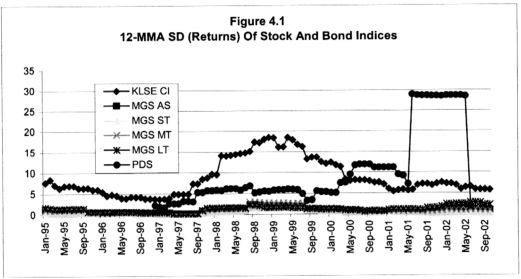
CHAPTER 4: RESEARCH ANALYSIS AND RESULTS

4.1) Bond And Stock Market Volatility Analysis

4.1.1) Description of Volatility Of Returns

12MMA SD provides a dynamic view of the changing volatility environment and demonstrates the large and rapid changes in bond and stock market volatility. It is calculated by using "STDEV" function of Microsoft Excel. Table 4.1 tabulates the 12MMA SD for stock and bond markets. The graphical form for table 4.1 is shown in figure 4.1.

Figure 4.1: 12 MMA SD For Stock And Bond Market



It is observed that stocks have higher volatility compared to bonds for the period of January 1994 to April 2000. However, PDS has the highest volatility for the period of May 2000 to May 2002. PDS is more volatile than the MGS, which is in line with the fact that PDS is more risky than MGS in terms of default risk theoretically. The standard deviation of returns for MGS is lower than 2%, compared to the SD for PDS and stocks, which are greater than 5%. MGS bonds and the stock have the same 12MMA SD profile but the magnitude of SD for stocks is about 8 times the SD for the MGS. The average 12MMA SD for stocks, MGS AS, MGS ST, MGS MT, MGS LT and PDS is 8.71%, 0.97%, 0.55%, 1.10%, 1.29% and 10.28% respectively. The

SD for MGS is pretty much low compared to the SD for stocks and PDS. PDS has the highest average volatility of 10.28% compared to the average of 8.71% for stocks, which might be due to the sudden jump of the RAM Listed Bond index on June 2001. The 99.62% return for the PDS contributes to the 12MMA SD for 12 months and this creates significant impact on the average SD for this financial asset.

Figure 4.2 shows the 12MMA SD for the stocks, MGS and PDS individually. The 12MMA SD for KLSE CI fluctuates from the lowest point of 3.66% on January 1997 to the highest record of 18.52% on December 1998. Another peak occurred on April 1999 at 18.50%. The SD for stock rises sharply from July 1997 at 4.86% to the peak of 18.52% on December 1998. The 12MMA SD for KLSE CI exceeds 8% for the period of October 1997 (8.40%) to April 2000 (8.34%), which covered the 1997 Asian financial crisis. Stocks have the highest volatility during this period. KLSE CI drops dramatically during this period due to the economic downturn. The lowest volatility period occurred from February 1996 to March 1997, which is lower than 4.5%. The average SD fluctuates within 4 – 8%.

Figure 4.2: 12 MMA SD For (i) Stocks, (ii) MGS And (iii) PDS

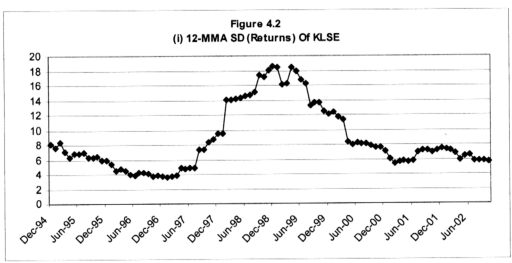


Figure 4.2
(ii) 12-MMA SD (Returns) Of MGS Bonds

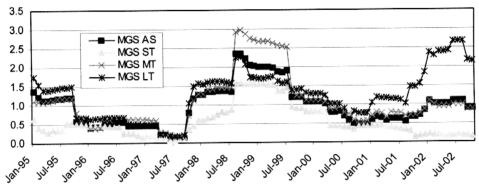
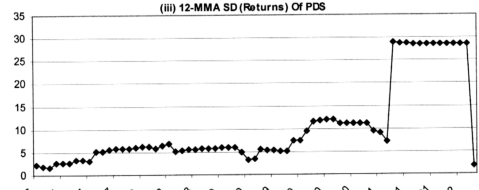


