CHAPTER 4

RESULT AND DISCUSSION

4.0 Introduction

Chapter 4 provides interpretations and discussions of the findings. Considering the study has four objectives, explanations of the results and discussions are divided into four major sections. The first section presents the results and discussions on objective 1. The section includes the comparative analysis of exposure level from the symmetric and asymmetric aspects. The analyses are divided into two steps, namely the overall analysis using the Panel model and the firm-level analysis using the ordinary least square (OLS) with generalised autoregressive conditional heteroscedasticity (GARCH(1,1)). The second section presents the results and discussions on objective 2 and objective 3, respectively. The analysis in objective 1 is expanded by incorporating the time varying factor (objective 2), and multiscale exposure (objective 3). The time-varying exposure incorporates three significant financial events in Malaysia. The multiscale exposure decomposes the data into several time horizons. The third section presents the results and discussions on objective 4. The results and discussions on the analysis of corporate hedging practice in Malaysia encompass the foreign currency derivative practice and operational hedging. The analysis is further extended to measure the effect of corporate hedging practice towards the multiscale foreign currency exposure.

4.1 Descriptive Statistics of Stock Returns and Exchange Rate

Table 4.1 provides a summary on the descriptive statistics of the variables used in the measurement of currency exposure. The mean of stock returns for all firms fluctuated throughout the sample period, with the mean values were mostly negative between 1995-2005. Starting from 2006, the mean values of the stock returns started to comprise mostly positive values. The positive mean values signalled that the firms began to experience stable and higher profit and shareholders' wealth. The stability was attributable to the firms' business maturity as well as stable economic conditions.

Another aspect is the volatility of the stock return as shown by the standard deviation values. From the table, the stock returns of the firms showed small fluctuation as the standard deviation values only changed between 0 to 0.15. The only exception was in 1997 with the largest standard deviation value of 0.3667. As larger standard deviation suggests larger sensitivity of the stock returns to exchange rate changes, the value was in line with the occurrence of Asian financial crisis in 1997. This is followed by the standard deviation of 0.1589 in 2008, in consideration of the global financial crisis.

Descriptive statistics of the exchange rate variable are presented in Table 4.2. Dividing the data into six sub-periods, the mean value of the Malaysian ringgit per USD was MYR3.57 during the AFC. Once the peg ended, the ringgit returned to MYR3.58 and strengthened in post-GFC at MYR3.24. Additionally, the largest dispersion was observed during the AFC between the maximum exchange rate at MYR4.35 with the minimum

exchange rate at MYR2.64. The large currency fluctuation was attributed to the nature of the crisis that specifically attacked the currency market. High volatility in currency exchange during the period was indicated by the standard deviation of 0.4840, which suggested higher expected exchange rate exposure. The other periods showed modest fluctuation of the currency, including during the global financial crisis.

Table 4.1: Descriptive Statistics of Stock Returns, 1995-2016.

Year	Mean	Median	Maximum	Minimum	Std. Dev.	Sum	Sum Sq. Dev.
1995	0.0730	0.0636	0.7340	-0.1186	0.0915	15.1133	1.7253
1996	-0.0281	-0.0224	0.3328	-0.5373	0.0809	-5.8082	1.3493
1997	-0.2580	-0.2187	0.4474	-3.5532	0.3667	-53.4087	27.7047
1998	-0.0417	-0.0498	0.4433	-0.3267	0.1335	-8.6296	3.6718
1999	0.0799	0.0637	0.6332	-0.5845	0.1129	16.5404	2.6265
2000	-0.1617	-0.1510	0.1284	-0.6604	0.1317	-33.4654	3.5723
2001	0.0130	0.0090	0.3939	-0.2628	0.0923	2.6858	1.7562
2002	-0.0224	-0.0156	0.5978	-0.3831	0.0930	-4.6375	1.7802
2003	0.0079	0.0000	1.1040	-0.3095	0.1239	1.6275	3.1644
2004	-0.0157	-0.0145	0.2687	-0.3887	0.0820	-3.2459	1.3857
2005	-0.0178	0.0000	0.3053	-0.5878	0.0942	-3.6842	1.8269
2006	0.0017	0.0000	0.4097	-0.3155	0.0865	0.3423	1.5424
2007	0.0203	0.0152	0.3862	-0.3572	0.0856	4.2102	1.5088
2008	0.0068	0.0041	0.9163	-0.9214	0.1589	1.4077	5.2043
2009	0.0130	0.0102	0.8194	-0.4384	0.1109	2.6827	2.5334
2010	0.0428	0.0283	0.4161	-0.2177	0.0882	8.8621	1.6028
2011	0.0140	0.0158	0.3536	-0.3254	0.0842	2.9072	1.4598
2012	0.0062	0.0011	0.8056	-0.6286	0.0977	1.2761	1.9671
2013	0.0017	-0.0005	0.4915	-0.2429	0.0773	0.3533	1.2306
2014	-0.0686	-0.0783	1.3967	-0.2974	0.1341	-14.2070	3.7049
2015	0.0173	0.0000	0.4951	-0.6678	0.1024	3.5884	2.1621
2016	0.0238	0.0069	1.4469	-0.3216	0.1214	4.9254	3.0359

Table 4.2: Descriptive Statistics of Exchange Rate, 1995-2016

	Pre-AFC	AFC	De-peg	GFC	Post-GFC
Mean	2.5089	3.5720	3.5707	3.5766	3.2361
Median	2.5119	3.6618	3.6205	3.607	3.1864
Maximum	2.555	4.3531	3.7795	3.7044	3.5591
Minimum	2.4373	2.636	3.2355	3.4375	2.961
Std. Dev.	0.0302	0.4840	0.1604	0.0971	0.1972
Sum	75.2681	42.8644	107.1196	25.0359	97.0857
Sum Sq. Dev.	0.0264	2.5773	0.74590	0.0565	1.1279
Observations	30	12	30	7	30

4.2 Symmetric and Asymmetric Foreign Currency Exposure

Results of currency exposure in this section encompassed the investigation of the exposure level from the overall and firm-level perspectives. The results were obtained using the panel, OLS and GARCH(1,1) models as discussed in Chapter 3. This section explains the first research objective which was to measure the level of currency exposure of Malaysian non-financial firms. Analysis in this section starts with analysing the exposure level for the overall sample by including all sample firms in panel analysis. This was followed with firm-level analysis in which the exposure level was measured for each firm. Firm-level analysis was conducted in addition to the overall sample analysis considering firms at the overall level could have different types of exposure.

4.2.1 Overall Symmetric Foreign Currency Exposure

Panel model was employed to examine the exposure level for the overall sample firms. Preliminary Hausman test indicates the better consistency of the Random Effects model in the analysis. The model was presented by equation (3.1) in Chapter 3.

Referring to the results of symmetric exposure in Table 4.3, one percent increment in the USD would, on average, cause a 0.0633% decrement in the overall stock returns. In other words, strengthening of the USD would reduce the expected stock return for net importers in the sample firms. Assertion of firms' trading position based on the direction of exposure (Muller & Verschoor, 2007) was parallel to a preliminary analysis conducted on the sample firms. Majority of the sample firms were shown to be net importers by comparing the amount of their account payable and receivable. Data on the payables and receivables amounts were available in the Appendix 3 section. Hence, appreciation of the USD would put the firms at disadvantage due to higher payable amount and lower profitability and stock return. The effect was significant for the overall stock return. The finding synchronised for emerging market that is associated with volatile exchange rate movements. Rapid growth in emerging market particularly in term of economic openness and activity enabled the emerging markets to accumulate significant share of world trade (Muller & Verschoor, 2007).

Table 4.3: Overall Symmetric Foreign Currency Exposure

Constant	-0.0036
	(0.0000)[c]
Market Index	1.1314
	(0.0000)[c]
Currency Exchange	-0.0633
	(0.0000)[c]

This table reports the result of the following regression: $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \beta_{US\$} S_{US\$,t} + \mu_{it}$ for symmetric regression. p-values are shown in parentheses. [c] Significant at 1% level.

4.2.2 Overall Asymmetric Foreign Currency Exposure

In continuation of the symmetric exposure estimation, the section presents the analysis on the asymmetric exposure. Initially, the presence of asymmetric effect in the overall model was tested by using the model proposed by Koutmos and Martin (2003). Results of the analysis are shown in Table 4.4. Asymmetric effect is shown to be present in the sample firms based on the significant dummy variable at 10% significant level. Ascertaining the presence of exposure as asymmetric exposure in the sample study thus justified the further analysis on the level of asymmetric that follows.

Table 4.4: Asymmetric Effect of the Overall Sample Firms

Constant	-0.0028
	(0.0000)[c]
Market Index	1.1309
	(0.0000)[c]
Currency Exposure	0.0135
	(0.6474)
Asymmetric Dummy	0.1404
	(0.0101)[c]

This table reports the result of the following regression: $R_{it} = \theta_0 + \theta_1 R_{mt} + (\theta_{US\$} + \theta_{D,US\$} D_{it}) US\$_t + \varepsilon_{it}$. p-values are shown in parentheses. [c] Significant at 1% level.

Afterward, the study continues with the panel data estimation of the asymmetric currency exposure. Preliminary Hausman test indicates the better consistency of the Eandom Effects model in the analysis. As for the asymmetric exposure results in Table 4.5, the beta coefficient for the USD appreciation showed a negative effect of the

exposure towards the firms' stock return. In this sense, one percent appreciation of the USD would reduce the stock returns by 0.0107%.

The positive beta coefficient for the USD depreciation indicated the firms would benefit from the USD depreciation, conforming to our previous findings on symmetric exposure pertaining the sample firms' importing nature. Beta coefficient value of 0.0152 showed the stock return would increase by 0.0152% for any one percent depreciation in the USD.

Table 4.5: Overall Asymmetric Foreign Currency Exposure

Constant	0.0028
	(0.0000)[c]
Market Index	1.1315
	(0.0000)[c]
Currency Appreciation	-0.0107
	(0.6370)
Currency Depreciation	0.0152
	(0.0003)[c]

This table reports the result of the following regression: $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \beta^P_{US\$} S^P_{US\$,t} + \beta^N_{US\$} S^N_{US\$,t} + \mu_{it}$ for asymmetric regression. p-values are shown in parentheses. [c] Significant at 1% level.

The findings also conformed to Bacha's et al. (2013) assertion of Malaysian importing nature as the results showed significant sensitivity of the sample firms to any negative change in the USD. Such sensitivity arose as depreciation of the USD would induce profits for the importing firms.

4.2.3 Firm-level Symmetric Foreign Currency Exposure

This section discusses the firm level analysis of symmetric currency exposure. In addition to the overall level analysis, more detailed information on the level of currency exposure was obtained from the firm-level analysis. Firm level symmetric currency exposure is presented in Table 4.6. The result shows 35.75% of all sample firms had statistically significant exchange rate exposure. The high exposure level was in contrary to the relatively small significance level in developed country as evidenced in landmark studies by Jorion (1990), and Bodnar and Gentry (1993). Taking the study on developed country by Jorion (1990) as a comparison, the 35.75% in this study was significantly higher than the 5% exposure level reported by Jorion (1990). Similarly, Bacha et al. (2013) which also focused on the Malaysian listed firms showed that 62.50% of the sample firms were affected by the currency movements.

Table 4.6: Firm-level Symmetric Foreign Currency Exposure

	Symmetric
Mean of beta	-0.2942
Median of beta	-0.2758
SD of beta	0.4615
Maximum beta	1.1102
Minimum beta	-2.2429
No of Positive Cases (%)	59 (28.5024)
No of Negative Cases (%)	148 (71.4976)
Significant Positive Cases at 10% (%)	9 (4.3478)
Significant Negative Cases at 10% (%)	65 (31.4009)
Total of Significant Cases at 10% (%)	74 (35.7488)

This table reports the result of the following regression: $R_t = \alpha_0 + \alpha_1 R_{m,t} + \beta_{US\$} S_{US\$,t} + \mu_t$ for symmetric regression.

Hence, it was deduced that Malaysia's position as an active trading country and its volatile market condition prompted the market to experience higher exposure to currency movement. The high proportion was in parallel with the high exposure levels reported by Bacha et al. (2013) for a developing country.

Among the significantly affected firms, only nine firms had significant positive exposure, leaving a mass proportion of the significant sample firms (65 firms) to be negatively affected by the USD movement. Hence, the 65 firms were indicated to be adversely affected by any movement in the USD and characterised by decrease in their stock return when the exchange went up (Bae et al., 2018). With this, these firms required proper measures to offset the exposure they faced from the currency fluctuations.

4.2.4 Firm-level Asymmetric Foreign Currency Exposure

In testing the firm-level asymmetric exposure, the study initially tested the presence of asymmetric effect at the firm-level by utilising the model by Koutmos and Martin (2003). The results are presented in Table 4.7. Firm-level analysis of the model provides an insight into the extend of the presence of asymmetric effect of the sample firms. The analysis managed to indicate the significant asymmetric effect towards 11% of the sample firms at 10% significant level. Further observation on the proportion of affected firms showed higher number of firms positively affected by currency exposure ($\theta_{US\$} > 0$), while the asymmetric dummy negatively affected most of the sample firms

($\theta_{d,US\$} < 0$). Putting together the signages of the beta coefficients ($\theta_{US\$}$ and $\theta_{d,US\$}$), The results were consistent with the conditions of net importers' pricing-to-market (PTM) strategy with market share objective.

The findings further justified the results of preliminary analysis that indicated the sample firms mostly consisted of net importers. It appeared that the sample firms had beneficial effects from the depreciation of the USD and incline to price their products and services to maintain their market share in the foreign market. Bigger proportion of firms enjoy higher stock return during the USD depreciation, compared to the composition of firms benefiting during the USD appreciation. Thus, the model provides justifications on the presence of asymmetric exposure and also the net importer position of the sample firms.

