Chapter 4: EMPIRICAL RESULTS

4.1 Sample Data

This study uses three different time periods. The first time period (T1) is the period from February 1994 to July 1997. This period is alternatively referred to in this study as pre-crisis period. This is because the period covers from the beginning of the sample period right until the month before KLCI took the hit from the Financial Crisis. Meanwhile, the second time period (T2) is the period from August 1997 to February 2001. This period covers the period of crisis and the process of recovery from the Financial Crisis. Alternatively, this period is referred to as post-crisis period. The third time period (T3) covers the overall time period, starting from February 1994 to February 2001. The number of sample data used in this study is 85. January 1994 monthly prices for all the assets are dropped in the return computation. Then, the sample is separated equally into two halves, consisting of 42 monthly data each. All data that are used for the analysis of this study are monthly mean returns and standard deviation.

The separation of the time periods T1 and T2 is deliberately done to analyse the effect of the crisis towards the three assets: 1) KLCI; 2) BOND; and 3) CPO futures. Furthermore, this study attempts to investigate whether there are some diversification benefits by including CPO futures as a part of a portfolio during such volatile period e.g. T2. Besides that, T3 would allow us to analyse the overall picture of the sample period.

4.2 Risk and Return Analysis of Assets

Table 1 presents results on risk and returns analysis. For the time period T1 or pre-crisis period, CPO futures registers the highest mean return of almost 0.4 % while KLCI records the lowest mean return of –0.2 %. As for the standard

deviations of all the three assets, CPO futures is the most volatile asset with 7.6% standard deviation, whereas BOND is the least volatile asset with 3.0% standard deviation. During this time, KLCI registers 5.9 % standard deviation. The high degree of volatility of CPO futures is expected as, in most cases, futures tend to be more volatile than spot market. In addition, CPO futures has a maximum return of 18.1% and a minimum return of –11.9%, while KLCI has a maximum return of 10.4% and a minimum return of –16.7%. As for BOND, its maximum and minimum returns are 18.2% and –6.9% respectively.

During time period T2 or post-crisis period, as expected, KLCI registers the lowest mean return of –1.4%, while BOND posts the highest mean return of 0.9%. CPO futures shows a decline in this period, registering –1.1% mean return. From Table 1, KLCI portrays a large increase in its standard deviation from 5.9% to 12.8%. KLCI is not the only asset to register a higher standard deviation than registered during time period T2. CPO futures also experiences an increase in its standard deviation from 7.6% to 10.2%. However, BOND has a slightly lower standard deviation, which is 1.43 as compared to 3.0% in T1. CPO futures and KLCI have maximum returns of about 29.0%, while their minimum returns are –24.6% and –28.5% respectively.

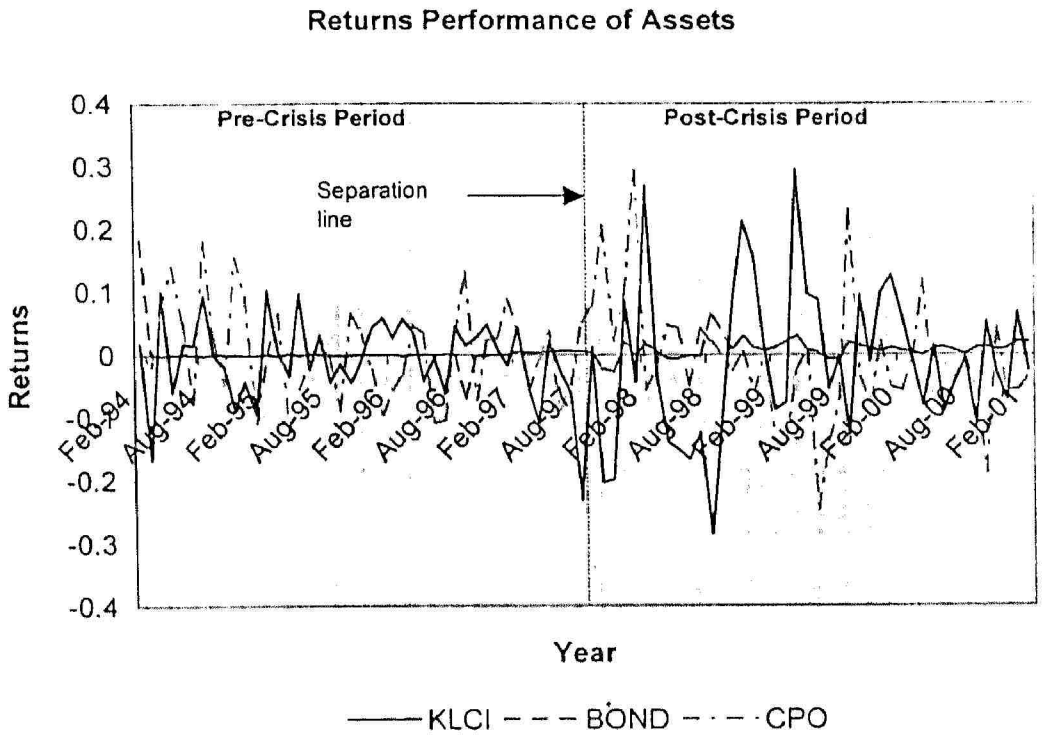
During the whole period or T3, only BOND posts a positive mean return of 0.6%. CPO futures and KLCI register a negative mean return of 0.4% and 0.8% respectively. Apart from that, KLCI records the highest standard deviation of 10.0%. Meanwhile, BOND registers the lowest standard deviation of 2.4% during the same period. The highest maximum return is recorded by KLCI, which is 29.4%, while the lowest maximum return is registered by BOND which is 18.2%. In addition, KLCI has a minimum return of –28.5%, while BOND has a minimum return of –6.9%.