Figure 4.2
(iii) 12-MMA SD (Returns) Of PDS



The 12MMA for MGS AS, ST, MT and LT have the same profile. The SD graph shows "Head And Shoulder" during the Asian financial crisis and another minor "Head and Shoulder" seems to be forming from January 2000. 12MMA SD for MGS moves downwards from December 1994 to September 1997. SD for MGS shoots up tremendously after September 1997. The left shoulder appeared on November 1997. The standard deviation achieved the highest point during September 1998. There is a sharp rise in SD for the MGS during the period of September 1997 to September 1998. MGS MT has the highest increment of 2185% (SD increased from 0.13 to 2.97) during this period, followed by MGS AS (1708%, 0.13 to 2.35), MGS ST (1355%, from 0.11 to 1.60) and MGS LT (985%, from 0.21 to 2.28). The "Head" is formed for the period of August 1998 to July 1999. The volatility for the bonds drops

sharply on August 1999, when the right shoulder starts to form. The right shoulder hits the bottom point on August 2000. After August 2000, MGS ST has been stable and fluctuated below the 0.4% level. MGS AS and MT are moving towards a higher level of volatility (0.50 to 1.00%) compared to the period before the 1997 Asian financial crisis. MGS LT rises sharply from August 2000 at 0.56% to the second peak of 2.68% on June and July 2002. The second peak is higher than the first peak on September 1999. MGS LT is more volatile than its counterparts. However, MGS MT is more volatile than MGS LT bonds during the "Head" formation during the period of August 1998 to July 1999. MGS MT has the highest volatility record of 2.97% (September 1998), followed by MGS LT (2.68%, June 2002), MGS AS (2.35%, September 1998) and MGS ST (1.60%, September 1998). MGS LT is less volatile than MGS MT might be due to the investors' expectation that the economic crisis will affect Malaysia economy in the medium term time horizon, rather than long term.

Figure 4.2 (iii) shows that the volatility for PDS is increasing overtime. SD for the PDS fluctuates within 1.68% on February 1997 to 28.97% on June 2001. The highest SD occurred on June 2001 contributed by the sharp rise of the RAM Listed Bond index that caused a rise of 99% of PDS bond returns on June 2001. An analysis on the SD for discrete, non-overlapping 12-month calendar time periods (figure 4.3) shows that the most volatile period for the stock, MGS AS, MGS ST and MGS MT occurred in 1998 during the Asian Economy downturn. For MGS LT and PDS, the most volatile year happened in 2001. The peaks and troughs of 12MMA SD for stock and bonds are summarised on table 4.2.

Figure 4.3: Discrete 12M SD (Returns) For Stocks And Bonds

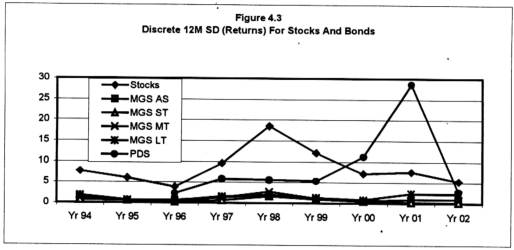


Table 4.2: Summary For 12MMA SD

Index	Highest SD		Lowest SD		Range (%)	Avrg (%)	Volatile Year
	%	Month	%	Month			
KLSE CI	18.52 18.50	Dec 1998 Apr 1999	3.66	Jan 1997	14.86	8.71	1998
MGS AS	2.35	Sept 1998	0.12 0.46	June 1997 Dec 2000	2.23	0.97	1998
MGS ST	1.60	Sept 1998	0.08	July 1997	1.52	0.55	1998
MGS MT	2.97	Sept 1998	0.13	June 1997 Sept 1997	2.84	1.10	1998
MGS LT	2.68 2.28	June 2002 July 2002 Sept 1998	0.19 0.56	Aug 1997 Aug 2000	2.49	1.29	2001
PDS	28.97	June 2001	1.68	Feb 1997	27.29	10.28	2001

