

Does Market Portfolio Index Really Affect Foreign Exchange Exposure? An Empirical Evidence from Malaysian Nonfinancial Firms

Abdullah Bin Omar¹, Kamarun Nisham Taufil Mohammad², Haris Khurram³

¹ National College of Business Administration & Economics Lahore (Sup-Campus Multan), Pakistan

² School of Economics, Finance and Banking, University Utara Malaysia (UUM), Malaysia

³ FAST University (Chiniot Campus), Pakistan

Corresponding author: abdullah@ncaemultan.edu.pk

Received: 25 June 2019 Revised: 11 July 2019 Accepted: 26 June 2019 Published: 31 December 2019

Abstract

Financial theory holds that fluctuations in exchange rate significantly influence open market firms by affecting their cash flows and firm value. Because of high market openness and fluctuations in Malaysian exchange rate, this study first investigates the extent to which 224 sampled firms of Malaysia face foreign exchange risk during the period of 2008 to 2014. It is found that 37% of the firms are exposed to (*total*) foreign exchange rate exposure during sample period. The dominance of Malaysian firms with positive β_i in each year implies that most of the Malaysian firms in the sample are net-exporters. To test the sensitivity of market portfolio index in exposure model, the Malaysian market index, i.e., FBMEMAS, is added in the exposure model and foreign exchange exposure for Malaysian firms is re-estimated over the sample period. It is obvious from the results that the number of significant coefficients of market index remains surprisingly high throughout the sample period than that of trade-weighted Index (TWI). A 67% of total firms have significant relationship with market index over the sample period as compared to 9% of TWI which shows drastic decreased in foreign exchange exposure by 76%. These results confirm that sometimes market portfolio index as a whole become strongly correlated with exchange rate changes and, in result, it dramatically reduces foreign exchange exposure.

Keywords: FX Exposure, Market Portfolio, Residual Exposure

INTRODUCTION

As recent international financial events have demonstrated that an exchange rate risk can expand quickly into a broader of any economy and cause financial and economic crisis (Jeon, Zhu, & Zheng, 2017). However, the business world has little doubt about the existence of currency risks (Lan, Chen, & Chuang, 2015). The problem has been greatly aggravated since currencies began to float after the breakdown of the Bretton Woods Agreement in 1973. Since then currencies have fluctuated sharply, and can be caused very large gains and losses if the risks are not avoided or managed (Bernoth & Herwartz, 2019).

The rapid expansion of exchange rate crises beyond the foreign exchange markets reflects in part the importance of the exchange rate to firm profitability. Exchange rates affect profitability through many routes. For example, they affect directly those firms with financial assets and liabilities (most notably debt) denominated in foreign currency and those firms with foreign operations. Thus, a potentially wide range of firms could be exposed to movements in foreign exchange rates, regardless of their direct financial exposure (Zarei, Ariff, & Bhatti, 2019).

The extent to which exchange rate exposure affects firm value remains an interesting empirical question. Previous studies that have examined this issue, in the context of the US and other developed markets, have found minimal impact of exchange rate exposure on firm value (Hutson & Stevenson, 2010). This should not be surprising since the US and developed European markets are among the least open economies. Foreign trade as a ratio of Gross Domestic Product (GDP) is small for these countries. When the issue is examined for small and open emerging markets, the results have been vastly different. Exchange rate exposure appears to impact a much larger proportion of firms within emerging economies and at a much higher magnitude (Parsley & Popper, 2006).

As Malaysia is a small and open economy, exchange rate volatility is its major concern. Since the introduction of the flexible exchange rate system in 1973, the exchange rate has shown itself to be somewhat volatile (Bank Negara Malaysia., 1994). Malaysian firms have been at the forefront of the country's push for greater economic diversification. This has coincided with a steady process of liberalizing capital account transactions. A major relaxation in 1978-89 was accompanied by steps to de-regulate the financial system (Hui-Nee, 2014). With these developments, it is possible that the vulnerability of the cash flows of Malaysian firms to exchange rate movements have increased. Therefore, it would be interesting to examine

whether Malaysian companies exhibit any evidence of foreign exchange exposure. Before going further, a discussion of foreign exchange exposure would be in order.

Foreign exchange exposure is a measure of the potential for a firm's profitability, net cash flow, and market value to change because of a change in exchange rates (Eiteman, Stonehill, & Moffett, 2007). Foreign exchange exposure can be sub-divided into three categories: transaction exposure, economic exposure and translation exposure. Foreign exchange exposure can be however mitigated by financial and operational hedging undertaken by a firm. Financial hedging can be done through the use of forward contracts, money market hedging, options and other derivatives instruments. As for the operating hedging, it can be undertaken by matching foreign income to foreign expenses, diversifying operations into different regional markets and currency swaps.

Thus, it goes to show that there is some possible linkage between foreign currency exposure and firm value. The linkage can appear in two forms. Firstly, the heading or lack of it can possibly affect firm value as it influences that degree a firm is exposed to foreign exchange risk. Secondly, in the event of currency devaluation, foreign investors especially institutional investors pull out of the domestic stock market as currency devaluation causes their domestic portfolios to be worthless. This linkage has no direct connection to the hedging policies undertaken by the firm in order to mitigate its foreign exchange exposure.

Generally, Malaysia's foreign exchange risk exposure is high because of its active international trade. The sum of both annual import and export activities ranged from 1.55 to 2.01 times of annual gross domestic product (GDP) for 1995 to 2000 (Bacha, Mohamad, Zain, & Rasid, 2012). This means that the value of the ringgit is relative to the value of the currency of its major trade partners (i.e., United States, Japan, Europe, and East Asian countries), which is crucial to ensuring the stability and sustainability of Malaysia's economic growth.

These issues motivate us towards the investigation of foreign exchange rate exposure of Malaysian firms. Therefore, the primary purpose of this study is to estimate foreign exchange rate exposure of Malaysian public listed nonfinancial firms over the period of 2008 to 2014. The key objective behind this effort is to examine the effect of market portfolio index in exposure model in order to check how it changes the firm's exposure arises due to fluctuations in foreign exchange rate. This study is organized as follows. The next section reviews past studies of theoretical as well as empirical work on the underlying reasons why firm value can

be expected to be affected by exchange rate movements. In Section 3 the empirical methodology used to measure and test for foreign exchange rate exposure is discussed and the econometric model used to test the exposure conjecture is discussed. Section 4 discusses the results and analysis and discusses the empirical findings. The last section concludes the study and provide future direction.

LITERATURE REVIEW

There is extensive literature examining the relationship between foreign exchange exposure and firm value, the measurement of foreign exchange exposure and the determinants of exchange rate exposure. The focus would be on empirical studies conducted in developed countries and a few touching on Malaysia. Empirical investigation on the relationship in developed countries have on a whole, been mixed. Some studies have found a strong relationship between sensitivity of firm value to foreign exchange variability. However, other studies have found the relationship to be a weak one. There seems to be no common consensus among researchers on the issue, which has fueled tremendous debate.