Table 4.7: Firms Level Analysis on the Presence of Asymmetric Effect among the Sample Firms

	Currency Exposure	**Asymmetric Dummy**
Number of Significantly Exposed Firms at 10%	33 (16%)	22 (11%)
Number of Positively Exposed Firms	94	123
Number of Negatively Exposed Firms	113	84

This table reports the result of the following regression: $R_t = \theta_0 + \theta_1 R_{mt} + (\theta_{US\$} + \theta_{D,US\$} D_t) US\$_t + \varepsilon_t$. Significance level is at 10%.

In continuation of the previous analysis on the presence of asymmetric effects, this section further discusses on the level of asymmetric exposure among the sample

firms. The second and third columns in Table 4.8 summarise the evidences of firm-level asymmetric exposure and highlight the different nature of exchange rate movements. The proportions of affected firms were shown to vary between the USD appreciation and depreciation. The USD appreciation significantly affected 16.43% of the 207 sample firms. Specifically, the percentage of` firms positively affected by the USD appreciation were 7.73%. Higher proportion of the sample firms was negatively affected by the USD appreciation at 8.69%. As for the USD depreciation, 10.14% of the sample firms were significantly affected by the currency movement. Proportion of positively affected firms was higher (5.79%) compared to 4.35% for negatively affected firms. It could be seen that the sample firms were more negatively affected during the USD appreciation in consideration of the high volatility during the currency movement.

Secondly, the negative mean value for the parameter estimates under the USD appreciation indicated the adverse effect of the USD appreciation towards the firms, consistent with the negative correlation found by Aguiar (2005). The beta was -0.0357, indicating a 1% appreciation of the USD against the ringgit would decrease the value of firm by 0.04 percentage point. Hence, firms with future payables would need to incur higher payable amount and lower their stock return.

Table 4.8: Firm-level Asymmetric Foreign Currency Exposure

	Asymmetric	
	USD Appreciation	USD Depreciation
Mean of beta	-0.0357	0.1224
Median of beta	-0.0339	0.0669
SD of beta	0.4901	0.5666
Maximum beta	1.3871	1.8042
Minimum beta	-3.0609	-1.6844
No of Positive Cases (%)	95 (45.89)	113 (54.59)
No of Negative Cases (%)	112 (54.11)	94 (45.41)
Significant Positive Cases at 10% (%)	16 (7.73)	12 (5.79)
Significant Negative Cases at 10% (%)	18 (8.69)	9 (4.35)
Total of Significant Cases at 10% (%)	34 (16.43)	21 (10.14)

This table reports the result of the following regression: $R_t = \alpha_0 + \alpha_1 R_{mt} + \beta^P_{US\$} S^P_{US\$,t} + \beta^N_{US\$} S^N_{US\$,t} + \mu_t$ for asymmetric regression.

On the other hand, the beta value was positive under the USD depreciation at 0.1224. In this regard, any 1% depreciation of the USD would boost the firms' stock return by 0.12%. Holding the sample firms as net importers, the positive effect of the USD depreciation indicated that the firms were obliged to lower payable and obtained greater stock return during the USD depreciation. The findings sat well with the postulate of import base firms in Malaysia as shown in our preliminary analysis and the findings by Bacha et al. (2013). As net importers, firms would be at advantage when the local currency is strengthened against the foreign currency.

Clearer overview on the findings is shown in Figure 4.1. The figure illustrates the composition of positively and negatively affected firms under both the USD appreciation and depreciation. The figure accentuates the earlier discussion of higher

composition of positively affected firms was shown during the USD depreciation. In contrary, bigger composition of firms were negatively affected during the USD appreciation. The sample firms were prone to be badly affected by the USD strengthening. Meanwhile, majority of the sample firms tended to benefit from the depreciation of the USD.

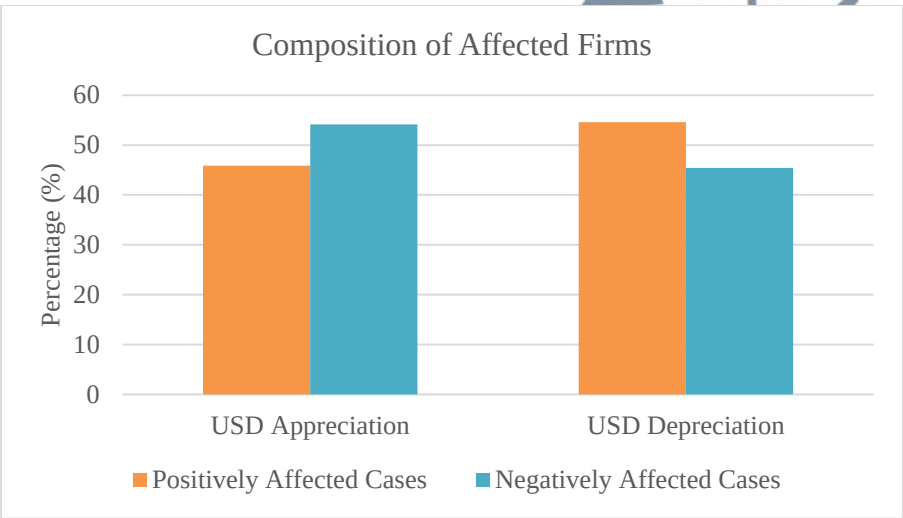

Figure 4.1: Composition of Affected Firms

Based on these discussions, it was concluded that Malaysian firms were affected by both the positive and negative exposure resulted by the USD movement against the Malaysian ringgit. Appreciation of the USD would cause the local currency to decrease in value and lower the revenues generation. The lower revenue would eventually prompt lower stock returns for the importing firms. Otherwise, effect could be observed when the USD experienced depreciation. The firms enjoyed higher returns during the USD depreciation which was relevant for our sample firms that mainly consisted of

importing firms. The importing firms would benefit from the lower payable amount due to the stronger local currency. Hence, the firms' overall revenue and stock returns would also improve. Additionally, larger dispersion was observed during the USD appreciation than the dispersion during the USD depreciation. The lower currency fluctuations during the USD depreciation further supported the postulate of better effects of the USD strengthening when most of our sample firms were import-based firms.

4.2.5 Conclusion on Symmetric and Asymmetric Foreign Currency Exposure

From the discussions on the symmetric and asymmetric foreign currency exposure, the symmetric analysis showed currency exposure caused negative effects to the sample firms' stock returns. Segregating the exposure based on their respective direction, the asymmetric analysis showed varying effects of currency exposure towards the sample firms under different USD movements. The sample firms were shown to benefit from the USD depreciation, while the USD appreciation caused lower stock returns. Consequently, more in-depth findings were provided by the firm-level analyses. Firstly, the study managed to show 35.75% of the sample firms were significantly affected by the currency movement. The mean values of the beta coefficient indicated the currency exposure negatively affected the sample firms. Secondly, contrasting effects were observed between the USD appreciation and depreciation at the firm-level analysis. The findings were analogous to the results of overall asymmetric exposure.

In this regard, the findings showed slightly different results between symmetric and asymmetric measurements. The symmetric analysis proved that currency exposure caused negative effect towards the sample firms, which was a classic result in the currency exposure and stock return nexus. However, scrutinising the exposure from the asymmetric aspect showed that the USD appreciation and depreciation caused different effects towards these firms. Thus, any investment and risk management strategies should consider the direction of the currency movements rather than directly adopting the residual values. This way, the measurement could avoid the possibility of bias arising from the commingling off positive and negative exposure. The results were within expectation for the study in which the percentage of significantly affected firms was high for the sample firms. The contradiction between the symmetric and asymmetric measurement also corroborated the objective of the study to undertake various measurement approaches in order to provide meaningful exposure measures.

4.3 Time-varying Symmetric and Asymmetric Foreign Currency Exposure

Following the symmetric and asymmetric currency exposure explained in Section 4.2, the study advances to include time-varying factor to answer the second research objective. The second research objective aims to analyse the variation of currency exposure among the Malaysian non-financial firms across different financial events. The results in this section were generated using the panel and OLS with GARCH(1,1) specification.

4.3.1 Overall Time-varying Symmetric Foreign Currency Exposure

In order to investigate the overall time-varying symmetric exposure, the analysis was segregated under significant financial events. The significant events were pre-Asian financial crisis (pre-AFC), middle-Asian financial crisis (middle-AFC), pegged period, de-peg period, middle global financial crisis (middle-GFC), and post GFC. In estimating the panel data, preliminary Hausman test indicates the better consistency of the Random Effects model in the analysis. Findings for the overall time-varying symmetric currency exposure were included in Table 4.9. In addition to the positive or negative effects of the currency exposure, the study also looked into the significance of exposure towards the sample firms. The significance of each sub-period signalled the occurrences taking place within the Malaysian economic backdrop.

Of all the sub-periods under study, the middle-AFC (p-value=0.0026), peg (p-value=0.0000), and de-peg (p-value=0.0004) periods were found to exert significant exposure towards the sample firms. The significant effect during the middle-AFC was expected to influence the close association between Malaysia and Thailand as the epicentre of the crisis. Apart from the close geographically association between Malaysia and Thailand, both the countries also shared mass cross-border trading and exposed to similar systematic risk. Thus, it came as no surprise for middle-AFC to significantly affect the sample firms.

However, the significant effect of peg period required some close observations on the market considering the peg period was a period of hypothetically no/minimal exchange rate movement. Conforming to similar findings by Bacha et al. (2013), the significant effect of the peg period was reasoned by the undervaluation nature of the pegging establishment. The ringgit was *de facto* pegged at a value of MYR3.80 per USD in 1998. The fact that the peg was set at a much lower value and the myriad of price controls in Malaysia had negatively affected the firm value of importing firms. Despite being a one-off effect of policy intervention, the effect continued as long the peg was in place because importing firms had to tackle the higher import cost due to the devaluation of the local currency while obligating to the price controls which made it hard to pass the import costs to the end consumers.

Once the peg was lifted, the market's vigorous reaction to the floating ringgit caused significant effect of currency exposure. Hence, the significant effect of the de-peg period was expected as the firms responded to the lifting of the peg system. The global market was once again hit by a bout of financial crisis in 2008. However, the middle-GFC did not significantly affect (p-value=0.6483) the sample firms. The middle-GFC indeed halted the global economy, but Malaysia was better positioned to meet the GFC compared to the previous AFC. Triennial survey by the Bank of International Settlement (2020) showed that a total of 7642 derivatives were used in 2016 in the Malaysia market compared to 1143 derivative in 1998 which signified better

market advancement in the financial sector. Additionally, the crisis mainly affected the US market as it was prompted by the country's failing subprime mortgage practice.

Subsequently, the currency exposure under the post-GFC period was also insignificant. While the global economy was struggling its way out of the crisis, Malaysia managed to lessen the impact through its policy control and market interventions. Supported by the country's strong domestic demand and economic fundamentals, one notable government intervention was the adjustments by the Bank Negara Malaysia (BNM) on the overnight policy rate (OPR). Such interventions were meant to balance out the series of effects from the subprime mortgage problem. With numerous interventions and around the clock monitoring by the central bank, the insignificant effect of the currency exposure under the post-GFC period was within expectation. The period saw active involvement of the government on any imbalance in the foreign currency reserves and the movement of the ringgit (Umezaki, 2019).

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Table 4.9: Overall Time-varying Symmetric Foreign Currency Exposure

Market Index	1.1329
	(0.0000)[c]
Pre-AFC	-0.0538
	(0.7824)
Middle-AFC	0.0941
	(0.0026)[c]
Peg	-0.0035
	(0.0000)[c]
De-peg	0.4261
	(0.0004)[c]
Middle-GFC	0.0463
	(0.6483)
Post-GFC	-0.0035
	(0.9208)

This table reports the result of the following regression: $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \sum_{j=1}^{5} \beta_{j,US\$} D_j S_{US\$,t} + \mu_{it}$ for symmetric regression. P-values are shown in parentheses. [c] Significant at 1% level.

Another consideration was the beta coefficient for each period. Negative effect was observed during the pre-AFC, in line with the mainstream expectation of higher currency that would cause lower firms' performance and stock returns. Beta coefficient value of -0.0538 indicated that the firms' stock return would decrease by 0.05% for any one percent increase in the currency. The coefficient value under the middle-AFC stood at 0.0941. Within expectation, the peg period exerted negative effect as pegging the ringgit to the USD destroyed the sample firms' value. The beta was recorded at -0.0035, hence any one percent increment in currency exposure would reduce the firm value by 0.03%. Consequently, liberalization of the ringgit from the USD under the de-peg period caused positive effect towards the sample firms. Once the peg was lifted, exposure to the currency movements enabled the ringgit to better respond to the real

currency value. The effect was large in which the firms' stock return rose by 0.43% for any one percent increase in the currency exposure.

As for the GFC period, similar pattern could be seen between the middle-AFC and middle-GFC. The beta exposure during the middle-GFC was 0.046. The finding showed the sample firms experienced low level of currency exposure during the GFC in comparison to the beta level during the AFC. Finally, the post-GFC period showed negative exposure, likewise to the negative effect during the pre-AFC period. Both pre-AFC and post-GFC period showed the sample firms' stock return were insignificantly affected by the currency movements when the market was without any robust market fluctuations and crises.

