CHAPTER 5
RESEARCH RESULTS

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This chapter provides descriptive statistics of the joint time series and reports on the findings of the regression analyses. The former provides results for the hypotheses developed in Chapter 4 and presents some explanation for the documented results. The research results are divided into four sub-sections. The first sub-section describes in detail the average returns from both the stock and bond markets based on the three indices chosen for the study. The second sub-section provides the descriptive statistics on the volatility of the respective markets. The third sub-section reveals the results of the *t*-test for significance of differences in the scores for both average returns and market volatility. The final sub-section contains the results of the regression analyses and discusses the correlation or co-movement of the stock and bond market.

5.1 AVERAGE RETURNS

Table 2 below presents the average returns and its components for the stock and bond market[17]. On a yearly basis, the stock market outperformed the bond market during the pre-crisis (1996) and post-crisis (1998 and 1999) periods. However, during the crisis period of 1997, investors in the stock market would experience greater losses (-5.45 per cent) when compared to investors in the bond market (-0.48 per cent). Share prices on the KLSE fell as soon as the Ringgit was subjected to attacks and was devalued. The KLCI was about 1,000 points in early 1997. By the end of 1997, it had dipped to around 600. In tandem with the plunge in the equity market, prices for listed bonds were traded marginally lower as reflected by the drop in the RLBI (RAM's Listed Bond Index) from 100 points in early 1997 to around 90 points at end 1997.

The mix of policies and measures introduced by the Government and the KLSE during 1998 helped to turn the market around. On September 2, 1998, selective exchange control measures came into effect. Pengurusan Danaharta Nasional Berhad (Asset Management Company), Danamodal Nasional Berhad (Bank refinancing Company) and the Corporate Debt Restructuring Committee (CDRC) was set up to address the problems of non-performing loans and bank recapitalisation. Prices on the KLSE rallied strongly once the Singapore over-the-counter market called CLOB (Central Limit Order Book) was put out of action.

As the markets stabilises and regroups, the stock market returns recovered at a faster rate than the bond market. When the US and global markets weakens, and the Central Bank announcing interest rate cuts, the stock market returns moves into negative territory in 2000 and 2001. This low interest rate scenario attributed to the bond market becoming a more viable investment opportunity in 2000 (1.85 per cent) and 2001 (0.42 per cent) as investors seek better returns for their investments.

[17] A detailed month-by-month average returns for the period from April 1996 to May 2001 is shown as Exhibit 2 of Appendices

Table 2

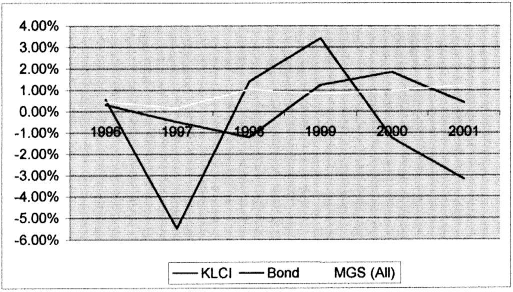
Summary Statistics of Average Returns for the Stock and Bond Market for the period from April 1996 to May 2001 (*in percentage*)

Year	KLCI	Bonds	MGS			
			All	Short	Medium	Long
1996	0.57	0.31	0.45	0.43	0.33	0.55
1997	-5.47	-0.48	0.17	0.46	.019	0.03
1998	1.41	-1.22	1.04	0.83	1.03	1.13
1999	3.41	1.24	0.83	0.85	1.08	1.00
2000	-1.25	1.85	0.98	0.49	0.77	1.12
2001	-3.18	0.42	1.23	0.61	1.20	1.97
Overall	-0.56	0.35	0.75	0.62	0.74	0.88
Lowest	-24.77	-12.40	-2.68	-0.79	-2.71	-3.51
Highest	34.23	21.12	6.55	4.85	8.63	5.32

Overall, the bond market provides an investor with a **positive net return of 0.35 per cent and 0.75 per cent** respectively for PDS and MGS. In comparison, the stock market has a negative return of 0.56 per cent during the 5-year period from April 1996 to May 2001. Typically, MGS outperform corporate bonds when the economy slows down. Therefore, for a risk adverse investor, he or she is better off investing in risk-free government securities (MGS) during the 5-year period. The above results clearly shows that the bond market is a more viable investment alternative during the period of our study[18]. Therefore, we can safely reject our *null hypothesis*, which states that the stock market is a more viable investment alternative than the bond market. A graphical illustration of the movement of the three asset returns is shown in *Figure 3*.