A study undertaken by Doidge, Griffin, and Williamson (2006), using the traditional regression framework, found that it was difficult to detect exchange rate exposure across 21 developed and 29 developing countries. Nevertheless, it was noted that exposure was generally greater in emerging markets than in developed markets. The analysis on a country by country basis estimated for portfolio of high foreign sales firm revealed significantly positive exposure in Hong Kong and New Zealand and significantly negative exchange rate exposure in Canada, Germany, Italy, Japan, Malaysia, Spain and the U.S. Ramasamy (2000) in examining Malaysian multinationals during the period before and during the Asian financial crises, found 56 out of 146 firms having significant exposure to foreign exchange exposure. However, contrary to conventional wisdom that a depreciating local currency has a positive effect on firm value, all but two of the firms sampled showed significant negative exposure.

Othman and Zaidi (2000) examining the relationship between exchange rate changes and stock index changes before and during the currency turmoil found that exchange rates tended to move in tandem with the stock market indices during the period of currency turmoil. Nevertheless, when tests of causality were employed using the Granger causality, the results were mixed at best indicating there was inconclusive evidence that fluctuation in the Ringgit had any influence on the movement of the stock market, or vice versa.

Researchers have offered differing opinions with regards to the insignificant influence of foreign exchange variability on firm value. Some of the possible explanations are given below.

Risk management activities undertaken by the firm could mitigate the foreign exchange exposure. This can be done using financial hedging and operational hedging. Financial hedging includes the use of forward contracts, futures, currency options and other derivative instruments. Examples of operational hedging could mean the sourcing of factor inputs overseas and facility location decisions to adapt to favorable exchange rate movements (Palia and Thomas, 1997). Using the data on hedging activity for 276 multinational firms from 1992 to 1996, Crabb (2001) found evidence that previous findings of no significant exposure for large cross-sectional samples were likely due in part to the financial hedging activities of multinational firms.

The insignificance of the findings could also be due to experimental issues and sample selection procedures. One of these was the specification to the exchange rate variable and its assumed relationship to a firm's stock returns. Some researchers used a basket of currencies to represent the exchange rate variable (Jorion, 1990; Pritamani et al., 2001; He and Ng 1998). In reality, many companies might be exposed to just one or two currencies. As different exchange rates did not perfectly correlate with each other, the typical research design does not pick up the exact exchange rate exposure faced by each firm (Palia and Thomas, 1997).

Boudt, Neely, Sercu, and Wauters (2019) use intraday data to estimate the daily foreign exchange exposure of U.S. multinationals and show that macroeconomic news affects these firms' foreign exchange exposure. Results show that news creates a substantial shift in the joint distribution of stock and exchange rate returns that has both a transitory and a persistent component. Dwumfour and Addy (2019) examines the impact of changes in interest rate and exchange rates and their unexpected changes on industry and size portfolio returns on the Ghana Stock Exchange (GSE) controlling for the 2007/2008 financial crisis. Their study found that only depreciation of the Gh¢/USD reduces the returns of financial stocks and large firms. There is a direct positive impact of the financial crisis on the returns due to investment shift from developed markets where crisis occurs. Variations in the returns are mostly explained by the market index returns (RM), which has a positive impact. However, they find that the positive impact of RM on the portfolio returns (finance, medium and large portfolios) is reduced during the financial crisis.

RESEARCH METHODOLOGY

Several past studies estimate total as well as residual exposure and provide evidence about the influence of market-portfolio index in exposure model. For example, several researchers empirically estimate *total* foreign exchange exposure by regressing firms' stock returns on foreign exchange rate changes (e.g., see Adler & Dumas, 1984; Bodnar & Wong, 2003; Chow & Chen, 1998; Chow, Lee, & Solt, 1997a, 1997b; Du, Hu, & Wu, 2014; Ito, Koibuchi, Sato, & Shimizu, 2016; Koutmos & Martin, 2007; Parsley & Popper, 2006; Priestley & Ødegaard, 2002; Pritamani, Shome, & Singal, 2004). By following them, this study estimates total foreign exchange exposure of Malaysian firms by examining the impact of foreign exchange rate fluctuations on a return of firms' stock. However, later on, the market portfolio index would be included in exposure model and then its impact is also examined on firm's stock returns.

Hypothesis Development

Fluctuations in foreign exchange rates affect firm's value and its cash flows. Jorion (1990) argues that foreign exchange rate exposure represents the variation in firm value arises due to the fluctuations in foreign exchange rate. Several studies measure foreign exchange exposure by testing the impact of foreign exchange rate movements on stock return at firm level. Results of this relationship are heavily dependent on the nature of economy. Studies that are conducted on developed and closed economies find lesser foreign exchange exposure as compared to open and emerging economies' exposure. Amihud (1994), Jorion (1990), Zhou and Wang (2013), Loudon (1993), Bartov and Bodnar (1994) and Nguyen and Faff (2003), for example, provide weak evidence for foreign exchange rate sensitivity on stock returns for developed and closed economies.

In contrast, various studies find that firms who operate in open and small developing economies are more likely to be sensitive from foreign exchange rate fluctuations. The studies of De Jong, Ligterink, and Macrae (2006) on Netherlands and Hutson and Stevenson (2010) on 23 economies, for example, present evidence that stock returns of those firms that are operating in open economies are highly sensitive to foreign exchange rate movements. Similarly, He and Ng (1998) and Nydahl (1999) find that, respectively, Japanese and Swedish firms are highly affected by exchange rate variations. In line with these arguments, it can be concluded that firms existing in more emerging and open economies are more likely to expose foreign exchange rate risk *vis-à-vis* closed economies. Since Malaysia is an open and emerging

economy therefore, it can be expected that Malaysian firms would be highly exposed to foreign exchange rate risk. In the light of above facts, the following hypothesis can be developed:

H₁: Foreign exchange rate volatilities affect stock returns of Malaysian firms.

As discussed in previous section that several studies examined the influence of market portfolio index in exposure model and investigate the extent to which foreign exchange rate exposure is affected from market index. The results of these studies are mixed. Some studies found that market-portfolio index have strong influence on estimated foreign exchange rate exposure. While, on the other hand, several studies found that there is insignificant relationship between foreign exchange rate exposure and market portfolio index. Therefore, these divergent results demand for the robust investigation whether or not the market portfolio index have any strong influence on Malaysian foreign exchange rate exposure. To test this, following hypothesis can be developed:

H₂: Market portfolio index and foreign exchange rate exposure are related with each other.

Model Specification

There are several methods to test the degree of relationship among explanatory variables but this study use ordinary least square (OLS) method to examine the impact of foreign exchange rate randomness on firms' stock return by following Muller and Verschoor (2007), Nguyen and Faff (2003), Judge (2006) and Khumawala, Ranasinghe, and Yan (2016). The model is explained in detail below.

