The Relationship between Stock Price and Exchange Rate Fluctuations

New Zealand Evidence

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Abstract

My intention is to examine whether there is a relationship between stock return and the trade-weighted index (TWI) exchange rate fluctuations in the New Zealand Stock market, by testing the sensitivity of firms' stock return in relation to exchange rate fluctuation, the existence of Fama-French factor in the exchange rate, as well as the lead-lag relationship between them.

The main focus will be on the long-term exchange rate risk exposure, so the sample period cover is from March 1990 to December 2007 in the firm level analysis and from December 1990 to June 2008 in the portfolio level analysis. Using the firm level analysis, 23 out of 298 firms (7.72%) were significantly exposed to fluctuations in the exchange-rate at the five percent significant level and 51 (17.11%) of those firms at the ten percent level with low explanatory power on the return. For the portfolio level analysis the coefficients on the portfolios of importers and exporters are statistically significant, so it documents that the exchange rate factor can explain the portfolio return. In addition, the inclusion of Fama and French's (1993) three factors in the exchange rate, the book-to-market factor, the exchange rate factor and the market risk factor can explain the portfolio return rather than the size factor. For the lead-lag relationship analysis there is a strong negative relationship between the future exchange rate movements and the past portfolio price. If the returns of stock decrease for nine months, the trading strategy is to buy and hold the main currencies for seven months, the accumulative lagged IMX for nine months can explain the movement of accumulative leaded TWI for seven months. Thus investors can use the past nine month's stock price information to mark profit for the next seven months within the New Zealand foreign exchange market.

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Introduction

Exchange rate fluctuations impact the value of firms, they can directly and indirectly affect a firms' cash flow and cost of capital, which is known as foreign exchange economic exposure resulted from changes of the domestic currency value of the firm and unexpected changes in the exchange rates. Eiteman, Stonehill, and Moffett (2004) explain that exchange rate movements can affect a firm's economic and financial results in three ways; the reported value of foreign assets in consolidated financial statements, the expected results of transactions in foreign currencies, and the present value of the firm due to any changes in future operating cash flows of the firm. Consequently, operating exposure can change the affect the firm' value of future cash flows earned overseas in foreign currencies can have and finally has the influence on a firm's competitive position.

Due to the globalization markets foreign currency exposure risk has become an increasingly significant issue for investors and financial managers. Therefore, the purpose of this paper is to examine whether there is a relationship between the change of stock prices and the trade-weighted index (TWI) exchange rate fluctuations in the New Zealand Stock market, by testing the sensitivity of a firms' stock return in relation to exchange rate fluctuation, the existence of the Fama-French factor in exchange rates, as well as the lead-lag relationship between them.

Many studies focus on analysing the exchange rate exposure in the U.S. stock market by using firm specific level analysis or industry portfolio level analysis. However, this form of analysis can only find the weakness about the systematic exchange rate exposure in the US. For example, Jorion (1991) examined the exchange rate risk exposure by using two-factor and multi-factor arbitrage pricing models. He concluded that there is no pricing of exchange rates in the stock market across industries. Moreover, Muller and Verschoor (2003) found that U.S. multinationals with insignificant exposure effects are concentrated only in a small number of industries; mining, construction, agriculture, primary metals and fabricated metal sectors.

The question that needs to be addressed is; why is it that researchers can not find strong evidence about the exchange rate exposure risk in the US stock market? The first and most obvious reason is that the U.S. stock market is situated in one of the countries with the largest and least open economy compared to that of Canada or Japan. Jong, Ligterink and Macrae (2002) point out that firms in a country with a small and open economy are more sensitive to exchange-rate fluctuations than firms based in a country with a larger and less open economy. According to the data obtained from DataStream, US exports of goods and services are about 10.67% of the total GDP in average, while in New Zealand exports of goods and services in average are 30.07%. Meanwhile, US imports of goods and services take up 13.59% of the total GDP in average, while the average in New Zealand is 39.52%. Compared with the US, the economy of New Zealand is much more open. [1] Moreover, the effect of the exchange rate on an open and external economy is a significant percentage of the GDP for that country. As a result, a proportional contribution of this paper is to address this key issue by studying New Zealands' stock market. As New Zealand's small economy lends its self towards being more open, this leads to firms in New Zealand becoming more sensitive in regards to exchange rate fluctuation. Therefore it is more meaningful to capture the effect of exchange rate risk on determining the value of firms.

Secondly, a possible rationalization for the difficulties in documenting a quantifiable impact of foreign exchange risk on stock market values is that firms realize their currency exposures and purposefully get rid of foreign currency risk by hedging (Bartov & Bodnar, 1994). Firms have been able to match their foreign currency revenues and costs leaving them with little net exposure. Such operational hedges may help to explain low or negligible levels of exposure when studying the sensitivity of stock price in comparison to foreign exchange exposure (Bodnar & Marston, 2000). When these hedging activities are reflected in the stock prices, the correlation between stock returns and exchange rate fluctuation will be reduced in the short-term. Therefore, the second contribution is that I will examine a long-term time period, because longer time periods provide more informative information in regards to capturing exchange rate risk exposure. For example, Muller and Verschoor (2006) find that about 13% of their sample group of 817 European multinational firms experienced economically significant exposure effects towards the Japanese yen, 14% to the US dollar and 22% to the

[1] The annual percentage is obtained from DataStream and shown in the table 10 in the Appendix

UK pound. They also reported that short-term exposure seems to be relatively well hedged, where considerable evidence of long-term exposure is found. In contrast, results of the firm level analysis in this paper found that 23 out of 298 firms (7.72%) were significantly exposed to fluctuations in the exchange-rate at the five percent level from March 1990 to December 2007 and 51 firms (17.11%) at the ten percent level with low explanatory power on the return. As a result there is not strong evidence about exchange rate exposure shown in this paper.

The last contribution is that I adopted a different way to form portfolios by imitating Fama and French's three-factor model to develop a zero-investment portfolio in portfolio level analysis. Most studies form the portfolio according to the specific type of exposure to risk or the sector that firms belong to. There is no study to use the coefficients of exchange rate movements for each firm to form the zero-investment portfolio. For example, Jorion (1991) form the industry portfolio on the basis of the industry and Martinez-Solano (2000) form the portfolio of net exporters, net importers, as well as a purely foreign debt portfolio and a purely domestic portfolio. My intention is to add a new factor, a combination of the exchange rate factor (IMX), the CAPM and Fama-French model so that I can test whether exchange rate risk is priced in the firm's return. Therefore, my methodology is original due to the means of sorting the coefficients on the exchange rate factor to form the Fama and French exchange rate factor portfolios.

The main result for the portfolio level analysis is that the coefficients on the portfolios of importers and exporters are statistically significant, so it documents that the exchange rate factor can explain the portfolio return. In addition, including Fama and French's (1993) three factors and exchange rate, I found that the book-to-market factor, exchange rate factor, and market risk factor can explain the portfolio return, rather than the size factor. There is a positive relationship between book-to-market ratio or market risk and portfolio return. The intercept is indifferent from zero. Therefore, I conclude that there is a strong relationship between contemporary exchange rate exposure and contemporary portfolio returns.

In the meantime, for lead-lag relationship analysis there is a strong negative relationship between the future exchange rate movement and the past portfolio price. When I accumulate leaded TWI for seven months and lagged IMX for nine months, the coefficient has the highest t-statistic value and the highest R^2 at the one percent significant level. Therefore, if the return of stocks decreases for nine months, the trading strategy is to buy and hold the main currencies for seven months in order to earn the profit. Thus investors can use the past nine month's stock price information to mark profit for the next seven months in the New Zealand foreign exchange market.

This paper is organized as follows; section two reviews the previous literatures, section three describes the data and sample selection, as well as methodologies (firm level analysis, portfolio level analysis, and lead-lag relation analysis), section four presents the empirical results and section five concludes the paper.

Literature Review

Since the breakdown of the Bretton Woods fixed-parity system in the early 1970s, the volatility of exchange rates and its related risks have become an increasingly significant issue for international financial management. Exchange rate movements are an important source of macroeconomic uncertainty and have a significant influence on firm value, no matter whether the firm is domestically or internationally oriented (Hodder, 1982). Therefore, a lot of literature pays attention to the foundations of exchange rate risk exposure and the determinants of this exposure in order to improve the understanding of the mechanism through which exchange rate shocks affect firm value. Pritamani, Shome, and Singal (2004) propose a dual-effect hypothesis to explain total exposure for multinational or exporting firms incorporating both firm-specific and macroeconomic effects. They also suggest an equally-weighted portfolio of purely domestic firms and report significantly negative residual exposure for exporters and significantly positive exposure for importers.

According to Eiteman et al., (2004), the exchange rate exposure is traditionally classified as transaction exposure and economic exposure. Transaction exposure, showing the effect of exchange rate changes on committed cash flows such as accounts receivable and accounts payable, is short-term exposure, while economic exposure indicates the impact of exchange rate fluctuations on a firm's long-term cash flows. Although direct exposure, such as transaction and translation exposure, can be effectively managed by well diversified hedging strategies, indirect exposure (economic exposure) provides significant unpredictability in cash flows for most multinational firms. Chow et al. (1997) gives evidence that transaction exposure, economic exposure, the interest rate changes, as well as exchange rate changes work together to determine the exchange rate exposure of stock returns. They explain that regressing short-horizon returns on short-horizon exchange rate movements in the previous literature only captures the transaction-exposure rather than the economic-exposure part of the exchange rate exposure. The long-term impact of exchange rate changes will be impounded in a firms' stock price only as information about future cash flows are revealed.