Figure 3

Graphical Illustration of Average Yearly Returns for the Stock and Bond Market for the Period from April 1996 to May 2001



The graphical illustration clearly indicates a positive co-movement between the returns of the stock and bond market as suggested by Shiller and Beltratti (1992), and Campbell and Ammer (1993). We shall investigate this relationship further in our regression analysis. It is also clear that the drop and rise in average returns for the stock market over the period of the study is greater than the bond market. We attribute this to market volatility.

[18] However, we must take note of the fact that other factors like capital gains and dividend payments, and discount rates are not mentioned in this study.

5.2 MARKET VOLATILITY

We examine the relative volatility of stock returns compared to the volatility of bond returns. The two specific measures of relative volatility are:

1. A moving standard deviation of monthly rates of return for 12-month calendar periods (*Exhibit 3 of Appendices*).

2. The standard deviation for discrete, non-overlapping 12-month calendar time periods.

The first measure provides a dynamic view of the changing volatility environment over this 5-year period and demonstrates the large and rapid changes in the volatility of stock and bond market returns. The second measure provides discrete measures and allows us to test for significant changes over time on a year-by-year basis.

Figure 4 shows the 12-month moving standard deviation of average returns for the period from April 1996 to May 2001. The results show the moving volatility of the KLCI steadily increasing to 18.50 per cent in December 1998 and following a brief respite, peaking at a high of 18.80 per cent in April 1999. This double peak is clearly the most volatile period in the stock market. During the same period, the bond market volatility increased from 2.60 per cent in April 1997 to level off at 6.00 per cent in April 1999. It is worth mentioning that the stock market volatility increased by 291 per cent during the 2-year period 1997-1999 as compared to the 131 per cent increase in the bond market volatility for the same period. The following years shows a steady declined in the stock market volatility due to low market activity and investors switching over to the bond market. The bond market experienced similar volatility levels as the stock market during year 2000 but eventually declined as the global economy downturn sets in. As anticipated, the MGS market has low-volatility levels since most issues are bought and kept until maturity.

Figure 4

Graphical Illustration of the Moving Standard Deviation of Returns for the Stock and Bond Markets for the Period from April 1997 to May 2001

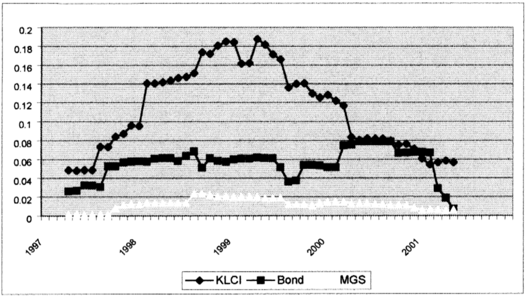


Table 3 below provides the summary statistics and lists the standard deviation for the stock and bond market returns for the 5-year period from 1996-2001. The results indicate that the high volatility years for the stock market are during the period 1998-1999, with the most volatile year being 1998 (18.50 per cent). The bond market experienced three consecutive years of relatively high volatility during the period 1998-2000, with a high of 6.70 per cent in year 2000. Overall, the average annual standard deviation for stocks is two times higher than bonds (11.50 per cent versus 5.20 per cent) but ten times more volatile than MGS (11.50 per cent versus 1.30 per cent). While the high and low stock market volatility years are almost similar to the bond market volatility results in terms of concentration, bond market volatility is more stable than stock market volatility.

Table 3

Summary Statistics of Standard Deviation for Discrete, Non-Overlapping 12-Month Calendar Time Periods for the Stock and Bond Market

(*in percentage*)

Year	KLCI	Bonds	MGS			
			All	Short	Medium	Long
1996	3.94	1.53	0.24	0.15	0.32	0.24
1997	9.58	5.74	1.27	0.60	1.30	1.56
1998	18.52	5.72	2.03	1.56	2.72	1.72
1999	12.52	5.33	1.23	0.81	1.12	1.31
2000	7.10	6.73	0.87	0.42	0.57	0.78
2001	6.72	0.46	0.86	0.18	1.11	1.39
Overall	11.49	5.20	1.30	0.84	1.48	1.26