4.1.2) F-Tests For Significant Changes In Stock And Bond Volatility

To test whether the level of volatility for bond and stock returns has changed overtime, F-tests are carried out to examine the significant differences of the bond and stock returns over time. F-tests are carried out for the 12-month-non-overlapping periods, 6-month-non-overlapping periods and the 12-month, 6-month overlapping periods. The non-overlapping periods / overlapping provide the discrete / dynamic measures to test for significant bond and stock volatility changes over time. F-tests ratio is calculated by using the "F-TEST" function of Microsoft Excel. This function provides the results of the one tailed

probability that the variances in 2 arrays are not significantly different. Thus, if the variances between the arrays were to be significant different at 95%, the results of the F-tests should be less than or equal to 0.05. Table 4.3 (appendix) shows the results of F-tests for the 12-month-non-overlapping, 6-month-non-overlapping and 12-month, 6-month-overlapping periods. The summary of the F-tests results is shown in table 4.4 as below.

Table 4.4: Summary Of F-Tests On MGS And PDS Returns

Index	12-M Non Overlapping			6-M Non-Overlapping			12M-6M Overlapping		
	No of Data	No of Sig. Data	% of Sig. Data	No of Data	No of Sig. Data	% of Sig. Data	No of Data	No of Sig. Data	% of Sig. Data
KLSE	7	3	43	16	0	0	15	1	7
MGS AS	7	3	43	16	3	19	15	3	25
MGS ST	7	6	86	16	4	25	15	5	33
MGS MT	7	4	57	16	4	25	15	4	27
MGS LT	7	3	43	16	5	31	15	4	27
PDS	5	3	60	12	5	42	11	3	27

Table 4.3 and 4.4 show that for the 12-month non-overlapping period, majority of F-test ratios (6 out of 7 or 86% of the data) are statistically significant for the MGS ST, followed by PDS (60%), MGS MT (57%), MGS AS (43%), MGS LT (43%) and stocks (43%). The discrete 6-month F-tests suggest that 5 out of 12 or 42% of the F-test ratios are statistically significant for the PDS, followed by MGS LT (31%), MGS ST, MGS MT (25%) and MGS AS (19%). The stock market has no significant changes over the 6-month discrete time periods. For the 12-month, 6-month overlapping F-tests, results suggest that 5 out of 15 or 33% of the F-test ratios are statistically significant for the MGS ST. This is followed by PDS (27%), MGS LT (27%), MGS MT (27%), MGS AS (25%) and stock (7%). F-tests suggest that there are more significant changes in bonds overtime compared to stocks on the 12-month-non-overlapping basis, 6-month-non overlapping period basis and the 12-month, 6-month moving average overlapping basis.

4.1.3) Results Of Volatility Analysis

Results show that the level of volatility for stock and PDS is approximately 8 times the volatility for MGS bonds. The highest volatility for the stocks, MGS and PDS occurred at different time periods. F-tests show that the MGS ST and PDS market volatility changes tremendously over time compared to the other MGS and stocks. Besides, the number of significant changes overtime for the bonds and stocks reduces if the time period is shortened, meaning the bonds and stocks volatility do not change significantly in short term. This can be shown by the reduction of the percentage of significant changes for the 6-month non-overlapping time periods compared to the 12-month non-overlapping time periods. Generally, it's observed that while the level of volatility is higher for stocks, stocks market volatility is more stable than bond market volatility.