4.3.2 Overall Time-varying Asymmetric Foreign Currency Exposure

Results from the analysis of asymmetric exposure level under significant financial events are presented in Table 4.10. Before conducting the analysis, preliminary Hausman test indicates the better consistency of the Random Effects model in the analysis. Segregating the exposure based on the direction of movement, currency movement was shown to significantly affect the sample firms during the pre-AFC period. The beta coefficients for the USD appreciation differed from the USD depreciation. Currency exposure exerted negative effect during the USD appreciation, while positive effect was observed during the USD depreciation. Specifically during the pre-AFC period, one percent appreciation of the USD would lower the firm value

by 1.00%, while one percent of the USD depreciation would increase the firm value by 0.46%.

Similar trend was shown during the AFC, in which the USD movements caused different effects towards the sample firms. Specifically, one percent appreciation of the USD would lower the firm value by 0.07%, while one percent depreciation of the USD would increase the firm value by 0.51% during the middle-AFC. As the beta coefficient for the USD depreciation was larger than the beta coefficient for the USD appreciation, the sample firms were shown to be largely affected by the USD depreciation. Again, the findings sat well with the preliminary analysis which showed majority of the sample firms were net importers.

The next discussion was on the peg period. Collinearity issue in the model prompted the analysis to regard the peg period as the control period. Negative exposure effect was observed during the peg period as one percent increase of the USD would lower the firm value by 0.0045%. The sample firms were also found to be significantly affected by the fixation of the ringgit to the USD. While the peg was meant to abstain the currency from the effect of major currency movement, the fact that ringgit was pegged at much lower value leaves the local firms to absorb the effects from any changes in the USD.

Table 4.10: Overall Time-varying Asymmetric Foreign Currency Exposure

	USD Appreciation	USD Depreciation
Market Index	1.1272	
	(0.0000)[c]	
Pre-AFC	-1.0042	0.4591
	(0.0025)[c]	(0.0025)[c]
Middle-AFC	-0.0656	0.5005
	(0.0821)[a]	(0.0000)[c]
Peg	-0.0045	
	(0.0000)[c]	
De-peg	0.9452	0.1934
	(0.0001)[c]	(0.1886)
Middle-GFC	0.0588	0.0604
	(0.6175)	(0.7671)
Post-GFC	0.1799	-0.3363
	(0.0001)[c]	(0.0000)[c]

This table reports the result of the following regression: $R_{it} = \gamma_0 + \gamma_1 R_{mt} + \sum_{j=1}^{5} \beta_{j,US\$}^{P} D_j S_{US\$,t}^{P} + \sum_{j=1}^{5} \beta_{j,US\$}^{N} D_j S_{US\$,t}^{N} + \mu_{it}$ for asymmetric regression. p-values are shown in parentheses. Control period was the peg period. [a] Significant at 10% level. [c] Significant at 1% level.

Additionally, the ringgit was still affected by the changes of other currencies despite the fixation to the USD. Thus, there are still extraneous effect that need to be absorbed while maintaining the pegged value between USD and MYR. Hence, the significance of currency exposure during the peg period was expected for the Malaysian market. Consistent with the previous symmetric exposure results, the analysis showed significant currency exposure effect during the de-peg period. Under both the USD appreciation and depreciation, the firms were positively affected by any movement in the USD.

Meanwhile, the effect of currency exposure during the GFC were insignificant for both asymmetric directions. The insignificant effect of middle-GFC was in consideration of the indirect effect of GFC as Malaysia was located outside of the epicentre of the financial turmoil. In term of effect magnitude, the sample firms were positively affected by the USD movements. For any direction of USD movements during the crisis, the movement in the currency seemed to benefit the Malaysian market.

According to Umezaki (2019), the middle-GFC and post-GFC periods were very much involved with market interventions. The government highly regulated the currency movements through numerous channels including changing the OPR and buying/selling of foreign currency vis-à-vis. As a result, the market prompted positive effects towards the sample firms. During the GFC, the government intervened by moderating the excessive exchange rate volatility. The main objective of the government intervention was to ensure minimal effect from the GFC towards the local market. This was supported by the small beta coefficient values for both the USD appreciation and depreciation. For both the USD movements, a one percent change in the USD would spur the firm value by 0.06%.

On another note, the post-GFC period saw significant effect of the currency movements towards the sample firms. The effect of the USD appreciation was positive while the USD depreciation turned out to be negative. The significant effect was attributable to the robust market response to the post-crisis market condition. In

addition, the length of post-GFC period that run from 2008 to 2016 was also believed to contribute to the significant exposure level under the period.

4.3.3 Firm-level Time-varying Symmetric Foreign Currency Exposure

Results of time-varying symmetric currency exposure are reported in Table 4.11. In line with the previous analysis, the highest number of firms were exposed to currency exposure during AFC (71.49%). The result was consistent with the significant currency exposure effect under the middle-AFC period at the overall level under Section 4.3.1. Thus, the 71.49% of the 207 sample firms significantly affected firms was within expectation as the AFC mainly affected the Asian currency including Malaysia. The negative mean beta coefficient of -0.8775 showed that the firms were adversely affected by the currency movement under the middle-AFC. One percent increment in the USD movement during the financial period reduced firm's stock return by 0.88%.

As for the peg period, 5.31% of the firms were affected by the changes in the USD. Even though the proportion was considered as modest for Malaysian market, the result was equal to the findings by Jorion (1990). Once the peg was lifted, the proportion of sample firms affected by the currency movements rose to 20.77% under the de-peg period. In this regard, the managed floating exchange rate after the liberalisation of the ringgit significantly affected one-fifth of the sample firms. The mean of beta coefficient was 0.48, denoting positive effect of the currency exposure towards firms' stock return during de-peg period.

The effect of currency exposure during the middle-GFC was 23.67%, which equated to almost one-third of the value observed during the middle-AFC. The negative mean of beta coefficient showed that the sample firms experienced lower stock return for any one percent change in the currency movement. Compared to the middle-AFC, the mean of beta value during the middle-GFC was lower at -0.11. The mean of beta during the middle-AFC was -0.88. The fairly lower level of significance and magnitude during middle-GFC was natural in consideration of the comparatively smaller effect of middle-GFC towards the Asian countries. Similarly, the post-GFC period showed almost similar negative effect of the currency exposure. However, the proportion of affected firms was lower during the period. The lower significant proportion was due to the myriad of government intervention and policy controls to minimise the aftermath impact of the GFC towards the market.

In overall, the analysis managed to provide evidences of relatively high exposure level among the sample firms in Malaysia under all periods. Majority of the firms were negatively affected by the exposure under almost both financial crises and post-GFC period. However, the sample firms were shown to be positively affected by establishment and lifting of the peg. These different signages implied the different responses by the sample firms under each significant sub period.

Table 4.11: Firm-level Time-varying Symmetric Foreign Currency Exposure

	Middle AFC	Peg	De-peg	Middle GFC	Post GFC
Mean	-0.8775	1.8563	0.4831	-0.1107	-0.1193
Median	-0.8465	2.2609	0.5800	-0.0528	-0.0896
Maximum	3.6921	35.6626	16.8796	10.0461	1.2798
Minimum	-13.8061	-26.3228	-7.0812	-8.2245	-1.8446
Std. Dev.	1.3330	7.0189	2.0664	2.4719	0.4696
Positive Cases	38	138	138	101	85
%	18.3575	66.6667	66.6667	48.7923	41.0628
Negative Cases	169	69	69	106	122
%	81.6425	33.3333	33.3333	51.2077	58.9372
Significantly Positive	21	7	24	18	8
%	10.1449	3.3816	11.5942	8.6957	3.8647
Significantly Negative	127	4	19	31	28
%	61.3527	1.9324	9.1787	14.9759	13.5266
Significant Cases at 5%	127	6	30	40	21
%	61.3527	2.8986	14.4928	19.3237	10.1449
Significant Cases at 10%	148	11	43	49	36
%	71.4976	5.3140	20.7729	23.6715	17.3913

This table reports the result of the following regression: $R_t = \alpha_0 + \alpha_1 R_{mt} + \sum_{j=1}^{5} \beta_{j,US\$} D_j S_{US\$,t} + \mu_t$. p-values are shown in parentheses.

4.3.4 Firm-level Time-varying Asymmetric Foreign Currency Exposure

The section entails the analysis on currency exposure with consideration of asymmetric exposure and time variation. In Table 4.12, 23.19% of the sample firms showed significant exposure to the USD appreciation during middle-AFC while 14.01% were significantly affected by the USD depreciation. Consistent with the findings on the overall level for the middle-AFC period, the firm-level results also showed negative effect on the stock return for the USD appreciation while the USD depreciation caused positive effect. Specifically, one percent increase in the USD would prompt the stock return to reduce 0.22%. Meanwhile, one percent depreciation of the

USD increased the stock return by 0.47%. It was important to highlight the effect experienced by these firms during the middle-AFC due to the nature of the crisis. Segregating the direction of exposure still showed high percentage of sample firms that were significantly exposed to currency fluctuations during middle-AFC period.

The peg period was used as the control variable due to the collinearity issue arising from the use of dummy variable. The significant level was high during the period despite the fixation of the ringgit to the USD during the peg period. As per the previous discussion, the study assumed the nature of the pegging caused the domestic firms to absorb the effect of the ringgit undervaluation under the peg system.

As for the de-peg period, the percentage that significantly affected firms under the USD appreciation was 7.25% while the USD depreciation saw significant exposure effect on 16.43% of the sample firms. In fact, the percentage for de-peg during the USD depreciation was higher than the percentages observed during the middle-AFC and middle-GFC. Considering the mean of beta coefficient for both the USD appreciation (0.60) and depreciation (0.56), the result indicted that the sample firms positively responded to the significant effect of the de-peg period. In other words, the managed floating exchange rate benefitted the sample firms.

Another financial crisis in the study was the global financial crisis, denoted as middle-GFC. Interestingly, the significant cases during the middle-GFC was also high

at 16.91% during the appreciation in the USD and 10.63% during the USD depreciation. While the values were not as high as those in middle-AFC, the results showed both crises exerted significantly towards the firms' exposure level. During the middle-AFC, any one percent appreciation in the USD would lower the stock return by 0.13. Meanwhile, one percent depreciation of the USD would boost the stock return by 0.26. Additionally, the magnitude of middle-GFC was smaller than middle-AFC as the mean values were smaller during the middle-GFC. Comparison on the magnitude of the crises conformed the postulate of greater effect of AFC towards the Malaysian market compared to the GFC.

The percentages of affected firms during the post-GFC period for both the USD appreciation and depreciation indicated fairly lower affected firms compared to the other sub-periods. The proportion of firms significantly affected by the USD appreciation was 8.69%, while 5.79% of the sample firms were affected by the USD depreciation. The percentages during the post-GFC were low, particularly due to the continuous effort and intervention by the government to control the market from any spurious fluctuations.

Table 4.12: Firm-level Time-varying Asymmetric Foreign Currency Exposure

	USD Appreciation					USD Depreciation					Peg	Market
	Pre-AFC	Middle-AFC	De-peg	Middle-GFC	Post-GFC	Pre-AFC	Middle-AFC	De-peg	Middle-GFC	Post-GFC		
Mean	-1.10	-0.22	0.60	-0.13	0.05	0.59	0.47	0.54	0.26	-0.09	0.24	1.06
Median	-1.16	-0.14	0.58	0.03	0.03	0.39	0.49	0.42	0.24	-0.11	0.15	1.08
Maximum	17.05	5.90	8.77	6.01	1.70	8.08	3.91	11.45	21.72	7.55	3.25	2.12
Minimum	-14.66	-3.36	-6.78	-6.89	-1.67	-9.52	-2.96	-8.98	-13.21	-1.87	0	0
Std. Dev.	3.65	0.78	2.26	1.69	0.45	2.73	1.03	2.05	3.22	0.79	0.37	0.39
Positive Cases	58	66	129	107	117	122	142	136	127	84	206	200
%	28.02	31.88	62.32	51.69	56.52	58.94	68.59	65.70	61.35	40.58	99.52	96.62
Negative Cases	149	141	78	100	90	85	65	71	80	123	1	205
%	71.98	68.12	37.68	48.31	43.48	41.06	31.40	34.29	38.65	59.42	0.48	99.03
Significant at 5%	21	39	11	25	12	10	18	20	16	10	131	205
%	10.14	18.84	5.31	12.08	5.79	4.83	8.69	9.66	7.73	4.83	63.29	99.03
Significant at 10%	22	48	15	35	18	14	29	34	22	12	136	205
%	10.63	23.19	7.25	16.91	8.69	6.76	14.01	16.43	10.63	5.79	65.70	99.03
Significantly positive	8	12	13	10	14	5	20	19	14	6	135	198
%	3.86	5.79	6.28	4.83	6.76	2.42	9.66	9.18	6.76	2.89	65.22	95.65
Significantly negative	14	36	2	25	4	9	9	15	8	6	1	7
%	6.76	17.39	0.97	12.08	1.93	4.35	4.35	7.25	3.86	2.89	0.48	3.38

This table reports the result of the following regression $R_t = \alpha_0 + \alpha_1 R_{m,t} + \sum_{j=1}^{5} \beta_{j,US\$} D_j S_{US\$,t} + \mu_t$ for symmetric regression, and $R_t = \gamma_0 + \gamma_1 R_{m,t} + \sum_{j=1}^{5} \beta_{j,US\$}^{P} D_j S_{US\$,t}^{P} + \sum_{j=1}^{5} \beta_{j,US\$}^{N} D_j S_{US\$,t}^{N} + \mu_t$ for asymmetric regression. p-values are shown in parentheses.

Thorough observations on the compositions of affected firms during the USD appreciation and depreciation are illustrated in Figure 4.2 and Figure 4.3, respectively. Discussions on the graph will be oriented on the trend of positively and negatively affected firms. Figure 4.2 focuses on the USD appreciation in which bigger proportions of negatively affected firms were observed during the pre-AFC and middle-AFC.