As a result, there are plenty of studies that prefer to examine the long-term influence of exchange rate exposure on a firm's value. For example, He and Ng (1998) found that about 25 percent of the sample of 171 Japanese multinationals' stock returns had economically significant exposure impacts from January 1979 to December 1993 and depreciation in the value of the yen relative to a trade weighted index caused a positive effect on Japanese firm value. Meanwhile, a firm exposed to exchange-rate changes can be explained by the level of its export ratio and by variables that are proxies for its hedging needs. Moreover, Williamson (2001) examines the effect of real exchange rate fluctuations on multinational firms in Japan and US markets and included the influence of intra-industry competition on the relationship between exchange rates and firm value from January 1973 to December 1995. The findings stated that there was significant exposure to exchange rate changes. In addition, there is evidence of time-variation in exchange rate exposure consistent with changes in the competitive environment within the industry. They also describe that foreign sales and the effectiveness of operational hedging through foreign production are main determinants of exposure.

On the other hand, other literature focuses on whether exchange rate risk, one of the important macroeconomic risks, should be priced in the firms' return since risk-return relations have always been an important and relevant question asked by both academic scholars and real-world business participants. Sharpe (1964) and Lintner (1965) propose in the famous Capital Asset Pricing Model (CAPM) that there is a linear relationship between the expected return on the asset and its market risk (beta). The systematic risk is the only factor to measure stock returns. However, later many studies question the usefulness of beta as the only factor to measure the return. For example, Fama and French (1992) examined the monthly returns of the NYSE stocks and found an insignificant relationship between beta and those specific returns. The results showed that only market capitalization and the ratio of book value to market value can explain return.

When the exchange rate factor needed to be included into the model some empirical studies focussed on the area of foreign exchange risk pricing, implementing a multi-factor framework based on the Capital Asset Pricing Model, while others choose the Fama-French three-factor model as the benchmark. As a result, recent empirical studies have reported mixed findings about the foreign exchange risk pricing, although it is clearly observable that the relationship between fluctuations in the exchange rate and returns to shareholders exists. For example, Jorion (1990) reports significant cross-sectional differences in the relationship between the values of U.S. multinationals and exchange rates fluctuations on the basis of CAPM. Only 15 out of the total 287 U.S. multinationals can be found to have significant exchange rate exposure. At the same time, Jorion (1991) examined the pricing of the exchange rate risk in the US stock market, using two-factor and multi-factor arbitrage pricing models. Results showed there is no pricing exchange rate in the stock market across industries. While, Di Iorio and Faff (2001) analyzed the foreign exchange exposure of the Australian equities market to movements in the Australian dollar/Japanese yen (AUD/JPY) and the Australian dollar/US dollar (AUD/USD) in a Fama-French framework using both daily data and monthly data, they found that implementing the AUD/USD exchange rate factor provides stronger results in the basic multi-factor and stability analyses. Therefore the exchange rate risk is priced in the Australian stock market. Consequently, I will adopt both CAPM and Fama-French's three factors model as the benchmark to test whether the exchange rate risk should be priced in the return of firms for portfolio level analysis.

It is meaningful to include the size when I tested the exchange rate risk exposure in the model, since large firms have the economies of scale in the cost of hedging. In contrast, because the bankruptcy cost increases less than proportionally with firm size, the benefit of hedging in the form of the decrease of expected bankruptcy cost is more important for smaller firms than for larger firms (Nance, Smith, & Smithson, 1993). In addition, the transaction exposure is considered to be simple to estimate and hedge, whereas the long-term effects on future cash flows of exchange rate fluctuations are difficult to determine thus meaning that economic exposure is not easily hedged. Therefore, it is more costly to hedge economic exposure than transaction exposure because the cost of implementing a financial hedge. Thus, the large firms' comparative advantage in the economies of the scale of a hedging program is greater for economic exposure than for transaction exposure. Furthermore, to the extent that the comparative advantage of large firms in hedging transaction exposure is insignificant, large firms would hedge economic exposure more than small firms, while out of the incentive to reduce expected bankruptcy costs, small firms would hedge transaction exposure even more so than large firms. Therefore, if the short-horizon exposure obtained by regressing short-term stock returns on short-term exchange rate changes mainly reflects transaction exposure, small firms' exposure is less than large firms for the short-term exposure, but vice versa for the long-term exposure (Chow & Chen, 1998). Therefore, because I tested the long-term exposure of the exchange rate, I expect that that small firms' exposure is more than that of larger firms.

Bodnar and Gentry (1993) propose a 'lagged response hypothesis' in which they argue that a noticeable response to exchange rate movements may not occur contemporaneously. Therefore, many studies can find more evidences for the exchange rate risk by testing the lead-lag relationship and causality between stock price and exchange rate exposure. For example, Di Iorio and Faff (2000) analyzed the foreign exchange rate exposure of the Australia stock market using the Australian/US exchange rate factor. They found a stronger lagged response than a contemporaneous response by testing the daily data. Bartov and Bodnar (1994) solved the problem of weak significant evidence of a contemporaneous exchange rate impact on the returns of firms by evaluating a sample of exporting firms in periods of large foreign currency adjustments. This study used the lagged return response to

quarterly exchange rate changes and shows a stronger exchange rate effect than that shown in previous studies. On the other hand, Granger, Huang and Yang (2000) tested the bivariate causality between stock prices and exchange rates. They found that exchange rates lead stock prices in Korea, while stock prices lead exchange rates with negative correlation in Philippines. Nevertheless, He and Ng (1998) describe that there is little evidence that lagged exchange rate fluctuations have explanatory power in the Japanese stock market. Therefore, the lead-lag relationship between the stock returns and exchange rate fluctuations are still debateable. I will then investigate whether lagged exchange-rate changes have any explanatory power for current stock returns by regressing stock returns against both contemporaneous and lagged exchange-rate changes. Significance of the coefficient on the latter means that contemporaneous stock returns can be forecast by lagged foreign-exchange fluctuations.

Data and Measures of Exchange rate

The Trade-weighted index (TWI) per New Zealand dollar is used as a measure to capture the medium-term effects of exchange rate changes on the New Zealand economy and inflation. The TWI is the weight on the base of the trade flows and relevant price elasticity between New Zealand and other exchange markets, instead of using the single main currency. There are three important reasons to choose the TWI as exchange rate measure. First, it is convenient to examine one exchange rate index rather than all major currencies' exchange rates. Secondly, due to high correlation coefficients between the major currencies, analysing all currencies result in the problem of multicollinearity (Zhang & Crack, 2005) (See Table 1 shown the correlation coefficients among major currencies). Thirdly, US, Japanese and Australia are main import and export countries attributed to the economy of New Zealand. For example, Japanese tourists contribute to the tourism industry of New Zealand. Australia as the friendly neighbouring country always develops international economic business with New Zealand. Therefore, it is important that I do not ignore any influences that each country has on the exchange rate exposure in New Zealand when choosing the trade-weighted index (TWI) per New Zealand dollar to measure the exchange rate factor. Since the exchange rate is measured by the TWI/NZD, if the NZD appreciate, the exchange rate decreases. I collected

the monthly data of the TWI from the Reserve Bank of New Zealand, this data showed that before 1999 currency weights consisting of the TWI were based on bilateral trade, but after 1999 weights depended on both bilateral trade (50%) and the size of the trading partner's economy (GDP) (50%).

Table 1 shows correlation coefficients among main currencies

Panel (A): Correlation Coefficients of Monthly Percentage Changes in each of the Four Exchange Rates from March 1990 to June 2008

	USA	**UK**	**Aust.**	**Japan**	**TWI**
USA	1				
UK	0.78	1			
Aust.	0.54	0.58	1		
Japan	0.78	0.44	0.25	1	
TWI	0.94	0.70	0.69	0.81	1

Panel (B): Correlation Coefficients of Monthly Percentage Changes in each of the Five Exchange Rates from January 1999 to June 2008

	USA	**UK**	**Aust.**	**Japan**	**TWI**	**Euro**
USA	1					
UK	0.95	1				
Aust.	0.65	0.74	1			
Japan	0.95	0.90	0.69	1		
TWI	0.98	0.96	0.76	0.97	1	
Euro	0.77	0.85	0.76	0.76	0.85	1

Note: Exchange rate data for Euro/NZD are only available from January 1999, so the correlation coefficients of the percentage change in four countries' exchange rates are shown in the Panel (A), while the correlation coefficients of five countries' exchange rates are shown in the Panel (B).

