Sharemarket Performance and the New Zealand Dollar: Inside the Relationships

Andrew Richard Paul Pech

2006

Sharemarket Performance and the New Zealand Dollar: Inside the Relationships

A thesis presented in partial fulfilment of the requirements for the degree

of

A Master of Applied Economics

Massey University

Palmerston North, New Zealand

Andrew Richard Paul Pech

2006

Abstract

New Zealand is often described as a small open economy with substantial foreign ownership of its assets. The economy is therefore sensitive to exchange rate movements and the sharemarket being the barometer of economic activities should be no exception. Further, exchange rates may also be endogenous to sharemarket fluctuations. This thesis analyses the relationship between the value of the New Zealand dollar vis a vis the currencies of its five largest trading partners and the New Zealand sharemarket performance between 1999 and mid-2005 using the vector autoregression (VAR) and vector error correction model (VECM) approaches. Findings from the research suggest the New Zealand sharemarket is robust to currency fluctuations in both the short- and long-term. The only exception to this is the New Zealand dollar–Australian dollar exchange rate (NZD/AUD), which has a negative short term effect on the sharemarket. The NZD/AUD is also the only exchange rate to depreciate following a positive shock to the sharemarket.

Acknowledgements

Table of Contents

List of Tables

List of Figures

List of Abbreviations:

Foreign Currencies
AUD..............................Australian Dollar
CAD ....Canadian Dollar
DEM.............................German Deutschmark
EUR..............................Euro
GBP..............................Great British Pound Sterling
JPY.................................Japanese Yen
MYR.............................Malaysian ringgit
NZD..............................New Zealand Dollar
THB..............................Thailand Baht
TWI..............................Trade-weighted Index
USD..............................United States Dollar

Share Price code of the New Zealand Companies Researched

AMP...................AMP Limited
APT...................AMP NZ Office Trust
AIA................... Auckland International Airport Limited
ANZ ....Australia and New Zealand Banking Group Limited
AXA...................AXA Asia Pacific Holdings Limited
BRY...................BIL International Limited
CNZ...................Capital Properties New Zealand Limited
CAH...................Carter Holt Harvey Limited
CAV...................Cavalier Corporation Limited
FPH...................Fisher & Paykel Healthcare Corporation Limited
FBU...................Fletcher Building Limited
HLG ....Hallenstein Glasson Holdings Limited
HBY ....Hellaby Holdings Limited
IFT ....Infratil Limited
KIP ....Kiwi Income Property Trust
LNN ....Lion Nathan Limited
MFT...................Mainfreight Limited
MHI ....Michael Hill International Limited
NOG ....New Zealand Oil & Gas Limited
NGC...................Natural Gas Corporation Holdings Limited
NPX...................Nuplex Industries Limited
POT...................Port of Tauranga Limited (NS)
POA...................Ports of Auckland Limited

PFI ....Property For Industry Limited
RBD..................Restaurant Brands New Zealand Limited
SAN...................Sanford Limited
SKC....................Sky City Entertainment Group Limited (NS)
STU...................Steel & Tube Holdings Limited
TEL...................Telecom Corporation of New Zealand Limited (NS)
TLS..................Telstra Corporation Limited
TEN.................Tenon Limited
THL..................Tourism Holdings Limited
TPW..................TrustPower Limited
WHS..................Waste Management NZ Limited
WAM.................The Warehouse Group Limited

Other Abbreviations

AIC....................Akaike Information Criterion
BLUE...................Best Linear Unbiased Estimator
DC 500.................Department of Commerce Index of 500 stocks
EG.....................Engle and Granger (1987) test for cointegration
GARCH...............Generalised autoregressive conditional
                heteroskedasticity.
GDP....................Real gross domestic product
GIRF..................Generalised Impulse Response Function
ECM...................Error Correction Model
FASTER...............stands for Fully Automated Screen Trading and
                Electronic Registration
FDI....................Foreign Direct investment
FTSE ....Financial Times Stock Exchange
JJ Test................Johansen (1988) and Johansen and Juselius (1990)
                cointegration test
LM.....................Breusch-Godfrey Lagrange Multiplier test
LR.....................Long run
MNC....................Multinational corporation
Mid-Cap 30.............New Zealand sharemarket index including
                constituents in the NZSX 50 minus the smallest ten
                companies (in terms of capitalisation) and those in
                the NZSX 10.
NASDAQ.............National Association of Securities Dealers
                Automated Quotations.
NZ.....................New Zealand
NZSX-10.............Sharemarket index comprising the ten largest
                companies listed in the New Zealand sharemarket.
NZSX-50.............Sharemarket index comprising the 50 largest
                companies listed in the New Zealand sharemarket.

NZSX-All..............Sharemarket index comprising all companies listed in the New Zealand sharemarket.

NZTE............New Zealand Trade and Enterprise

OCR...............Official cash rate

OECD.............Organisation for Economic Cooperation and Development

OIRF..............Orthogonalised Impulse Response Function

RBNZ.............Reserve Bank of New Zealand

S&P 500..........Standard & Poors 500 Index

SBC...............Schwarz Bayesian Criterion

SE...............Standard error

SIC...............Schwarz Information Criterion

SM...............Sharemarket

SOE............Small open economy

SP...............Share price

SR..............Short run

US..............United States of America

VAR............Vector autoregression

VECM...........Vector error correction model

VOT.............Volume of Trade

Chapter One:

INTRODUCTION

"International companies now know that
what happens to the currencies in which
they tot up the costs, revenues and assets,
affects their results as much as their success
in making and selling products."

- The Economist, April 4, 1987

1.1: Introduction

Economies are more interconnected today than ever before: exporters, importers and multinationals are continuously expanding operations into new and existing foreign markets. Further, technological advances are reducing barriers to international capital flows for shareholders and financial intermediaries.

Following such expansion necessitates foreign exchange turnover to increase, which may result in uncertain company and share price performances.

Costs, revenues and competitive environments for importers, exporters and multinationals are prone to exchange rates. Their values also influence overseas investment decisions and affects repayments on overseas borrowing. An appreciating domestic currency enhances investment returns to foreign investors, but dampens returns to domestic investment abroad. The notion of exchange rate pass-through also affects consumers directly and these all have flow-on effects throughout an economy. Hence, much of the economy's performance is a function of exchange rates.

Because few elements of business practice are untouched by exchange rate fluctuations, the subsequent company management of exchange rate exposure can significantly affect profitability, which is the main driver of company share price.

The sharemarket (SM) is an aggregate weighted index of overall corporate performance. Therefore its value is sensitive to exchange rate fluctuations. This causal inference is often identified as the Goods Market approach. The Portfolio Balance approach is another theory, suggesting the existence of a feedback mechanism from the SM to exchange rates.

Empirical results are scattered between these two theories, which are both likely to characterise an economy. It is of value however, to understand the intricacies of such relationships, and this is the researcher's intention. This research unravels answers to the following question:

What relationships are there between the New Zealand Sharemarket performance and currency fluctuations?

Employed methodologies include cointegration and vector error correction estimation, which provide insight into short- and long-run relationships. Further complementing this, are block Granger causality, weak exogeneity tests, and generalised impulse response functions.

Exchange rates included in the research are those comprising New Zealand's trade weighted index (TWI). These include the NZD/USD, NZD/AUD, NZD/JPY, NZD/GBP, and NZD/EUR (refer to the list of abbreviations, p.7). Specific SM indexes to be analysed include the NZSX10, MidCap30, NZSX50 and NZSXALL. Ninety day bank bill rates will be included into the analysis, for the arguments put forward in Section 3.3.2.

1.2: Thesis Outline

Following this chapter, Chapter Two describes theories on how companies can be exposed, and how the SM is integrated with exchange rates. The historical performance of both the New Zealand SM and New Zealand dollar (NZD) are also within this chapter. Following Chapter Two is a literature review contributing relevant empirical background and more theory. Chapter Three also justifies the methodology employed in this thesis, which is outlined in Chapter Four. Results are within Chapter Five, and the conclusion in Chapter Six. Before Chapter Two begins, the value of researching this area is justified.

1.3: Value of this Research

To examine links between New Zealand's currency and its SM is of interest to several groups. These include domestic and foreign investors-current and potential, as well as economists, investment analysts, general managers of New Zealand (NZ), members of the public sector and fellow researchers.

Results will give an estimate of how significant foreign currency fluctuations are to NZ's SM, and how significant fluctuations in the SM are to the NZD. To estimate the intricacies of how the SM and Foreign exchange markets have been integrated in the past, will uncover information regarding the exchange rate forces upon the SM performance in the future.

It was reported in early 2000 that 55 per cent of NZ's SM was foreign-owned (Newman and Briggs, 2000, p.62). By 2005, this proportion was

approximately 48 percent (Stuff, 2006b). Foreign investment is a function of both share price movements and exchange rate fluctuations.[1] Figures 1.1 and 1.2 below illustrate the favourable and unfavourable scenarios, from the perspective of foreign shareholders invested in New Zealand.

Figure 1.1: Favourable Scenario   Figure 1.2:Unfavourable Scenario
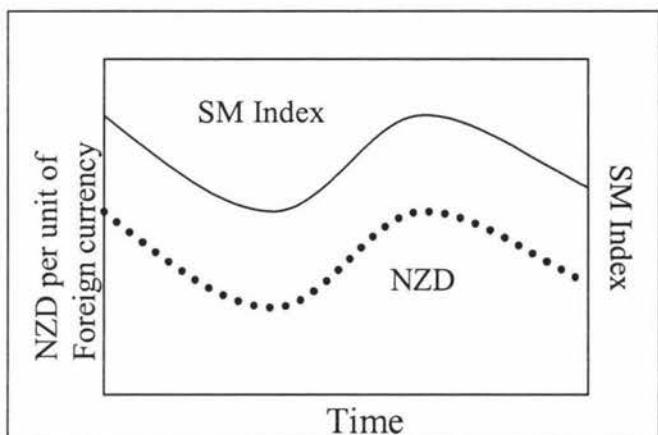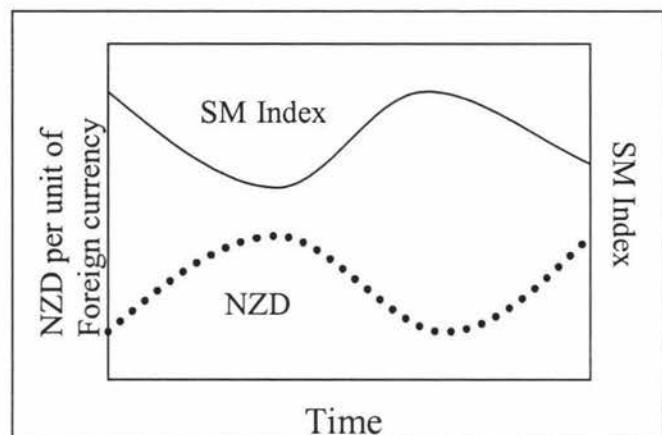
Foreign investment returns in NZ are thus catalysed when both the NZD and share prices are low, and characterised by a pro-cyclical relationship: share value increases if the NZD is appreciating, but drops while depreciating. The unfavourable scenario inverts this relationship, such that share prices are negatively associated with a strongly performing NZD. Hence, the unfavourable scenario is where the exchange rate works against any gains made by foreign investment.

Results of this thesis will give insight towards which foreign investment sources should reap above-normal yields, and which currency sources earn relatively unattractive returns. Results shall therefore provide information for international portfolio investors, of investment risk in the NZ SM.

---

[1] For simplicity, dividend yields are ignored in this thesis.

If it is found that the NZD/USD and NZ SM increase together, it means US-sourced investment could share a similar characteristic to Figure 1.1. Results could therefore promote further investment by NZ companies. In the case where the NZ SM shares a minimal relationship with a particular currency such as the NZD/JPY, it indicates investment in the NZ SM to be robust, which could eliminate some degree of currency risk for Japanese-based investment portfolios.

Currency exposure is among the many risks facing share price performance.[2] Nonetheless, it is a risk that investors desire to hedge in their international portfolios. Results from this analysis will provide information for foreign investors, in deciding whether to incorporate NZ-based SM investments into their portfolio mix.

The Reserve Bank of New Zealand Act 1989 makes the primary responsibility for the Reserve Bank Governor to control price stability by altering the official cash rate (OCR). In January 2006, the most recent update of the Policy Targets Agreement was signed on September 17 2002, stating that "in pursuing its price stability objective, the Bank shall implement monetary policy in a sustainable, consistent and transparent manner and shall seek to avoid unnecessary instability in output, interest rates and the exchange rate."[3]

---

[2] These include credit and interest rate risk, taxation, and inflation, among others. For a good summary of each of these, along with these risks to investment, refer to Watson, C. (2004, p.29).

[3] Quoted from Bollard, A., and Cullen, M. (2002). Policy Targets Agreement 2002. *Cited from* www.rbnz.co.nz. Retrieved January 19, 2006. A relevant description of the price stability target has been described as "...maintaining a stable level of prices, so that monetary policy can make its maximum contribution to sustainable economic growth, employment and development opportunities within the New Zealand economy." Quoted from RBNZ. (March, 1998). The Reserve Bank of New Zealand Act 1989: Our Accountability to New Zealanders, p. 6. *Cited from* www.rbnz.co.nz. , Retrieved January 19, 2006.

Exchange rate forecasts have predicted the NZD to depreciate significantly in 2006. In January that year, the NZD/USD remained approximately US$0.68. At the time, this exchange rate was forecast fall by around 15 per cent (to US$0.58) by December 2006.[4]

Because the SM is an indicator of an economy's performance,[5] it is important for the Reserve Bank to fully understand the dynamics between exchange rates, interest rates and SM performance. Tightening monetary policy in response to inflationary pressure will have more support for instance, if the NZD is currently depreciating, and findings suggest such depreciation to spur the economy via its SM (since interest rates generally appreciate a currency). On the other hand, if it is known the falling NZD dampens SM performance, there may be a new justification not to intervene, since inflationary pressures may naturally ease. This research contributes information to such matters.

For the arguments in Section 3.3.2, ninety-day bank bill rates are included in the analysis. These are a proxy for NZ interest rates overall. The Reserve Bank will therefore have more understanding on the effect interest rates have on the SM and exchange rates.

---

[4] In January, 2006 both the Bank of New Zealand (BNZ) and Australia and New Zealand Banking Group (ANZ) forecast the NZD/USD exchange rate in December , 2006 to be US$0.58. This BNZ forecast was sourced from: Alexander, T. (2006), BNZ Weekly Overview, January12. Cited from www.bnz.co.nz .Retrieved January 21, 2006. The ANZ forecast was sourced from: McDermott, et al. (2006, January 16). *Market Focus: New Zealand*: Australia and New Zealand Banking Group. Cited from www.anz.co.nz Retrieved January 21, 2006.

[5] Empirical evidence linking the performance of the economy positively with the SM is vast. See for instance Goenewold (2004) finding this evidence for Australia, Fama (1990), Chen et al., (1986), Schwert (1990), find this evidence for the US. and Cheung and Ng (1997) provide evidence for various countries.

Supporting the comments of Chen *et al.*(2004), most research has focused this topic on large economies/sharemarkets. This thesis provides insight towards SM and exchange rate interactions of small open economies.

Chapter Two:

BACKGROUND

"By our reckoning it's the most overvalued
currency in the western world."

-Westpac Chief economist Brendan O'Donovan,
describing the New Zealand dollar
in March 2005 (Beckford, 2005).

2.1: Introduction

Section 2.2 outlines the types of exchange rate exposure and how companies may hedge this risk. This is followed by Section 2.3, which describes the theory of causality between exchange rates and the SM. Sections 2.4 and 2.5 then follow to describe the historical performance of the NZD and NZ SM, respectively.

2.2: Theoretical Background on Exchange Rate Exposure

2.2.1: Types of Foreign Exchange Exposure.

Foreign exchange exposure can be divided among three types: accounting exposure, transaction exposure and operating exposure.[6] The latter two are cash flow exposures.

Accounting exposure represents an exchange rates' impact on equity, from consolidating foreign-owned financial statements into one. The currency conversion of foreign operations, to the parent company represent accounting exposure.

Transaction exposure denotes the change to profitability of existing contractual obligations when the exchange rate changes (Eitman *et al.,* 2001, p. 152).

---

[6] Accounting exposure is sometimes called translation exposure, and operating exposure is sometimes called competitive, economic or strategic exposure.

Operating exposure measures changes to the present value of the firm (or future operating cash flows), resultant from price changes following exchange rate movements. It accounts for the exchange rate's impact upon future costs, revenues, and therefore competitiveness and business profitability.

Researchers argue operating exposure to be the relatively more substantial, out of the three (see Srinivasulu, 1981, Aggarwal and Soenen, 1989, Grant and Soenen, 1991 and Pringle, 1991). Translation exposure is strong in NZ however, with approximately 30 per cent of listed company earnings sourced abroad (Oliver, 2003).

2.2.2: Exposure and International Trade

It is common knowledge that an appreciating NZD generally harms domestic exporters while improving the competitiveness of domestic importers.

An appreciating domestic currency[7] can have a detrimental impact for domestic exporters because generally, their goods will be relatively less competitive in world markets: foreign importers must now convert more of their own domestic currency, to purchase the same quantity of New Zealand exports. Foreign importers may react by importing relatively cheaper exports elsewhere, and/or purchase a lower quantity of the domestic country's exports. To offset such a reaction, the exporter may be forced to lower their prices, change their marketing strategy, or hedge against the currency (see section 2.2.6).

---

[7] 'Domestic currency' will hereafter be denoted 'currency' unless otherwise stated.

Consequently, domestic exporters exhibit lower cashflows following a domestic currency appreciation, since it forces a combination of lower foreign demand and/or lower mark-up on cost. This latter point is dependent upon the degree of exchange rate pass-through.[8]

Domestic importers on the other hand, benefit from such an appreciation. Their purchasing power has increased so that more foreign exports can be bought at a similar cost, or the same quantity purchased at a lower cost. Cashflows are likely to improve due to an effectively lower mark-up on cost (once again dependent on the degree of pass-through). This potentially increases profit margins on those goods for re-sale in the domestic market.

Import competitors (which are domestic companies facing competition from foreign companies) are affected similarly to domestic exporters. If this appreciation translates into lower prices in the domestic market, imports become more competitive with domestic output. This can harm profit margins and market share of import competitors.

2.2.3: Exposure and Non-Tradable Firms

Exchange rates influence more groups than merely exporters, importers and import competitors. An exposed firm can be where costs, revenues, assets or liabilities are affected by exchange rate movements (Amihud and Levich, 1994, p.3).

---

[8] Exchange rate passthrough is a term describing the degree to which tradeable firms pass on the effects of fluctuating exchange rates to the consumer. When exchange rates fluctuate but prices remain unchanged, we have zero passthrough. On the other hand complete passthrough describes the scenario where an item's price changes as a direct consequence of exchange rate movements.

Domestic firms with no foreign trade (a non-tradable firm) may be indirectly affected when their competitors are exposed. Extending upon this, consider an oligopolistic market with some domestic businesses supplying only to the domestic market and others additionally exporting overseas. An appreciation in the domestic currency may encourage this latter group to supply more stock in the domestic market, since their exports lose competitiveness overseas. This exerts potential for the market to be oversupplied, consequently putting downward pressure on price and (potentially) forcing change to domestic businesses strategy. A consequent adjustment to market share will affect all market participants. Profit margins are likely to contract for those firms importing a relatively higher proportion of necessary inputs from overseas as well.

Dornbusch (1975) and Gavin (1989) provide macroeconomic models supporting a positive relation between non-tradable sectors and exchange rates. They suggest a domestic appreciation forces a transfer of capital resources into the non-tradable sector, thus placing upward pressure on the market value of such capital. This theory suggests the value of non-tradable industries to gain relative to exporters under an appreciating domestic currency. Depreciation has the opposite affect under this theory.

Internationally isolated sectors of the economy may be indirectly affected as a consequence of the exchange rates' impact towards the business climate of an economy.

Finally, the values of foreign denominated assets are directly linked to the exchange rate (accounting exposure). An appreciation generally decreases their value plus any cashflow stream from such a foreign source.

2.2.4: Short- vs. Long-Term Exposure and Asymmetric Behaviour

In addition to identifying components of its business that are exposed to foreign exchange risks, management should also determine whether current trends in the exchange rate are a short term affair, or a long term adjustment to its equilibrium level.[9] If the exchange rate movement tends to be characterised by the latter, it may lead to ongoing resource allocation problems, with pressures on risk management, cost structure and business strategies.

Unfavourable short term currency fluctuations can be hedged (see Section 2.2.6). However, more extensive strategies may be initiated, if forecast to persist. For example, foreign supply lines may be forced to switch for comparably cheaper substitutes from another domestic or foreign market.

The degree of substitutability can therefore be an important factor to determine if and when such negative exposures can be reduced. Niche inputs and contracts may restrict such options from becoming viable in the short term. Similarly, these restrictions can prohibit a firm's ability to take advantage of favourable exchange rate movements.

Some companies shift operations towards their main export markets to limit foreign exchange exposure. In 2004 a survey of 800 Australian manufacturers found that one in five were considering a shift in

---

[9] "3-month forecasts by money-market dealers, economists and technical analysts tend to be done quite accurately, and are even better over long time horizons such as ten years. However anything shorter than three months often leads to problems." Sheeran, G. (2004, December 5). Taking a punt on a strong Kiwi dollar. *Sunday Star Times,* p. D7.

operations to China, because of the strong AUD.[10] A similar survey on 60 NZ exporters in the same year, concluded the persistent strength of the NZD was financially straining business operations. It was concluded the NZD value was likely to cause alterations towards employment, production and business strategy (ibid). In 2006, Fisher & Paykel Appliance were in the process of investing a plant in Ohio, not only to reduce freight and transportation costs, but also eliminate some exposure to the USD.

Gains from such investment must outweigh the additional co-ordination, variable and fixed capital costs of the project in order to be viable. When unwanted exchange rate trends seem permanent, such radical change will become more justified.

Some research has noted a significant currency depreciation to attract foreign capital investment due to the relatively lower barriers to entry (see Baldwin, 1986, 1988, Baldwin and Krugman, 1989). They suggest foreign market entry to be attractive when the associated gross profits are higher than sunk entry costs, but the decision to exit the market will eventuate only when expected gross profits become negative. Firm entry/exit behaviour is therefore suggested by them to be asymmetric with respect to fluctuating exchange rates.[11]

Asymmetric behaviour is not only apparent in long-term entry and exit decision making, but also in short-term pricing strategies. The term "pricing to market" (PTM) denotes the action of exporters not fully

---

[10] Wilson, C. (May, 2004). Coping with the pressure of the rising dollar. *Bright, 4*, 6-8.

[11] Empirical support on this 'hysteresis in trade' effect can be found in Campa (1993), and Roberts and Tybout (1997), among others.

adjusting their prices, after an influential exchange rate change (or similarly import prices not falling by the same degree of the domestic currency appreciation).

Reasons for this limited exchange rate pass-through include imperfect competition among heterogeneous products (see Krugman, 1987). Imperfectly competitive companies are price setters and price elasticity of demand is an important consideration in setting prices. This elasticity is a function of substitutability and therefore a function of domestic and international competition. Empirical evidence of PTM has been found by Bernhofen and Xu (2000), Gross and Schmitt (2000), and Khalaf and Kichian (2000).

2.2.5: Exposure to Capital Flows

A fluctuating exchange rate may inhibit foreign capital investment for two reasons. Firstly, exchange rate volatility creates noise in the market, adding difficulties to the foreign shareholder in monitoring investment performance. Secondly, it may cause some foreign investors to attach a high risk premium, hindering investment in those, which may otherwise seem desirable (Amihud and Levich, 1994, p.2).

2.2.6: Hedging Exposure

Exchange rate exposure is no longer an uncertainty that companies must encounter. Today's hedging instruments provide various means of currency protection, and include forward, call and put options, currency

swaps, and futures.[12] Companies may limit currency exposure by other means, such as natural hedges, invoicing in local currency, or adopt a similar strategy to Fischer & Paykel, mentioned above.[13]

A forward contract "involves contracting today to buy or sell a foreign currency at a future date at an exchange rate agreed today" (Brookes, *et al.*, 2000, p.23). Options are similar to forwards, however the owner of an option has the *choice* to exercise its use, not the *obligation*. When the owner of an option does not exercise its use it expires.