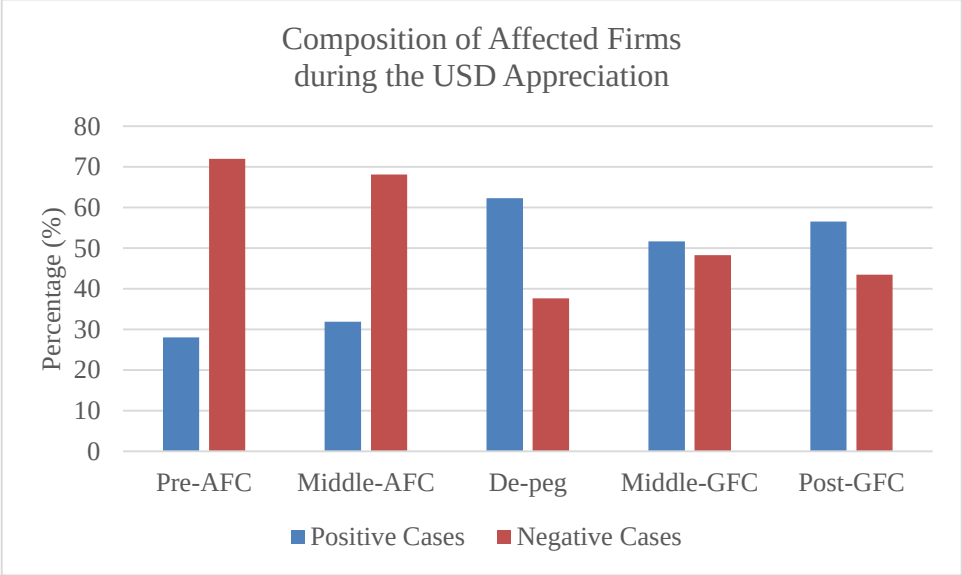

Figure 4.2: Composition of Affected Firms under the USD Appreciation

As for Figure 4.3, the graph illustrates the composition of affected firms during the USD depreciation. Ever since the pre-AFC period until the middle-GFC, larger proportion of the firms enjoyed greater stock returns during the depreciation of the USD. The trend was strongly relevant for the net importers position for majority of the sample firms.

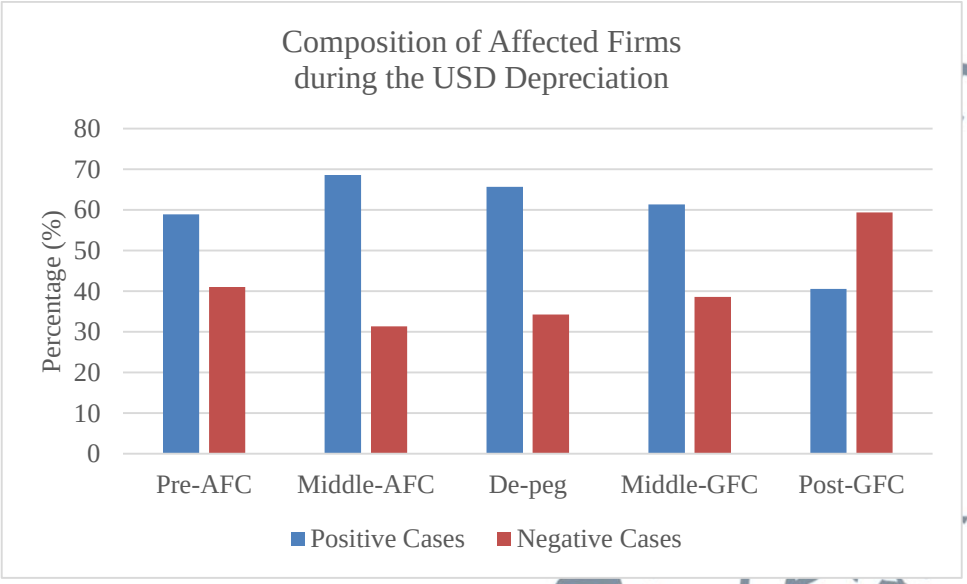

Figure 4.3: Composition of Affected Firms under the USD Depreciation

In overall, the results suggested that most of the firms were negatively affected by the USD appreciation, while positive effect was shown by most of the sample firms from the USD depreciation. Bacha et al. (2013) mentioned on how positive and negative exposure could be clearly illustrated by the direction of trade and trading position of the firms. In the same essence, these importing firms were also negatively affected from the USD appreciation. The overall trend of exposure indicated that the importing firms in Malaysia experienced higher stock returns during the USD depreciation. The results also show the high association between the nature of importing – exporting firms with the direction of currency movement.

Even though the analysis showed that majority of the sample firms demonstrated significant exposure levels under almost all periods, the level differed significantly

according to respective sub-periods. Such outcome was especially highlighted when involving time-variation as connoted by Bacha et al. (2013), Dominguez and Tesar (2006), and Muller and Verschoor (2007).

4.3.5 Conclusion on Time-varying Symmetric and Asymmetric Foreign Currency Exposure

Firstly, firm-level analysis showed currency exposure during the middle-AFC and middle-GFC exerted positive negative effect towards the sample firms. Secondly, currency exposure was also shown to significantly affected the sample firms during the middle-AFC and peg periods. The findings were relevant in consideration of the locality of the AFC and also the devaluation nature of the peg system.

Thirdly, the results showed positive effect of currency exposure during the de-peg period. Optimistic relationship illustrated the active adjustments made by the firms after the ringgit was de-pegged. In this regard, the sample firms were shown to be significantly affected by the currency movements during the period as they could respond to the real value of ringgit. Given the ringgit was pegged- at a much lower value in the previous period, liberalisation of the currency exerted positive effect to the sample firms. Hence, any form of peg or monetary policies in the future should strictly consider the potential undervaluation of overvaluation effect at which the currency was pegged.

Fourthly, the sample firms were not significantly affected by the currency exposure during the middle-GFC and post-GFC periods. Such insignificant effect under these

periods lied on three domineering reasons. First, the insignificance of currency exposure effect during the middle-GFC was due to the fact that the GFC did not directly affect the Malaysian economy. Malaysia may take the hit in the form of indirect causal effect through trade deficits and other third-party countries that were hit by the GFC. As for the post-GFC, the extensive moves by the government to minimise any potential residual effects from the GFC had successfully delivered their cause. Under such close governmental watch, it came as no surprise for the currency exposure to exert insignificant effect under the post-GFC period. Lastly, the development in the use of derivative tools among the firms contributed to the lower level of exposure. The advancement was illustrated by the increasing volume of derivative use over the years as shown by the Triennial Central Bank Survey by the Bank of International Settlement (2020).

4.4 Multiscale Foreign Currency Exposure

Sequential to the currency exposure analysis, the section discusses the results of currency exposure under several time scales. Instead of monthly data, the analysis used decomposed daily data to answer the third research objective which was to investigate the level of currency exposure of Malaysian non-financial firms across different time-scales. Multiscale analysis had become an important aspect in economic and finance. The analysis provided the ability to better cater the different dynamic structures among investors which involved varying time-scales across different horizons. Such capacity was especially important for a market such as Malaysia that was based on the assumption that market player may have different horizon length of investment.

4.4.1 Overall Multiscale Foreign Currency Exposure

Table 4.13 shows the results of estimating beta coefficient β_i^j and R^2. The results were obtained by regressing the individual sock returns for each decomposed j scale crystals of the market index R_m^j and currency exchange D_{usd}^j. The mean, max, and min were shown for distribution of scale j movements in the currency exchange return to the stock return. These coefficients represented the scale-specific betas for the respective scale crystal. In Table 4.13, the beta coefficient for the selected non-financial firm in Malaysia showed multiscale tendency. This was illustrated by the non-monotonous change in the beta values across the time scales.

Comparing the mean of D1 as the shortest interval and D7 as the longest interval, the mean value was observed to be the lowest under the shortest horizon (D1). The findings were relevant for the relation between risk and trading interval. Masih et al. (2010) found similar findings and proposed higher systematic risk faced by long-term investors compared to short-term investors. The highest mean value was in the D4 which denoted the 16-32 days interval and equalled the conventional monthly data frequency. Interestingly, the mean of beta for all crystals were significantly higher than the beta values obtained through the OLS without data decomposition.

Table 4.13: Regression Results from the Decomposed Crystals of Individual Stock Return

	Non-decomposed	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**
Mean	-0.050	0.281	-0.373	-0.316	0.078	-0.069	-0.397	-0.344
Max	0.311	0.789	0.139	0.302	0.783	0.557	0.551	0.791
Min	-0.514	-0.509	-1.491	-1.426	-0.522	-1.007	-1.831	-1.777
R^2	0.000	0.005	0.055	0.0297	0.136	0.221	0.296	0.449
Mean of Positive Exposure	0.095	0.296	0.105	0.121	0.215	0.269	0.235	0.238
Mean of Negative Exposure	-0.132	-0.256	-0.387	-0.367	-0.197	-0.308	-0.643	-0.601

Better illustration on the different measurement results utilising the OLS and wavelet decomposition is shown in Figure 4.4 and 4.5. The means of positive exposure obtained from the standard data were lower than the positive means of decomposed data. In similar fashion, means of negative exposure were smaller from the OLS estimation compared to the results of wavelet model. Either case, the exposure using the OLS model tended to provide lower and constant exposure level for all time intervals. Hence, the results provided two critical observations.

Firstly, decomposition of the exchange rate data accentuated the varying exposure levels across different time scales in the study. Secondly, the exposure levels were actually higher that the level obtained through the widely-used OLS model. While the exposure levels were expected to vary across the time-scales, the fact that higher

magnitude of exposure further justified the relevancy of the multiscale analysis in the study of currency exposure. Decomposing the data enabled more prudent measurement on the effect of currency exposure towards the sample firms.

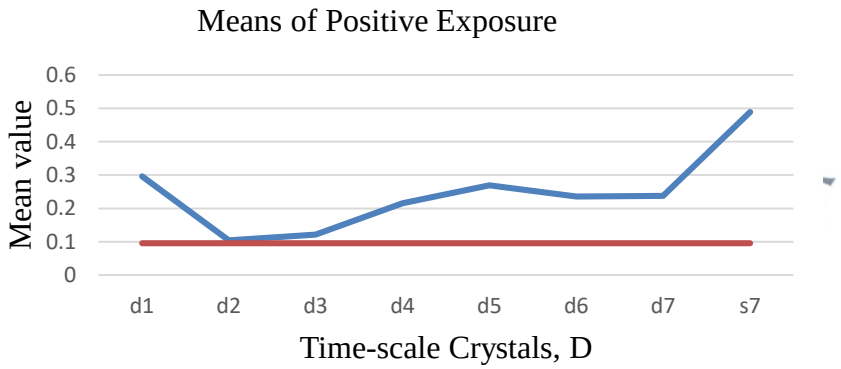

Figure 4.4: Means of Positive Exposure of Decomposed and Non-decomposed Data.

* Blue line indicates the beta coefficients of decomposed data. Red line indicates beta coefficient of non-decomposed data from OLS model.

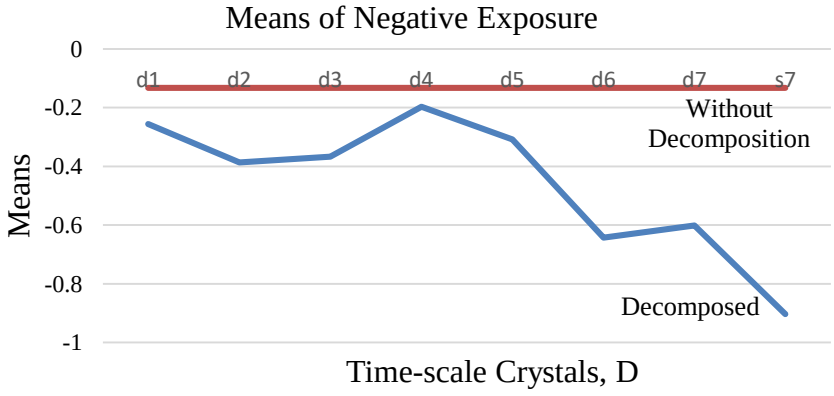

Figure 4.5: Means of Negative Exposure of Decomposed and Non-decomposed Data.

* Blue line indicates the beta coefficients of decomposed data. Red line indicates beta coefficient of non-decomposed data from OLS model.

Similar trend was observed for the R^2 in Table 4.13 as lower value (0.0004) was obtained through the OLS regression as compared to the R^2 results using the wavelet decomposed data (0.0052-0.4498). Higher R^2 value indicated better capability of the market index and currency return to explain the individual stock return when the time scale nature of the time-series was taken into consideration. Comparing the R^2 value of D4 crystal with those of the OLS estimation as both periods represented one-month interval, the difference between the values was very significant. The R^2 value of D4 crystal was substantially bigger than the R^2 value in the OLS estimation. As the R^2 increased monotonically from the short scale to long scale, the extent of currency exposure was said to be more profound in the higher scales than lower scales. Specifically, currency risk faced by individual firms was better captured in the low frequency (long horizon) part of the market. It could also be said the magnitude of currency risk was more apparent when the estimation was done using the decomposed data.

In term of percentage of affected firms, more than one-third of the sample firms were shown to be significantly affected under all time-crystals. The lowest proportion was during the D2 crystal at 33.33%, which was equivalent to the 35.75% obtained from the overall analysis using non-decomposed data in Section 4.2.3. Two critical findings were apparent in Table 4.14. Firstly, all firms were affected by currency exposure under the D7 crystal. As D7 equated to one-year period, it was shown that all firms were significantly exposed to currency fluctuations if the period was elongated.