A. Firm Level Analysis

i. Data and Methodology

Data is available from March 1990 to December 2007. I choose the longer term period, because Zhang and Crack (2005) point out that managers can adopt the hedging strategies or diversify their operations to avoid the short-term exchange rate exposure. Meanwhile, Chow, Lee, and Solt (1997) consider that investors have short-horizon errors of returns in predicting the long-term effect of current foreign exchange rate changes. Therefore, I cannot capture the exchange rate effect and price this risk in the short-term period. Moreover, the market index price of NZX All is available only after February 1990 from the DataStream, so I set the sample period from March 1990 to December 2007. The sample includes all dead and active firms in the New Zealand stock market, so there are about 298 observations. In addition, I used the 90-days Bank Bill yield as the risk free rate to calculate the excess return complied from the Reserve Bank of New Zealand and convert annual yield to monthly return by using the following formula: $r_{month} = (1 + r_{annual})^{1/12} - 1$

As specified in the capital market approach developed by Adler, Dumas, and Simon (1986), the exchange rate exposure of a firm is simply measured by the part of the firm's stock return variance that is related to exchange rate fluctuations, which is often regraded as the total exposure of a firm. However, because other macroeconomic variables may simultaneously covary with exchange rate movements and stock returns, failure to include them in the exposure model could result in exaggerated estimates of the proportion of variance in stock returns attributable to foreign currency movements. Therefore, Jorion (1990) prefers measuring the firm-specific exchange rate sensitivity, called residual exposure, in excess of the market's reaction to exchange rate changes. Consequently, for the firm level analysis I followed the Jorion's (1991) two-factor model, which regards the market risk and exchange rate as two factors to explain the stock return, so it is interpreted a test of the CAPM against the non-diversified factor, the exchange rate exposure. Defining all returns as nominal returns in the excess of risk free rate, $R_{it} = r_{it} - r_{ft}$, the two-factor model captures a linear relationship between expected returns and the exchange rate movements.

Since the market risk and exchange rate fluctuation may be related, I tested the relationship between them, first by using the Ordinary Least Squares (OLS) regression:

$$R_{st} = a + bR_{mt} + F_{st} \quad (1)$$

where Rst is the change of TWI exchange rate in period t, Rmt is the return on the equal-weighted market portfolio in period t and F_{st} is referred to as the residual exchange rate exposure in the period t. If the coefficient on market return is statistically significant, indicating that there is a correlation between the market return and the exchange rate factor, I will use the residual series in the two-factor model as the second factor in order to reduce the exchange rate orthogonal to the market.

Then I will use the cross-sectional analysis to examine the relation between each firm's return and exchange rate by using following equation:

$$R_{it} = \delta_0 + \delta_1 R_{mt} + \delta_2 F_{st} + \varepsilon_{it} \quad (2)$$

where Rit is the return on the ith firm's common stock in period t, Rmt is the market return in period t and Fst is the residual of the trade-weighted exchange-rate index, measured foreign currency per unit of New Zealand Dollar in period t, ε_{it} is the residual. The signs of the parameter show the positive or negative relationship and the values of the delta two indicate how strong or weak the relationship is between stock return and exchange rate exposure. Consequently, I can rank the coefficients on the exchange rate residual from the most negative to the most positive to identify the import firms and the export firms.

ii. Firm Level Analysis Results

The cross-sectional distribution of the estimated exposure coefficients of 298 New Zealand firms is presented in Panel (A), Table (2). As we can see the average level of exchange rate exposure coefficient is 0.1075, which means that on average New Zealand firms in the

sample gain 0.1075% in value if the NZ dollar appreciates by 1%, as a result the exchange rate factor will decrease, because of measuring by TWI/NZD. The range of the coefficients on exchange rate risk exposure is from 13.09 to -18.44. In addition, I identified that 153 firms of the total 298 New Zealand firms have a positive exposure coefficient, which are regarded as export firms.

With regards to the significance levels of exchange rate exposure coefficients, I can see that 23 out of 298 firms (7.72%) are significantly exposed to fluctuations of the exchange rate at the five percent level and 51 (17.11%) firms at the ten percent level (see Panel (B) and Panel (C) in Table (2)). Therefore, I conclude that there is not very strong evidence regarding exchange rate risk exposure to the firms' value, compared with He and Ng's (1998) findings that stated that about 25% of the sample of 171 Japanese multinationals' stock returns had economically significant positive exposure impacts from January 1979 to December 1993.

The number of firms with significant exchange rate exposure coefficients is very few and there is a low explanatory power of exchange rate risk on the return of the individual firm since the average value of R^2 is about 0.15. In summation, few firms with significant coefficients and the low explanatory power of exchange rate show that there is only weak evidence about the relationship between firm's value and exchange rate exposure in the firm level analysis.

Table 2 reports the statistics and significant coefficients for the estimated economic exposure of a sample of 298 New Zealand firms from March 1990 to December 2007. Coefficients, $\delta 2$, have been estimated by the monthly time-series regressions (OLS) on the basis of stock returns on market returns and exchange rate changes.

$$R_{it} = \delta_0 + \delta_1 R_{mt} + \delta_2 F_{st} + \varepsilon_{it}$$

Panel (A) Descriptive statistic	
	β2
Mean	-0.1075
Standard Deviation	2.44297
Minimum	-18.441
Median	-0.0118
Maximum	13.0908
Firms in sample	298

Panel (B): Significant at 5 % (Two-tailed test)	
Number of firms	23
Positive	7
Negative	16
Percent of total	7.72%

Panel (C): Significant at 10 % (Two-tailed test)	
Number of firms	51
Positive	23
Negative	28
Percent of total	17.11%

B. Portfolio Level Analysis

i. Construction of Exchange Rate Factor

Following Fama and French's (1993) three factor model, I formed the portfolios on the basis of coefficients on the exchange rate factor which are used in the two factor model for the portfolio level analysis. For example, the SMB (small size of market capitalization minus big size) and HML (high book to market ratio minus low ratio) are used to form the zero investment portfolios. So I generated the IMX, which is the difference between the returns on the negative beta portfolio of all import firms minus the positive beta portfolio of export firms. In addition, Fama and French (1992) rank the size and book to market ratio factor from the lowest to the highest in order to form 25 portfolios, so I also rank the beta of exchange

rate factor from the most negative to the most positive to form ten portfolios. The equation is shown in the following similar to the Fama and French (1993):

$$R_{pt} = \alpha + \beta_1 R_{mt} + \beta_2 IMX_t + \varepsilon_{it} \qquad (3)$$

where R_{pt} is the return on the ith portfolio in period t and R_{mt} is the excess return on a value-weighted aggregate market proxy of ten portfolios in period t. The parameter β_2 indicates the relationship between the return of portfolios and changes of exchange rate zero-investment portfolio. The sign shows the positive or negative relationship between them. If the estimator is statistically significant then the exchange rate factor is priced in the stock return so that investors therefore need compensation as a result of bearing the exchange rate risk.

Every year some firms are delisted (e.g. merge or bankrupt) and new firms are registered with the New Zealand stock market, this causes firms included in each portfolio in the sample set to differ every month as a result I needed to rebalance the portfolio by moving the monthly period window following Fama and MacBeth's (1973) approach. I used the first three years (March 1990-Feburary 1993) as the portfolio construction period to run the two factor model in the firm level analysis and get the coefficients on the exchange rate of each firm, and then ranked the δ_2 from the lowest to the highest to form ten portfolios, so in the testing period (March 1993) I could match the portfolios with the firms' return to get each portfolio's return. Then by dropping one month it rebalances the portfolio by moving the period window (April 1990-March 1993). Therefore, using this method ensures that the IMX portfolios form on the actual coefficients on the exchange rate exposure.[2]

ii. Stable Test

[2] Since the number of firms change every month, the actual number of observations in each month has been shown in the table 11 of the Appendix.

After rebalancing the portfolios every month by moving the period window, the number of firms will change in each portfolio in different time periods so I use the turnover statistic to test the stability of firms in each portfolio. The formula of the turnover statistic is: Turnover = No. of unique firms/ Total No. of firms in this portfolio. By comparing with the firms in the previous month you are able to get the unique firms of each month in each portfolio.

As results shown in the figure 1 and table 3, portfolio one and ten have a lower turnover than other portfolios indicated by an inverted U shape, with the value of about 16.8% and 15.4%, indicating firms in portfolio one and ten are relatively stable. Firms with the most negative beta, which is defined as import firms, are always in portfolio one and firms with the most positive beta, which is regarded as export firms, have a tendency to stay in portfolio ten. However, other firms in portfolio five or six, which may not have obvious characters of belonging to export, import or domestic firms keep changing among those portfolios. Therefore, as we see, an average turnover statistics for each portfolio has an inverted U shape.

