Pickett et al. 2005). We have used the following equations as the regression models:

$$\text{Spread} = \alpha + \beta_1 \text{ Equity Volatility} + \beta_2 \text{ SGS Interest rate} \quad (1)$$

$$\text{Spread} = \alpha + \beta_1 \text{ Equity Volatility} + \beta_2 \text{ SGS Interest rate} + \beta_3 \text{ Credit rating} \quad (2)$$

We pooled all panel data by treating each bond trading transaction as an independent observation and run ordinary least square (OLS) regression in order to estimate the relationship between corporate bond yield spread and other deterministic group of variables.

After that, we will use those independent variables to estimate fixed effect regression for each bond issuer. This method has a purpose of removing the pure cross-sectional variation of each firm and find the relationship between corporate bond yield spread and equity volatility and other deterministic variables in the same issuing firm.

(iv) Empirical Result

To capture the effect of equity volatility, Singaporean government security (SGS) interest rate and credit rating on corporate bond yield spread regression analysis was performed as proposed by Campbell and Taksler (2003). As in our sample most of the bonds have different issue date and maturity date so they were analysed individually. The analysis is divided into two parts first to capture the effect collectively and then of each independent variable individually. Table 4.1 represents the statistical values for equity volatility and SGS rates when they were regressed over yield spread.

By performing regression analysis bond wise it was found that for most bonds yield spread was affected positively by equity volatility and SGS rates except for few. These findings are congruent with the findings of Campbell and Taksler (2003) and Longstaff and Schwartz (1995) according to which equity volatility and government securities always have a positive impact on the corporate bond yields.

Table 2 **Test Statistic and P-values of Equity Volatility and SGS Rates**

Sector	*Company*	*Bond*	*Volatility T-Stat*	*P-value*	*SGS-T-Stat*	*P-Value*
Banks	Huntington Bancshares Inc.	HBAN	15.2914	0.0000	22.0926	0.0000
Banks	KeyBank/KeyCorp	KEY	4.0429	0.0001	-8.2719	0.0000
Banks	KeyBank/KeyCorp	KEY2	18.0667	0.0000	15.3154	0.0000
Banks	KeyBank/KeyCorp	KEY3	2.3624	0.0188	-0.5846	0.5592
Banks	KeyBank/KeyCorp	KEY4	14.1203	0.0000	2.4646	0.0139
Banks	KeyBank/KeyCorp	KEY5	13.9813	0.0000	-1.4635	0.1437
Banks	KeyBank/KeyCorp	KEY6	21.6547	0.0000	19.1565	0.0000
Banks	KeyBank/KeyCorp	KEY7	21.6947	0.0000	18.3489	0.0000
Banks	Wells Fargo & Company (NYSE)	WFC1	23.2643	0.0000	15.6131	0.0000
Banks	Wells Fargo & Company (NYSE)	WFC2	20.8972	0.0000	15.5579	0.0000
Banks	Wells Fargo & Company (NYSE)	WFC3	22.2455	0.0000	16.1755	0.0000
Banks	Wells Fargo & Company (NYSE)	WFC4	13.6342	0.0000	-9.6345	0.0000
REITs	Health Care REIT, Inc. (NYSE)	HCN1	-1.5353	0.1342	-6.3662	0.0000
REITs	Health Care REIT, Inc. (NYSE)	HCN2	1.2678	0.2063	0.5455	0.5860
REITs	Health Care REIT, Inc. (NYSE)	HCN3	18.0749	0.0000	-2.6318	0.0089
REITs	Health Care property Investors	HCP1	21.8658	0.0000	6.7647	0.0000
REITs	Health Care property Investors	HCP2	21.7133	0.0000	5.3274	0.0000
REITs	Health Care property Investors	HCP3	16.0623	0.0000	-5.1477	0.0000
REITs	Health Care property Investors	HCP4	21.1657	0.0000	17.5454	0.0000
REITs	Host Hotels and Resorts Inc.	HST1	23.6905	0.0000	9.6171	0.0000
REITs	Host Hotels and Resorts Inc.	HST2	24.0537	0.0000	13.2496	0.0000
REITs	Host Hotels and Resorts Inc.	HST3	27.0517	0.0000	18.7043	0.0000
REITs	Host Hotels and Resorts Inc.	HST4	21.3482	0.0000	16.0456	0.0000
REITs	Host Hotels and Resorts Inc.	HST5	1.7215	0.0879	-0.5182	0.6053
REITs	KimCo Realty Corp NY	KIM1	4.1614	0.0000	-2.8339	0.0049
REITs	KimCo Realty Corp NY	KIM2	0.6508	0.5169	-3.9023	0.0002
REITs	KimCo Realty Corp NY	KIM3	19.6808	0.0000	1.7474	0.0809
REITs	KimCo Realty Corp NY	KIM4	21.4197	0.0000	14.9631	0.0000
REITs	KimCo Realty Corp NY	KIM5	-8.1274	0.0000	20.2075	0.0000
REITs	KimCo Realty Corp NY	KIM6	21.7225	0.0000	10.0555	0.0000
REITs	KimCo Realty Corp NY	KIM7	18.6732	0.0000	18.7540	0.0000
REITs	KimCo Realty Corp NY	KIM8	22.8247	0.0000	12.0427	0.0000
REITs	KimCo Realty Corp NY	KIM9	23.4928	0.0000	12.6496	0.0000
REITs	Plum Creek Timber Co. Inc.	PCL1	-0.9949	0.3268	-2.8664	0.0071
REITs	Plum Creek Timber Co. Inc.	PCL2	17.7615	0.0000	15.0541	0.0000
REITs	Simon Property Group Inc.	SPG1	21.5145	0.0000	5.5649	0.0000
REITs	Simon Property Group Inc.	SPG2	0.8954	0.3715	4.9937	0.0000
REITs	Simon Property Group Inc.	SPG3	-0.6620	0.5095	-9.7708	0.0000
REITs	Simon Property Group Inc.	SPG4	1.8972	0.0580	1.8753	0.0000
REITs	Simon Property Group Inc.	SPG5	1.1158	0.2656	5.6649	0.0000
REITs	Simon Property Group Inc.	SPG6	-1.1782	0.2394	6.9981	0.0000
REITs	Simon Property Group Inc.	SPG7	16.0116	0.0000	-2.5509	0.0111
REITs	Simon Property Group Inc.	SPG8	6.5113	0.0000	4.0880	0.0001
REITs	Vornado Realty Trut	VNO	20.2693	0.0000	15.8137	0.0000