Table 4.14: Number of Significantly Affected Firms under Different Time Scales

Time-crystal	Number of Significantly Affected Firms
D1	31 (41.33%)
D2	25 (33.33%)
D3	35 (46.67%)
D4	39 (52.00%)
D5	44 (58.57%)
D6	60 (80.00%)
D7	75 (100.00%)
Number of Significantly Affected Firms Using Non-decomposed Data	
Firm-level Symmetric Exposure	35.75%

More than half of the sample firms were significantly affected by D4. Speaking of D4, the proportion of affected firms under the time crystal was 52%. Considering D4 denoted one-month period, the time crystal was equivalent to the time period used in the non-decomposed analysis under Sections 4.2 and 4.3, respectively. Bringing the results of the D4 crystal (52%) and monthly data (35.75%) together, it could be seen that more firms were affected by the currency movements if the analysis was taken into consideration to lessen the effect of noises in the data. De-noising the data was successfully conducted with the wavelet analysis, which proved that more firms were affected by the currency exposure.

4.4.2 Industry Level Multiscale Foreign Currency Exposure

In Table 4.15, the decomposed individual stock returns were regressed according to their respective industries. List of the firms according to their respective industry is shown in Appendix 1. A few industries show the mean of beta increased for bigger return

interval. The industries are travel and leisure, industrial engineering and transportation, oil and gas producers and equipment, industrial metals and mining, chemicals, automobile and parts, general retailer, household goods and home construction, technology hardware, software, equipment and services, and personal and leisure goods.

Table 4.15: Regression Results from the Decomposed Crystals of Individual Stock Return According to Industry

Panel A: Travel and Leisure									
	OLS	D1	D2	D3	D4	D5	D6	D7	S7
Mean	-0.02	0.07	-0.30	-0.27	0.07	0.18	-0.22	0.13	0.33
Mean of (+)	0.06	0.21	0.00	0.01	0.20	0.25	0.11	0.22	0.95
Mean of (-)	-0.77	-0.51	-0.30	-0.33	-0.12	-0.10	-0.44	-0.21	-0.61
Panel B: Industrial Engineering and Transportation									
Mean	-0.07	0.31	-0.33	-0.46	-0.07	0.04	-0.63	-0.48	-0.28
Mean of (+)	0.01	0.31	0.00	-0.46	0.19	0.32	0.07	0.00	0.13
Mean of (-)	-0.09	0.00	-0.33	0.00	-0.25	-0.15	-0.79	-0.48	-0.38
Panel C: Food and Beverages Producers									
Mean	0.01	0.17	-0.09	-0.03	0.11	-0.14	0.08	0.13	-0.21
Mean of (+)	0.04	0.21	0.00	0.11	0.17	0.25	0.16	0.25	0.16
Mean of (-)	-0.03	-0.01	-0.09	-0.13	-0.10	-0.24	-0.05	-0.31	-0.45
Panel D: Oil and Gas Producers and Equipment									
Mean	-0.01	0.28	-0.28	-0.29	0.05	-0.02	-0.46	-0.77	-0.53
Mean of (+)	0.14	0.28	0.07	0.08	0.15	0.21	0.16	0.19	0.21
Mean of (-)	-0.23	0.00	-0.36	-0.79	-0.33	-0.37	-0.88	-1.02	-1.02
Panel E: General Industrial									
Mean	-0.05	0.21	-0.45	-0.14	0.12	0.16	-0.03	0.05	-0.83
Mean of (+)	0.02	0.21	0.00	0.07	0.16	0.33	0.51	0.14	0.19
Mean of (-)	-0.09	0.00	-0.45	-0.19	-0.06	-0.10	-0.16	-0.34	-1.09

Table 4.15: Regression Results from the Decomposed Crystals of Individual Stock Return According to Industry (cont.)

Panel F: Construction and Materials									
Mean	0.13	0.27	-0.28	-0.39	-0.01	-0.35	-0.41	-0.65	-0.74
Mean of (+)	0.27	0.27	0.00	0.00	0.19	0.00	0.05	0.00	0.00
Mean of (-)	-0.77	0.00	-0.28	-0.39	-0.14	-0.35	-0.52	-0.65	-0.74
Panel G: Industrial Metals and Mining									
Mean	-0.03	0.32	-0.20	-0.15	0.04	-0.21	-0.74	-0.63	-1.38
Mean of (+)	0.09	0.32	0.14	0.23	0.12	0.41	0.12	0.00	0.00
Mean of (-)	-0.06	0.00	-0.29	-0.24	-0.29	-0.37	-0.96	-0.63	-1.38
Panel H: Chemicals									
Mean	-0.05	0.25	-0.24	-0.24	0.08	-0.02	0.03	-0.49	-0.81
Mean of (+)	0.09	0.25	0.00	0.00	0.11	0.05	0.27	0.00	0.06
Mean of (-)	-0.08	0.00	-0.24	-0.24	-0.04	-0.14	-0.94	-0.49	-1.03
Panel I: Automobile and Parts									
Mean	-0.04	0.28	-0.25	-0.21	0.11	0.02	-0.62	-0.38	-0.67
Mean of (+)	0.14	0.28	0.00	0.00	0.27	0.29	0.07	0.34	0.32
Mean of (-)	-0.09	0.00	-0.25	-0.21	-0.13	-0.39	-0.79	-0.56	-0.92
Panel J: General Retailer									
Mean	-0.10	0.32	-0.39	-0.39	0.02	-0.24	-0.59	-0.46	-0.77
Mean of (+)	0.06	0.32	0.00	0.00	0.39	0.18	0.00	0.05	0.00
Mean of (-)	-0.14	0.00	-0.39	-0.39	-0.24	-0.34	-0.59	-0.59	-0.77
Panel K: Household Goods and Home Construction									
Mean	-0.09	0.35	-0.67	-0.57	0.24	-0.14	-0.38	-0.39	-0.76
Mean of (+)	0.06	0.35	0.00	0.00	0.32	0.47	0.55	0.29	0.00
Mean of (-)	-0.19	0.00	-0.67	-0.57	-0.08	-0.29	-0.61	-0.86	-0.76
Panel L: Technology Hardware, Software, Equipment and Services									
Mean	0.03	0.26	-0.38	-0.19	0.33	-0.09	-0.70	-0.67	-0.28
Mean of (+)	-0.12	0.26	0.00	0.00	0.33	0.27	0.32	0.00	2.07
Mean of (-)	-0.11	0.00	-0.38	-0.19	0.00	-0.34	-0.96	-0.67	-0.87
Panel M: Forestry and Paper									
Mean	-0.15	0.41	-0.64	-0.57	0.02	-0.09	-0.75	-0.17	-1.23
Mean of (+)	0.08	0.41	0.00	0.00	0.15	0.56	0.00	0.51	0.19
Mean of (-)	-0.21	0.00	-0.64	-0.57	-0.17	-0.26	-0.75	-0.62	-1.58

Table 4.15: Regression Results from the Decomposed Crystals of Individual Stock Return According to Industry (cont.)

Panel N: Personal and Leisure Goods									
Mean	-0.12	0.22	-0.41	-0.18	-0.19	-0.13	-0.09	-0.37	-0.22
Mean of (+)	0.01	0.22	0.00	0.00	0.12	0.22	0.42	0.42	0.73
Mean of (-)	-0.15	0.00	-0.41	-0.18	-0.39	-0.64	-0.42	-0.57	-0.46
Panel O: Electronic and Electrical Equipment									
Mean	-0.19	0.49	-0.69	-0.64	0.25	-0.01	-0.46	-0.01	-0.99
Mean of (+)	0.07	0.49	0.00	0.00	0.33	0.33	0.29	0.14	0.00
Mean of (-)	-0.26	0.00	-0.69	-0.64	-0.09	-0.49	-0.65	-0.21	-0.99

Following the arguments by Handa et al. (1989) which stressed smaller estimated beta towards larger interval for large firms, the trend was relevant for the general industrials, construction and materials, and electronic and electrical equipment. Industries such as the construction and materials were often involved in long-term investment. Thus, these firms may undertake necessary investment move such as hedging to offset exposure arising from long investment period.

The overall results show thirteen out of fifteen industries showed increasing negative exposure towards larger return interval. The industries were industrial engineering and transportation, oil and gas producers and equipment, general industrial, construction and materials, industrial metals and mining, chemicals, automobile and parts, general retailer, household goods and home construction, technology hardware, software, equipment and services, forestry and paper, personal and leisure goods and electronic and electrical equipment. This was in contrary to only five industries which showed increasing beta trend for positive exposure.

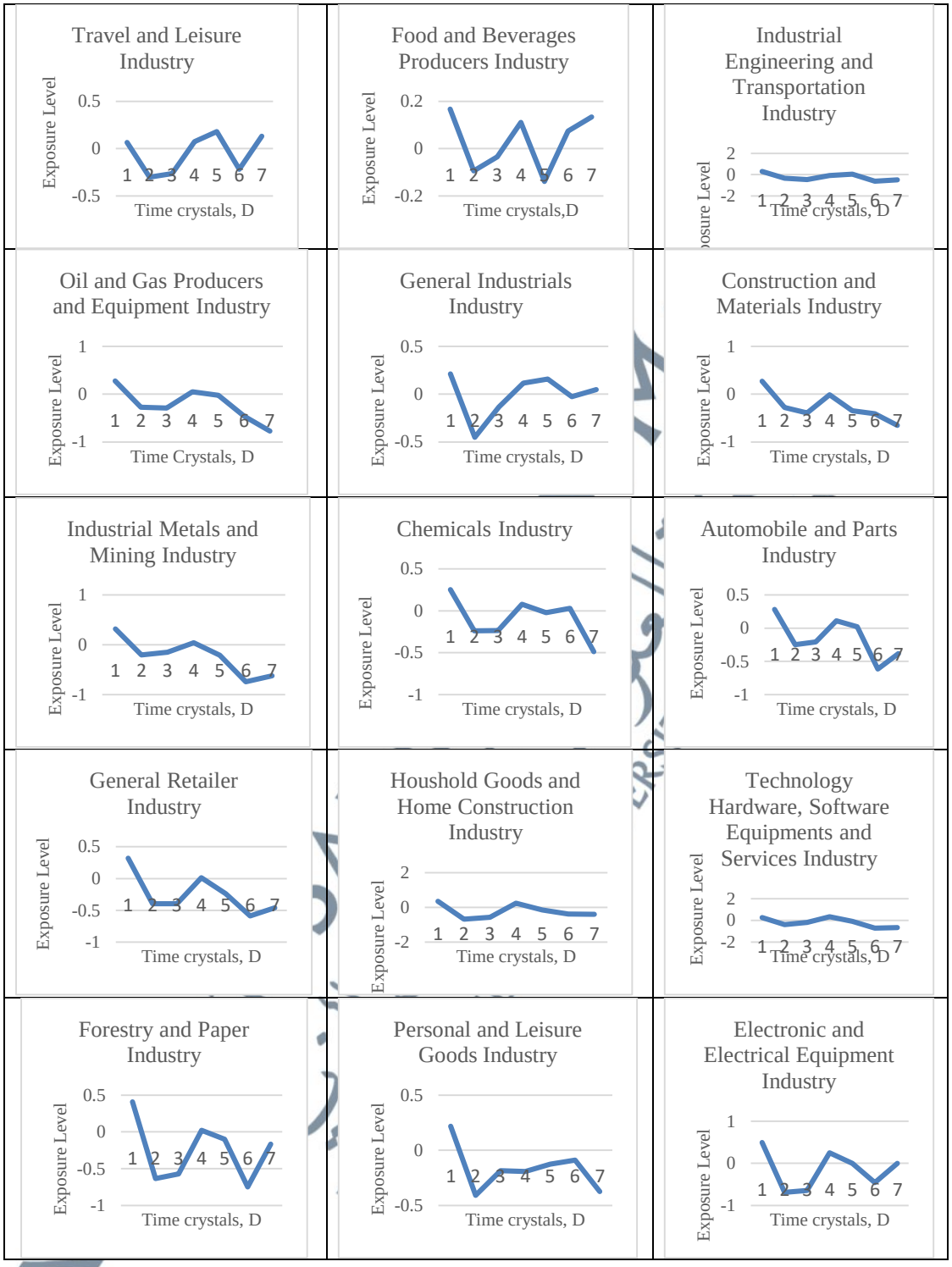

Figure 4.6: Means of Exposure According to Industry

In this regard, the study concluded that the overall exposure in this study exhibited multiscale nature due to the non-monotonic change of exposure levels across the scales. Figure 4.6 illustrates the changing mean values for all industries across the time-scales.

Firstly, the results indicated different currency exposure levels under varying time scales for each industry. This is a natural process considering the different nature of these businesses. Secondly, the results even managed to show that some industries actually experience positive exposure under certain time-scales. The positive exposure was in contrary to the negative relationship between currency exposure and stock return shown in the previous overall level analysis in Section 4.4.1.

Hence, scrutinising the results justified the importance to analyse currency exposure from the industry level as the industries responded differently to the exposure. Measurement with better precision would inevitably provide suitable risk management practice among the firm managers.

4.4.3 Conclusion on Multiscale Foreign Currency Exposure

A few critical findings were concluded from the multiscale analysis. Firstly, multiscale tendency existed as the mean values varied across time-scales. This supported the findings of studies on varying exposure across time-scales. Secondly, higher exposure was shown in OLS model compared to the model using the decomposed data. In fact, exposure level fluctuated across time-scales, suggesting potential cancel out of

the effect in the OLS model. Thus, the findings justified the postulate of better precision using the de-composed data. It also showed firms' exposure was not only limited to monthly frequency.