The owner of a call option has the right to buy foreign currency at a specified exchange rate within a specified time period. The owner of a put option on the other hand, has the option to sell foreign exchange under the same circumstances. Registered banks usually act as the medium between buyers and sellers.

A currency swap is an agreement to simultaneously buy and sell foreign exchange at a specified rate, where either the purchase or sale is conducted at the time of the contract, and the other at a specified future date.

Each instrument has its advantages and disadvantages relative to each other, and relative to the option not to hedge. Forward contracts for instance, eliminate currency exposure; however eliminate the potential to

---

[12] These are the basic tools, however among each type, are various specialised types, which will not be explained. These include forward-forward swaps and nondeliverable forwards.

[13] Reduced operation and transaction exposure will be partially offset by accounting exposure, however.

make currency gains if the forward rate unexpectedly differs to the spot rate at maturity.

The unexpected NZD depreciation following the Asian crisis (see section 2.4) disadvantaged NZ exporters that were locked in forward contracts (Brookes *et al.*, 2000, p. 25). The depreciation gave a relative advantage for those in an unhedged position (or those hedging with call/put options).

Companies consist of numerous departments that are influenced differently by exchange rate fluctuations: while costs to the production department may decline with an appreciation due to lower imported inputs, the marketing department may struggle with declining demand for their exported products.

Management cannot afford to ignore the effects of exchange rate movements, despite the numerous and often complex linkages their firm may have with them. This is particularly true for companies facing international competition where exchange rates strongly influence the market climate.

2.3: Theory behind Causality of the Two Financial Markets

Consensus over the relationship between exchange rates and the SM is relatively more elusive than the relationship between individual companies and exchange rates. This arises not from the question surrounding whether a relationship exists, but over which financial market *causes* the other to change.

This is different from research on company-specific exposure, because causality is not an issue here: While some companies are likely to be influenced by exchange rate fluctuations, everyday practice is unlikely to be substantial enough to create a significant change to the NZD on a frequent basis. Therefore, at the aggregate level, the question is whether aggregate share prices cause exchange rates to change, or vice-versa.

Theories behind exchange rate determination have proliferated throughout the latter quarter of the 20th century since currencies began to float. Exchange rate determination initially focused on the relative price levels between any two countries. Much of this theory is accredited to the economist Gustav Cassel for his work between the two world wars (Copeland, 2005, p.43). From this Purchasing Power Parity (PPP) theory, spawned other numerous models of exchange rate determination including the monetary model (which stems from theory by David Hume, 1741), Mundell-Fleming model (see Mundell, 1962, Fleming, 1962), Dornbusch model (see Dornbusch, 1975, 1976), and the portfolio balance (PB) model (see Bransen, 1984).

PPP and the quantity theory of money formed the backbone of the monetary model, and the Mundell-Fleming model extended this by considering the balance of payments and fiscal policy changes. The Dornbusch model amalgamates the former two while also accounting for expectations, but it was the PB approach that became the popular model of exchange rate determination. Initially the PB approach assumed people to hold wealth in the form of the domestic money base, plus in domestic and foreign bonds.

None of this early theoretical literature initially gave explicit consideration to the sharemarket, although comments were occasionally made. Kouri (1976, p.301) noted the sharemarket may characterise exchange rate behaviour given its speculative nature.

Gavin (1989) was among the first to formally propose the SM's presence into a model of exchange rate determination. He substituted the real interest rate for the sharemarket, to create a model determining aggregate demand and exchange rate relationships.

Since the late 1980s, other research has provided argument for the sharemarket to be included within the PB model including Smith (1992), who examined the impact of bonds, money stock and equities in exchange rate determination. Smith found the US sharemarket to have more influence on the USD/DEM and USD/JPY exchange rates, over other variables composing wealth in the PB Model.

Over time the PB model has been broadened to include the sharemarket among the models' wealth portfolio of domestic and overseas money, and domestic and overseas securities.

2.3.1: The Portfolio Balance Model

The PB model asserts that individuals allocate wealth among the various assets noted above. It hypothesizes domestic demand for money to be inversely related to domestic and foreign interest rates. Further, the demand for domestic bonds is positively related to domestic interest rates, but negatively to foreign interest rates. Similarly the model assumes the

demand for foreign bonds to be positively related with foreign interest rates but negatively to domestic interest rates. The exchange rates' purpose is to balance asset demand and supply, so that changes to the demand or supply of these assets will change the equilibrium exchange rate (Ajayi *et al.*, 1998).

Take an example of the PB approach, where the sharemarket index currently has a downward trend (a bear market). Domestic wealth in such a case falls and money demand consequently decreases, to put downward pressure on domestic interest rates. Relatively lower interest rates attract less foreign capital than before, given the relatively higher returns elsewhere. Hence, the demand for domestic currency declines to pressure the domestic currency to depreciate. The relatively higher valued foreign assets also attract some domestic investment overseas, to add more downward pressure to the domestic currency, via increases to the supply of domestic currency in the foreign exchange market.

The PB model therefore implies positive causality running from the sharemarket to exchange rates, meaning an improvement to the domestic sharemarket causes the domestic currency to appreciate, and vice-versa. Other research has provided similar arguments to how changes to the SM affect foreign capital inflows and outflows (see Bahmani-Oskee and Sohrabian, 1992, Solnik, 1987, Qiao, 1996).

2.3.2: The Goods Market Approach

In contrast to the PB theory is the Goods Market approach. This suggests exchange rates to affect the economy's trade balance, company performance and competitiveness, consequently affecting share value. Bodnar and Gentry (1993) highlighted three effects on business practice a fluctuating currency can have. It may (1) affect competition among foreign firms, domestic exporters and import competitors; (2) force change to import costs used by those importing foreign inputs to production or for firms importing to sell domestically; (3) alter the value of assets denominated in foreign currency, which are owned by domestic enterprises.

Following a change to the exchange rate these effects aggregate to an overall change in the SM, suggesting a causal relationship running from exchange rates to the SM.

This causality may be positive or negative and could depend on the division between net exporters and importers within the SM. If net exporters represent a higher proportion of the SM, the markets' performance is likely to improve in the case of a domestic depreciation. This would suggest an inverse relationship. In the case where net importers represent a relatively higher share, the Goods Market approach suggests this relationship to be positive.

2.4: Historical and Statistical Overview of the New Zealand Dollar

While the 1970s were characterised by oil shocks, high inflation and substantial government intervention, the 1980s witnessed the start of "one of the most radical market liberalisation programmes initiated anywhere in the world".[14] Part of this free-market regime included relinquishing government exchange rate interventions and international capital flows. This has led the NZD in 2005 to be the 11th most-traded currency, despite the nation accounting for only 0.2 per cent of the world economy.[15]

From March, 1985 the NZD has operated under a clean float and since then, has been characterised by considerable fluctuations, seen in Figure 2.1 below.

Figure 2.1: New Zealand Dollar History[16]

---
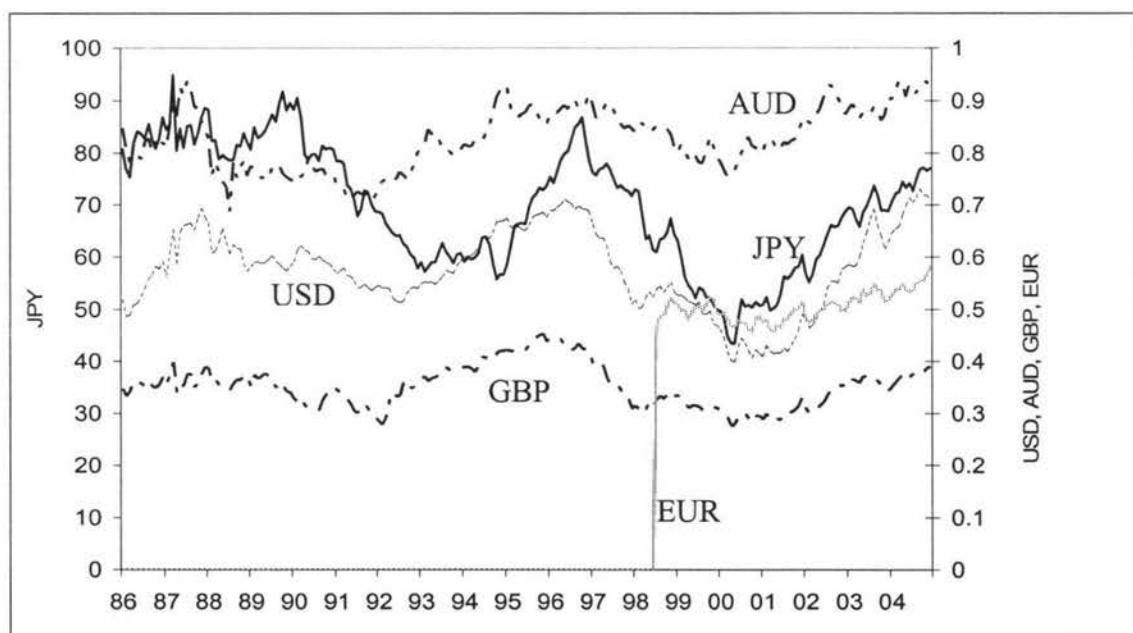
[14] Quoted from David Henderson, Economic reform: New Zealand in an International Perspective, New Zealand Business Roundtable, August, 1996.) when describing New Zealand's economic reforms.

[15] Beckford, G. (March 9, 2005), High Kiwi Set For A Fall, But Not Yet, cited from *http://xtramsn.co.nz/business/o,,5011-4178828,00.html*. Retrieved March 9, 2005.

[16] Source: www.rbnz.co.nz

From 1990 the NZD depreciated against its top four trading partners, stabilising in 1992. This depreciation was particularly due to the lower interest rates; a move by the RBNZ to spring the economy out of its 1991 recession.

The NZD closely trends with the US dollars' performance with their trading partners. Therefore if the USD weakens against its dominant trade partners the NZD does too, *ceteris paribus*.[17] The beginning of 1992 saw the USD appreciate strongly against the JPY and DEM following clear signs of the US economy recovering from its earlier 1990 slump. The NZD consequently moved parallel with this appreciation against NZ's major trading partners from late 1992 (ibid).

A long period of appreciation followed. Some of this can also be accredited to the large short term capital inflows, following the high interest rates the RBNZ set to offset inflationary pressures. In 1997 came a significant turning point for the NZD: the Asian financial crisis.

Prior to this shock to the economy the NZD had (by comparing minimum maximum values) fluctuated since its float by approximately 36% against the AUD, 63% against the GBP, 70% against the JPY, and 63% against the USD.[18] A lot of this variability for NZ is attributed to fluctuating net capital inflows, a universal characteristic for SOEs in current account

---

[17] NZIER Quarterly Predictions, (June, 1992), "Exchange Rates", p. 23.

[18] These were calculated by taking the percentage change between the maximum and minimum values between 1985 and 1998. The date of the NZD/AUD minimum was January 1989. For the NZD/GBP; August 1992. For the NZD/JPY this minimum fell on April 1995, and August 1986 for the NZD/USD. Maximum values for the NZD/AUD and NZD/GBP fell on January, 1988 and May, 1996 respectively. The maximum value for the NZD/JPY fell on September, 1987 and November, 1996 for the NZD/USD.

deficit (Chatterjee and Birks, 2001, p. 315). Tables 2.1 and 2.2 show the NZD's performance against the currencies of NZ's five largest trading partners, between January 1999 and July 2005.

Table 2.1: Yearly Means for the NZD[19]

	USD	AUD	JPY	GBP	EUR
1999	0.53	0.82	60.25	0.33	0.50
2000	0.46	0.79	49.23	0.3	0.49
2001	0.42	0.81	51.09	0.29	0.47
2002	0.46	0.85	58.02	0.31	0.49
2003	0.58	0.89	67.33	0.36	0.51
2004	0.66	0.9	71.75	0.36	0.53
2005	0.72	0.93	75.95	0.38	0.56
Entire Period	0.54	0.85	60.9	0.33	0.5
Min	0.4	0.75	42.71	0.27	0.44
Max	0.74	0.95	77.66	0.39	0.59
Min-Max Range (%)	87.4	26.5	81.8	73.3	33.6

The general trend was for the NZD to depreciate until it hit a low point in 2000, and then appreciate for the rest of the period. Dissipating capital inflows following the Asian crisis were the primary cause of the plummeting NZD for the three years before 2000. Severe droughts in 1998 and 1999, which harmed agricultural exports augmented its dive (Smith, 2004, p. 15).

---

[19] Note that 2005 data only covers the first half of the year. Original data came from ASB Bank Chief Economist Anthony Byett. Daily data was transformed into a weekly frequency (for arguments put forward in Section 4.3).

Table 2.2: Yearly Percentage Change in the Means for the NZD

	99-00	00-01	01-02	02-03	03-04	04-05	Entire Period
USD	-13.7%	-7.9%	10.3%	25.3%	14.2%	7.8%	29.3%
AUD	-4.3%	3.6%	4.9%	4.9%	0.8%	2.8%	6.7%
JPY	-18.3%	3.8%	13.6%	16.1%	6.6%	5.9%	27.9%
GBP	-8.1%	-2.9%	5.7%	15.2%	1.9%	5.6%	18.6%
EUR	-0.6%	-4.9%	4.5%	4.7%	3.8%	4.5%	25.4%

Between late 2000 and mid-2005 the NZD had reached both its highest and lowest points since its float. November 21, 2000 saw the NZD/USD fall to its lowest level ever of US$0.3914. Its highest value reached US$0.7448 on March 18 2005. The appreciation between these dates equates to 90.3 per cent. Substantial appreciation of the NZD between 2000 and 2005 gave it the reputation as the world's best performer since the start of the millennium.[20] Figure 2.2 below indexes figure 1 above, with January holding a base value of 1000.[21]

---

[20] Beckford, G. (March 9, 2005), High Kiwi Set For A Fall, But Not Yet, cited from *http://xtramsn.co.nz/business/o,,5011-4178828,00.html*. Retrieved March 9, 2005.
[21] Plotted data is a weekly frequency.

Figure 2.2: The Indexed NZD from January 1999 to July 2005
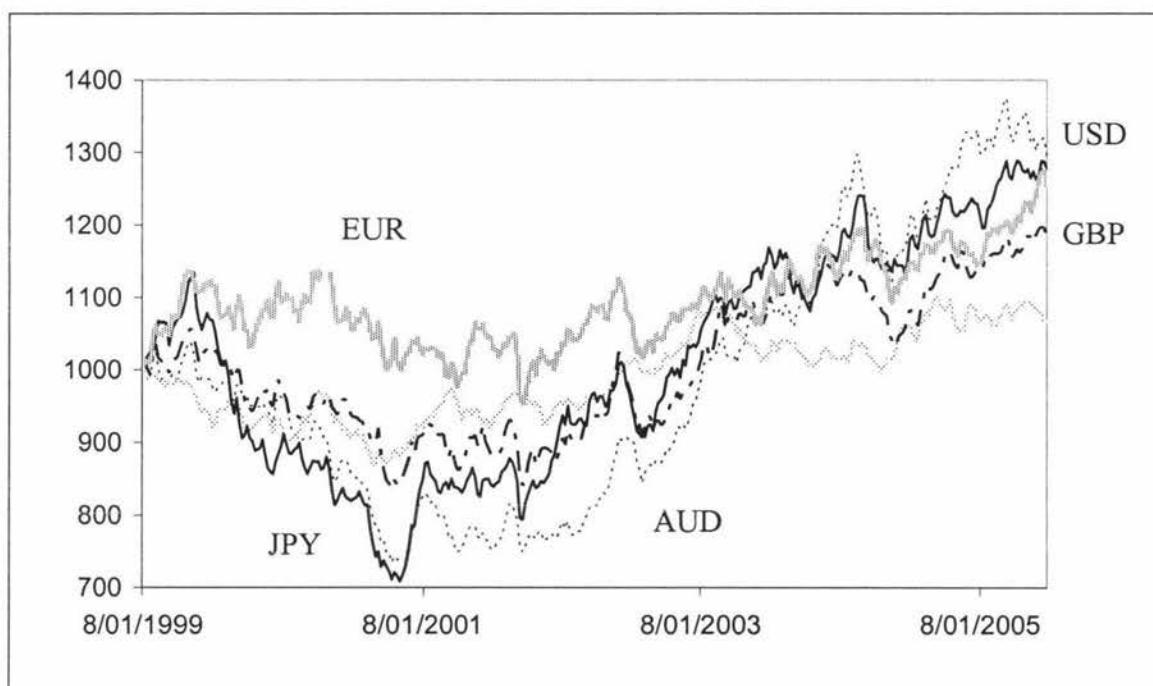
Referring to Figure 2.2, the period of depreciation is noticeable from 1999 until 2001. During this time, the NZD reached eight-year lows against both the AUD and GBP, a record low against the JPY. This general trend was a consequence of many factors including rising oil prices, a high current account deficit, projected economic growth slowdown following increases to the OCR, and widespread concern over the new Employment Relations legislation (Story, 200a).

Between 2003 and mid-2005 the appreciating NZD had largely been attributed to NZ's strong economic growth and the RBNZ's eight successive rises of the OCR since January 2004. Since this date the OCR increased from 5.0 per cent, to 6.75 per cent in July 2005; the highest among all OECD economies.[22] The effect was to push all domestic

---

[22] OCR vales, dates and information within this paragraph were found in http://www.rbnz.govt.nz retrieved November 18, 2005.

interest rates up and attract foreign capital inflows, pressuring the NZD to appreciate.

Intentions of this long period of contractionary monetary policy[23] were to limit inflation from breaching the RBNZ's medium-term cap of three per cent. Inflationary pressures in 2005 mounted in lieu of the rising petrol prices, strong business fixed investment, strong labour market and substantial property boom.[24]

The NZD maintained its upward trend in 2005 as a consequence of other macroeconomic factors as well. A Treasury report notes the depreciating USD (which was a consequence of weaker GDP growth) explained some of the appreciating NZD/USD for 2002.[25] In 2005, Alan Bollard commented the high NZD was a result from high commodity prices.[26] Carry trades were another factor to keep the NZD/JPY at its eight and a half year high (Reuters, 2006).

The consensus for late 2005 was that the NZD was extremely overvalued. The growing current account deficit and forecasted slowdown of the economy suggest this appreciation to reverse in the near future.[27]

---

[23] The continuous OCR hikes lack the vigour they once had, since around 70% of mortgage rates are fixed (and therefore temporarily unaffected). This is generating concern among members of the RBNZ (Morgan, G., November 19, 2005, p.C2).

[24] See Alexander, T. (2005, November 17), BNZ Weekly Overview, p.2. Cited from www.bnz.co.nz. Retrieved November 17, 2005.

[25] Treasury Report: Exchange Rate Developments and Implications. (2003), (Report No. T2003/109), p.5.

[26] Reuters. (2005, March 11), NZD Reflects Commodity Prices- RBNZ, cited from *http://xtramsn.co.nz/business/0,,5011-4187437,00.html*. Retrieved March 12, 2005.

[27]Stuff. (2005, November 25). Close: NZ dollar nears post float record, cited from *http://www.stuff.co.nz/stuff/0,2106,3491368a6023,00.html*. Retrieved November 25, 2005.

Heading into 2006, analysts estimated the overvalued NZD/USD to slide toward its equilibrium level of around US$0.58 by the end of 2006.[28] Sanford Limited is NZ's largest seafood exporter and suffered significantly from the overvalued currency in 2005. In November 2005 their Managing Director, Mr Barratt, fittingly commented "I think the fundamentals are that (the NZD) has to fall...I hope it happens tomorrow."[29]

2.5: History of the New Zealand Sharemarket

Foundations of the NZ SM[30] began with the gold rush of the 1870s. Rules and regulations have been eased since, particularly its marketing after WWII and during the reforms beginning in 1984. The SM has changed and grown exponentially since the 1980s, driven by advances in technology, internationalisation and changing consumer demands. This latter factor, coupled with bankruptcy and mergers led only 15 companies from the SM in 1974 to remain listed in2004.[31]

---

[28] The BNZ estimate the NZD/USD to fall to US$0.66 by March and US$0.58 by December, 2006. (See "BNZ Weekly Overview, (2005, November 24), p.11. Brendon O'Donovan suggests this equilibrium level to be between US$0.56 and US$0.58. See Beckford, G., (2005, March 9), High Kiwi Set For A Fall, But Not Yet., cited from *http://xtramsn.co.nz/business/o,,5011-4178828,00.html*. Retrieved March 9, 2005.

[29] See Vaughn, G. (2005, November 24), Hedging saves Sanford profit., Cited at http://www.stuff.co.nz/stuff/0,2106,3488988a13,00.html. Retrieved November 24, 2005.

[30] On May 30, 2003, the previously titled *New Zealand Stock Exchange Limited* got changed to *New Zealand Exchange Limited*, or NZX for short. The NZX comprises three market groups: the NZDX (NZ Debt Market), NZAX (NZ Alternative Market), and finally the NZSX- the NZ sharemarket.

[31] Watson, C. (2004). *Risk, Return and Reality: An introduction to portfolio investing.* Tauranga: Bays Print Management, p. 52.

Technology has eased the process of investing both domestically and internationally. A computerised Screen Trading System was introduced in mid-1991 with an enhanced FASTER system that following year.[32] These upgrades helped to reduce the settlement time of a transaction and lessen paperwork. All share trades were automated from May 18, 1998, with more improvements following in 1999.[33] These technological advancements, together with growing per-capita incomes and development of the internet,[34] catalysed investment growth among world sharemarkets.

In 2005 the NZ SM had a market capitalisation (which is the sum of all share prices times shares issued) of approximately $69 billion, or one-half of NZ's GDP.[35] This proportion is comparatively larger than 15 years earlier, when the SM's capitalisation was approximately $20 billion (in 2005 dollars), representing one-eighth of NZ GDP at the time.[36] In

---

[32] FASTER stands for Fully Automated Screen Trading and Electronic Registration.

[33] Cited from http://www.nzx.com/aboutus/who_we_are/history/view retrieved November 11, 2005.

[34] The internet has reduced asymmetric information regarding company performance.

[35] Figures taken from Yarwood, V. (October, 2005). Are our capital markets dying? cited from *http://www.equity.co.nz/scripts/mgarchives.asp*. Retrieved November 11, 2005. The article also notes other OECD nations' SM to GDP ratios: Australia's is approximately 114 per cent of GDP; the US, 140 per cent; and Singapore 190 per cent.

[36] Raw data for calculating the information from 1990 came from: http://www.globalfinancialdata.com/index.php3 retrieved November 11, 2005. 1990's sharemarket capitalisation and GDP were quoted at US$8,840 million and US$73,514 million respectively. Dividing 8,840 by 73,514 gives us 0.12025 (4 D.P.), which means the capitalisation of NZ's SM was approximately one-eighth of NZ's GDP in 1990. In calculating 1990's capitalisation in today's terms, US$8,840 million was converted using the average exchange rate for 1990 of US$0.5886 per NZ$1(*ibid*). This converts to approximately NZ$15,019 million. This value was then inflated into 2005 (quarter 3) dollars, using the "CPI Inflation calculator" (approximately NZ$20 billion), cited from www.rbnz.govt.nz retrieved November 11, 2005.

November, 2005 NZ's four largest firms combined, had a capitalisation larger than this dollar value.[37]

Despite this massive surge of growth, the NZSX is a small player by international standards. As of February 2004, the size of the NZSX was ranked 43, just behind Egypt and Luxemburg. At this time, the Australian SM was approximately 18 times larger than NZ's; Japan's around 100, and the US SM just over 525 times larger (Watson, 2004, p. 63).