5.3 *T*-TEST FOR SIGNIFICANCE OF DIFFERENCES IN TWO MEANS

The *t*-test is a technique used to test the hypothesis that the mean scores on some variable will be significantly different for two independent samples or groups. To use the *t*-test, we assume that the two samples are drawn from normal distributions. Because the population standard deviation is unknown, we assume the variances of the two groups are equal (homoscedasticity). The null hypothesis about the differences between groups is normally stated: $\mu_1 = \mu_2$ or $\mu_1 - \mu_2 = 0$. A series of *t*-test was conducted on the average returns as well as the moving standard deviation of monthly rates of return for 12-month calendar for the stock and bond market.

5.3.1 AVERAGE RETURNS

The null hypothesis is that there is no difference in the returns between stock and bond. The critical *t*-value of 1.98 must be surpassed by the calculated *t*-value if the hypothesis test is to be statistically significant at the 95 per cent confidence level (with n_1+n_2-2 degrees of freedom). The calculated *t*-value of –0.56 for stock-versus-bond returns does not exceed the critical value of *t* for statistical significance, so it is not significant at $\sigma = .05$. Similarly, the calculated *t*-value for stock-versus-MGS returns of –0.89 also does not exceed the critical *t*-value of 1.98. In other words, the research shows that bond return scores are not significantly higher than those of stock return. (The computer summary of the results are shown as *Exhibit 4* of Appendices)

5.3.2 VOLATILITY OF RETURNS

We apply a similar null hypothesis that there is no difference in the market volatility between stock and bond market returns. The calculated *t*-value of 8.51 for stock-versus-bond market volatility far exceeds the critical *t*-value of 1.98 for statistical significance, so it is therefore significant at $\sigma = 0.05$. Similarly, the calculated *t*-value of 15.60 for stock-versus-MGS market volatility also exceeds the critical value of *t* for statistical significance. Hence, we conclude that the market volatility of the stock market is significantly higher than the bond market for the period of our study. (The computer summary of the results are shown as *Exhibit 5* of Appendices)

5.4 REGRESSION ANALYSIS

An important question is whether the joint time series of the computed monthly returns for the stock and bond indices may be described, explained and forecasted. If successive observations are dependent, future market returns may be forecasted from past observations. We have evaluated the joint time series of stock and bond monthly return by running a multiple regression analysis explained under Section 4.4 (Data Analysis). The linear equilibrium relationship between return on stocks, R_{Stock}, and return on bonds, R_{Bond}, and returns on MGS, R_{MGS} is expressed using equation below.

- $R_{Stock} \quad = \quad \beta_0 + \beta_1 R_{Bond} + \beta_2 R_{MGS} + e$

To test the null hypothesis that R_{Bond} and R_{MGS} contributes no information for the prediction of R_s against the alternative that these variables are linearly related, we test:

H_o: $\beta_1 = \beta_2 = 0$

H_a: At least one of the parameters, β_1 and β_2, is non-zero.

<u>Table 4</u> provides the result of the regression where stock market returns is regressed against bond market returns and MGS returns using a 5 per cent significance level (The computer summary of the results are shown as <u>*Exhibit 6*</u> of Appendices).

Table 4

Results of the Regression Analysis of Joint Time Series from April 1996 to May 2001 where the Dependent Variable is Stock Market Returns and Independent Variables are Bond Market Returns and MGS Returns

Variables	Coefficients	T-Stat	P-value
Intercept (β_0)	-0.023171	-1.402390	0.166129
Bond Returns (β_1)	0.456862	1.657021	0.102916
MGS Returns (β_2)	2.116878	1.913617	0.060609
***F*-Ratio**	3.130471		
***R* Square**	0.097430		

Examining the results, we observe that both β_1 and β_2 are positive. Interpreting the results, we estimate stock market returns to increase by 0.46 per cent for every 1.00 per cent increase in bond market returns when MGS returns is held fixed. Similarly, we estimate stock market returns to increase 2.12 per cent for every 1.00 per cent increase in MGS returns when bond market returns is held fixed. The intercept coefficient is negative, which would imply that stock market returns are negative when bond and MGS returns are zero. These results would imply that there is a positive trend in the correlation between the rates of return for bonds and stocks, in tandem with studies done by Shiller and Beltratti (1992), and Campbell and Ammer (1993).