Thirdly, in term of affected firms, the number of significantly affected firms was higher using the decomposed data. The non-decomposed data for the OLS model used monthly data. At monthly frequency, the OLS analysis showed 35.75% of the firms were significantly affected by the currency exposure. However, de-noising the data showed higher proportion of affected firms.

In a nutshell, the analysis using the wavelet decomposed data managed to justify the initial postulate of varying exposure levels across time scales. In this regard, the findings also supported the inclusion of time-scale analysis into the assessment of currency exposure as they could provide more precise results. The multi-scale findings were parallel to the notion that foreign exchange volatilities tended to follow different scaling laws at different horizons (Gencay et al., 2001b). Varying exposure levels under different time scales signalled the different currency risk faced by the firms in the respective industry. This was in contrast to the exposure level obtained through the OLS estimation that assumed constant exposure over the designated period. However, assumption of time-invariant exposure was inappropriate given the time-varying nature of the currency exposure in many financial markets. Suitability of wavelet analysis was justified by its ability to decompose the financial data into several time scales. The

decomposition enabled the analysis to simultaneously localise a process in time and scale and better handle non-stationary data. The method was also proven to resolve some empirical anomalies of financial and economic data (Ramsey, 1996) that were associated with a handful of independent observations generated from long-horizon return series. Therefore, resorting to multiscale analysis was believed to lead firm managers to more reliable and valid decision making.

4.5 Corporate Hedging Practice

Up to this point, the study had analysed the currency exposure level of the sample firms by taking into consideration the symmetric, asymmetric, time-variance, and multiscale tendency. The findings answered the first, second, and third objectives of the study. Apart from the measurements and ascertaining the exposure level, the study further evaluated the significance of corporate hedging practice in Malaysia. This was in line with the fourth research objective which was to investigate the impact of corporate hedging practice on the level of currency exposure of Malaysian non-financial firms.

4.5.1 Financial Hedging Practice

Following the symmetric currency exposure in Section 4.1, the beta coefficient was used as the dependent variable against the financial hedging practice as denoted by the foreign currency derivative (FCD). The analysis tested the effect of the financial hedging practice towards the symmetric exposure in Malaysia. In Table 4.16, the financial hedging practice was significantly associated with foreign exchange exposure.

Considering the high exposure level recorded for the sample firms in the study, financial hedging was shown as beneficial for firms exposed to high currency exposure (Clark & Judge, 2008). The significant effect further enhanced the negative beta exerted by the financial hedging practice. The negative beta was translated to lower exposure with the financial hedging practice within the firms' operation. Statistically, any 1 percent increase in financial hedging intensity would reduce the extent of foreign currency exposure by 0.28 percent. Hence, it was shown that financial hedging practice was effective in managing the currency exposure faced by the sample firms. Employing FCD as a hedging tool to protect the firms' future cash flows from unexpected volatility as well as alleviated the market risk. Financial hedging was also associated with higher firm value if the practice was motivated by the shareholders' wealth maximisation (Sikarwar & Gupta, 2018).

Table 4.16: Effect of Financial Hedging Practice towards Foreign Currency Exposure

Currency Exposure and Financial Hedging Practice (FCD Use)	
Constant	0.0011
Financial Hedging	-0.2875
	(0.000)[c]

This table reports the result of the following regression: $EXP_i = \gamma_0 + \gamma_1 USE_i + \theta_i$. The study followed Newey-West procedure to produce robust standard error estimates in dealing with heteroscedasticity and serial correlation problems. The value in parenthesis indicates p-value. [c] Significant at 1% level.

4.5.2 Operational Hedging Practice

Similarly, the beta coefficient of symmetric currency exposure was used to test the effect of the operational hedging towards the sample firms. The beta coefficient was used as the dependent variable against the Hirshman-Herfindahl Index. In this section, the Hirshman-Herfindahl Index measured the operational dispersion across countries and regions. The beta coefficient was previously acquired in Section 4.1.

Table 4.17: Effect of Operational Hedging towards Foreign Currency Exposure

Panel A: Currency Exposure and Countries Index	
Constant	-0.0351
Countries Index	0.0958
	(0.4365)
Panel B: Currency Exposure and Regions Index	
Constant	-0.2902
Regions Index	-0.3229
	(0.8415)

This table reports the result of the following regression: $EXP_i = \gamma_0 + \gamma_1 disp_{index_i} + \theta_i$. The first regression was done for the countries index, followed by the regions index. The study followed Newey-West procedure to produce robust standard error estimates in dealing with heteroscedasticity and serial correlation problems. The value in parenthesis indicates p-value.

The index was based on two levels, namely the regions and countries indexes. In Table 4.17, the practice of operational hedging was insignificantly associated with foreign exchange exposure under both countries (β=0.0958, p-value=0.4365) and regions (β=-0.3229, p-value=0.8415) indexes. The results show that the sample firms were not affected by the geographical diversification regardless of the magnitude of the diversification. Two reasonings could be offered to interpret the insignificance of the operational hedging. First, the study acknowledged that the insignificant effect of

operational hedging was driven by the significance of the financial hedging practice. In accordance to Chowdhry (2002), firms tended to employ financial hedging which incurred lesser cost than the operational hedging.

Secondly, the study conducted some analysis on the distribution of countries and regions involved in the diversification activities. As can be seen in Figure 4.7, the firms were concentrated on six countries with more than ten firms having their operation plants in the countries. The rest of the sample firms had less than ten operation plants in the respective countries. While this was seen as dispersing enough, further observation on Figure 4.8 on the tabulation of firms according to regions showed the sample firms mainly diverged their operations in the South East Asia (SEA) region. There were 115 operation plants were established in the region. The figures justified the findings on insignificant operational hedging as the close association of the ringgit with the SEA currencies minimised the potential diversification effect. The second region with most operation plants was the Latin America and the Caribbean region. Comparing with 47 operation plants in the Latin region, it was obvious that the Malaysian sample firms were mainly diversified their operation in the ASEAN countries. The sample firms have also noticeably planted their operations in Australia and New Zealand with 20 operation plants in the region.

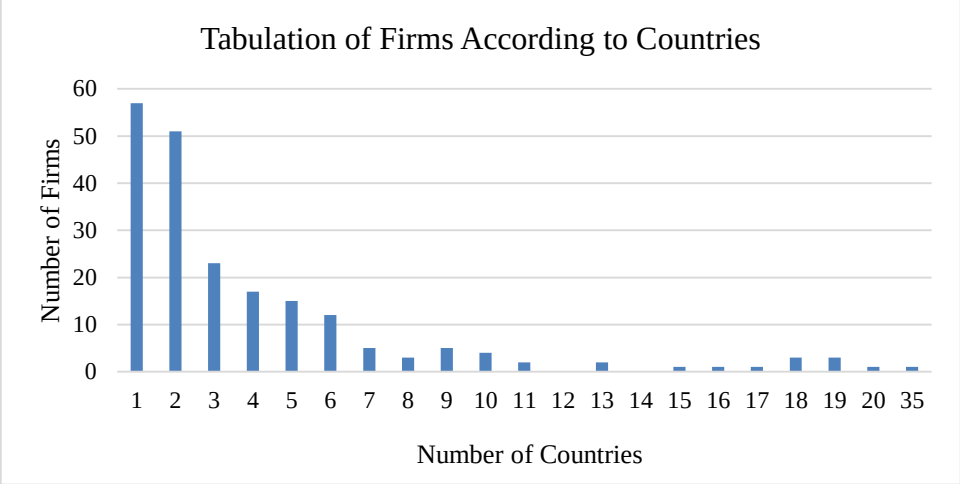

Figure 4.7: Tabulation of Firms across Countries Involved with the Firms' Multinational Operations

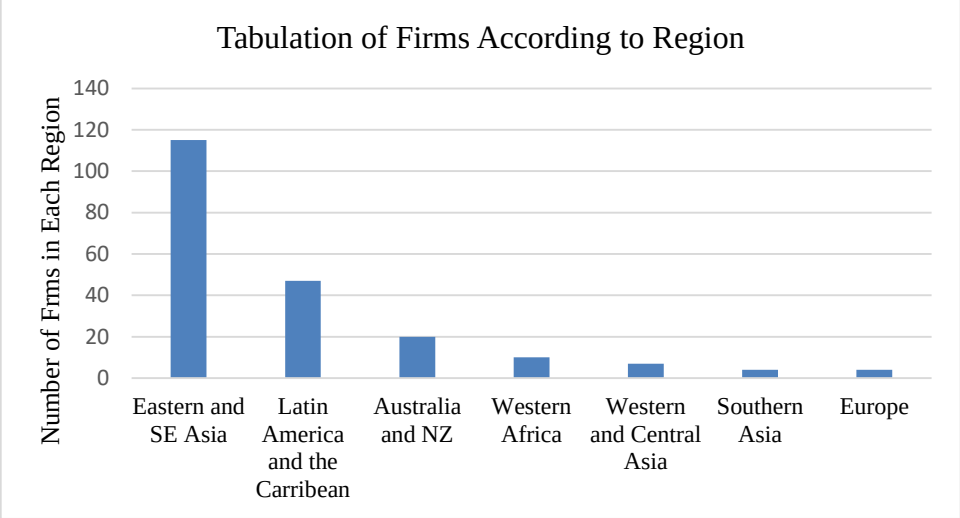

Figure 4.8: Tabulation of Firms across Regions Involved with the Firms' Multinational Operations

Another observation was the correlation between selected foreign currencies with the Malaysian ringgit in Table 4.18. Out of 55 currencies involved in the foreign operation of the sample firms, the ringgit was found to be significantly correlated with

16 currencies namely the Australian Dollar, Brazilian Real, Bruneian Dollar, Sri Lankan Rupee, Hong Kong Dollar, Indian Rupee, Indonesian Rupiah, South Korean Won, Mongolian Togrog, Norwegian Krone, Peruvian Sol, Singapore Dollar, Swiss Franc, New Taiwan Dollar, Thai Baht, and UAE Dollar. The correlation showed that the firms were significantly correlated with almost one-third of the involved currencies. Specifically, the ringgit was positively correlated with majority of Southeast Asian countries that also exhibited similar market characteristics. Thus, operational hedging into these countries did not fully reduce the currency exposure level for the sample firms.

Up to this point, the study managed to justify the insignificance of operational hedging as due to the close association between the ringgit and the currencies of which the sample firms had the foreign operations. In this sense, the diversification effect was minimal for the sample firms. The firms failed to fully benefit from the diversification such as minimising the risk of loss and safeguarding their firm value against adverse market effect because they were exposed to similar market volatility. Together with the significant financial hedging, the insignificance of the operational hedging was justified.

From the magnitude perspective, the negative beta coefficient for the regions index (-0.0351) sat well with the expected inverse relationship between the hedging practice and exposure level. The inverse relationship signified the effectiveness of regional diversification to manage the currency exposure faced by the sample firms. Operations across different regions with low correlation would expose the firms to different

exposure levels. Negative exposure in one particular region could be levelled out by better market condition in another region, ultimately increased the firms' revenue provided by the diversification benefits.

Meanwhile, the countries index imposed positive effect (0.0958) on the exposure level. Following the reasoning by Reeb et al. (1998), countries hedging tended to incur higher systematic risk and agency problems which would actually prompt higher exposure for the firms. Agency problem tended to arise when the firms faced constraints in monitoring the managers. The constraints could be caused by cultural differences, timing issues and geographical limitations. Ineffective monitoring would increase the fluctuations of the anticipated cash flows from overseas operations, thus further spurred the exposure level rather than diminishing the exposure effect (Reeb et a., 1998).

Table 4.18: Correlation of Foreign Currencies with the MYR/USD

Country	Currency	Correlation
Eastern Asia and South East Asia		
Brunei	Brunei Dollar	0.6121
Cambodia	Cambodian Riel	-0.3187
China	Renminbi	-0.0419
Hong Kong	Hong Kong Dollar	0.6181
Indonesia	Indonesian Rupiah	0.6199
Japan	Japanese Yen	0.0210
Korea	South Korean Won	0.7122
Laos	Laos Kip	-0.3497
Mongolia	Mongolian Togrog	-0.5028
Myanmar	Myanmar Kyat	0.3448
Philippine	Philippine Peso	0.2225
Vietnam	Vietnamese Dong	-0.2367
Taiwan	New Taiwan Dollar	0.6012
Thailand	Thai Baht	0.6952
Singapore	Singapore Dollar	0.6121
Australia and New Zealand		
Australia	Australian Dollar	0.6741
Western Africa		
Ghana	Ghanaian Cedi	-0.4153
Nigeria	Nigerian Nara	-0.4840
Seychelles	Seychellois Rupee	-0.4864
Mauritius	Mauritian Rupee	0.4210
Western Asia and Central Asia		
Qatar	Qatari Rial	0.1779
Turkey	Turkish Lira	0.2576
UAE	United Arab Emirates Dirham	-0.5370

Table 4.18: Correlation of Foreign Currencies with the MYR/USD (cont.)