2.5.1: Pre-1999 Performance Summary of the New Zealand Sharemarket

Investment into the SM grew considerably after the Labour Party came to power on July 14, 1984. Fiscal deregulation, floating the NZD, high interest rates, expanding overseas markets and liberalisation of the NZSX itself, all catalysed this growth for a further three years (Grant, D., 1997, p.272). Share trading turnover and capitalisation levels reached record levels every year preceding the world sharemarket crash in 1987,[38] and approximately 28 per cent of the NZ population (almost 900,000 New Zealanders) owned shares by 1986 (Grant, D., 1997, p. 284).

The system came under strain as transaction turnover intensified. Its inadequacy was noticeable when processing delays became commonplace. On August, 1986 KISMET boss, Bill Postgate,

---

[37] As of November 29, 2005, NZ's four largest firms in descending order were Telecom (with a capitalisation of $11.39B), Contact Energy ($3.17B), Fletcher Building ($3.51B) and Carter Holt Harvey ($3.27B).

[38] The New Zealand Stock Exchange: Annual Report. *Various issues.*

commented the current system could handle only one-third of the current transaction volume (*ibid*, p.280).

Other problems arose including the growing popularity of 'margin trading'. Brokers (who were in short supply) lacked appropriate systems to monitor customer credit worthiness. But the NZSX kept reaching record highs making it the best performing SM in the world over the ten years to 1986 (*ibid*, p.285).

Then in 1987 came a series of downturns. The NZD was strong and swelling the attractiveness to invest offshore. The RBNZ also predicted economic growth to slow and these factors caused the Barclay's Index (the SM index measurement at the time) to fall 20 per cent in February (Grant, 1997, p.304). Market values also fell $1.5 billion on May 18, followed the next day with a drop of six per cent (*ibid*).

On Monday 19 October 1987, news of a large US trade deficit, growing internal debt and uncertainty from the Iran-Iraq war caused the NZSX to fall $1.6 billion (Grant, 1997, p.306). The next day share values slid $5.7 billion in four hours (*ibid*, p. 308). In that week, the Dow Jones Index fell 33 per cent and Australia's AORD 41 per cent. Overpriced shares were said to also contribute to the crash among these markets (*ibid*).

The NZSX struggled to correct itself in 1990 due to low economic growth, poorly performing international capital markets and NZ's high real interest rates (NZ Stock Exchange: Annual Report 1990, p.2).

Prior to October 1987, market capitalisation was approximately $50 billion. The market's lowest point was in January 1991, where it was

$14.5 billion (NZ Stock Exchange: Sharemarket Review, 1992, p.2).This represents a fall in capitalisation of 71 per cent.

Outperforming Japan's Nikkei and Britain's FT100, the NZSX recovered in 1991 following similar growth to Australia's AORD and the US Dow Jones. Telecom was also listed in that year, with a market capitalisation of $6.11 billion, making it New Zealand's largest listed company (NZ Stock Exchange: Sharemarket Review 1991, p 3). Such listings had fallen considerably since the 1987. In July 1992, 140 companies were listed on the NZSX. Prior to the SM crash, 361 were listed (Grant, 1997, p.302).

Refurbished interest to invest in the NZ SM came in 1992 due to lower interest rates, a depreciating NZD and the introduction of screen trading. Trade volume consequently increased 33 per cent from 1991 and market capitalisation rose 66 per cent for the year ended 30 June 1992.[39]

The NZSX continued to expand over the following two years: GDP growth increased, inflation and unemployment fell, government spending was in surplus and NZ's international debt rating got upgraded (NZ Stock Exchange Annual Report: 1994). The average annual return on investment between 1991 and 1996 was 16.8 per cent for the NZSX10.[40]

Record levels of transaction turnover were reached for every consecutive year between 1995 and 1999. This was mainly due to a further easing of interest rates by the RBNZ over the period, but also from the move towards a fully electronic trading system in 1998, which sped up settlement times (NZ Stock Exchange Annual Report: 1998).

---

[39] The New Zealand Stock Exchange Annual Report: 1992.
[40] Listener, (1996, May 25); Evening Post, (1996, June 25).

The Asian crisis of late 1997/1998 dampened foreign direct investment (FDI) into NZ and gave a considerable shock to the SM. For the year to 31 March 1996, FDI increased 25 per cent, to \$49,212 million. This capital inflow increased 10 per cent for the year to 31 March 1997, and another 17 per cent to 31st March 1998. The year to 31 March 1999 however, saw FDI growth into NZ fall marginally, for the first time in that decade (New Zealand Official Yearbook, 2000, p.397).

2.5.2: Performance of the NZSX Since 1999

Investment turnover in the SM was yet again at record levels in 1999, up 22 per cent from 1998. The listing of Auckland International Airport and Contact Energy added 300,000 more share registers, helping to boost annual trades for the year to 695,000.[41] However market performance in 1999 started out flat as a consequence of poor economic performance amongst Asian economies and low commodity prices (*ibid*). This lacklustre 1999 performance can be seen in figure 2.3 below.

---

[41] NZ Stock Exchange Annual Report: 1999.

43

Figure 2.3: Performance of New Zealand's Four Main Sharemarket Indicators Between 1999 and mid- 2005[42]
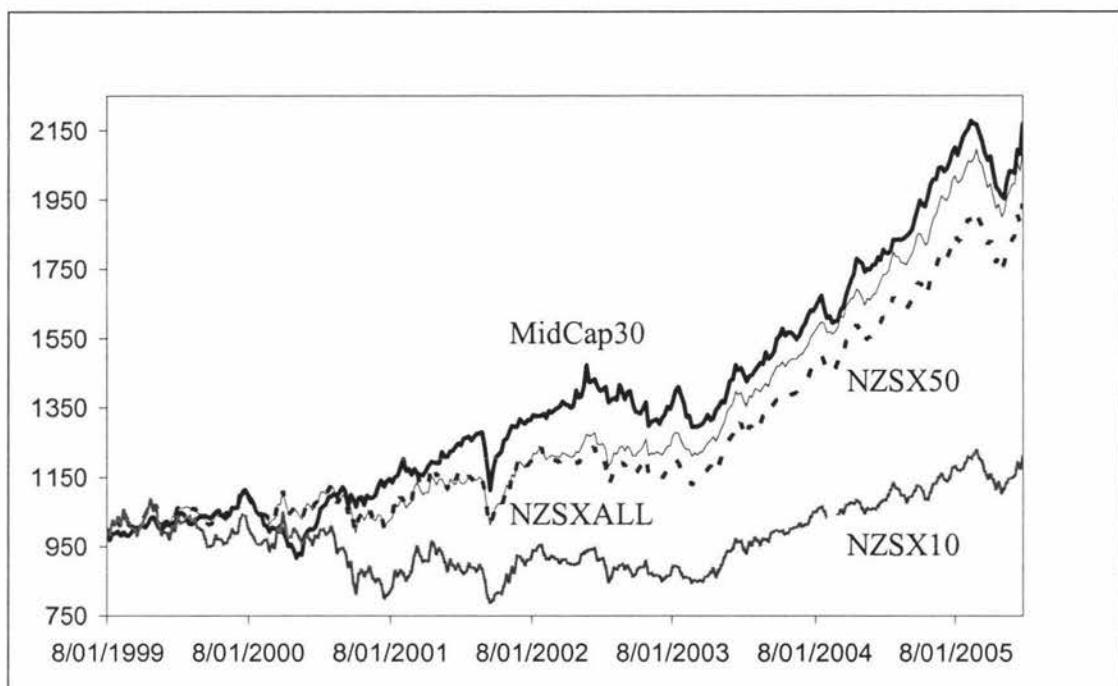
Figure 2.3 above shows the performance of NZ's main indexes since the beginning of 1999. For comparative purposes, each index was adjusted to make this starting date the base week (at 1000) for each index.

Another reason behind the slow SM growth into the new millennium was from the highly attractive returns outside NZ. These relatively more attractive returns were in the US, and Southeast Asia as economies recovered from 1997/1998. Not only did this reduce foreign capital investment in NZ, but it also lured NZ investment to foreign markets. The collective impact caused SM turnover for the year to fall by $1.2 billion 2000 (NZ Stock Exchange Annual Report: 2000, p. 2).

---

[42] Source: Global Financial Data: Cited from: *http://www.globalfinancialdata.com* Retrieved May 19, 2005.

Figure 2.3 highlights the poor performance among all indexes continued well into the new millennium. The SM performed similarly to the NASDAQ in 2000. Consumer confidence dropped across the ditch as the Australian economy anticipated the introduction of GST on selected items.[43] This added uncertainty to NZ's business climate in 2000 and 2001.

With reference to Figure 2.3 it is immediately apparent that NZ's ten largest companies had generally been outperformed by smaller listed companies included in the larger indexes. Refer to Appendix III for a list of companies listed under each index.

NZSX market heavyweight Telecom was at a two-year low in 2001, when it announced dividends would be trimmed by around 50 per cent.[44] Carter Holt Harvey was also struggling under difficult international conditions (Mallinson, 2002, p. 18).

Falling world growth rates in 2001 created the first synchronised global recession in 20-25 years.[45] The US Dow Jones fell approximately 15 per cent in 2001, the S&P 500 18 per cent, and the NASDAQ 36 per cent. Main drivers of these poor market performances were the technology bubble cracking and to a lesser extent, the September 11 terrorist attacks upon the World Trade Centres in New York (Watt, 2002 pp. 12-19).

---

[43] Rothschild Australia Asset Management Ltd., (2000, August). Australian sharemarket update June 2000. *New Zealand Investors' Monthly, 78,* 29.

[44] Story, M. (2000b, September). Investor news briefs. *New Zealand Investors' Monthly, 79,* 13.

[45] Caton, C. (2002, February). A rise to follow the fall: Expect the US economy to recover later in the year. *The New Zealand Investors' Monthly, 94,* 45-46.

These gloomy conditions led the US into recession and dampened global economic conditions and investor confidence. Economies around the world consequently eased monetary policies to stimulate growth and the OCR for both Australia and NZ fell over one per cent in the first half of 2001.

Growth in Europe and Japan continued slowing into 2002, which helped to create a *silver lining* for domestic investors (Story, 2001b, p.9), and consumer confidence rebounded for NZ in 2001 following higher growth expectations.[46] The threat of a SARS outbreak diminished and the domestic SM rapidly recovered from its September 11 downturn. Investors were confident in NZ's performance, and the relatively higher growth of the NZ SM from late 2001 attracted substantial foreign investment. Poorly performing Asian markets in late 2002 augmented this foreign investment (Story, 2003a, pp.47-49).

Three tables below indicate the performance of NZ's four most commonly quoted indexes. Table 2.3 also shows the annual means of NZ's ninety-day day bank bill yields (BB). Effects from the OCR reductions in late 2001 forced the mean annual BB down nearly one per cent between 2000 and 2003.

---

[46] JBWere Investment Management, (2001). Correction or Crisis: is the worst over? *New Zealand Investors' Monthly, 88,* 32-33.

Table 2.3: Annual Means for New Zealand's Sharemarket Indexes and Interest Rates

	Entire Period	1999	2000	2001	2002	2003	2004	2005
NZSX-All	2088.9	1650.3	1680.6	1773.7	1947.1	2160.8	2758.2	3188.8
NZSX-50	2112.8	1734.3	1766.2	1874.0	1988.2	2127.0	2692.5	3079.6
MidCap30	4342.5	3233.8	3300.8	3849.5	4296.5	4541.0	5701.3	6555.0
NZSX-10	989.2	1021.4	954.4	895.0	913.5	948.5	1102.1	1185.4
90DayBB	5.804	4.838	6.473	5.722	5.665	5.425	6.122	6.956

The NZ economy was in relatively better shape compared to the rest of the world in 2002 and 2003: high population growth, falling interest rates and a low NZD (see figure 2.1) assisted export earnings to increase, helping the NZSX recover from its stagnant growth in 2000 (Watt, 2002, pp.18-25).

Table 2.4: Yearly Percentage Change in the Means of New Zealand's Sharemarkets

	Entire Period	99-00	00-01	01-02	02-03	03-04	04-05
NZSX-10	21.2	-6.6	-6.2	2.1	3.8	16.2	7.6
MidCap30	116.7	2.1	16.6	11.6	5.7	25.6	15.0
NZSX-50	93.9	1.8	6.1	6.1	7.0	26.6	14.4
NZSX-All	109.1	1.8	5.5	9.8	11.0	27.6	15.6

Over the ten years to 2002, the NZSE 40 Gross index return was 155 per cent, or an average yearly compound return of 9.8 per cent (Mallison, 2002).

Table 2.5: Yearly Percentage Change in New Zealand Sharemarkets' Weekly Averages

	99-00	00-01	01-02	02-03	03-04	04-05
NZSX10	3.7	-19.2	11.4	-5.4	19.3	11.8
MidCap30	11.3	3.8	14.8	2.9	21.1	26.9
NZSX50	12.0	-6.7	15.2	-1.8	24.5	24.3
NZSXAll	12.0	-6.7	16.2	3.7	25.2	27.2

Table 2.5 indicates the NZ SM performed above this return of 9.8 per cent in 2001, 2003 and 2005. Only the NZSX-10 performed below this in 1999. Much of the NZ's positive SM performance between 2003 and 2005 was a result of strong economic growth. The NZ economy grew at 4.6 per cent for the year to September 2004, among the highest for OECD economies at the time.[47]

Comparing Tables 2.3 and 2.5, the SM outperformed the return from BB for 2003 and 2004, however, many investors over this period shifted capital into another form of investment- the NZ housing market. In 2004 and 2005 house prices increased 13.5 per cent and 15 per cent, respectively.[48] In 2005 higher house prices created a wealth effect, and consumer spending put pressure on the 3 per cent inflation limit set by the Reserve Bank Act, 1989. As a consequence, tightening monetary policy pressured interest rates up (see Table 2.3). Its effect was forecast to put downward pressure on both NZ property and SM performance in early 2006.[49]

---

[47] IRG Publication, (2005). *Investment Year Book*. Lower Hutt: Investment Research Group Limited.
[48] Stuff. (2006a, January 4). NZX ebbs in year of takeovers. Cited from *http://www.stuff.co.nz/stuff/0,2106,3529221a13,00.html* Retrieved January 4, 2006.
[49] Stuff. (2006b, January 3). Economy losing its sparkle. Cited from *http://www.stuff.co.nz/stuff/0,2106,3528535a13,00.html*. Retrieved January 3, 2006.

Chapter Three:

LITERATURE REVIEW

*"Most exposure coefficients are small relative to their
standard error, except in a few cases. Of course, this
does not necessarily mean that the true exposure
coefficients are all zero but rather that exposure is
imprecisely estimated."*

–Jorion (1990, p. 337)

3.1: Introduction

This chapter covers selective theoretical and empirical research on the linkages between exchange rates and the SM. Among the relevant literature; econometric models, time periods, countries, exchange rate measures, data values, sharemarket indexes, and data frequencies can vary between studies. Each variation brings a new range of choices to the forefront, shaping the methodology used in this research. As well as commenting on the progress of empirical results, this literature review justifies the methodology to follow in Chapter Four.

Section 3.2 outlines some early research on exchange rate and SM relationships. Sections 3.3 and 3.4 both describe and critique the two most common methodologies throughout literature in this field of research. Section 3.5 discusses more empirical results and explanations for why findings are generally mixed. Section 3.6 provides a brief overview of company and industry-specific (microeconomic) exposure. This is followed by some final comments in Section 3.7.

3.2: Estimating Relationships Early On

Researchers' conclusions have been scattered between the two contrasting theories of causality and some find minimal econometric support for causality existing at all (for instance, Granger *et al.*, 2000).

Empirical studies began with Franck and Young (1972) analysing how revaluations and devaluations affect the NYSE index. Causality was already assumed to follow the Goods Market approach and no econometric application was attempted. This application came later from Aggarwal (1981), claiming to have the first empirical research on SM and floating exchange rate relationships.

Using ordinary least squares (OLS) Aggarwal (1981) separately regressed the NYSE, S&P 500 and DC 500 against a contemporaneous and lagged TWI, which incorporated America's 46 largest trading partners. A monthly frequency from mid-1974, to the end of 1978 found a positive relationship between the two financial markets that was stronger when the TWI was not lagged.

Following Aggarwal (1981) was the work of Solnik (1987), Soenen and Hennigar (1988), Ma and Kao (1990) and Smith (1992). Findings were mixed. Solnik (1987) ran an OLS regression for the SMs of the world's eight largest economies, finding very weak evidence of a positive relation to support the PB approach.[50] Soenen and Hennigar (1988) found support for the goods Market approach, unable to reject their null hypothesis that a depreciating USD stimulated economic activity, and Ma and Kao (1990) found further support to this theory between US economy and a

---

[50] This was a finding he did not conclude, but seemed apparent from his model.

TWI incorporating six currencies. Results from this later study suggested export-dominant sharemarkets are harmed by a domestic currency appreciation and vice-versa.

Until 1992 no research relating the SM and foreign exchange markets tested for stationarity or cointegration in their data series,[51] nor accounted for the possibility of a two-way causal relationship between the two financial markets.

Furthermore, no thorough econometric investigation had been exercised in examining causality between the two financial markets- only OLS-based relationships. American economist Thomas Sowell once commented that "one of the first things taught in introductory statistics is that correlation is not causation. It is also one of the first things forgotten" (Sowell, 1995).

3.2.2: The Important Prerequisite Test: Stationarity

A stationary time series implies the values tend towards a long run mean, with the effects from shocks tending towards zero as time passes; hence the mean and variance are constant over time. All time series data can be classed under an order of integration. A data set is integrated of order 'd', denoted I(d); with 'd' standing for the number of times the series must be differenced, to achieve a stationary data set. Usually a series only needs to be differenced once (denoted I (1)), meaning the original data series

---

[51] Soenen and Hennigar (1988) may have inadvertently bypassed the problems associated with a unit root in their time series data by regressing the differences in each level series. No justification for this methodology was made in lieu of unit root problems, however. Other, more recent works to ignore testing for stationarity include Wu (2001)

has a "unit root". If the series is stationary without the need to difference, the series is I (0).

Nelson and Plosser (1982) found evidence that a majority of macroeconomic time series are characterised by a unit root, and Granger and Newbold (1974) and Phillips (1988), state regressions using such time series data will produce spurious results.

More specifically, within nonstationary data the coefficient of determination is inaccurately high, and both Durbin-Watson statistics and standard errors are inaccurately low. The latter may also be characterised by non-normal distribution and possible autocorrelation problems, invalidating the models' t- and F-statistics. This means parameter estimates under OLS estimation would no longer be the best linear unbiased estimator (BLUE) as they are inconsistent, unless cointegrated (Dickey *et al.*, 1991, p.58). Therefore the condition of stationarity is an important prerequisite test for econometric time series analysis.

Up until the early 1990s two significant problems in this research area existed: First is a lack among these papers for a feedback mechanism that created bias in their work. Research prior to 1992 only tested a one-way relationship between exchange rate changes and sharemarkets, either ignoring the possible causality of the PB model (e.g. Aggarwal, 1981, or Ma and Kao, 1990), or ignoring the goods Market approach (see Solnik, 1987).

Secondly, no stationarity tests were exercised so all findings were at risk of being spurious if data were nonstationary. Neither problem could have

been blamed upon a lack of economic or econometric development: the theoretical groundwork for these problems had already been laid.

The two contrasting theories of causality between the two financial markets were well established by the mid-1980s. Branson (1976, 1977, 1984), Dornbusch (1975) and Kouri (1976) contributed significantly to the PB model's development, with subsequent extensions from Girton and Henderson (1976), Allen and Kenen (1976), Obstfeld (1980), among others.

The Goods Market approach was already well-understood, as many companies became exposed to currencies floated in the late 1970s. Furthermore, the necessity and means for testing stationarity in time series data were well-established. As noted already, Nelson and Plosser (1982) found evidence supporting the common existence of nonstationarity, and they used a testing method developed by Dickey and Fuller (1979).

Granger and Newbold (1974) and Phillips (1988) warned of the threat from spurious regressions from nonstationary time series. Even the econometric methodology behind causality (see Granger, 1969 and Sims, 1972) and cointegration (see Engle and Granger, 1987) was publicly available at the time. None of these methods were utilised, however.

Nevertheless, research in the 1980s provoked more exploration into SM and exchange rate interactions and with improved techniques made possible by advancing econometric theory. It was only a matter of time before advanced econometric developments were fully exploited. This

catch-up between theory and econometric application began with the work of Bahmani-Oskooee and Sohrabian in 1992.

3.2.3: The Catch-up

Bahmani-Oskooee and Sohrabian (1992) applied some econometric techniques superior to previous work. They tested for stationarity using the Augmented Dickey-Fuller (ADF) test, giving credibility against their results from being spurious. ADF tests found both the S&P 500 and effective USD exchange rate to be I(1), which meant differenced data were to be used in the Granger causality test to follow.

A US-based S&P 500 index and an effective USD were tested for causality with monthly data from July 1973 to December 1988. The Granger causality model found a dual causal relationship between the two financial markets in the short term, but cointegration failed to uncover any long term relationships. Their work was among the first to test bi-directional causality between the two financial markets. They were also among the first to apply cointegration and Granger causality techniques, widely used and accepted methodologies within this research area. The application of each methodology, and associated empirical results are described in Sections 3.3 and 3.4 below.

3.3: Granger Causality Analysis

Developed by Clive Granger (1969), the Granger causality model intends to provide econometric support for directional causality between two related variables. Theoretical extensions (for instance Sims, 1972 Pierce and Haugh, 1976, Evans and Wells, 1983),[52] and empirical applications of Granger causality have grown substantially since 1969, and have been applied over a broad range of topics. Many saw potential in Bahmani-Oskooee and Sohrabian's approach in testing Granger causality between exchange rates and the SM, and followed their approach.

Ajayi *et al.* (1998) applied this approach and found that causality differs between advanced and developing countries. While unidirectional causality to support the PB theory was significant at 1% for all six advanced economies studied, only Indonesia and the Philippines supported this from the eight developing economies tested. Korea had the only sharemarket to support causality inferred by the Goods Market approach.

Muhammad and Rasheed (2003) applied standard Granger causality testing as well. Their results suggested a lack of causality for exchange rates and the SM in Pakistan and India, which was robust to lag order indicating the results to be strong.

Granger *et al.* (2000) found mixed results in their bivariate Granger causality tests for Asian countries: While they found South Korea to only be characterised by the Goods Market approach, a feedback mechanism

---

[52] Geweke, *et al.* (1983) state Granger's (1969) test is superior to Sims (1972).

was evident in Hong Kong, Malaysia, Singapore, Thailand and Taiwan. No apparent relationship was found between exchange rates and the SM of Japan and Indonesia.

Nath and Samanta (2003) found insignificant interactions between the Indian sharemarket and the Rupee per USD, which was later complemented by Granger causality testing from Mishra (2004).

Empirical results of standard Granger causality have varied too much to warrant an unambiguous (Granger) causal relationship between the two financial markets. Despite the model's popularity, perhaps the methodologies carried out by these people, carry part of the blame.

3.3.1: Interpreting Granger causality

Maddala and Kim (1998, p.189) convey their agreement with Adrian Pagan's summary of Granger causality:

> *"There was a lot of high powered analysis of this topic, but I came away from a reading of it with the feeling that is was one of the most unfortunate turnings for econometrics in the last two decades, and it has probably generated more nonsense results than anything else during that time."* – Adrian Pagan (1989)

Their concern deals with misinterpretation. Granger (1969) emphasised Granger causality does not prove causality, but simply precedence. The analogy that "the weatherman's prediction about the rain (Granger) causes the rain" - (Maddala and Kim, 1998, p. 189), represents the correct interpretation of Granger causality. This however it is not always the given interpretation. Some (such as

Ibrahim, 2000, Savarek, 2004) assert one variable to actually *cause* the other.

Toda and Phillips (1993) showed evidence that F-tests under Granger causality do not have a standard distribution, when variables are cointegrated. Another problem relates to omitted variable bias.

