

**The interrelationship between New Zealand
stock market and exchange rates**

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Table of Contents

Attestation of Authorship.....	III
Acknowledgements.....	IV
Abstract.....	V
1 Introduction.....	1
2 Literature Review.....	4
3 Data Description.....	10
3.1 Definition of the data.....	10
3.2 Interpretation of the data.....	12
4 Research Methodology.....	16
5 Results analysis.....	20
5.1 Correlation.....	21
5.2 Unit root.....	27
5.3 Cointegration.....	30
5.3.1 Engle-Granger Two steps methodology.....	30
5.3.2 Johansen-Juselius cointegration methodology.....	30
5.4 Lag length selection.....	32
5.5 Granger-Causality tests.....	35
5.5.1 Daily Granger-Causality tests.....	35
5.5.2 Weekly Granger-Causality tests.....	44
6 Conclusion.....	52
7 Limitations.....	53
8 References.....	55
9 Appendix.....	58

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Abstract

This paper analyzes the relationships between the New Zealand stock market and the USD/NZD, AUD/NZD and USD/AUD exchange rates. Both long run relationship and short run causality are examined using daily and weekly data. We employ the cointegration test and Granger Causality test after checking the unit root of each variable. The empirical results indicate that there is no long run relationship between these exchange rates and each sector of the New Zealand Stock Exchange (NZX) when we use both daily and weekly data. However the results regarding relationships in short run are mixed. We find causality relationships between the exchange rates and the NZX 10, NZX 15, NZX 50 indices. Causal relationships are also documented between exchange rates and the sectors of Forestry, Goods, Intermediate, Ports, Textiles, Leisure, Media, Service, Non-local-Australia, Non-local-World and Agriculture.

1 Introduction

The analysis of the interactions between New Zealand stock market and exchange rates is useful for many reasons. First, it provides incentives to New Zealand regulators to monitor New Zealand's financial markets. Financial markets provide leading indicators regarding the state of the country's economy. Regulators could potentially use information from financial markets in formulating economic policies. By understanding the relationship between exchange rates and the stock market, policymakers may make more informed decisions on monetary and fiscal policies to stimulate or control financial markets via the exchange rate mechanism.

Second, it is of potential value to financial institutions, multinational corporations and individual investors who are interested in holding international diversified portfolios. Due to the large differential in the yield between New Zealand's official cash rate and Japan's benchmark interest rate, "carry traders", who raise funds in Japan with low costs and convert into New Zealand Dollar and deposit into New Zealand banks with high returns or invest them in New Zealand market, have become a force to reckon with. Knowledge of the interaction between New Zealand stock market and exchange rates is useful to carry traders and investors who manage international investment portfolios. Multinational corporations in New Zealand can hedge their exchange rate risk more accurately by using the information from New Zealand stock market if there exists a relationship between the New Zealand Stock market and the New Zealand dollar exchange rate. In foreign exchange market, investors who are interested in trading New Zealand Dollar can also be benefit by using New Zealand stock market information.

Currencies of major industry countries were allowed to float freely in 1973. New Zealand allows its currency to float against other currencies in 1985. The floating exchange rate is an additional source of volatility to New Zealand's small but open economy. The secular increase in international trade makes firms in New Zealand increasingly exposed to exchange rate risk.

There are two fundamental frameworks for examining the link between stock market and exchange rates – the microeconomic and the macroeconomic. From a microeconomic viewpoint, the market value of firms depends on its future cash flows. The appreciation of the New Zealand dollar will reduce the income of multinational firms that is generated in foreign currencies. Furthermore, it also reduces the number of export orders from other countries. It also reduces the cost of purchases from overseas. Therefore, the value of firms that have overseas operations or have exports to overseas countries are expected to drop and the value of firms that have imports from overseas to rise when the New Zealand dollar appreciates against other currencies. When New Zealand dollar depreciates, it increases the multinational firm's overseas income stated in New Zealand dollars. This increases the firm's value, and makes goods produced in New Zealand cheaper and attractive to overseas buyers so that the orders from overseas increase. Therefore, the values of exporting firms in New Zealand are expected to increase. For firms that need to purchase from overseas, the lower value of New Zealand dollar results in higher costs of foreign purchases. The fluctuation of New Zealand dollar affects not only the values of firms that have international transactions but also the values of purely domestic firms. The appreciation of New Zealand dollars encourages firms in New Zealand to purchase the inventories or goods from other countries rather than from domestic firms. It will decrease the value of affected firms. On the other hand, the depreciation of New Zealand dollar will discourage purchasing from overseas and make domestic firms more competitive as compared to their international competitors. So, investors expect the value of domestic firms to increase.

From a macroeconomic perspective, during periods of expansion a rising stock market may cause the inflation to rise through rapidly increasing money supply. Monetary policy responses to cool down the overheated economy, such as an increase in the interest rates, selling of government bonds, increase in banks' reserve ratio etc. will strengthen the home currency. With the appreciation of home

currency, more international funds will be attracted to the market. Therefore the home currency will further appreciate. As a country's currency is appreciating, a huge amount of international hot money will flow into the country in order to profit from this currency appreciation. The hot money may also target the stock market, which will result in pushing up the stock price in accordance with the theory of supply and demand. When a country's economy is contracting, its stock market tends to go down. In order to stimulate the economy, the central bank may try to cut interest rates in order to reduce the cost of raising funds to firms. Furthermore, the central bank may also buy back government bonds, lower banks reserve ratio to pump more money into the economy. These activities will affect exchange rates negatively. They will also result in capital outflow making the depreciation worse. As these funds leave the stock market, it will result in a decline in the stock market as well.

From both the macroeconomic and microeconomic perspectives, one may expect a lag between the movements of stock price and exchange rates. A fluctuation in the exchange rate will affect trade and capital account sections of the country's balance of payment, resulting in a change in domestic stock prices. The stock prices changes may not react immediately to a change in the exchange rate since it takes time for capital to flow (Soenen and Henningar, 1988).

In this research, we will investigate the interactions between stock market prices and the exchange rates for the New Zealand market during the six year period from 2003 to 2008. We examine the long run and short relationships between the different sectors of the stock market in New Zealand and the major New Zealand exchange rates. We also examine whether larger, medium or smaller size firms react to exchange rates more? We also study the relationship between particular industries and the relevant exchange rate pairs. In the short run, is there any Granger-Causality between exchange rates and each sector of stock market? Our research complements insights gained from earlier studies by examining the

relationship between exchange rates and New Zealand stock market in greater details with more recent data. In addressing these research questions, the remainder of the report is organised into the following five sections; Section two contains the literature review and summarises previous studies in this area; Section three provides details regarding data description; Section four discusses our research methodology, focussing on the models which are used to carry out data analysis; Section five is devoted to an analysis of our results; Section six presents our conclusions; The final section lists limitations of this study.

2 Literature Review

The interrelationship between stock market and exchange rate has been studied in many ways. Researchers have used four major techniques to study the relationship between the stock market and exchange rates. The first approach is to use a simple regression between exchange rate market and stock market to investigate this interrelationship. Soenen and Hennigar (1988) investigate how exchange rate changes of the U.S. dollar affect U.S. stock prices. They regressed the change of stock market return on the change of effective exchange rate of U.S. dollar. Their results show that depreciation of the U.S. dollar resulted in a contemporaneous rise in U.S. stock prices. Their result is inconsistent with previous findings of studies that show that investments become more attractive as the home currency appreciates. Soenen and Hennigar also examined that whether there exists a lag between the change of stock price and change of exchange rate. They argued that the higher cost of import will affect the country's balance of payment account after the depreciation of home currency. They examine 12, 18, 24 and 36 month time lags. The results show no significant impact for 18, and 24 month lags based on F-statistics. They show significant results only for the 36month lag at a 5% level.

The second approach involves measuring the foreign exchange exposure on the return of the stock. Jorion (1990) estimates currency sensitivities for the universe of

US Multinationals over the period 1971-1987. He found that only 5% of total numbers of firms in his sample has a significant currency exposure. Diermeier and Solnik (2001) compared the stock factor of domestic firms with the stock factor of non-domestic firms. They find that the ratio of foreign sales has impact on the relation between the non-domestic stock market factor and the currency risk factor. The result is consistent with theoretical expectation. Foreign exchange rate has more impact on the net income of non-domestic firms as compared to domestic firms.

The third method uses a multifactor arbitrage pricing theory type of model. Hsing and Loo (1996) use this approach to investigate whether there is linkage between foreign exchange risk and common stock return for U.S., Canada, England and Japan. Their multi-factor arbitrage pricing theory model is specified as:

$$E(R)_{kt} = E(r)_k + \beta_{kw}E(r)_{wt} + \beta_{km}E(r)_{mt} + \beta_{ke}E(r)_{et} \quad (1)$$

APT model shows $E(R)_{kt}$, the expected return of a stock in country “k”, depends on expect returns from assets invested ($E(r)_k$), expect returns from world market ($E(r)_{wt}$), expect returns from national market ($E(r)_{mt}$) and expect return from foreign exchange rate ($E(r)_{et}$). β_{kw} , β_{km} , and β_{ke} are the sensitivities of the expect asset’s return to the expect returns of the world market, national market and foreign exchange rate respectively. Hsing and Loo set the restriction on the parameters in order to find whether there is significant effect on common stock returns from foreign exchange rate. First, Hsing and Loo used time-series ARIMA model to extract the white noises from the series of exchange rate movements to remove unanticipated shocks. Then, they checked the lags from 1 to 24 to test autocorrelation for each exchange rate series. They observed no autocorrelations and partial autocorrelations. Then, the likelihood ratio test was carried out on each β . Their results show the β of world market and national market are significant at 5% level while most of the β s of foreign exchange rate are also significant at the 5% level. Hsing and Loo’s results indicate that foreign exchange rate plays an important role in investors’ decisions. Their decisions in turn will affect the supply of funds

invested in the stock market. Therefore the linkage between foreign exchange rate and stock market is empirically supported.

Instead of examining the interrelationship between stock market and exchange rates in a few developed countries, Kroon and Veen (2004) have examined the currency sensitivity of global stocks. They select 1691 stocks from 24 countries over the 1996-2002 periods. They focus on the stocks' foreign currency exposures and use APT model to test it. They argue that the market indices are sensitive to currency movements. They regress the returns of indices against exchange rates. The coefficients in the regression are significant and therefore support their hypothesis. Using APT model they find that only 16% (278 companies) of all companies in the sample had one or more significant currency exposures. Their results are inconsistent with that of Hsing and Loo (1996)'s result that most companies have foreign exchange exposures. Kroon and Veen also grouped the result by the companies' regions. It shows that North America has the largest percentage of companies that have significant stock specific currency exposure (19% of North American companies have significant result), followed by European region (17%), Japan (14%) and Pacific except Japan (11%). The result by industry level shows that Capital Goods, Food & Staples Retailing, Insurance, Materials and Technology Hardware & Equipment industries have stock specific currency exposures. They also examine the size effect on stock specific currency exposures. However, their result shows no significant impact of firm size. Lastly, Kroon and Veen examine the impact of a country's openness on its currency exposure. They define the openness of a country as the sum of the exports and imports, as a percentage of GDP. They find that openness is not significant.

The fourth approach is to use cointegration and Granger causality tests. Horobet, Alexandra and Ilie, Iulia (2007) examine the dynamic link between stock prices and exchange rates in the small open eastern European country of Romania. They applied bivariate cointegration and Granger causality tests on daily and monthly

exchange rates and stock prices data over the 1999 to 2007 period after checking the unit roots with Augmented Dickey-Fuller tests. Two methods are used to run the cointegration. First, they used Engle-Granger two steps method which examines the unit root of the residuals that are generated by the regression between exchange rates and stock prices. No cointegration is reported for the whole sample period or the two sub-periods. Then, Johansen-Juselius cointegration test is used, and some cointegrations are found in the whole period and two sub-periods. They then used Granger-Causality test to check the short run relationship for those variables that are not cointegrated and found uni-directional causality from stock market to exchange rates for the whole period and the second sub-period, bidirectional causation is identified in the first sub-period. For testing the cointegrated variables, the authors used modified Granger causality tests that include error correction terms. The result of this modified Granger causality test shows that exchange rates lead the stock prices. They also find that stock market adjusts quite dramatically to changes in the exchange rates in a month.

Ajayi, Friedman & Mehdian (1998) study the relationship between exchange rates and stock markets for a set of developed countries and emerging Asian countries. Granger-Causality test is used on both daily and weekly data. Seven developed markets and eight Asian emerging markets are included in their study. They firstly run the unit root test with Dickey-Fuller test and find all data are stationary at first difference. Then, Akaike's final prediction error criterion (FPE) is used to select the optimal lag length. They found the optimal lag length is lag 5, which is consistent with Malliaris and Urrutia (1992). Ajayi, Friedman & Mehdian find uni-directional causality from stock return to the movement of exchange rates in all six advanced markets in both daily and weekly analysis. The daily data result shows three emerging Asian markets have uni-directional causality and four emerging Asian markets have no causality relationship, and one emerging country has bi-directional causality. However, only two emerging Asian markets have uni-directional causality from stock to currency and no causality is found for the rest of the markets. Their

findings indicate that currency market and stock market are well integrated in developed markets but not in emerging Asian markets. The authors argue that the smaller size, the lower access to foreign investors, and the higher concentration found in emerging Asian markets contributes to the different causality results as compared to developed markets.

Phylaktis and Ravazollo (2005) examine the long run and short run relationship between stock prices and exchange rates in Pacific basin countries. Cointegration and multivariate Granger causality tests are used to investigate this relationship for the period of 1980 to 1998. Their results indicate that a positive relationship exists in these markets. Abdall and Murinde (1997) carried out very detailed examination of the interactions between exchange rates and stock prices in the emerging market of Asia and Pacific basin regions. The sample period is from 1985 to 1994. The authors focus on Asian emerging markets because of their expansion in international trade and adoption of freely floating exchange rate. Abdall and Murinde first checked the stationarity and the order of integration of their variables with augmented Dickey-Fuller tests. Their results show that all their variables are I(1) series. Then, cointegration tests are run and it found cointegration in India and Philippine markets, but no cointegration is found in Korea and Pakistan markets. Two different methods were used to exam in their study. The standard Granger-Causality test method is used on Korean and Pakistani markets, and error correction model (ECM) is used on the Indian and Philippine markets. The authors argued that the reason why two different methods are used is that Granger-Causality tests can not be used for variables which have cointegration. In order to make sure that the Granger-Causality model to be used is free from conventional econometric problems, they checked for heteroscedasticity problems using White, Glejser and Ramsey tests, as well as the Lagrange Muttiplier test for checking autocorrelation with. They report no autocorrelation and heteroscedasticity problems. They next test the equation for structural break in order to examine whether the relationship between stock price and exchange rate holds over the entire sample period. Chow's

structural break test is used and the F-statistic shows no structural break for all the variables. After running the above tests, Granger-Causality test is carried out, and the results show that there exists uni-directional Granger-Causality from exchange rate to stock prices in Korean and Pakistani markets. ECM results indicate that India also has uni-directional causality from exchange rates to stock price, but there is uni-directional causality from stock prices to exchange rates in Philippines.

Some scholars have focused on the openness of the country's economy in examining the relationship between stock market and exchange rates. Friberg and Nydahl (1999) have focused on the degree of openness of a country's economy and the relationship with currency risk of listed firms. They analysed 13 stock market indices over the 1973-1996 period. As expected, their result shows that the openness of country's economy is positively correlated to the currency sensitivity of the country's stock market. Gavin (1989) focused on the relationship between exchange rate and stock market of the small open economy. He found evidence of an interaction of output, profitability, stock prices and aggregate demand tends to dampen the exchange rate. Wu (2000) found that Singapore's stock market forms a cointegrating relationship with changes in the exchange rate.

Most of existing studies have focused on large economies such as U.S. or Europe, or emerging markets in Asia. There are not many studies that investigate small developed economies such as New Zealand in detail. New Zealand is a small open developed economy in the Pacific basin region. The nature of New Zealand economy makes it different from U.S. and other Asian countries which are also in this region and have been already studied. As documented by Friberg and Nydahl (1999) and Gavin (1989), the relationship between exchange rates and stock market exists in a small open developed economy. This notion is confirmed by Obben, Pech and Shakur (2006). They investigated NZX All and MidCap 30 of New Zealand stock market with USD, AUD, JPY, GBP and EUR in the period from 1st January 1999 to 30th June 2006. They firstly checked the unit root of each variable

and found GBP and EUR are I(2) and others are I(1). For brevity, authors concluded that all the variables are I(1). Then, Johansen cointegration test was implemented to investigate long run relationships among the variables. They found bi-direction of that an increase in the NZX All leads to an appreciation of the NZD against the US dollar and an appreciation of the NZD against the US or Australian dollars stimulates New Zealand stock market. EUR and JPY do not have significant long run relationship with New Zealand share market. Appreciation of the NZD against GBP depresses New Zealand stock market. In short run, Error Correction Models are used. They found an increase in NZX All in one period leads to an appreciation of the NZD against all the currencies in the next period. An autonomous appreciation of the NZD against the Australian dollar depresses the New Zealand share market. Obben and Shakur (2006) only investigate two major indices of New Zealand stock market with exchange rates. However the details of New Zealand stock market such as different industries are not investigated. This research investigates the relationships between exchange rates and New Zealand stock market in more details. The relationships between each industry in New Zealand stock market and exchange rates are also investigated as well as NZX All, 10, 15, 50, Mid and Sml. Beside that, different methodologies and data frequencies from Obben, Pech and Shakur (2006)'s study are used to investigate both long run and short run relationship in this research.

3 DATA DESCRIPTION

3.1 Definition of the data

The period of this study runs from 1st June 2003 – 31st May 2008. We use two data sets: the first one contains exchange rate variables and the second one contains stock index data. During this period both the New Zealand dollar and the New Zealand stock market experienced volatile movements. Thus the choice of this period enables us to fully investigate the relationship between New Zealand stock market and exchange rates.

The first data set contains three variables: exchange rate between U.S. Dollar and New Zealand Dollar (USD/NZD); exchange rate between Australia Dollar and New Zealand Dollar (AUD/NZD); exchange rate between U.S. Dollar and Australia Dollar (USD/AUD). The reason to include the exchange rate of USD/AUD is that many NZ listed companies have operation in Australia. The fluctuation of the exchange rate of USD/AUD may have impact on Australian economy, which will affect the performance of these NZ companies.

The second set is New Zealand stock market data and it is classified on the basis of size, foreign exposure and sector into different groups.

First classification classifies NZSX by companies' size. It includes the following variables: NZX All, which comprises all domestic equity securities listed on the NZSX market. It is a value-weighted index. NZX 10, which is the index of top 10 listed companies and it is a "country" index which excludes overseas stocks; NZX 15, which is the 15 largest and most liquid domestic securities listed on NZSX Market. The constituent companies are reviewed every six months; NZX 50, which is the top 50 companies listed on the NZSX Market, either domestic or overseas securities. NZX 10, 15 and 50 are mutually inclusive sectors; NZX MID includes New Zealand's medium sized companies. NZX MID comprises all of the domestic constituents of the NZX 50 and excluding companies included in the NZX 10; NZX SML, which includes all domestic equity securities listed on the NZSX, excluding those included in the NZX 50. The market capitals of these sectors are available from NZX – Deep Archive Service web page.

The second classification is done on the basis of the country of operations of each firm. This categorisation has been done by the author. There are three groups that are formed on the basis of this classification: Local, Non-Local-Australia, and Non-Local World. Local, includes all companies listed in NZSX Market which has no direct overseas operations such as direct sales/purchase to/from overseas

clients, and overseas' branches. For each company, we compute market capitalization by multiplying the total ordinary shares outstanding at the end of previous financial accounting year by the company's daily share price (dividend adjusted closing price). We sum each company's daily market capitalization to get the aggregate market capitalisation of all Local Firms. The next group is Non-local-Australia, which includes companies that are directly related to Australia. Companies that have branches in Australia and/or have direct sales or purchases to/from Australia are included in this group. The last group is Non-local- world, which includes companies that are excluded in "Local" and "Non-local-Australia". The value of "Non-local-World" and "Non-local-Australia" are calculated in the same way as used for "Local". The details of this classification are summarised in Appendix Table I. The details of the listed companies' operations are available from "Company Profile" section from Deep Archive Service web page.

The last classification is based on sectoral grouping. NZ economy can be divided into 6 sectors and 13 sub-sectors. The six sectors are the Primary sector, Goods sector, Service sector, Energy sector, Property sector and Investment sector. The primary sector includes the Agriculture sub-sector, the Building sub-sector, the Mining sub-sector and the Forestry sub-sector. The Goods sector includes the Food sub-sector, the Textiles sub-sector and the Intermediate & Durable sub-sector. The Service sector includes the Consumer sub-sector, the Finance sub-sector, the Leisure sub-sector, the Media sub-sector, the Ports sub-sector and the Transport sub-sector. The market capital of each of these variables is available from NZX – Deep Archive Service web page.

3.2 Interpretation of the data

The following figures present the fluctuation of three exchange rates and the weight of market capitalization of each variable from above three classifications. It helps to provide a clear view of which variable is more important in New Zealand Stock Market. The market capitalisation at the end of the sample period (30/May/2008) is

used for each variable from the three classifications.

Figure i: Time plot of exchange rate USD/NZD

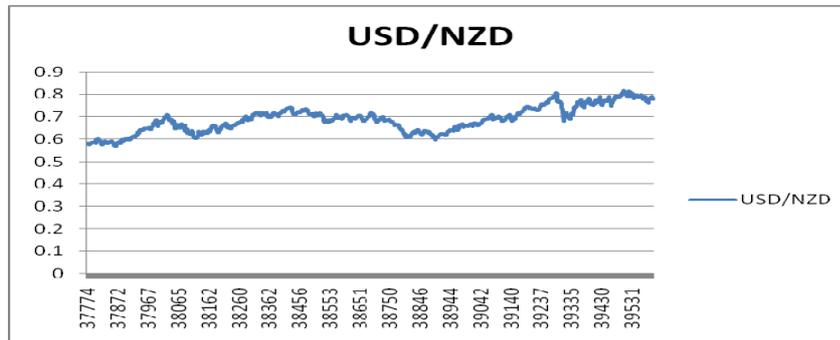


Figure ii: Time plot of exchange rate AUD/NZD

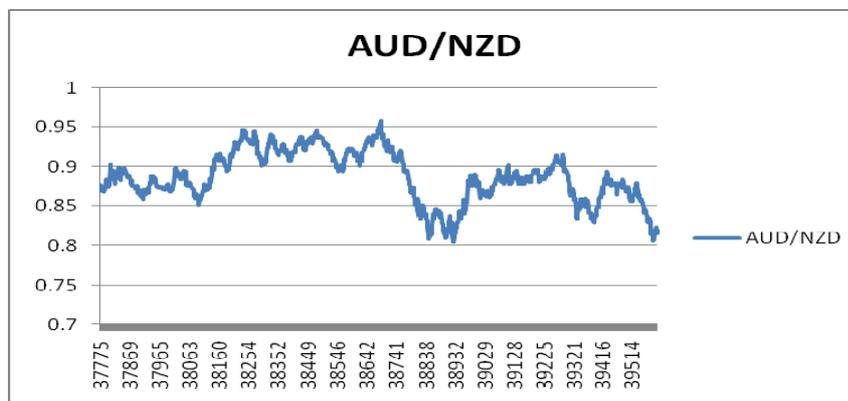
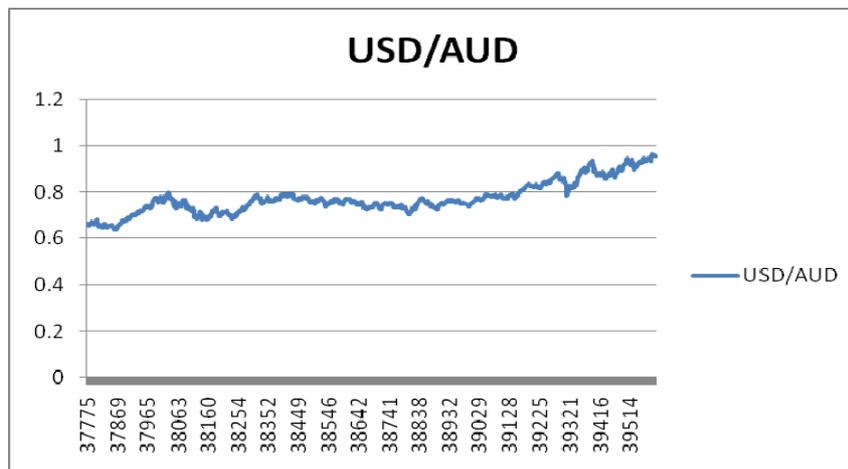
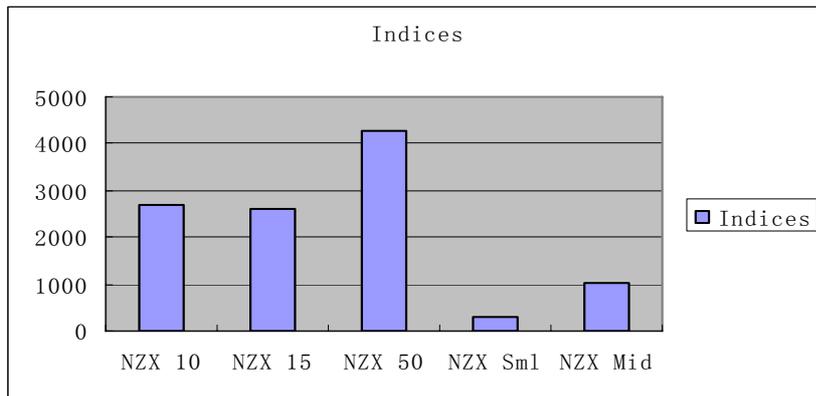


Figure iii: Time plot of exchange rate USD/AUD



In figure i and iii it can be observed that the main trends of USD/NZD and USD/AUD are both upward, and the trend of AUD/NZD is more mixed in figure ii.