The first exposure model is introduced by Adler and Dumas (1984) used to estimate sensitivity in firm's value due to the volatilities in foreign exchange rates. Several studies use this model to examine exposure profile of corporate firms related to different economies. Thus, by following Adler and Dumas (1984) approach, this study uses the same empirical model in order to capture variations in stock returns due to fluctuations in exchange rate and can be specified in following form:

$$R_{it} = \beta_0 + \beta_1 TWI_t^{JPM} + \epsilon_{it}$$

where;

- R_{it} is the rate of return on a common stock of i th firm in period t . Selection of different return horizons, such as daily, weekly, bi-weekly and monthly, remains controversial in previous studies from several aspects. Several researchers are in favor of using daily data (over monthly). Di Iorio and Faff (2000), for example, assert that monthly data is not appropriate to capture changes in foreign exchange rates. Similarly, the findings of Chamberlain, Howe, and Popper (1997) confirm the greater foreign exchange sensitivity in the model by using daily as compared to monthly data. Their study reports that results sensitivity can better explained through daily data than monthly data. Therefore, following the assumption that short horizon explains better measurement of foreign exchange exposure, this study uses daily return data.
- TWI_t^{JPM} is the JP Morgan Trade-Weighted Exchange Rate Index (TWI) used as a proxy for the movements in foreign exchange rates. It is measured in MYR per unit of a basket of foreign currencies. This index is available at Datastream and compiled by JP Morgan and it comprised on broad set of foreign currencies. The index encompasses 64 currencies including US Dollar, Singapore Dollar, Australian Dollar, Sterling Pound and Thai Baht that are of top Malaysian trading partners' currencies. Thus, depreciation of the MYR signifies an appreciation of the TWI and vice versa. The use of TWI over bilateral exchange rates has been subject to a greater debate in literature. Zhou and Wang (2013), for example, claims that to measure overall currency strength, the use of TWI is more appropriate than a bilateral exchange rate. They suggest that the TWI could be appropriate to use if it matches with the foreign activity profiles of sampled firms. Several studies in the literature use TWI instead of separate pair of currencies (see, e.g., Allayannis & Ofek, 2001; Bodnar & Gentry, 1993; He & Ng, 1998; Nguyen, Faff, & Marshall, 2007). In spirit of these studies, this study uses JP Morgan TWI as a proxy of fluctuations in exchange rate.

The decision of using real exchange rate or nominal exchange rate depends on to what extent both exchange rates are correlated with each other. De Jong et al. (2006), for example, use nominal rates for Dutch firms and argue that, for low inflation economies, results are less likely to be biased due to strong association between real and nominal exchange rates. Similarly, Atindéhou and Gueyie (2001) and Miller and Reuer (1998) claim that use of real or nominal exchange rate would have uniform effect on stock returns if the changes between them are highly correlated. Mark (1990) report strong and significant correlation between real and

nominal exchange rates for the seven sampled economies. In line with these predications, correlation was tested between nominal and real exchange rates of JP Morgan TWI over the period and both rates are found to be highly correlated¹. Therefore, the study takes nominal values for the selected index.

- Finally, β_0 is the intercept of the regression equation, β_1 is the coefficient of TWI sensitivity and measures foreign exchange rate exposure. It measures the extent to which returns on firm's stock are sensitive to the change in foreign exchange rates. Lastly, ϵ_{it} is the regression residual for the i th firm in period t . Summary of all variables used in exposure model are given in following table.

Table 0.1

Summary of the variables used exposure model: Estimation of foreign exchange rate exposure

Variables	Abbreviations	Measurement Proxy	Study/Reference
Return on firm's stock	R	---	Hutson and Laing (2014), Zhou and Wang (2013)
Trade-weighted Exchange Rate Index	TWI ^{JPM}	JP Morgan TWI, Malaysia, Nominal, Broad Basis (MYMGTWNB)	---

Period of Study, Sample Selection and Data Collection

This study estimates foreign exchange rate exposure with and without including market portfolio index in exposure model over the period of 2008 to 2014. The reasons for confining the study to this period is that the rate of variation in foreign exchange rate of Malaysia is relatively higher in this period (i.e. 2008 – 2014) as compared to earlier years. Therefore, it is more meaningful to measure foreign exchange rate exposure for this period as it would be more likely to be higher than other periods.

Selecting the right and appropriate sample is an important aspect of any research, especially in determining foreign exchange exposure it becomes more important as it significantly affect the results (De Jong et al., 2006). Sample is selected from the population of all firms listed in Bursa Malaysia over the period of 2008 to 2014. Total numbers of listed firms in the Main Market

¹ Pearson correlation between real and nominal exchange rates is 0.810 highly significant at 0.01 level.

were 806. Since this study is primarily interested in nonfinancial firms, so financial firms are excluded from the sample. This criterion excluded 56 financial firms which reduces total sample to 750. Further two filters are applied on a sample. First, firms that are continuously listed on Malaysian stock exchange over the study period are selected and firms are excluded that were delisted during that period as in Bacha et al. (2012). Secondly, following Allayannis and Weston (2001), Bartram, Brown, and Conrad (2011), El-Masry and Abdel-Salam (2007), Muller and Verschoor (2006) and Purnanandam (2008), only those firms are included in the sample that have consecutive historical non-missing data from January 2008 to December 2014. These two filters further reduce sample size by 473. Similarly, elimination due to lack of trading volumes, trading halts, suspensions and other gaps in data left sample size to 224. Finally, this study uses secondary data that is collected from two sources, Datastream and annual reports. Annual reports of sample firms are retrieved from Bursa Malaysia website over the period of 2008 to 2014.

Data of the current study is highly affected by outliers; therefore, this study employ winsorization method on dataset to mitigate the effect of extreme values.

RESULTS AND DISCUSSION

This section provides the summary and discussion of the results obtained from stage-one model in which daily stock returns of 224 Malaysian firms are annually regressed against TWI over the period of 2008 to 2014. TWI is the JP Morgan Trade-Weighted Exchange Rate Index used as a proxy of exchange rate changes. It is measured in MYR per unit of a basket of foreign currencies. β_I (the coefficient of TWI)² represents foreign exchange exposure measure because it describes the sensitivity of stock returns to unanticipated changes in exchange rate (Muller & Verschoor, 2006).

Descriptive Statistics

Table 0.2 reports descriptive statistics of β_I . Some notable facts can be observed here. The mean value, for example, of β_I ranges from 0.4650 to 0.8705 which implies that mean values of β_I are not considerably high in any of the year. Furthermore, average β_I for all sample firms

² β_I would be subsequently referred and interchangeably used as FX exposure, currency exposure or exposure to exchange rate.

remain positive in all years. Most notably, the high exposure is found in 2014 when mean β_i is maximum at 0.8705 indicating that, on average, Malaysian firms gain 0.8705% in firm value in case of MYR depreciates by 1%. The minimum and maximum β_i in 2014 are -1.9394 and 4.2351 respectively. In addition to that, high exposure years for Malaysian firms are 2014, 2011 and 2009 when mean values of β_i are slightly different from each other in these years with a value of 0.8705, 0.8635 and 0.8325, respectively. Quite the opposite, the lowest average value β_i is 0.4650 found in 2013 which implies that, on average, value of Malaysian firms rises by 0.4650% if MYR depreciates by 1%. The lowest and highest value of β_i in 2013 was -1.2483 and 2.1176 respectively. It is interesting to note that the standard deviation of the MYR against a basket of foreign currencies is higher in 2008 and 2009 as compared to other years which is most likely due to Global Financial Crises, whereas, it is lowest in 2013.