3.3.2: *Omitted Variable Bias*

The presence of cointegrating variables requires the inclusion of lagged residuals from the cointegrating regressions, according to Engle and Granger (1987). This term represents the speed of convergence towards a long run equilibrium relationship. Granger (1988) states its absence may bring about incorrect conclusions. Bahmani-Oskooee and Sohrabian (1992), Ajayi (1998) and Mishra (2004) failed to include this term. For the latter two researchers, its exclusion resulted because cointegration was not tested for, despite its public appraisal following Engle and Granger (1987).

Although the other researchers (such as Ibrahim, 2000) include this term, many bivariate tests risk the potential problem of omitted variable bias: Their intentions are to uncover dynamic causal relations between the two financial markets, however an abundant number of other variables can affect one, or both of these markets. Omitted variable bias is a strong shadow among the bivariate framework of numerous researchers noted thus far (including Mishra, 2004, Muhammad and Rasheed, 2003, and ironically Granger *et al.*, 2000, among others) and must therefore be addressed.

Granger (1969, p.429) warned empirical results are at risk of becoming spurious where relevant variables are omitted in testing bivariate causality.[53] Caporale and Pittis (1997) find causality to be sensitive to relevant variable omission. Furthermore, Ibrahim (2000) suggested the bivariate framework tested for by Bahmani-Oskooee and Sohrabian (1992), Qiao (1996), Abdalla and Murinde (1997) are due to this.

Numerous factors contribute to the performance of exchange rates and SMs. For example, a rise of NZ's official cash rate (OCR) increases general interest rates spurring foreign capital inflows. This may put upward pressure on the NZD, harming exporters within NZ on two fronts: higher interest rates increase the cost of borrowing (for exporters and importers). Furthermore a higher NZD reduces foreign demand for exporters' products. Importers would be expected to benefit from an appreciating NZD, and these relationships add credibility that a relationship exists between the two financial markets and interest rates.

Given the above comments over variable omission, the empirical analysis of this research will consist of not only exchange rates and the SM, but interest rates as well. BB rates will be used, since they are available at a high frequency and are a good proxy for general interest rate movements for the NZ economy.

Phylaktis and Ravazzolo (2000) also noted the problem of variable omission. Their analysis was applied to six Pacific Basin countries where

---

[53] Bivariate Granger causality differs from multivariate Granger causality. The multivariate approach tests Granger causality between n variables (where n>2). Bivariate Granger causality tests one variable against just one other (n=2).

they included the US stock market in their tests to account for this. The US SM was chosen because all six countries trade significantly with the US.

They argue that under the Goods Market approach a higher US stock market implies higher US imports and therefore higher Pacific Basin exports, theoretically appreciating their currencies, improving economic activity, and leading to an improvement in Pacific Basin SMs.

What was implicitly assumed here was that an appreciating currency's detrimental effects to the domestic exporting sector would not offset the gains made by US imports plus those to its import sector. Interest rates act as a more appropriate addition within the empirical testing because there is mutual agreement over its relationships with each financial market.

Changing interest rates impact capital inflows and outflows, affecting the supply and demand for domestic currency. Rising interest rates for example, increase foreign capital inflows, which aim to capture the relatively higher returns. This forces the domestic currency to appreciate.

Interest rates are a cost of capital to both investors and business: a higher interest rate increases the attractiveness of a cash-based investment, thereby reducing demand for investment in the SM. ABN Amro for instance, ranked cash-based investments ahead of all NZ stocks, for the year of 2006 (Vaughan, 2006).

A higher interest rate also increases the cost of borrowing for business, which may slow down operations and increase costs. Both investors and company reactions to higher interest rates reduce SM performance.

3.3.3: The Appropriateness of Granger Causality within this Research

From the ambiguity surrounding the credibility of the Granger causality model, the standard methodology will not be employed within this thesis to directly test for financial market causality. A more generalised 'block' Granger noncausality approach will be employed however, for the arguments put forward by Ericsson (1992). He stated "Invalid exogeneity assumptions may lead to inefficient or inconsistent inferences and result in misleading forecasts" (p.253). Granger noncausality provides information regarding the strength of exogeneity for a variable in a model.

Exogeneity can be classified among three strengths known as weak, strong and super- exogeneity (Engle *et al.,* 1983). "Strong exogeneity is the conjunction of weak exogeneity and Granger noncausality, and it ensures valid conditional forecasting" Ericsson (1992, p.259). If variable Y tends to be explained by variable X, then X is considered weakly exogenous if current Y does not also explain X (Kennedy, 2003, p.104).

Both Granger noncausality and weak exogeneity tests will therefore be employed. Their results will enrich the research, by providing information regarding the extent that exchange rates, interest rates and the SM interact. The degree of exogeneity also provides justification towards deciding which variable to 'shock' in a generalised impulse response

function (GIRF). To the author's knowledge, exogeneity testing and estimation of GIRFs are a pioneer effort in this field of research.

3.4: Cointegration Analysis of Financial Market Causality

Cointegration implies a long-run relationship holds between two or more variables. Two series are cointegrated if they are integrated of the same order, d, and a regression of one on the other has residuals integrated of an order less than d. This term was formally introduced by Granger (1981) and Engle and Granger (1987). The cointegration technique overcomes nonstationarity troubles, allowing both level and differenced data to be analysed.

With the exception of cointegration and error-correction approaches, I(1) data must be differenced to achieve statistically appropriate results. Differencing, however, disables the model from capturing information within level data. This suggests another weakness of Granger causality models. Miller and Russek (1990) and Miller (1991) however, note the existence of cointegration eliminates non-causality between the particular variables.

While Granger causality focuses on short-run relationships, cointegration analyses long-run equilibrium between two or more variables. In the absence of cointegration short-run relationships may still hold. The model developed by Engle and Granger (1987) encapsulates both short- and long-run relationships within one model: the Error Correction Model (ECM). This and the vector autoregressive model (VECM) have become

popular estimation procedures within this literature, providing valuable short- and long-term results. The model overcomes the necessity of Granger causality and OLS estimation to model I(0) variables, by estimating a model combining both differenced and level data.

The ECM will comprise a significant portion of the econometric analysis. A prerequisite for this model however, is the existence of at least one cointegrating rank within the model. Two popular approaches in testing cointegration, are the Johansen and Juselius approach, and the Engle-Granger two-step procedure.

3.4.1: Empirical Testing for Cointegration with the Engle-Granger (1987) Procedure

Engle and Granger (1987) were the first to formalise a test for cointegration. This approach (the EG approach hereafter) applies an ADF test to residuals of a linear model, which includes a deterministic trend and constant term (if significant).[54] If the ADF statistic is larger than its critical value, the ADF's null hypothesis is rejected and the residuals are characterised by stationarity. This suggests the two series are cointegrated. If the ADF null of nonstationarity cannot be rejected, the EG approach suggests the two series to lack a cointegrating relationship. The EG test therefore has the null hypothesis of no cointegration between the two variables.

Many researchers have applied the EG procedure in testing their relationships between the SM and foreign exchange market. Ajayi and Mougoue (1996) found cointegrating relationships between exchange

---

[54] The ADF test excludes both a deterministic trend and constant term.

rates and eight SMs from developed countries. Ibrahim (2000) applied both the EG and Johansen-Juselius (JJ) approach in his research on Malaysia's SM, as well as Muhammad and Rasheed (2003) in their analysis to Sri Lanka, India, Pakistan and Bangladesh.

A shortcoming of the EG cointegration approach is that only two variables can be tested for, making the likelihood of omitted variable bias within the test probable (Ibrahim, 2000, p.38). Interest rates are a significant force upon both the SM and the domestic currency for instance. If this was included in the test, it cannot be tested as an additional cointegrating relationship. When more than two variables comprise the model, more than one cointegrating relationship may be present, suggesting the EG approach to sometimes be inappropriate (Kennedy, 2003, p. 328).

Another drawback of the EG procedure relates to causality. One of the variables must be selected as the dependent variable, which creates an implicit assumption that the other explanatory variables are exogenous. If theory cannot support a division between endogenous and exogenous variables, the procedure may create a bias in the estimation and affect the outcome (Ibrahim, 2000, p. 40).

Economic theory outlined in Section 2.3 argues both financial markets to potentially affect each other, which suggests the EG procedure to be inappropriate in this field of research.

Yet another shortcoming of the EG procedure is that its results are sensitive to sample size, and the test is widely known to have a low power (*ibid*, p.40). This latter point means the test could find

cointegrating relations between variables, even when they do not actually exist.

Another popular cointegration test is the multivariate[55] approach developed by Johansen (1988) and Johansen and Juselius (1990). This is a more general procedure that is based on the Vector autoregression (VAR), developed by Sims (1980).

Because the JJ approach tests for all possible cointegrating relationships within a system, and treats all variables as endogenous, it is selected over the EG approach in this thesis. This method enables the inclusion of interest rates within the system and numerous exchange rates, rather than just one.

The JJ approach was found to be the more popular approach within the literature also. Abdulla and Murinde (1997) Caporale and Pittis (1997) Phylaktis and Ravazzolo (2000) Wu (2000, 2001), among others employed it in their analyses. However, results still have remained scattered despite this similar application of methodologies.

3.5: A Continuation of Mixed Results

Ajayi and Mougoue (1996) found further evidence of a feedback mechanism, improving on previous research by employing ECMs to distinguish between short and long run relationships. It was found that in

---

[55] Stock and Watson (1988) designed a multivariate cointegration test as well. This is also based on maximum likelihood estimators. Given the relatively higher degree of popularity and accessibility throughout common econometric software, the JJ test has been selected over this alternative.

the short run an improving stock market had a negative influence on five out of the eight countries tested for. There was an opposite long run relation for seven out of the eight tested SMs. In this case a depreciating currency had a negative short- and long run effect on the sharemarket for all eight sharemarkets.

Ajay and Mougoue (1996) found conflicting short-run and long-run causalities for eight advanced countries; Abdulla and Murinde (1997) found evidence of uni-directional causality from stock prices to exchange rates for India, Korea and Pakistan. Ajayi et al. (1998) however, find this causality to be the opposite for the US and South Korea. Phylaktis and Ravazzolo (2000) and Wu (2000) provide evidence supporting the Goods Market approach for many Asian countries, while a different methodology by Yu (1997) gave conflicting results. Ramasamy and Yeung (2005) find the direction of causality to vary, depending upon the time period analysed.

The noticeable ambiguity behind financial market causality has spurred an interesting array of theoretical explanations.

3.5.1: Theoretical Explanations for Such Disparity

A sizeable proportion of research in this field has been dedicated to large economies- particularly the US and Japan. Chen et al. (2004) highlight this to bear significance to the lack of exchange rate exposure among company performance. They argue international related factors such as exchange rates are of less importance to those investing in large-

economy-based companies, but of more importance for those investing in small open economies such as New Zealand.

A more detailed look into this explanation however, adds controversy to this point. Although theoretically sound, this explanation is empirically fragile. Figure 3.1 below plots New Zealand's degree of openness between 1992 and mid-2005.

Figure 3.1: Openness of New Zealand between 1990 and 2004[56]
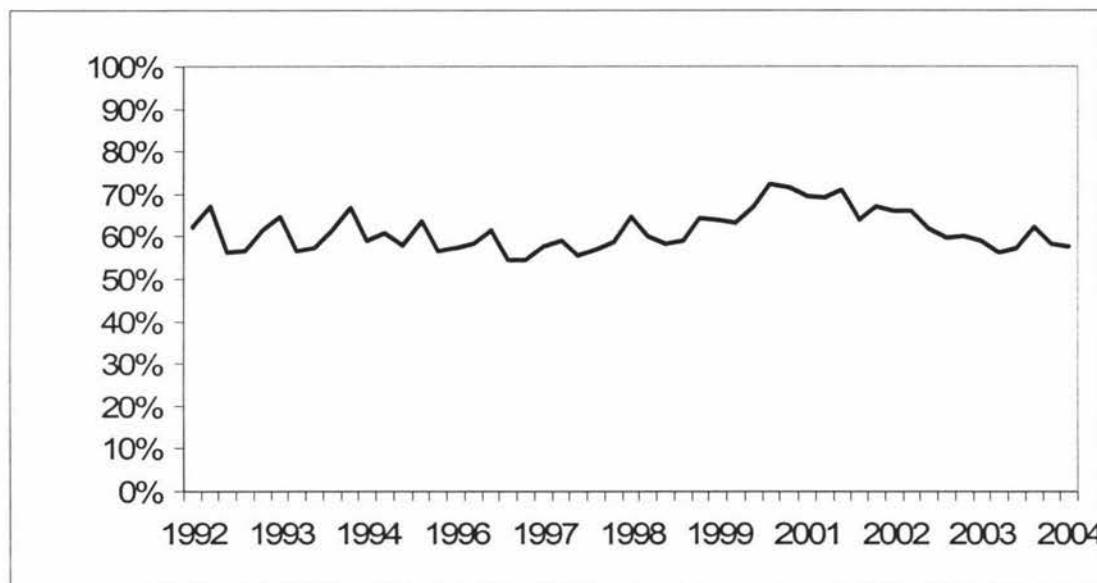
Openness in this case is defined as:

$$(3.1) \qquad Openness = \left(\frac{Ex + Im}{GDP} \right)$$

Ex and Im represent NZ's total exports and total imports respectively.[57] The degree of openness over the period has remained at approximately 60 per cent for the twelve years to 2004. Figure 3.1 reflects a similar result to

---

[56] All export and import values were adjusted for inflation, with the base year being the first quarter of 2005. The index used for this adjustment was the CPI Inflation. calculator, cited from http://www.rbnz.govt.nz/statistics/0135615.html Retrieved August 10, 2005.

[57] Data frequency is quarterly.

research by Guttmann and Richards (2005). They also found New Zealand to only have the 20th highest degree of openness out of the 30 OECD nations. NZ's degree of openness was below the OECD median of 70 per cent.

Despite this relatively smaller degree of openness, the argument by Chen *et al.* (2003) holds, because NZ's openness is ahead of OECD nations researched, including Australia at 39 per cent, and both the USD and Japan at approximately 20 per cent apiece (Guttmann and Richards, 2005).

Other possible explanations over the lack of consensus were noted by Nieh and Lee (2001). Reasoning behind their mixed results for G-7 countries, included inter-country disparities between government policy, the degree of internationalisation, liberalisation and capital control.

Ajayi *et al.* (1998) speculate disparity between the developed and developing economies' financial markets are a consequence of differences between foreign access and exchange rate controls. Furthermore they noted a relatively higher degree of integration in advanced economies, foreign investors' inaccessibility of investing in developing economies, and noted these are relatively more prone to speculative attack. They also note many developing nations' exchange rates to be relatively less flexible.

Granger *et al.* (2000) barriers to capital movement were a critical influence to their results, despite the deregulation within many countries since the late 1980s.

Morely and Pentecost (2000) suggested the insignificant evidence of a common trend is because they do not exist. They stated the two financial markets rather exhibit a short-run cyclical relationship. They test for "copendence", which is a term measuring the co-movement between stationary variables (instead of cointegration, which measures co-movement between nonstationary variables). Findings for the period 1982-1994 suggest a common cyclical pattern to exist for almost all G-7 countries, against both the USD and GBP.

The lack of both a theoretical and empirical consensus on the direction of causality between the two financial markets has justified many to empirically test specific companies, rather than an entire index. Aggregation of individual share prices in the form of a market index precludes one from linking any estimated exchange rate exposure to individual companies. To focus the analysis on individual share prices eliminates the discrepancy over causality, leading to company- or industry- specific results.

3.6: Empirical Evidence at the Microeconomic Level

Akin to research on indexes, results from testing company-level exchange rate exposure have varied as noticeably as their methodologies. Earlier empirical research suffered similar pitfalls to its macroeconomic equivalent, and new inconsistencies also became apparent. Overall however, this literature has provided adequate empirical work to estimating the effects of exchange rate exposure on company performance.

Empirical work applied to floating exchange rates began with Jorion (1990), who found only a small portion of 287 U.S. multinationals to be exposed to currency exposure. This research was extended in 1991 with similar, insignificant results. Following from this, Bodnar and Gentry (1993) tested exposure for a sample of Japanese, Canadian and US industries, to find exposure for only 11 out of 39. Other contributors include Choi and Prasad (1995), Allayannis (1996), Chamberlain, *et al.,* (1997), Di Iorio and Faff (1999), Hatemi-J and Irandoust (2002), Priestley and Odegaard (2002, 2004) and Dominguez, and Tesar (2003).

Over the period, the methodologies have evolved from symmetric analysis (see Jorion, 1990, 1991) to asymmetric (see Rangan and Lawrence, 1993, and Di Iorio and Faff, 1999). This has eventuated because many argue hedging activity has caused insignificant estimated exposure coefficients (see Levi, 1994).

With the exception of this consensus, other decisions within both macroeconomic and microeconomic analyses require subjectivity. Selection of the appropriate data frequency and exchange rate type are justified in the following chapter.

3.7: Final Comments

The intention by many researchers noted in this chapter, was to measure causality between various exchange rates and SMs. Results have differed considerably. No mutual agreement can be made over any particular exchange rate or SM.

This chapter notes results may have been mixed due to inferior econometric methodologies. This thesis intends to overcome many such limitations. Initial improvements include testing for both stationarity and cointegration. Stationarity tests will include the Augmented Dickey-Fuller (ADF) test, the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test, and Phillips-Peron (PP) Test. These methodologies are described in the following chapter. This chapter also justifies why the JJ approach to cointegration will be employed over the EG approach (Section 3.4).

Standard Granger causality tests will not be used, but a more generic version will be. Section 3.3.3 outlined the rationale for why many consider this model to lack valid empirical application, and also how the model was not optimally employed. Block Granger noncausality however, indicates exogeneity strength among the variables within a system (Ericsson, 1992). Due to the popularity of ECMs this methodology will also be utilised.

Chapter Four:

DATA SELECTION AND
METHODOLOGY

*"Stock prices, or the rate of return, are the appropriate
basis for measuring the effects of [exchange rate]
realignment because they are reported constantly and
should instantly reflect the revision of investors'
valuation."*

- Ang and Ghallab (1976)

4.1: Introduction

This chapter outlines the methodology to be employed for empirically testing the relationships between exchange rates and both the SM and New Zealand companies. The chapter begins by justifying the exchange rates to be modelled (Section 4.2), data frequency (Section 4.3), and the period to be researched (Section 4.4). Following this is a description of the econometric processes behind the three stationarity tests to be employed.

In the process of describing the cointegration test it is necessary to discuss the VAR framework, and how both the maximal eigenvalue and trace test statistics are generated. The Granger Representation Theorem is then noted, to depict the transformation of a cointegrated system into its equivalent error correction form.

With the intent to discover the degree of exogeneity within each system, the method of testing for block Granger noncausality and weak exogeneity for the variables are then described. This will enable justification for which variable(s) to shock within each system in a series of impulse response functions, described at the end of the macroeconomic section in this chapter.

4.2: An Appropriate Exchange Rate Measure

Exchange rates used within the literature can be categorised among four types: real (RER), nominal (NER), real effective (REER), or nominal effective (NEER). The decision over what type to use in finding a relationship between the two financial markets has an important bearing upon results.

An effective exchange rate is synonymous with a trade-weighted index of exchange rates, weighted in terms of trade volumes with respect to the domestic economy. There is no restriction to the number of exchange rates used in the index; most incorporate five weighted currencies, but Aggarwal (1981) for instance, used 46. This section provides an argument against testing with effective exchange rates.

NZ's TWI comprises the USD, weighted at 31.71 %; EUR (25.59%); JPY (17.4%); AUD (18.61%); and GBP (6.69%).[58] Two significant problems arise in using an effective exchange rate in the econometric analysis. Firstly there is the problem from offsetting currency exposures for companies within the index, and secondly, a change to an effective exchange rate can have so many different outcomes.

---

[58] Information regarding these weightings, took effect from December 21, 2004. Cited from: http://www.rbnz.govt.nz/statistics/exandint/twi/0144604.html, Retrieved September 12, 2005.

Consider the graph below plotting a theoretical scenario between the TWI and the NZSX50 against time.

Figure 4.1:TWI vs. A Theoretical NZSX50
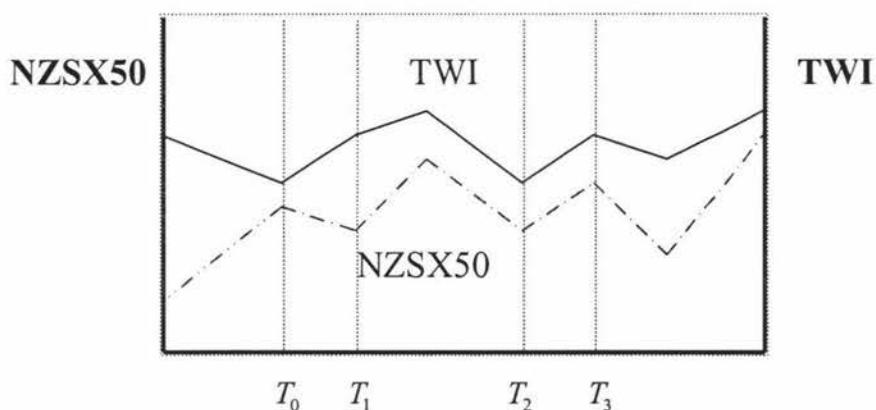
Suppose the appreciating TWI between T_0 and T_1 is a consequence of an appreciating NZD/GBP and NZD/USD, which is not offset by a depreciating NZD/JPY. Now suppose a similar appreciating TWI eventuates between T_2 and T_3, but this time represented by an appreciating NZD/JPY, with all others remaining relatively stable.

In the first scenario, NZ exporters to Japan are advantaged, but disadvantaged in scenario two. Furthermore, importers of goods sourced in Great Britain and the US are advantaged under the first scenario, but unaffected in the second.

The likelihood of these two scenarios (representing a theoretically similar TWI change), combine to affect the NZ SM similarly is improbable, and because such scenarios are eventuating continuously, this argument implies the true association between the NZ SM and 'exchange rates' is clouded when modelling with a TWI. Specific exchange rate movements

trending in different directions blur econometric results between SM and exchange rate movements. For this reason, the econometric methodology will focus particularly upon individual exchange rates.

CPI data in New Zealand is calculated quarterly. This is a different frequency to my preference of employing weekly data in my model. Furthermore, investor reactions are more likely to be captured from those exchange rates listed on the internet, newspapers and other sources, which are all quoted in nominal values.

4.3: Data Frequency

Selecting the appropriate data frequency is an important decision since many have found it to influence their results. Frequency has varied within the literature from daily (Chamberlain, *et al.,* 1997), to weekly (Yang, 2003), to monthly (Chow *et al.,* 1997) and even quarterly (Solnik 1987).

There have been strong arguments in favour of high-frequency data from its ability to capture more exposure estimates relative to low-frequency data. Chamberlain *et al.* (1997), and Di Iorio and Faff (1999) found this to be true in their empirical estimates.

Hussain and Liew (2004) state daily data contains more information than lower frequency data, due to continuous globalisation and liberalisation of financial markets, coupled with advances in technology and communications. In the past decade or so, up-to-date information can be accessed with minimal delay.

Yang (2003) provided an argument that daily data is too high a frequency, since it is characterised by excessive noise. On the other hand, a low frequency captures too much information, which may cloud results.

A weekly frequency will be tested in the analysis following the arguments by Yang (2003).Because NZ is a SOE, its SM lacks the liquidity of deeper, larger sharemarkets such as the Australian AORD and US Dow Jones. Performance of the NZ SM is therefore subject to shocks from large transactions in any given day. A weekly frequency helps to smooth the effect of such shocks.

4.4 The Period to Research

Some literature applied to this area of research examines currencies nonexistent after the launch of the euro on January 1, 1999 such as the French franc, German Deutsche mark and Italian Lira.[59]

Researching a pre-1999 period would mean we could neither extend the analysis beyond 1998, nor include the euro in our analysis: European currencies were getting phased out by the euro in 1999, so the value of such currencies became nonexistent.