Figure 1: Turnover Statistic Average plot

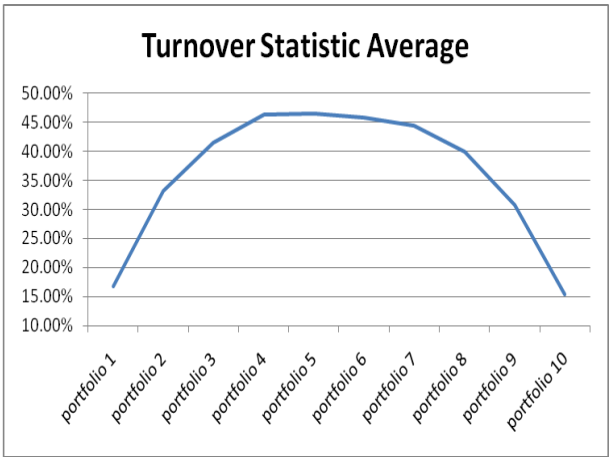


Table 3: Turnover Statistic Average

Portfolio	TO Statistic Average
Most negative beta	16.76%
2	33.24%
3	41.55%
4	46.29%
5	46.51%
6	45.76%
7	44.41%
8	39.94%
9	30.77%
Most positive beta	15.36%

iii. Construction of Exchange Rate Factor Results

By analysing the economic exposure of foreign exchange risk by forming ten portfolios and running time-series regressions, I have identified five import portfolios with negative beta and five export portfolios with positive beta. The table (4) shows that market risk and exchange rate risk are used to capture the return of stock. The coefficients on market risk are all statistically significant at the one percent level with high t-statistic value. In addition, all coefficients on the IMX are statistically significant at the one percent level, except those coefficients on the sixth portfolio are statistically significant at the five percent significant level with the t-statistic value of -1.99. Moreover, there is a positive relationship between return of importers and zero-investment portfolio's (IMX) return, whereas there is negative relationship between return of exporters and zero-investment portfolio's (IMX) return. Portfolio one with the most negative beta has the highest value of coefficient and t-statistic, 1.52 and 9.52, and portfolio ten with the most positive beta has the lowest coefficient and t-statistic, -1.19 and -7.36. Results are consistent with economic theory, if NZD appreciate 1%, the import portfolios' return will increase by 1.52%, while the export portfolios' return will decrease by 1.19%. In addition, the five portfolios' coefficients on intercepts are statistically significant at ten percent significant level, which means other factors may explain the portfolio return.

Given the strong coefficients on IMX, it is not surprising that adding the return of zero-investment portfolio to the regressions results will increase R^2 compared with only including market factor R^2 of the ten portfolios increases dramatically with the range between 0.55 and 0.7. Therefore, I conclude that the exchange rate risk has the significant explanatory power, so the exchange rate factor can affect the portfolio returns for investors.

Table 4 reports time-series regressions of excess portfolio returns on the excess market return and the mimicking portfolio returns for the exchange rate exposure (IMX) factor. Rm is the market excess return. IMX is exchange rate factor mimicking returns. Alpha is the regression intercept from regressing factor returns. The last two columns report on the R^2 of the regression. T-statistics are in parentheses.

$$R_{pt} = \alpha + \beta_1 R_{mt} + \beta_2 IMX_t + \varepsilon_{it}$$

Dependent variable is the excess returns on ten portfolios formed on the value of coefficients on exchange rate risk

Portfolios	β1	β2	α	R^2	SE(e)
Most negative beta (import)	1.2800**	1.5198**	-0.0161**	0.59	0.0554
	(12.91)	(9.52)	(-3.82)		
2	0.9505**	0.2818**	0.0002	0.59	0.0341
	(15.55)	(2.86)	(0.08)		
3	0.9797**	0.2116**	0.0070**	0.70	0.0274
	(19.99)	(2.68)	(3.34)		
4	0.9473**	0.3584**	0.0070**	0.64	0.0306
	(17.28)	(4.06)	(2.98)		
5	0.8352**	0.3757**	0.0021	0.60	0.0299
	(15.61)	(4.36)	(0.94)		
6	0.7993**	-0.1715*	0.0019	0.57	0.0299
	(14.92)	(-1.99)	(0.84)		
7	0.8302**	-0.3871**	0.0077**	0.59	0.0305
	(15.23)	(-4.41)	(3.30)		
8	0.9361**	-0.4221**	-0.0025	0.55	0.0375
	(13.96)	(-3.91)	(-0.88)		
9	0.9325**	-0.5790**	0.0001	0.57	0.0365
	(14.26)	(-5.50)	(0.03)		
Most positive beta (export)	1.5092**	-1.1875**	-0.0073***	0.62	0.0559
	(15.07)	(-7.36)	(-1.72)		

Year	1993	1994	1995	1996	1997
Average Observations	119	126	137	141	146
Year	1998	1999	2000	2001	2002
Average Observations	154	145	146	158	158
Year	2003	2004	2005	2006	2007
Average Observations	156	158	173	173	175

Notes: The individual coefficient is statistically significant at the *5% level or **1%, or ***10% significance level using two-sided test. T-statistics are in parentheses.

C. Fama-French three factors and Exchange rate factor Analysis

i. Sample Selection

Merton (1973) describe that in time-series regressions, a well-specified asset-pricing model produces intercepts that are indistinguishable from zero. The estimated intercepts provide a simple return metric and provide a formal test of how well different combinations of the common factors capture the cross-section of average returns. Therefore, in accordance with significant coefficients on the intercepts in the portfolio level analysis, I found that there are other factors that can explain portfolio return accordingly, I included Fama-French factors: size and book-to-market ratio.

Fama and French (1992) form six portfolios from various sorts of stock composed of size and book-to-market equity to mimic the underlying risk factors in returns, therefore I can form eight portfolios from sorting the stocks on the basis of exchange rate, size and book-to-market ratio factors. I excluded the financial firms, because the high leverage which is normal for these firms possibly does not have the same meaning for non-financial firms, where high leverage is more likely to show distress. Meanwhile, a firm must have stock prices for December of year t – 1, June of t and book common equity for year t – 1, accordingly there are about 159 firms in the New Zealand stock market. The data period started from June 1991 although I need the coefficient on the exchange rate to sort and form a portfolio in June 1994. Therefore, the period from June 1991 to June 1994 is the construction period and the method is the same as the portfolio level analysis of constructing the exchange rate factor. Moreover, the testing period is from July 1994 to June 2008 for 14 years.

According to Fama and French (1993), in June of each year t from 1994 to 2008, all stocks on NZX All are ranked on market capitalization. The median NZX All size is then used to split NZX All, so stocks are divided into two groups: small and big (S and B). Size is measure by the market equity at the end of June of t. In addition, I also split NZX All stocks into two book-to-market equity groups based on the breakpoints for the 50% (Low) and 50% (High) of the ranked values of BE/ME. Fama and French (1992) define the book value of stockholders' equity, plus balance-sheet deferred taxes and investment tax credit (if available), minus the

book value of preferred stock as the book common equity (BE). Book-to-market equity (BE/ME) is then book common equity for the fiscal year ending in calendar year t - 1, divided by market equity at the end of December of t - 1. I excluded negative BE firms as calculating the breakpoints for BE/ME or when forming the size-BE/ME portfolios. Moreover, I break the NZX All stocks into two exchange rate factor groups dependent on 50%-50% split: import firms and export firms (I and X). The first five portfolios are import firms and the last five portfolios are export firms in the portfolio level analysis. Exchange rate exposure is measured by the beta sensitivity on the residual of the exchange rate for every firm at the end of June of t-1. Therefore, I divide the firms in each portfolio into two groups on ME, BE/ME and the exchange rate due to the insufficient firms in NZX all.

ii. Testing Exchange factor within Fama-French three factors

I constructed eight portfolios (I/S/L, I/S/H, I/B/L, I/B/H, X/S/L, X/S/H, X/B/L, and X/B/H) from the intersections of the two exchange rate groups, two size groups and the two BE/ME groups. For example, the I/S/L portfolio contains the stock of the import firms group that are also in the small ME group and in the low-BE/ME group, while the X/B/H portfolio contains the stock of the export firms group that are also in the big ME group and in the high-BE/ME group. Monthly value-weighted returns on the eight portfolios are calculated from July of year t to June of t + 1 and the portfolios are reformed in June of t + 1. I calculated returns at the beginning in July of year t in order to make sure that book equity for year t - 1 is known.

The proposed Exchange rate and the portfolio IMX (import minus export), which is return on a value-weighted, zero-investment, exchange rate factor mimicking portfolios, is defined as the difference between the simple average of the monthly returns on the four import portfolios (I/S/L, I/S/H, I/B/L, and I/B/H) and the average of the monthly returns on the four export portfolios (X/S/L, X/S/H, X/B/L, and X/B/H). Therefore, IMX is the difference between the returns on import and export portfolios without the influence of weighted-average size and BE/ME equity, focusing only on the different return behaviours of firms' exchange rate exposure.

Size- the portfolio SMB (small minus big), which mimics the risk factor in returns related to size, is the difference between the simple average of the monthly returns on the four small size portfolios (I/S/L, I/S/H, X/S/L, and X/S/H) and the simple average of the monthly returns on the four big size portfolios (I/B/L, I/B/H, X/B/L, and X/B/H). Therefore, SMB is the difference between the returns on small and big sized portfolios with the same weighted-average exchange rate and book-to-market equity, focusing only on the different return behaviours due to the size of stocks.

BE/ME - the portfolio HML (high minus low), which mimics the risk factor in returns related to book-to-market equity, is the difference between the simple average of the monthly returns on the four high BE/ME portfolios (I/S/H, I/B/H, X/S/H, and X/B/H) and the average of the monthly returns on the four low BE/ME portfolios (I/S/L, I/B/L, X/S/L, and X/B/L). Therefore, HML is the difference between the returns on high and low BE/ME portfolios with the same weighted-average exchange rate and size equity, only paying attention to the different return behaviours due to the high and low BE/ME firms.

Market- the proxy for the market factor in stock returns is the excess market return, which is the return on the value-weighted portfolio of the stocks in the eight size-BE/ME-exchange rate portfolios.