The R^2 value of 0.10 means that about 10 per cent of the variation in stock market returns is explained by variation in bond market returns and MGS returns. In general, the larger the value of R^2, the better the model fits the data. The low R^2 or multiple coefficient of determination implies a lack of fit of the model to the data. To check the predictive ability of the model, a statistical test of hypothesis is necessary, that is, a test to determine whether the model is really useful for predicting stock market returns.

5.4.1 REJECT OR "ACCEPT" NULL HYPOTHESIS?

Conducting individual *t*-test on each β parameter in the above model is generally not a good way to determine whether the model is contributing information for the prediction of R_{Stock}. A better way to test the overall utility of the above model is to conduct a test involving *all* the β parameters (except β_0) simultaneously. The test statistic used in the test for model utility is an *F*-statistic[19]. With k = 2 and 5 percent level of significance (σ = 0.05), the critical value based on 58 degrees of freedom (61-3) for the critical *F*-Ratio is 3.16. Since the computed value of the test statistic, F = 3.13, is marginally lower than the critical value, we cannot reject the null hypothesis. In other words, the model does not appear to be useful for predicting stock market returns.

However, the outcome will be different if we were to use a 10 percent significance level instead of the above 5 percent significance level. The new critical value for the *F*-Ratio will now be 2.40. Since the computed value of the test statistic does not vary significantly, F = 3.13, exceeds the new critical value, the null hypothesis can be rejected. It should be clear from the results that whether we accept or reject the null hypothesis depends critically on alpha, the level of significance or the *probability of committing a type 1 error* – the probability of rejecting the true hypothesis.

Ideally, we would like to minimize both type I and type II[20] errors. But unfortunately, for any given sample size, it is not possible to minimize both the errors simultaneously. The classical approach to this problem, embodied in the work of Neyman and Pearson, is to assume that a type I error is likely to be more serious in practice than a type II error. Therefore, one should try to keep the

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[19] The *F*-test statistic is based on k numerator (where k is the number of b parameters in the model, excluding b_0) and $n - (k + 1)$ denominator degrees of freedom. The values of F for alpha = .10, .05, .025 and .01 are taken from the table of critical values for the *F*-statistic.

[20] The probability of accepting the null hypothesis when it is, in fact, false, is called a type II error.

probability of not committing type I error at a fairly low level, such as 0.01 or 0.05, and then try to minimize the type II error as much as possible.

5.4.2 ADDING A NEW VARIABLE

Due to the marginal outcome of using a 5 per cent significance level as well as the priority in keeping the probability of committing type I error at a fairly low level, we have decided to introduce a new variable into the model at the 5 per cent significance level. The third independent variable will be the *monthly fixed deposits returns from finance companies* (shown as *Exhibit 7* of Appendices). The new linear equilibrium relationship between return on stocks, R_{Stock}, and return on bonds, R_{Bond}, and return on MGS, R_{MGS}, and return of fixed deposits, R_{FD}, is expressed using equation (5) below.

- $R_{Stock} = \beta_0 + \beta_1 R_{Bond} + \beta_2 R_{MGS} + \beta_3 R_{FD} + e$ (5)

To test the null hypothesis that R_{Bond}, R_{MGS} and R_{FD} contributes no information for the prediction of R_{Stock} against the alternative that these variables are linearly related, we test:

H_o: $\beta_1 = \beta_2 = \beta_3 = 0$

H_a: At least one of the parameters, β_1, β_2, and β_3 is non-zero.

The result of the regression where stock market returns is regressed against bond market returns, MGS returns and fixed deposit returns using a 5 per cent significance level is shown as *Table 5* (The computer summary is shown as *Exhibit 8* of Appendices).

Table 5

Results of the Regression Analysis of Joint Time Series from April 1996 to May 2001 where the Dependent Variable is Stock Market Returns and Independent Variables are Bond Market Returns, MGS Returns and Fixed Deposits Returns.