4.2) Relative Volatility Analysis

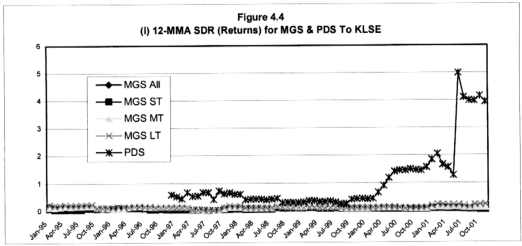
Relative volatility analysis examines the level of bond market volatility compared to the stock market volatility besides providing the trend of the bond market volatility. Two specific measures of relative volatility examined in the study are:

a) 12-month moving average standard deviation ratio (12MMA SDR). F-tests are carried out for the 12-month non-overlapping and 12-month, 6month-ovelapping periods to determine the significant changes in the ratio of volatility over time.
b) A moving measures of systematic risk (beta) for bond returns relative to stock returns

4.2.1) 12MMA SDR

Table 4.5 shows the statistics comparing the 12MMA SDR for MGS and PDS relative to stock. The graphical form for table 4.5 is shown on figure 4.4, which includes the 12MMA SDR for the (i) MGS and PDS combination and (ii) MGS. Figure 4.5 shows the SDR historical record for each MGS and PDS and their least square trend-line respectively.

Figure 4.4: 12MMA SDR for Bonds



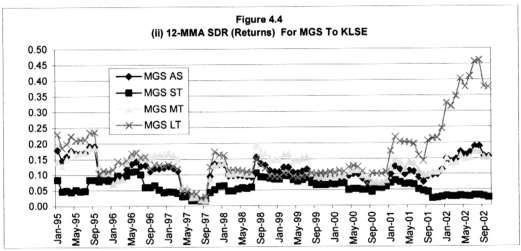
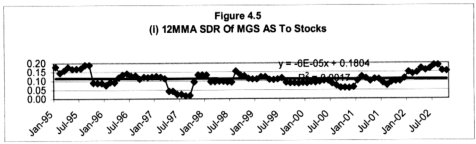
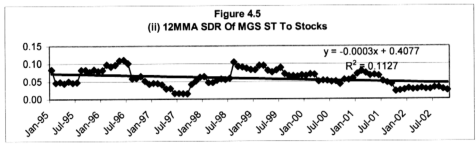
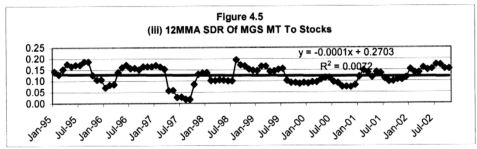
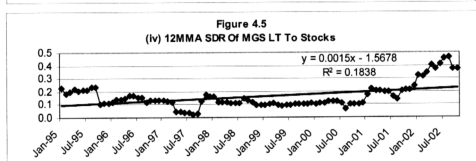


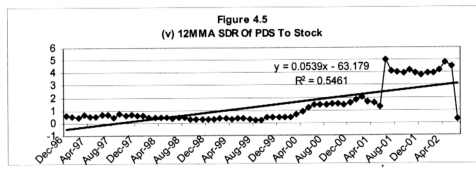
Figure 4.5: SDR And Least Square Trend line For Stocks And Bonds