Table 0.2

Descriptive statistics of β_i

Years	Mean	Median	S.D.	Minimum	Maximum
2008	0.5712	0.4832	0.9342	-3.5110	4.0350
2009	0.8325	0.7574	1.3366	-4.5590	6.6546
2010	0.5912	0.5445	0.6796	-2.1685	2.5352
2011	0.8635	0.7858	0.8389	-2.5896	4.1975
2012	0.5591	0.5535	0.7264	-3.6557	2.7302
2013	0.4650	0.4138	0.5336	-1.2483	2.1176
2014	0.8705	0.7186	0.8107	-1.9394	4.2351

This table shows the descriptive statistics of β_i used in stage-one model which is used to estimate the FX rate exposure of 224 nonfinancial Malaysian firms over the period of 2008 to 2014. The stage-one model is: $R_{it} = \beta_0 + \beta_1 TWI_t^{JPM} + \epsilon_{it}$; where R_{it} refers to the return rate on i th firm's security in time t ; TWI_t^{JPM} is the JP Morgan TWI used as a proxy of exchange rate changes and measured in MYR per unit of a basket of foreign currencies; β_0 is the intercept of the regression equation; β_1 is the coefficient of TWI refers to FX exposure; and lastly, ϵ_{it} is the regression residual for the i th firm in period t .

Magnitude and Significance of β_i at Different Significance Levels

Table 0.3 represents the direction of foreign exchange exposure in terms of positive (greater than zero) and negative (less than zero) signs of β_i . Clearly, the decision about a firm whether it is a net-exporter or net-importer is based on a direction and magnitude of foreign exchange exposure (Bacha et al., 2012). For example, exporting goods of a firm become more expensive in international market by the appreciation of Ringgit against TWI and, in result, foreign

demand of exporting goods would be reduced which leads to a fall in foreign sales revenue of Malaysian exporting firms. Similarly, a depreciation of the Ringgit against TWI makes exporting goods cheaper in international market, and this may lead to rise in foreign demand of exports and, consequently, rise in foreign sales revenue of Malaysian exporting firms. Therefore, the β_1 should be positive for net-exporters.

It is evident from the Table 0.3 that firms with positive β_1 are more than quadruple from those of negative β_1 over the study period as shown in Figure 0.1. However, the change between the number of positive and negative β_1 across years is negligible which indicates that positive and negative β_1 are evenly distributed over the study period. The dominance of Malaysian firms with positive β_1 in each year implies that most of the Malaysian firms in the sample are net-exporters. Out of 1568 firm-year observations, 1337 (85%) are net-exporters while the rest are net-importers over the study period. Two explanations can be given to support this finding. First, firms' cross-border transactions may involve domestic purchases and production, which ultimately leads them towards positive margins in net export result. Second, several firms that are listed in Malaysian stock exchange are larger in size and Malaysian domestic market is too small for them. Therefore, these firms are more likely to engage in overseas transactions; hence, more likely to be net exporter.

Table 0.3 also demonstrates the significance of β_1 at different levels of significance. Overall, 48%, 37% and 21% of Malaysian firms having significant β_1 at 10%, 5% and 1% level respectively over the period. The foreign exchange exposure continuously increases between 2008 and 2011 but afterwards decline. In 2011, the foreign exchange exposure reaches its maximum level when 136 (61%) firms are significantly exposed to exchange rate changes at 10% level as compared to other years. On the contrary, 2008 is a favorable year for Malaysian firms when the least number of firms is exposed to foreign exchange risk. These results confirm first hypothesis (H_1) that volatilities in exchange rates affect stock prices of Malaysian firms.

Table 0.3

Direction and significance of β_1 at different levels of significance

Years	$\beta_1 < 0$	$\beta_1 > 0$	Total Number of Firms	Significance of β_1 at different levels		
				1% (+ve, -ve)	5% (+ve, -ve)	10% (+ve, -ve)
2008	42	182	224	30 (13%) (30, 0)	61 (27%) (59, 2)	79 (35%) (76, 3)
2009	40	184	224	39 (17%) (38, 1)	76 (34%) (74, 2)	104 (46%) (100, 4)

Years	$\beta_1 < 0$ $\beta_1 > 0$		Total Number of Firms	Significance of β_1 at different levels		
				1% (+ve, -ve)	5% (+ve, -ve)	10% (+ve, -ve)
2010	32	192	224	60 (27%) (60, 0)	93 (42%) (92, 1)	111 (50%) (110, 1)
2011	23	201	224	83 (37%) (83, 0)	112 (50%) (112, 0)	136 (61%) (135, 1)
2012	38	186	224	29 (13%) (29, 0)	71 (32%) (70, 1)	98 (44%) (94, 4)
2013	38	186	224	43 (19%) (43, 0)	79 (35%) (79, 0)	100 (45%) (100, 0)
2014	18	206	224	50 (22%) (50, 0)	94 (42%) (94, 0)	117 (52%) (115, 2)
Total*	231 (14%)	1337 (85%)	1568	334 (21%)	586 (37%)	745 (48%)

* Total percentages are out of 1568 firm-year observations

This table shows the direction (column 2 and 3) and significance of β_1 at 1%, 5% and 10% level of significance (last three columns) estimated from stage-one model which is used to estimate the FX rate exposure of 224 nonfinancial Malaysian firms over the period of 2008 to 2014. The stage-one model is: $R_{it} = \beta_0 + \beta_1 TWI_t^{JPM} + \epsilon_{it}$; where R_{it} refers to the return rate on i th firm's security in time t ; TWI_t^{JPM} is the JP Morgan TWI used as a proxy of exchange rate changes and measured in MYR per unit of a basket of foreign currencies; β_0 is the intercept of the regression equation; β_1 is the coefficient of TWI refers to FX exposure; and lastly, ϵ_{it} is the regression residual for the i th firm in period t .