Table 1: Descriptive Statistics for Monthly Returns of Assets

	Time Period								
	Feb 1994 – July 1997			Aug 1997 – Feb 2001			Feb 1994 – Feb 2001		
	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND
Min	-0.119	-0.167	-0.069	-0.246	-0.285	-0.027	-0.246	-0.285	-0.069
Max	0.181	0.104	0.182	0.293	0.2944	0.063	0.293	0.294	0.182
Mean	0.004	-0.002	0.003	-0.011	-0.014	0.009	-0.004	-0.008	0.006
Std. Dev.	0.076	0.059	0.030	0.102	0.128	0.014	0.090	0.100	0.024

Chart 1 illustrates the returns performance during the whole period. CPO futures and KLCI have returns that fluctuate more as compared to BOND returns.

Chart 1: Returns Performance of Assets



4.3 Correlation Between Assets

Table 2 shows the sample correlation of the returns registered by all the three assets. During T1, CPO futures shows a weak correlation of 0.11 with KLCI. Furthermore, CPO futures has a negative correlation of 0.10 with BOND. Meanwhile, the correlation between KLCI and BOND is 0.01. This indicates a weak correlation between these two assets. During T2, CPO futures further shows very weak correlation with both KLCI and BOND by registering –0.29 and –0.17 correlation respectively. However, there is a slight increase in correlation of KLCI and BOND. The correlation is 0.26 as compared to 0.01 during T1. The overall picture of the correlation between assets is captured by T3. CPO futures has a negative correlation with KLCI and BOND with –0.17 and –0.12 respectively. Meanwhile, KLCI and BOND have a weak correlation of 0.10. The result as shown in Table 2 is expected, as CPO futures, a commodity-based

asset, usually registers returns that move in the opposite direction in relation to the movement of returns of stocks and bonds. Therefore, from the results, CPO futures could provide some diversification benefits if it is considered as a part of a portfolio.

Table 2: Correlation Between Assets

	Time Period								
	Feb 1994 – July 1997			Aug 1997 – Feb 2001			Feb 1994 – Feb 2001		
	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND
CPO futures	1.00			1.00			1.00		
KLCI	0.11	1.00		-0.29	1.00		-0.17	1.00	
BOND	-0.10	0.01	1.00	-0.17	0.26	1.00	-0.12	0.10	1.00

4.4 Portfolio Analysis

4.4.1 Optimal Weights of Assets

By utilizing the S-Plus version 6.0 software, this study has come out with 4 experimental portfolios that are optimally constructed. Table 3 depicts the weights of assets allocated in each portfolio. The optimal weights are generated with the objective of minimising the variance of return of the portfolio. The weights assigned to each asset are according to the time period. Thus, we will find that weights of assets of Portfolio I are different during T1 than during T2. Besides that, the minimum mean return that is used as a constraint in the construction of the portfolios is almost the same as used in all the portfolios, which is 0.05%, except for two portfolios, portfolio II during T2 and portfolio II during T3. In these portfolios, the minimum mean return used is negative infinity as both portfolios have mean returns that are so low. Hence, it is not possible to

generate a portfolio using the same constraint (r_{min} = 0.05%) as the other portfolios.