Finally, I can build the model including Fama and Frenchs' three factors and exchange rate factor shown in the following equation:

$$R_{it} = \gamma_0 + \gamma_1 R_{mt} + \gamma_2 IMX_t + \gamma_3 SMB_t + \gamma_4 HML_t + \varepsilon_{it} \qquad (4)$$

Table 5 shows the correlation between the 1994-2008 monthly mimicking returns for the exchange rate, the size, book-to-market factors and market factor. There is a negative weak relationship between IMX and HML, with the value of -0.2, but it seems that there is no relationship between IMX and SMB with the smallest value of -0.01, as well as the low

positive correlation between HML and SMB. Furthermore, both HML and SMB are negatively related with Rm, whereas the IMX has a positive relationship with Rm. In addition, true mimicking portfolios for the common risk factors in returns minimize the variance of firm-specific factors. Since the eight portfolios on the basis of exchange rate, size, book-to-market ratio factors are value-weighted, mimicking portfolios can minimize variance. Moreover, using value-weighted components in mimicking portfolios capture the different return behaviours of import stock and export stock, small and big stocks, or high and low BE/ME stocks corresponding to realistic investment opportunities.

Table 5 Correlation among the mimicking portfolios for the common risk factors (IMX, SMB, and HML) and market risk (Rm) from June 1994 to June 2008

	IMX	SMB	HML	Rm
IMX	1			
SMB	-0.01	1		
HML	-0.20	0.17	1	
Rm	0.18	-0.19	-0.28	1

iii. Testing Exchange Rate Factor Results

Table 6 shows how the market risk, size, book to market factors, as well as adding exchange rate factors affect the portfolio returns. Considering the value of the coefficients on each factor, the most of t-statistics value on the coefficient of the mimicking return for the exchange rate factor (IMX), the book-to-market factor (HML), the size factor (SMB) and market risk factors (RM) are very high, greater than 4, so coefficients are all statistically significant different from zero at the one significant level. However, two t-statistics on the mimicking return for the size factor (SMB) are very low, with the value of 0.38 and 0.49, which means that the coefficients on the SMB are not statistically significant for big and high BE/ME ratio firms. However, the rest of the coefficients on the SMB are statistically

significant. Therefore, I conclude that there is strong evidence about the explanatory power of the book-to-market factor, exchange rate factor, and market risk factor on the return of the firms in the New Zealand stock market.

Considering the sign of the coefficients on each factor, I find that small size firms have positive slopes on SMB. Some big size firms have a negative relationship with the portfolio return and others have a positive relationship, which does not show consistent signs for big sized firms. For the HML factor, high book-to-market ratios have strong positive slopes on HML, while low book-to-market ratios have a negative relationship with the portfolio return. Moreover, the import firms have a positive relationship with the portfolio return, while the export firms have a negative relationship with the return, which is consistent with the results in the portfolio level analysis. When the firms' size changes from small to big, the portfolio return may decrease, which only can document the weak evidence about negative relationships between size and return. In the New Zealand stock market, most of the firms have small market capitalizations and only a few firms belong to the bigger sector, so it is hard to observe the size effects. However, as the book-to-market ratio of the firms increase, the portfolio return will also increase, which indicates that there is a strong positive relationship between book-to-market ratio and return. When the firms change from the import firms to export firms, I observed that the relationship between the exchange rate zero-investment portfolios and the portfolio return also changed from positive to negative. In addition, the coefficients on market risk factors (RM) show a positive relationship with portfolios' return, which is also consistent with Sharp (1964) CAPM's findings.

Given the significant coefficients on SMB and HML for stock, it is not surprising that adding the two factors to the regressions cause the value of R^2 to increase. The exchange rate factor alone produces the R^2, with the average value of 0.6, as I have included the size and book-to-market ratio factor, the average value of R^2 increased to 0.7 as shown in the table 6. The range of R^2 is from 0.6 for imports, big size and high book-to-market portfolio to 0.81 for import, small size and low book-to-market portfolio. In addition, consistent with Fama and

French (1993), the intercept of most portfolios are statistically insignificant at five percent significant level, which means that only size, book-to-market equity, exchange rate factors and market risk can explain the stock return rather than other factors having the explanatory power. Moreover, since the intercepts are undistinguished from zero, the proposed model is a well-specified asset-pricing model.

Table 6 shows that regressions of excess stock returns on the mimicking returns for the size (SMB), book-to-market equity (HML), and exchange rate (IMX) factors: July 1994 to June 2008, 168 months observations. [3]

$$R_{it} = \gamma_0 + \gamma_1 R_{mt} + \gamma_2 IMX_t + \gamma_3 SMB_t + \gamma_4 HML_t + \varepsilon_{it}$$

Dependent Variable: Excess returns on 8 portfolios formed on size, B/M, and coefficients on Exchange rate

Coefficient	Rm	SMB	IMX	HML	Γ0	R^2
I/S/L	0.9840	0.5970	0.6201	-0.6991	0.0012	0.81
I/S/H	0.9772	0.5024	0.5724	0.7882	-0.0029	0.78
I/B/L	0.9918	-0.1204	0.6411	-0.3146	0.0028	0.75
I/B/H	0.9216	0.0151	0.4037	0.5263	0.0023	0.60
X/S/L	1.0333	0.4351	-0.5470	-0.3640	0.0036	0.65
X/S/H	0.8800	0.4596	-0.4082	0.5757	0.0014	0.71
X/B/L	0.8654	0.0825	-0.4769	-0.3215	-0.0043	0.64
X/B/H	1.0958	0.0170	-0.3306	0.4106	0.0025	0.69
T-Statistic	Rm	SMB	IMX	HML	Intercept	SE(e)
I/S/L	15.43	15.68	6.71	-9.49	0.51	0.0275
I/S/H	16.82	14.48	6.80	11.75	-1.42	0.0250
I/B/L	15.88	-3.23	7.09	-4.36	1.25	0.0269
I/B/H	13.95	0.38	4.22	6.90	0.97	0.0285
X/S/L	14.03	9.90	-5.13	-4.28	1.38	0.0317
X/S/H	14.95	13.08	-4.79	8.47	0.69	0.0253
X/B/L	14.63	2.33	-5.56	-4.71	-2.03	0.0255
X/B/H	18.75	0.49	-3.90	6.08	1.20	0.0252

Note: RM is the value-weighted percent monthly excess return on all the stocks in the 8 size-BE/ME –Exchange rate portfolios, SMB (small minus big) is the return on the mimicking

[3] The number of firms is shown in the table 12 of Appendix.

portfolio for the size factor in stock returns. HML (high minus low) is the return on the mimicking portfolio for the book-to-market factor. IMX (import minus export) is the return on the mimicking portfolio for the exchange factor. The eight size-BE/ME –Exchange rate portfolios are formed as follows. Each year t from 1994 to 2008 quintile breakpoints for size, ME, measured at the end of June, are used to allocate stocks to two size quintiles. Similarly, quintile breakpoints for BE/ME and exchange rate are used to allocate stocks to two book-to-market equity and two exchange rate quintiles. In BE/ME, BE is book common equity for the Fiscal year ending in calendar year t - 1, exchange rate and ME is at the end of December t - 1. The stocks in the 8 size-BE/ME –Exchange rate portfolios are the intersections of the two sizes, two exchange rates and the two BE/ME groups. Value-weighted monthly percent excess returns on the 8 portfolios are calculated from July of t to June of t+1. R square and the residual standard error are adjusted for degrees of freedom. Gamma zero is the regression intercept from regressing factor returns. T-statistics are reported below.

D. Lead-Lag relationship

According to the results in firm level analysis, portfolio level analysis and the Fama-French three factor analysis, there was strong evidence to support the notion that exchange rate fluctuations are able to be regarded as an important factor in determining the stock price and that investors should get the compensation for bearing the risk of exchange rate exposure. Furthermore, I studied the lead-lag relationship between exchange rate fluctuations and stock price change, since the economic benefit for investors is based on whether they can use the current information about exchange rate or stock price to predict the price or exchange rate.

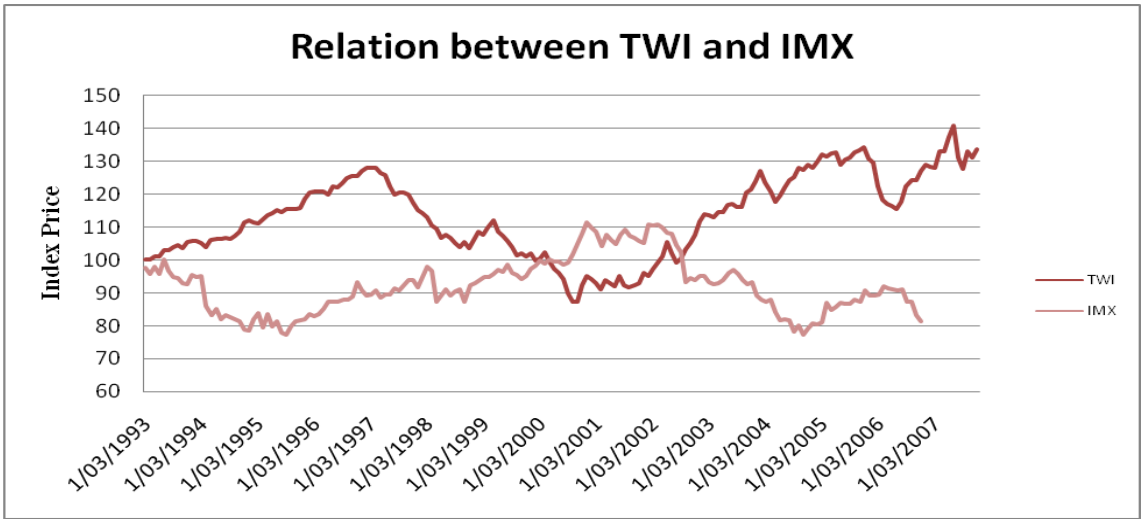
i. Correlation Coefficient Analysis

Before analysing the statistical lead-lag relationship, I observed the correlation coefficient between the trade-weighted index (TWI) and the exchange rate zero-investment mimicking portfolio (IMX) from the graph. As I need to observe the tendency of TWI and IMX, I calculated the index price for the exchange rate and portfolio by using the following formula:

$$P_1 = 100$$
$$P_2 = 100 * (1 + IMX_1)$$
$$P_3 = 100 * (1 + IMX_1) * (1 + IMX_2)$$
.
.
.
$$P_n = 100 * (1 + IMX_1) ..... (1 + IMX_n)$$