Country	Currency	Correlation
Latin America and the Caribbean		
Argentina	Argentine Peso	-0.0278
Brazil	Brazilian Real	0.6377
Canada	Canadian Dollar	0.4793
Cayman Island	Cayman Island Dollar	-0.3371
Czech	Czech Koruna	0.3700
Mauritius	Mauritian Rupee	0.4210
Mexico	Mexican Peso	0.0443
Peru	Peruvian Sol	-0.6839
Seychelles	Seychellois Rupee	-0.4864
Southern Asia		
Bangladesh	Bangladeshi Taka	-0.4540
India	Indian Rupee	0.5529
Pakistan	Pakistani Rupee	0.2531
Sri Lanka	Sri Lankan Rupee	-0.1269
Colombo	Sri Lankan Rupee	0.5809
Europe		
Austria	Euro	0.3682
Belgium	Euro	0.3682
British	Pound Sterling	-0.3371
Bulgaria	Bulgarian Lev	0.3723
Finland	Euro	0.3682
France	Euro	0.3682
Germany	Euro	0.3682
Greece	Euro	0.3682
Hungary	Hungarian Forint	0.4429
Italy	Euro	0.3682
Luxemburg	Euro	0.3682
Netherland	Euro	0.3682
Norway	Norwegian Krone	0.5987
Poland	Polish Zloty	0.4312
Romania	Romanian Leu	0.3897
Sweden	Swedish Krona	0.0697
Switzerland	Swiss Franc	0.5576
Slovakia	Euro	0.3682
Spain	Euro	0.3682

4.5.3 Interaction Term

Interaction term tests the relationship between the Hirshman-Herfindahl index and the financial hedging practice. The results are presented in Table 4.19. The table comprised the countries index, regions index, financial hedging, interaction term of countries index and regions index, interaction term of countries index and financial hedging use, and interaction term of regions index and financial hedging. These variables are tested under four models in order to identify any specific behaviour or patterns of the corporate hedging practice among the sample firms. For comparison purpose, results from the regressions of financial and operational hedging were put in columns 1 -3.

The first model in column 4 focused on the interaction between the countries index and the regions index. Both countries and regions indexes exerted negative effects towards the currency exposure, indicating the ability of the hedging practices to lower the exposure level. As for the interaction term, simultaneous effect of countries and regions indexes managed to provide some forms of hedging effect as it lowered the exposure by 0.0583 percent with 1% increase of interaction term. However, the hedging effect of these two indexes was insignificant at 0.9, thus indicated embedding both the countries and regions operational diversification become ineffective to hedge the level of currency exposure.

The second model in column 5 tested the interaction between the countries index and financial hedging practice. The across countries operational diversification and

financial hedging was both found to provide minimal hedging effect to lower the exposure level at -0.0664 and -0.0708, respectively. However, the hedging effect for both variables were insignificant at p-values of 0.6731 and 0.5296. Interacting the countries index and financial hedging practice also showed insignificant hedging effect for the sample firms. However, the effect was positive which indicated simultaneous implementation of financial hedging and countries index would actually increase the exposure level. In this regard, the effect was similar to the previous finding on Section 4.5.2 where the countries index was shown to increase the exposure level. The positive beta coefficient for the interaction term was attributable to agency problem and diversification of operation on countries with highly correlated currencies as shown by Table 4.18.

The third model in column 6 tested the effect of regions index and financial hedging to minimise the exposure level among the sample firms. Both the regions index and financial hedging managed to lower the exposure level by 0.3074 and 0.0154 percent, respectively. However, the effect of financial hedging was insignificant while the regions index significantly provided hedging effect. Interacting the regions index and the financial hedging could lower the exposure level by 0.6834 with p-value of 0.0234. Hence, having regional diversification and financial hedging practice in place could provide significant minimising effect towards the currency exposure level faced by the sample firms.

The last model in column 7 included all the variables. Consistently, the regions index (β=-1.1389, p-value=0.0453) and financial hedging (β=-0.2518, p-value=0.0323) maintained their significant effect towards the exposure level. Countries index remained insignificant (β=-0.1451, p-value=0.3181). Interacting the countries index with regions index and financial hedging resulted in insignificant effect to lower the foreign currency exposure level (β=-0.2744, p-value=0.4702). In this regard, the effect of countries diversification was said to be insignificantly correlated with the regional diversification and financial hedging. Ineffective countries-based operational hedging was detrimental to the firms' risk management strategy as it caused the existing regional diversification and financial contracts failed to significantly hedge the firm's exposure (Chowdhry, 2002). Hence, firms should diligently scrutinise their risk management decision as one strategy could actually alleviate the effectiveness of the other risk management moves in place.

Discussions on the 7 models interacting the countries index, regional index, and financial hedging indicated better risk management effect through regional diversification compared to country-level diversification. Infusing financial hedging into the operational hedging practices further enhanced the risk management effect for the sample firms.

Table 4.19: Effects of Financial Hedging, Operational Hedging, and Interaction Terms towards Foreign Currency Exposure

Dependent Variable: Currency Exposure							
	1	**2**	**3**	**4**	**5**	**6**	**7**
	Countries Index (As in Section 4.5.2)	Regional Index (As in Section 4.5.2)	Financial Hedging (As in Section 4.5.1)	Countries and Regions Indexes	Countries Index and Financial Hedging	Regions Index and Financial Hedging	Countries and Regions Indexes and Financial Hedging
Constant	-0.0351	-0.2902	0.0011	-0.1519	-0.3001	-0.2887	-0.2499
Countries Index	0.0958 (0.4365)	-	-	-0.331 (0.0020)[c]	-0.0664 (0.6731)	-	-0.1451 (0.3181)
Regions Index	-	-0.3229 (0.8415)	-	-0.0291 (0.9050)	-	-0.3074 (0.0784)[a]	-1.1389 (0.0453)[b]
Financial Hedging	-		-0.2875 (0.0000)[c]	-	-0.0708 (0.5296)	-0.0154 (0.8364)	-0.2518 (0.0323)[b]
Interaction Term of Countries Index and Regions Index	-	-	-	-0.0583 (0.9000)	-	-	1.7204 (0.0964)[a]
Interaction Term of Countries Index and Financial Hedging	-	-	-	-	0.3927 (0.1391)	-	0.8498 (0.0029)[b]
Interaction Term of Regions Index and Financial Hedging	-	-	-	-	-	-0.6834 (0.0234)[b]	-0.2744 (0.4702)

This table reports the result of the following regression: $EXP_i = \gamma_0 + \gamma_1 disp_{countriesindex_i} + \gamma_2 disp_{regionsindex_i} + \gamma_3 FCD_i + \gamma_4 Countries * Regions_i + \gamma_5 Countries * FCD_i + \gamma_6 Regions * FCD_i + \theta_i$. The first regression was done for countries index, followed by regions indexes, financial hedging, countries and regions indexes and financial hedging, countries index, financial hedging and interaction term, regions index, financial hedging and interaction term, and lastly all corporate hedging indexes, financial hedging and interaction terms. The study followed Newey-West procedure to produce robust standard error estimates in dealing with heteroscedasticity and serial correlation problems. The value in parenthesis indicates p-value. [a] Significant at 10% level, [b] Significant at 5% level, [c] Significant at 1% level.

4.5.4 Multiscale Corporate Hedging Practice

Another consideration on the study of corporate hedging is the inclusion of the multiscale exposure. In Table 4.20, the corporate hedging practice was analysed in accordance to multiscale exposure. Discussion on the table is oriented on the specific component of the corporate hedging practice namely the financial hedging and operational hedging.

In accordance to the flow of the analysis in the previous sections, the discussion starts with the effect of financial hedging towards the multiscale currency exposure among the non-financial firms in Malaysia. At the D2 and D4 time scales, significant negative relationships were recorded between the financial hedging and multiscale currency exposure. Specifically, the beta coefficient values of -3.00 (at D2) and -1.8836 (at D4) implied that 1% increase in financial hedging intensity would reduce the level of currency exposure by 3% and 1.88%, respectively. As time domain increases from D5 to S7, financial hedging turned to exert insignificant effect to lower the effect of the currency exposure. It was concluded that the financial hedging was effective to manage short term exposure, but the effect of financial hedging became ineffective to minimise the exposure under longer time scale with low data frequency.

However, the negative signages maintained across all time scale domains. The findings sat well with the short-term nature of the financial hedging as the derivatives in the hedging strategy were periodically entered for a stipulated time period. Hence, financial hedging provided protection from transactional exposure rather than economic

exposure. The findings conformed to Nguyen and Faff (2003) and Chiang and Lin (2007) which recorded significant effect of financial hedging practice towards the foreign currency exposure among their sample firms for monthly data. Analysis on longer horizon data showed the relationship between financial hedging and foreign currency exposure had become insignificant.

The study also considers the restriction to acquire detailed information on the financial hedging practice in the study. Unavailability of a standard footnote of the actual financial derivative forced he study to represent the hedging activity by dummy variable instead of true values of financial hedges. Inability to specifically recognise the exact derivative class being used by the sample firms had made it difficult to conduct empirical examination of hedging theories (Chiang & Lin, 2007). Hence, the insignificant effect of financial hedging under longer time horizon could also be attributed to the absence of exact information of the derivative use for the study to recognise the apt period the derivatives were being used. Still, the findings were parallel to the findings of financial hedging using monthly data in Table 4.16.

As for operational hedging, the country index was shown to be effective to manage short term exposure and became insignificant when the time scale increases. Similarly, the region index was also found to exert insignificant effect for short term exposure. The insignificance of the operational hedging practice in this study was attributable to the minimal dispersion effect from the operational diversification practised by the sample firms. The sample firms were largely concentrated on a few countries and regions which

provided lesser diversification benefits. This was supported by the preposition brought forward by Prantzalis et al. (2001) who suggested that multinational firms that practised greater network breadth tended to be less exposed to foreign currency exposure. On the contrary, firms that were highly concentrated on a few networks (greater depth) were more likely to be exposed to the uncertainty of currency movements. The reasonings sat well with our sample firms that mostly diversified their operations on countries whose currencies were highly correlated with the Malaysian ringgit.

Subsequently, the table indicted mixed findings on the relationship between the interactive terms and foreign currency exposure. The interaction terms incorporated both the financial and operational hedging practices. The first interaction term comprised the countries and region indexes. Incorporated the countries and region indexes showed the approach was ineffective to manage both the short- and long-term exposure. The result was supported by Allayannis et al (2001) who concluded the inability of operational hedging strategy to reduce foreign exchange exposure. Meanwhile, interacting the countries index and financial hedging turned out to be detrimental as the approach increased the exposure level for both short- and long-term periods. The findings echoed similar outcome previously discussed in Table 4.19. It was supported that the countries-based operational hedging was ineffective regardless of the time scales due to the high concentration on countries with highly correlated currencies. As highly correlated currencies tended to move in the same direction, advantage of currency diversification cannot be maximised and operational hedging cannot function (Chiang & Lin, 2007).

Table 4.20: Effects of Financial Hedging and Operational Hedging towards Foreign Currency Exposure across Different Time Domains

	D2 (4-8 days)	D4 (16-32 days)	D5 (33-64 days)	D6 (65-128 days)	D7 (129-256 days)	S7
Constant	2.3061	1.4821	0.3259	2.1593	0.4742	1.3154
Countries Index	-5.5838 (0.0005) [c]	-2.9443 (0.0616) [a]	0.1857 (0.8636)	-3.3823 (0.4607)	1.7011 (0.5697)	-3.3374 (0.4604)
Regions Index	1.9109 (0.2153)	0.3751 (0.721)	-1.9239 (0.2662)	-2.7437 (0.4754)	-3.6128 (0.3769)	3.5872 (0.5761)
Financial Hedging	-3.0083 (0.0048) [c]	-1.8836 (0.0852) [a]	-0.1369 (0.8662)	-2.4387 (0.4138)	-0.1293 (0.946)	-0.8967 (0.7339)
Interaction Term of Countries Index and Regions Index	-0.6920 (0.3945)	-0.0192 (0.9771)	0.1866 (0.8192)	2.4162 (0.2382)	-0.2101 (0.8978)	-1.4762 (0.7644)
Interaction Term of Countries Index and Financial Hedging	8.7311 (0.0003) [c]	4.4544 (0.0418) [b]	0.0332 (0.9837)	5.5817 (0.3775)	-1.9731 (0.6487)	5.6368 (0.4155)
Interaction Term of Regions Index and Financial Hedging	-2.8334 (0.0882) [a]	-0.8844 (0.4738)	2.212 (0.2695)	0.3538 (0.9362)	-4.8125 (0.2901)	-4.5522 (0.5641)
R2	0.3997	0.2851	0.0647	0.1261	0.0514	0.0698

This table reports the result of the following regression: $|EXP_i| = \gamma_0 + \gamma_1 disp_{countriesindex_i} + \gamma_2 disp_{regionsindex_i} + \gamma_3 FCD\ Use_i + \gamma_4 Countries * Regions_i + \gamma_5 Countries * FCD\ Use_i + \gamma_6 Regions * FCD\ Use_i + \theta_i$ for 31 firms. The multi-scale exchange rate exposure estimates were extracted from maximal overlap discrete wavelet transform (MODWT) analysis. The regressions were done under different time scales namely D2, D4, D5, D6, D7 and S7. The value in parenthesis indicates p-value. The study followed Newey-West procedure to produce robust standard error estimates in dealing with heteroscedasticity and serial correlation problems. [a] Significant at 10% level, [b] Significant at 5% level, [c] Significant at 1% level.

4.5.5 Conclusion on Corporate Hedging Practice

The elaborate discussions on both financial and operational hedging practices in the previous sections highlighted the important findings from this study. Firstly, the study managed to show the significant effects of financial hedging as a form of risk management practice among the sample firms. The findings were more novel given the preliminary analysis showed only a small fraction of the sample firms practised financial hedging. It was thus proven necessary for the sample firms and the Malaysian firms in general to further accentuate their risk management plan with appropriate financial hedging practice.