When we ran the analysis for individual effect of equity volatility and SGS rates we found that equity volatility provided highest explaining power to bond yield spread which is in line with those of Campbell and Taksler (2003), Kwan (1996) and Collin-Dufresne et al. (2001) With the exception of a few bonds in our study, most of them gave an R-square value ranging between 22% and 33% with the highest value as large as 39%. This shows that volatility alone has a very strong influence on the bond yield spreads. For SGS rates the R-square values for most of the bonds were on an average of 20% which means that the SGS rates/credit spread has been significant as a determinant of the bond yield spreads but lower than equity volatility.

To further extend our analysis regression analysis was performed to capture the effect of credit rating on yield spread. The sample consisted of 43 bonds each having different issuing date and maturity date. In order to regularize the data average values for all the bonds were considered from January 2010 to December 2010. To capture the effect of credit rating a dummy variable was also introduced. The dummy variable took the value of one for AA- and A- credit rating and value of zero for BBB+, BBB- , BB- and BBB. The value of SGS interest is different for few bonds as few they were issued on different dates in 2010. Table 3 represents the average value of yield spread, equity volatility, SGS interest rates and credit rating for each bond.

Table 3 Average value of Yield Spread, Equity Volatility, SGS Rates & Credit Rating

Bond	*Avg_yield Sprd*	*Avg_volatility*	*Avg_sgs*	*Credit Rating*
HBAN	362.5523	0.0417	1.9250	0
KEY	29.4068	0.0395	1.9250	0
KEY2	288.4423	0.0395	1.9250	0
KEY3	261.9309	0.0395	1.9250	0
KEY4	189.4942	0.0395	1.9250	0
KEY5	278.6033	0.0395	1.9250	0
KEY6	226.0971	0.0395	1.9250	0
KEY7	229.0509	0.0395	1.9250	0
WFC1	136.8512	0.0308	1.9250	1
WFC2	152.0542	0.0308	1.9250	1
WFC3	169.4318	0.0308	1.9250	1
WFC4	89.2912	0.0308	1.9250	1
HCN1	218.6566	0.0152	2.0067	0
HCN2	-5.1665	0.0201	1.8984	0
HCN3	-24.2668	0.0200	1.9250	0
HCP1	233.3096	0.0265	1.9250	0
HCP2	216.5518	0.0265	1.9250	0
HCP3	252.3505	0.0265	1.9250	0
HCP4	262.0227	0.0265	1.9250	0
HST1	392.1926	0.0354	1.9250	0
HST2	395.6492	0.0354	1.9250	0
HST3	393.7688	0.0354	1.9250	0
HST4	527.9409	0.0354	1.9250	0
HST5	510.9190	0.0271	1.7154	0
KIM1	209.5156	0.0310	1.9250	0
KIM2	139.0558	0.0245	1.7597	0
KIM3	151.9935	0.0310	1.9250	0
KIM4	228.0794	0.0310	1.9250	0
KIM5	627.3005	0.0310	1.9250	0
KIM6	225.5049	0.0310	1.9250	0
KIM7	237.9535	0.0310	1.9250	0
KIM8	183.4432	0.0310	1.9250	0
KIM9	201.7350	0.0310	1.9250	0
PCL1	199.3626	0.0170	1.9941	0
PCL2	238.7780	0.0230	1.9250	0
SPG1	176.2969	0.0278	1.9250	1
SPG2	164.3073	0.0278	1.9204	1
SPG3	141.0581	0.0209	1.7237	1
SPG5	183.2737	0.0278	1.9204	1
SPG6	408.6341	0.0278	1.9250	1
SPG7	220.3715	0.0278	1.9250	1
SPG8	113.0086	0.0278	1.9250	1
VNO	249.4002	0.0269	1.9250	0
SPG1	176.2969	0.0278	1.9250	1

Two tests were performed to capture the effect of equity volatility, SGS rate and credit rating on yield spread for overall sample. The first test includes equity volatility and SGS rate (equation 1) and the second test includes equity volatility, SGS rate and credit rating (equation 2). The results are shown in Table 4.