Hence, there is a need to decide whether to select a time period ending in late December, 1998 and research exchange rates including French franc, German Deutsche mark and Italian Lira among others (but exclude the euro), or start in early 1999 and research exchange rates including the

---

[59] On this date, 11 countries of the European Union adopted the euro: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. (See Eitman *et al.*, 2001, p. 58).

euro, but excluding the French franc, German Deutsche mark and Italian Lira.

The first week of January 1999 will be the starting date of the series. To find a relationship between NZ shares and redundant European currencies would lack relevance in today's business climate. Additionally, to ignore the euro would be imprudent, in light of European Union countries collectively representing NZ's second largest trading partner behind Australia.[60] The effects of the 1997/1998 Asian Crisis can therefore be ignored in the analysis as well.

The final observation is June 30, 2005. This was selected both to maximise the degrees of freedom and keep the findings up to date. Hence every variable modelled on a weekly frequency resulted in 339 data entries for every series. The models to be tested are defined in Section 4.9.

4.5: Testing for Stationarity

Unit root tests will be done on all relevant exchange rates and all share price time series data sets, prior to any other test. They are necessary to confirm the level of integration for each data set in order for models to avoid the problem of becoming spurious (see Granger and Newbold, 1974, and Phillips, 1986). This is more likely to occur if a series is trending up or down over the period. Watsham and Parramore (1997, p.201) note such a series in a regression creates "a degree of correlation that overstates any underlying causal relationship".

---

[60] Statistics NZ, August, 2005, pp. 89-91.

Three unit root tests will be undertaken:

- Augmented Dickey Fuller (ADF) test;
- Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test;
- Phillips Peron (PP) Test.

These are described below.

4.5.1: The Augmented Dickey-Fuller (ADF) Test

This test is an extension from the earlier Dickey Fuller (1979) test, as it includes multiple lags to account for possible autocorrelation. The Dickey-Fuller (DF) test itself is conducted by testing the null that $H_0 : \alpha = 0$ against the alternative $H_1 \; \alpha < 0$ in a modified AR(1) framework shown below.

(4.1) $$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \varepsilon_t$$

Above, $\Delta y_t = y_t - y_{t-1}$, $\alpha = \rho - 1$ and ε_t is assumed to be white noise, which means the error term has a zero mean and is randomly distributed and uncorrelated with past values with a finite variance. It is this assumption that the ADF improves upon.

If the series is correlated over a lag-length greater than one, the white noise assumption is violated. The ADF allows for a greater number of lags, hence it follows an AR(p) process, leading the ADF to take the form:

(4.2) $$\Delta y_t = \alpha + \beta t + (\rho - 1)y_{y-1} + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + a_t$$

79

y_t is the data set, which may be an exchange rate or stock price/index, Δy_t is y_t differenced once, t is a trend variable and a_t is a white noise error term. The null hypothesis is $H_0 : \rho = 1$ and if this cannot be rejected, it tells us that y_t is nonstationary in this form and needs to be differenced, then re-tested. Hence the alternative hypothesis exists if $\rho \neq 1$ suggesting the series to be stationary. The t-ratio used to test the significance of ρ does not follow the standard t-distribution (Dickey and Fuller, 1979). A comprehensive range of asymptotic critical values for the test will be used from MacKinnon (1996).

Three versions of this ADF test will be done due to its recommendation by Engle and Granger (1987):

- The random walk form, where $\alpha = 0$ and $\beta = 0$, i.e. with no constant and no time trend.

(4.3)
$$\Delta y_t = (\rho - 1)y_{y-1} + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + a_t$$

- The random walk with drift form, where just $\beta = 0$, but a constant term is estimated;

(4.4)
$$\Delta y_t = \alpha + (\rho - 1)y_{y-1} + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + a_t$$

- The trend stationarity form, where a constant term and time trend parameters are estimated (see equation (4.2) above). If the time trend is significant, it suggests the series to be characterised by a

time trend. If the null hypothesis of nonstationarity is rejected the series is said to be trend stationary.

Of these three, the relevant measure will depend upon the significance of the constant and time trend. Where both are significant at the five per cent level, equation (4.2) will be relevant. If neither is significant equation (4.3) will test stationarity of the series. Equation (4.4) will be employed if the constant is insignificant.

EViews will be used to test the data for stationarity. This programme compares the ADF test statistics to critical values from Mackinnon (1996), and length is automatically optimised by minimising the Schwarz (1978) information criterion (SIC) given by:

$$(4.5) \qquad SIC = -2\left(\frac{l}{T}\right) + \frac{k \log(T)}{T}$$

Above, l represents the log of the likelihood function, T the number of observations and k represents the number of estimated parameters.

Appropriate lag length is important. A number of lags may be needed to ensure no serial correlation exists in the residuals, however too many lags reduce the test's power since degrees of freedom fall. As this falls, it increases the probability of concluding the tested series to be nonstationary.

Despite the popularity of the ADF test, it has been argued by many to be of a low power, meaning the test can make the mistake of detecting stationarity where it does not actually exist. One reason for this reputation

is that it does not consider the existence of structural breaks.[61] A more common criticism is that "their failure to reject a unit root may be attributed to their low power against weakly stationary alternatives" (Ajayi and Mougoue, 1996, p.197).

Kwiatkowski, Phillips, Schmidt, and Shin (1992) suggested a new and more vigorous test for stationarity, where the null and alternative hypotheses where switched.[62] In this test, the presence of stationarity could only be accepted if the null hypothesis could not be rejected. This test is described below.

4.5.2: *The Kwiatkowski, Phillips, Schmidt, and Shin (1992) Test*

The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test models the time series as the sum of a deterministic time trend, random walk and stationary error term. It then tests whether the random walk has a zero variance (Kennedy, 2003, p.352).

The KPSS test begins with the model:

$$(4.6) \qquad\qquad y_t = x_t + z_t$$

x_t is a random walk such that $x_t = x_{t-1} + v_t$, $v_t \sim iid(0, \sigma_v^2)$ and z_t is a stationary process. From this, the KPSS test proposes the null that

---

[61] The existence of a structural break leads the ADF test result to be biased towards accepting the null hypothesis of a unit root.

[62] These are not the only tests with this hypothesis. Other unit root tests with stationarity as the null include Park (1990), Leybourne and McCabe (1994), Choi (1994), among others

$H_0 : \sigma_v^2 = 0$ against the alternate hypothesis of $H_1 : \sigma_v^2 > 0$. If the null hypothesis is rejected, it suggests the variance to be greater than zero and the series to be nonstationary. The KPSS test statistic is calculated from:

$$(4.7) \qquad KPSS = \frac{1}{T^2} \sum_{t=1}^{T} \frac{S_t^2}{\hat{\sigma}_\infty^2}$$

where

$S_t = \sum_{j=1}^{t} \hat{w}_j$ and $\hat{w}_j = y_t - \bar{y}$ and σ_∞^2 is an estimator of

$$(4.8) \qquad \sigma_\infty^2 = \frac{\lim}{T \longrightarrow \infty} T^{-1} Var \left(\sum_{t=1}^{T} z_t \right)$$

The test will also be conducted under the notion that a deterministic trend is present, and if significant, will be the relevant KPSS model used. With this in mind equation (4.6) will instead become:

$$(4.9) \qquad y_t = \mu_{1t} + x_t + z_t$$

and $\hat{w}_t$ will come from the regression

$$(4.10) \qquad y_t = \mu_0 + \mu_{1t} + w_t$$

Following the notation of Ajayi and Mougoue (1996) the LM statistic for the KPSS test is defined as:

$$(4.11) \qquad \eta_u = T^{-2} \sum \left(\frac{S_t^2}{s^2(L)} \right)$$

where

$$(4.12) \qquad S_t = \sum_{i=1}^{t} e_i, \quad t=1,2,3,\ldots,T$$

and

$$(4.13) \qquad s^2 = T^{-1} \sum_{t=1}^{T} e_t^2 + 2T^{-1} \sum_{s=1}^{t} \left(1 - \frac{s}{(L+1)} \right) \sum_{t=s+1}^{T} e_t e_{t-s}$$

L is the lag length, e_t are the residuals from regressing the series against a constant, and T the number of observations.

Test values will be compared with the critical values from Kwiatkowski, Phillips, Schmidt, and Shin (1992, Table 1, p.166). The purpose for this test in the analysis is to reinforce the ADF test results with the opposite null. Of course, it is possible for the KPSS conclusion to clash with the ADF's. This will be investigated if it eventuates.

4.5.3: The Phillips-Peron (1988) Test

The PP test is a generalised ADF in that its assumptions of the error terms are loosened, controlling for autocorrelation alternatively from increasing lag length. It tests the original DF (1979) test (shown above in equation 4.1), but adjusts the t-ratio for alpha, in order to overcome the problem of serial correlation affecting the t-values' asymptotic distribution. Following the notation from EViews 5 User Guide, p. 508, the PP statistic is calculated with the following equation:

(4.14)
$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\tilde{\alpha}))}{2f_0^{1/2}s}$$

with $\tilde{\alpha}$ being the estimate and t_α being the t-ratio for alpha. $se(\tilde{\alpha})$ and s are the standard errors for alpha and the test regression respectively. γ_0 represents an approximation of the true error variance, which is estimated by:

(4.15)
$$\gamma_0 = \frac{(T-k)s^2}{T}$$

k is the number of regressors. f_0 is an estimator of the residual spectrum at a zero frequency.

The ADF test does not account for the possible existence of GARCH errors (Chan *et al.*, 2003, p.4), which can lead the ADF test to over-reject the null hypothesis of a unit root (see Kim and Schmidt, 1993). The PP test gives no assumption to "the type of serial correlation or heteroskedasticity in the disturbances, and can have a higher power than the ADF test under a wide range of circumstances" (Chan *et al.*, 2003, p.4). The PP test will therefore act as a third and final test for stationarity.

None of the above tests account for the possibility of a unit root greater than one, and this may be considered a weakness. To overcome such a problem, stationarity tests under the three methods will be conducted in both level and difference form. The latter form therefore tests if data is I(1) or I(2).

4.6: The Johansen Approach to Testing Cointegrating Relationships

This section describes the methodology of finding the number of long run relationships among variables in the model. This process is also a necessary prerequisite step to VECM estimation. The section begins with describing how to optimise VAR(p) lag length (Section 4.6.1). Following

this, is Section 4.6.2, detailing the two cointegration tests. Lastly, the methodology of VECM is described.

4.6.1: The Optimal VAR(p)

Cointegration starts with the estimation of an unrestricted[63] VAR(p) where p represents the optimal lag order for the system. This model was constructed by Sims (1980) with the intent to allow all variables within the system to be considered endogenous. The VAR(p) model is represented by the following equation.[64]

$$Y_t = A_1 Y_{t-1} + ... + A_p Y_{t-p} + BX_t + \varepsilon_t$$

or:

(4.16)
$$Y_t = A \sum_{i=1}^{p} Y_{t-i} + BX_t + \varepsilon_t$$

Y_t is an n × 1 (or column) vector of I(1) variables (including the SM, five exchange rates and ninety day bank bill yields, for a total of n=7). A represents an n × m matrix (where m=n) and X_t is a d × 1 vector of d deterministic variables. ε_t carries the white noise characteristics of a normal, independent and random distribution about zero ($E(\varepsilon_t) = 0$ and $E(\varepsilon_t \varepsilon_t') = \Omega$) for all t.

---

[63] This term means all variables within the VAR(p) are free to affect every other variable within the system. By placing restrictions with economic justification, the model becomes restricted in that one or more variables do not affect other variables. This increases the degrees of freedom, improves their forecasting performance and eases interpretation of the impulse response functions (Kennedy 2003, pp. 331-332).

[64] This notation follows the EViews 5 User's Guide and Dickey (1991).

Cointegration was formally established by Granger (1981) and extended upon by others.[65] Optimal lag length for the VAR(p) will be found by maximising the Akaike (1973) information criterion (AIC) statistic, which is calculated from the following equation:

(4.17)
$$AIC = -2\left(\frac{l}{T}\right) + 2\left(\frac{k}{T}\right)$$

Above, l represents the log of the likelihood function, T the number of observations and k represents the number of estimated parameters.

The Schwarz Bayesian Criterion (SBC) will also test the optimal lag length of each model. This is similar to the AIC, but penalises the inclusion of more coefficients more vigorously. Equivalent to the SIC, the SBC is defined by equation (4.5) above.

Johansen (1995, pp. 80-84) describes five potential cases for the cointegrating system with varying deterministic components. Among the five, Case 2 has been selected to represent each of the four (potentially) cointegrated systems within this research.

Case 1 requires each series to be stationary with a zero mean and Case 5 is used rarely (see EViews, p.725). EViews' arguments behind the appropriateness of each Case suggest Case 2 to be the best fit given that the series within each system do not have linear trends. This is described below:

(4.18)
$$H_1^*(r):\prod Y_{t-1} + BX_t = \alpha(\beta'Y_{y-1} + \rho_0)$$

---

[65] Others include Engle and Granger (1987), Banerjee and Hendry (1992), Johansen and Juselius (1990), Johansen (1988, 1991, 1992, 1995)

Hence the cointegrating equations have intercepts, but no deterministic trends are present in the level data. The appropriateness of this model is justified, given the lack of apparent linear trend among each model below.[66] Refer to Section 4.9 for a definition of each Model.

Figure 4.2A:Model I
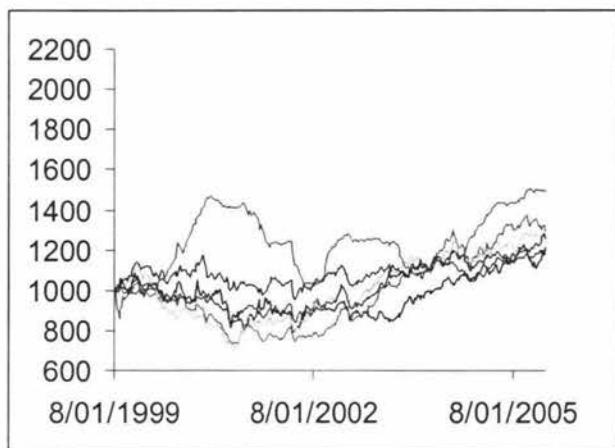
Figure 4.2B: Model III
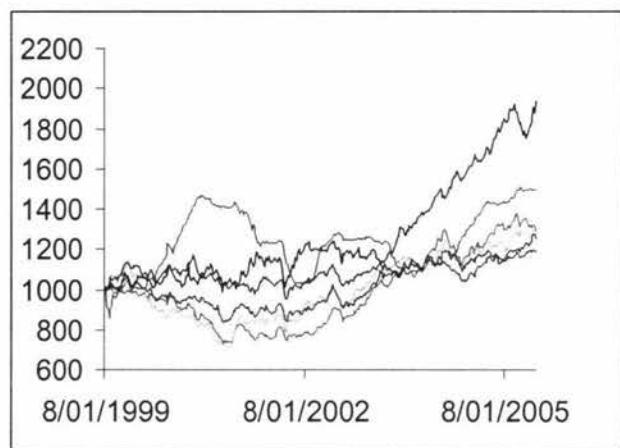
Figure 4.2C: Model II
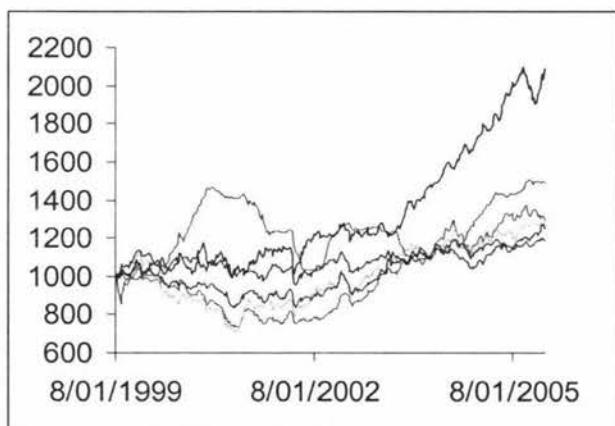
Figure 4.2D: Model IV
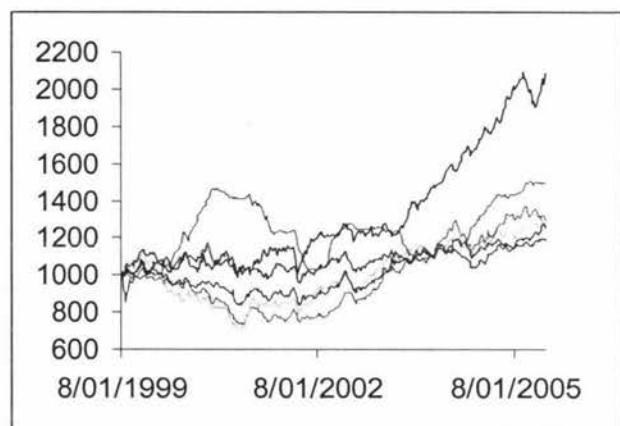
Case 2 is also appropriate when following the AIC criterion under the 'Pantula principle' which tests the appropriateness of deterministic

---

[66] All data has been indexed such that 1000 represents each series' value on the first sample date of January 8, 1999. The purpose here is to see the overall trend (and prove the lack of linear trend) amongst each collective system- not to compare trends within each system. Therefore no key has been given.

components and cointegration within the system. Results from the Pantula principle can be found in Appendix IV.[67]

4.6.2: Maximal Eigenvalue and Trace Test Methodologies

Both the maximal eigenvalue test and trace test detect the cointegrating rank within the system. A good explanation behind the objective behind the JJ test for cointegration is "to find an n by n matrix B', of rank n, such that B'Y_t decomposes Y_t into its stationary and nonstationary components. This is accomplished by obtaining a k by n sub-matrix of B',β' of rank k such that the transformed series β'Y_t is stationary" (Dickey *et al.*, 1991, p.61). The cointegrating vectors are the k rows within the B' matrix that are stationary.

The maximal eigenvalue test is considered superior to the trace (Johansen and Juselius, 1990). This tests the null hypothesis a system has a cointegrating rank of r, against a rank of r +1

(4.19) $$H_0 \; rank\left(\prod Y\right) = r$$

(4.20) $$H_A : rank\left(\prod Y\right) = r + 1$$

where r=0, 1, 2,..., k-1. The maximal eigenvalue statistic is calculated by:

(4.21) $$LR_{\max}(r|r+1) = -T \log(1 - \lambda_{r+1})$$

$$= LR_{tr}(r|k) - LR_{tr}(r+1|k)$$

---

[67] Recent literature (see Hjelm and Johansson, 2005) suggest this to have bias towards selecting an unrestricted constant, when a restricted constant is the better fit, however case 2 still looks to be the best fit, given my other documented explanations.

The trace test compares the null of r or less cointegrating vectors, against the alternative hypothesis of a full rank (r=k):

(4.22) $\qquad H_0 \; rank\left(\prod Y\right) = r$

(4.23) $\qquad H_0 \; rank\left(\prod Y\right) = k$

Where once again, r=0, 1, 2,..., k-1.[68] The trace statistic is calculated by:

(4.24) $\qquad LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i)$

Above, λ_i is the ith largest eigenvalue, in the $\prod$ matrix.

Critical values at the five per cent level will be used. The cointegrating rank indicated from these statistics will then be compared with economic theory behind the expected number of cointegrating relationships (see Section 5.4).

The cointegrating rank of r within each system necessitates r restrictions to be placed in order to form the ECM (selection of these restrictions are discussed in the next chapter). This necessity has divided economists. While some favour the traditional unrestricted VAR (see Sims, 1980), others prefer the restricted, cointegrating VAR (see Blanchard and Watson, 1986). The latter type enables ECM modelling, which is to be used here.

---

[68] Refer to Johansen (1988) for a detailed econometric description of these statistics.

Some, however, argue that restrictions remove the main feature of the unrestricted VAR: that all variables are considered endogenous. Harvey (1997, p.199) commented VAR to be an acronym for "Very Awful Regression".[69]

Research has found asymptotic properties not to hold in the unrestricted VAR in the presence of cointegration (see Park and Phillips, 1988 and Sims *et al.,* 1990). Other proponents of the cointegrating VAR have demonstrated it to be a more efficient estimator (see Clements and Hendry, 1995, and Naka and Tufte, 1997). This was one reason for its development (Enders, 1995, p.322), along with an attempt to eliminate another significant drawback.

The unrestricted VAR's main flaw is its common lack of meaningful impulse responses (Kennedy, 2003, p.331). This drawback stems from the endogenous characteristic assumed by all variables within the system. To shock one variable will not only affect the others, but the change to these will feedback into the initially shocked variable.

To overcome this limitation, weak and strong exogeneity will be tested for, and the VAR(p) will become restricted when estimating the cointegrating relationships and VECMs. For a more through description of the cointegrating methodology, refer to Johansen (1988) or Banerjee *et al.* (1993).

---

[69] For more discussion in this area, see Cooley and LeRoy (1985), Runkle (1987), Pagan (1995)

4.6.3: *Vector Error Correction Modelling*

The Engle-Granger Representation Theorem (see Engle and Granger, 1987) demonstrates a mathematical proof that a cointegrated VAR can be transformed into a vector error correction model (VECM). Following this identity, the VAR(p) above can be transformed into its VECM equivalent below:

(4.25)
$$\Delta Y_t = \prod Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + BX_t + \varepsilon_t$$

where:

(4.26)
$$\prod = \sum_{i=1}^{p} A_i - I,$$

and:

(4.27)
$$\Gamma_i = -\sum_{j=i+1}^{p} A_j$$

In expanding the matrices (and assuming a VAR(1) for simplicity) the VECM model with two cointegrating relationships specified, is represented by the following equation for this thesis.[70]

---

[70] This notation follows the EViews 5.0 User's Guide and Dickey (1991). The two restrictions to the long run relationships are (1) the NZD/GBP has no influence on the SM and (2) the NZD/JPY has no influence on BB rates. An explanation of these restrictions is discussed in Section 5.4.

$$(4.28) \quad \begin{pmatrix} \Delta SM_{z,t} \\ \Delta USD_t \\ \Delta AUD_t \\ \Delta JPY_t \\ \Delta GBP_t \\ \Delta EUR_t \\ \Delta BB_t \end{pmatrix} = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} & \phi_{15} & \phi_{16} & \phi_{17} \\ \phi_{21} & \phi_{22} & \phi_{23} & \phi_{24} & \phi_{25} & \phi_{26} & \phi_{27} \\ \phi_{31} & \phi_{32} & \phi_{33} & \phi_{34} & \phi_{35} & \phi_{36} & \phi_{37} \\ \phi_{41} & \phi_{42} & \phi_{43} & \phi_{44} & \phi_{45} & \phi_{46} & \phi_{47} \\ \phi_{51} & \phi_{52} & \phi_{53} & \phi_{54} & \phi_{55} & \phi_{56} & \phi_{57} \\ \phi_{61} & \phi_{62} & \phi_{63} & \phi_{64} & \phi_{65} & \phi_{66} & \phi_{67} \\ \phi_{71} & \phi_{72} & \phi_{73} & \phi_{74} & \phi_{75} & \phi_{76} & \phi_{77} \end{pmatrix} \begin{pmatrix} \Delta SM_{z,t-1} \\ \Delta USD_{t-1} \\ \Delta AUD_{t-1} \\ \Delta JPY_{t-1} \\ \Delta GBP_{t-1} \\ \Delta EUR_{t-1} \\ \Delta BB_{t-1} \end{pmatrix} + \ldots$$

$$\ldots + \begin{pmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \\ \alpha_{61} & \alpha_{62} \\ \alpha_{71} & \alpha_{72} \end{pmatrix} \begin{pmatrix} SM_{z,t-1} - \eta_1 USD_{t-1} - \eta_2 AUD_{t-1} - \eta_3 JPY_{t-1} - \eta_4 EUR_{t-1} - \eta_5 BB_{t-1} \\ BB_{t-1} - \delta_1 SM_{z,t-1} - \delta_2 USD_{t-1} - \delta_3 AUD_{t-1} - \delta_4 GBP_{t-1} - \delta_5 EUR_{t-1} \end{pmatrix} + \ldots$$

$$\ldots + \begin{pmatrix} \pi_1 \\ \pi_2 \\ \pi_3 \\ \pi_4 \\ \pi_5 \\ \pi_6 \\ \pi_7 \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \\ \varepsilon_{5,t} \\ \varepsilon_{6,t} \\ \varepsilon_{7,t} \end{pmatrix}$$

Above, z denotes the type of SM (i.e. NZSX10, MidCap30, NZSX50, or NZSXALL). Hence there are four models to be estimated, defined in Section 4.9. $\phi_{n,m}$ represents the short run effect that a lagged change to variable m, has on the nth dependent variable. $\alpha_{n,r}$ denotes the weekly adjustment of the nth variable towards its long run equilibrium relationship with the cointegrating vector, r. π_n represents the estimated constant term for variable n, and $\varepsilon_{n,t}$ is the error term for variable n, with the same characteristics as those error terms in the ε_t vector in equation (4.16). To complement this methodology, the joint significance of each

$\alpha_{n,r}$ error correction row will be tested. This process is titled the weak exogeneity test.