I calculated the price of the exchange rate by using the similar formula as the above, by changing the variable IMX to variable TWI. Thus, I can plot the TWI exchange rate and IMX portfolio to observe the linear relationship altering over time. As Figure 2 indicates, they have the opposite tendency in the long-term period. For example, from 2001 to 2006, I found that the index price of the TWI has the uptrend, while prices on IMX follow the downside trend. Therefore, I tested the correlation coefficient between them and the result shows that there is a strong negative relationship, with the value of -0.715. Therefore, I predict that the TWI exchange rate and IMX stock price may have a linear and negative lagged relationship, which is also consistent with economy theory. As the New Zealand Dollar appreciates the exchange rate (TWI/NZD) will decrease, whereas IMX will increase because the import firms' return will increase and the export firms' return will decrease, which shows the negative relationship between them.

Figure 2 shows the relationship between TWI and IMX.



ii. Lagged Response Analysis

Since I observed that there is a relationship between them, I used the statistical analysis to examine which lagged time periods' exchange rate has the explanatory power on the current change of the share price. Certain lagged month's changes in share prices can forecast the current exchange rate fluctuations. The method that I used is the Ordinary Least Squares (OLS) regression with current, lead and lagged exchange rates (TWI) and portfolio return (IMX) within the 12 month period. At the beginning I ran regression including all variables in order to identify the significant independent variables. I found that the all lead TWI and IMX are statistically insignificant, therefore I only included the variables with lags in order to capture the lagged response of exchange rate and portfolio return. I followed the below equation to test whether lagged portfolio return can affect the contemporaneous changes of exchange rate by using following equations:

$$TWI_t = \alpha + \beta_i IMX_{t-p} + \varepsilon_t \qquad \text{p=1, 2….12} \quad (5)$$

where TWI_t is the change of the exchange rate in period t, IMX_{t-p} means lag p months return on the portfolio, and ε_t is the residual in the period t.

At the same time, I can test whether lagged exchange rate changes affect the contemporaneous stock returns using the below equation:

$$IMX_t = \alpha + \beta_i TWI_{t-p} + \varepsilon_t \qquad \text{p=1, 2….12} \quad (6)$$

where IMX_t is the return on the mimicking portfolio in period t, TWI_{t-p} means lagged p months of exchange rate movement, and ε_t is the residual in the period t.

Table 7 sets the Trade-weighted Index exchange rate (TWI) as the dependent variable and runs the regressions with lagged portfolio return (IMX). By including different lagged periods of IMX, I found that only IMX with lag six-month period can explain the current change of exchange rate at ten percent significant level, which means that lagged portfolio change in a single month has very low explanatory power on the movement of the exchange rate. On the other hand, in the Table (8), I changed the Trade-weighted Index exchange rate (TWI) to the independent variable and portfolio return (IMX) as a dependent variable. By adding different lagged periods from lag 1 to lag 12 months of exchange rate, I found that by including four lag periods on the TWI as independent variables, such as TWI (-1), TWI (-2), TWI (-3) and TWI (-4), and then only the lag one period on the TWI can explain the change of portfolios. At the same time coefficients on TWI with other lag periods are insignificant at the ten percent level. Therefore, there is no obvious evidence that a lagged TWI can explain the stock price movement, which means that there is no predication ability for the exchange rate in the stock market.

Table 7 shows that regression of the exchange rate movement on the mimicking returns for zero investment portfolios with lag p periods.

$$TWI_t = \alpha + \beta_i IMX_{t-p} + \varepsilon_t$$

Dependent Variable: Trade-Weight Index (TWI) exchange rate

Regressors	1	2	3	4	5	6	7
IMX (-1)	-0.0605	-0.0608	-0.0614	-0.0633	-0.0712	-0.0693	-0.0750
	(-1.02)	(-1.03)	(-1.05)	(-1.09)	(-1.23)	(-1.21)	(-1.32)
IMX (-2)	0.0195	0.0193	0.0185	0.0201	0.0254	0.0186	0.0200
	(0.32)	(0.32)	(0.31)	(0.34)	(0.43)	(0.32)	(0.35)
IMX (-3)	-0.0638	-0.0635	-0.0629	-0.0657	-0.0699	-0.0671	-0.0683
	(-1.06)	(-1.06)	(-1.06)	(-1.12)	(-1.20)	(-1.17)	(-1.19)
IMX (-4)	-0.0601	-0.0598	-0.0610	-0.0620	-0.0638	-0.0655	-0.0676
	(-0.99)	(-1.00)	(-1.03)	(-1.06)	(-1.10)	(-1.14)	(-1.18)
IMX (-5)	-0.0685	-0.0681	-0.0687	-0.0653	-0.0659	-0.0674	-0.0675
	(-1.14)	(-1.14)	(-1.17)	(-1.13)	(-1.14)	(-1.17)	(-1.18)
IMX (-6)	-0.1068*	-0.1060*	-0.1045*	-0.1053*	-0.1103*	-0.1108*	-0.1047*
	(-1.77)	(-1.79)	(-1.79)	(-1.82)	(-1.91)	(-1.92)	(-1.84)
IMX (-7)	-0.0673	-0.0681	-0.0685	-0.0656	-0.0635	-0.0582	
	(-1.12)	(-1.15)	(-1.17)	(-1.13)	(-1.09)	(-1.01)	
IMX (-8)	-0.0700	-0.0697	-0.0684	-0.0702	-0.0602		
	(-1.18)	(-1.18)	(-1.17)	(-1.21)	(-1.04)		
IMX (-9)	-0.0748	-0.0752	-0.0759	-0.0802			
	(-1.25)	(-1.27)	(-1.29)	(-1.38)			
IMX (-10)	0.0237	0.0240	0.0222				
	(0.40)	(0.41)	(0.38)				
IMX (-11)	0.0090	0.0093					
	(0.15)	(0.16)					
IMX (-12)	0.0009						
	(0.02)						
C	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015
	(0.88)	(0.88)	(0.90)	(0.93)	(0.93)	(0.98)	(1.01)
N	166	167	168	169	170	171	172
R^2	0.0731	0.0730	0.0728	0.0736	0.0622	0.0559	0.0508

Notes: The individual coefficient is statistically significant at the **5% or *10% significance level using two-sided test. . T-statistics are in parentheses.

Table 8 shows that regression of the exchange rate movement on the excess market return and the mimicking returns for zero investment portfolios with lag p periods.

$$IMX_t = \alpha + \beta_i TWI_{t-p} + \varepsilon_t$$

Dependent Variable: Mimicking returns for exchange rate factor (IMX)

Regressors	1	2	3	4	5	6	7	8	9
TWI(-1)	0.1991*	0.2070*	0.2063*	0.2063*	0.2031*	0.2035*	0.2045*	0.1928*	0.1800*
	(1.79)	(1.87)	(1.88)	(1.89)	(1.88)	(1.89)	(1.91)	(1.80)	(1.69)
TWI(-2)	-0.1307	-0.1438	-0.1459	-0.1461	-0.1488	-0.1456	-0.1521	-0.1508	-0.1329
	(-1.13)	(-1.26)	(-1.28)	(-1.29)	(-1.33)	(-1.30)	(-1.38)	(-1.37)	(-1.21)
TWI(-3)	-0.1330	-0.1260	-0.1348	-0.1349	-0.1321	-0.1297	-0.1215	-0.1268	-0.1381
	(-1.13)	(-1.08)	(-1.16)	(-1.17)	(-1.15)	(-1.14)	(-1.08)	(-1.13)	(-1.23)
TWI(-4)	-0.1327	-0.1474	-0.1436	-0.1435	-0.1504	-0.1633	-0.1706	-0.1658	-0.1375
	(-1.11)	(-1.25)	(-1.22)	(-1.22)	(-1.30)	(-1.43)	(-1.50)	(-1.46)	(-1.25)
TWI(-5)	0.0830	0.0810	0.0760	0.0757	0.0814	0.0881	0.0912	0.0977	
	(0.67)	(0.66)	(0.62)	(0.62)	(0.67)	(0.74)	(0.77)	(0.86)	
TWI(-6)	0.0464	0.0477	0.0543	0.0546	0.0491	0.0496	0.0346		
	(0.37)	(0.39)	(0.44)	(0.45)	(0.41)	(0.41)	(0.30)		
TWI(-7)	-0.0816	-0.0850	-0.0810	-0.0813	-0.0777	-0.0490			
	(-0.65)	(-0.68)	(-0.65)	(-0.66)	(-0.64)	(-0.42)			
TWI(-8)	0.1074	0.1172	0.1160	0.1161	0.1028				
	(0.86)	(0.94)	(0.94)	(0.94)	(0.88)				
TWI(-9)	-0.0302	-0.0388	-0.0404	-0.0413					
	(-0.24)	(-0.31)	(-0.32)	(-0.34)					
TWI(-10)	0.0213	0.0261	-0.0027						
	(0.17)	(0.21)	(-0.02)						
TWI(-11)	-0.0675	-0.1074							
	(-0.53)	(-0.89)							
TWI(-12)	-0.1308								
	(-1.07)								
C	0.0005	0.0003	0.0003	0.0003	0.0002	0.0003	0.0002	0.0000	0.0005
	(0.23)	(0.16)	(0.17)	(0.17)	(0.11)	(0.17)	(0.10)	(0.02)	(0.24)
N	166	167	168	169	170	171	172	173	174
R^2	0.0713	0.0645	0.0613	0.0613	0.0609	0.0564	0.0566	0.0533	0.0476