In regression equation 1, we find that the equity volatility group could explain strongly explain corporate bond yield spread with confidence level of 99.9%. This finding was different from the empirical evidence of Campbell and Taksler (2003) in U.S. market that found the market

volatility did not explain corporate bond yield spread. We also find that the level of interest rate, which represent from the closest government bond yield have positive impact on bond spread. This finding is congruent with the findings of Campbell and Taksler (2003) according to which equity volatility has a positive impact of yield spread.

Then, we include equity volatility, SGS rate and credit rating altogether as in equation (2). We get that this regression has the highest adjusted R-squared at 42% for full sample data. This means that all the variables in each group could provide additional information to explain corporate bond yield spreads. The sign of all variables are positive except for higher rated bonds. This finding is similar to the results of Ederington, Yawitz and Roberts (1984, 1987) who found that a downgrade announcement by rating agencies causes an adverse movement in the market whereas an upgrade movement has a very negligible effect.

Table 4 **Explaining Corporate Bond yield Spreads Using OLS**

	Regression 1	*Regression 2*
Equity Volatility	12.09**	13.28**
SGS Rate	1.75**	1.93**
Credit rating		
Above A		-11.85**
Below A		22.52**
Number of Observations	2766	2766
R^2	0.3645	0.4210

** Denotes Significant at 99.9%

V. Conclusion & Limitations

The basic objective of our research was to see if there is a correlation between the equity volatilities and bond yield spreads. Along with the stock volatility, we added other determinants of yield spread as well as our independent variables such as: credit rating and interest rate spread (SGS rates). Our findings concluded that the stock volatility is significantly correlated with the bond yield spread with an overall positive relationship between the two in the presence of the other two variables (credit rating and SGS rate/interest rate spread). However as found by Campbell and Taksler (2003), our analysis also concludes that the stock volatility has the highest explaining power to the yield spreads. This signifies that whenever interest rates increase, it affects the bond value and the investors should perform valuation on a timely basis. Secondly, if the corporate bond yield is higher than that of the government bonds, it means that the interest rates are about to rise causing the value of the bond to change.

The volatility risk is of course always present in the market since the equities do experience changes in prices. But the relationship between volatility and yield is just like the risk and reward relationship.

Even though our findings match with those of the previous researchers, the results would have been much more accurate had we the panel data regression. It could not be applied to this research because panel data would have required all the 45 bonds to have the same sample period. But since in our data, each of the bonds were issued at different dates and had different maturities, we used the OLS regression model. This study was conducted on Singapore stock exchange and bond market to analyse the effect of volatility, credit rating and interest rate spread on the bond yield. This study can further be extended and cross sectional analysis can be done among the emerging market indices or using different bond markets of different countries.