Table 3: Optimal Weights of Assets in the Portfolios

	Time Period								
	Feb 1994 – July 1997			Aug 1997 – Feb 2001			Feb 1994 – Feb 2001		
	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND	CPO futures	KLCI	BOND
Port. I	-	20.81	79.19	-	0.04	99.96	-	3.35	96.65
Port. II	46.22	53.78	-	58.76	41.24	-	54.25	45.75	-
Port. III	15.95	-	84.05	4.08	-	95.92	8.90	-	91.10
Port. IV	12.29	16.17	71.54	4.06	0.10	95.83	9.34	4.25	86 41

Notes: All figures are expressed in percentages

Portfolio I : KLCI and BOND
Portfolio II : CPO futures and KLCI
Portfolio III : CPO futures and BOND
Portfolio IV: CPO futures, KLCI and BOND

4.4.2 Risk and Return Analysis of the Portfolios

Table 4 presents the results of descriptive statistics of all the portfolios according to their time period. During T1, Portfolio III register the highest mean return of 0.4%, whereas Portfolio II record the lowest mean return of 0.1%. During the same time period, Portfolio IV register the lowest standard deviation of 2.5%, while Portfolio II post the highest standard deviation of 5.0%. The inclusion of 12.3% weights of CPO futures in Portfolio I to become Portfolio IV has slightly reduced the risk from 2.7% to 2.5%. Hence, it could be suggested that the diversification effect of CPO futures may play a role in reducing the risk in Portfolio IV.

During T2, Table 4 shows that Portfolio I record the highest mean return of 0.9%, while Portfolio II register the lowest mean return of -1.2%. As for the risk, Portfolio III and Portfolio IV post the lowest risk of 1.4% standard deviation. It is interesting to point out that the risk incurred by all the portfolios is considerably lower than that of any single asset. For instance, Portfolio II have a risk of 6.8% standard deviation compared to 10.2% and 12.8% of CPO futures and KLCI as a stand-alone asset.

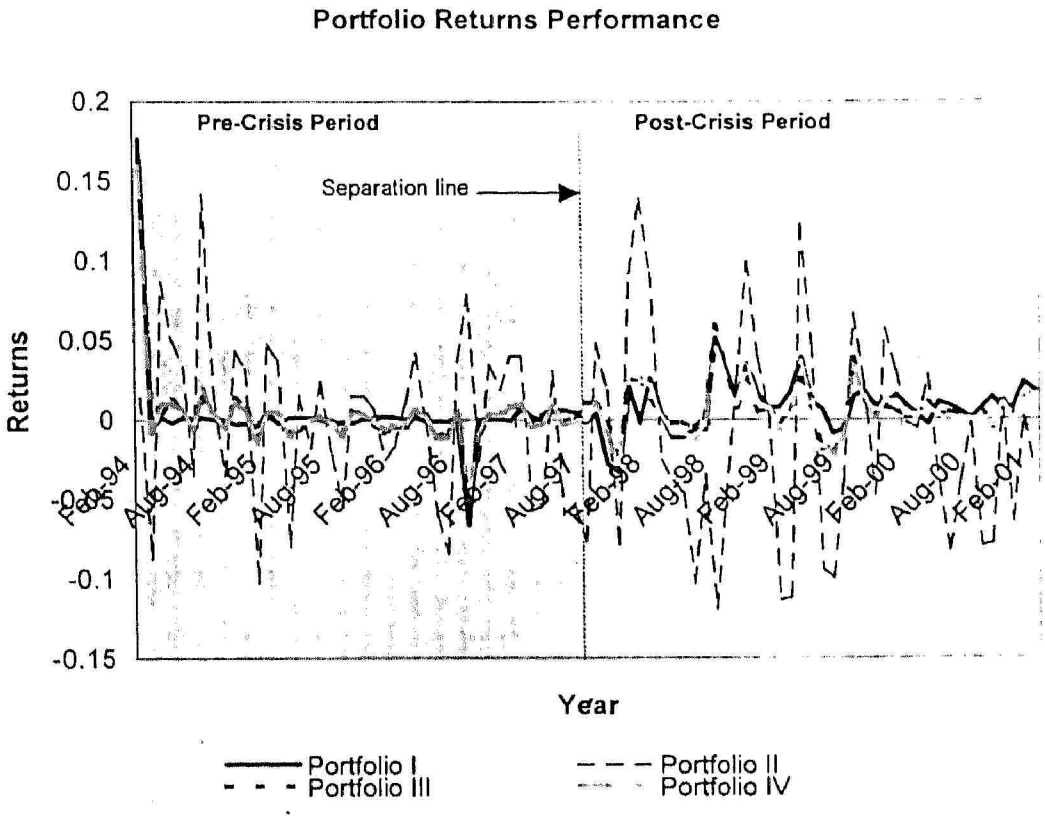
During T3, Portfolio I register the highest mean return of 0.6%, while Portfolio II post the lowest mean return of –0.6%. Portfolio III and IV incur the lowest risk of 2.2% standard deviation, while Portfolio II incur the highest risk of 6.0%. The overall returns performance of the all the portfolios are illustrated in Chart 2.