Notes: The individual coefficient is statistically significant at the **5% or *10% significance level using two-sided test. . T-statistics are in parentheses.

iii. Cumulative lead-lag Relation Analysis

There is weak evidence on the lagged response for each month, this could be a result of the accumulation of several lagged month periods of the IMX and TWI on the current or lead change of the exchange rate and stock price. Therefore, I accumulated the different lag periods on IMX and the TWI to form new independent variables, $CIMX_{(t-1,t-p)}$ and $CTWI_{(t,t-q)}$ by using the formula: $CIMX_{(t-1,t-p)} = IMX(-1) + ... + IMX(-q)$. For example, if p=12, the accumulative lagged variable is created by summing from TWI (-1) to TWI (-12). Meanwhile, I used the same method to form the new dependent variable: $CTWI_{(t,t+m)}$ and $CIMX_{(t,t+m)}$. I also ran the OLS regression, but without the intercept due to the insignificant coefficients on them. If the coefficients on the accumulative lagged factors are significantly statically different from zero, there is cumulative lagged effect between the exchange rate fluctuations and stock returns. Therefore, I can predict the movement of the exchange rate or price in the next several months. If the profit from excess return is greater than the transaction cost then investors make a profit. However, the accumulative variables with the sum of different lag periods in the TWI are insignificant, so I do not add these accumulative lagged terms into the equation. Consequently, I only used the following equation to test the influence of an accumulative lagged period in IMX on the accumulative lead period in the TWI.

$$CTWI_{(t,t+m)} = \beta_j CIMX_{(t-1,t-q)} + \varepsilon_t \qquad \text{m= q= 1, 2……12} \quad (8)$$

Where $CTWI_{(t,t+m)}$ is the accumulative lead exchange rate fluctuation, $CIMX_{(t-1,t-p)}$ is the cumulative lagged p month's return on the mimicking portfolio, and ε_t is the residual in the period t.

Table 9 shows how the accumulative lagged portfolio return can predict how long the accumulative lead exchange rate change will be. In order to analyse the effects of portfolio return on the current exchange rate movement, I observed that the results of the first row in the table show that the least accumulative lagged IMX for four months have the effect on the fluctuation of the exchange rate at a ten percent significant level. As the number of

cumulative lagged IMX increases, the value of the t-statistic keeps increasing until I accumulated lagged IMX for nine months with the highest t-statistic value of 3.27 at the one percent significant level. Also $CIMX_{(t-1,t-9)}$ has the highest R^2 with the value of 0.0527, which means that current fluctuation of the exchange rate can be explained by the accumulative previous nine month stock price changes. The coefficient on the $CIMX_{(t-1,t-9)}$ is -0.0637, which shows that if the returns on the accumulative lagged portfolio for nine months increased by 1% then the current exchange rate will move down 0.0637 %. In addition, there is a strong negative relationship between the current exchange rate movement and the previous portfolio price no matter how many lag periods are added thus being consistent with the result in figure (2).

At the same time, I also analysed the accumulative lead effect in TWI so that I could generate the trading strategy. As the number of cumulative lead TWI increased, in general t-statistic of the coefficients also kept increasing. When I gathered the leaded TWI for seven months and lagged IMX for nine months, the coefficient had the highest t-statistic value of -6.55 at the one percent significant level and the highest R^2 with the value of 0.1789. The value of coefficient on the $CIMX_{(t-1,t-9)}$ is -0.4076, which means that if the returns on accumulative lagged portfolio for nine months decreased by 1% then the accumulative lead exchange rate for seven months will move up 0.4076 % in total. Therefore, if the return of stocks decreased for nine months, the trading strategy is to buy and hold the main currencies for seven months in order to earn the profit. Thus investors consider that main currencies will appreciate and the New Zealand dollar will depreciate for seven months. Moreover, there is a strong negative relationship between the future exchange rate movement and the previous portfolio price no matter how many lagged or leaded months are included. In summation, investors can use the past nine month's stock price information to generate the trading strategy by buying or selling the currency so that they can mark profit during the next seven months in the New Zealand foreign exchange market

Table 9 shows the regression of the current and accumulative lagged mimicking portfolio returns on the current and accumulative lead exchange rate movement by using the equation:

$$CTWI_{(t,t+m)} = \alpha + \beta_j CIMX_{(t-1,t-q)} + \varepsilon_t$$

Coefficient	CIMX(0)	CIMX(-1)	CIMX(-2)	CIMX(-3)	CIMX(-4)	CIMX(-5)	CIMX(-6)	CIMX(-7)	CIMX(-8)	CIMX(-9)	CIMX(-10)	CIMX(-11)	CIMX(-12)
CTWI (0)	0.0233[4]	-0.0787[4]	-0.0282[4]	-0.0466[4]	-0.0524	-0.0516	-0.0626	-0.0613	-0.0602	-0.0637	-0.0526	-0.0479	-0.0455
	(0.23)	(-1.43)	(-0.68)	(-1.33)	(-1.73)	(-1.91)	(-2.54)	(-2.73)	(-2.86)	(-3.27)	(-2.84)	(-2.69)	(-2.66)
CTWI (1)	-0.0560[4]	-0.0787[4]	-0.0282[4]	-0.0466[4]	-0.0524	-0.0516	-0.0626	-0.0613	-0.0602	-0.0637	-0.0526	-0.0479	-0.0455
	(-0.85)	(-1.43)	(-0.68)	(-1.33)	(-1.73)	(-1.91)	(-2.54)	(-2.73)	(-2.86)	(-3.27)	(-2.84)	(-2.69)	(-2.66)
CTWI (2)	-0.0222[4]	-0.1337[4]	-0.1332[4]	-0.1587	-0.1775	-0.1877	-0.1969	-0.1964	-0.1876	-0.1698	-0.1482	-0.1453	-0.1464
	(-0.43)	(-1.20)	(-1.59)	(-2.28)	(-2.99)	(-3.57)	(-4.13)	(-4.55)	(-4.64)	(-4.49)	(-4.11)	(-4.21)	(-4.44)
CTWI (3)	-0.0418[4]	-0.1865[4]	-0.1862	-0.2366	-0.2498	-0.2567	-0.2736	-0.2555	-0.2386	-0.2170	-0.1979	-0.1949	-0.1972
	(-0.97)	(-1.41)	(-1.87)	(-2.89)	(-3.56)	(-4.15)	(-4.92)	(-5.04)	(-5.01)	(-4.87)	(-4.68)	(-4.81)	(-5.10)
CTWI (4)	-0.0475[4]	-0.2345[4]	-0.2708	-0.3157	-0.3232	-0.3375	-0.3362	-0.3074	-0.2869	-0.2679	-0.2486	-0.2467	-0.2457
	(-1.24)	(-1.57)	(-2.43)	(-3.45)	(-4.14)	(-4.93)	(-5.43)	(-5.43)	(-5.41)	(-5.41)	(-5.29)	(-5.49)	(-5.71)
CTWI (5)	-0.0518[4]	-0.3261	-0.3620	-0.3962	-0.4082	-0.3967	-0.3869	-0.3508	-0.3369	-0.3205	-0.3011	-0.2982	-0.2877
	(-1.48)	(-1.99)	(-2.97)	(-3.98)	(-4.83)	(-5.33)	(-5.74)	(-5.68)	(-5.84)	(-5.98)	(-5.93)	(-6.14)	(-6.15)
CTWI (6)	-0.0607	-0.3947	-0.4266	-0.4756	-0.4582	-0.4370	-0.4227	-0.3937	-0.3846	-0.3683	-0.3470	-0.3345	-0.3171
	(-1.90)	(-2.20)	(-3.22)	(-4.41)	(-4.99)	(-5.39)	(-5.74)	(-5.87)	(-6.16)	(-6.36)	(-6.31)	(-6.32)	(-6.20)
CTWI (7)	-0.0610	-0.4454	-0.5105	-0.5214	-0.4916	-0.4692	-0.4625	-0.4342	-0.4279	-0.4076	-0.3756	-0.3562	-0.3366
	(-2.06)	(-2.30)	(-3.58)	(-4.48)	(-4.95)	(-5.34)	(-5.83)	(-6.02)	(-6.39)	(-6.55)	(-6.32)	(-6.20)	(-6.06)
CTWI (8)	-0.0594	-0.5415	-0.5482	-0.5462	-0.5171	-0.5057	-0.5015	-0.4762	-0.4674	-0.4344	-0.3945	-0.3732	-0.3569
	(-2.16)	(-2.60)	(-3.56)	(-4.34)	(-4.80)	(-5.33)	(-5.86)	(-6.14)	(-6.47)	(-6.43)	(-6.09)	(-5.97)	(-5.91)
CTWI (9)	-0.0638	-0.5166	-0.5318	-0.5460	-0.5359	-0.5304	-0.5349	-0.5062	-0.4851	-0.4439	-0.4023	-0.3850	-0.3683
	(-2.48)	(-2.31)	(-3.20)	(-4.02)	(-4.62)	(-5.19)	(-5.82)	(-6.04)	(-6.18)	(-6.03)	(-5.71)	(-5.67)	(-5.64)
CTWI (10)	-0.0538	-0.5145	-0.5454	-0.5822	-0.5761	-0.5757	-0.5770	-0.5311	-0.5005	-0.4562	-0.4183	-0.3995	-0.3824
	(-2.21)	(-2.15)	(-3.07)	(-4.01)	(-4.63)	(-5.27)	(-5.84)	(-5.87)	(-5.89)	(-5.72)	(-5.50)	(-5.47)	(-5.45)
CTWI (11)	-0.0479	-0.5427	-0.5986	-0.6364	-0.6349	-0.6273	-0.6084	-0.5496	-0.5157	-0.4754	-0.4350	-0.4150	-0.3969
	(-2.07)	(-2.13)	(-3.18)	(-4.13)	(-4.83)	(-5.39)	(-5.76)	(-5.66)	(-5.65)	(-5.57)	(-5.36)	(-5.33)	(-5.31)
CTWI (12)	-0.0518	-0.6106	-0.6660	-0.7064	-0.6968	-0.6617	-0.6282	-0.5643	-0.5357	-0.4915	-0.4493	-0.4281	-0.4015
	(-2.28)	(-2.27)	(-3.31)	(-4.32)	(-4.95)	(-5.30)	(-5.53)	(-5.41)	(-5.48)	(-5.40)	(-5.20)	(-5.17)	(-5.02)