Figure 1: Market capitalizations comparison among sectors in first classification



In figure 1, the market capitalization of each variable in first classification is compared. It is easy to see NZX 50's market capitalization is much more than others. Market capitalizations of NZX 10 and 15 are very close to each others. NZX Sml has the smallest market capitalization. If NZX All has any relationship with exchange rates, it is expected that NZX 50 should contribute the most into this relationship than other sectors as it contains both large and medium sizes companies listed in NZSX and it also has the largest market capitalizations than others. The constituents of NZX 10 and 15 are very similar to each other, which brings the expectation of similar results in the relationships with exchange rates.

The variables from the other two classifications are mutually exclusive. The “pie” graphs are used to present the weights of market capitalizations of these variables.

Figure 2: Weights of market capitalizations of sectors in second classification

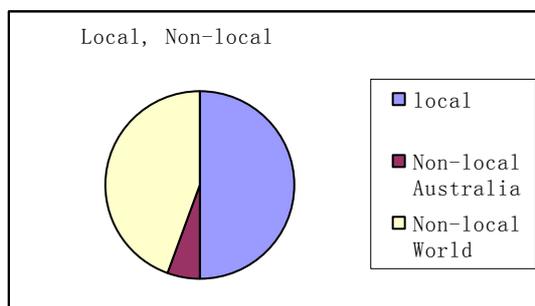


Figure 2 presents the weights of market capitalizations of local, non-local Australia and non-local world. More than half weight of market capitalization is from firms which operate domestically. Non-local world seems to be much larger than non-local Australia. This leads us to expect that NZSX should be more correlated to

USD/NZD than to AUD/NZD and USD/AUD.

Figure 3: Weights of market capitalizations of sectors in third classification

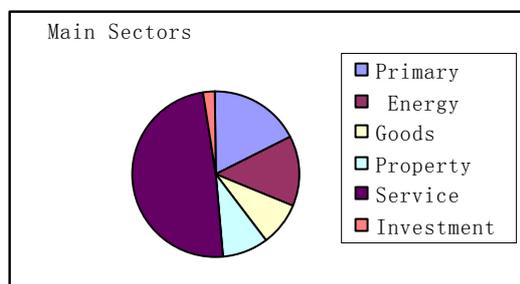


Figure 3 shows the market capitalizations of Primary, Energy, Goods, Property, Service and Investment sectors. In the New Zealand Stock Market, Service sector is the most important sector since it accounts for almost half the market capitalization of the entire stock market, followed by the Primary sector, Energy sector, Property sector, Goods sector and Investment sector. This brings the expectation of that the relationship between the Service sector and exchange rate should have more impact on the relationship between the NZX All and exchange rate than other sectors do. New Zealand is an export orientated country, and Primary products provide most of the export income. From above chart, we can see Primary sector is only the second largest sector in NZSX following Service sector. This indicates that the domestic sector which includes the Service sector plays a much more important role than the exporting sector.

The following charts present the market capitalizations of compositions of the Primary sector, the Goods sector and the Service sector.

Figure 4: Weights of market capitalizations of sub-sectors in the Primary sector

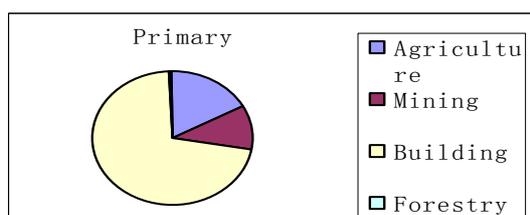


Figure 5: Weights of market capitalizations of sub-sectors in the Goods sector

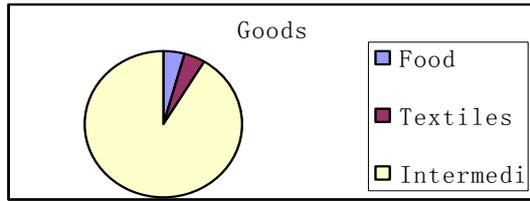
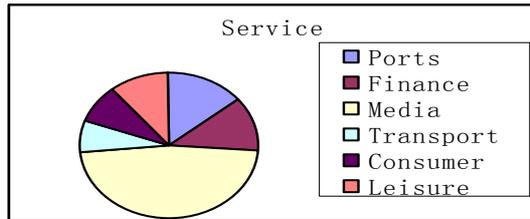


Figure 6: Weights of market capitalizations of sub-sectors in the Service sector



In our study, we investigate the relationships between exchange rates and the main sectors and their sub-sectors. It is worth to look at the relationship between the main sectors and their sub-sectors. The relationship between exchange rates and Primary sector should be similar to the relationship between exchange rates and Building sub-sector since almost 75% of Primary sector is contributed by Building sub-sector. For the same reason, Intermediate & Durable sub-sector and Media sub-sector should have similar results as Goods sector and Service sector.

4 Research Methodology

The objective of this study is to examine if there exists a significant relationship between the stock market and exchange rates. First, we use Pearson's pair wise correlation to examine the strength of the relationship between NZSX and exchange rates. Then, we conduct unit root test before performing linear regression. If the variables included in linear regression are non-stationary, then the F test statistic will have non-standard distribution. Any "shock" to a non-stationary series will persist in the system which will affect the analysis and lead to spurious results. On the other hand, the effect of any "shock" will gradually disappear in a stationary series that makes results more meaningful. Therefore the stationarity of each

variable is required to be examined. The Augmented Dickey-Fuller (ADF) unit root test is applied to examine the stationarity of each variable in this study. This test consists of regressing each series on its own lagged value and lagged difference terms. The ADF tests involve the estimation of the following regression:

$$\Delta x_t = \alpha + \beta t + \delta x_{t-1} + \sum \Delta x_{t-1} + \varepsilon \quad (2)$$

where “x” is the test variable, “ x_{t-1} ” is x’s own lagged value with coefficient “ δ ”, “ Δx_{t-1} ” is x’s lagged difference terms and “ ε ” is the error term.

Variable X is stationary if $\beta=0$ and $|\delta| < 1$; if $\beta=0$ and $\delta = 1$, variable X is I (1) series. Variable X is trend stationary series if $\beta \neq 0$ and $|\delta| < 1$. The null hypothesis in ADF test is that series contains a unit root against the alternative hypothesis that the series is stationary.

We use Akaike information criterion to determine the number of lagged differences that are required in the regression. If the variables have unit root at the level, we need to check their first differences. Most financial data are I(1) series and their first differences are stationary. After checking the stationarity of variables, we use the cointegration test and Granger causality test to detect the relationship between exchange rates and stock markets,

Engle and Granger (1987) developed the concept of cointegration. Generally speaking, I(1) variables should be differenced to make them to be I(0) before including them in linear regression in order to avoid spurious results. Engle and Granger discussed that the regression result of two I(1) variables might not be spurious if these two variables are cointegrated. If y_t and x_t are two I(1) variables, a combination of y_t and x_t , such as $y_t - \beta x_t$, is also I(1) for any number β . However there may be a case in which $\beta \neq 0$ and $y_t - \beta x_t$ is I(0) rather than I(1). In such a case, there is a constant mean, variance and the time distance between any two variables in the series is the only basis of autocorrelation. If there exists a β that makes the above case hold, then we say that series y_t and x_t are cointegrated and β

is cointegrating parameter. In this case, the result of regression of y_t on x_t is not spurious. Cointegration indicates long run relationship between two variables. Most financial data are non-stationary and are related to the same influences (e.g. supply demand forces, investors' confidence etc) which make them move together in time. Therefore these data are related to each other in the long run.

There are several methodologies available to run the cointegration test. In our study we use two different methodologies to investigate the interaction between exchange rates and New Zealand stock market. The first method is called the Engle-Granger test approach. This method first uses the OLS regression to estimate the parameters of the following model between exchange rate and stock market:

$$y_t = \beta_1 + \beta_2 x_{2t} + \beta_3 x_{3t} + \dots + u_t \quad (3)$$

The second step in this method involves testing the unit root on the residuals of u_t by estimating the following regression:

$$\Delta u_t = \psi u_{t-1} + v_t \quad (4)$$

If the results of the unit root test indicate the rejection of the null hypothesis of non-stationarity, we conclude that the exchange rate and stock market are cointegrated. In another words, there is a long run relationship between exchange rate and stock market. One draw back of this Residuals-based approach is that it is capable of testing at most one cointegrating relationship. If there are multi variables in the system, this method will fail to test all possible cointegrating relationships.

The second method is Johansen's cointegration test. Johansen's cointegration test uses the maximum likelihood estimation in a VAR model. There are two statistics generated by this method: the trace statistic and maximum Eigenvalue. The Trace statistic tests the null hypothesis that there is at most r number of cointegrating vectors against hypothesis of r or more than r number of cointegrating vectors. The maximum Eigenvalue statistics tests for r number of cointegrating vectors against the hypothesis of $r + 1$ number of cointegrating vectors. The Johansen's cointegration test will show if there exists a long run relationship between exchange

rates and NZSX Market. There are two possible situations when we examine the short run relationship. The first situation is that the two variables are cointegrated in long run, and second situation is they are not cointegrated.

If two variables are not cointegrated, we can apply the Granger causality test (Granger, 1969) to check the short run relationship between variables. The Granger causality test checks whether variable Y's current value can be explained by its own past value and whether the explanatory power could be improved by adding the past value of another variable X. If the coefficient of X is statistically significant, X is said to Granger cause Y. The model for Granger causality test is as following:

$$Y_t = \alpha_0 + \sum \alpha_k Y_{t-k} + \sum \beta_t X_{t-k} + u \quad (5)$$

$$X_t = \varphi_0 + \sum \varphi_k X_{t-k} + \sum \omega_t Y_{t-k} + v \quad (6)$$

Where α , β , φ and ω are the coefficients of X and Y, u and v are residuals with the mean equals to zero and $\sigma^2 < \infty$. The null hypothesis that X_t doesn't Granger-cause Y_t is rejected if β_t 's, $k > 0$ in equation (4) are jointly significantly different from zero by using the F-test. The null hypothesis that Y_t doesn't Granger-cause X_t is rejected if ω_t 's, $k > 0$ in equation (5) are jointly significantly different from zero by using F-test. If both β_t 's, $k > 0$ and ω_t 's, $k > 0$ are jointly significantly different from zero, then there is bi-directional causality between X and Y. In our study, we use the first difference of log of exchange rates and log of stock market variables to perform Granger causality tests. The equation (5) & (6) will be like:

$$\Delta \text{Exchange rates}_{(t)} = \alpha_{(0)} + \sum \alpha_{(k)} \Delta \text{Exchange rates}_{(t-k)} + \sum \beta_t \Delta \text{Stock}_{(t-k)} + u \quad (7)$$

$$\Delta \text{Stock}_{(t)} = \varphi_{(0)} + \sum \varphi_{(k)} \Delta \text{Stock}_{(t-k)} + \sum \omega_{(t)} \Delta \text{Exchange rates}_{(t-k)} + v \quad (8)$$

Another situation that is possible is that the two variables are cointegrated. If the two variables are cointegrated, then there must be either uni-directional or bi-directional causality. That's because Granger causality tests are well specified if they are applied in a standard vector autoregressive form to first differenced data only for non-cointegrated variables (MacDonald and Kearney, 1987; Miller and

Russeck, 1990). An Error Correction Term is required as extra explanatory variable to correctly specify the Granger test. Error Correction Term is the residual generated from the cointegrating regression. The models used in our study are as following:

$$\Delta \text{Exchange rates}_{(t)} = \alpha_{(0)} + \sum \alpha_{(k)} \Delta \text{Exchange rates}_{(t-k)} + \sum \beta_t \Delta \text{Stock}_{(t-k)} + \lambda \text{ECT}_{t-1} + u \quad (9)$$

$$\Delta \text{Stock}_{(t)} = \varphi_{(0)} + \sum \varphi_{(k)} \Delta \text{Stock}_{(t-k)} + \sum \omega_{(t)} \Delta \text{Exchange rates}_{(t-k)} + \chi \text{ECT}_{t-1} + v \quad (10)$$

The ECT_{t-1} in equation (9) is the residual from the cointegrating regression where exchange rate is the dependent variable and stock market variable is independent variable, and the ECT_{t-1} in equation (10) is based on the model with stock market as the dependent variable. If λ and χ are statistically significant, then it means that exchange rates adjust towards their long-run levels.

The Granger causality test is very sensitive to the lags used in the OLS regressions (Gujarati, 2003; Hamilton, 1994; Wooldridge, 2006). In our study, various lag length selection criteria are used in order to pick up the lags for Granger causality test. The teste we use are (1) LR – sequential modified LR test statistic, (2) FPE – Final prediction error, (3) AIC – Akaike information criterion, (4) SC – Schwarz information criterion and (5) HQ – Hannah-Quinn information criterion. The VAR test is used to identify the number of lags given by each of these lag length selection criteria. These methods may not always generate the same result, therefore we run the Granger causality tests with all the lag lengths denoted by each one of these methods.

5 Results Analysis

In this section, correlations between New Zealand stock market and exchange rates of USD/NZD, AUD/NZD and USD/AUD will be reported and interpreted first in sub-section 5.1. In sub-section 5.2, unit root tests' results are reported. Long run relationship test results are present and discussed in sub-section 5.3. Sub-section 5.4 present the lag length selection results and short run Granger-Causality tests' results are reported and discussed in sub-section 5.5 finally.

5.1 Correlation

First, the correlations between each of the sectors from stock market and exchange rates are checked by Pearson's pair wise correlation method. The results are presented in Table 1a and 1b in order to give some idea about the direction and strength of relationship between stock sectors and exchange rates before further relationship tests.

Table 1a: Daily correlations between each sector of New Zealand stock market and three exchange rates

Daily Correlations	USD/NZD	AUD/NZD	USD/AUD
Classification One			
nzx 10	0.304324	0.293541	0.170163
nzx 15	0.570591	-0.16304	0.61963
nzx 50	0.533023	-0.02877	0.526782
nzx all	-0.16813	0.031154	-0.17546
nzx mid	-0.25004	-0.31131	-0.11025
nzx sml	-0.47631	0.177094	-0.53452
Classification Two			
local	0.572669	0.086865	0.517132
Non-Local-Australia	0.27723	0.028544	0.256123
Non-Local-World	0.568081	-0.08784	0.587385
Sectors of the Economy			
Primary Sector			
agriculture	0.25785	-0.2514	0.354838
building	-0.30665	-0.29884	-0.17042
forestry	0.623669	-0.28555	0.722522
mining	-0.56595	0.541775	-0.77459
	0.769172	-0.2848	0.862739

Goods Sector	-0.01111	-0.25343	0.095912
food	-0.34859	-0.50267	-0.12515
Intermediate & Durable	0.208727	-0.30472	0.329823
textiles	-0.44182	0.5514	-0.65876
Service sector	-0.47014	0.418804	-0.63031
consumer	-0.4803	-0.13588	-0.4067
finance	-0.05325	0.390539	-0.21578
leisure	-0.12873	-0.27588	-0.00823
media	-0.48504	0.638909	-0.73732
ports	-0.042	-0.10814	0.004941
transport	0.008801	-0.36356	0.16149
Energy Sector	-0.06862	-0.35918	0.084874
Property Sector	0.570339	-0.37575	0.70897
Investment Sector	0.642013	-0.11968	0.670439

Table 1b: Weekly correlations between each sector of New Zealand stock market and three exchange rates

Weekly Correlations	USD/NZD	AUD/NZD	USD/AUD
Classification One			
nzx 10	0.300782	0.285813	0.166102
nzx 15	0.571292	-0.158828	0.615688
nzx 50	0.534364	-0.024966	0.522662
nzx all	-0.17426	0.022495	-0.17221
nzx mid	-0.25404	-0.309807	-0.1097
nzx sml	-0.47878	0.168652	-0.52624
Classification Two			
local	0.577949	0.094121	0.516564
non-local-Australia	0.28437	0.02564	0.26212
non-local-world	0.565013	0.036821	0.528541
Sectors of the Economy			
Primary Sector	0.25697	-0.25603	0.35962
agriculture	-0.31778	-0.301112	-0.17423
building	0.627622	-0.280478	0.722616
forestry	-0.56891	0.535532	-0.77463
mining	0.771428	-0.281378	0.860299
Goods Sector	-0.01022	-0.25329	0.09507
food	-0.34543	-0.506018	-0.11427
Intermediate & Durable	0.209188	-0.300691	0.326259
textiles	-0.44228	0.543981	-0.66006

Service sector	-0.47493	0.407373	-0.62664
consumer	-0.48489	-0.137333	-0.40144
finance	-0.05545	0.384115	-0.21933
leisure	-0.13949	-0.26657	-0.02001
media	-0.4889	0.627668	-0.736
ports	-0.05783	-0.107121	-0.00547
transport	0.00472	-0.368624	0.166928
Energy Sector	-0.07079	-0.366147	0.094241
Property Sector	0.571718	-0.373186	0.710335
Investment Sector	0.645389	-0.118838	0.672653

In first classification, NZX All has a weak negative correlation to USD/NZD and USD/AUD and very weak positive correlation to AUD/NZD. New Zealand economy is mainly based on exports and imports activities, this brings expectation that the entire New Zealand stock market (NZX All) should strongly correlate to foreign exchange rates. However this expectation can not be confirmed by correlation results between NZX All and three exchange rates here. One reason why NZX All is not correlated to exchange rates as our expectations is that most companies which are related to imports and exports activities could have already hedged their foreign exchange exposures. Therefore, it is possible that the entire market value is not affected by the fluctuation of exchange rates. Another possible reason is that the companies with strong exports may gain when New Zealand dollar is weak, however those companies which import substantially may suffer when New Zealand dollar is weak. The gain may be offset by the loss and therefore there is no overall effect. NZX All is expected to have similar result as compared to NZX 10, 15 and 50 since these indices contain stocks with the largest market capitalizations in NZSX. However, NZX All's correlation results are quite different from NZX 10, 15 and 50. NZX 15 and 50 both have moderate positive correlations with USD/NZD and USD/AUD and weak negative correlations with AUD/NZD. NZX 10 has weak positive correlations with all three exchange rates. Small and medium sizes of companies have negative correlation to USD/NZD and USD/AUD whereas larger size companies have positive correlation to USD/NZD and

USD/AUD. It suggests the smaller and medium sizes of companies in NZSX will be negatively affected by the up movement of USD/NZD and USD/AUD, and the larger size of companies will be positively affected by the up movement of these two exchange rates. The result for AUD/NZD is mixed. NZX All includes all large, medium and small sizes firms, and the opposite correlation results between large size firms and medium & small size firms may cause NZX All's correlation with exchange rates to be weak.

In second classification, the results are surprising. Local sector and non-local-world sector both have moderate positive correlations with both USD/NZD and USD/AUD. These two sectors are supposed to have negative correlation to exchange rates since the appreciation of domestic currency will boost imports which in turn will hurt domestic firms' sales. Also the profit from overseas operation will be less when converted into New Zealand Dollar when the New Zealand Dollar appreciates. However the correlation results don't support this point in our data. When New Zealand dollar gets stronger against USD, it may attract investment capital from overseas into New Zealand market. This may push up the market value of firms in New Zealand if these funds are invested in stock market. This may be a reason why local and non-local world sectors' values are positively correlated to USD/NZD. It has also been noticed that many New Zealand firms have operations in Australia. This leads us to expect that businesses that have operation in Australia should have a strong correlation with AUD/NZD rather than with USD/NZD since the profits or cost are measured in Australia Dollars. The appreciation of Australian Dollar against New Zealand Dollar should affect non-local-Australia sector positively. However, our result shows that non-local-Australia has a very weak positive correlation with AUD/NZD, and a weak positive correlation with USD/NZD. This may due to the hedging of foreign exchange risk by those firms included in non-local-Australia sectors, and the amounts of investment capital that flows from Australia into New Zealand.

There are several sectors in third classification. The Primary sector has positive

weak correlations with USD/NZD and USD/AUD, a negative weak correlation with AUD/NZD. Its two main sub-sectors are: Building sub-sector and Mining sub-sector and both have semi-strong and strong positive correlations to USD/NZD and USD/AUD. The opposite signs of correlations between Building & Mining sub-sectors and Agriculture & Forestry sub-sectors with USD/NZD and USD/AUD may cause the relationship between Primary sector and the exchange rates to become weaker. The mineral products are priced by using U.S. Dollar internationally. Australia and New Zealand are known as “Commodity” countries whose market values are sensitive to USD. The result shows that the Mining sub-sector has the strong correlation to the exchange rate of USD/AUD and USD/NZD. Most of New Zealand’s mining companies have operations in Australia. The higher USD/AUD will negatively affect the value of these firm’s Australian parts which measures value in Australian dollar. Therefore, a strong negative correlation between the Mining sub-sector and USD/AUD is expected. Higher USD/NZD also negatively affects value of these firm’s New Zealand parts and a strong negative correlation between the Mining sub-sector and USD/NZD is expected. However our correlation results show strong positive correlations between the Mining sub-sector to both USD/AUD and USD/NZD. The strong New Zealand dollar attracts investments and also boosts real estate markets, which may positively relate building sub-sector to USD/NZD. The expansion of New Zealand economy will cause the New Zealand dollar to become stronger, meanwhile the domestic demand on mineral products may increase due to the expansion, therefore it may drive positive correlation between mining sub-sector and USD/NZD.