4.7: Exogeneity and Block Granger Non-causality

Ericsson (1992, p. 259) defines a strongly exogenous variable to be one that is not Granger caused by other variables within the VAR(p) system, and is weakly exogenous. The methodology for testing these two terms therefore needs to be described. Finding the degree of exogeneity of variables within each tested VAR(p) will further inform us on the relationships between the variables. It will also help determine which variable(s) to shock in the GIRFs. See Ericsson (1992, pp.255-262) for detailed econometric definitions of both weak and strong exogeneity.[71]

4.7.1: Weak Exogeneity

Weak exogeneity results are found by testing whether the nth row of alpha matrix in equation (4.28) is significantly different from zero. This alpha matrix represents the estimated adjustment coefficients. The null and alternative hypotheses are:

H_0 : The nth row in the alpha matrix is insignificantly different from zero. Therefore the nth variable is weakly exogenous.

H_A : The nth row in the alpha matrix is significantly different from zero. Therefore the nth variable is not weakly exogenous.

---

[71] Burke and Hunter (2005, Ch 5) provides a very descriptive explanation of exogeneity.

Weak exogeneity tests will be conducted from EViews 5.0 with a log-likelihood ratio test.[72] This follows an asymptotic chi-square(df) distribution, where df represents the degrees of freedom. The likelihood ratio test compares the goodness-of-fit between the ECM with and without restrictions. If any variable(s) within the unstructured VAR(p) is weakly exogenous, there will be no feedback loop if the variable is shocked under the GIRF.

4.7.2: Block Granger Non-causality

Block Granger non-causality will be applied to test causality of the variables within the unrestricted VAR(p). Chi-square(df) output from two likelihood ratio tests on each variable will explain two things: (1) if lagged values of variable X help explain current values of all other variables, and (2) if the lagged variables from this complementary set of variables help to explain the current value of variable X. There are therefore two tests, and two separate null hypotheses:

H_0 : The Variable in question does not Granger cause the other variables in the unrestricted VAR. Its lagged coefficients are not significantly different from zero.

H_A : The Variable does Granger cause the other variables in the unrestricted VAR. Its lagged coefficients are significantly different from zero.

And:

---

[72] The LR test assumes errors are normally distributed (EViews 5.0, p. 436).

H_0 : All variables apart from X within the unrestricted VAR do not Granger cause variable X in the system. Their lagged coefficients in the equation for X, are not jointly significantly different from zero.

H_A : All the other lagged variables apart from X within the unrestricted VAR do Granger cause variable X in the system. Their lagged coefficients in the equation for X jointly, are significantly different from zero.

The first test determines whether the n-1 variables within the VAR(p) system Granger cause variable X. The second test determines whether variable X Granger causes n-1 variables in the VAR(p). Of particular interest are those variables that cannot reject the null hypothesis of the second test. Combining those variables with acceptance of the weak exogeneity null hypothesis indicates the variable to be strongly exogenous within the system.

4.8: Generalised Impulse Response Functions

An impulse response function traces the estimated impact from a one-standard deviation shock of one variable, to others within the unstructured VAR(p) over time. Two versions have been created: the orthogonalised impulse response function (OIRF) by Sims (1980) and the GIRF by Koop *et al.* (1996) and Pesaran and Shin (1998).

GIRFs will be used within this research, as the model amends the major shortcoming of the orthogonalised version. The OIRF results are highly

sensitive to the ordering of variables within the VAR(p). Results under the GIRF stay robust to such ordering (Pesaran and Shin, 1998, p.17). Refer to Pesaran and Shin (1998, pp. 18-20) for a detailed econometric description behind the formation of the GIRF.

Because the GIRF measures the effects within an unstructured VAR(p) from a shock to one variable within the system, it is important to shock the most suitable one. As noted above, to shock an exogenous variable suggests no mechanism feeds back into it.

The degree of exogeneity for each variable is therefore important. Ericsson substantiates this point stating "invalid exogeneity assumptions may lead to inefficient or inconsistent inferences" (Ericsson, 1992, p.253).

4.9: Defining Each Tested System and Outlining Data Sources

Given that four types of sharemarkets are tested, four systems are defined I, II, III and IV respectively, with the following series amongst each:

System I: [NZSX10, NZD/USD, NZD/AUD, NZD/JPY, NZD/GBP, NZD/EUR, 90-Day Bank Bills]

System II: [MidCap30, NZD/USD, NZD/AUD, NZD/JPY, NZD/GBP, NZD/EUR, 90-Day Bank Bills]

System III: [NZSX50, NZD/USD, NZD/AUD, NZD/JPY, NZD/GBP, NZD/EUR, 90-Day Bank Bills]

System IV: [NZSXALL, NZD/USD, NZD/AUD, NZD/JPY, NZD/GBP, NZD/EUR, 90-Day Bank Bills]

EViews 5.0 will provide results of all three stationarity tests and weak exogeneity tests. Microfit 4.0 will provide all other results. Exchange rate data were provided by ASB Bank Chief Economist Anthony Byett in a daily frequency, which was conventionally averaged into weekly series. SM data came from *http://www.globalfinancialdata.com*, which is an official provider of financial data worldwide. Each SM index accounts for dividends, imputation credits and share splits. Ninety-day bank bill rates were taken from *http://www.rbnz.co.nz* and weekly averages were calculated from daily frequencies. Unless stated otherwise, the terms "significant" and "insignificant" refer to statistical significance at the five per cent level. All variables have been logged and all exchange rates are indirect quotations. Because all exchange rates are with respect to the NZD, this term has been dropped out in results tables and figures. The NZD/USD is therefore represented by USD, NZD/AUD by AUD, NZD/JPY by JPY, NZD/GBP by GBP, and NZD/EUR by EUR.

Chapter Five:

RESULTS

"Many of our people are coping far better today with a high dollar, which we know from past experience will come down again."

<div align="right">

-Export NZ Director Gilbert Ullrich,
quoted from Stock. (2004, December 5).

</div>

5.1: Introduction

Two prerequisite tests are firstly conducted in Section 5.2. This is followed by results regarding the optimal VAR lag length, and order of integration for each model. Section 5.3 notes some limitations.

Section 5.4 provides a theoretical discussion for the appropriate cointegrating rank within the models. This is followed by reviewing the long term cointegrating relationship results in Section 5.5. Section 5.6 discusses the ECM results, which is followed by Section 5.7 covering the Granger causality and weak exogeneity results. GIRF results are in Section 5.8. The chapter ends with some final comments under Section 5.8.

5.2: Prerequisite Test I: Stationarity

Table 5.1 below provides the stationarity results for each data series in both level and first-difference form. Critical values come from Mackinnon (1996) and can be found under Appendix I. The ADF null hypothesis of nonstationarity cannot be rejected for any of the above time series at the one, five, or ten per cent significance levels, while differenced series can reject the null at the 1 per cent level, strongly suggesting each series to be I(1).

Table 5.1: Stationarity Tests

	Levels[73]			First-Differences [74]		
	ADF	KPSS	PP	ADF	KPSS	PP
NZSX10	0.503	0.496***	0.670	-19.153***	0.299	-19.699***
NZSX50	2.188	0.450***	2.494	-18.284***	0.272	-18.403***
MidCap30	-2.161	0.273***	-2.365	-17.392***	0.158	-17.407***
NZSXALL	2.612	0.491***	2.924	-18.288***	0.324	-17.949***
BB	1.199	0.189**	1.004	-12.947***	0.135	-13.546***
USD	-1.831	0.497***	-1.715	-13.376***	0.119*	-13.321***
AUD	-3.198	0.221***	-3.172	-14.303***	0.144	-14.280***
JPY	-2.110	0.377***	0.743	-13.958***	0.278	-13.899***
GBP	-2.230	0.432***	-0.782	-14.514***	0.226	-14.169***
EUR	-3.048	0.425***	-1.202	-13.426***	0.080	-14.859***

*   Significant at 10 % level

**   Significant at 5% level

***   Significant at 1% level

The KPSS null hypothesis of stationarity can be rejected for all series at the 5 per cent level of significance, but cannot be for each differenced series. This method also suggests the data to be I(1).

---

[73] Constant terms and the time trend for the ADF test were significant at the five per cent level, for all exchange rates and the MidCap30. Constant terms and time trends were insignificant under the ADF test for the other four indexes. The time trend was significant under the KPSS test for all series. Both the constant term and time trend was significant under the PP test for the MidCap30, NZD/USD and NZD/AUD, but insignificant for all other series.

[74] Among the three tests, a time trend was only significant for the NZD/USD exchange rate. Constant terms under the ADF and PP tests were significant only for the NZSX50, MidCap30 and NZSXALL indexes. Constant terms were insignificant at the five per cent level for all exchange rates.

PP results imply all time series are nonstationary at the 1 per cent level of significance and I(1), since each differenced series can reject the null at the one per cent level of significance.

Hendry and Juselius (2000, p.39) note Monte Carlo tests have demonstrated that statistical inference is more reliable if near-unit roots are treated as unit roots. Given the results above however, it is evident that all three stationarity test results mutually indicate each series to be I(1).

5.3: Prerequisite Test II: Cointegration

5.3.1: VAR Order

Table 5.2 below shows the AIC and SBC values of the four unrestricted VARs. Microfit 4.0 provides AIC and SBC results such that a higher statistic implies a better lag order. The AIC results suggest a VAR order of 2 (VAR(2)) for each model, since the AIC values are maximised for each model with two lags. SBC results suggest each to be VAR(1).

Table 5.2: AIC and SBC Values for Optimal VAR Lag Order

Lag Order	I AIC	I SBC	II AIC	II SBC	III AIC	III SBC	IV AIC	IV SBC
14	9018.7	7694.4	9147.3	7822.9	9079.3	7754.9	9110.8	7786.4
13	9034.6	7803	9159.6	7928	9096.2	7864.5	9126.3	7894.7
12	9050.8	7911.9	9165.9	8027	9110.6	7971.7	9140.4	8001.5
11	9055.2	8009	9170.1	8123.9	9113.3	8067	9142	8095.7
10	9075.2	8121.7	9185.3	8231.8	9134.3	8180.8	9163.4	8209.9
9	9090.2	8229.4	9201	8340.2	9148.2	8287.4	9177.6	8316.8
8	9111.7	8343.6	9222.6	8454.5	9170.5	8402.4	9199	8430.9
7	9122	8446.6	9232.1	8556.7	9179.8	8504.4	9206.2	8530.8
6	9137.3	8554.6	9248	8665.3	9196	8613.3	9222.3	8639.6
5	9158.5	8668.5	9269.7	8779.7	9217.9	8727.9	9244.1	8754.1
4	9175.8	8778.5	9282.5	8885.2	9236.9	8839.6	9261.7	8864.4
3	9206.9	8902.3	9309.4	9004.8	9267.9	8963.3	9292.4	8987.8
2	9225.4*	9013.5	9332.6*	9120.7	9288.2*	9076.3	9312.3*	9100.4
1	9163	9043.8*	9264.5	9145.3*	9223.9	9104.7*	9246.7	9127.6*

Note: Above "*" represents the largest optimal lag length the statistic estimates for a given model.

Serial correlation is less problematic as lag order increases. To ensure this risk is minimised, each model will be estimated by a VAR(2), hence following the AIC approach.

Results from serial correlation tests for each VAR(2) can be found under Appendix II. Two serial correlation tests were considered; the Breusch-Godfrey Lagrange Multiplier (LM) test, and the F-Test. The null hypothesis for each test is that serial correlation does not exist. Reported Chi-square(1) values indicate this hypothesis cannot be rejected. The next step is to test for cointegration for each model.

5.3.2: Cointegration Results

Below are the maximal eigenvalue and trace test results, indicating the cointegrating rank of Models I, II, III and IV. 90 per cent and 95 per cent critical values are also provided.

In Table 5.3 the trace test statistics for Model I indicate three cointegrating relationships within the system at the 95 per cent significance level. Maximal eigenvalue results suggest a cointegrating rank of two.

Table 5.3: Cointegration Results for Model I

Null	95 % Critical Eigenvalue	90 % Critical Eigenvalue	Eigenvalue Stat	95% Critical Trace	90 % Critical Trace	Trace Test Stat
$r = 0$	45.630	42.70	66.920**	124.620	119.68	185.057**
$r \leq 1$	39.830	36.84	45.978**	95.870	91.40	118.137**
$r \leq 2$	33.640	31.02	28.245	70.490	66.23	72.159**
$r \leq 3$	27.420	24.99	24.281	48.880	45.70	43.914
$r \leq 4$	21.120	19.02	10.898	31.540	28.78	19.633
$r \leq 5$	14.880	12.98	8.562	17.860	15.75	8.736

Below in Table 5.4, the trace test signals two cointegrating relationships for Model II, while the maximal eigenvalue results suggest just one. At the 10 percent level of significance, the trace test indicates three cointegrating vectors, but still one under the maximal eigenvalue criterion.

Table 5.4: Cointegration Results for Model II

Null	95 % Critical Eigenvalue	90 % Critical Eigenvalue	Eigenvalue Stat	95% Critical Trace	90 % Critical Trace	Trace Test Stat
$r = 0$	45.630	42.70	67.130**	124.620	119.68	175.645**
$r \leq 1$	39.830	36.84	38.821	95.870	91.40	108.515**
$r \leq 2$	33.640	31.02	28.437	70.490	66.23	69.695*
$r \leq 3$	27.420	24.99	20.939	48.880	45.70	41.258
$r \leq 4$	21.120	19.02	12.529	31.540	28.78	20.319
$r \leq 5$	14.880	12.98	7.530	17.860	15.75	7.790

At the 95 per cent significance level, both trace test statistics and maximal eigenvalues conclude two cointegrating relationships exist among the variables in Model III. Table 5.5 provides these results. A similar description can be found for Model IV in table 5.6. Two cointegrating relationships are estimated at the 95 per cent significance level, given the null hypothesis of one or less cointegrating relationships is rejected, but the null of two or less, is accepted.

Results from the two methodologies, suggest different cointegrating relationships for two of the four models. Both eigenvalue and trace test statistics suggest the existence of two cointegrating vectors for models III and IV. Model I however, has an eigenvalue suggesting two cointegrating relationships, but trace statistics suggest three. The trace test for Model II suggests two cointegrating relationships, while eigenvalues suggest just one.

Table 5.5: Cointegration Results for Model III

Null	95 % Critical Eigenvalue	90 % Critical Eigenvalue	Eigenvalue Stat	95% Critical Trace	90 % Critical Trace	Trace Test Stat
$r = 0$	45.630	42.70	66.180**	124.620	119.68	172.236**
$r \leq 1$	39.830	36.84	40.433**	95.870	91.40	106.056**
$r \leq 2$	33.640	31.02	25.533	70.490	66.23	65.623
$r \leq 3$	27.420	24.99	23.721	48.880	45.70	40.090
$r \leq 4$	21.120	19.02	8.725	31.540	28.78	16.369
$r \leq 5$	14.880	12.98	7.130	17.860	15.75	7.644

Table 5.6: Cointegration Results for Model IV

Null	95 % Critical Eigenvalue	90 % Critical Eigenvalue	Eigenvalue Stat	95% Critical Trace	90 % Critical Trace	Trace Test Stat
$r = 0$	45.630	42.70	66.367**	124.620	119.68	171.138**
$r \leq 1$	39.830	36.84	39.150**	95.870	91.40	104.771**
$r \leq 2$	33.640	31.02	25.256	70.490	66.23	65.621
$r \leq 3$	27.420	24.99	23.052	48.880	45.70	40.365
$r \leq 4$	21.120	19.02	9.226	31.540	28.78	17.313
$r \leq 5$	14.880	12.98	7.536	17.860	15.75	8.088

Economic theory would suggest a cointegrating rank of one in such a system to be underspecified. Goods Market theory, currency exposure and the PB approach provide adequate arguments for at least one long run relationship to hold between the SM and exchange rates (see section 2.3).

Referring to section 2.3.1 which explained the PB approach, the variable joining exchange rates and the SM are interest rates: A positive shock to the SM increases wealth, which increases money demand and therefore interest rates. This appreciates the currency because more foreign capital inflows chase these higher returns, and this increases the demand for domestic currency.

The PB approach therefore suggests a relationship over and above the SM and exchange rates. It suggests domestic interest rates to exhibit a relationship with exchange rates as well. The state of NZ's high interest rates in 2005 and early 2006 support this notion. With the OCR the highest in the developed world in late 2005 there was substantial media coverage over foreign investment holding the NZD at its above average levels (see Beckford, 2005, Reuters, 2006, Stuff, 2005d). Economic theory therefore suggests both the SM and BB to hold cointegrating behaviour with exchange rates.

5.3.3: Limitations to the Cointegration Results

Economic and financial theory would find difficulties in arguing a different number of cointegrating relationships among the four models. The portfolio mix between each varies greatly, however this variation

cannot define an argument to isolate additional relationships any model has over another.

It could be argued for example, that a SM index comprising more companies is likely to have more cointegrating relationships with exchange rates (and BB), than a SM index comprising less. Therefore, because the NZSXALL represents all listed New Zealand companies, it is likely Model IV has more cointegrating relationships than Model I, which includes the NZSX10.

A counter-argument exists. Because the NZSXALL represents a larger portfolio than the NZSX10, possible cointegrating relationships that specific companies within the NZSXALL have, offset each other. Hence, cointegration tests would not pick up on these additional relationships, because the SM index is unaffected overall.

From this discussion, the choice has been made to specify two cointegrating ranks for each system. Maximal eigenvalue and trace tests support this selection for Model II and III. The trace test for Model IV and maximal eigenvalue test for Model I also support this specification.

It is possible via cross-rates that additional cointegrating trends exist within each system. For simplicity, these will be ignored. Because this possibility cannot be isolated, the option to specify two cointegrating ranks within each system is the less-bias and more economically reasonable alternative.

5.4: The Placement of Appropriate Restrictions to Each Cointegrating System

A cointegrating rank of two within each system means two restrictions must be placed, raising the question of which restrictions to place. The degree of interaction between NZ and each of the five currencies assists this process.

It is argued the degree of foreign trade and investment with New Zealand is an appropriate means of finding restrictions: a country with less trade and less investment with NZ would suggest the relevant exchange rate to have a relatively less substantial relationship with NZ relative to other currencies.

5.4.1: The Degree of Trade and Investment between NZ and its Five Largest Trading Partners from 1999 to Mid-2005.

The level of trade depends on the level of imports and exports NZ has with the five countries. Openness is a term used to describe the degree of trade interaction between two countries and is calculated by:

$$(5.1) \qquad Openness_i = \left(\frac{Ex_i + Im_i}{GDP} \right)$$

Where i represents the openness that NZ has with the particular country, Ex_i represent NZ's exports to that country and Im_i are imports from that country. Because we wish to compare the degree of openness between NZ and other countries, we can drop the denominator (GDP) from the equation, giving us:

$$(5.2) \qquad VoT_i = Ex_i + Im_i$$

Where VoT_i represents the volume of trade with the ith country.

Results from this equation between 1999 and mid-2005 are given below in Figure 5.1.

Figure 5.1: Volume of Trade between NZ and its Largest Trading Partners from 1999- Mid-2005.
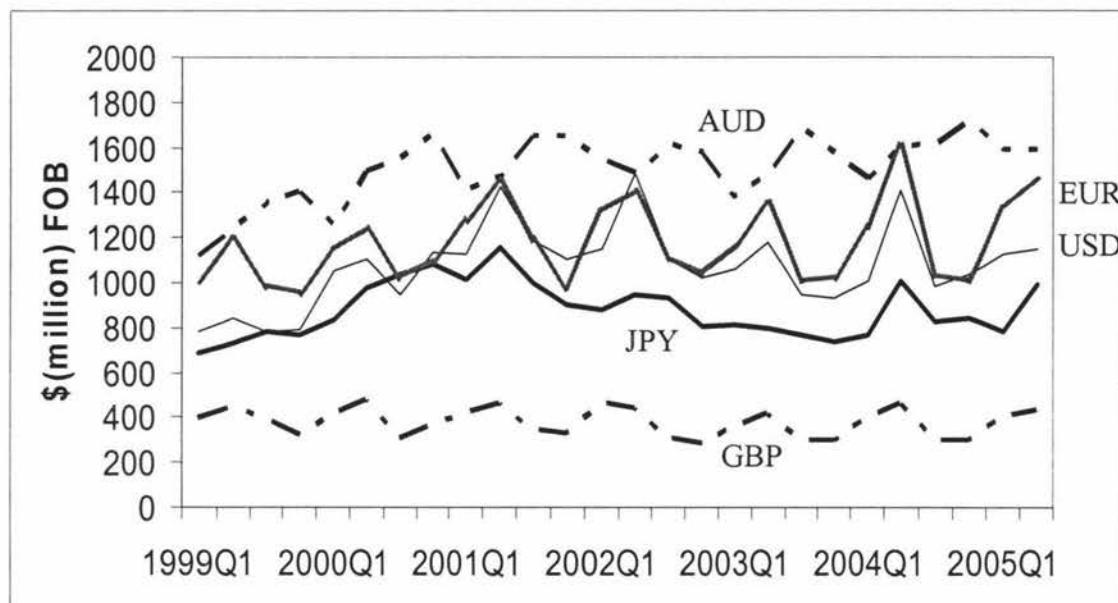
We can see that Great Britain is NZ's smallest trading partner, which suggests NZ business has relatively less interaction with the GBP. Enforcing this point is the currency's weighting in NZ's TWI. It holds the lowest weighting at 6.69 per cent. The next highest is the JPY with 17.54 per cent.[75] Hence an appropriate restriction is that the GBP does not influence the SM. This also means the SM is the subject of the equation i.e. the equation is normalised on the SM. Hence, the first cointegrating vector (CV1) is normalised on the sharemarket index and the GBP is restricted to have a zero coefficient.

---

[75] Information regarding these weightings, took effect from December 21, 2004. Cited at: http://www.rbnz.govt.nz/statistics/exandint/twi/0144604.html, Retrieved September 12, 2005.

5.5.2: Cointegrating relationships for Model II

Referring to the parameters of CV1 in Table 5.8, the MidCap30 is independent of BB yields and all exchange rates, even at the ten per cent level of significance.

Similar to results of Model I, CV2 parameters indicate that an appreciating NZD/GBP and depreciating NZD/EUR positively influence BB rates in the long run. No other variables are significantly different from zero within CV2.

Table 5.8: Model II Cointegration Results

CV	Dependant Variable	USD	AUD	JPY	GBP	EUR	BB	Mid-Cap30
1	MidCap30	-0.310	15.390	-16.265	-	36.402	-7.561	-
	(SE)	2.669	16.230	14.186	-	34.082	6.354	-
2	BB	-0.844	-0.345	-	6.140***	-9.747***	-	0.1231
	(SE)	0.879	1.180	-	2.020	2.349	-	0.2365

5.5.3: Cointegrating relationships for Models III and IV

Tables 5.9 and 5.10 indicate parameter estimates of CV1 for Models III and IV that are similar Model II. Neither the NZSX50 nor NZSXALL have a significant long run relationship with exchange rates or BB yields. At the ten per cent level however, the NZD/JPY and BB coefficients are significant for Model III. These indicate an appreciating NZD/JPY harms performance of the NZSX50 in the long run- a similar effect seen in Model I. At this significance level, BB yields are also negatively related to the NZSX50 over the long run, but not for Model IV.