[4] T-statistics are given in parentheses under coefficients. The individual coefficient is statistically insignificant at the 10% significant level using two-sided test.

R^2	CIMX(0)	CIMX(-1)	CIMX(-2)	CIMX(-3)	CIMX(-4)	CIMX(-5)	CIMX(-6)	CIMX(-7)	CIMX(-8)	CIMX(-9)	CIMX(-10)	CIMX(-11)	CIMX(-12)
CTWI (0)	0.0003	0.0026	0.0	0.0014	0.0084	0.0132	0.0288	0.0347	0.0393	0.0527	0.0396	0.0355	0.0346
CTWI (1)	0.0039	0.0026	0.0	0.0014	0.0084	0.0132	0.0288	0.0347	0.0393	0.0527	0.0396	0.0355	0.0346
CTWI (2)	0.0002	0.0	0.0	0.0115	0.0326	0.0541	0.0766	0.0950	0.1001	0.0944	0.0796	0.0841	0.0936
CTWI (3)	0.0042	0.0	0.0	0.0259	0.0502	0.0747	0.1086	0.1155	0.1156	0.1101	0.1023	0.1084	0.1227
CTWI (4)	0.0079	0.0	0.0068	0.0408	0.0691	0.1051	0.1300	0.1315	0.1314	0.1327	0.1274	0.1381	0.1500
CTWI (5)	0.0120	0.0	0.0160	0.0548	0.0929	0.1183	0.1398	0.1384	0.1479	0.1555	0.1544	0.1663	0.1679
CTWI (6)	0.0197	0.0	0.0190	0.0681	0.0960	0.1173	0.1364	0.1441	0.1596	0.1716	0.1706	0.1724	0.1670
CTWI (7)	0.0238	0.0	0.0282	0.0678	0.0912	0.1121	0.1380	0.1484	0.1692	0.1789	0.1684	0.1637	0.1571
CTWI (8)	0.0261	0.0	0.0245	0.0589	0.0817	0.1092	0.1368	0.1527	0.1716	0.1709	0.1550	0.1494	0.1477
CTWI (9)	0.0344	0.0	0.0099	0.0439	0.0723	0.1004	0.1339	0.1469	0.1560	0.1496	0.1342	0.1333	0.1331
CTWI (10)	0.0274	0.0	0.0038	0.0423	0.0713	0.1038	0.1343	0.1375	0.1400	0.1328	0.1227	0.1225	0.1236
CTWI (11)	0.0244	0.0	0.0061	0.0454	0.0793	0.1090	0.1292	0.1260	0.1269	0.1240	0.1151	0.1156	0.1167
CTWI (12)	0.0324	0.0	0.0094	0.0532	0.0846	0.1041	0.1171	0.1125	0.1175	0.1152	0.1076	0.1080	0.1025

Note: the R^2 of the regression is shown in the second part of this table.

Conclusion

I examined whether there is a relationship between the change of stock prices and the trade-weighted index (TWI) exchange rate fluctuations in the New Zealand Stock market by testing the sensitivity of a firms' stock return to exchange rate fluctuation, the existence of the Fama-French factor in exchange rates, as well as the lead-lag relationship between them. I mainly focussed on the long-term exchange rate risk exposure, so the sample period covered March 1990 until December 2007 in the firm level analysis and from December 1990 till June 2008 in the portfolio level analysis.

Using the firm level analysis in this paper I found that 23 out of 298 firms (7.72%) were significantly exposed to fluctuations in the exchange-rate at the five percent level from March 1990 to December 2007 and 51 firms (17.11%) at the ten percent level with low explanatory power on the return. As a result there is not strong evidence regarding exchange rate exposure. Moreover, the main result for the portfolio level analysis is that the coefficients on the portfolios of importers and exporters are statistically significant so it documents that the exchange rate factor can explain the zero-investment portfolio (IMX) return. In addition, including Fama and French's (1993) three factors and exchange rate, I found that the book-to-market factor, exchange rate factor, and market risk factor can explain the portfolio return rather than the size factor. There is a positive relationship between book-to-market ratio, market risk and portfolio returns. Therefore, I conclude that there is a strong relationship between contemporary exchange rate exposure and contemporary portfolio returns. Investors should get compensation for bearing the unsystematic risk. In addition, for lead-lag relationship analysis there is a strong negative relationship between the future exchange rate movement and the past portfolio price. Accumulative lagged IMX for nine months can explain the movement of accumulative leaded TWI for seven months. Therefore, if the returns of stocks decrease for nine months, the trading strategy is to buy and hold the main currencies for seven months in order to earn the profit. Thus investors can use the past nine month's stock price information to mark profit next seven months in New Zealand foreign exchange market.

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Appendix

Table 10: Exports and Imports of Goods and Services (% GDP) in New Zealand and US

Name	US EXPORTS	NZ EXPORTS	US IMPORTS	NZ IMPORTS
1990	9.52	26.52	10.86	26.19
1991	9.95	28.90	10.41	25.80
1992	10.02	30.91	10.55	29.02
1993	9.85	30.66	10.83	27.97
1994	10.19	30.58	11.52	28.33
1995	10.98	29.67	12.21	28.44
1996	11.11	28.29	12.34	27.84
1997	11.50	27.71	12.73	27.31
1998	10.93	29.19	12.76	28.79
1999	10.70	29.89	13.51	30.87
2000	11.17	34.35	15.03	33.36
2001	10.20	35.65	13.82	32.65
2002	9.61	33.21	13.66	31.87
2003	9.50	29.67	14.05	28.83
2004	10.12	29.04	15.38	29.54
2005	10.56	27.98	16.30	30.05
2006	11.24	29.05	16.98	30.65
2007	12.04	28.43	17.17	29.54
2008	13.60	31.60	18.10	33.80
Average	10.67	30.07	13.59	29.52

Table 11: Number of observations in each month for the construction of exchange rate analysis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993			119	121	121	121	119	119	118	117	117	117
1994	117	118	120	125	125	128	128	126	129	130	131	133
1995	135	134	134	136	136	139	137	137	137	138	138	138
1996	138	138	139	139	140	141	141	141	144	143	143	146
1997	146	147	146	146	146	147	146	147	146	145	145	148
1998	150	151	151	151	153	156	156	156	156	157	153	153
1999	152	148	147	147	146	145	144	142	141	141	142	144
2000	143	143	145	147	146	144	144	143	145	147	149	151
2001	151	151	153	152	154	161	160	162	163	162	162	161
2002	160	160	160	160	160	161	159	157	155	155	155	155
2003	156	156	157	158	158	157	156	155	155	155	155	155
2004	155	153	153	154	160	160	159	158	159	161	162	164
2005	168	169	172	173	174	178	176	176	173	172	172	173
2006	172	173	173	173	173	172	172	172	172	172	173	174
2007	174	174	175	176	175	175	175	175	175	174	175	177

Table 12: Number of firms for the testing exchange rate factor within Fama-French three factor

Year	1994	1995	1996	1997	1998	1999	2000
Observation	24	34	42	53	58	59	62
Year	2001	2002	2003	2004	2005	2006	2007
Observation	74	95	93	92	97	108	111