History shows that the 12MMA SDR of the MGS moves in the same trend. The lowest SDR occurred during the period of March 1997 to September 1997. The highest SDR occurred during the period of January 1995 to September 1995, July 1998 to July 1999 and December 2000 to November 2001. MGS LT has the highest volatility among the MGS even though its volatility is lower than the MGS AS and MGS MT during the period of August 1998 to August 1999. This might be in line with the fact that the investors expect the economic downturn to affect the economy in medium term instead of contributing long-term effect to Malaysia economy. Overall, the least squares SDR trend line for the MGS AS, MGS ST and MGS MT have a slight negative slope while the MGS LT has a positive slope SDR trend-line. This implies that only the ratio of stock volatility to MGS LT volatility declined overtime. However, the SDR for the MGS AS and MT bonds was moving upwards starting from November 2000, indicating that the volatility of stocks to the MGS AS and MGS MT starts to decline from November 2000 till October 2002. SDR for MGS ST decreases over the period of study, indicating the decay of MGS ST volatility relative to stock volatility over time. Figure 4.4 also shows that the SDR for PDS is extremely high compared to the MGS and it has an increasing trend over time. This indicates that PDS volatility is increasing faster than the volatility of stock. The average SDR is 1.34, which means that the stock market volatility is about 0.75 times the volatility of the PDS bonds during the period under study. For the period of January 1995 to March 2000, the average SDR for PDS is 0.46, indicating that the volatility of PDS is about 50% of the stock volatility. However, for the period from April 2000 to June 2002, the SDR rises to 2.71. Summary of the 12MMA SDR for the bonds is shown in table 4.6.

Table 4.6: Summary of 12MMA SDR For MGS And PDS

Bond	Highest SDR		Lowest SDR		Avrg SDR	High SDR Periods	Low SD Ratio Periods	SDR Tr.line Slope
	Value	Date	Value	Date				
MGS AS	0.19	Aug95 Sep95 July02 Aug02	0.02	Aug97 Sep97	0.11	Jan95-Sep95 Jan02-Oct02	Apr97-Sep97 Aug00-Nov00	Negative
MGS ST	0.11	Jun96	0.02	Jun97 To Sep97 Oct01	0.06	Aug95-Jul96 Aug98-Mar00	Nov96-Oct97 Nov01-Oct02	Negative
MGS MT	0.19	Sep95 Aug98	0.02	Aug97 Sep97	0.12	Jan95-Oct95 Apr96-Mar97 Aug98-Jul99 Jan02-Oct02	Apr97-Sep97 Sep00-Dec00	Negative
MGS LT	0.46	Jul02 Aug02	0.03	Aug97 Sep97	0.16	Jan95-Sep95 Jan01-Oct02	Apr97-Sep97	Positive
PDS	4.99	Jun01	0.25	Aug97 Sep97	1.34	May00-May02	Sep98-Sep99	Positive

4.2.1.1) F-Tests For Significant Changes In MGS And PDS SDR

We carry out the F-tests (using "FTEST" function of Excel) for the 12-month-non-overlapping periods and the 12-month moving average with 6 months overlapping periods for examining the significant changes in the SDR for the bonds. Results show that there are more significant changes in the SDR for MGS LT, PDS and MGS AS compared to the MGS ST and MGS MT. This indicates that the volatility (SDR) for MGS ST and MGS MT is more stable compared to MGS LT, PDS and MGS AS; and MGS LT heavily influences MGS AS. Results of F-tests are tabulated in table 4.7 (appendix) and table 4.8 below shows the summary of the F-test results.

Table 4.8: Summary Of F-Tests On MGS And PDS SDR

Index	12-M Non Overlapping			12M-6M Overlapping		
	No of Data	No of Sig. Data	% of Sig. Data	No of Data	No of Sig. Data	% of Sig. Data
MGS AS	6	3	50	13	4	31
MGS ST	6	1	17	13	2	16
MGS MT	6	1	17	13	1	8
MGS LT	6	5	85	13	7	54
PDS	4	2	50	9	5	56

4.2.1.2) Results Of SDR Analysis

MGS LT and PDS have positive SDR trend-line slope, indicating decline in the ratio of stock volatility to the MGS LT and PDS overtime. The SDR trend-line for MGS AS, MGS ST and MGS MT has negative slope, indicating that the volatility of stock market increases in a faster manner than these assets. It seems that the SDR moves in the positive trend after November 2000 for MGS AS and MGS MT, indicating that the volatility of MGS AS and MGS MT increases faster than the stock volatility thereafter.