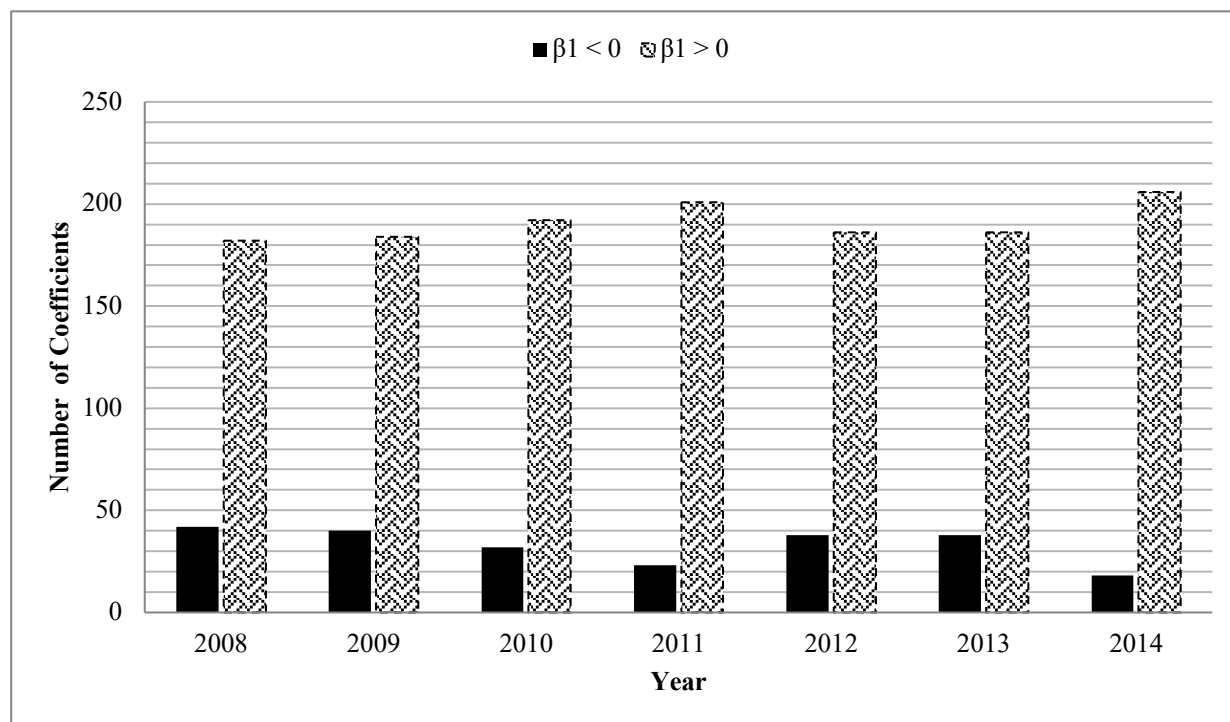


Figure 0.1 Annual distribution of positive and negative β_1 over the study period

If these results are compared with previous studies, it can be concluded that Malaysian firms are more exposed to the changes in exchange rate. For instance, Pritamani et al. (2004) find only 4% of the US firms are negatively exposed to foreign exchange rate changes. Similarly,

findings of Bodnar and Wong (2003) reveal that 15% of the 910 US firms are significantly exposed to exchange rate changes at 1-18 month return horizon. Likewise, Parsley and Popper (2006) conduct their study on eleven Asia-Pacific countries including Malaysia. In general, their results exhibit that 49% of all sampled firms are significantly exposed to fluctuations in USD, while for Malaysian firms, 65% and 37% are significantly exposed to USD and Japanese Yen, respectively. Similarly, Du et al. (2014) estimate total exposure for 815 Taiwanese public listed firms as well as self-constructed twenty-five stock portfolios and find that 90% of sample firms have significant total exposure while all stock portfolios are significantly exposed to exchange rate changes. In a similar study, using deciles and sector portfolios, Koutmos and Martin (2007) find that total exposure is positive and statistically significant for the deciles and sector portfolios. Likewise, Priestley and Ødegaard (2002) estimate exposure of eight industry indices of Norway and find that all Norwegian industrial sectors are significantly and negatively exposed to the European Currency Unit (ECU) and positively exposed to USD.

Sensitivity of Market Portfolio Index

Although several studies in empirical literature provide evidence on firm's total exposure to exchange rate changes, however, some researchers also add control variables, such as market portfolios, in empirical exposure model and estimate *residual* foreign exchange exposure for different economies (e.g., see Allayannis, 1997; Bodnar & Gentry, 1993; Chamberlain et al., 1997; Choi & Prasad, 1995; Loudon, 1993; Williamson, 2001). These market portfolio indices control for macro-economic effects, such as changes in expected interest rate, market risk premium, unexpected inflation, variations in risk-free rate, industrial production growth, and investor sentiment, that affect valuation of all firms (Bodnar & Wong, 2003).

Although, total foreign exchange exposure of Malaysian firms is estimated and discussed earlier, however, this study also tests the impact of market portfolio index on empirical results by incorporating it in exposure model by following Jorion (1990) among others. Therefore, the augmented exposure model would be:

$$R_{it} = \gamma_1 + \gamma_2 RM_t + \gamma_3 TWI_t^{JPM} + \theta_{it} \quad \text{Equation 0.1}$$

Where, R_{it} is the daily return on i th firm's common stock in period t ; TWI_t^{JPM} is the daily return on JP Morgan TWI measured in MYR per one unit of a basket of foreign currencies; γ_1 and θ

are intercept and error term respectively; while γ_2 and γ_3 are the coefficients of market portfolio index and TWI respectively. Finally, RM_t is the daily return on Malaysian market portfolio index in period t . FBMEMAS is used as a proxy of market portfolio index. Previous Malaysian studies, such as Bacha et al. (2012), Ramasamy (2000) and Pillay and Rangel (2002), used FBMKLCI as a proxy of market portfolio index while measuring foreign exchange exposure. This study selects FBMEMAS for result robustness; reasons are twofold. First, FBMKLCI & FBMEMAS indexes are highly correlated with each other; hence, no significant differences in results are expected by using either index³. Second, the limitation of using FBMKLCI is that it consists of only 30 stocks, whereas, in contrast, FBMEMAS is a broader index than FBMKLCI in which total number of constituents are 262. For these reasons, this study, therefore, use FBMEMAS and expects to obtain relatively more robust and generalized results.

Results of Augmented Exposure Model

Table 4.3 demonstrates the comparison between significant coefficients of market portfolio index, i.e., RM, and TWI at different significance levels. If we take the 5% significance level as basis of comparison then it is obvious from the table that the number of significant coefficients of RM remains high throughout the sample period than that of TWI. A total of 67% (1045) firm-year coefficients of RM are significant over the period of 2008 to 2014 as compared to 9% (139) significant firm-year coefficients of TWI. Less than 10% of all firms are exposed to less foreign exchange risk in all years with the exception of 2010 in which 17% (39) firms are exposed to exchange rate risk. In 2008, the lowest number of firms, i.e. 13 (6%), is affected by the changes in exchange rate. These findings indicate that firm's exposure to TWI dramatically reduces after the inclusion of RM. This also implies that firms are exhibiting more exposure to market portfolio index in all years as compared to exchange rate changes after the inclusion of RM in stage-one model.

³ Pearson correlation between FBMEMAS and FBMKLCI was found 0.999 highly significant at 0.01 level.