The Goods sector has weak correlations with all three exchange rates. The weak positive correlation of Intermediate & Durable sub-sector with USD/NZD is offset by the weak negative correlation of the other two sub-sectors, and therefore causes the Goods sector to have weak negative correlation with USD/NZD. The semi-strong negative correlation of Food sub-sector with AUD/NZD is offset by the semi-strong positive correlation of textile sub-sector with AUD/NZD. This makes

the Goods sector to have similar correlation results as its main sub-sector: Intermediate & Durable sub-sector. The strong negative correlation of Textile sub-sector with USD/AUD offsets the weak positive correlation of Intermediate & Durable sub-sector and therefore makes the Goods sector has a negative correlation with USD/AUD. Young (1985) studied U.S. market and found that food sector is not expected move up with appreciation of U.S. Dollar. Soenen and Hennigar (1988) found textile sector in U.S. market is negatively relates to the movement of U.S. Dollar. In our Goods sector, the Food sub-sector includes three companies. All of these three companies have exports to Australian market. This may bring the expectation that lower AUD/NZD has positive effect on the Food sub-sector. Our result shows the Food sub-sector has the weak negative correlation to USD/NZD, moderate negative correlation with AUD/NZD and very weak negative correlation with USD/AUD. This indicates that food sector is not expected to gain when New Zealand Dollar is appreciating against U.S. Dollar and Australian Dollar, which is the same as food sector in U.S. market. Textile sub-sector is negatively related to the movement of New Zealand Dollar in NZSX as well, which is similar to textile sector in U.S. market.

In the service sector, we find moderate negative correlation to USD/NZD and moderate positive correlation to AUD/NZD and semi-strong negative correlation to USD/AUD, which matches the results from its largest sub-sector: Media sub-sector. The most important company of all three listed companies in Media sub-sector is Telecom Corporation of New Zealand Limited which has large operation in Australia since 1999. The market value of Telecom Corporation of New Zealand Limited depends both on the operation in New Zealand and Australia. This may cause Media sub-sector to be strongly and negatively correlated to the exchange rate of AUD/NZD since appreciation of Australian Dollar brings more profit in New Zealand Dollars to New Zealand parent company. Our result does show a semi-strong correlation for Media sub-sector but the sign is positive. It suggests that when New Zealand dollar appreciates against Australian dollar, investors are

expecting more business opportunities for media companies in New Zealand than in Australia due to the better outlook of New Zealand economy than Australian economy. Therefore it makes Media sub-sector have a positive semi-strong correlation with AUD/NZD.

The correlations between Energy sectors and all three exchange rates are weak. We find strong correlations between Property sector & Investment sector and USD/NZD & USD/AUD. It indicates that when either New Zealand dollar or Australian dollar appreciates against U.S. dollar, it brings better outlook of New Zealand economy and therefore stimulates both property and investment industries in New Zealand.

These correlation results only show whether there exists a linear relationship between New Zealand Stock Market and some exchange rates. It doesn't indicate anything about the direction of causality between the New Zealand Stock Market and the exchange rates. To investigate this additional statistical tests are required.

5.2 Unit root

Unit root tests for individual series have been carried out using the Augmented Dickey-Fuller (ADF) test. The “log” value of each variable is used for testing. The results are shown in Table 2a & 2b.

Table 2a: Unit root results for all variables in daily data

DAILY			
	Test Statistic	Test Statistic	Critical Value
	at level	at first Difference	at 5%
USD/NZD	-2.36438	-19.03544	-3.413496
AUD/NZD	-2.411645	-25.31518	-3.413496
USD/AUD	-2.386433	-21.56215	-3.413496
Classification One			
nzx 10	-1.955254	-32.44052	-3.413496
nzx 15	-0.989448	-24.52834	-3.413496
nzx 50	-1.130518	-31.78438	-3.413496

nzx all	-2.426315	-34.86553	-3.413496
nzx mid	-2.129687	-35.2457	-3.413496
nzx sml	-2.666467	-35.14784	-3.413496
Classification Two			
local	-3.163392	-33.81188	-3.413496
Non-local Australia	-1.423397	-34.25365	-3.413496
Non-local world	-2.160124	-34.48592	-3.413496
Sector of the Economy			
Primary Sector	-2.384375	-34.1612	-3.413496
agriculture	-1.579155	-34.25436	-3.413496
building	-0.293487	-32.08782	-3.413496
forestry	-2.308825	-35.18373	-3.413496
mining	-2.123987	-33.90655	-3.413496
Goods Sector	-1.08557	-32.87786	-3.413496
food	-1.920124	-35.41156	-3.413496
intermediate & durable	-0.544708	-32.63591	-3.413496
textiles	-2.520588	-34.08124	-3.413496
Service Sector	-2.52554	-35.82779	-3.413496
consumer	-1.895878	-35.47949	-3.413496
finance	-2.734136	-36.41567	-3.413496
leisure	-2.245439	-21.08093	-3.413496
media	-2.547745	-17.56024	-3.413496
ports	-2.311059	-8.366988	-3.413496
transport	-2.457006	-34.72898	-3.413496
Energy Sector	-2.579738	-34.50857	-3.413496
Investment Sector	-2.463691	-34.69735	-3.413496
Property Sector	-2.086944	-38.16785	-3.413496

As we can see, all variables' statistics at "level" are smaller than the critical value, showing all variables are non-stationary at level. Next column shows variables' statistics at first difference, and it is very obviously that all variables statistics are much larger than the critical value. Therefore all variables are stationary at their first difference and first difference of variables should be used for further cointegration and Granger causality tests.

Table 2b: Unit root results for all variables in weekly data

WEEKLY			
	Test Statistic	Test Statistic	Critical Value
	at level	at first Difference	at 5%
USD/NZD	-2.460096	-13.1748	-3.427271
AUD/NZD	-2.503561	-14.25855	-3.427271
USD/AUD	-2.218661	-15.81852	-3.427271
Classification One			
nzx 10	-1.751895	-17.29024	-3.427271
nzx 15	-0.638759	-16.76022	-3.427271
nzx 50	-0.956648	-16.85384	-3.427271
nzx all	-2.387514	-15.66493	-3.427271
nzx mid	-2.126747	-16.2635	-3.427271
nzx sml	-2.66239	-16.2147	-3.427271
Classification Two			
local	-3.232335	-17.2119	-3.427271
Non-local Australia	-1.537859	-15.71516	-3.427271
Non-local world	-1.926365	-15.97693	-3.427271
Sector of the Economy			
Primary Sector	-2.364418	-15.86402	-3.427271
agriculture	-1.585401	-15.86441	-3.427271
building	0.152069	-16.67909	-3.427271
forestry	-2.290292	-17.12238	-3.427271
mining	-2.850587	-6.634017	-3.427271
Goods Sector	-0.909574	-12.20898	-3.427271
food	-1.911603	-16.38175	-3.427271
intermediate & durable	0.026544	-9.209061	-3.427271
textiles	-2.544548	-16.34594	-3.427271
Service Sector	-2.381084	-15.93734	-3.427271
consumer	-1.866326	-15.90596	-3.427271
finance	-2.604818	-16.2508	-3.427271
leisure	-2.560837	-6.06597	-3.427271
media	-2.402322	-13.03156	-3.427271
ports	-2.416516	-8.252349	-3.427271
transport	-2.483785	-15.92783	-3.427271
Energy Sector	-2.582035	-16.34636	-3.427271
Investment Sector	-2.438364	-15.81537	-3.427271
Property Sector	-2.080355	-15.39965	-3.427271

Similar to the daily data, above weekly data also show that variables are non-stationary at their level and stationary at first difference. Therefore cointegration and Granger causality test for weekly data should also use their first difference.

This unit root test confirmed with the expectation that most log value of financial variables are non-stationary at their level and are stationary by transferring into their first difference.

5.3 Cointegration

In this section, we will investigate the long run relationships between sectors of New Zealand stock market and exchange rates. The cointegration results generated by Engle-Granger two steps methodology and Johansen-Juselius cointegration methodology will be discussed in sub-section 5.3.1 and 5.3.2 respectively. The “log” value of each variable is used for testing.

5.3.1 Engle-Granger Two steps methodology

First, we use Engle-Granger two steps method to test cointegration, which tests the unit root of the residual that generated by establishing the equation between exchange rate and stock market variable. The results are not presented here since we have found all residuals that generated from established equation have unit root. Exchange rate and stock market are not cointegrated if the residual generated by these two variables is non-stationary. Therefore, based on Engle-Granger two steps method, there is no long run relationship between New Zealand stock market and USD/NZD, AUD/NZD and USD/AUD has been detected. We want to see whether the result from Engle-Granger two steps method can be confirmed by Johansen-Juselius methodology.

5.3.2 Johansen-Juselius cointegration methodology

Details of the daily and weekly Johansen-Juselius cointegration test’s results are

presented in Appendix Tables from 1a to 2c in appendix. The Trace and Max-Eigenvalue tests' statistics are less than the critical value for both none and at least one cointegration in all tests. This indicates that we didn't find any significant results that more than zero number of cointegration exists between each sector in New Zealand stock market and three exchange rates. Our Johansen-Juselius cointegration test's results consistent with Engle-Granger two steps test's results that there is no long run relationship between New Zealand stock market and exchange rates in either daily or weekly data.

Obben, Pech and Shakur (2006) have found that there are two cointegrations between NZX All and USD/NZD in weekly data, and one cointegration between AUD/NZD and NZX All, which indicates bi-direction relationships exist between NZX All and USD/NZD and uni-direction relationship exist between AUD/NZD and NZX All in long run. We also expected that the entire New Zealand stock market (NZX All) should cointegrate with exchange rates since the high dependence of New Zealand economy on exports and imports. However our results show no cointegration between the entire New Zealand stock market (NZX All) and exchange rates. One possible reason why our results are so different from our expectation is that some significant results may be offset by other significant results. If some import orientation firms are positively related to exchange rates, this effect could be possibly offset by other export orientation firms which are negatively related to exchange rate and makes the entire market to have no relationship with exchange rates (Offset Effect). Another reason why New Zealand stock market is not related to exchange rate may caused by that most large firms have already hedged their exchange rate risk (Hedge Effect). Therefore it makes the value of firm not to be affected by the fluctuation of exchange rate. The different time periods used between this study and Obben, Pech and Shakur (2006)'s research may make the two results are not consistent.

In details of the New Zealand stock market, none of large, medium or small sizes of

firms are cointegrated with exchange rates. We expect that larger sizes of firms in New Zealand may be affected by movement of exchange rate more than smaller sizes of firms are. Most of large sizes of firms in New Zealand have international transactions which are close to exchange rates. The movement of exchange rate will affect these larger size firms' free cash flows more deeply than smaller size firms'. However our result doesn't support this point. Which indicates that Offset Effect or Hedge Effect is applied to all sizes firms in New Zealand. We also expect some stock prices of sectors such as Primary, Goods, Service sectors and some of their sub-sectors should have more influence from the movement of New Zealand dollar since the firms included in these sectors are more related to sales and purchase to/from overseas. Well, our results indicate that there is no industry cointegrating with exchange rate in long run either. Even Mining sub-sector shows the strongest correlation with USD/NZD and USD/AUD, its cointegration test results are all insignificant. This indicates that correlation can only show Mining sub-sector is correlated with these two exchange rates closely, however it doesn't mean the movement of one variable will lead another variable to move. The results for the Non-local-Australia, Non-local-world and Local are insignificant either. Although we expect Non-local-Australia should have long run relationship with AUD/NZD, the Offset Effect or/and Hedge Effect may make the overall effect to be disappeared.

5.4 Lag length selection

As mentioned in section 4 – Research Methodology, if there is cointegration between two variables, there must be Granger-Causality between the two variables, but not another way around. After testing the cointegration between New Zealand stock market and exchange rates, our conclusion is there is no cointegration between these two areas, in another word, there is no long run relationship between them. Error Correction term is not needed to further investigate the short run relationship between cointegrated variables as none of variables is cointegrated with each other. Next, Granger-Causality test can be

applied to non-cointegrated variables in order to investigate the short run relationship between New Zealand stock market and exchange rates. Before that, the number of lags must be decided since Granger-Causality test is sensitive to the lag length. The details of lag lengths that are picked up by each of lag length selection criteria (LR, FPE, AIC, SC and HQ) are presented in Appendix Tables from 3a to 4c in appendix. All lag lengths suggested by these five criteria will be used in Granger-Causality tests. The summary of the lag length for each sector of New Zealand stock market is reported in Table 3a and 3b:

Table 3a: Summary of suggested lag lengths for daily Granger-Causality tests

Daily	USD/NZD	AUD/NZD	USD/AUD
Classification One			
nzx 10	lag 1, 4	lag 1, 6	lag 1, 2
nzx 15	lag 1, 2, 4	lag 1, 6	lag 1, 2
nzx 50	lag 1, 2, 4	lag 1, 6	lag 1, 2
nzx all	lag 1	lag 1	lag 1
nzx mid	lag 1, 2	lag 1, 2	lag 1
nzx sml	lag 1	lag 1	lag 1
Classification Two			
Local	lag 1, 2	lag 1	lag 1
Non-local Australia	lag 1, 2	lag 1	lag 1, 2
Non-local world	lag 1, 2	lag 1	lag 1
Sector of the Economy			
Primary Sector	lag 1, 2	lag 1	lag 1
agriculture	lag 1	lag 1	lag 1
building	lag 1, 2	lag 1, 2, 6	lag 1, 2
forestry	lag 1, 2	lag 1, 2, 7	lag 1
mining	lag 1, 2	lag 1, 6	lag 1
Goods Sector	lag 1, 3	lag 1, 2, 6	lag 1
food	lag 1, 5	lag 1, 2	lag 1
intermediate & durable	lag 1, 2, 3, 4	lag 1, 2, 6	lag 1
textiles	lag 1, 2	lag 1	lag 1
Service Sector	lag 1, 2, 5	lag 1, 4	lag 1
consumer	lag 1	lag 1, 2	lag 1

finance	lag 1, 2	lag 1, 2, 6	lag 1, 2
leisure	lag 1, 2	lag 1, 2	lag 1, 2
media	lag 1, 5	lag 1, 4, 6	lag 1
ports	lag 2, 5	lag 1, 2, 6	lag 1, 2
transport	lag 1	lag 1	lag 1
Energy Sector	lag 1	lag 1	lag 1
Property Sector	lag 1, 2, 5	lag 1, 2	lag 1, 2
Investment Sector	lag 1, 2	lag 1, 2	lag 1

Table 3b: Summary of suggested lag lengths for weekly Granger-Causality tests

Weekly	USD/NZD	AUD/NZD	USD/AUD
Classification One			
nzx 10	lag 2, 7	lag 1, 2	lag 1, 7
nzx 15	lag 1, 2	lag 1, 2	lag 1, 7
nzx 50	lag 1, 2	lag 1, 2	lag 1, 7
nzx all	lag 1, 2	lag 1	lag 1
nzx mid	lag 1, 2, 7	lag 1	lag 1
nzx sml	lag 1, 2	lag 1, 5	lag 1
Classification Two			
Local	lag 1	lag 1, 2	lag 1
Non-local Australia	lag 1	lag 1	lag 1
Non-local world	lag 1	lag 1	lag 1
Sector of the Economy			
Primary Sector	lag 1, 2	lag 1	lag 1
agriculture	lag 1, 2	lag 1	lag 1, 8
building	lag 1, 2	lag 1	lag 1
forestry	lag 1, 2	lag 1, 2, 7	lag 1
mining	lag 1, 2	lag 1	lag 1
Goods Sector	lag 1, 2, 3	lag 1	lag 1, 6
food	lag 1, 2	lag 1	lag 1
intermediate & durable	lag 1, 3	lag 1, 4	lag 1, 6
textiles	lag 1, 2	lag 1	lag 1
Service Sector	lag 1, 2, 3	lag 1	lag 1
consumer	lag 1, 2	lag 1	lag 1, 6
finance	lag 1, 2	lag 1	lag 1
leisure	lag 1, 2, 7	lag 1	lag 1
media	lag 1, 2, 3, 8	lag 1, 2	lag 1, 8
ports	lag 1, 2, 3, 6	lag 1, 2, 6	lag 1, 6

transport	lag 1, 2	lag 1	lag 1
Energy Sector	lag 1, 2	lag 1	lag 1
Property Sector	lag 1, 2, 3	lag 1	lag 1
Investment Sector	lag 1, 2	lag 1, 2	lag 1, 6

Granger-Causality test can not be applied if there is no lag length suggested by criteria. All lag length selection criteria we used provide us at least 1 lag length. Therefore we can apply the Granger-Causality test with those lags.

5.5 Granger-Causality tests

The results of short run Granger-Causalities between New Zealand stock market and exchange rates are discussed in this section. The first difference of the log value of variable is used for testing. The daily and weekly Granger-Causality tests' results are presented in sub-section 5.5.1 and 5.5.2 respectively. Granger (1969) has mentioned that the daily data may be more desirable in Granger-Causality test because a frequency less than one day may introduce spurious statistical significance. The weekly data may have less autocorrelation problem comparing to daily data. However the weekly data results may not be as useful as daily data results to those short term traders who are interesting in the daily relationship between New Zealand stock market and exchange rates. Therefore both daily and weekly Granger-Causality tests are used in this research. Sub-section 5.5.1 presents daily Granger-Causality test's results and sub-section 5.5.2 presents weekly results.

5.5.1 Daily Granger-Causality tests

The Granger-Causality tests on daily data are run first. The full details of Granger-Causality tests' results for all variables are reported in Appendix Tables from 5a to 7c in appendix. Only those results that have statistically significant are summarised here. Table 4 summarises the statistically significant results of the daily Granger-Causality between USD/NZD and New Zealand stock market.

Table 4: Summary of statistically significant daily Granger-Causality tests' results

between New Zealand stock market and USD/NZD

USD/NZD		Null Hypothesis	F-test	P-value
nzx 10	lag 4	LN_USD_NZD_R DNGC LN_NZ10_CAP	3.54307	0.00698
nzx 15	lag 1	LN_USD_NZD_R DNGC LN_NZ15_CAP	5.09785	0.02413
	lag 4	LN_USD_NZD_R DNGC LN_NZ15_CAP	4.90399	0.00063
nzx 50	lag 4	LN_USD_NZD_R DNGC LN_NZ50_CAP	2.5496	0.03775
Property Sector	lag 1	LN_USD_NZD_R DNGC LN_PROPERTY_CAP	4.35105	0.03719
	lag 2	LN_USD_NZD_R DNGC LN_PROPERTY_CAP	3.04071	0.04816
	lag 5	LN_USD_NZD_R DNGC LN_PROPERTY_CAP	2.63038	0.02249
Goods Sector	lag 1	LN_USD_NZD_R DNGC LN_GOODS_CAP	6.23335	0.01267
	lag 3	LN_USD_NZD_R DNGC LN_GOODS_CAP	7.21611	0.00008
Intermediate & Durable	lag 1	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	6.06841	0.0139
	lag 2	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	8.19537	0.00029
	lag 3	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	7.12488	0.000096
	lag 4	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	5.74936	0.00014
textiles	lag 2	LN_USD_NZD_R DNGC LN_TEXTILES_CAP	3.79453	0.02276
ports	lag 5	LN_USD_NZD_R DNGC LN_PORTS_CAP	3.16509	0.00762
forestry	lag 1	LN_USD_NZD_R DNGC LN_FORESTRY_CAP	5.4363	0.01988

Note: "DNGC" stands for Does Not Granger Cause.

56 Granger-Causality tests are run with USD/NZD in daily data. 16 of them (29%) are detected to have Granger-Causality. All of them are uni-directional from exchange rates to stock markets. We should emphasise that we are focusing on the results of sectors rather than on the individual firms in New Zealand stock market since this research tries to investigate the causality for each sector and compare the causality results among different sectors in New Zealand stock market.

As we mentioned in the introduction and cointegration results section, we expect that the movements of exchange rates have more impact on large size firms in New Zealand stock market. However we couldn't find any evidence to support this contention in the cointegration tests. The Granger-Causality test between USD/NZD and New Zealand stock market shows that the returns of all sectors that represent the large size firms have short run relationship with the movement of USD/NZD. The p-values are all significant at 5% level for the Granger-Causality test between

USD/NZD and NZX 10, 15 and 50. We find only uni-directional Granger-Causality relationships from the movement of USD/NZD and the NZX 10, 15 and 50, but not the other way around. This indicates that large size firms in New Zealand are sensitive to the movement of USD/NZD in the short run. This result suggests us that the change of values of larger sizes of firms in New Zealand stock market can be better explained with the movement of the exchange rate of USD/NZD that occurred 4 days ago. The appreciation or depreciation of New Zealand dollar against U.S. dollar will change the return of the stock prices of large size of firms in New Zealand stock market within 1 or 4 days. This may indicate that the New Zealand market will take up to 4 days to absorb the information from the USD/NZD exchange rate and then, incorporate their expectation into the value of large size firms in New Zealand stock market. One day's movement of exchange rate may not help the market to fully understand what is happening in the market immediately. Market participants may not able to fully assess the impact of the movement of exchange rate of USD/NZD on these large size firms immediately. Even though the change of values of large size firms in New Zealand stock market is Granger caused by exchange rate of USD/NZD, the entire market, NZX All, does not Granger cause exchange rate of USD/NZD or is Granger caused by USD/NZD. Also, there is no Granger-causality between exchange rate of USD/NZD and NZX Small and Medium.

In data description we present that NZX 10, 15 and 50 contain larger market capitalization companies. Their relationships with exchange rates should have more impact on the relationship between entire market and exchange rates. If there is Granger-Causality between the exchange rate of USD/NZD and these larger size firms sectors, it is supposed that New Zealand stock market as a whole should have similar Granger-Causality result as larger sizes firms have. However our Granger-Causality test results don't support this point. The Granger-Causality results for NZX All – USD/NZD is similar to the results of NZX Sml, Mid – USD/NZD instead of the results of NZX 10, 15 and 50 – USD/NZD.

Intermediate & Durable and Textiles sub-sectors take over 90% weight of Goods sector. We can see all these two sub-sectors are Granger-Caused by USD/NZD and therefore this makes the Goods sector itself to be Granger-Caused by USD/NZD. The Property sector is Granger-caused by USD/NZD. This indicates as USD/NZD fluctuating, capital investment may be attracted to or leave from New Zealand market via real estate which affects New Zealand property industry.

From correlation analysis, we see that Mining sub-sector has strong correlation with USD/NZD, but we did not find cointegration between Mining sub-sector and USD/NZD. We also did not find short run relationship between Mining sub-sector and USD/NZD. Forestry sub-sector has moderate correlation with USD/NZD, and it is also Granger-Caused by USD/NZD. Forestry sub-sector is the only sub-sector found to be Granger-Caused by USD/NZD under the Primary sector. Its weight in Primary sector is very small so that it is not surprising to see the Primary sector has no Granger-Causality with USD/NZD. Similar to Forestry sub-sector, the Ports sub-sector doesn't have much weight in Service sector, and therefore not surprising to see that Service sector has no Granger-Causality with USD/NZD.

We also didn't find any Granger-Causality between Non-Local-World sector and USD/NZD. We don't find either long run or short run relationship between those firms that are related to international transaction and exchange rate of USD/NZD. This may be either caused by Offset Effect or Hedge Effect that were mentioned before. There is no long run or short run relationship between Local sector and USD/NZD either, which indicates that movement of USD/NZD doesn't have significant impacts on the local firms in New Zealand.

Next, the daily Granger-Causality tests between New Zealand stock market and exchange rate of AUD/NZD are reported in table 5.