Variables	Coefficients	T-Stat	P-value[21]
Intercept (β_0)	-0.018480	-1.188940	0.239394
Bond Returns (β_1)	0.370263	1.426102	0.159293
MGS Returns (β_2)	0.748632	0.662901	0.510066
FD Returns (β_3)	-0.657300	-3.034220	0.003629
***F*-Ratio**	5.451102		
***R* Square**	0.222939		

The results indicates a negative correlation between stock market returns and fixed deposits returns; stock market returns decreases by 0.66 per cent for every 1.00 per cent increase in fixed deposit returns when bond market returns and MGS returns are held fixed. Ideally, this is true, as the investors would place cash into risk-free fixed deposits if the rates are attractive rather than invest in the stock market. The R^2 value has improved to 0.22, which means that about 22 per cent of the variation in stock market returns is explained by variation in bond market returns, MGS returns and fixed deposit returns.

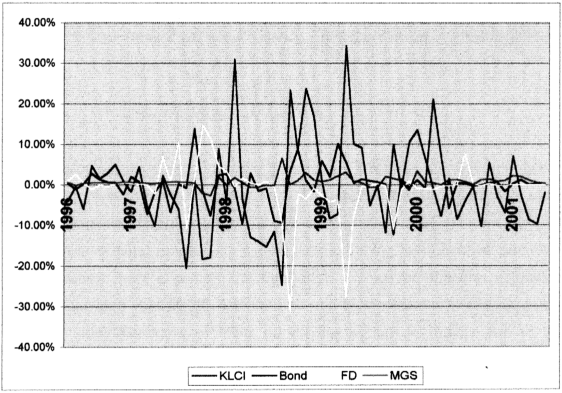
With k = 3 and 5 per cent level of significance, the critical value based on 57 degrees of freedom (61-4) for the F-Ratio is 2.77. Since the computed value of the test statistic, F = 5.45, exceeds the critical F-Ratio, we can now safely reject the null hypothesis. In other words, with the inclusion of fixed deposit returns as the third independent variable, the model now appears to be useful for predicting

[21] The p-value is often referred to as the observed significance level of the test. Usually, the null hypothesis will be rejected if the observed significance level is less than the chosen fixed significance level.

stock market returns. The co-movement of the various asset returns is graphically illustrated in *Figure 5* below.

Figure 5

Graphical Illustration of the Co-Movement of Computed Monthly Returns for the Stock, Bond, MGS & Fixed Deposits for the Period from April 1997 to May 2001



5.4.3 MARKET VOLATILITY

Based on the standard deviation for discrete, non-overlapping 12-month calendar time periods for the stock and bond market data provided in Table 3, we also ran a regression on the volatility of the stock market returns against the volatility of both the bond market and MGS returns using a 5 per cent significance level (The computer summary is shown as Exhibit 9 of Appendices). The linear equilibrium relationship between the volatility of return on stocks, V_{Stock}, and volatility of return on bonds, V_{Bond}, and return on MGS, V_{MGS}, is expressed by equation (6) below

- $V_{Stock} = \beta_4 + \beta_5 V_{Bond} + \beta_6 V_{MGS} + e$ (6)

The regression results shown in Table 6 indicate a negative correlation between volatility of stock returns and bond returns. This implies that the volatility of stock returns will decrease marginally by 0.08 per cent for every 1.00 per cent increase in the volatility of bond returns. In simple terms, trading in stocks will decrease marginally when there is a demand for bonds. However, there is a positive correlation between volatility of stock returns and MGS returns. We attribute the increase in trading volume of MGS during the period as mainly due to the increase in the issuance of MGS and the reduction in interest rates. During the year 2000 alone, the Government floated five issues of MGS amounting to RM16.4 billion (1999: RM10.0 billion), with maturities of 3, 5 and 10 years. The regular issue of the MGS will also continue to provide support for a benchmark yield curve to promote a liquid secondary domestic bond market.

The high coefficient of determination, $R_2 = 0.94$, means that the volatility of the bond and MGS returns are responsible for 94 per cent of the variation in the volatility of stock market returns. The computed F-Ratio of 23.53 exceeds the critical value of 9.55, which implies that the regression model appears to be useful for predicting stock market volatility.

<u>Table 6</u>

Results of the Regression Analysis of Market Volatility from April 1996 to May 2001 where the Dependent Variable is Stock Market Volatility and Independent Variables are Bond Market Volatility and MGS Volatility

Variables	Coefficients	T-Stat	P-value
Intercept (β_4)	0.006321	0.398152	0.717160
Bond Volatility (β_5)	-0.078910	-0.225610	0.835999
MGS Volatility (β_6)	8.623630	5.690217	0.010759
***F*-Ratio**	23.527120		
***R* Square**	0.940065		