Table 0.3

Results after incorporating RM in stage-one model

Years	Significance at 1% level		Significance at 5% level		Significance at 10% level	
	RM	TWI	RM	TWI	RM	TWI
2008	140 (63%)	3 (1%)	159 (71%)	13 (6%)	170 (76%)	29 (13%)
2009	111 (50%)	6 (3%)	134 (60%)	16 (7%)	145 (65%)	31 (14%)
2010	103 (46%)	19 (8%)	134 (60%)	39 (17%)	150 (67%)	45 (20%)
2011	145 (65%)	3 (1%)	158 (71%)	20 (9%)	165 (74%)	28 (13%)
2012	80 (36%)	6 (3%)	109 (49%)	19 (8%)	130 (58%)	39 (17%)
2013	140 (63%)	5 (2%)	164 (73%)	14 (6%)	172 (77%)	31 (14%)
2014	171 (76%)	4 (2%)	187 (83%)	18 (8%)	198 (88%)	33 (15%)
Total *	890 (57%)	46 (3%)	1045 (67%)	139 (9%)	1130 (72%)	236 (15%)

* Total percentages are obtained out of 1568 firm-year observations (i.e. 224 x 7)

This table presents the summary of stage-one mode (or augmented exposure model) estimated after adding market portfolio index. This model estimates the FX rate exposure of 224 nonfinancial Malaysian firms over the period of 2008 to 2014 after controlling macroeconomic effects. The augmented exposure model is: $R_{it} = \gamma_1 + \gamma_2 RM_t + \gamma_3 TWI_t^{JPM} + \theta_{it}$; where R_{it} refers to the return rate on i th firm's security in time t ; RM_t is the daily return on Malaysian market portfolio index (i.e. FBMEMAS) in period t ; TWI_t^{JPM} is the JP Morgan TWI used as a proxy of exchange rate changes and measured in MYR per unit of a basket of foreign currencies; γ_1 is the intercept of the regression equation; γ_2 is the coefficient of RM_t ; γ_3 is the coefficient of TWI refers to FX exposure; and lastly, θ_{it} is the regression residual for the i th firm in period t .

Table 4.4 makes comparison between significant TWIs with and without incorporating RM in exposure model over the sample period. It is evident from the table that firms are more exposed to the changes in TWI in the absence of market index in exposure model. After adding market index, firms' exposure to exchange rate drastically reduced. A total of 37% firm-year observations are significant without adding market index; whereas, this figure is reduced to 9% when exposure is estimated along with market index as shown in **Error! Reference source not found.** In both cases (with and without market index), 2010 and 2011 are found to be the most significant years in which maximum number of firms are exposed to exchange rate changes; while in 2008 the least number of firms is exposed to exchange rate volatilities.

Table 0.4 Comparison of significant TWIs with and without using RM in stage-one model at 5% level

Years	Significance at 5% level	
	<i>TWI (without RM)</i> *	<i>TWI (with RM)</i> **
2008	61 (27%)	13 (6%)
2009	76 (34%)	16 (7%)
2010	93 (42%)	39 (17%)
2011	112 (50%)	20 (9%)
2012	71 (32%)	19 (8%)
2013	79 (35%)	14 (6%)
2014	94 (42%)	18 (8%)
Total[^]	586 (37%)	139 (9%)

* This column is extracted from Table 0.3 ** This column is extracted from Table 4.3

[^] Total percentages are obtained out of 1568 firm-year observations (i.e. 224 x 7)

This table compares the results of significant coefficients of TWI which were earlier estimated with and without using *RM*, in Table 0.3 and Table 4.3 respectively.

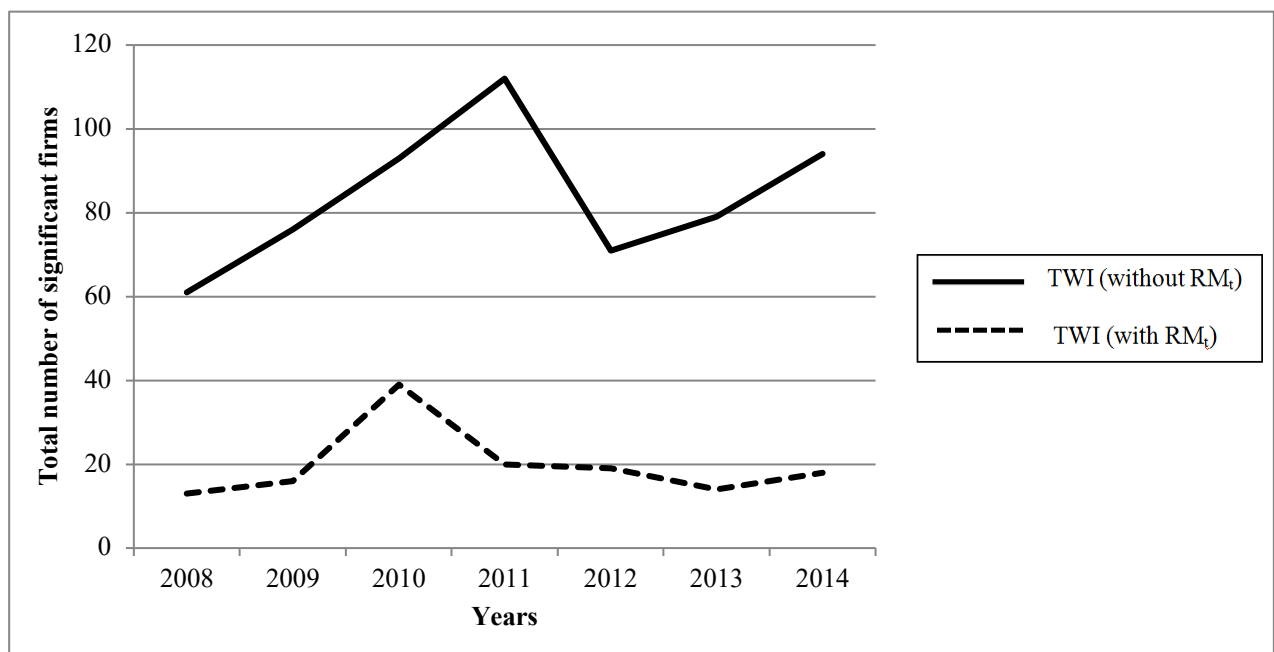


Figure 0.2 Comparison of significant TWIs with and without using RM in stage-one model at 5% level

CONCLUSION

Initially, the foreign exchange rate exposure of Malaysian firms is estimated through exposure model over the period of 2008 to 2014 by using daily returns. The results show that 37% of the firms (586 firm-year observations) are exposed to foreign exchange rate changes at a 5% level of significance during sample period. Furthermore, firms with positive β_i are more than quadruple the firms with negative β_i over the study period. The dominance of Malaysian firms with positive β_i in each year implies that most of the Malaysian firms in the sample are net-exporters.

The sensitivity of market portfolio index is tested in exposure model. Malaysian market index, i.e., FBMEMAS, is added in the stage-one model and foreign exchange exposure for Malaysian firms is estimated over the sample period. It is obvious from the results that the number of significant coefficients of market index remains surprisingly high throughout the sample period than that of TWI. A 67% of total firms (1045 firm-year observation) have significant relationship with market index over the sample period as compared to 9% (139 firm-year observations) of TWI which shows drastic decreased in foreign exchange exposure by 76%. These results confirms the argument of Dominguez and Tesar (2006), Ito et al. (2016), Priestley and Ødegaard (2002) and Bodnar and Wong (2003) that sometimes market portfolio index as a whole become strongly correlated with exchange rate changes and, in result, it dramatically reduces foreign exchange exposure.

This study is practically important for investors to guide them to first asses exposure to exchange rate of those firms in which they are intend to invest. Similarly, current study also provides guidance to regulators, government and central bank of Malaysia to formulate strategies for nonfinancial firms in such a way that they can reduce their foreign exchange rate exposure at optimal level.