Table 5: Summary of statistically significant daily Granger-Causality tests' results between New Zealand stock market and AUD/NZD

AUD/NZD		Null Hypothesis	F-test	P-value
nzx 10	lag 6	LN_AUD_NZD_R DNGC LN_NZ10_CAP	3.28699	0.00327
nzx 15	lag 6	LN_AUD_NZD_R DNGC LN_NZ15_CAP	3.23613	0.00369
nzx 50	lag 6	LN_AUD_NZD_R DNGC LN_NZ50_CAP	3.35398	0.00278
Goods Sector	lag 1	LN_AUD_NZD_R DNGC LN_GOODS_CAP	11.8929	0.00058
	lag 2	LN_AUD_NZD_R DNGC LN_GOODS_CAP	6.91372	0.00103
	lag 6	LN_AUD_NZD_R DNGC LN_GOODS_CAP	3.70881	0.00117
Intermediate & Durable	lag 1	LN_AUD_NZD_R DNGC LN_INTERMEDIATE_CAP	14.9964	0.00011
	lag 2	LN_AUD_NZD_R DNGC LN_INTERMEDIATE_CAP	8.71463	0.00017
	lag 6	LN_AUD_NZD_R DNGC LN_INTERMEDIATE_CAP	4.7904	0.000077
Service Sector	lag 4	LN_SERVICE_CAP DNGC LN_AUD_NZD_R	2.76759	0.02624 *
	leisure	lag 1	LN_AUD_NZD_R DNGC LN_LEISURE_CAP	7.70293
	lag 2	LN_AUD_NZD_R DNGC LN_LEISURE_CAP	3.86768	0.02116
	lag 4	LN_MEDIA_CAP DNGC LN_AUD_NZD_R	2.39122	0.04903 **
		LN_AUD_NZD_R DNGC LN_MEDIA_CAP	2.59391	0.03507 **
	lag 6	LN_PORTS_CAP DNGC LN_AUD_NZD_R	2.50511	0.02055 *
	lag 1	LN_AUD_NZD_R DNGC LN_FORESTRY_CAP	7.94139	0.00491
	lag 2	LN_AUD_NZD_R DNGC LN_FORESTRY_CAP	4.62709	0.00996
	lag 7	LN_FORESTRY_CAP DNGC LN_AUD_NZD_R	2.0808	0.04285 **
		LN_AUD_NZD_R DNGC LN_FORESTRY_CAP	2.94015	0.00468 **

Note: “*” indicates stock market Granger-Cause exchange rate

“**” indicates there are two ways Granger Causality

53 Granger-Causality tests are run with AUD/NZD using daily data and 17 of them (32%) are detected to have Granger-Causality, either uni or bi-directional. Within these significant results, 13 of these 17 (76%) are uni-directional from exchange rates to stock market, 2 of these 17 (6%) is uni-directional from stock market to exchange rates and another 2 of these 17 (6%) are bi-directional.

In this Granger-Causality test result, we can see that most sectors that are Granger-Caused by USD/NZD are also Granger-Caused by AUD/NZD except Ports, Property and Textile sectors. However the lags it takes for AUD/NZD to Granger-Cause New Zealand stock market are longer than that of USD/NZD.

It takes 6 days for NZX 10, 15 and 50 to react to the information regarding AUD/NZD exchange rate. This indicates that the larger firms in New Zealand stock market react faster to the fluctuation of USD/NZD than to the fluctuation of AUD/NZD. For the sectors that are Granger-Caused by both USD/NZD and AUD/NZD, it may indicate that all these sectors are sensitive to the fluctuation of New Zealand dollars against both U.S. dollar and Australian dollar. Our results imply that when New Zealand dollar appreciates or depreciates against either U.S. dollar or Australian dollar, this information will have impact on NZX 10, 15, 50, Goods sector, Forestry, Intermediate & Durable and Ports sub-sectors after a few days.

The Offset Effect and Hedge Effect may be the main reasons why NZX All has no Granger-Causality with AUD/NZD whereas its major constituents NZX 10, 15 and 50 are Granger-Caused by AUD/NZD. For the same reasons, Non-local-Australia has no Granger-Causality with AUD/NZD which is inconsistent with our expectations.

Intermediate & Durable sub-sector is under Goods sector. Our result shows both time lags and Granger-Causality is the same for them. This result is as our expectation since Intermediate & Durable sub-sector accounts for more than 80% of total weights of Goods sector.

Media sub-sector has the strongest correlation with AUD/NZD. This is confirmed by Granger-Causality test, which shows that a short run relationship exists between Media sub-sector and AUD/NZD. Under the Service sector, its most weighted sub-sector, Media sub-sector is found to have bi-directional Granger-Causality with AUD/NZD whereas the Service sector itself has uni-directional Granger-Causality from stock market to exchange rates. The reason why Service sector has different results from its main sub-sector may be due to the offset effect from Leisure

sub-sector which has uni-direction from exchange rate to stock market and other sub-sectors which have no Granger-Causality with AUD/NZD.

Forestry sub-sector has only a minor weight in the Primary sub-sector. Therefore the Primary sector has no Granger-Causality with AUD/NZD as its other sub-sectors do even though Forestry sub-sector has mixed Granger-Causality results with AUD/NZD at different lag lengths.

In the Granger-Causality tests between New Zealand stock market and USD/NZD, we only find uni-directional Granger-Causality relationship between the exchange rate and stock market. Here, we have found both uni and bi-directional Granger-Causalities with AUD/NZD. The relationship between two economies crossing Tasman Sea is more connected than the connection between New Zealand economies to the rest of the world. This may explain why complex Granger-Causalities are found between New Zealand stock market and exchange rates of New Zealand dollar and Australian dollar. This also raises concerns that New Zealand firms have more foreign exchange exposure to the exchange rate of AUD/NZD than previously believed.

Next, the daily Granger-Causality tests between New Zealand stock market and exchange rate of USD/AUD are reported in table 6.

Table 6: Summary of statistically significant daily Granger-Causality tests' results between New Zealand stock market and USD/AUD

USD/AUD		Null Hypothesis	F-test	P-value
nzx 15	lag 1	LN_USD_AUD_R DNGC LN_NZ15_CAP	5.84434	0.01577
	lag 2	LN_USD_AUD_R DNGC LN_NZ15_CAP	3.39443	0.03388
non-local-Australia	lag 1	LN_USD_AUD_R DNGC LN_N_A_CAP	5.81263	0.01606
	lag 2	LN_USD_AUD_R DNGC LN_N_A_CAP	3.11995	0.04452
leisure	lag 1	LN_USD_AUD_R DNGC LN_LEISURE_CAP	5.76266	0.01652
	lag 2	LN_USD_AUD_R DNGC LN_LEISURE_CAP	3.92264	0.02004

37 Granger-Causality tests are run with daily USD/AUD data, and 6 of them (16%) are detected to have Granger-Causality. All the Granger-Causalities that are detected are uni-directional from exchange rates to stock market.

Leisure sub-sector is Granger-Caused by USD/AUD. It looks like Leisure sub-sector is affected by Australian dollar since it has no short run relationship with USD/NZD but with AUD/NZD and USD/AUD under Granger-Causality test. Also, Leisure sub-sector has a strong correlation with USD/AUD and the Granger-Causality test confirms that there is a relationship between Leisure sub-sector and USD/AUD. One may argue that the shocks on Leisure sub-sector are coming from Australian market into New Zealand market since it has relationship with USD/AUD and AUD/NZD but not with USD/NZD. USD/AUD has short run relationship with NZX 15 but not NZX 10, 50 and NZX All, which indicates that most of the large and all medium and small firms in New Zealand have no short run relationship with exchange rates that exclude the New Zealand dollar.

There is Granger-Causality from USD/AUD to Non-Local-Australia sector. We expect that firms in Non-Local-Australia sectors should have relationship with the Australian dollar. We did not find evidence to support this point with the exchange rate of AUD/NZD. However, we find short run relationship between firms in Non-Local-Australia sector and USD/AUD. This indicates that these firms are more related to USD/AUD rather than AUD/NZD. As the fluctuations of Australian dollar against US dollar, affects Australian economy it has impact on Australian market. As those New Zealand firms classified in Non-Local-Australia have operations in the Australian market, their performances will be highly affected by the performance of Australian economy. This may lead to a co-movement between Non-local-Australia sector and USD/AUD in the short run.

Granger-Causality tests between New Zealand stock market and USD/AUD shows that there are only one-way Granger-Causalities as are found with USD/NZD. There

are fewer much less stock market sectors that have short run relationship with USD/AUD than with USD/NZD and AUD/NZD. This finding indicates that most of the sectors in New Zealand stock market are more closely aligned to the New Zealand dollar than to the other exchange rate pairs which exclude New Zealand dollar. It suggests that more New Zealand firms have foreign exchange risk exposure to exchange rates related to New Zealand dollar rather than other exchange rates that exclude New Zealand dollar.

By using daily Granger-Causality tests, we did not find confirmatory evidence that there is Causality between New Zealand stock market as a whole and the movement of New Zealand dollar as in Obben, Pech and Shakur (2006). The results also don't support Friberg and Nydahl (1999) and Gavin (1989)'s findings that relationship between stock market index and exchange rates exists in small and open economies. However we do find some short run relationships either uni-directional or bi-directional between some sectors in New Zealand stock market and exchange rates. Looking at the big picture, of the 146 Granger-Causality tests that are run between New Zealand stock market sectors and three exchange rates in daily data, we find that there are 39 significant Granger-Causalities accounting for 27% of all the tests. 11% of them are with USD/NZD, 12% of them are with AUD/NZD and 4% are with USD/AUD. This indicates that only a minority of the sectors in New Zealand stock market have Granger-Causality with exchange rates in daily data. Most of them have short run relationships with USD/NZD and AUD/NZD, only a few of them have short run relationship with USD/AUD. Within these 39 Granger-Causalities, 35 or 90% of them are uni-directional from exchange rates to stock market, 2 or 5% of them are uni-directional from stock market to exchange rates and the other 2 or 5% of them are bi-directional. This indicates that most of the short term shocks are from currency market into segments of New Zealand stock market.

Looking at each exchange rate pair, 16 or 29% of total 56 Granger-Causality tests

with USD/NZD are found to be significant. 100% of these 16 are uni-directional Granger-Causality from exchange rate to stock markets. For AUD/NZD, 17 or 32% of total 53 Granger-Causality tests are found to be significant. 13 of these 17 (76%) are uni-directional from exchange rates to stock market, 2 of these 17 (6%) is uni-directional from stock market to exchange rates and another 2 of these 17 (6%) are bi-directional. For USD/AUD, 6 or 16% of total 37 Granger-Causality tests are found to be significant. 100% of these 6 are detected as uni-directional from exchange rates to stock market. To summarise, only uni-directional Granger-Causality from exchange rates to stock markets is found with USD/NZD and USD/AUD. Most of Granger-Causality relationships between New Zealand stock market to AUD/NZD are uni-directional from exchange rates to stock market, and very few are bi-directional and uni-directional from stock market to exchange rates.

Furthermore, large size firms are more exposed to the fluctuation of USD/NZD and AUD/NZD than medium and small size firms. Primary, Energy and Investment sectors have no Granger-Causality with any of the three exchange rate pairs. Service sector has been found to have uni-directional Granger-Causality from stock market to AUD/NZD, and Goods sector has been found to have uni-directional Granger Causality from both AUD/NZD and USD/NZD to the stock market. No Granger-Causality was found between either Local or Non-Local-World and the three exchange rate pairs. However Non-Local-Australia has uni-directional Granger-Causality from USD/AUD to stock market.

5.5.2 Weekly Granger-Causality tests

The results of Granger-Causality tests in weekly data are analysed in this section. The details of results for all variables are reported in Appendix Tables from 8a to 10c in appendix. Table 7 summarises the statistically significant results of the weekly Granger-Causality test between USD/NZD and the New Zealand stock market sectors:

Table 7: Summary of statistically significant weekly Granger-Causality tests' results between New Zealand stock market and USD/NZD

USD/NZD		Null Hypothesis	F-test	P-value
nzx 10	lag 2	LN_NZ10_CAP DNGC LN_USD_NZD_R	3.64614	0.02747 **
		LN_USD_NZD_R DNGC LN_NZ10_CAP	4.25429	0.01523 **
	lag 7	LN_NZ10_CAP DNGC LN_USD_NZD_R	3.58611	0.00109 *
nzx 15	lag 2	LN_USD_NZD_R DNGC LN_NZ15_CAP	4.11575	0.01742
	lag 1	LN_USD_NZD_R DNGC LN_NZ15_CAP	8.20177	0.00453
nzx 50	lag 2	LN_USD_NZD_R DNGC LN_NZ50_CAP	3.41211	0.0345
	lag 1	LN_USD_NZD_R DNGC LN_NZ50_CAP	6.12266	0.01399
nzx all	lag 1	LN_USD_NZD_R DNGC LN_NZALL_CAP	5.31795	0.02191
	lag 2	LN_USD_NZD_R DNGC LN_NZALL_CAP	3.39656	0.03502
Goods Sector	lag 1	LN_USD_NZD_R DNGC LN_GOODS_CAP	9.56379	0.0022
	lag 2	LN_USD_NZD_R DNGC LN_GOODS_CAP	6.14538	0.00248
	lag 3	LN_USD_NZD_R DNGC LN_GOODS_CAP	4.43653	0.00465
Intermediate & Durable	lag 1	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	13.8384	0.00024
	lag 3	LN_USD_NZD_R DNGC LN_INTERMEDIATE_CAP	5.43474	0.00123
Service Sector	lag 1	LN_USD_NZD_R DNGC LN_SERVICE_CAP	6.07421	0.01437
	lag 2	LN_USD_NZD_R DNGC LN_SERVICE_CAP	4.21781	0.01578
	lag 3	LN_USD_NZD_R DNGC LN_SERVICE_CAP	3.01122	0.03076
media	lag 1	LN_MEDIA_CAP DNGC LN_USD_NZD_R	4.41485	0.03661 **
		LN_USD_NZD_R DNGC LN_MEDIA_CAP	5.77763	0.01694 **
	lag 2	LN_MEDIA_CAP DNGC LN_USD_NZD_R	3.95603	0.02033 **
		LN_USD_NZD_R DNGC LN_MEDIA_CAP	3.38937	0.03527 **
	lag 8	LN_MEDIA_CAP DNGC LN_USD_NZD_R	3.59822	0.00058 *
ports	lag 1	LN_USD_NZD_R DNGC LN_PORTS_CAP	6.72538	0.01005
	lag 2	LN_USD_NZD_R DNGC LN_PORTS_CAP	5.32657	0.00542
	lag 3	LN_USD_NZD_R DNGC LN_PORTS_CAP	3.94221	0.00898
	lag 6	LN_USD_NZD_R DNGC LN_PORTS_CAP	2.84919	0.01065

Note: “*” indicates stock market Granger-Cause exchange rate

“**” indicates there are two ways Granger Causality

62 Granger-Causality tests are run with weekly USD/NZD data. 23 or 37% of total 62 tests are found to be significant. 18 or 78% of these 23 Granger-Causalities are uni-directional from exchange rates to stock markets. 2 or 9% of these 23 Granger-Causalities are uni-directional from stock market to exchange rates, and 3 or 13% of these 23 Granger-Causalities are bi-directional.

The above result shows that NZX 10, 15 and 50 have Granger-Causality with USD/NZD. NZX 15 and 50 are Granger-Caused by USD/NZD as we found in daily data, whereas NZX 10 is found to have bi-directional Granger-Causality with USD/NZD at lag 2 and uni-directional Granger Causality in lag 7. The lag length of 7 indicates the impact from movement of NZX 10 will affect the value of USD/NZD in 7 weeks time. The NZX All which represents the New Zealand stock market as whole is Granger-Caused by USD/NZD. We did not find any short run relationship between NZX All and exchange rates with daily data even though large size firms are found to have short run relationship with exchange rates. However with weekly data, we find results that are consistent with our expectation that NZX All should have similar results as compared to large size firms. Our results are in conformity with Obben, Pech and Shakur (2006)'s results showing the existence of causality between NZX All and USD/NZD with weekly data. Our results suggest that the movement of New Zealand stock market can be better explained by including movements of USD/NZD that occurred one or two weeks ago.

Goods sector, Ports and Intermediate & Durable sub-sectors have very weak correlation with USD/NZD, but they are all found to have short run relationship with USD/NZD. Media sub-sector and Service sector have moderate correlation with USD/NZD and their Granger-Causality tests with USD/NZD are also significant at the 5% level.

Goods sector's Granger-Causality result with USD/NZD is similar to the result of the Intermediate & Durable sub-sector with weekly data since Intermediate & Durable sub-sector is the main sub-sector in the Goods sector. In daily Granger-Causality tests, we found that even though the most important sub-sectors in Service sector are found to have Granger-Causality with USD/NZD, Service sector is not related to USD/NZD in short run. However in our weekly data tests, we have found that Service sector also is Granger-Caused by USD/NZD. One interesting finding is that Service sector has uni-directional Granger-Causality with

USD/NZD, however Media sub-sector, the most important sub-sector in Service sector, is found to have both uni and bi-directional Granger-Causality with USD/NZD with different lags. The Offset Effect and Hedge Effect may be contributing to the different results observed for the Service sector as compared to the Media sub-sector.

We expect the result of NZX All to be not different from the result of the Service sector due to the high weight of the Service sector in the New Zealand stock market. In weekly Granger-Causality tests, it is found that both NZX All and Service sector are Granger-Caused by USD/NZD with lag 1 and 2. That means when New Zealand dollar moves against U.S. dollar, the firms in service industry in New Zealand market will be affected. As the market capitalisation of these firms play a major role in entire New Zealand stock market, the NZX All is also affected by the movement of USD/NZD.

As reported in our Daily results, we do not find significant Granger-Causality between Non-Local-World and USD/NZD. The opposite effects of import-oriented firms and export-oriented firms are probably offsetting each other and therefore the overall result is insignificant.

NZX 10 and Media sectors both have Granger-Causality from stock market to USD/NZD with long lags (around two months time lag). As we discussed in the introduction, stock market is the indicator of a country's economic performance. Its performance will lead the fiscal and monetary policies, which will be reflected by some microeconomic variables such as exchange rates. Our results may indicate that the movement of these two sectors could be related to some policy variables, such as interest rates, which are used by policymakers to affect the value of New Zealand dollar against U.S. dollar with a time lag.

We summarise the weekly Granger-Causality tests with AUD/NZD in Table 8:

Table 8: Summary of statistically significant weekly Granger-Causality tests' results between New Zealand stock market and AUD/NZD

AUD/NZD		Null Hypothesis	F-test	P-value
nzx 15	lag 1	LN_AUD_NZD_R DNGC LN_NZ15_CAP	5.50608	0.01971
nzx 50	lag 1	LN_AUD_NZD_R DNGC LN_NZ50_CAP	4.2952	0.03922
nzx sml	lag 5	LN_NZSML_CAP DNGC LN_AUD_NZD_R	2.60162	0.02583 *
Local	lag 1	LN_AUD_NZD_R DNGC LN_LOCAL_CAP	8.04555	0.00493
	lag 2	LN_AUD_NZD_R DNGC LN_LOCAL_CAP	3.76754	0.02443
Non-local world	lag 1	LN_AUD_NZD_R DNGC LN_N_W_CAP	5.20895	0.0233
forestry	lag 7	LN_FORESTRY_CAP DNGC LN_AUD_NZD_R	2.09932	0.04438 *

Note: “*” indicates stock market Granger-Cause exchange rate

40 Granger-Causality tests are run with weekly AUD/NZD data. 7 or 18% are found to Granger-Causalities out of the total 40 tests. 5 or 71% of a total of 7 significant results are uni-directional from exchange rates to stock market, 2 or 29% of total 7 significant results are uni-directional from stock market to exchange rates. No bi-directional Granger-Causality is detected.

We found both large and small size firms have Granger-Causality with AUD/NZD. Inconsistent with our expectation, NZX All was found to have no Granger-Causality with AUD/NZD even though NZX 15 and 50 are both found to have Granger Causality. This may due to the offsetting of the positive and negative relationships between the firms in NZX 15, 50 and AUD/NZD. We found smaller firms (NZX Sml) Granger-Cause AUD/NZD. This implies that the movement of NZX Sml will affect the value of AUD/NZD in five weeks time. The market capitalization of smaller sizes firms in New Zealand market is very small. These firms do not have high level of exports and imports activities as larger size firms do. Thus smaller size firms are not found to have Granger-Causality with exchange rates except for AUD/NZD. This is the only relationship between small firms in New Zealand stock market and exchange rates that we have detected so far.

An interesting result is that there is only one industry sector that is found to have Granger-Causality. That sector is the Forestry sub-sector which is the smallest

component in the Primary sector and its weight is extremely small in overall New Zealand stock market. Therefore we can even say there is no Granger-Causality between AUD/NZD and New Zealand stock market classified by industry for all practical purposes.

Non-Local-Australia is supposed to have a stronger relationship to AUD/NZD. But, Local and Non-Local-World sectors are found to Granger-Cause AUD/NZD. However, Non-local-Australia has no Granger-Causality with AUD/NZD as per our expectations. This may be due to New Zealand firms with Australian market hedging their foreign exchange rate risk. Alternately, gain/loss from exporting firms is offset by the loss/gain by importing firms from Australia.

Table 9 summarises our last weekly Granger-Causality test, which is between New Zealand stock market and USD/AUD.

Table 9: Summary of statistically significant weekly Granger-Causality tests' results between New Zealand stock market and USD/AUD

USD/AUD		Null Hypothesis	F-test	P-value
nzx 10	lag 7	LN_NZ10_CAP DNGC LN_USD_AUD_R	2.66533	0.01132 *
nzx 15	lag 1	LN_USD_AUD_R DNGC LN_NZ15_CAP	4.5908	0.03309
Service Sector	lag 1	LN_USD_AUD_R DNGC LN_SERVICE_CAP	4.2655	0.0399
media	lag 1	LN_USD_AUD_R DNGC LN_MEDIA_CAP	3.96593	0.04749
	lag 8	LN_MEDIA_CAP DNGC LN_USD_AUD_R	2.8601	0.00472 *
agriculture	lag 8	LN_USD_AUD_R DNGC LN_AGRICULTURE_CAP	2.03025	0.04377
Intermediate & Durable	lag 6	LN_USD_AUD_R DNGC LN_INTERMEDIATE_CAP	2.25298	0.03908

Note: “*” indicates stock market Granger-Cause exchange rate

38 Granger-Causality tests are run with weekly USD/AUD data. 7 or 18% of total tests are detected to have Granger-Causalities. 5 or 71% of these total 7 Granger Causalities are uni-directional from exchange rate to stock markets, and 2 or 29% are uni-directional from stock markets to exchange rate.

The results show that NZX 10 Granger-Causes USD/AUD and NZX 15 is Granger-Caused by USD/AUD, but nothing is found for NZX All. Intermediate & Durable sub-sector is found to be Granger-Caused by USD/AUD but not its main sector – the Goods sector. We also see that Service sector has similar result to Media sub-sector's result, the only difference being that the Media sub-sector also has bi-directional Granger Causality with lag 8. We didn't find Granger-Causality between Non-Local-Australia and USD/AUD, which is inconsistent with our expectation.