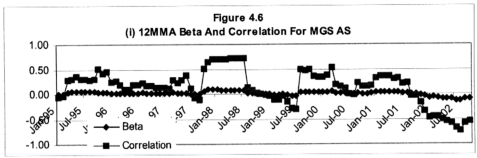
4.2.2) 12 MMA Regression Coefficient (Beta) And Correlation Analysis

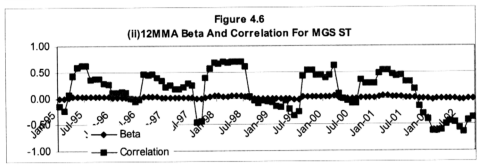
A moving measure of systematic risk (beta) of the 12-month moving average regression model is used to determine the beta of the bond markets. By plotting the bond market returns against the stocks market returns, the beta coefficient is equivalent to the slope of the regression. Thus, the beta coefficients for bonds are calculated by using the "SLOPE" function in Excel. It's essential to study the profile of the 12MMA beta by examining the comparative 12MMA correlation for the bonds, as the correlation is a factor explaining the movement of beta for a financial asset. Correlations for the bonds are calculated by using the "CORREL" function of Excel. Section 4.2.2.1 discusses about the trend of the 12MMA beta and correlation while section 4.2.2.2 discusses the SDR and the 12MMA beta movement.

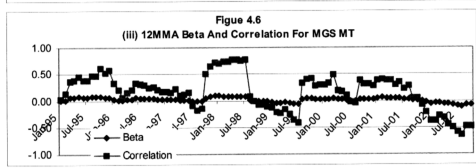
4.2.2.1) 12MMA Beta And Correlation

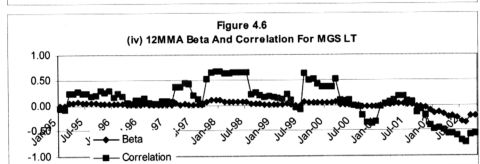
Table 4.9 shows the statistics summary for the 12MMA beta and correlation for bonds. Figure 4.6 shows the superimposition of the data in table 4.9 in order to examine the movement of these parameters. Based on equation "$\beta = \rho_{(B,S)} \sigma_B \sigma_S / \sigma_M^{2}$", the moving 12-month correlation graphs are expected to have the same profile as the beta graphs for bonds. Results show that the 12MMA beta and correlation for MGS and PDS have the similar trend. The similar-profile correlations explain and verify the movement of the 12MMA beta for bonds over time as per expected.

Figure 4.6: 12MMA Beta And Correlation For Bonds









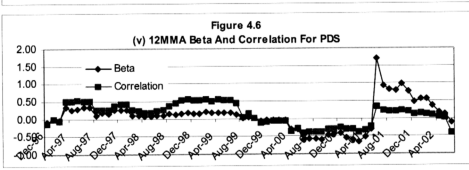
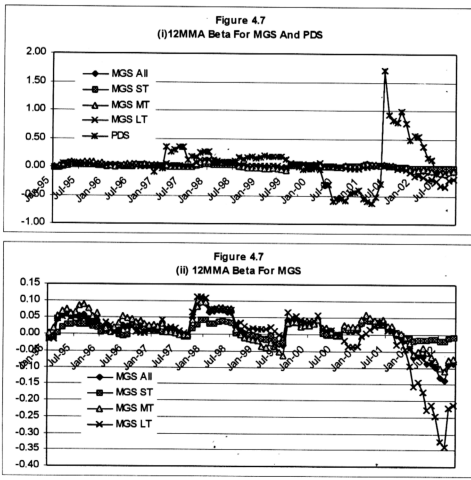
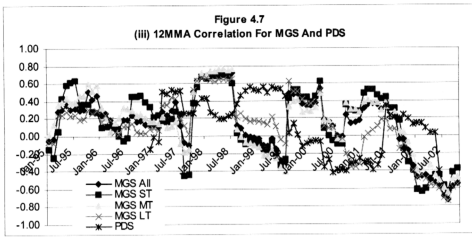