Secondly, the effect of operational hedging practice was shown to be insignificant in alleviating the currency exposure among the sample firms. Similar findings were recorded for the multiscale corporate hedging practice. Two reasonings were provided for the insignificant effect. Firstly, the insignificance of operational hedging in contrast to the significant financial hedging indicated the firms were better off with hedging strategy that focused on minimising the effect of exposure level. This was in reference to the different natures of risk alleviation effect provided by financial and operational hedging practices. Specifically, financial hedging focused on eliminating the effect of exposure while operational hedging mainly concerned on reducing the source of the exposure (Laing et al., 2020). Secondly, further investigation also showed minimal effect of operational hedging was due to concentration on only one or two countries and regions. Both conditions led to minimal and insignificant effect of the operational hedging. Additionally, the interaction terms managed to show the higher importance of regional diversification compared to the cross-countries operations. With this, the effectiveness of operational

hedging was concluded as dependent on the correlation between the national and foreign currencies, well-dispersed diversification across various places, minimal agency problem, and close monitoring by the firm managers. Diversifying the firms' operations must be done on foreign countries whose currency exhibited minimal correlation with the local currency to optimise the exposure offsetting effect from the operational diversification. Another crucial point of consideration was ensuring effective management and governance in the foreign plants to minimise the potential agency problem arising from poor monitoring. Numerous financial adversities would be inflicted by the inefficiency of the main management to oversee the operation in foreign operations. One of the potential agency conflicts was the risk management strategy that benefited the individual firm manager rather than maximising the firm value. As such, agency cost was shown as a significant factor influencing the level of hedging intensity (Kumar & Rabinovitch, 2013).

4.6 Robustness Tests

4.6.1 Overall Symmetric Foreign Currency Exposure

Consequent to the results shown in the previous sections, additional tests were conducted to examine the consistency of the results. The results were tested to be robust to the use of alternative exchange-rate index to estimate the firm's exposure. Instead of using nominal exchange rate, the study resorted to the broader real exchange rate data. First, the study examined the level of symmetric exposure equivalent to the measurement in Section 4.2.1.

Table 4.21: Robustness Results of Overall Symmetric Foreign Currency Exposure

	Real Exchange Rate	Nominal Exchange Rate (Base Case)
Constant	-0.0003	-0.0036
Market	1.2283	1.1314
Index	(0.0000)[c]	(0.0000)[c]
Currency	-0.0809	-0.0633
Exchange	(0.0002)[b]	(0.0000)[c]

This table reports the result of the following regression: $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \beta_{US\$} S_{US\$,t} + \mu_{it}$ for symmetric regression. p-values are shown in parentheses. [b] Significant at 5% level, [c] significant at 1% level.

In Table 4.21, the significant effect of the currency exposure towards the overall stock return (p-value=0.0002) was consistent with the previous analysis in Table 4.3. Meanwhile, the effect of currency exposure was negative (-0.0809) likewise to the result of the base-case analysis (-0.0633). In consideration of Bartram and Bodnar (2012) who mentioned the more visible inflation level in emerging markets compared to developed countries, the use of real exchange rate would justify the robustness of the analysis despite the inflation effect in the real exchange rate. Hence, the overall results consistently justified the findings of the base-case study in which the overall stock return of the sample firms in Malaysia was significant to the movement of the USD.

4.6.2 Overall Asymmetric Foreign Currency Exposure

Next, the study also re-estimated the asymmetric exposure level using the real exchange rate. Consistent with previous analysis, depreciation of the USD significantly affected the overall stock return (p-value=0.0001). Apparently, insignificant effect of the USD appreciation was also observed in this model using

the real exchange rate (p-value=0.6097). The firms were also positively affected by the USD depreciation (0.3986), lending further justification on the advantage of the USD depreciation as majority of the sample firms were net importers. These net importers benefited from lower payable amount in

Table 4.22: Robustness Results of Overall Asymmetric Foreign Currency Exposure

	Real Exchange Rate	Nominal Exchange Rate (Base Case)
Constant	0.0079	0.0028
Market Index	2.0304	1.1315
	(0.0000)[c]	(0.0000)[c]
Currency Appreciation	-0.0168	-0.0107
	(0.6097)	(0.6370)
Currency Depreciation	0.3986	0.0152
	(0.0001)[c]	(0.0003)[c]

This table reports the result of the following regression: $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \beta_{US\$} S_{US\$,t} + \mu_{it}$ for symmetric regression, and $R_{it} = \alpha_0 + \alpha_1 R_{mt} + \beta^P_{US\$} S^P_{US\$,t} + \beta^N_{US\$} S^N_{US\$,t} + \mu_{it}$ for asymmetric regression. p-values are shown in parentheses. [a] Significant at 10% level. [c] Significant at 1% level.

USD. Hence, the study concluded that consistent results are shown in Table 4.22 in both terms of significance and magnitude of the currency exposure effect. The consistency supported the robustness of the results of asymmetric currency exposure provided in Table 4.5.

4.6.3 Multiscale Foreign Currency Exposure

Results of the wavelet analysis were also re-tested for consistency by using the broader real exchange rate data. As presented in Table 4.23, higher currency exposure was observed across the time scales. Higher mean of beta (0.4048) for

longer return interval negative was likewise to the findings of the base case study in Table 4.13.

Table 4.23: Robustness Results for the Decomposed Crystals of Individual Stock Return using the Real Exchange Rate

Real Exchange Rate	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**
Mean	0.19	-0.27	-0.22	-0.06	-0.324	-0.22	0.40
Max	0.79	0.67	0.71	1.01	1.69	0.71	3.70
Min	-0.77	-1.49	-1.43	-1.29	-2.61	-1.43	-2.09
Mean of Positive Exposure	0.32	0.24	0.21	0.21	0.32	0.89	1.09
Mean of Negative Exposure	-0.18	-0.44	-0.43	-0.26	-0.58	-0.73	-0.68
Nominal Exchange Rate (Base case)	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**
Mean	0.28	-0.37	-0.32	0.08	-0.07	-0.39	-0.34
Max	0.79	0.14	0.30	0.78	0.56	0.55	0.79
Min	-0.51	-1.49	-1.43	-0.52	-1.01	-1.83	-1.78
R^2	0.01	0.06	0.03	0.14	0.22	0.29	0.45
Mean of Positive Exposure	0.29	0.11	0.12	0.22	0.27	0.24	0.24
Mean of Negative Exposure	-0.26	-0.39	-0.37	-0.19	-0.31	-0.64	-0.60

Consistent with previous analysis, mean of negative exposure follows the traditional higher negative exposure (-0.6757) for longer scale (low frequencies). Considering the higher exposure level in developing country in emerging markets as shown by the previous robustness analyses, the findings signalled varying

significant influence of inflation towards firms' operations and returns across the different time scales.

Further emphases on the results are illustrated in Figure 4.9 and Figure 4.10. In the figures, both the negative and positive mean values obtained using the decomposed data showed similar exposure trends across the time-crystals. Consistent with the base case study, the graphs showed higher exposure levels obtained for both positive and negative mean values. Hence, the postulate of better accentuation of exposure level using the decomposed data as discussed in Section 4.4.1 was further supported in this section.

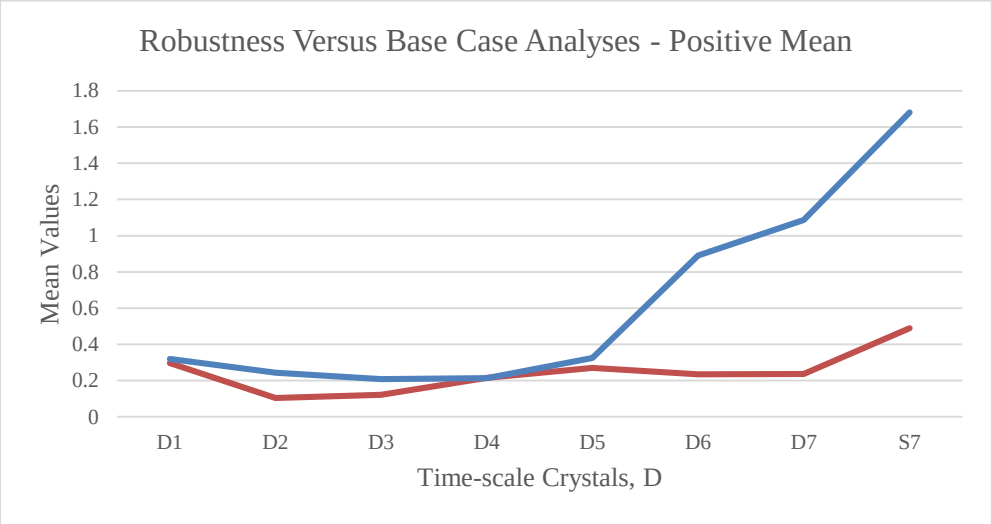

Figure 4.9: Positive Means of Decomposed Nominal Exchange Rate (Base Case) and Real Exchange Rate (Robustness Test)

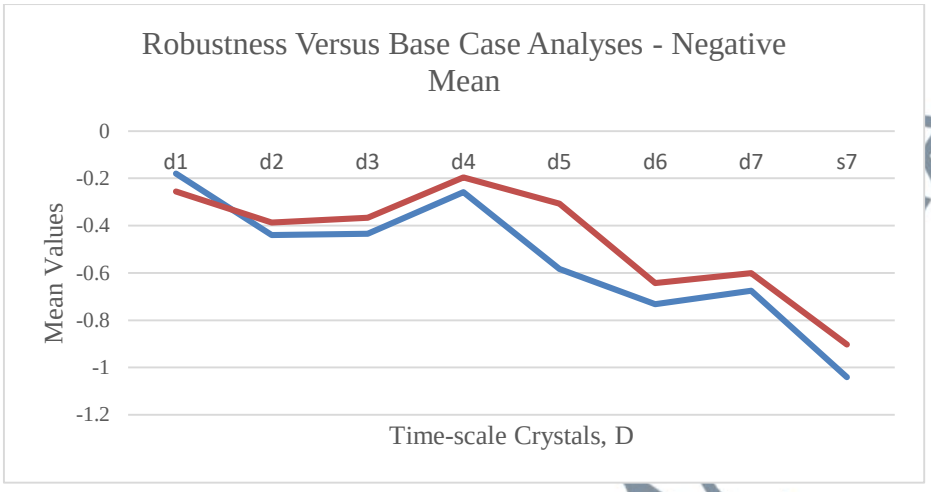

Figure 4.10: Negative Means of Decomposed Nominal Exchange Rate (Base Case) and Real Exchange Rate (Robustness Test)

4.6.4 Financial Hedging Practice

As for the significant effect of financial hedging, robustness test was performed by considering the potential effect of symmetric currency exposure towards the financial hedging practice. In Table 4.24, the significant effect of financial hedging practice was similar to the base case result in Table 4.16, providing evidence of significant effect of financial hedging practice on the level of exchange rate exposure. The negative beta coefficient of -0.1308 showed the financial hedging managed to alleviate the exchange rate exposure level among the sample firms. Any 1% increase in financial hedging tend to reduce the level real exposure by 0.136% in comparison to nominal exposure by 0.29%. The results were robust against the base case results of the effects of the financial hedging practice.

Table 4.24: Robustness Results of Effect of Financial Hedging Practice towards Foreign Currency Exposure

	Real Exchange Rate	Nominal Exchange Rate
Constant	0.3247	0.0011
Financial Hedging	-0.1308	-0.2875
	(0.0248)[b]	(0.000)[c]

This table reports the result of the following regression: $EXP_i = \gamma_0 + \gamma_1 USE_i + \theta_i$. The value in parenthesis indicates p-value. [b] Significant at 5% level, [c] significant at 1% level.

4.6.5 Operational Hedging Practice

In addition to the financial hedging practice, results of the operational hedging were also tested for robustness. Observation on the beta coefficient values in Table 4.25 indicated the hedging practice provided minimal effect to alleviate currency exposure among the sample firms. This alleviating effect was indicated by the negative beta coefficient values. As for the countries index, use of the operational hedging could increase the exposure to USD movements by 0.09%. Meanwhile, diversification of operations at the regional level showed the ability to reduce the currency exposure by 0.04%. Secondly, the operational hedging practice was also found to be insignificant for both country and regions indexes. The findings were analogous to the base case result in Table 4.17 in which both indexes were shown to cause insignificant effect to hedge the currency exposure. As discussed earlier, the study had conducted further investigation and suggested two underlying factors for the minimal effect of operational hedging.

Table 4.25: Robustness Results of Effect of Operational Hedging towards Foreign Currency Exposure

	Real Exchange Rate	Nominal Exchange Rate
Panel A: Countries Index		
Constant	-0.3229	-0.0351
Countries Index	0.0958	0.0958
	(0.4396)	(0.4365)
Panel B: Regions Index		
Constant	-0.2902	-0.2902
Regions Index	-0.0351	-0.3229
	(0.8319)	(0.8415)

This table reports the result of the following regression: $EXP_i = \gamma_0 + \gamma_1 disp_{index_i} + \theta_i$. The first regression was done for the countries index, followed by the regions index. The value in parenthesis indicates p-value.

The first condition was the existence of significant financial hedging in place of the firms' structure. The effect of operational hedging was shown to be minimal and indicated the firms responded better to financial hedging strategy that focused on minimising the effect of the exposure level rather than alleviating the source of exposure through operational hedging (Laing et al., 2020). Secondly, the firms were shown to concentrate their operations in one or two countries only which minimise the effects of the diversification process. The fact that MYR/USD was highly correlated with almost one-third of the foreign currencies also contributed to the insignificant effect of the operational hedging. Hence, the benefits of diversification strategy were not maximised to offset the potential adverse effect in one market. In a nutshell, the results were robust against the base case results of the effects of the financial hedging practice.