In weekly data analysis, 140 Granger-Causality tests are run between New Zealand stock market sectors and the three exchange rate pairs. There are 37 or 26% significant results of Granger-Causalities overall. This result indicates only a minority of the sectors in New Zealand stock market have Granger-Causality with exchange rates in weekly data. Out of these 37 Granger-Causalities that have been detected, 28 or 76% of them are uni-directional running from exchange rates to New Zealand stock market. 6 or 16% of them are uni-directional from New Zealand stock market to exchange rates and only 3 or 8% of them are bi-directional. Bi-directional Granger-Causality is only found between USD/NZD and New Zealand stock market, none is found with either AUD/NZD or USD/AUD. Out of the 37 significant Granger Causalities, 23 or 62% of them are with USD/NZD, 7 or 19% are with AUD/NZD and another 7 or 19% are with USD/AUD. USD/NZD is the exchange rate pair that has the most Granger-Causality results with New Zealand stock market in weekly data. Most of the weekly Granger-Causalities detected are uni-directional running from exchange rate to New Zealand stock market. Bi-directional Granger-Causality is found between USD/NZD and New Zealand stock market, but no bi-directional Granger-Causality is found with either AUD/NZD or USD/AUD.

For the USD/NZD exchange rate pair, 23 or 37% of total 62 Granger-Causality tests with are found to be significant. 18 or 78% of these 23 Granger-Causalities are

uni-directional from exchange rates to stock markets. 2 or 9% of these 23 Granger-Causalities are uni-directional from stock market to exchange rates, and 3 or 13% of these 23 Granger-Causalities are bi-directional. For AUD/NZD, 7 or 18% are of total 40 Granger-Causality tests are found to be significant. 5 or 71% of total 7 significant results are uni-directional from exchange rates to stock market, 2 or 29% of total 7 significant results are uni-directional from stock market to exchange rates. No bi-directional Granger-Causality is detected. For USD/AUD, 7 or 18% of total 38 Granger-Causality tests are found to be significant. 5 or 71% of these total 7 Granger Causalities are uni-directional from exchange rate to stock markets, and 2 or 29% are uni-directional from stock markets to exchange rate.

In our weekly analysis, we have found that NZX All, which represents New Zealand stock market as a whole has short run relationship with USD/NZD. This is consistent with the findings of Friberg and Nydahl (1999) and Gavin (1989) who found that in small open economies there exists a relationship between the stock market and exchange rates. Large and medium size firms also have Granger-Causality with all three exchange rates. NZX 15 and 50 have uni-directional from exchange rates to stock markets, however NZX 10 has bi-directional with USD/AUD and uni-directional from stock market to both USD/AUD and USD/NZD. Small size firms (NZX Small) have uni-directional causality from stock market to only AUD/NZD. No Granger-Causality has been found between Primary, Energy, Property and Investment sectors and the three exchange rates. Goods sector has been found to have uni-directional causality from USD/NZD to stock market. Service sector is also been found to have uni-directional causality, but from both USD/NZD and USD/AUD to stock market.

We have detected eight uni-directional Granger-Causalities from stock market to exchange rates, six are from weekly data and only two are from daily data. All of them are with long lags. This is different from the uni-directional Granger-Causalities from exchange rates to stock market, most of which are with

short time lags. This may indicate that: the speed with which the New Zealand stock market reacts to the shocks from exchange rates is faster than the speed with which exchange rates reacts to the shocks from stock market. When exchange rate changes, market can understand the impact and react based on their expectations. However, it takes time for policymakers to recognize and assess the impact of changes in stock market valuation and adjust policies, and it also takes time for policies to become active. Another point is that the movement of exchange rate is not solely caused by the monetary policies but several other factors drive the changes. The asymmetry can be illustrated by using the following example. When U.S. dollar appreciates against NZD or AUD, the commodity prices will drop, and the value of those firms that export the commodity from New Zealand and Australia will drop within a short time period as the profit expected will drop. However, if the values of the stocks of these commodities related firms are drop, it will not affect the USD/NZD and USD/AUD as fast as stock prices.

6 Conclusion:

This research employs both daily and weekly exchange rates and indexes of stock sectors in New Zealand stock market in order to investigate the long run and short run relationships between some major exchange rates to New Zealand market and each sector of New Zealand stock market. The Engle-Granger and the Johansen-Juselius cointegration methodologies are applied to explore long run relationship, and Granger-Causality test is applied to explore short run relationship in New Zealand, which is a small open developed country in Pacific Region. Three exchange rates - USD/NZD, AUD/NZD and USD/AUD are used with 28 different indices and sectors in New Zealand stock market. The period involved in this research is from 1st/Jun/2003 – 31st/May/2008, which captures the cycle of both appreciation and depreciation of New Zealand dollars.

For the tests of long run relation, the cointegration results from both Engle-Granger and Johansen-Juselius methodologies are consistent in both daily and weekly data.

No cointegration between the three exchange rates and 28 indices and sectors in New Zealand stock market is detected.

For the tests of short run causality, the results are mixed with most of the Granger-Causalities detected are uni-directional from exchange rates to stock market sectors and a few are bi-directional and uni-directional from stock market sectors to exchange rates in both daily and weekly data. New Zealand stock market as a whole is found only to have uni-directional causality from weekly stock market return to weekly movement of USD/NZD. Large size firms are found to have more Granger-Causalities with exchange rates than medium and small sizes of firms. Goods and Service sectors have the most Granger-Causalities with exchange rates than other sectors which are classified by firms' industry. If classified by the country of their operations of firms, the only Granger-Causality detected in daily data is uni-directional from USD/AUD to Non-Local-Australia, and two Granger-Causalities detected in weekly data are uni-directional from Local to AUD/NZD and uni-directional from Non-Local-World to AUD/NZD.

Investors and multinational corporations may be unable to use the interaction between New Zealand stock market and these three exchange rate pairs to hedge their risk in long run as no cointegration exist among them. However some hedging strategies may be available within some sectors in New Zealand stock market which have short run causalities with these three exchange rate pairs. Regulators in New Zealand may also use these short run causalities between New Zealand stock market and these exchange rates to monitor the New Zealand financial markets.

7 Limitations:

One limitation of this study is that cointegration method tests long-run relationship between variables. However the span of the sample period of this study is relatively short due to the relatively short trading history of many companies listed in NZSX. Another limitation of this study is that Granger Causality test can be only applied to

pairs of variables. It will produce misleading results when the true relationship involves more than two variables. For example, the fluctuation of interest rate may have effects on both the stock market and the exchange rates. Granger Causality test may provide a significant result even there is no true relationship between the stock market and the exchange rates. This may be the reason for some unexpected causality results in our results.

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Appendix

The second classification of companies

Appendix Table I: classification of Local, Non-Local-Australia and Non-Local-World with companies' codes

Local	Local	Non-Local-Australia	Non-Local-World	Non-Local-World	Non-Local-World
ABA	TPW	CAV	AFF	NPX	WHS
APF	TWR	EBO	AIA	NZE	BGR
CDI	ALF	HBV	AIR	NZO	BLT
CEN	CTG	HGD	BWY	NZR	BOZ
DPC	CYT	IFT	CER	POT	CCC
HED	GEN	MCH	CHA	PVO	FPA
MET	IMP	RBD	CMO	RNS	GMT
NTH	ING	SKC	FBU	RPL	LPL
PFI	KIP	SPY	FPH	SCT	NEW
PGW	KRK	THL	HLG	SLG	RBC
RYM	NAP	FIN	LPC	SPN	SKL
SAN	NZX	MOW	MCK	STU	TUA
TAY	WFD		MFT	SVY	WDT
TEL			MHI	TEN	

Daily Johansen-Juselius Cointegration test results

Appendix Table 1a: Daily Johansen-Juselius Cointegration test results with USD/NZD

USD/NZD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	9.735203	20.26184	7.250103	15.8921
	r = 1	2.4851	9.164546	2.4851	9.164546
nzx 15	r = 0	13.63656	20.26184	11.21877	15.8921
	r = 1	2.417791	9.164546	2.417791	9.164546
nzx 50	r = 0	12.35524	20.26184	10.25803	15.8921
	r = 1	2.097208	9.164546	2.097208	9.164546
nzx all	r = 0	14.21856	20.26184	9.541614	15.8921
	r = 1	4.676949	9.164546	4.676949	9.164546
nzx mid	r = 0	10.23605	20.26184	6.090307	15.8921
	r = 1	4.145748	9.164546	4.145748	9.164546
nzx sml	r = 0	13.10911	20.26184	9.212596	15.8921
	r = 1	3.896512	9.164546	3.896512	9.164546
local	r = 0	16.94221	20.26184	10.75275	15.8921
	r = 1	6.189463	9.164546	6.189463	9.164546
Non local Australia	r = 0	10.60788	20.26184	6.709669	15.8921
	r = 1	3.898207	9.164546	3.898207	9.164546

Non local world	r = 0	12.17415	20.26184	7.352257	15.8921
	r = 1	4.821893	9.164546	4.821893	9.164546
Agriculture	r = 0	9.459378	20.26184	8.206758	15.8921
	r = 1	1.25262	9.164546	1.25262	9.164546
building	r = 0	15.82728	20.26184	13.74163	15.8921
	r = 1	2.085656	9.164546	2.085656	9.164546
consumer	r = 0	14.69358	20.26184	9.027011	15.8921
	r = 1	5.666565	9.164546	5.666565	9.164546
energy	r = 0	12.26785	20.26184	10.11987	15.8921
	r = 1	2.147981	9.164546	2.147981	9.164546
finance	r = 0	11.39647	20.26184	9.271315	15.8921
	r = 1	2.125158	9.164546	2.125158	9.164546
food	r = 0	10.43075	20.26184	7.812634	15.8921
	r = 1	2.618117	9.164546	2.618117	9.164546
forestry	r = 0	13.69801	20.26184	10.75425	15.8921
	r = 1	2.94376	9.164546	2.94376	9.164546
goods	r = 0	15.6832	20.26184	11.12528	15.8921
	r = 1	4.557913	9.164546	4.557913	9.164546
intermediate & Durable	r = 0	16.02729	20.26184	13.21574	15.8921
	r = 1	2.81155	9.164546	2.81155	9.164546
investment	r = 0	14.78904	20.26184	12.41569	15.8921
	r = 1	2.373344	9.164546	2.373344	9.164546
leisure	r = 0	15.07631	20.26184	9.881587	15.8921
	r = 1	5.19472	9.164546	5.19472	9.164546
media	r = 0	8.15174	20.26184	5.905376	15.8921
	r = 1	2.246364	9.164546	2.246364	9.164546
mining	r = 0	15.39669	20.26184	8.412259	15.8921
	r = 1	6.984433	9.164546	6.984433	9.164546
ports	r = 0	14.21056	20.26184	10.79221	15.8921
	r = 1	3.418349	9.164546	3.418349	9.164546
primary	r = 0	14.24689	20.26184	11.01286	15.8921
	r = 1	3.234028	9.164546	3.234028	9.164546
property	r = 0	11.05902	20.26184	9.496349	15.8921
	r = 1	1.562673	9.164546	1.562673	9.164546
service	r = 0	10.82296	20.26184	6.247408	15.8921
	r = 1	4.57555	9.164546	4.57555	9.164546
textiles	r = 0	9.912924	20.26184	6.586546	15.8921
	r = 1	3.326378	9.164546	3.326378	9.164546
transport	r = 0	11.94632	20.26184	9.407211	15.8921
	r = 1	2.539108	9.164546	2.539108	9.164546

Appendix Table 1b: Daily Johansen-Juselius Cointegration test results with AUD/NZD

AUD/NZD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	10.28884	20.26184	8.871891	15.8921
	r = 1	1.41695	9.164546	1.41695	9.164546
nzx 15	r = 0	9.331577	20.26184	6.158862	15.8921
	r = 1	3.172715	9.164546	3.172715	9.164546
nzx 50	r = 0	11.38936	20.26184	8.738343	15.8921
	r = 1	2.651017	9.164546	2.651017	9.164546
nzx all	r = 0	9.687362	20.26184	7.414286	15.8921
	r = 1	2.273076	9.164546	2.273076	9.164546
nzx mid	r = 0	9.132742	20.26184	5.860392	15.8921
	r = 1	3.27235	9.164546	3.27235	9.164546
nzx sml	r = 0	10.8327	20.26184	8.292186	15.8921
	r = 1	2.540512	9.164546	2.540512	9.164546
local	r = 0	13.40306	20.26184	9.942802	15.8921
	r = 1	3.460258	9.164546	3.460258	9.164546
Non local Australia	r = 0	7.412405	20.26184	5.471617	15.8921
	r = 1	1.940788	9.164546	1.940788	9.164546
Non local world	r = 0	9.463021	20.26184	5.766189	15.8921
	r = 1	3.696831	9.164546	3.696831	9.164546
Agriculture	r = 0	8.765471	20.26184	6.745351	15.8921
	r = 1	2.02012	9.164546	2.02012	9.164546
building	r = 0	11.54768	20.26184	7.597149	15.8921
	r = 1	3.950532	9.164546	3.950532	9.164546
consumer	r = 0	7.196519	20.26184	4.922794	15.8921
	r = 1	2.273725	9.164546	2.273725	9.164546
energy	r = 0	10.12878	20.26184	7.154314	15.8921
	r = 1	2.974464	9.164546	2.974464	9.164546
finance	r = 0	10.4334	20.26184	8.286638	15.8921
	r = 1	2.146764	9.164546	2.146764	9.164546
food	r = 0	15.5646	20.26184	12.48792	15.8921
	r = 1	3.076678	9.164546	3.076678	9.164546
forestry	r = 0	14.24189	20.26184	7.427075	15.8921
	r = 1	6.814817	9.164546	6.814817	9.164546
goods	r = 0	5.759649	20.26184	4.686024	15.8921
	r = 1	1.073625	9.164546	1.073625	9.164546
intermediate & Durable	r = 0	5.953201	20.26184	4.326336	15.8921
	r = 1	1.626865	9.164546	1.626865	9.164546
investment	r = 0	6.317486	20.26184	4.088427	15.8921
	r = 1	2.229059	9.164546	2.229059	9.164546
leisure	r = 0	10.19791	20.26184	7.944668	15.8921

	r = 1	2.253245	9.164546	2.253245	9.164546
media	r = 0	12.83504	20.26184	11.59207	15.8921
	r = 1	1.242973	9.164546	1.242973	9.164546
mining	r = 0	11.7897	20.26184	7.538118	15.8921
	r = 1	4.251578	9.164546	4.251578	9.164546
ports	r = 0	10.57891	20.26184	7.605849	15.8921
	r = 1	2.973057	9.164546	2.973057	9.164546
primary	r = 0	7.995567	20.26184	5.001838	15.8921
	r = 1	2.99373	9.164546	2.99373	9.164546
property	r = 0	6.810354	20.26184	4.724997	15.8921
	r = 1	2.085356	9.164546	2.085356	9.164546
service	r = 0	10.34697	20.26184	9.006363	15.8921
	r = 1	1.340605	9.164546	1.340605	9.164546
textiles	r = 0	10.25626	20.26184	8.834565	15.8921
	r = 1	1.421697	9.164546	1.421697	9.164546
transport	r = 0	9.039278	20.26184	5.922571	15.8921
	r = 1	3.116707	9.164546	3.116707	9.164546

Appendix Table 1c: Daily Johansen-Juselius Cointegration test results with USD/AUD

USD/AUD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	9.621212	20.26184	7.51295	15.8921
	r = 1	2.108262	9.164546	2.108262	9.164546
nzx 15	r = 0	11.49424	20.26184	9.397245	15.8921
	r = 1	2.096997	9.164546	2.096997	9.164546
nzx 50	r = 0	11.51974	20.26184	9.777966	15.8921
	r = 1	1.741775	9.164546	1.741775	9.164546
nzx all	r = 0	13.83655	20.26184	10.80262	15.8921
	r = 1	3.033925	9.164546	3.033925	9.164546
nzx mid	r = 0	7.942007	20.26184	5.350303	15.8921
	r = 1	2.591704	9.164546	2.591704	9.164546
nzx sml	r = 0	13.32326	20.26184	11.13645	15.8921
	r = 1	2.186808	9.164546	2.186808	9.164546
local	r = 0	14.11704	20.26184	10.2534	15.8921
	r = 1	3.863633	9.164546	3.863633	9.164546
Non local Australia	r = 0	9.430651	20.26184	6.097425	15.8921
	r = 1	3.333226	9.164546	3.333226	9.164546
Non local world	r = 0	9.862446	20.26184	5.516712	15.8921
	r = 1	4.345734	9.164546	4.345734	9.164546
Agriculture	r = 0	10.62878	20.26184	9.350546	15.8921
	r = 1	1.278234	9.164546	1.278234	9.164546

building	r = 0	16.58284	20.26184	14.42838	15.8921
	r = 1	2.154465	9.164546	2.154465	9.164546
consumer	r = 0	14.17918	20.26184	10.90889	15.8921
	r = 1	3.270291	9.164546	3.270291	9.164546
energy	r = 0	13.04224	20.26184	11.81877	15.8921
	r = 1	1.223473	9.164546	1.223473	9.164546
finance	r = 0	12.25844	20.26184	9.969214	15.8921
	r = 1	2.289225	9.164546	2.289225	9.164546
food	r = 0	8.03157	20.26184	6.832519	15.8921
	r = 1	1.199051	9.164546	1.199051	9.164546
forestry	r = 0	15.1271	20.26184	12.18986	15.8921
	r = 1	2.937242	9.164546	2.937242	9.164546
goods	r = 0	11.30009	20.26184	7.428955	15.8921
	r = 1	3.87114	9.164546	3.87114	9.164546
intermediate & Durable	r = 0	11.74279	20.26184	8.997041	15.8921
	r = 1	2.745745	9.164546	2.745745	9.164546
investment	r = 0	13.05422	20.26184	10.86409	15.8921
	r = 1	2.190125	9.164546	2.190125	9.164546
leisure	r = 0	11.9562	20.26184	8.902827	15.8921
	r = 1	3.053378	9.164546	3.053378	9.164546
media	r = 0	10.81418	20.26184	7.378739	15.8921
	r = 1	3.43544	9.164546	3.43544	9.164546
mining	r = 0	16.81378	20.26184	11.09794	15.8921
	r = 1	5.715842	9.164546	5.715842	9.164546
ports	r = 0	12.73984	20.26184	10.63805	15.8921
	r = 1	2.101789	9.164546	2.101789	9.164546
primary	r = 0	12.38067	20.26184	10.04518	15.8921
	r = 1	2.335493	9.164546	2.335493	9.164546
property	r = 0	10.49693	20.26184	8.974978	15.8921
	r = 1	1.521953	9.164546	1.521953	9.164546
service	r = 0	13.64627	20.26184	10.45975	15.8921
	r = 1	3.186518	9.164546	3.186518	9.164546
textiles	r = 0	10.60176	20.26184	7.307901	15.8921
	r = 1	3.293857	9.164546	3.293857	9.164546
transport	r = 0	12.08961	20.26184	10.52204	15.8921
	r = 1	1.56756	9.164546	1.56756	9.164546

Weekly Johansen-Juselius Cointegration test results

Appendix Table 2a: Weekly Johansen-Juselius Cointegration test results with USD/NZD

USD/NZD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	7.058339	20.26184	5.350593	15.8921

	r = 1	1.707746	9.164546	1.707746	9.164546
nzx 15	r = 0	12.52495	20.26184	10.33587	15.8921
	r = 1	2.189077	9.164546	2.189077	9.164546
nzx 50	r = 0	10.31339	20.26184	8.3685	15.8921
	r = 1	1.944887	9.164546	1.944887	9.164546
nzx all	r = 0	13.72272	20.26184	10.07986	15.8921
	r = 1	3.642864	9.164546	3.642864	9.164546
nzx mid	r = 0	8.836506	20.26184	5.43923	15.8921
	r = 1	3.397276	9.164546	3.397276	9.164546
nzx sml	r = 0	13.94694	20.26184	10.70257	15.8921
	r = 1	3.244365	9.164546	3.244365	9.164546
local	r = 0	10.94729	20.26184	7.43622	15.8921
	r = 1	3.51107	9.164546	3.51107	9.164546
Non local Australia	r = 0	9.105669	20.26184	5.442448	15.8921
	r = 1	3.663221	9.164546	3.663221	9.164546
Non local world	r = 0	11.15452	20.26184	6.114336	15.8921
	r = 1	5.040186	9.164546	5.040186	9.164546
Agriculture	r = 0	8.451943	20.26184	7.072034	15.8921
	r = 1	1.379909	9.164546	1.379909	9.164546
building	r = 0	14.40893	20.26184	12.05202	15.8921
	r = 1	2.356917	9.164546	2.356917	9.164546
consumer	r = 0	14.49539	20.26184	10.41943	15.8921
	r = 1	4.075951	9.164546	4.075951	9.164546
energy	r = 0	11.51816	20.26184	9.931219	15.8921
	r = 1	1.586941	9.164546	1.586941	9.164546
finance	r = 0	11.72539	20.26184	8.772368	15.8921
	r = 1	2.953027	9.164546	2.953027	9.164546
food	r = 0	10.11207	20.26184	7.952693	15.8921
	r = 1	2.159382	9.164546	2.159382	9.164546
forestry	r = 0	14.11045	20.26184	10.72644	15.8921
	r = 1	3.384004	9.164546	3.384004	9.164546
goods	r = 0	17.79516	20.26184	12.61916	15.8921
	r = 1	5.175997	9.164546	5.175997	9.164546
intermediate & Durable	r = 0	19.53584	20.26184	15.77237	15.8921
	r = 1	2.763475	9.164546	2.763475	9.164546
investment	r = 0	14.34305	20.26184	12.35749	15.8921
	r = 1	1.98556	9.164546	1.98556	9.164546
leisure	r = 0	13.40549	20.26184	9.224859	15.8921
	r = 1	4.180629	9.164546	4.180629	9.164546
media	r = 0	7.982976	20.26184	5.724312	15.8921
	r = 1	2.258664	9.164546	2.258664	9.164546
mining	r = 0	13.60872	20.26184	8.800994	15.8921

	r = 1	4.807731	9.164546	4.807731	9.164546
ports	r = 0	15.74016	20.26184	12.73467	15.8921
	r = 1	3.005492	9.164546	3.005492	9.164546
primary	r = 0	14.12886	20.26184	11.29042	15.8921
	r = 1	2.838441	9.164546	2.838441	9.164546
property	r = 0	7.955698	20.26184	6.61308	15.8921
	r = 1	1.342619	9.164546	1.342619	9.164546
service	r = 0	9.688791	20.26184	5.770206	15.8921
	r = 1	3.918585	9.164546	3.918585	9.164546
textiles	r = 0	9.740891	20.26184	6.520053	15.8921
	r = 1	3.220838	9.164546	3.220838	9.164546
transport	r = 0	11.6048	20.26184	9.421562	15.8921
	r = 1	2.183235	9.164546	2.183235	9.164546

Appendix Table 2b: Weekly Johansen-Juselius Cointegration test results with AUD/NZD