Figure 4.7 shows the historical (i) 12MMA beta for the combination of MGS and PDS (ii) 12MMA beta for the MGS (iii) 12MMA correlation for the combination MGS and PDS. The systematic risk relationship between bonds and stocks clearly is not stable over time, as shown by the significant changes in the 12MMA beta and correlation overtime. It is observed that the 12MMA beta for PDS is pretty much higher than the MGS beta. The beta of the MGS bonds returns is very low. MGS LT has the highest beta among the MGS, being the highest at 0.1107 achieved on November 1997. The trough for MGS LT beta is recorded at –0.3410 on August 2002. The highest beta for PDS happened in June 2001 at 1.7016, which is about 5 times the biggest beta magnitude (0.3410) achieved by MGS.

Figure 4.7: 12MMA Beta For Bonds





The risk of investing in MGS changes overtime. There are three changes in the degree of risk of MGS bonds as stated below:

- January 1995 to February 1997 – MGS AS and MGS MT are more risky than MGS LT
- March 1997 to August 2000 – MGS LT has the highest beta
- September 2000 to October 2002 – MGS LT, being least correlated or more negatively correlated to the other MGS bonds, is the least risky MGS bonds

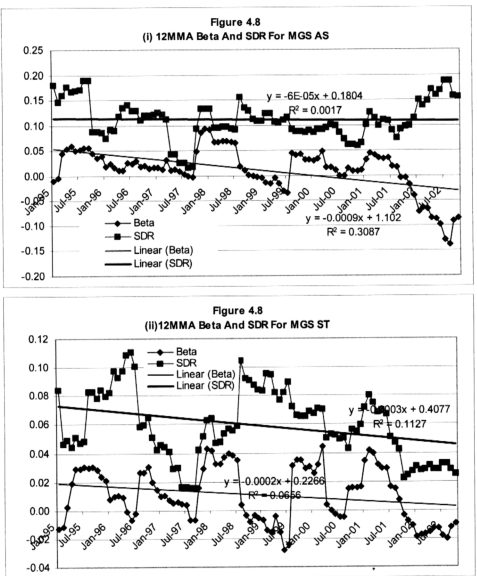
Started from the middle of year 2001, MGS becomes negatively correlated to the stocks while the PDS became highly correlated to the stocks. All MGS categories have the negative beta trend-line, indicating a secular decrease in the systematic risk for MGS relative to the stocks in the Malaysia capital market. This indicates the suitability of MGS for market risk hedging due to the low relationship between MGS bonds and stocks. On the other hand, PDS shows positive beta trend and its systematic risk increases relative to the stocks overtime.

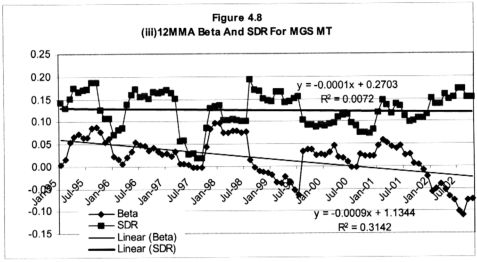
4.2.2.2) 12MMA Beta And SDR For MGS and PDS

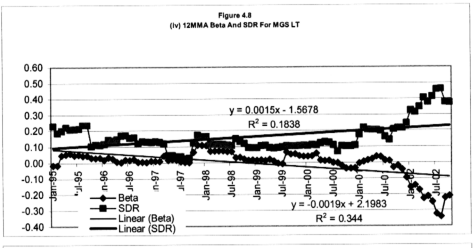
Figure 4.8 shows the 12MMA beta and SDR graphs for the MGS and PDS. It is observed that the 12MMA beta moves both in the same and different direction during the time period recorded in table 4.10 (column 2 and 3). It is worth noticing the time periods with "Positive Beta, High SDR" (PBHS) and periods with "Negative Beta, High SDR" (NBHS). HBHS implies that the