REFERENCES

- Adler, M., & Dumas, B. (1984). Exposure to currency risk: definition and measurement. *Financial Management*, 41-50.
- Allayannis, G. (1997). *The time-variation of the exchange rate exposure: An industry analysis*. Paper presented at the 57th Annual American Finance Association Conference, (New Orleans), January.
- Allayannis, G., & Ofek, E. (2001). Exchange rate exposure, hedging, and the use of foreign currency derivatives. *Journal of International Money and Finance*, 20(2), 273-296.
- Allayannis, G., & Weston, J. P. (2001). The use of foreign currency derivatives and firm market value. *Review of Financial Studies*, 14(1), 243-276.
- Amihud, Y. (1994). Exchange rates and the valuation of equity shares. *Exchange rates and corporate performance*, 11, 49-59.
- Atindéhou, R. B., & Gueyie, J. P. (2001). Canadian chartered banks' stock returns and exchange rate risk. *Management Decision*, 39(4), 285-295. doi: doi:10.1108/EUM0000000005463
- Bacha, O. I., Mohamad, A., Zain, S. R. S. M., & Rasid, M. E. S. M. (2012). Foreign exchange exposure and impact of policy switch – the case of Malaysian listed firms. *Applied Economics*, 45(20), 2974-2984. doi: 10.1080/00036846.2012.684790
- Bank Negara Malaysia. (1994). Money & Banking in Malaysia-35th Anniversary Edition 1959-1994. *Kuala Lumpur: Bank Negara Malaysia*.
- Bartov, E., & Bodnar, G. M. (1994). Firm valuation, earnings expectations, and the exchange-rate exposure effect. *The Journal of Finance*, 49(5), 1755-1785.
- Bartram, S. M., Brown, G. W., & Conrad, J. (2011). The effects of derivatives on firm risk and value. *Journal of Financial and Quantitative Analysis*, 46(04), 967-999.
- Bernoeth, K., & Herwartz, H. (2019). *Exchange Rates, Foreign Currency Exposure and Sovereign Risk*. DIW Discussion Papers, No. 1792. Deutsches Institut für Wirtschaftsforschung (DIW), Berlin.

- Bodnar, G. M., & Gentry, W. M. (1993). Exchange rate exposure and industry characteristics: evidence from Canada, Japan, and the USA. *Journal of International Money and Finance*, 12(1), 29-45.
- Bodnar, G. M., & Wong, M. F. (2003). Estimating exchange rate exposures: Issues in model structure. *Financial Management*, 35-67.
- Boudt, K., Neely, C. J., Sercu, P., & Wauters, M. (2019). The response of multinationals' foreign exchange rate exposure to macroeconomic news. *Journal of International Money and Finance*, 94, 32-47. doi: <https://doi.org/10.1016/j.jimonfin.2019.01.009>
- Chaieb, I., & Mazzotta, S. (2013). Unconditional and conditional exchange rate exposure. *Journal of International Money and Finance*, 32, 781-808. doi: <http://dx.doi.org/10.1016/j.jimonfin.2012.07.001>
- Chamberlain, S., Howe, J. S., & Popper, H. (1997). The exchange rate exposure of U.S. and Japanese banking institutions. *Journal of Banking & Finance*, 21(6), 871-892. doi: [https://doi.org/10.1016/S0378-4266\(97\)00002-2](https://doi.org/10.1016/S0378-4266(97)00002-2)
- Chen, J., & King, T.-H. D. (2014). Corporate hedging and the cost of debt. *Journal of Corporate Finance*, 29, 221-245. doi: <http://dx.doi.org/10.1016/j.jcorpfin.2014.09.006>
- Chen, N.-F., Roll, R., & Ross, S. A. (1986). Economic forces and the stock market. *Journal of Business*, 383-403.
- Chiao, C., & Hung, K. (2000). Exchange-Rate Exposure of Taiwanese Exporting Firms. *Review of Pacific Basin Financial Markets and Policies*, 03(02), 201-233. doi: 10.1142/S0219091500000133
- Choi, J. J., Mao, C. X., & Upadhyay, A. D. (2013). Corporate Risk Management under Information Asymmetry. *Journal of Business Finance & Accounting*, 40(1-2), 239-271. doi: 10.1111/jbfa.12008
- Choi, J. J., & Prasad, A. M. (1995). Exchange risk sensitivity and its determinants: a firm and industry analysis of US multinationals. *Financial Management*, 77-88.
- Chow, E. H., & Chen, H.-L. (1998). The determinants of foreign exchange rate exposure: Evidence on Japanese firms. *Pacific-Basin Finance Journal*, 6(1), 153-174.

- Chow, E. H., Lee, W. Y., & Solt, M. E. (1997a). The economic exposure of U.S. multinational firms. *Journal of Financial Research*, 20(2), 191-210. doi: 10.1111/j.1475-6803.1997.tb00244.x
- Chow, E. H., Lee, W. Y., & Solt, M. E. (1997b). The Exchange-Rate Risk Exposure of Asset Returns. *The Journal of Business*, 70(1), 105-123.
- De Jong, A., Ligterink, J., & Macrae, V. (2006). A Firm-Specific Analysis of the Exchange-Rate Exposure of Dutch Firms. *Journal of International Financial Management & Accounting*, 17(1), 1-28. doi: 10.1111/j.1467-646X.2006.00119.x
- Di Iorio, A., & Faff, R. (2000). An analysis of asymmetry in foreign currency exposure of the Australian equities market. *Journal of Multinational Financial Management*, 10(2), 133-159.
- Doidge, C., Griffin, J., & Williamson, R. (2006). Measuring the economic importance of exchange rate exposure. *Journal of Empirical Finance*, 13(4-5), 550-576. doi: <http://dx.doi.org/10.1016/j.jempfin.2005.12.003>
- Dominguez, K. M. E., & Tesar, L. L. (2006). Exchange rate exposure. *Journal of International Economics*, 68(1), 188-218. doi: <http://dx.doi.org/10.1016/j.jinteco.2005.01.002>
- Du, D., Hu, O., & Wu, H. (2014). Emerging market currency exposure: Taiwan. *Journal of Multinational Financial Management*, 28(0), 47-61. doi: <http://dx.doi.org/10.1016/j.mulfin.2014.10.001>
- Dwumfour, R. A., & Addy, N. A. (2019). Interest Rate and Exchange Rate Exposure of Portfolio Stock Returns: Does the Financial Crisis Matter? *Journal of African Business*, 1-19. doi: 10.1080/15228916.2019.1583977
- Eiteman, D. K., Stonehill, A. I., & Moffett, M. H. (2007). *Multinational business finance*: Pearson/Addison-Wesley.
- El-Masry, A., & Abdel-Salam, O. (2007). Exchange rate exposure: do size and foreign operations matter? *Managerial Finance*, 33(9), 741-765.