AUD/NZD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	12.41981	20.26184	11.7626	15.8921
	r = 1	0.657214	9.164546	0.657214	9.164546
nzx 15	r = 0	11.07942	20.26184	7.975572	15.8921
	r = 1	3.103851	9.164546	3.103851	9.164546
nzx 50	r = 0	12.92751	20.26184	10.59081	15.8921
	r = 1	2.336695	9.164546	2.336695	9.164546
nzx all	r = 0	11.75407	20.26184	9.441233	15.8921
	r = 1	2.31284	9.164546	2.31284	9.164546
nzx mid	r = 0	9.897788	20.26184	5.943477	15.8921
	r = 1	3.954311	9.164546	3.954311	9.164546
nzx sml	r = 0	12.46411	20.26184	9.2306	15.8921
	r = 1	3.233512	9.164546	3.233512	9.164546
local	r = 0	12.57999	20.26184	8.717954	15.8921
	r = 1	3.862037	9.164546	3.862037	9.164546
Non local Australia	r = 0	8.384931	20.26184	5.562636	15.8921
	r = 1	2.822295	9.164546	2.822295	9.164546
Non local world	r = 0	10.59618	20.26184	6.299262	15.8921
	r = 1	4.296919	9.164546	4.296919	9.164546
Agriculture	r = 0	9.924919	20.26184	6.817578	15.8921
	r = 1	3.10734	9.164546	3.10734	9.164546
building	r = 0	12.95144	20.26184	8.678177	15.8921
	r = 1	4.27326	9.164546	4.27326	9.164546
consumer	r = 0	9.756272	20.26184	6.858113	15.8921
	r = 1	2.898159	9.164546	2.898159	9.164546
energy	r = 0	11.01643	20.26184	6.854871	15.8921

	r = 1	4.161559	9.164546	4.161559	9.164546
finance	r = 0	11.92557	20.26184	9.442323	15.8921
	r = 1	2.48325	9.164546	2.48325	9.164546
food	r = 0	18.02131	20.26184	14.21375	15.8921
	r = 1	3.807556	9.164546	3.807556	9.164546
forestry	r = 0	15.7348	20.26184	8.755569	15.8921
	r = 1	6.979229	9.164546	6.979229	9.164546
goods	r = 0	6.33189	20.26184	5.621129	15.8921
	r = 1	0.710762	9.164546	0.710762	9.164546
intermediate & Durable	r = 0	5.788451	20.26184	4.987814	15.8921
	r = 1	0.800637	9.164546	0.800637	9.164546
investment	r = 0	7.203961	20.26184	4.812631	15.8921
	r = 1	2.391329	9.164546	2.391329	9.164546
leisure	r = 0	11.55368	20.26184	9.740235	15.8921
	r = 1	1.81345	9.164546	1.81345	9.164546
media	r = 0	16.53261	20.26184	14.56268	15.8921
	r = 1	1.969936	9.164546	1.969936	9.164546
mining	r = 0	11.43315	20.26184	6.679814	15.8921
	r = 1	4.753336	9.164546	4.753336	9.164546
ports	r = 0	13.21709	20.26184	9.670366	15.8921
	r = 1	3.546722	9.164546	3.546722	9.164546
primary	r = 0	9.77246	20.26184	5.954254	15.8921
	r = 1	3.818206	9.164546	3.818206	9.164546
property	r = 0	7.953354	20.26184	6.066082	15.8921
	r = 1	1.887272	9.164546	1.887272	9.164546
service	r = 0	13.77521	20.26184	12.22947	15.8921
	r = 1	1.545738	9.164546	1.545738	9.164546
textiles	r = 0	12.00991	20.26184	10.34902	15.8921
	r = 1	1.660898	9.164546	1.660898	9.164546
transport	r = 0	9.952216	20.26184	6.108548	15.8921
	r = 1	3.843668	9.164546	3.843668	9.164546

Appendix Table 2c: Weekly Johansen-Juselius Cointegration test results with USD/AUD

USD/AUD		Trace Test		Max-Eigenvalue Test	
		Statistic	Critical Value	Statistic	Critical Value
nzx 10	r = 0	8.52461	20.26184	5.556937	15.8921
	r = 1	2.967673	9.164546	2.967673	9.164546
nzx 15	r = 0	12.64189	20.26184	10.58734	15.8921
	r = 1	2.054542	9.164546	2.054542	9.164546
nzx 50	r = 0	11.12891	20.26184	9.195511	15.8921
	r = 1	1.933399	9.164546	1.933399	9.164546
nzx all	r = 0	13.43171	20.26184	11.36256	15.8921

	r = 1	2.069151	9.164546	2.069151	9.164546
nzx mid	r = 0	7.233099	20.26184	4.846123	15.8921
	r = 1	2.386976	9.164546	2.386976	9.164546
nzx sml	r = 0	15.36731	20.26184	13.59424	15.8921
	r = 1	1.773072	9.164546	1.773072	9.164546
local	r = 0	9.614229	20.26184	6.800454	15.8921
	r = 1	2.813776	9.164546	2.813776	9.164546
Non local Australia	r = 0	8.482044	20.26184	5.48877	15.8921
	r = 1	2.993274	9.164546	2.993274	9.164546
Non local world	r = 0	9.688101	20.26184	5.969958	15.8921
	r = 1	3.718144	9.164546	3.718144	9.164546
Agriculture	r = 0	10.01847	20.26184	8.482096	15.8921
	r = 1	1.536372	9.164546	1.536372	9.164546
building	r = 0	17.39582	20.26184	14.53915	15.8921
	r = 1	2.856666	9.164546	2.856666	9.164546
consumer	r = 0	13.80653	20.26184	11.99982	15.8921
	r = 1	1.806706	9.164546	1.806706	9.164546
energy	r = 0	12.16735	20.26184	11.06493	15.8921
	r = 1	1.102422	9.164546	1.102422	9.164546
finance	r = 0	12.05313	20.26184	9.804572	15.8921
	r = 1	2.248555	9.164546	2.248555	9.164546
food	r = 0	7.776143	20.26184	6.690133	15.8921
	r = 1	1.086009	9.164546	1.086009	9.164546
forestry	r = 0	12.9414	20.26184	9.777333	15.8921
	r = 1	3.164067	9.164546	3.164067	9.164546
goods	r = 0	11.46264	20.26184	7.570451	15.8921
	r = 1	3.89219	9.164546	3.89219	9.164546
intermediate & Durable	r = 0	12.52175	20.26184	9.577268	15.8921
	r = 1	2.944482	9.164546	2.944482	9.164546
investment	r = 0	12.80758	20.26184	10.99267	15.8921
	r = 1	1.814905	9.164546	1.814905	9.164546
leisure	r = 0	12.0442	20.26184	9.27553	15.8921
	r = 1	2.768671	9.164546	2.768671	9.164546
media	r = 0	10.96108	20.26184	6.436187	15.8921
	r = 1	4.52489	9.164546	4.52489	9.164546
mining	r = 0	12.62883	20.26184	8.609534	15.8921
	r = 1	4.019299	9.164546	4.019299	9.164546
ports	r = 0	15.33144	20.26184	13.47387	15.8921
	r = 1	1.857573	9.164546	1.857573	9.164546
primary	r = 0	12.64626	20.26184	10.75204	15.8921
	r = 1	1.89422	9.164546	1.89422	9.164546
property	r = 0	7.399784	20.26184	5.942853	15.8921

	r = 1	1.456931	9.164546	1.456931	9.164546
service	r = 0	13.68367	20.26184	11.00278	15.8921
	r = 1	2.680892	9.164546	2.680892	9.164546
textiles	r = 0	11.90952	20.26184	9.268167	15.8921
	r = 1	2.641349	9.164546	2.641349	9.164546
transport	r = 0	11.44874	20.26184	10.14168	15.8921
	r = 1	1.307055	9.164546	1.307055	9.164546

Daily lag length selection

Appendix Table 3a: Daily lag length selection with USD/NZD

USD/NZD	LR	FPE	AIC	SC	HQ
nzx 10	4	4	4	1	1
nzx 15	4	4	4	1	2
nzx 50	4	2	2	1	2
nzx all	1	1	1	1	1
nzx mid	1	2	2	1	1
nzx sml	1	1	1	1	1
Local	2	2	2	1	1
Non-local Australia	2	2	2	1	1
Non-local world	1	2	2	1	1
agriculture	1	1	1	1	1
building	2	2	2	1	2
consumer	1	1	1	1	1
energy	1	1	1	1	1
finance	2	2	2	1	1
food	5	1	1	1	1
forestry	2	2	2	1	1
goods	3	3	3	1	1
intermediate & Durable	3	4	4	1	2
investment	1	2	2	1	1
leisure	2	2	2	1	1
media	5	1	1	1	1
mining	2	2	2	1	1
ports	5	2	2	2	2
primary	2	2	2	1	1
property	5	2	2	1	2
service	5	2	2	1	1
textiles	1	2	2	1	1
transport	1	1	1	1	1

Appendix Table 3b: Daily lag length selection with AUD/NZD

AUD/NZD	LR	FPE	AIC	SC	HQ

nzx 10	6	6	6	1	1
nzx 15	6	6	6	1	1
nzx 50	6	6	6	1	2
nzx all	1	1	1	1	1
nzx mid	1	2	2	1	1
nzx sml	1	1	1	1	1
Local	1	1	1	1	1
Non-local Australia	1	1	1	1	1
Non-local world	1	1	1	1	1
agriculture	1	1	1	1	1
building	6	2	2	1	2
consumer	1	2	2	1	1
energy	1	1	1	1	1
finance	6	2	2	1	1
food	1	2	2	1	1
forestry	7	2	2	1	1
goods	6	2	2	1	2
intermediate & Durable	6	2	2	1	2
investment	1	2	2	1	1
leisure	2	2	2	1	2
media	6	4	4	1	1
mining	6	1	1	1	1
ports	6	2	2	1	2
primary	1	1	1	1	1
property	2	2	2	1	2
service	4	1	1	1	1
textiles	1	1	1	1	1
transport	1	1	1	1	1

Appendix Table 3c: Daily lag length selection with USD/AUD

USD/AUD	LR	FPE	AIC	SC	HQ
nzx 10	2	2	2	1	1
nzx 15	2	2	2	1	1
nzx 50	2	2	2	1	1
nzx all	1	1	1	1	1
nzx mid	1	1	1	1	1
nzx sml	1	1	1	1	1
Local	1	1	1	1	1
Non-local Australia	1	2	2	1	1
Non-local world	1	1	1	1	1
agriculture	1	1	1	1	1
building	1	2	2	1	1

consumer	1	1	1	1	1
energy	1	1	1	1	1
finance	1	2	2	1	1
food	1	1	1	1	1
forestry	1	1	1	1	1
goods	1	1	1	1	1
intermediate & Durable	1	1	1	1	1
investment	1	1	1	1	1
leisure	1	2	2	1	1
media	1	1	1	1	1
mining	1	1	1	1	1
ports	2	2	2	1	2
primary	1	1	1	1	1
property	2	2	2	1	1
service	1	1	1	1	1
textiles	1	1	1	1	1
transport	1	1	1	1	1

Weekly lag length selection

Appendix Table 4a: Weekly lag length selection with USD/NZD

USD/NZD	LR	FPE	AIC	SC	HQ
nzx 10	7	2	2	2	2
nzx 15	2	2	2	1	2
nzx 50	2	2	2	1	2
nzx all	2	2	2	1	1
nzx mid	7	2	2	1	1
nzx sml	2	2	2	1	1
Local	1	1	1	1	1
Non-local Australia	1	1	1	1	1
Non-local world	1	1	1	1	1
agriculture	2	2	2	1	1
building	2	2	2	1	1
consumer	1	2	2	1	1
energy	2	2	2	1	1
finance	2	2	2	1	2
food	2	2	2	1	1
forestry	2	2	2	1	1
goods	3	3	3	1	2
intermediate & Durable	3	3	3	1	3
investment	2	2	2	1	1
leisure	7	2	2	1	1
media	8	3	3	1	2
mining	2	2	2	1	1

ports	6	3	3	1	2
primary	2	2	2	1	1
property	2	3	3	1	2
service	2	3	3	1	2
textiles	2	2	2	1	1
transport	2	2	2	1	1

Appendix Table 4b: Weekly lag length selection with AUD/NZD

AUD/NZD	LR	FPE	AIC	SC	HQ
nzx 10	2	2	2	1	1
nzx 15	2	2	2	1	1
nzx 50	2	2	2	1	1
nzx all	1	1	1	1	1
nzx mid	1	1	1	1	1
nzx sml	5	1	1	1	1
Local	2	2	2	1	1
Non-local Australia	1	1	1	1	1
Non-local world	1	1	1	1	1
agriculture	1	1	1	1	1
building	1	1	1	1	1
consumer	1	1	1	1	1
energy	1	1	1	1	1
finance	1	1	1	1	1
food	1	1	1	1	1
forestry	7	2	2	1	1
goods	1	1	1	1	1
intermediate & Durable	1	4	4	1	1
investment	1	2	2	1	1
leisure	1	1	1	1	1
media	2	2	2	1	1
mining	1	1	1	1	1
ports	6	2	2	1	1
primary	1	1	1	1	1
property	1	1	1	1	1
service	1	1	1	1	1
textiles	1	1	1	1	1
transport	1	1	1	1	1

Appendix Table 4c: Weekly lag length selection with USD/AUD

USD/AUD	LR	FPE	AIC	SC	HQ
nzx 10	7	1	1	1	1
nzx 15	7	1	1	1	1

nzx 50	7	1	1	1	1
nzx all	1	1	1	1	1
nzx mid	1	1	1	1	1
nzx sml	1	1	1	1	1
Local	1	1	1	1	1
Non-local Australia	1	1	1	1	1
Non-local world	1	1	1	1	1
agriculture	8	1	1	1	1
building	1	1	1	1	1
consumer	6	1	1	1	1
energy	1	1	1	1	1
finance	1	1	1	1	1
food	1	1	1	1	1
forestry	1	1	1	1	1
goods	6	1	1	1	1
intermediate & Durable	6	1	1	1	1
investment	6	1	1	1	1
leisure	1	1	1	1	1
media	8	1	1	1	1
mining	1	1	1	1	1
ports	6	1	1	1	1
primary	1	1	1	1	1
property	1	1	1	1	1
service	1	1	1	1	1
textiles	1	1	1	1	1
transport	1	1	1	1	1

Daily Granger Causality tests

Appendix Table 5a: Daily Granger Causality tests between first classification and USD/NZD

USD/NZD			F-test	P-value
nzx 10	lag 4	LN_NZ10_CAP does not Granger Cause LN_USD_NZD_R	0.94246	0.43844
		LN_USD_NZD_R does not Granger Cause LN_NZ10_CAP	3.54307	0.00698
	lag 1	LN_NZ10_CAP does not Granger Cause LN_USD_NZD_R	2.20919	0.13745
		LN_USD_NZD_R does not Granger Cause LN_NZ10_CAP	0.18789	0.66476
nzx 15	lag 4	LN_NZ15_CAP does not Granger Cause LN_USD_NZD_R	0.78407	0.53553
		LN_USD_NZD_R does not Granger Cause LN_NZ15_CAP	4.90399	0.00063
	lag 1	LN_NZ15_CAP does not Granger Cause LN_USD_NZD_R	0.60159	0.43812
		LN_USD_NZD_R does not Granger Cause LN_NZ15_CAP	5.09785	0.02413
	lag 2	LN_NZ15_CAP does not Granger Cause LN_USD_NZD_R	0.56182	0.57032
		LN_USD_NZD_R does not Granger Cause LN_NZ15_CAP	2.88618	0.05617
nzx 50	lag 4	LN_NZ50_CAP does not Granger Cause LN_USD_NZD_R	0.63905	0.63471
		LN_USD_NZD_R does not Granger Cause LN_NZ50_CAP	2.5496	0.03775
	lag 2	LN_NZ50_CAP does not Granger Cause LN_USD_NZD_R	0.40126	0.66957

		LN_USD_NZD_R does not Granger Cause LN_NZ50_CAP	0.96436	0.38152
	lag 1	LN_NZ50_CAP does not Granger Cause LN_USD_NZD_R	0.48776	0.48506
		LN_USD_NZD_R does not Granger Cause LN_NZ50_CAP	0.11144	0.73857
nzx all	lag 1	LN_NZALL_CAP does not Granger Cause LN_USD_NZD_R	0.42597	0.51409
		LN_USD_NZD_R does not Granger Cause LN_NZALL_CAP	0.29568	0.5867
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_USD_NZD_R	0.15657	0.69241
		LN_USD_NZD_R does not Granger Cause LN_NZMID_CAP	2.05059	0.1524
	lag 2	LN_NZMID_CAP does not Granger Cause LN_USD_NZD_R	0.21683	0.8051
		LN_USD_NZD_R does not Granger Cause LN_NZMID_CAP	1.769	0.17094
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_USD_NZD_R	0.27559	0.5997
		LN_USD_NZD_R does not Granger Cause LN_NZSML_CAP	0.11454	0.73509

Appendix Table 5b: Daily Granger Causality tests between first classification and AUD/NZD

AUD/NZD			F-test	P-value
nzx 10	lag 6	LN_NZ10_CAP does not Granger Cause LN_AUD_NZD_R	1.25796	0.27405
		LN_AUD_NZD_R does not Granger Cause LN_NZ10_CAP	3.28699	0.00327
	lag 1	LN_NZ10_CAP does not Granger Cause LN_AUD_NZD_R	0.06472	0.79923
		LN_AUD_NZD_R does not Granger Cause LN_NZ10_CAP	0.50862	0.47587
nzx 15	lag 6	LN_NZ15_CAP does not Granger Cause LN_AUD_NZD_R	1.62946	0.13542
		LN_AUD_NZD_R does not Granger Cause LN_NZ15_CAP	3.23613	0.00369
	lag 1	LN_NZ15_CAP does not Granger Cause LN_AUD_NZD_R	0.0177	0.89418
		LN_AUD_NZD_R does not Granger Cause LN_NZ15_CAP	0.01434	0.9047
nzx 50	lag 6	LN_NZ50_CAP does not Granger Cause LN_AUD_NZD_R	1.59649	0.14459
		LN_AUD_NZD_R does not Granger Cause LN_NZ50_CAP	3.35398	0.00278
	lag 1	LN_NZ50_CAP does not Granger Cause LN_AUD_NZD_R	0.1163	0.73314
		LN_AUD_NZD_R does not Granger Cause LN_NZ50_CAP	3.43138	0.06421
	lag 2	LN_NZ50_CAP does not Granger Cause LN_AUD_NZD_R	0.15836	0.85356
		LN_AUD_NZD_R does not Granger Cause LN_NZ50_CAP	1.7094	0.18141
nzx all	lag 1	LN_NZALL_CAP does not Granger Cause LN_AUD_NZD_R	0.25892	0.61096
		LN_AUD_NZD_R does not Granger Cause LN_NZALL_CAP	0.03118	0.85987
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_AUD_NZD_R	1.64758	0.19953
		LN_AUD_NZD_R does not Granger Cause LN_NZMID_CAP	1.45857	0.22739
	lag 2	LN_NZMID_CAP does not Granger Cause LN_AUD_NZD_R	0.80741	0.44625
		LN_AUD_NZD_R does not Granger Cause LN_NZMID_CAP	0.72859	0.4828
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_AUD_NZD_R	0.66181	0.41608
		LN_AUD_NZD_R does not Granger Cause LN_NZSML_CAP	0.13481	0.71356

Appendix Table 5c: Daily Granger Causality tests between first classification and USD/AUD

USD/AUD			F-test	P-value
nzx 10	lag 2	LN_NZ10_CAP does not Granger Cause LN_USD_AUD_R	1.56575	0.20935
		LN_USD_AUD_R does not Granger Cause LN_NZ10_CAP	0.75097	0.47213
	lag 1	LN_NZ10_CAP does not Granger Cause LN_USD_AUD_R	2.70649	0.1002

		LN_USD_AUD_R does not Granger Cause LN_NZ10_CAP	0.88127	0.34804
nzx 15	lag 1	LN_USD_AUD_R does not Granger Cause LN_NZ15_CAP	5.84434	0.01577
		LN_NZ15_CAP does not Granger Cause LN_USD_AUD_R	0.97392	0.3239
	lag 2	LN_USD_AUD_R does not Granger Cause LN_NZ15_CAP	3.39443	0.03388
		LN_NZ15_CAP does not Granger Cause LN_USD_AUD_R	1.1829	0.30674
nzx 50	lag 1	LN_NZ50_CAP does not Granger Cause LN_USD_AUD_R	1.62444	0.20272
		LN_USD_AUD_R does not Granger Cause LN_NZ50_CAP	2.47342	0.11604
	lag 2	LN_NZ50_CAP does not Granger Cause LN_USD_AUD_R	1.10807	0.33053
		LN_USD_AUD_R does not Granger Cause LN_NZ50_CAP	2.31901	0.09881
nzx all	lag 1	LN_NZALL_CAP does not Granger Cause LN_USD_AUD_R	0.15894	0.6902
		LN_USD_AUD_R does not Granger Cause LN_NZALL_CAP	0.23057	0.63119
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_USD_AUD_R	0.14097	0.70738
		LN_USD_AUD_R does not Granger Cause LN_NZMID_CAP	0.63254	0.42658
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_USD_AUD_R	0.00055	0.98132
		LN_USD_AUD_R does not Granger Cause LN_NZSML_CAP	0.01802	0.89323

Appendix Table 6a: Daily Granger Causality tests between second classification and USD/NZD

USD/NZD			F-test	P-value
local	lag 2	LN_LOCAL_CAP does not Granger Cause LN_USD_NZD_R	0.87401	0.41754
		LN_USD_NZD_R does not Granger Cause LN_LOCAL_CAP	0.52494	0.59172
	lag 1	LN_LOCAL_CAP does not Granger Cause LN_USD_NZD_R	1.47069	0.22547
		LN_USD_NZD_R does not Granger Cause LN_LOCAL_CAP	1.06575	0.30211
Non local Australia	lag 2	LN_N_A_CAP does not Granger Cause LN_USD_NZD_R	0.31181	0.73218
		LN_USD_NZD_R does not Granger Cause LN_N_A_CAP	0.94894	0.38744
	lag 1	LN_N_A_CAP does not Granger Cause LN_USD_NZD_R	0.64524	0.42198
		LN_USD_NZD_R does not Granger Cause LN_N_A_CAP	1.16936	0.27975
Non local world	lag 2	LN_N_W_CAP does not Granger Cause LN_USD_NZD_R	2.37473	0.09347
		LN_USD_NZD_R does not Granger Cause LN_N_W_CAP	0.22835	0.79588
	lag 1	LN_N_W_CAP does not Granger Cause LN_USD_NZD_R	0.02655	0.87058
		LN_USD_NZD_R does not Granger Cause LN_N_W_CAP	0.00141	0.97007

Appendix Table 6b: Daily Granger Causality tests between second classification and AUD/NZD

AUD/NZD			F-test	P-value
local	lag 1	LN_LOCAL_CAP does not Granger Cause LN_AUD_NZD_R	0.0008	0.97748
		LN_AUD_NZD_R does not Granger Cause LN_LOCAL_CAP	0.29164	0.58927
Non local Australia	lag 1	LN_N_A_CAP does not Granger Cause LN_AUD_NZD_R	0.26209	0.60878
		LN_AUD_NZD_R does not Granger Cause LN_N_A_CAP	3.36351	0.0669

Non local world	lag 1	LN_N_W_CAP does not Granger Cause LN_AUD_NZD_R	0.24729	0.61908
		LN_AUD_NZD_R does not Granger Cause LN_N_W_CAP	0.48734	0.48525

Appendix Table 6c: Daily Granger Causality tests between second classification and USD/AUD

USD/AUD			F-test	P-value
local	lag 1	LN_LOCAL_CAP does not Granger Cause LN_USD_AUD_R	2.14445	0.14335
		LN_USD_AUD_R does not Granger Cause LN_LOCAL_CAP	2.24011	0.13473
non-local Australia	lag 1	LN_N_A_CAP does not Granger Cause LN_USD_AUD_R	1.07636	0.29972
		LN_USD_AUD_R does not Granger Cause LN_N_A_CAP	5.81263	0.01606
	lag 2	LN_N_A_CAP does not Granger Cause LN_USD_AUD_R	0.80356	0.44797
		LN_USD_AUD_R does not Granger Cause LN_N_A_CAP	3.11995	0.04452
non-local world	lag 1	LN_N_W_CAP does not Granger Cause LN_USD_AUD_R	0.02324	0.87887
		LN_USD_AUD_R does not Granger Cause LN_N_W_CAP	0.16748	0.68243

Appendix Table 7a: Daily Granger Causality tests between third classification and USD/NZD