References

Black, F. and Scholes, M. (1973), "The Pricing of Options and Corporate liabilities", *Journal of Political Economy*, 81, 637-654

Blume, M.E., Lim F., and MacKinlay A.C., (1998), "The Declining Credit Quality of U.S. Corporate Debt: Myth or Reality?", *Journal of Finance*, 53, 1389-1413.

Campbell, J. Y. and Taksler, G. B. (2003), "Equity Volatility and Corporate Bond Yields", *The Journal of Finance*, 58, 2321-2349

Campbell, J.Y. Lo, A. and MacKinlay, A.C. (1997), "The Econometrics of Financial Markets", Princeton University Press, Princeton, NJ

Campbell, J.Y., Lettau M., Malkiel, B.G. and Xu Y. (2001), "Have Individual Stocks Become More Volatile? An Empirical Explanation of Idiosyncratic Risk", *Journal of Finance*, 56, 1-43

Collin-Dufresne, P. Goldstein R.S. and Martin S. (2001), "The Determinants of Credit Spread Changes"

Journal of Finance, 56, 2177-2207

Donald B. Keim, Robert F. Stambaugh (1986) "Predicting Returns in the Stock and Bond Markets", *Journal of Financial Economics*, 17

Duffee, G. R. (1998), "The Relationship between Treasury Yields and Corporate Bond Yield Spreads", *Journal of Finance*, 53, 2225-2241

Ederington, H. L, Yawitz J.B. and Roberts B.E. (1984), "The Information Content of Bond Ratings", Working Paper No. 1323, National Bureau of Economic Research

Ederington, H. L, Yawitz J.B. and Roberts B.E. (1987), "The Informational Content of Bond Ratings", *Journal of Financial Research,* 10, 211–226

Fama, Eugene F., and Kenneth R. French, (1993), "Common Risk Factors in the Returns on Stocks and Bonds", *Journal of Financial Economics* 33, 3–56.

Gebhardt, William R., Soeren Hvidkjaer and Bhaskaran Swaminathan, (2005), "Stock and Bond Market Interaction: Does momentum spill over", *Journal of Financial Economics* 75, 651-690

Griffin, Paul A, and Antonio Z. Sanvicente, (1982), "Common Stock Returns and Rating Changes: A Methodological Comparison", *Journal of Finance* 37, 103-119.

Guha, Debashis, and Lorene Hiris, (2002), "The Aggregate Credit Spread and the Business Cycle", *International Review of Financial Analysis* 11, 219-227.

Huang, J. and Huang, M. (2000), "How Much of The Corporate-Treasury Yield Spread is Due to Credit Risk?" Unpublished paper, Graduate School of Business, Stanford University

Kim Hiang Liow (1997) "The Historical Performance of Singapore Property Stocks", *Journal of Property Finance,* 8, 111-125.

Kim, Sangbae and Francis In, (2007), "On the Relationship between Changes in Stock Prices and Bond Yields in the G7 countries: Wavelet Analysis", *Journal of International Financial Markets, Institution and Money* 17, 167-179.

Kisgen, D.J. (2006), "Credit Ratings and Capital Structure", *Journal of Finance*, 61, 1035–1072

Klinger, D. Sarig, O. (2000) "The Information Value of Bond Ratings", *Journal of Finance*, 12, 2879-2902

Kwan, S. (1996), "Firm-Specific Information and the Correlation between Individual Stocks and Bonds", *Journal of Financial Economic*, 40, 63-80

Leland, H. E. (1994), "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads", *Journal of Finance*, 49, 1213-1252

Longstaff, F.A. and Schwartz E.S. (1995), "A Simple Approach to Valuing Risky Fixed and Floating Rate Debt", *Journal of Finance*, 50, 789-819

Longstaff, Francis A., Sanjay Mithal, and Eric Neis, (2005), "Corporate Yield Spreads: Default Risk or Liquidity Risk? New evidence from the Credit Default Swap Market", *Journal of Finance* 5, 2213-2253

Merton, Robert C., (1974), "On the pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance* 29, 449-470.

Seong-Eng Ong, Joseph Ooi and Tien Foo Sing (2000), "Asset Securitization in Singapore: A Tale of Three Vehicles", *Journal of Real Estate Finance.*

Tsuji, Chikashi, (2005), "The Credit Spread Puzzle", *Journal of International Money and Finance* 24, 1073-1089.

Wakeman, M. (1981), "The Real Function of Bond Rating Agencies", *Chase Financial Quarterly* 1: 19 - 25