- He, J., & Ng, L. K. (1998). The Foreign Exchange Exposure of Japanese Multinational Corporations. *The Journal of Finance*, 53(2), 733-753. doi: 10.1111/0022-1082.295575
- Howell, D. C. (2016). *Fundamental statistics for the behavioral sciences*. New York, NY: Nelson Education.
- Hui-Nee, A. (2014). *Risk management in Malaysian commercial banks*. Paper presented at the The UUM international conference on governance.
- Hutson, E., & Laing, E. (2014). Foreign exchange exposure and multinationality. *Journal of Banking & Finance*, 43(0), 97-113. doi: <http://dx.doi.org/10.1016/j.jbankfin.2014.03.002>
- Hutson, E., & Stevenson, S. (2010). Openness, Hedging Incentives and Foreign Exchange Exposure: A Firm-Level Multi-Country Study. *Journal of International Business Studies*, 41(1), 105-122. doi: 10.2307/27752480
- Ito, T., Koibuchi, S., Sato, K., & Shimizu, J. (2016). Exchange rate exposure and risk management: The case of Japanese exporting firms. *Journal of the Japanese and International Economies*, 41, 17-29. doi: <http://dx.doi.org/10.1016/j.jjie.2016.05.001>
- Jeon, B. N., Zhu, L., & Zheng, D. (2017). Exchange rate exposure and financial crises: evidence from emerging Asian markets. *Risk Management*, 19(1), 53-71. doi: 10.1057/s41283-016-0011-7
- Jorion, P. (1990). The exchange-rate exposure of US multinationals. *Journal of Business*, 331-345.
- Judge, A. (2006). The determinants of foreign currency hedging by UK non-financial firms. *Multinational Finance Journal*, 10(1&2), 1-41.
- Khumawala, S., Ranasinghe, T., & Yan, C. J. (2016). Why hedge? Extent, nature, and determinants of derivative usage in U.S. municipalities. *Journal of Accounting and Public Policy*, 35(3), 303-325. doi: <http://dx.doi.org/10.1016/j.jaccpubpol.2015.12.004>

- Koutmos, G., & Martin, A. D. (2007). Modeling time variation and asymmetry in foreign exchange exposure. *Journal of Multinational Financial Management*, 17(1), 61-74. doi: <http://dx.doi.org/10.1016/j.mulfin.2006.03.004>
- Lan, L.-H., Chen, C.-C., & Chuang, S.-S. (2015). Exchange rate risk management: What can we learn from financial crises? *Economic Modelling*, 45(0), 187-192. doi: <http://dx.doi.org/10.1016/j.econmod.2014.11.018>
- Lievenbrück, M., & Schmid, T. (2014). Why do firms (not) hedge? — Novel evidence on cultural influence. *Journal of Corporate Finance*, 25, 92-106. doi: <http://dx.doi.org/10.1016/j.jcorpfin.2013.10.010>
- Lind, D. A., Marchal, W. G., & Wathen, M. (2012). *Basic Statistics for Business & Economics*. New York, NY: McGraw-Hill.
- Loudon, G. (1993). The foreign exchange operating exposure of Australian stocks. *Accounting & Finance*, 33(1), 19-32.
- Manchiraju, H., Pierce, S., & Sridharan, S. (2014). *Do firms use derivatives for hedging or non-hedging purposes? Evidence based on SFAS 161 disclosures*. Paper presented at the Sixth ISB Accounting Research Conference, Hyderabad, India.
- Mark, N. C. (1990). Real and nominal exchange rates in the long run: An empirical investigation. *Journal of International Economics*, 28(1-2), 115-136.
- Miller, K. D., & Reuer, J. J. (1998). Asymmetric corporate exposures to foreign exchange rate changes. *Strategic Management Journal*, 19(12), 1183-1191.
- Muller, A., & Verschoor, W. F. (2007). Asian foreign exchange risk exposure. *Journal of the Japanese and International Economies*, 21(1), 16-37.
- Muller, A., & Verschoor, W. F. C. (2006). European Foreign Exchange Risk Exposure. *European Financial Management*, 12(2), 195-220. doi: 10.1111/j.1354-7798.2006.00316.x
- Nguyen, H., & Faff, R. (2003). Can the use of foreign currency derivatives explain variations in foreign exchange exposure?: Evidence from Australian companies. *Journal of*

- Multinational Financial Management*, 13(3), 193-215. doi:
[http://dx.doi.org/10.1016/S1042-444X\(02\)00051-8](http://dx.doi.org/10.1016/S1042-444X(02)00051-8)
- Nguyen, H., Faff, R., & Marshall, A. (2007). Exchange rate exposure, foreign currency derivatives and the introduction of the euro: French evidence. *International Review of Economics & Finance*, 16(4), 563-577.
- Nydahl, S. (1999). Exchange rate exposure, foreign involvement and currency hedging of firms: some Swedish evidence. *European Financial Management*, 5(2), 241-257. doi: 10.1111/1468-036X.00091
- Panaretou, A. (2013). Corporate risk management and firm value: evidence from the UK market. *The European Journal of Finance*, 20(12), 1161-1186. doi: 10.1080/1351847X.2013.766625
- Parsley, D. C., & Popper, H. A. (2006). Exchange rate pegs and foreign exchange exposure in East and South East Asia. *Journal of International Money and Finance*, 25(6), 992-1009.
- Pillay, S. S., & Rangel, G. (2002). Are Values of Malaysian Companies Affected By Foreign Exchange Rate Changes? *Malaysian Finance Association (MFA)*, 10(1), 1-22.
- Priestley, R., & Ødegaard, B. A. (2002). New evidence on exchange rate exposure. *Norwegian school of management working paper*.
- Pritamani, M. D., Shome, D. K., & Singal, V. (2004). Foreign exchange exposure of exporting and importing firms. *Journal of Banking & Finance*, 28(7), 1697-1710. doi: <http://dx.doi.org/10.1016/j.jbankfin.2003.06.002>
- Purnanandam, A. (2008). Financial distress and corporate risk management: Theory and evidence. *Journal of Financial Economics*, 87(3), 706-739. doi: <http://dx.doi.org/10.1016/j.jfineco.2007.04.003>
- Ramasamy, B. (2000). *Foreign Exchange Rate Exposure During a Financial Crisis: The Case of Malaysian Multinationals*: Citeseer.
- Rasiah, R., & Shari, I. (2001). Market, government and Malaysia's new economic policy. *Cambridge Journal of Economics*, 25(1), 57-78.

Tabachnick, B. G., Fidell, L. S., & Osterlind, S. J. (2001). *Using multivariate statistics* (5th Ed.). Boston: Pearson Education Incorporation.

Williamson, R. (2001). Exchange rate exposure and competition: evidence from the automotive industry. *Journal of Financial Economics*, 59(3), 441-475. doi: [http://dx.doi.org/10.1016/S0304-405X\(00\)00093-3](http://dx.doi.org/10.1016/S0304-405X(00)00093-3)

Zarei, A., Ariff, M., & Bhatti, M. I. (2019). The impact of exchange rates on stock market returns: new evidence from seven free-floating currencies. *The European Journal of Finance*, 1-12. doi: 10.1080/1351847X.2019.1589550

Zhou, V. Y., & Wang, P. (2013). Managing foreign exchange risk with derivatives in UK non-financial firms. *International Review of Financial Analysis*, 29, 294-302. doi: 10.1016/j.irfa.2012.07.005