Table 5.9: Model III Cointegration Results

CV	Dependant Variable	USD	AUD	JPY	GBP	EUR	BB	NZSX50
1	NZSX50	-0.582	8.458	-9.560*	-	22.587	-4.662*	-
	(SE)	1.764	7.158	6.687	-	18.189	3.079	-
2	BB	-0.545	-0.054	-	6.126***	-11.167***	-	0.173
	(SE)	0.963	1.148	-	2.334	3.231	-	0.353

Table 5.10: Model IV Cointegration Results

CV	Dependant Variable	USD	AUD	JPY	GBP	EUR	BB	NZSX ALL
1	NZSXALL	-0.854	10.223	-11.539	-	27.808	-5.583	-
	(SE)	2.193	10.193	9.547	-	25.565	4.361	-
2	BB	-0.613	0.037	-	6.124***	-10.924***	-	0.124
	(SE)	0.976	1.170	-	2.327	3.172	-	0.330

In summary, the cointegration results suggest the MidCap30, NZSX50 and NZSXALL indexes to share no long run relation with any exchange rates. The NZSX10 shares a long run relationship with the NZD/AUD, NZD/JPY and BB yields. The relatively smaller degree of diversification, from the index including just ten companies, may explain the higher degree of sensitivity.

The MidCap30, NZSX50 and NZSXALL share no long run relationship with BB rates, however there is once again evidence the NZD/GBP and NZD/EUR have a significant influence on BB yields.

5.6: Error Correction Results

The ECM results for Models I, II, III, and IV are reported in Tables 5.11 to 5.14, respectively. Below individual parameter estimates in each cell are the corresponding standard errors (SE).

5.4.2: Foreign Investment in New Zealand

The degree of foreign investment into NZ is another measure of foreign involvement with NZ companies. It is profitable for those overseas, to invest into an appreciating NZD. Converting NZ currency back into its foreign equivalent after the NZD has appreciated, enhances the return to investment.

Foreign direct investment (FDI) is an indicator of international investment in New Zealand. It represents the flow of foreign ownership over domestic assets; including investment in the SM. Figure 5.2 below represents the flow of FDI into NZ between 1999 and 2003, by country of origin.

Figure 5.2: FDI by Country of Origin, between 1999 and 2003[76]
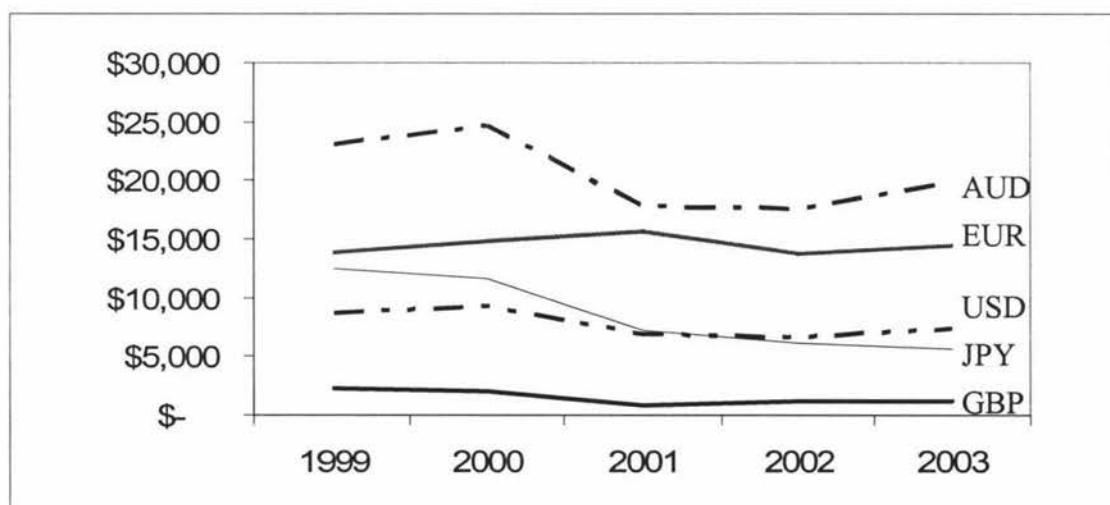
[76] Source: The Official New Zealand Year Book, Various issues. The Y-axis is in millions of NZD.

Figure 5.2 indicates the flow of FDI from Japan to be substantially less than Australia, Europe, Great Britain and the United States. This indicates Japan has relatively less impact towards NZ-based investment markets including the equity (SM) and money markets (BB). Figure 5.3 below substantiates Japans lack of involvement with NZ's financial markets.

Figure 5.3: NZD Turnover in the Foreign Exchange Market for the Year to June 2005[77]
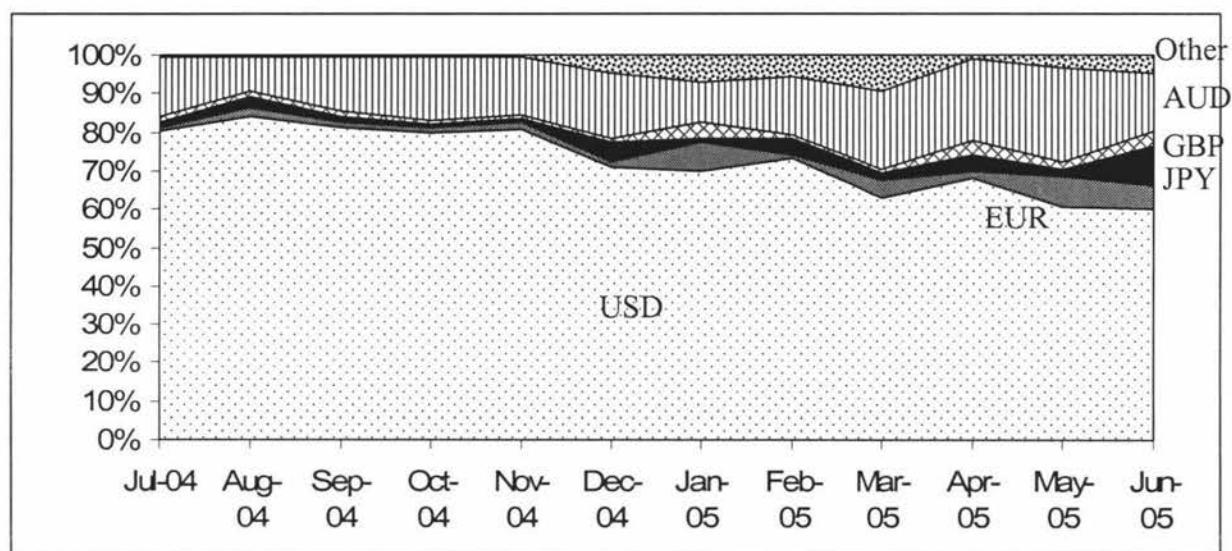
Figure 5.3 above shows the proportion of total foreign currency turnover between New Zealand and its five highest traded currencies. It highlights the relatively smaller involvement the NZ economy has with Great Britain and Japan, compared to Australia and the US. Foreign exchange turnover is approximately US $4.2 billion every day. Approximately two-thirds of this is against the US dollar (Ryan, 2001).

Figures 5.2 and 5.3 jointly underscore the lack of foreign investment denominated in JPY. Consequently, its value has the lowest effect on the

---

[77] Source: www.rbnz.govt.co.nz

demand for domestic equity and cash-based investments. For this reason, changes in the JPY will bear relatively less interaction with NZ's money marks, and therefore affect NZ interest rates. Therefore the second restriction is that changes to the JPY do not affect the return of NZ BB. Hence, the second cointegrating vector (CV2) is normalised on the BB and the JPY is restricted to have a zero coefficient.

5.5: The Estimated Cointegrating Relationships

Estimation of the equation (4.16) was estimated with the following results. The significance of each statistic was calculated by comparing t-statistics with critical values provided by Wooldridge (2003, p.817).

5.5.1: Cointegrating relationships for Model I

In Table 5.7, the parameters of CV1 for Model I indicates the NZSX10 shares a significant long run relationship with the NZD/AUD, NZD/JPY and BB returns at the 5% level These represent the parameter estimates of $\eta_{n,m}$ (CV(1)) and $\delta_{n,m}$ (CV(2)) from equation (4.28). An appreciating NZD/AUD is a positive influence to the NZSX10; however performance of this SM index is harmed in the long run by an appreciating NZD/JPY.

Table 5.7: Model I Cointegration Results

CV	Dependant Variable	USD	AUD	JPY	GBP	EUR	BB	NZSX10
1	NZSX10	-0.567	3.256**	-2.857**	-	6.920*	-1.390**	-
	(SE)	0.556	1.552	1.426	-	4.164	0.663	-
2	BB	-0.678	0.464	-	6.189***	-11.683***	-	0.591
	(SE)	1.134	1.107	-	2.369	3.207	-	0.860

A possible reason behind such long run relationships could be the ten companies characterising the NZSX10, heavily import from Australia and export to Japan. The positive association this SM index has with the NZD/AUD also implies that as this exchange rate appreciates, there may be a stronger demand by Australian investors for shares among these ten firms (see Appendix III for a list of these firms).

BB yields dampen performance of the NZSX10; however this long run relationship is relatively smaller than the other two significant long term relationships. The effect of BB rate follow the economic reasoning outlined in Section 3.3.2.

Considering the second cointegrating vector for Model I, BB yields are affected in the long run by the NZD/GBP and NZD/EUR. The NZD/USD, NZD/AUD and NZSX10 are not found to have a significant long term association with BB yields. Appreciations to the NZD/GBP and/or a depreciating NZD/EUR are associated with increasing BB returns, over the long run.

Table 5.11: ECM Results for Model I

	dNZSXten	dUSD	dAUD	dJPY	dGBP	dEUR	dBB
Intercept	-0.113***	-0.046*	-0.082***	-0.018	-0.078**	-0.074***	0.066***
	0.042	0.025	0.015	0.029	0.024	0.025	0.024
dNZSX10	-0.068	0.108***	0.070***	0.092**	0.129**	0.121***	0.067**
	0.056	0.034	0.020	0.039	0.032	0.033	0.031
dUSD1	0.088	0.356***	0.068	0.110	0.002	0.058	-0.037
	0.143	0.086	0.050	0.098	0.080	0.083	0.080
dAUD1	-0.363**	0.043	0.220***	0.049	0.020	0.017	0.112
	0.160	0.095	0.055	0.109	0.090	0.093	0.089
dJPY1	-0.045	-0.091	-0.053	0.209***	-0.044	-0.020	-0.009
	0.109	0.065	0.038	0.074	0.061	0.063	0.060
dGBP1	0.169	-0.024	-0.066	-0.093	0.156	-0.160	0.049
	0.174	0.104	0.060	0.119	0.098	0.102	0.097
dEUR1	0.056	-0.002	0.056	0.001	0.118	0.311***	-0.060
	0.143	0.086	0.050	0.098	0.080	0.084	0.080
dBB1	0.007	0.124**	0.113***	0.115*	0.072	0.149***	0.240***
	0.096	0.058	0.033	0.066	0.054	0.056	0.054
ECM1(-1)	-0.024**	-0.005	-0.020***	0.003	0.018***	-0.010	0.006
	0.011	0.007	0.004	0.008	0.006	0.007	0.006
ECM2(-1)	-0.004	0.006	-0.008***	0.011**	-0.005	0.006	-0.011**
	0.008	0.005	0.003	0.005	0.004	0.005	0.004
Adjusted R-Squared	0.020	0.128	0.161	0.093	0.103	0.116	0.166
F- Statistic	1.756*	6.472***	8.167***	4.821***	5.266***	5.922***	8.435***
Serial Correlation: LM	0.047	0.230	0.069	0.080	0.218	0.798	2.452
Serial Correlation: F	0.045	0.223	0.067	0.078	0.211	0.774	2.389
Heteroskedasticity: LM	1.657	0.176	0.375	1.036	0.614	8.557***	12.178***
Heteroskedasticity: F	1.656	0.175	0.373	1.033	0.612	8.728***	12.560***

118

5.6.1: ECM Results for Model I

An appreciating NZD/AUD is estimated to harm the performance of the NZSX10. This negative result differs from the long term positive effect found in Table 5.7.

All other exchange rates, plus BB yields are insignificant in explaining changes to the NZSX10, and the associated F-statistic of 1.756 reflects this. Further, the NZSX10 is estimated to follow a very slow adjustment of 2.4 per cent per week towards its long run equilibrium state.

Referring to the other ECM results, the NZSX10 has a significant and positive impact on each of the currencies in the short run. A positive short run effect is also estimated for BB yields, not found within the long term cointegrating relationships.

With the exception of the NZD/JPY and NZD/GBP, BB yields are significantly different from zero, and imply an increasing BB return increases the NZD/USD, NZD/AUD, and NZD/EUR exchange rates in the short term. A rise in BB yields has a comparatively larger short term impact on the NZD/USD, NZD/AUD NZD/JPY NZD/EUR over an equivalent increase in the NZSX10.

Only the NZSX10 has a short term impact on BB yields, and this is positive. Even at the ten per cent level, no exchange rate affects BB yields. This contrasts with the long term results under Table 5.7, suggesting BB yields to be influenced only by the NZD/GBP and NZD/EUR exchange rates, but not the NZSX10.

5.6.2: ECM Results for Model II

Similar to Model I, ECM estimates with the MidCap30 Index, are not significantly different from zero, except the NZD/AUD exchange rate. The NZD/AUD has a negative short term impact on the MidCap30, similar the NZSX10. Referring to Table 5.12, the error correction term of 0.000 (3dp) is insignificant, suggesting the MidCap30 does not adjust at all to any long run equilibrium value with the other variables.

The MidCap30 is a significant and positive force to all exchange rates except the NZD/AUD in the short run. This is stronger than BB yields for all exchange rates except the NZD/AUD. Once again, no exchange rate has a short term impact on BB yields, which has a very slow rate of adjustment, similar to all other error correction estimates.

5.6.3: ECM Results for Model III

Referring to Table 5.13, the NZSX50 is only affected by the NZD/AUD in the short run, similar to the NZSX10 and MidCap30. Analogous to Model II, the NZSX50 fails to adjust to any long run relationship with other variables in the system. This is seen by the error correction term of -0.001, or -0.1 per cent each week that is not significantly different from zero.

Similar to the NZSX10 and MidCap30, the NZSX50, has a positive impact to all exchange rates including the NZD/AUD, which was insignificant in Model II. A description of Model IV is provided on page 124.

Table 5.12: ECM Results for Model II

	dMid Cap30	dUSD	dAUD	dJPY	dGBP	dEUR	dBB
Intercept	-0.017	-0.034	-0.132***	0.049	-0.144***	-0.181***	0.023
	0.060	0.050	0.030	0.058	0.047	0.049	0.046
dMidCap30	0.001	0.173***	0.033	0.107**	0.167***	0.161***	0.133***
	0.056	0.046	0.028	0.053	0.044	0.045	0.043
dUSD1	0.169	0.323***	0.067	0.074	-0.015	0.054	-0.050
	0.103	0.086	0.051	0.099	0.081	0.084	0.079
dAUD1	-0.331***	0.099	0.225***	0.077	0.071	0.059	0.151*
	0.117	0.097	0.058	0.112	0.092	0.095	0.090
dJPY1	-0.131*	-0.068	-0.033	0.241***	-0.023	-0.025	-0.014
	0.077	0.064	0.038	0.074	0.061	0.063	0.059
dGBP1	0.121	-0.019	-0.053	-0.102	0.186*	-0.118	0.085
	0.126	0.104	0.062	0.120	0.099	0.102	0.096
dEUR1	-0.093	-0.009	0.040	0.007	0.088	0.292***	-0.082
	0.103	0.086	0.051	0.098	0.081	0.084	0.079
dBB1	-0.075	0.106*	0.100***	0.104	0.038	0.107*	0.221***
	0.069	0.057	0.034	0.066	0.054	0.056	0.053
ECM1(-1)	0.000	-0.001	-0.003***	0.002	-0.004***	-0.004***	0.000
	0.002	0.001	0.001	0.001	0.001	0.001	0.001
ECM2(-1)	0.006	0.008	-0.005	0.015**	-0.007	-0.002	-0.018***
	0.006	0.005	0.003	0.006	0.005	0.005	0.005
Adjusted R-Squared	0.035	0.135	0.124	0.088	0.101	0.123	0.185
F- Statistic	2.347**	6.834***	6.269***	4.616***	5.190***	6.229***	9.467***
Serial Correlation: LM	0.018	0.134	0.599	0.041	0.025	2.878*	2.823*
Serial Correlation: F	0.018	.12964	0.580	0.040	0.024	2.808*	2.754*
Heteroskedasticity: LM	0.421	0.665	1.308	2.014	0.261	7.973***	18.641***
Heteroskedasticity: F	0.419	0.662	1.305	2.015	0.260	8.118***	19.615***

Table 5.13: ECM Results for Model III

	dNZSX50	dUSD	dAUD	dJPY	dGBP	dEUR	dBB
Intercept	-0.036	-0.034	-0.132***	0.052	-0.142***	-0.153***	0.035
	0.067	0.048	0.028	0.055	0.045	0.047	0.045
dNZSX50	-0.041	0.146***	0.067***	0.123***	0.162***	0.160***	0.098***
	0.056	0.041	0.024	0.047	0.038	0.040	0.038
dUSD1	0.074	0.349***	0.074	0.091	0.010	0.071	-0.033
	0.119	0.086	0.050	0.098	0.080	0.083	0.080
dAUD1	-0.346***	0.069	0.230***	0.073	0.047	0.038	0.127
	0.133	0.096	0.056	0.109	0.090	0.093	0.089
dJPY1	-0.028	-0.088	-0.046	0.223***	-0.048	-0.042	-0.022
	0.090	0.065	0.038	0.074	0.061	0.063	0.060
dNZD/GBP1	0.123	-0.025	-0.060	-0.106	0.169*	-0.138	0.062
	0.144	0.104	0.061	0.119	0.098	0.101	0.097
dEUR1	0.001	-0.008	0.039	0.003	0.097	0.300***	-0.068
	0.118	0.085	0.050	0.097	0.080	0.083	0.079
dBB1	0.006	0.124**	0.104***	0.123*	0.060	0.133**	0.234***
	0.080	0.058	0.034	0.066	0.054	0.056	0.054
ECM1(-1)	-0.001	-0.001	-0.006***	0.003	-0.006***	-0.006***	0.000
	0.003	0.002	0.001	0.003	0.002	0.002	0.002
ECM2(-1)	0.007	0.008	-0.006**	0.015***	-0.006	0.001	-0.014***
	0.007	0.005	0.003	0.006	0.005	0.005	0.005
Adjusted R-Squared	0.012	0.134	0.141	0.101	0.111	0.131	0.174
F- Statistic	1.456	6.783***	7.130***	5.191***	5.673***	6.634***	8.847***
Serial Correlation: LM	0.148	0.468	0.045	0.000	0.206	0.471	2.156
Serial Correlation: F	0.143	0.454	0.043	0.000	.19895	0.456	2.099
Heteroskedasticity: LM	0.016	0.524	0.444	2.624	0.510	12.396***	16.327***
Heteroskedasticity: F	0.016	0.522	0.442	2.629	0.508	12.793***	17.057***

Table 5.14: ECM Results for Model IV

	dNZSX ALL	dUSD	dAUD	dJPY	dGBP	dEUR	dBB
Intercept	-0.043	-0.031	-0.132***	0.049	-0.139***	-0.161***	0.027
	0.063	0.049	0.029	0.056	0.046	0.047	0.045
dNZSXALL	-0.038	0.163***	0.072***	0.136***	0.176***	0.175***	0.120***
	0.056	0.043	0.026	0.050	0.041	0.042	0.040
dUSD1	0.127	0.345***	0.072	0.089	0.005	0.069	-0.033
	0.111	0.085	0.050	0.098	0.080	0.083	0.079
dAUD1	-0.324***	0.065	0.228***	0.068	0.042	0.032	0.127
	0.124	0.095	0.056	0.109	0.090	0.093	0.088
dJPY1	-0.057	-0.087	-0.045	0.222***	-0.046	-0.043	-0.026
	0.084	0.065	0.038	0.074	0.061	0.063	0.060
dGBP1	0.105	-0.030	-0.058	-0.111	0.168*	-0.136	0.064
	0.135	0.104	0.061	0.119	0.098	0.101	0.097
dEUR1	0.003	-0.007	0.036	0.006	0.095	0.298***	-0.071
	0.110	0.085	0.050	0.097	0.080	0.083	0.079
dBB1	0.009	0.126**	0.105***	0.123*	0.062	0.133**	0.234***
	0.075	0.058	0.034	0.066	0.054	0.056	0.053
ECM1(-1)	-0.001	-0.001	-0.005***	0.002	-0.005***	-0.005***	0.000
	0.002	0.002	0.001	0.002	0.002	0.002	0.002
ECM2(-1)	0.006	0.008*	-0.006**	0.015***	-0.006	0.000	-0.015***
	0.006	0.005	0.003	0.006	0.005	0.005	0.005
Adjusted R-Squared	0.016	0.138	0.141	0.101	0.113	0.135	0.181
F- Statistic	1.601	6.952***	7.149***	5.190***	5.733***	6.828***	9.241***
Serial Correlation: LM	0.251	0.451	0.013	0.004	0.151	0.618	1.612
Serial Correlation: F	0.243	0.437	0.012	0.004	0.146	0.599	1.567
Heteroskedasticity: LM	0.265	0.383	0.641	2.249	0.283	12.734***	18.474***
Heteroskedasticity: F	0.264	0.381	0.638	2.250	0.281	13.156***	19.430***

5.6.4: ECM Results for Model IV

The results for Model IV in Table 5.14 are very similar to those of Model III in Table 5.13. This is expected since the NZSXALL includes all companies within the NZSX50, and the remaining listed companies represent less than one-third of the NZSXALL.[78]

Below is a summary table of the short run (SR) relationships provided by the ECM, plus the long run (LR) relationships from the cointegrating vectors, in Section 5.5. Similar to the other tables(except 5.2) ***, **, * represent the one, five and ten per cent significance levels, respectively.

Table 5.15: A Summary of Short- and Long-Run Relationships

Model	Dependent Variable		SM	USD	AUD	JPY	GBP	EUR	BB
Model I	NZSX10	SR			-**				
	NZSX10	LR			+**	-**		+*	-**
	BB	SR	+**						
	BB	LR			-**		+***	-***	
Model II	MidCap30	SR			-***				
	MidCap30	LR							
	BB	SR	+***		+*				
	BB	LR					+***	-***	
Model III	NZSX50	SR			-*				
	NZSX50	LR				-*			-*
	BB	SR	+***						
	BB	LR					+***	-***	
Model IV	NZSXALL	SR			-***				
	NZSXALL	LR							
	BB	SR	+***						
	BB	LR					+***	-***	

---

[78] As of 12/2/06, capitalisation of the NZSX50 and NZSXALL were $46,456,968,000. and $68,105,633,000 respectively. Hence the NZSX50 represented approximately two-thirds of the NZSXALL index at this time. (Data cited from www.nzx.com , retrieved February 12, 2006).

Referring to Table 5.15, it is clear BB yields and SMs within each model behave similarly. With the exception of the NZSX10, the other three indexes bear no long run relationship with exchange rates or BB yields. The NZSX10 is positively associated with the NZD/AUD, but negatively related with the NZD/JPY and BB yields in the long run.

The SM aggregate under each model affects BB yields positively in the short run. In the long run, each model indicates the SM is positively related to the NZD/GBP, and negatively related to both BB rates and the NZD/EUR.

The NZD/JPY only has a significant relationship with the NZSX10 in the long run, but not with any other SM. The NZD/USD has no significant relationship with any of the four indexes, nor BB yields, neither in the short- or long-term.