Table 4: Descriptive Statistics for All the Portfolios

	Time Period											
	Feb 1994 – July 1997				Aug 1997 – Feb 2001				Feb 1994 – Feb 2001			
	Port. I	Port. II	Port. III	Port. IV	Port. I	Port. II	Port. III	Port. IV	Port. I	Port. II	Port. III	Port. IV
Min	-0.051	-0.101	-0.037	-0.031	-0.027	-0.116	-0.025	-0.025	-0.066	-0.119	-0.051	-0.047
Max	0.148	0.135	0.155	0.134	0.063	0.154	0.062	0.061	0.177	0.142	0.167	0.159
Mean	0.002	0.001	0.004	0.003	0.009	-0.012	0.008	0.008	0.006	-0.006	0.005	0.005
Std. Dev.	0.027	0.050	0.027	0.025	0.014	0.068	0.014	0.014	0.024	0.060	0.022	0.022

Notes: Portfolio I : KLCI and BOND
Portfolio II : CPO futures and KLCI
Portfolio III : CPO futures and BOND
Portfolio IV: CPO futures, KLCI and BOND

Chart 2: Portfolio Returns Performance



4.4.3 CPO futures analysis

Table 5 presents the results of risk and returns of Portfolios II, III and IV, which include CPO futures, as well as CPO futures as a stand-alone asset. It is done to analyse whether CPO futures is better as a stand-alone asset than as a part of a portfolio. From Table 5, during all time periods, by including CPO futures in a portfolio, the level of uncertainty has substantially been decreased. For instance, during T1, the risk is reduced from 7.6% to less than 5.0% in all the portfolios. Likewise, during T2 and T3, all the portfolios have a lesser risk than the risk of CPO futures as a single asset. As for returns, in all time periods, mean returns of these portfolios have more or less the same with the return of CPO futures. The mean returns of these portfolios have been compared with mean return of CPO futures by testing them using standard two samples t-Test. The results show that

all the mean returns are not significantly different from the mean return of CPO futures at any reasonable significant level.

Table 5: Risk and Return of the Portfolios (II, III and IV) and CPO futures

	Time Period											
	Feb 1994 – July 1997				Aug 1997 – Feb 2001				Feb 1994 – Feb 2001			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Port. II	0.001 (0.22)	0.050	-0.101	0.135	-0.012 (0.063)	0.068	-0.116	0.154	-0.006 (-0.17)	0.060	-0.119	0.142
Port. III	0.004 (-0.01)	0.027	-0.037	0.155	0.008 (1.16)	0.014	-0.025	0.062	0.005 (0.86)	0.022	-0.051	0.167
Port. IV	0.003 (0.08)	0.025	-0.031	0.134	0.008 (1.16)	0.014	-0.025	0.061	0.005 (0.80)	0.022	-0.047	0.159
CPO futures	0.004	0.076	-0.119	0.181	-0.011	0.102	-0.246	0.293	-0.004	0.090	-0.246	0.293

Notes: T-statistics are in parentheses (df=82 for T1 and T2, while df=166 for T3).

Portfolio II : CPO futures and KLCI
Portfolio III : CPO futures and BOND
Portfolio IV: CPO futures, KLCI and BOND

From Table 5, we could say that it may be better off to include CPO futures as a part of a portfolio than to treat it as a stand-alone asset. This is because all the portfolios would offer almost the same mean returns, but with a lower risk. However, in most investment theory, the performance of these portfolios should be measured in terms of risk-adjusted basis. Mean returns of the portfolios should be measured against their risk. Therefore, in the next section, we will measure the portfolios performance using Sharpe, Treynor and Adjusted Jensen Alpha Index.