USD/NZD			F-test	P-value
agriculture	lag 1	LN_USD_NZD_R does not Granger Cause LN_AGRICULTURE_CAP	0.00469	0.94539
		LN_AGRICULTURE_CAP does not Granger Cause LN_USD_NZD_R	0.02501	0.87438
building	lag 2	LN_BUILDING_CAP does not Granger Cause LN_USD_NZD_R	0.01137	0.98869
		LN_USD_NZD_R does not Granger Cause LN_BUILDING_CAP	2.31973	0.09873
	lag 1	LN_BUILDING_CAP does not Granger Cause LN_USD_NZD_R	0.03625	0.84903
		LN_USD_NZD_R does not Granger Cause LN_BUILDING_CAP	2.68465	0.10158
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_USD_NZD_R	0.01931	0.8895
		LN_USD_NZD_R does not Granger Cause LN_CONSUMER_CAP	0.54845	0.45909
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_USD_NZD_R	0.09168	0.76211
		LN_USD_NZD_R does not Granger Cause LN_ENERGY_CAP	0.31905	0.57228
finance	lag 2	LN_FINANCE_CAP does not Granger Cause LN_USD_NZD_R	0.07543	0.92735
		LN_USD_NZD_R does not Granger Cause	1.90497	0.14927

		LN_FINANCE_CAP		
	lag 1	LN_FINANCE_CAP does not Granger Cause LN_USD_NZD_R	0.12201	0.72692
		LN_USD_NZD_R does not Granger Cause LN_FINANCE_CAP	3.7766	0.0522
food	lag 5	LN_FOOD_CAP does not Granger Cause LN_USD_NZD_R	0.6808	0.63804
		LN_USD_NZD_R does not Granger Cause LN_FOOD_CAP	1.04884	0.38737
	lag 1	LN_FOOD_CAP does not Granger Cause LN_USD_NZD_R	1.11947	0.29024
		LN_USD_NZD_R does not Granger Cause LN_FOOD_CAP	0.03278	0.85636
forestry	lag 2	LN_FORESTRY_CAP does not Granger Cause LN_USD_NZD_R	0.06322	0.93874
		LN_USD_NZD_R does not Granger Cause LN_FORESTRY_CAP	2.7004	0.06758
	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_USD_NZD_R	0.00364	0.95189
		LN_USD_NZD_R does not Granger Cause LN_FORESTRY_CAP	5.4363	0.01988
goods	lag 3	LN_GOODS_CAP does not Granger Cause LN_USD_NZD_R	0.43952	0.72477
		LN_USD_NZD_R does not Granger Cause LN_GOODS_CAP	7.21611	8.40E-05
	lag 1	LN_GOODS_CAP does not Granger Cause LN_USD_NZD_R	0.14815	0.70037
		LN_USD_NZD_R does not Granger Cause LN_GOODS_CAP	6.23335	0.01267
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.81023	0.36823
		LN_USD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	6.06841	0.0139
	lag 2	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.62023	0.53799
		LN_USD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	8.19537	0.00029
	lag 3	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.69318	0.55625
		LN_USD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	7.12488	9.60E-05
	lag 4	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.62473	0.64492
		LN_USD_NZD_R does not Granger Cause	5.74936	0.00014

		LN_INTERMEDIATE_CAP		
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_USD_NZD_R	0.30246	0.58245
		LN_USD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	1.78618	0.18164
	lag 2	LN_INVESTMENT_CAP does not Granger Cause LN_USD_NZD_R	0.20113	0.81784
		LN_USD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	2.22836	0.10814
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_USD_NZD_R	1.00621	0.31601
		LN_USD_NZD_R does not Granger Cause LN_LEISURE_CAP	0.32678	0.56767
	lag 2	LN_LEISURE_CAP does not Granger Cause LN_USD_NZD_R	0.51902	0.59523
		LN_USD_NZD_R does not Granger Cause LN_LEISURE_CAP	0.79241	0.45298
media	lag 5	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	0.40727	0.84398
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	2.22049	0.0501
	lag 1	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	0.8454	0.35804
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	0.20207	0.65314
mining	lag 2	LN_MINING_CAP does not Granger Cause LN_USD_NZD_R	0.44431	0.64137
		LN_USD_NZD_R does not Granger Cause LN_MINING_CAP	0.46782	0.62648
	lag 1	LN_MINING_CAP does not Granger Cause LN_USD_NZD_R	0.70435	0.40149
		LN_USD_NZD_R does not Granger Cause LN_MINING_CAP	0.69098	0.40599
ports	lag 5	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	1.7712	0.11584
		LN_USD_NZD_R does not Granger Cause LN_PORTS_CAP	3.16509	0.00762
	lag 2	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	0.29106	0.74752
		LN_USD_NZD_R does not Granger Cause LN_PORTS_CAP	2.91114	0.05479
primary	lag 2	LN_PRIMARY_CAP does not Granger Cause LN_USD_NZD_R	0.47137	0.62426
		LN_USD_NZD_R does not Granger Cause	2.24109	0.10678

		LN_PRIMARY_CAP		
	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_USD_NZD_R	0.7664	0.3815
		LN_USD_NZD_R does not Granger Cause LN_PRIMARY_CAP	2.61181	0.10633
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	0.02975	0.86309
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	4.35105	0.03719
	lag 2	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	0.09944	0.90535
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	3.04071	0.04816
	lag 5	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	0.21328	0.95696
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	2.63038	0.02249
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	0.69358	0.40511
		LN_USD_NZD_R does not Granger Cause LN_SERVICE_CAP	0.38431	0.53542
	lag 2	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	0.53161	0.58779
		LN_USD_NZD_R does not Granger Cause LN_SERVICE_CAP	0.83422	0.43446
	lag 5	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	0.6724	0.64444
		LN_USD_NZD_R does not Granger Cause LN_SERVICE_CAP	2.05025	0.06922
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_USD_NZD_R	0.73335	0.39197
		LN_USD_NZD_R does not Granger Cause LN_TEXTILES_CAP	0.56588	0.45204
	lag 2	LN_TEXTILES_CAP does not Granger Cause LN_USD_NZD_R	0.76145	0.46721
		LN_USD_NZD_R does not Granger Cause LN_TEXTILES_CAP	3.79453	0.02276
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause LN_USD_NZD_R	0.02414	0.87654
		LN_USD_NZD_R does not Granger Cause LN_TRANSPORT_CAP	0.07197	0.78853

Appendix Table 7b: Daily Granger Causality tests between third classification and AUD/NZD

AUD NZD			F-test	P-value
agriculture	lag 1	LN_AGRICULTURE_CAP does not Granger Cause LN_AUD_NZD_R	0.06321	0.80154
		LN_AUD_NZD_R does not Granger Cause LN_AGRICULTURE_CAP	0.04495	0.83212
building	lag 1	LN_BUILDING_CAP does not Granger Cause LN_AUD_NZD_R	2.06282	0.15119
		LN_AUD_NZD_R does not Granger Cause LN_BUILDING_CAP	0.6641	0.41527
	lag 2	LN_BUILDING_CAP does not Granger Cause LN_AUD_NZD_R	1.1974	0.30233
		LN_AUD_NZD_R does not Granger Cause LN_BUILDING_CAP	0.43267	0.64887
	lag 6	LN_BUILDING_CAP does not Granger Cause LN_AUD_NZD_R	0.75694	0.60393
		LN_AUD_NZD_R does not Granger Cause LN_BUILDING_CAP	1.63004	0.13527
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_AUD_NZD_R	0.00038	0.98454
		LN_AUD_NZD_R does not Granger Cause LN_CONSUMER_CAP	3.01567	0.08272
	lag 2	LN_CONSUMER_CAP does not Granger Cause LN_AUD_NZD_R	0.87096	0.41881
		LN_AUD_NZD_R does not Granger Cause LN_CONSUMER_CAP	1.53771	0.21529
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_AUD_NZD_R	0.0075	0.93099
		LN_AUD_NZD_R does not Granger Cause LN_ENERGY_CAP	0.29479	0.58726
finance	lag 1	LN_FINANCE_CAP does not Granger Cause LN_AUD_NZD_R	1.83972	0.17523
		LN_AUD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.19563	0.65835
	lag 2	LN_FINANCE_CAP does not Granger Cause LN_AUD_NZD_R	1.1725	0.30994
		LN_AUD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.1158	0.89066
	lag 6	LN_FINANCE_CAP does not Granger Cause LN_AUD_NZD_R	1.37456	0.22153
		LN_AUD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.2872	0.94319
food	lag 1	LN_FOOD_CAP does not Granger Cause LN_AUD_NZD_R	1.10688	0.29297
		LN_AUD_NZD_R does not Granger Cause LN_FOOD_CAP	1.68286	0.19479
	lag 2	LN_FOOD_CAP does not Granger Cause LN_AUD_NZD_R	0.70538	0.49412

		LN_AUD_NZD_R does not Granger Cause LN_FOOD_CAP	1.35808	0.25754
forestry	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	1.09723	0.29508
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	7.94139	0.00491
	lag 2	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	1.18813	0.30514
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	4.62709	0.00996
	lag 7	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	2.0808	0.04285
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	2.94015	0.00468
goods	lag 1	LN_GOODS_CAP does not Granger Cause LN_AUD_NZD_R	0.10337	0.74787
		LN_AUD_NZD_R does not Granger Cause LN_GOODS_CAP	11.8929	0.00058
	lag 2	LN_GOODS_CAP does not Granger Cause LN_AUD_NZD_R	0.58665	0.55634
		LN_AUD_NZD_R does not Granger Cause LN_GOODS_CAP	6.91372	0.00103
	lag 6	LN_GOODS_CAP does not Granger Cause LN_AUD_NZD_R	0.60481	0.72668
		LN_AUD_NZD_R does not Granger Cause LN_GOODS_CAP	3.70881	0.00117
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_AUD_NZD_R	0.00849	0.9266
		LN_AUD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	14.9964	0.00011
	lag 2	LN_INTERMEDIATE_CAP does not Granger Cause LN_AUD_NZD_R	0.50379	0.60436
		LN_AUD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	8.71463	0.00017
	lag 6	LN_INTERMEDIATE_CAP does not Granger Cause LN_AUD_NZD_R	1.00546	0.4201
		LN_AUD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	4.7904	7.70E-05
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_AUD_NZD_R	3.70378	0.05452
		LN_AUD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	0.11928	0.72987
	lag 2	LN_INVESTMENT_CAP does not Granger Cause LN_AUD_NZD_R	2.39464	0.09163
		LN_AUD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	0.47421	0.62249
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_AUD_NZD_R	3.62373	0.0572
		LN_AUD_NZD_R does not Granger Cause LN_LEISURE_CAP	7.70293	0.0056
	lag 2	LN_LEISURE_CAP does not Granger Cause	2.38219	0.09278

		LN_AUD_NZD_R		
		LN_AUD_NZD_R does not Granger Cause LN_LEISURE_CAP	3.86768	0.02116
media	lag 1	LN_MEDIA_CAP does not Granger Cause LN_AUD_NZD_R	1.63352	0.20146
		LN_AUD_NZD_R does not Granger Cause LN_MEDIA_CAP	0.00683	0.93415
	lag 4	LN_MEDIA_CAP does not Granger Cause LN_AUD_NZD_R	2.39122	0.04903
		LN_AUD_NZD_R does not Granger Cause LN_MEDIA_CAP	2.59391	0.03507
	lag 6	LN_MEDIA_CAP does not Granger Cause LN_AUD_NZD_R	1.77014	0.10184
		LN_AUD_NZD_R does not Granger Cause LN_MEDIA_CAP	1.95444	0.06927
mining	lag 1	LN_MINING_CAP does not Granger Cause LN_AUD_NZD_R	0.22301	0.63684
		LN_AUD_NZD_R does not Granger Cause LN_MINING_CAP	1.69682	0.19295
	lag 6	LN_MINING_CAP does not Granger Cause LN_AUD_NZD_R	0.62581	0.70976
		LN_AUD_NZD_R does not Granger Cause LN_MINING_CAP	1.62767	0.13591
ports	lag 1	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	1.43291	0.23152
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	0.59779	0.43957
	lag 2	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	0.80517	0.44725
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	0.849	0.4281
	lag 6	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	2.50511	0.02055
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	0.70729	0.64379
primary	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_AUD_NZD_R	0.33722	0.56155
		LN_AUD_NZD_R does not Granger Cause LN_PRIMARY_CAP	1.4813	0.22381
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_AUD_NZD_R	0.86475	0.3526
		LN_AUD_NZD_R does not Granger Cause LN_PROPERTY_CAP	0.73661	0.39092
	lag 2	LN_PROPERTY_CAP does not Granger Cause LN_AUD_NZD_R	1.24508	0.28828
		LN_AUD_NZD_R does not Granger Cause LN_PROPERTY_CAP	0.35803	0.69913
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_AUD_NZD_R	1.27533	0.25899
		LN_AUD_NZD_R does not Granger Cause LN_SERVICE_CAP	0.0526	0.81863
	lag 4	LN_SERVICE_CAP does not Granger Cause LN_AUD_NZD_R	2.76759	0.02624
		LN_AUD_NZD_R does not Granger Cause LN_SERVICE_CAP	0.38505	0.81945
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_AUD_NZD_R	0.42365	0.51524
		LN_AUD_NZD_R does not Granger Cause LN_TEXTILES_CAP	0.78403	0.37609
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause	0.00293	0.95684

		LN_AUD_NZD_R		
		LN_AUD_NZD_R does not Granger Cause LN_TRANSPORT_CAP	0.44211	0.50623

Appendix Table 7c: Daily Granger Causality tests between third classification and USD/AUD

USD AUD			F-test	P-value
agriculture	lag 1	LN_AGRICULTURE_CAP does not Granger Cause LN_USD_AUD_R	0.06496	0.79886
		LN_USD_AUD_R does not Granger Cause LN_AGRICULTURE_CAP	0.00393	0.95002
building	lag 1	LN_BUILDING_CAP does not Granger Cause LN_USD_AUD_R	0.63694	0.42498
		LN_USD_AUD_R does not Granger Cause LN_BUILDING_CAP	1.62304	0.20291
	lag 2	LN_BUILDING_CAP does not Granger Cause LN_USD_AUD_R	0.4434	0.64196
		LN_USD_AUD_R does not Granger Cause LN_BUILDING_CAP	1.49813	0.22396
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_USD_AUD_R	0.04026	0.841
		LN_USD_AUD_R does not Granger Cause LN_CONSUMER_CAP	0.09374	0.75953
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_USD_AUD_R	0.06388	0.80051
		LN_USD_AUD_R does not Granger Cause LN_ENERGY_CAP	0.07101	0.78992
finance	lag 1	LN_FINANCE_CAP does not Granger Cause LN_USD_AUD_R	2.05228	0.15223
		LN_USD_AUD_R does not Granger Cause LN_FINANCE_CAP	3.40664	0.06518
	lag 2	LN_FINANCE_CAP does not Granger Cause LN_USD_AUD_R	1.18543	0.30597
		LN_USD_AUD_R does not Granger Cause LN_FINANCE_CAP	1.74708	0.17472
food	lag 1	LN_FOOD_CAP does not Granger Cause LN_USD_AUD_R	2.9783	0.08464
		LN_USD_AUD_R does not Granger Cause LN_FOOD_CAP	1.07154	0.3008
forestry	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_USD_AUD_R	0.3618	0.54762
		LN_USD_AUD_R does not Granger Cause LN_FORESTRY_CAP	0.56374	0.4529
goods	lag 1	LN_GOODS_CAP does not Granger Cause LN_USD_AUD_R	0.40873	0.52274
		LN_USD_AUD_R does not Granger Cause LN_GOODS_CAP	0.29847	0.58494
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_AUD_R	0.87199	0.35059
		LN_USD_AUD_R does not Granger Cause	0.06145	0.80426

		LN_INTERMEDIATE_CAP		
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_USD_AUD_R	0.44347	0.50558
		LN_USD_AUD_R does not Granger Cause LN_INVESTMENT_CAP	2.84199	0.09209
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_USD_AUD_R	0.01039	0.91882
		LN_USD_AUD_R does not Granger Cause LN_LEISURE_CAP	5.76266	0.01652
	lag 2	LN_LEISURE_CAP does not Granger Cause LN_USD_AUD_R	0.32019	0.72607
		LN_USD_AUD_R does not Granger Cause LN_LEISURE_CAP	3.92264	0.02004
media	lag 1	LN_MEDIA_CAP does not Granger Cause LN_USD_AUD_R	0.06601	0.79729
		LN_USD_AUD_R does not Granger Cause LN_MEDIA_CAP	0.30041	0.58372
mining	lag 1	LN_MINING_CAP does not Granger Cause LN_USD_AUD_R	1.56494	0.21118
		LN_USD_AUD_R does not Granger Cause LN_MINING_CAP	3.06073	0.08046
ports	lag 1	LN_PORTS_CAP does not Granger Cause LN_USD_AUD_R	0.20256	0.65274
		LN_USD_AUD_R does not Granger Cause LN_PORTS_CAP	1.26453	0.26102
	lag 2	LN_PORTS_CAP does not Granger Cause LN_USD_AUD_R	0.43448	0.6477
		LN_USD_AUD_R does not Granger Cause LN_PORTS_CAP	1.53846	0.21513
primary	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_USD_AUD_R	1.73732	0.18773
		LN_USD_AUD_R does not Granger Cause LN_PRIMARY_CAP	0.98311	0.32163
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_USD_AUD_R	0.10878	0.74159
		LN_USD_AUD_R does not Granger Cause LN_PROPERTY_CAP	2.98664	0.08421
	lag 2	LN_PROPERTY_CAP does not Granger Cause LN_USD_AUD_R	0.89253	0.40989
		LN_USD_AUD_R does not Granger Cause LN_PROPERTY_CAP	2.5261	0.08039
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_USD_AUD_R	0.05122	0.82099
		LN_USD_AUD_R does not Granger Cause LN_SERVICE_CAP	0.28081	0.59627
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_USD_AUD_R	0.37931	0.53809
		LN_USD_AUD_R does not Granger Cause LN_TEXTILES_CAP	0.06764	0.79485
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause LN_USD_AUD_R	0.05233	0.8191
		LN_USD_AUD_R does not Granger Cause LN_TRANSPORT_CAP	0.01858	0.89161

Weekly Granger Causality tests

Appendix Table 8a: Weekly Granger Causality tests between first classification and USD/NZD

USD NZD			F-test	P-value
nzx 10	lag 2	LN_NZ10_CAP does not Granger Cause LN_USD_NZD_R	3.64614	0.02747
		LN_USD_NZD_R does not Granger Cause LN_NZ10_CAP	4.25429	0.01523
	lag 7	LN_NZ10_CAP does not Granger Cause LN_USD_NZD_R	3.58611	0.00109
		LN_USD_NZD_R does not Granger Cause LN_NZ10_CAP	1.77337	0.09334
nzx 15	lag 2	LN_NZ15_CAP does not Granger Cause LN_USD_NZD_R	2.67039	0.07118
		LN_USD_NZD_R does not Granger Cause LN_NZ15_CAP	4.11575	0.01742
	lag 1	LN_NZ15_CAP does not Granger Cause LN_USD_NZD_R	1.58397	0.20934
		LN_USD_NZD_R does not Granger Cause LN_NZ15_CAP	8.20177	0.00453
nzx 50	lag 2	LN_NZ50_CAP does not Granger Cause LN_USD_NZD_R	1.62606	0.19875
		LN_USD_NZD_R does not Granger Cause LN_NZ50_CAP	3.41211	0.0345
	lag 1	LN_NZ50_CAP does not Granger Cause LN_USD_NZD_R	2.00411	0.15809
		LN_USD_NZD_R does not Granger Cause LN_NZ50_CAP	6.12266	0.01399
nzx all	lag 1	LN_NZALL_CAP does not Granger Cause LN_USD_NZD_R	0.7608	0.3839
		LN_USD_NZD_R does not Granger Cause LN_NZALL_CAP	5.31795	0.02191
	lag 2	LN_NZALL_CAP does not Granger Cause LN_USD_NZD_R	1.66256	0.19172
		LN_USD_NZD_R does not Granger Cause LN_NZALL_CAP	3.39656	0.03502
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_USD_NZD_R	0.06062	0.80572
		LN_USD_NZD_R does not Granger Cause LN_NZMID_CAP	1.09963	0.29534
	lag 2	LN_NZMID_CAP does not Granger Cause LN_USD_NZD_R	0.95025	0.38802
		LN_USD_NZD_R does not Granger Cause LN_NZMID_CAP	0.71994	0.48778
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_USD_NZD_R	0.0252	0.87399
		LN_USD_NZD_R does not Granger Cause LN_NZSML_CAP	0.5599	0.45499
	lag 2	LN_NZSML_CAP does not Granger Cause LN_USD_NZD_R	0.42333	0.65533
		LN_USD_NZD_R does not Granger Cause LN_NZSML_CAP	0.91408	0.4022

Appendix Table 8b: Weekly Granger Causality tests between first classification and AUD/NZD

AUD NZD			F-test	P-value
nzx 10	lag 1	LN_NZ10_CAP does not Granger Cause LN_AUD_NZD_R	3.84064	0.05111
		LN_AUD_NZD_R does not Granger Cause LN_NZ10_CAP	3.66155	0.0568
	lag 2	LN_NZ10_CAP does not Granger Cause LN_AUD_NZD_R	2.60162	0.07614
		LN_AUD_NZD_R does not Granger Cause LN_NZ10_CAP	1.74455	0.17682
nzx 15	lag 1	LN_NZ15_CAP does not Granger Cause LN_AUD_NZD_R	1.23173	0.26811

		LN_AUD_NZD_R does not Granger Cause LN_NZ15_CAP	5.50608	0.01971
	lag 2	LN_NZ15_CAP does not Granger Cause LN_AUD_NZD_R	3.00002	0.05156
		LN_AUD_NZD_R does not Granger Cause LN_NZ15_CAP	2.62648	0.0743
nzx 50	lag 1	LN_NZ50_CAP does not Granger Cause LN_AUD_NZD_R	2.1703	0.14193
		LN_AUD_NZD_R does not Granger Cause LN_NZ50_CAP	4.2952	0.03922
	lag 2	LN_NZ50_CAP does not Granger Cause LN_AUD_NZD_R	1.76024	0.1741
		LN_AUD_NZD_R does not Granger Cause LN_NZ50_CAP	2.08379	0.12659
nzx all	lag 1	LN_NZALL_CAP does not Granger Cause LN_AUD_NZD_R	0.10893	0.74164
		LN_AUD_NZD_R does not Granger Cause LN_NZALL_CAP	0.74587	0.3886
	lag 2	LN_NZALL_CAP does not Granger Cause LN_AUD_NZD_R	1.25662	0.28638
		LN_AUD_NZD_R does not Granger Cause LN_NZALL_CAP	0.43272	0.64922
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_AUD_NZD_R	0.29352	0.58844
		LN_AUD_NZD_R does not Granger Cause LN_NZMID_CAP	0.41631	0.51936
	lag 2	LN_NZMID_CAP does not Granger Cause LN_AUD_NZD_R	1.14794	0.31894
		LN_AUD_NZD_R does not Granger Cause LN_NZMID_CAP	0.36538	0.6943
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_AUD_NZD_R	0.0363	0.84905
		LN_AUD_NZD_R does not Granger Cause LN_NZSML_CAP	0.16691	0.68322
	lag 5	LN_NZSML_CAP does not Granger Cause LN_AUD_NZD_R	2.60162	0.02583
		LN_AUD_NZD_R does not Granger Cause LN_NZSML_CAP	0.51417	0.76545

Appendix Table 8c: Weekly Granger Causality tests between first classification and USD/AUD