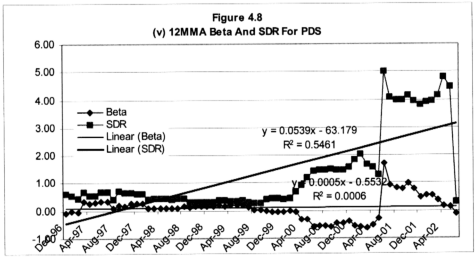
bonds volatility increased more than stock volatility, in addition, the bond is more correlated with stocks. NBHS implies that bond is relatively volatile as measured by the SDR, but in addition the rates of bond return is moving counter to stocks, which is also known as the "decoupling" effect (Harper, 2003). Theoretically, NBHS is desired for risk hedging purposes. On the other hand, PBHS will increase the overall market risk facing the stock-bond portfolio.

Figure 4.8: 12MMA Beta And SDR For Bonds









Again, it is observed from figure 4.8 that the NBHS periods for MGS AS, MGS ST and MGS MT occurred during the same time period. The NBHS periods for MGS LT and PDS happened at different time periods. For the period of

September 2001 to October 2002, SDR for MGS LT skyrockets but the beta is becoming less or negatively correlated with stocks. On the other, during the time period of June 2001 to February 2002, the SDR and beta for PDS is increasing tremendously, showing that the volatility for PDS increases and PDS is highly correlated to stock. The suitability of MGS as a risk hedging instrument is further supported by the decreasing beta trend-line slope over time, which indicates a decrease in the systematic risk / level of volatility for MGS relative to stocks in Malaysia. The statistical summary for the 12MMA beta and SDR analysis is tabulated in table 4.10 as below.

Table 4.10: Summary Of Historical Beta & SDR For Bond Markets

	Same Beta & SDR Profile	Counter Beta & SDR Profile	PBHS	NBHS	Beta Trend	SDR Trend	Beta Range
MGS All	Apr97-Jul98 Aug99-Aug01	Dec95-Mar97 Jan99-Jul99 Sep01-Oct02	Mar95-Sep95 Oct97-Jul98	Nov98-Jul99 Sep01-Oct02	-	-	-0.1379 to 0.0929
MGS ST	Aug96-Jun98 Aug99-Sep02	Jun98-Sep99 Jan95-Aug96 Nov01-Oct02	Oct97-Jul98 Aug99-ar00 Jan01-Jun01	Jan96-Jul96 Sep98-Jul99 Oct01-Oct02	-	-	-0.0278 to 0.0440
MGS MT	Jan95-Jul98 Sep99-Mar00 Oct00-Jul01	Aug98- Aug99 Apr00-Sep00 Aug01-Oct02	Apr95-Oct95 Nov97-Jul98 Jan01-Jun01	Sep98-Jul99 Nov01-Oct02	-	-	-0.1106 to 0.0967
MGS LT	Feb95-Aug00 Jan01-Aug01	Sep00- Dec00 Sep01-Oct02	Oct97-Jul98 Aug99-Mar00	Aug00-Jan01 Sep01-Oct02	-	+	-0.3410 to 0.1107
PDS	Jan97-Feb00 Jun01-Feb02	Mar00- May01 Mar02-Jun02	Jun01-Feb02	Oct99-May01	+	+	-0.6392 to 1.7016

Note: For Table 4.10 "-" indicates negative, "+" indicates positive

4.2.3) Results Of Relative Volatility Analysis

MGS have negative beta trend-line, indicating a secular decrease in the systematic risk for MGS relative to stocks in the Malaysia capital market. The negative SDR trend-line for MGS AS, ST and MT (MGS LT) shows that the volatility of these bond markets increases slower (faster) than the increment in stock volatility. In opposite, PDS has the positive beta and SDR trend-line and its volatility and systematic risk increases relative to the stocks overtime. Overall, MGS is a better choice for risk hedging purposes compared to the PDS.