4.4.4 Portfolio Performance

Table 6 summarises the results of the linear regression of the market model. All the portfolios have beta values that are low, in the range of 0.01 to 0.61. This should indicate that the 4 portfolios have systematic risk that are lower than that of the market portfolio. Furthermore, all the beta values of the portfolios are lower during T2 than during T1. Hence, it could be implied that an investment in a portfolio would be better because it offers diversification benefits especially during adverse economic period such as during T2.

Table 6: Systematic Risk (Beta) of Portfolios

	Time Period					
	Feb 1994 – July 1997		Aug 1997 – Feb 2001		Feb 1994 – Feb 2001	
	Beta	t-value	Beta	t-value	Beta	t-value
Port. I	0.21	3.28**	0.03	1.74*	0.06	2.21**
Port. II	0.61	6.44**	0.28	3.94**	0.37	6.98**
Port. III	0.03	0.38	0.02	1.13	0.01	0.30
Port. IV	0.18	3.00**	0.02	1.20	0.05	2.04**

Notes: **Significant at 5% level
* Significant at 10% level

This study will use the beta values summarised in Table 6 in its computation of the performance indices. Table 7 summarises the performance measures of the portfolios and CPO futures. We find that Portfolio II show the best performance during all time periods compared with the rest of the portfolios. Portfolio II have the highest negative index in all the measurement employed than the other portfolios. During T1 or pre-crisis period, Portfolio I,II and IV have Treynor Indices of –0.25, –0.09 and –0.29, which are higher than the value of –0.35 for

CPO futures. As for the Sharpe and Adjusted Jensen Alpha Index, CPO futures registers a higher value than the value recorded by all the portfolios during all time periods.

The results summarised in Table 7 may be quite surprising as we recalled that CPO futures has a considerably higher risk than all the portfolios during all time periods. Furthermore, it also has mean return that is not significantly different than all the portfolios. Upon closer inspection, we find that the higher index values recorded by CPO futures may be due to higher average risk-free rates during the time periods of the study. The risk-free rate registered its highest average annual figure of 6.86 % in 1998, during which the Financial Crisis was at its worst. The high risk-free rate was one of the initial steps taken by the Government to overcome the Financial Crisis. However, the high average risk-free rates could affect the computation of all the measurement indices. For example, a higher, negative figure of excess return (Rp- Rf) divides by a large and positive standard deviation will result in a higher, negative Sharpe Index. Thus, CPO futures, whose risk is higher than the risk of the portfolios and mean return is almost the same as the mean returns of all the portfolios, registers a better Sharpe Index value than the values recorded by the portfolios.

Table 7: Performance Measures of the Portfolios and CPO futures

	Time Period								
	Feb 1994 – July 1997			Aug 1997 – Feb 2001			Feb 1994 – Feb 2001		
	Sharpe Index	Treynor Index	Adjusted Jensen Alpha Index	Sharpe Index	Treynor Index	Adjusted Jensen Alpha Index	Sharpe Index	Treynor Index	Adjusted Jensen Alpha Index
Port. I	-1.95	-0.25	-0.19	-2.21	-1.07	-1.01	-1.79	-0.75	-0.69
Port. II	-1.09	-0.09	-0.03	-0.77	-0.19	-0.13	-0.88	-0.14	-0.09
Port. III	-1.90	-1.83	-1.78	-2.38	-1.72	-1.67	-1.92	-5.66	-5.61
Port. IV	-2.08	-0.29	-0.23	-2.38	-1.63	-1.58	-1.98	-0.89	-0.84
CPO futures	-0.68	-0.35	-0.29	-0.50	0.22	0.28	-0.57	0.33	0.38

4.4.5 Pre- and Post-Crisis Return Performance

Table 8 presents the results of the mean returns comparison between the same portfolios during the pre-crisis and post-crisis periods. All mean returns are not significantly different during the two periods at any reasonable significant levels. Thus, we find no evidence that the Financial Crisis may affect the return outlays of the constructed portfolios.

Table 8: Standard two-sample t-Test for Pre- and Post-Crisis Return Performance of the Portfolios

	Time Period		
	Feb 1994 – July 1997	Aug 1997 – Feb 2001	
	Mean Return	Mean Return	t-value
Portfolio I	0.002	0.009	-1.32
Portfolio II	0.001	-0.011	0.95
Portfolio III	0.003	0.008	-0.92
Portfolio IV	0.003	0.008	-1.17