USD AUD			F-test	P-value
nzx 10	lag 1	LN_NZ10_CAP does not Granger Cause LN_USD_AUD_R	0.56092	0.45458
		LN_USD_AUD_R does not Granger Cause LN_NZ10_CAP	3.12218	0.07843
	lag 7	LN_NZ10_CAP does not Granger Cause LN_USD_AUD_R	2.66533	0.01132
		LN_USD_AUD_R does not Granger Cause LN_NZ10_CAP	1.1761	0.31716
nzx 15	lag 1	LN_NZ15_CAP does not Granger Cause LN_USD_AUD_R	0.1013	0.75054
		LN_USD_AUD_R does not Granger Cause LN_NZ15_CAP	4.5908	0.03309
	lag 7	LN_NZ15_CAP does not Granger Cause LN_USD_AUD_R	1.89596	0.07091
		LN_USD_AUD_R does not Granger Cause LN_NZ15_CAP	1.68416	0.11353
nzx 50	lag 1	LN_NZ50_CAP does not Granger Cause LN_USD_AUD_R	0.33194	0.56503
		LN_USD_AUD_R does not Granger Cause LN_NZ50_CAP	2.42426	0.1207
	lag 7	LN_NZ50_CAP does not Granger Cause LN_USD_AUD_R	1.58747	0.13976
		LN_USD_AUD_R does not Granger Cause LN_NZ50_CAP	1.28496	0.25837
nzx	lag 1	LN_NZALL_CAP does not Granger Cause LN_USD_AUD_R	0.20479	0.65126

all				
		LN_USD_AUD_R does not Granger Cause LN_NZALL_CAP	2.78731	0.09624
nzx mid	lag 1	LN_NZMID_CAP does not Granger Cause LN_USD_AUD_R	0.00318	0.95507
		LN_USD_AUD_R does not Granger Cause LN_NZMID_CAP	0.59131	0.44262
nzx sml	lag 1	LN_NZSML_CAP does not Granger Cause LN_USD_AUD_R	0.89339	0.34545
		LN_USD_AUD_R does not Granger Cause LN_NZSML_CAP	0.01694	0.89653

Appendix Table 9a: Weekly Granger Causality tests between second classification and USD/NZD

USD NZD			F-test	P-value
Local	lag 1	LN_LOCAL_CAP does not Granger Cause LN_USD_NZD_R	1.48058	0.22481
		LN_USD_NZD_R does not Granger Cause LN_LOCAL_CAP	0.11592	0.73379
Non-local Australia	lag 1	LN_N_A_CAP does not Granger Cause LN_USD_NZD_R	0.14772	0.70105
		LN_USD_NZD_R does not Granger Cause LN_N_A_CAP	0.43285	0.51119
Non-local world	lag 1	LN_N_W_CAP does not Granger Cause LN_USD_NZD_R	0.04692	0.82869
		LN_USD_NZD_R does not Granger Cause LN_N_W_CAP	2.98496	0.08526

Appendix Table 9b: Weekly Granger Causality tests between second classification and AUD/NZD

AUD NZD			F-test	P-value
Local	lag 1	LN_LOCAL_CAP does not Granger Cause LN_AUD_NZD_R	2.18406	0.14069
		LN_AUD_NZD_R does not Granger Cause LN_LOCAL_CAP	8.04555	0.00493
	lag 2	LN_LOCAL_CAP does not Granger Cause LN_AUD_NZD_R	1.23748	0.29188
		LN_AUD_NZD_R does not Granger Cause LN_LOCAL_CAP	3.76754	0.02443
Non-local Australia	lag 1	LN_N_A_CAP does not Granger Cause LN_AUD_NZD_R	0.06553	0.79816
		LN_AUD_NZD_R does not Granger Cause LN_N_A_CAP	0.94683	0.33145
Non-local world	lag 1	LN_N_W_CAP does not Granger Cause LN_AUD_NZD_R	0.33017	0.56607
		LN_AUD_NZD_R does not Granger Cause LN_N_W_CAP	5.20895	0.0233

Appendix Table 9c: Weekly Granger Causality tests between second classification and USD/AUD

USD AUD			F-test	P-value
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Local	lag 1	LN_LOCAL_CAP does not Granger Cause LN_USD_AUD_R	0.05198	0.81984
		LN_USD_AUD_R does not Granger Cause LN_LOCAL_CAP	2.58361	0.10922
Non-local Australia	lag 1	LN_N_A_CAP does not Granger Cause LN_USD_AUD_R	0.02779	0.86774
		LN_USD_AUD_R does not Granger Cause LN_N_A_CAP	0.02132	0.88402
Non-local world	lag 1	LN_N_W_CAP does not Granger Cause LN_USD_AUD_R	0.18558	0.66699
		LN_USD_AUD_R does not Granger Cause LN_N_W_CAP	0.14095	0.70765

Appendix Table 10a: Weekly Granger Causality tests between third classification and USD/NZD

USD NZD			F-test	P-value
agriculture	lag 1	LN_AGRICULTURE_CAP does not Granger Cause LN_USD_NZD_R	0.07524	0.78408
		LN_USD_NZD_R does not Granger Cause LN_AGRICULTURE_CAP	3.76189	0.05353
	lag 2	LN_AGRICULTURE_CAP does not Granger Cause LN_USD_NZD_R	0.03866	0.96209
		LN_USD_NZD_R does not Granger Cause LN_AGRICULTURE_CAP	2.08879	0.12597
building	lag 1	LN_BUILDING_CAP does not Granger Cause LN_USD_NZD_R	0.92143	0.33801
		LN_USD_NZD_R does not Granger Cause LN_BUILDING_CAP	1.2448	0.26559
	lag 2	LN_BUILDING_CAP does not Granger Cause LN_USD_NZD_R	1.29484	0.27575
		LN_USD_NZD_R does not Granger Cause LN_BUILDING_CAP	0.6446	0.52573
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_USD_NZD_R	0.00174	0.96678
		LN_USD_NZD_R does not Granger Cause LN_CONSUMER_CAP	2.13853	0.14487
	lag 2	LN_CONSUMER_CAP does not Granger Cause LN_USD_NZD_R	0.23497	0.79077
		LN_USD_NZD_R does not Granger Cause LN_CONSUMER_CAP	1.19941	0.30308
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_USD_NZD_R	3.70E-06	0.99848
		LN_USD_NZD_R does not Granger Cause LN_ENERGY_CAP	2.66114	0.10406
	lag 2	LN_ENERGY_CAP does not Granger Cause LN_USD_NZD_R	0.10063	0.9043
		LN_USD_NZD_R does not Granger Cause	1.47532	0.23067

		LN_ENERGY_CAP		
finance	lag 1	LN_FINANCE_CAP does not Granger Cause LN_USD_NZD_R	3.54525	0.06085
		LN_USD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.27738	0.59888
	lag 2	LN_FINANCE_CAP does not Granger Cause LN_USD_NZD_R	1.83716	0.16139
		LN_USD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.15116	0.85979
food	lag 1	LN_FOOD_CAP does not Granger Cause LN_USD_NZD_R	0.3928	0.53139
		LN_USD_NZD_R does not Granger Cause LN_FOOD_CAP	0.90891	0.3413
	lag 2	LN_FOOD_CAP does not Granger Cause LN_USD_NZD_R	0.2449	0.78297
		LN_USD_NZD_R does not Granger Cause LN_FOOD_CAP	1.09258	0.33693
forestry	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_USD_NZD_R	0.00265	0.95901
		LN_USD_NZD_R does not Granger Cause LN_FORESTRY_CAP	1.53924	0.21587
	lag 2	LN_FORESTRY_CAP does not Granger Cause LN_USD_NZD_R	0.27497	0.75982
		LN_USD_NZD_R does not Granger Cause LN_FORESTRY_CAP	1.23885	0.29147
goods	lag 1	LN_GOODS_CAP does not Granger Cause LN_USD_NZD_R	0.25031	0.61728
		LN_USD_NZD_R does not Granger Cause LN_GOODS_CAP	9.56379	0.0022
	lag 2	LN_GOODS_CAP does not Granger Cause LN_USD_NZD_R	0.31748	0.72827
		LN_USD_NZD_R does not Granger Cause LN_GOODS_CAP	6.14538	0.00248
	lag 3	LN_GOODS_CAP does not Granger Cause LN_USD_NZD_R	0.7964	0.49688
		LN_USD_NZD_R does not Granger Cause LN_GOODS_CAP	4.43653	0.00465
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.73769	0.39121
		LN_USD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	13.8384	0.00024
	lag 3	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_NZD_R	0.86054	0.46215
		LN_USD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	5.43474	0.00123
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_USD_NZD_R	0.05273	0.81856
		LN_USD_NZD_R does not Granger Cause	2.47201	0.11712

		LN_INVESTMENT_CAP		
	lag 2	LN_INVESTMENT_CAP does not Granger Cause LN_USD_NZD_R	1.84862	0.15957
		LN_USD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	2.23365	0.10925
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_USD_NZD_R	1.46952	0.22654
		LN_USD_NZD_R does not Granger Cause LN_LEISURE_CAP	0.6273	0.42908
	lag 2	LN_LEISURE_CAP does not Granger Cause LN_USD_NZD_R	0.64624	0.52488
		LN_USD_NZD_R does not Granger Cause LN_LEISURE_CAP	0.27495	0.75984
	lag 7	LN_LEISURE_CAP does not Granger Cause LN_USD_NZD_R	0.58025	0.77173
		LN_USD_NZD_R does not Granger Cause LN_LEISURE_CAP	1.56192	0.14752
media	lag 1	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	4.41485	0.03661
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	5.77763	0.01694
	lag 2	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	3.95603	0.02033
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	3.38937	0.03527
	lag 3	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	2.62292	0.05117
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	2.54399	0.05672
	lag 8	LN_MEDIA_CAP does not Granger Cause LN_USD_NZD_R	3.59822	0.00058
		LN_USD_NZD_R does not Granger Cause LN_MEDIA_CAP	1.13055	0.34337
mining	lag 1	LN_MINING_CAP does not Granger Cause LN_USD_NZD_R	0.40424	0.52548
		LN_USD_NZD_R does not Granger Cause LN_MINING_CAP	0.2618	0.60932
	lag 2	LN_MINING_CAP does not Granger Cause LN_USD_NZD_R	0.99771	0.37017
		LN_USD_NZD_R does not Granger Cause LN_MINING_CAP	0.61886	0.53937
ports	lag 1	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	0.44621	0.50474
		LN_USD_NZD_R does not Granger Cause	6.72538	0.01005

		LN_PORTS_CAP		
	lag 2	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	2.60055	0.07622
		LN_USD_NZD_R does not Granger Cause LN_PORTS_CAP	5.32657	0.00542
	lag 3	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	1.61269	0.18693
		LN_USD_NZD_R does not Granger Cause LN_PORTS_CAP	3.94221	0.00898
	lag 6	LN_PORTS_CAP does not Granger Cause LN_USD_NZD_R	1.13062	0.34505
		LN_USD_NZD_R does not Granger Cause LN_PORTS_CAP	2.84919	0.01065
primary	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_USD_NZD_R	0.13048	0.71823
		LN_USD_NZD_R does not Granger Cause LN_PRIMARY_CAP	1.85519	0.17438
	lag 2	LN_PRIMARY_CAP does not Granger Cause LN_USD_NZD_R	1.98815	0.13908
		LN_USD_NZD_R does not Granger Cause LN_PRIMARY_CAP	1.12997	0.32467
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	2.06108	0.15232
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	2.48891	0.11589
	lag 2	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	2.65608	0.07218
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	2.89004	0.05741
	lag 3	LN_PROPERTY_CAP does not Granger Cause LN_USD_NZD_R	1.8318	0.14186
		LN_USD_NZD_R does not Granger Cause LN_PROPERTY_CAP	2.10064	0.10067
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	1.14901	0.28477
		LN_USD_NZD_R does not Granger Cause LN_SERVICE_CAP	6.07421	0.01437
	lag 2	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	2.4492	0.08841
		LN_USD_NZD_R does not Granger Cause LN_SERVICE_CAP	4.21781	0.01578
	lag 3	LN_SERVICE_CAP does not Granger Cause LN_USD_NZD_R	1.70189	0.16715
		LN_USD_NZD_R does not Granger Cause	3.01122	0.03076

		LN_SERVICE_CAP		
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_USD_NZD_R	0.00033	0.98555
		LN_USD_NZD_R does not Granger Cause LN_TEXTILES_CAP	0.09129	0.76279
	lag 2	LN_TEXTILES_CAP does not Granger Cause LN_USD_NZD_R	0.22616	0.79775
		LN_USD_NZD_R does not Granger Cause LN_TEXTILES_CAP	0.07879	0.92426
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause LN_USD_NZD_R	0.02523	0.87392
		LN_USD_NZD_R does not Granger Cause LN_TRANSPORT_CAP	1.93469	0.16545
	lag 2	LN_TRANSPORT_CAP does not Granger Cause LN_USD_NZD_R	1.03262	0.35757
		LN_USD_NZD_R does not Granger Cause LN_TRANSPORT_CAP	1.47882	0.22987

Appendix Table 10b: Weekly Granger Causality tests between third classification and AUD/NZD

AUD NZD			F-test	P-value
agriculture	lag 1	LN_AGRICULTURE_CAP does not Granger Cause LN_AUD_NZD_R	0.95491	0.3294
		LN_AUD_NZD_R does not Granger Cause LN_AGRICULTURE_CAP	0.50396	0.47841
building	lag 1	LN_BUILDING_CAP does not Granger Cause LN_AUD_NZD_R	0.087	0.76827
		LN_AUD_NZD_R does not Granger Cause LN_BUILDING_CAP	0.13308	0.71556
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_AUD_NZD_R	0.36938	0.54388
		LN_AUD_NZD_R does not Granger Cause LN_CONSUMER_CAP	0.01821	0.89276
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_AUD_NZD_R	0.20717	0.64938
		LN_AUD_NZD_R does not Granger Cause LN_ENERGY_CAP	0.50038	0.47998
finance	lag 1	LN_FINANCE_CAP does not Granger Cause LN_AUD_NZD_R	0.73075	0.39344
		LN_AUD_NZD_R does not Granger Cause LN_FINANCE_CAP	0.60007	0.43926
food	lag 1	LN_FOOD_CAP does not Granger Cause LN_AUD_NZD_R	0.00E+00	0.9998
		LN_AUD_NZD_R does not Granger Cause	0.0317	0.85883

		LN_FOOD_CAP		
forestry	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	2.04809	0.15362
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	0.01353	0.90748
	lag 2	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	1.26176	0.28493
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	0.25758	0.77312
	lag 7	LN_FORESTRY_CAP does not Granger Cause LN_AUD_NZD_R	2.09932	0.04438
		LN_AUD_NZD_R does not Granger Cause LN_FORESTRY_CAP	0.71602	0.65851
goods	lag 1	LN_GOODS_CAP does not Granger Cause LN_AUD_NZD_R	0.00684	0.93414
		LN_AUD_NZD_R does not Granger Cause LN_GOODS_CAP	2.6716	0.10338
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_AUD_NZD_R	0.05734	0.81095
		LN_AUD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	3.08775	0.08008
	lag 4	LN_INTERMEDIATE_CAP does not Granger Cause LN_AUD_NZD_R	1.85243	0.11944
		LN_AUD_NZD_R does not Granger Cause LN_INTERMEDIATE_CAP	1.11422	0.35033
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_AUD_NZD_R	0.00436	0.94739
		LN_AUD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	2.5184	0.11376
	lag 2	LN_INVESTMENT_CAP does not Granger Cause LN_AUD_NZD_R	0.82953	0.43744
		LN_AUD_NZD_R does not Granger Cause LN_INVESTMENT_CAP	1.23604	0.29228
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_AUD_NZD_R	0.12051	0.72877
		LN_AUD_NZD_R does not Granger Cause LN_LEISURE_CAP	0.20762	0.64902
media	lag 1	LN_MEDIA_CAP does not Granger Cause LN_AUD_NZD_R	2.73306	0.09952
		LN_AUD_NZD_R does not Granger Cause LN_MEDIA_CAP	0.71615	0.3982
	lag 2	LN_MEDIA_CAP does not Granger Cause LN_AUD_NZD_R	2.08904	0.12594
		LN_AUD_NZD_R does not Granger Cause	0.3193	0.72695

		LN_MEDIA_CAP		
mining	lag 1	LN_MINING_CAP does not Granger Cause LN_AUD_NZD_R	0.34923	0.55507
		LN_AUD_NZD_R does not Granger Cause LN_MINING_CAP	2.46522	0.11763
ports	lag 1	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	0.27925	0.59765
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	1.65395	0.19958
	lag 2	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	0.76101	0.46826
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	0.87241	0.4192
	lag 6	LN_PORTS_CAP does not Granger Cause LN_AUD_NZD_R	0.78689	0.58094
		LN_AUD_NZD_R does not Granger Cause LN_PORTS_CAP	0.57626	0.7491
primary	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_AUD_NZD_R	0.02735	0.86877
		LN_AUD_NZD_R does not Granger Cause LN_PRIMARY_CAP	0.67484	0.41213
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_AUD_NZD_R	0.00275	0.95825
		LN_AUD_NZD_R does not Granger Cause LN_PROPERTY_CAP	1.0704	0.30183
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_AUD_NZD_R	0.44152	0.50699
		LN_AUD_NZD_R does not Granger Cause LN_SERVICE_CAP	0.50319	0.47875
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_AUD_NZD_R	0.36376	0.54696
		LN_AUD_NZD_R does not Granger Cause LN_TEXTILES_CAP	0.56161	0.4543
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause LN_AUD_NZD_R	0.20606	0.65026
		LN_AUD_NZD_R does not Granger Cause LN_TRANSPORT_CAP	0.00498	0.94381

Appendix Table 10c: Weekly Granger Causality tests between third classification and USD/AUD

USD AUD			F-test	P-value
agriculture	lag 1	LN_AGRICULTURE_CAP does not Granger Cause LN_USD_AUD_R	0.1829	0.66926
		LN_USD_AUD_R does not Granger Cause	1.49701	0.22226

		LN_AGRICULTURE_CAP		
	lag 8	LN_AGRICULTURE_CAP does not Granger Cause LN_USD_AUD_R	1.36803	0.21137
		LN_USD_AUD_R does not Granger Cause LN_AGRICULTURE_CAP	2.03025	0.04377
building	lag 1	LN_BUILDING_CAP does not Granger Cause LN_USD_AUD_R	0.00144	0.96973
		LN_USD_AUD_R does not Granger Cause LN_BUILDING_CAP	1.56511	0.21206
consumer	lag 1	LN_CONSUMER_CAP does not Granger Cause LN_USD_AUD_R	0.39033	0.53268
		LN_USD_AUD_R does not Granger Cause LN_CONSUMER_CAP	1.39989	0.23784
	lag 6	LN_CONSUMER_CAP does not Granger Cause LN_USD_AUD_R	1.18763	0.31347
		LN_USD_AUD_R does not Granger Cause LN_CONSUMER_CAP	0.67878	0.66693
energy	lag 1	LN_ENERGY_CAP does not Granger Cause LN_USD_AUD_R	0.25178	0.61626
		LN_USD_AUD_R does not Granger Cause LN_ENERGY_CAP	1.0447	0.30769
finance	lag 1	LN_FINANCE_CAP does not Granger Cause LN_USD_AUD_R	1.1935	0.27565
		LN_USD_AUD_R does not Granger Cause LN_FINANCE_CAP	0.02212	0.88189
food	lag 1	LN_FOOD_CAP does not Granger Cause LN_USD_AUD_R	1.77357	0.18413
		LN_USD_AUD_R does not Granger Cause LN_FOOD_CAP	0.08689	0.7684
forestry	lag 1	LN_FORESTRY_CAP does not Granger Cause LN_USD_AUD_R	3.16758	0.0763
		LN_USD_AUD_R does not Granger Cause LN_FORESTRY_CAP	2.21951	0.13751
goods	lag 1	LN_USD_AUD_R does not Granger Cause LN_GOODS_CAP	2.25069	0.13479
		LN_GOODS_CAP does not Granger Cause LN_USD_AUD_R	1.16746	0.28094
	lag 6	LN_USD_AUD_R does not Granger Cause LN_GOODS_CAP	1.54589	0.1639
		LN_GOODS_CAP does not Granger Cause LN_USD_AUD_R	1.66236	0.13094
intermediate & Durable	lag 1	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_AUD_R	0.82021	0.36597
		LN_USD_AUD_R does not Granger Cause	3.60633	0.05868

		LN_INTERMEDIATE_CAP		
	lag 6	LN_INTERMEDIATE_CAP does not Granger Cause LN_USD_AUD_R	1.86308	0.08785
		LN_USD_AUD_R does not Granger Cause LN_INTERMEDIATE_CAP	2.25298	0.03908
investment	lag 1	LN_INVESTMENT_CAP does not Granger Cause LN_USD_AUD_R	0.58776	0.44399
		LN_USD_AUD_R does not Granger Cause LN_INVESTMENT_CAP	0.29109	0.58999
	lag 6	LN_INVESTMENT_CAP does not Granger Cause LN_USD_AUD_R	1.00576	0.42213
		LN_USD_AUD_R does not Granger Cause LN_INVESTMENT_CAP	0.70724	0.64406
leisure	lag 1	LN_LEISURE_CAP does not Granger Cause LN_USD_AUD_R	1.42808	0.23318
		LN_USD_AUD_R does not Granger Cause LN_LEISURE_CAP	0.20093	0.65435
media	lag 1	LN_MEDIA_CAP does not Granger Cause LN_USD_AUD_R	0.13668	0.71191
		LN_USD_AUD_R does not Granger Cause LN_MEDIA_CAP	3.96593	0.04749
	lag 8	LN_MEDIA_CAP does not Granger Cause LN_USD_AUD_R	2.8601	0.00472
		LN_USD_AUD_R does not Granger Cause LN_MEDIA_CAP	0.87418	0.53891
mining	lag 1	LN_MINING_CAP does not Granger Cause LN_USD_AUD_R	0.04557	0.83114
		LN_USD_AUD_R does not Granger Cause LN_MINING_CAP	1.75087	0.18695
ports	lag 1	LN_PORTS_CAP does not Granger Cause LN_USD_AUD_R	1.66654	0.19789
		LN_USD_AUD_R does not Granger Cause LN_PORTS_CAP	3.29781	0.07054
	lag 6	LN_PORTS_CAP does not Granger Cause LN_USD_AUD_R	1.30146	0.25713
		LN_USD_AUD_R does not Granger Cause LN_PORTS_CAP	1.98247	0.06885
primary	lag 1	LN_PRIMARY_CAP does not Granger Cause LN_USD_AUD_R	1.19513	0.27532
		LN_USD_AUD_R does not Granger Cause LN_PRIMARY_CAP	0.53617	0.46469
property	lag 1	LN_PROPERTY_CAP does not Granger Cause LN_USD_AUD_R	0.04513	0.83194
		LN_USD_AUD_R does not Granger Cause	1.1024	0.29473

		LN_PROPERTY_CAP		
service	lag 1	LN_SERVICE_CAP does not Granger Cause LN_USD_AUD_R	0.02899	0.86494
		LN_USD_AUD_R does not Granger Cause LN_SERVICE_CAP	4.2655	0.0399
textiles	lag 1	LN_TEXTILES_CAP does not Granger Cause LN_USD_AUD_R	0.17389	0.67702
		LN_USD_AUD_R does not Granger Cause LN_TEXTILES_CAP	0.38029	0.538
transport	lag 1	LN_TRANSPORT_CAP does not Granger Cause LN_USD_AUD_R	0.55157	0.45836
		LN_USD_AUD_R does not Granger Cause LN_TRANSPORT_CAP	1.6449	0.20082