Among the ECM results, no exchange rate has a short term effect on another, since no associated parameter estimate is significantly different from zero. This implies all five exchange rates with respect to the NZD, move independently of each other in the short run. No exchange rate has a short term effect on BB rates.

Apart from the NZSX10 and NZSXALL ECMs, F-statistics for all others reject the null hypothesis that all coefficients are significantly different from zero. Serial correlation is nonexistent for all ECM models. Heteroskedastic residuals are present only for ECMs modelled with BB rates and the NZD/EUR as the dependent variable.

The NZD/USD is not found to converge towards any long run equilibrium for any of the four models. However, similarly to all other currencies, their value tends to appreciate in the short run following a rise in any SM or BB rate. With the exception of the MidCap30's insignificant short run impact in the NZD/AUD, a rise to any SM index appreciates all five exchange rates, since their lagged coefficients are significantly different from zero. Each SM also increases BB rates in the short term.

Many error correction terms are found to be statistically indifferent from zero. Only the NZSX10 is found to converge towards a long run relationship however. This is under CV1, at a rate of 2.4 per cent per week- the fastest significant rate of adjustment among all ECMs.

The next stage includes block Ganger non-causality testing, and formally testing significance of all error correction terms.

5.7: Block Granger Non-Causality and Weak Exogeneity

By testing for weak exogeneity and comparing these results with block Granger causality tests, we can understand the degree of exogeneity each variable is characterised by, within the four models. Those variables which are weakly, (but preferably strongly) exogenous, will be those which can be shocked in the generalised impulse response functions following this section.

The first column of numbers in Table 5.16 below represents results of the Granger non-causality test. The null hypothesis states lagged coefficients of the variable in question (X) are not significantly different from zero. In Table 5.16, results indicate the NZD/USD, NZD/AUD and NZD/GBP to accept this hypothesis, meaning each of these variables do not Granger cause others within the VAR(2). All other variables (NZSX10, NZD/JPY, NZD/EUR and BB) reject this null, suggesting them to Granger cause other variables within the system.

Table 5.16: Block Granger Non-Causality Chi-Square (2) Values for Model I

Variable X	X is Granger non-causal to all others	All other variables are Granger non-causal to X	Weak Exogeneity	Weakly Exogenous (5 %)	Strongly Exogenous (5 %)
NZSX10	38.690***	23.450**	5.344*	√	
USD	14.580	29.273***	1.810	√	
AUD	19.942*	49.042***	16.371***		
JPY	29.274***	27.056***	1.227	√	
GBP	19.793*	38.925***	9.681***		
EUR	39.713***	48.263***	4.403	√	
BB	41.500***	39.987***	9.946***		

The second column of numbers represents result from testing the null hypothesis that lagged coefficients for all variables (apart from X), are not jointly significant from zero. Hence, rejecting this null indicates the given variable is Granger caused by all others jointly, within the VAR(2). Referring to the results for Model I, this null is rejected for every variable.

The null hypothesis for weak exogeneity tests define variable (X) to be weakly exogenous. Within Model I, the NZSX10, NZD/USD, NZD/JPY and NZD/EUR are weakly exogenous .

To simplify interpretation, the second-to-last column indicates (with a tick) whether the variable is weakly exogenous. The final column represents strong exogeneity, under the condition outlined by Ericsson (1992, p.259) (noted in Section 4.7). Granger non-causality is given by accepting the null hypothesis, in the second numbered column of results. No variable is strongly exogenous in Model I.

Results for Model II below, suggest only the NZD/USD and NZD/GBP not to Granger cause the other variables. All variables reject the null hypothesis that lagged values from all variables are not jointly significant from zero. Hence, the current value of variable X can be explained by some joint combination of other lagged values within the Model II. Only the NZD/AUD and NZD/EUR are not weakly exogenous. No variable is strongly exogenous in Model II.

Table 5.17: Block Granger Non-Causality Chi-Square(2) Values for Model II

Variable X	X is Granger non-causal to all others	All other variables are Granger non-causal to X	Weak Exogeneity	Weakly Exogenous (5 %)	Strongly Exogenous (5 %)
MidCap30	41.610***	22.125**	1.159	√	
USD	19.639*	29.053***	2.840	√	
AUD	28.247***	31.893***	11.778***		
JPY	29.669***	24.379**	1.813	√	
GBP	20.850*	38.945***	4.559	√	
EUR	50.206***	43.640***	9.559***		
BB	36.715***	45.091***	3.687	√	

The first column of results for Model III and Model IV (below) are similar to Models I and II, in that both NZD/USD and NZD/GBP do not Granger cause the other variables. Both Models III and IV accept the null hypothesis, that all other variables are Granger non-causal to the NZSX50 and NZSXALL, respectively. Further, both SMs are weakly exogenous, proposing the NZSX50 and NZSXALL to be strongly exogenous variables.

Table 5.18: Block Granger Non-Causality Chi-Square (2) Values for Model III

Variable X	X is Granger non-causal to all others	All other variables are Granger non-causal to X	Weak Exogeneity	Weakly Exogenous (5 %)	Strongly Exogenous (5 %)
NZSX50	41.643***	17.529	1.105		√
USD	14.280	27.797***	2.278	√	
AUD	21.532**	40.520***	9.469***		
JPY	27.471***	27.218***	0.696	√	
GBP	19.761*	38.990***	8.783**		
EUR	43.936***	44.618***	5.867*	√	
BB	39.101***	42.566***	3.952	√	

Table 5.19: Block Granger Non-Causality Chi-Square (2) Values for Model IV

Variable X	X is Granger non-causal to all others	All other variables are Granger non-causal to X	Weak Exogeneity	Weakly Exogenous (5 %)	Strongly Exogenous (5 %)
NZSXALL	43.530***	19.538*	1.353		√
USD	14.321	28.903***	2.695	√	
AUD	22.195**	39.986***	10.205***		
JPY	27.517***	27.671***	0.961	√	
GBP	19.632*	39.130***	8.302**		
EUR	44.410***	45.530***	6.919**		
BB	38.645***	45.176***	4.739*	√	

The NZD/USD, NZD/JPY, and BB yields are weakly exogenous in Models III and IV. The former model is also characterised by a weakly exogenous NZD/EUR exchange rate.

The NZD/USD and NZD/JPY exchange rates are weakly exogenous under all four models. This implies, current values of these exchange rates are not explained by past values of other variables within each model (Kennedy, 2003, p.104). BB rates are weakly exogenous for all but Model I. Both the NZSX10 and MidCap30 are characterised by this as well.

The high number of weakly exogenous variables within each system was expected, in light of the numerous insignificant error correction terms among Tables 5.11 to 5.14. This gives freedom in deciding which variable(s) to shock. Because the only two strongly exogenous variables are SM indexes (the NZSX50 NZSXALL), and the NZSX10 and MidCap30 indexes are both weakly exogenous, the SM will be shocked for each Model under the GIRF framework.

5.8: Generalised Impulse Response Functions

The next page displays the GIRFs for Model I, split into two groups to ease interpretation. The X-axis represents the number of periods in weeks after the positive shock eventuates. It ranges from 0 to 16 weeks (four months) and was chosen because the GIRFs stabilised beyond this point and did not provide any more relevant information.

The Y-axis indicates the rate of change for a given variable. Multiplying this by 100 converts it into percentage form. Therefore, when interpreting the shock's effect on an exchange rate, the Y-axis represents the overall rate of appreciation/depreciation at a given period after the shock.

The GIRFs in Figures 4A and 4B indicate a positive one-standard deviation shock to the NZSX10, exerts an appreciation to the NZD/USD, NZD/JPY, NZD/GBP and NZD/EUR exchange rates.

The extent of appreciation is largest for the NZD/JPY, then NZD/USD exchange rates, but still minimal, only peaking at 0.25 and 0.15 per cent respectively. This peak is one week after the positive shock. After this peak, all four exchange rates tend to depreciate, however do not revert back to their original level. Of the four currencies to initially appreciate, the NZD/GBP and NZD/EUR depreciate faster than the NZD/JPY and NZD/USD.

5.7.1: A Shock to the NZSX10 under Model I

Figure 5.4A: Model I(A)
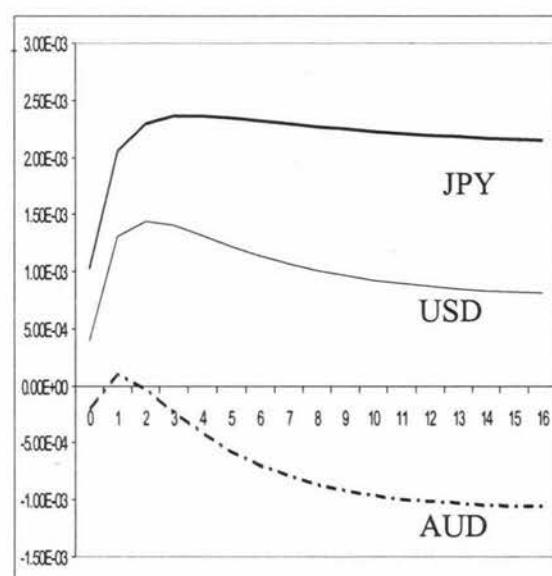
Figure 5.4B: Model I(B)
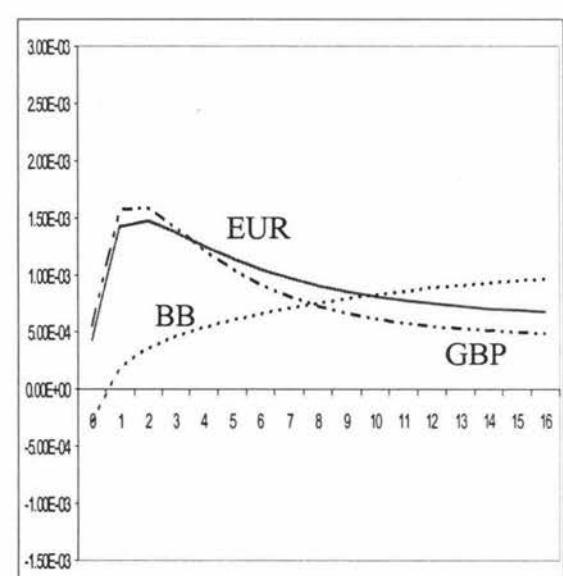
The positive shock has a minimal effect on the NZD/AUD initially, but becomes negative, levelling off after three weeks and stabilising to cause an overall depreciation of just 0.1 per cent. The shock exerts upward pressure on BB rates; however this impact also tends to level off after a similar period. No variable tends back towards zero after the shock eventuates.

5.7.2: A Shock to the MidCap30 under Model II

GIRFs for Models II, III and IV are similar to those of Model I, with some exceptions. The negative effects apparent in the NZD/AUD exchange rate tends to be smaller, the larger the shocked SM. That is, a shock to the NZSX10 depreciates the NZD/AUD to a stronger degree, than for the Midcap30, NZSX50 and NZSXALL. A shock to the NZSXALL creates a positive, but minute degree of appreciation for the first month after the shock.

Figure 5.5A: Model II(A)   **Figure 5.5B: Model II(B)**
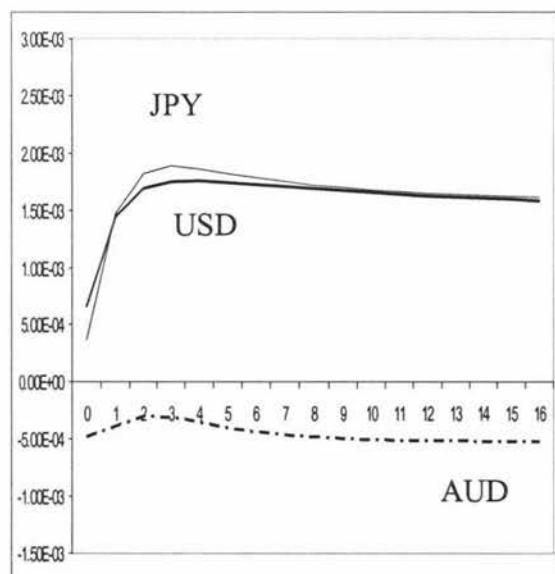
132
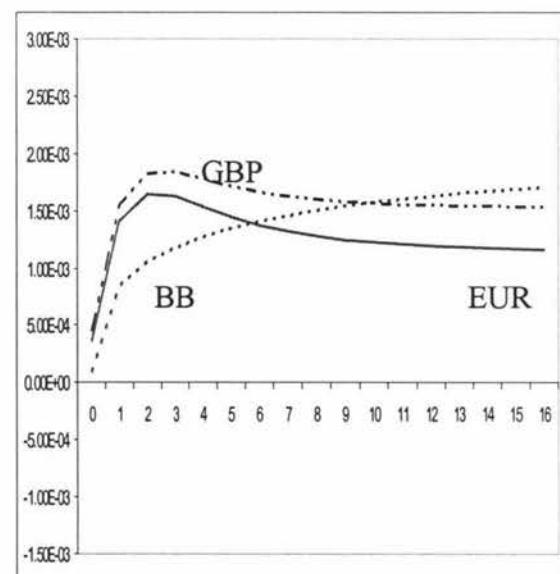
5.7.3: A Shock to the NZSX50 under Model III

Figure 5.6A: Model III(A)　　　　　　**Figure 5.6B: Model III(B)**
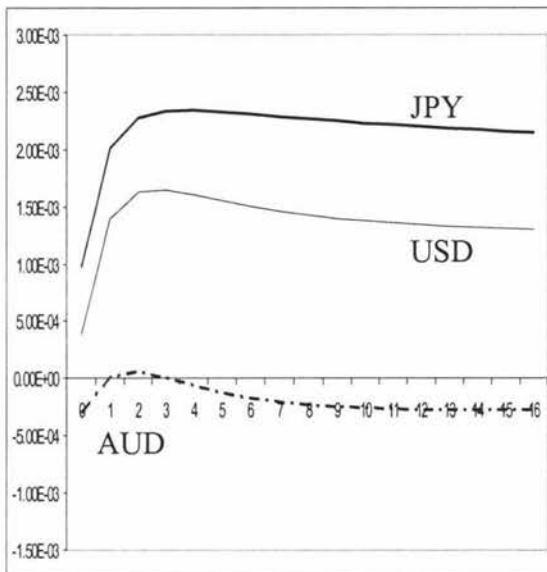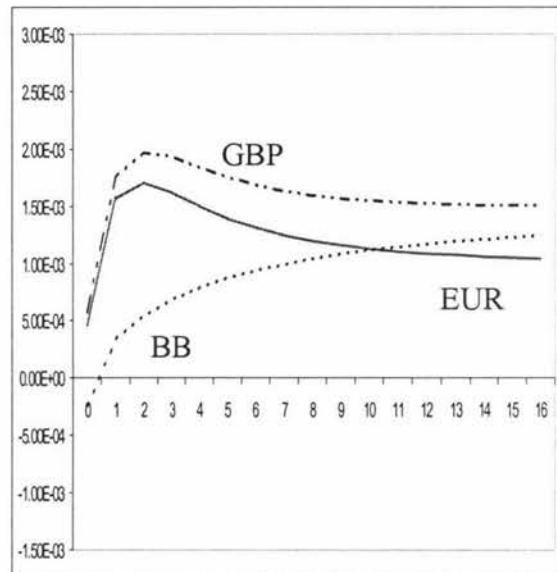
The estimated NZD/JPY appreciation following a shock to the NZSX10, NZSX50 and NZSXALL are similar, and larger than its effect on the NZD/USD. However, when the MidCap30 is shocked, it closely follows a similar (and smaller) degree of appreciation to the NZD/USD.

BB returns react similarly across all four theoretical shocks, increasing, but at a decreasing rate, with no tendency to revert back towards its initial rate.

Referring to the GIRFs, the shock looks to dissolve after approximately 12 weeks. To measure this with more accuracy, Pesaran and Shin (1996) introduced 'persistence profiles,' which estimate the speed for the shock to dissipate towards zero within the system.

Appendix V plots persistence profiles for each cointegrating vector, for the four models. A value of one is given to the period of shock, while zero represents the period when the effects of the shock disappear. These profiles suggest the shock's impact to fade after three months, meaning that no variable continues to change beyond this time as a result of the shock. A lack of convergence implies a degree of hysteresis among exchange rates and bank bills.

5.7.4: A Shock to the NZSXALL under Model IV

Figure 5.7A: Model IV(A)   **Figure 5.7B: Model IV(B)**
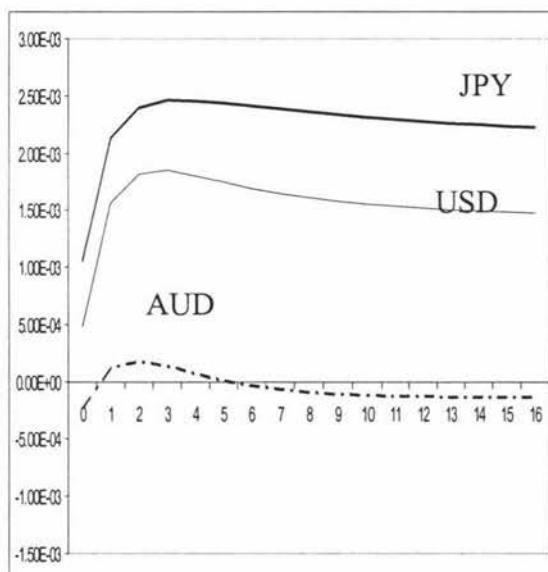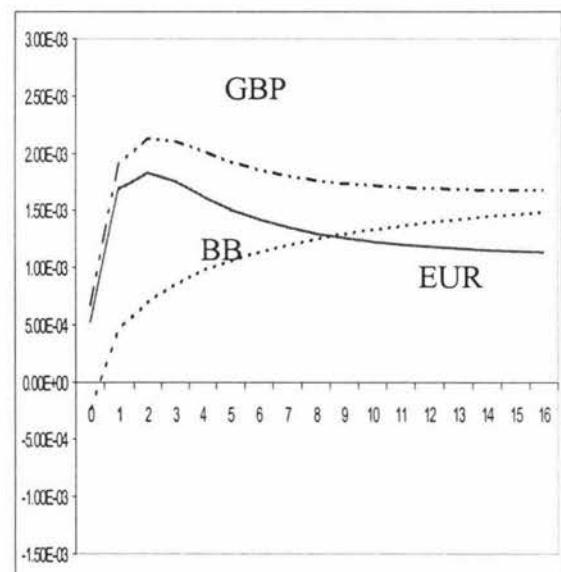
5.7.5: The Value of these Shocks

This value is equivalent to a one-standard deviation change and differs between each estimated equation. Appendix VI displays what the actual standard deviations were, and the maximum absolute reaction from the dependent variable over the first three months after the shock (in percentage terms). Peak reaction of the NZD/USD, NZD/JPY, NZD/GBP and NZD/EUR are all in the second week after the shock, and dissipate

thereafter at a decreasing rate. Table 5.20 below standardises these shocks to one per cent and displays the implied currency and BB rate responses.

Table 5.20: Generalised Impulse Response Functions Standardised to One Per Cent.

	Model I		Model II		Model III		Model IV	
	NZSX10	Max %	MidCap30	Max %	NZSX50	Max %	NZSXALL	Max %
	SHOCK%	Impact	SHOCK%	Impact	SHOCK%	Impact	SHOCK%	Impact
USD	1.00	0.78	1.00	1.24	1.00	1.00	1.00	1.03
AUD	1.00	-0.80	1.00	-0.30	1.00	-0.21	1.00	-0.19
JPY	1.00	0.79	1.00	0.87	1.00	0.88	1.00	0.92
GBP	1.00	0.72	1.00	1.10	1.00	0.98	1.00	1.01
EUR	1.00	0.76	1.00	1.09	1.00	0.94	1.00	0.97
BB	1.00	0.65	1.00	2.45	1.00	0.98	1.00	1.24

The content of Table 5.20 suggests a one-percent increase to the NZSX10 causes a maximum appreciation to the NZD/USD, NZD/JPY, NZD/GBP and NZD/EUR of approximately 0.76 per cent. The NZD/AUD responds in a maximum depreciation of 0.80 per cent.

The MidCap30 seems to have a stronger overall impact on the NZD/USD, NZD/GBP and NZD/EUR, but a weaker effect on the NZD/AUD.

A one-percent increase in the NZSX50 or NZSXALL have similar effects on all currencies, and the estimated maximum appreciation is all close to one, except the NZD/AUD.

5.8: Final Comments on the Results

This chapter has provided the results of an econometric investigation into the relationships between NZ's four most commonly quoted SM indexes, five exchange rates and NZ BB returns. Although the three stationarity methodologies conferred all variables to be I(1), cointegrating methodologies indicated varying results for two of the four models. Section 5.4 justified the placement of two cointegrating relationships for each model. This was followed by the decision to normalise on the SM while restricting the NZD/GBP to have a zero coefficient in the CV1, and to normalise on BB while restricting the NZD/JPY to have a zero coefficient in the CV2.

Long run relationships indicated an appreciating NZD/GBP and depreciating NZD/EUR to be associated with rising BB yields in the long run. ECM results indicated that no exchange rate has a short run impact on BB rates.

Overall, error correction terms suggest a very slow rate of adjustment between variables within each system. Of the four indexes only the NZSX10 had an error correction term significantly different from zero. Its speed of adjustment towards long run equilibrium was 2.4 per cent per week. This was the fastest rate of convergence of all estimated ECMs. Error correction terms for BB yields ranged between 1.1 per cent for Model I, to 1.8 per cent for Model II.

The NZD/AUD was the only variable to significantly impact SMs in the short run. This impact was estimated to be negative, meaning an appreciating NZD/AUD dampens SM performance in the short run.

Weak exogeneity and block Granger causality results signal the NZSX10 and MidCap30 to be weakly exogenous within Models I and II. Furthermore, the NZSX50 and NZSXALL were strongly exogenous, indicating BB yields and exchange rates have no significant influence on these SMs. This finding conflicts with the ECM estimate that the NZD/AUD harms the NZSX50 in the short run.

GIRF results suggest the NZD/AUD exchange rate to have the smallest reaction in each of the four SM shocks. This is the only exchange rate to depreciate following the positive shock: all others appreciate, however the extent of this appreciation remains less than half a per cent. BB returns also rise, and persistence profiles suggest the overall impact of a SM shock to fade after three months. A given shock however, forces the NZD to rise only marginally. The NZD/JPY is affected more strongly than other currencies, with an estimated appreciation peaking in the second period, at 0.25 per cent for Models I, II and IV. Normalising on this translates a one percent shock to appreciate the NZD/JPY by just under one per cent.

NZ interest rates in general, tend to rise if the NZD/GBP appreciates, and/or the NZD/EUR depreciates. A possible explanation behind this could be the NZD/GBP and NZD/EUR have a cyclical relationship with the NZ economy's performance: a booming NZ economy leads to increasing inflationary pressures, which are often countered by the RBNZ

raising the OCR.[79] Further investigation of this point however, is beyond the scope of this research.

Referring to the volume of trade (Figure 5.1) and currency turnover (Figure 5.3) it is surprising to find the NZD/AUD and NZD/USD, to lack a significant long run relationship with NZ SMs. The significance of the NZD/GBP on BB yields is another surprise, given the relatively smaller degree of FDI and currency turnover.

Table 5.20 suggests a one percent rise in NZ SM indexes translates into an appreciation of approximately one per cent for all exchange rates but the NZD/AUD. This exchange rate has a negative relationship and depreciates marginally (less than 0.5 per cent) following a positive shock. This depreciation is approximately 0.8 per cent for following a one per cent shock of the NZSX10.

---

[79] An argument of whether each relationship is pro-cyclical or a-cyclical could be argued either way. Increasing interest rates (and therefore BB rates) are often a lagged reaction to inflationary pressures following strong growth. However because their effect generally dampens growth it is unsure whether an appreciating NZD/GBP for instance, follows the strong growth with the initial increasing interest rates (hence pro-cyclical), or the slower growth following the economy's reaction to further interest rate hikes (a-cyclical). This depends on the lagged response the NZ economy has to interest rate increases.

Chapter Six

CONCLUSION

"...the history of economic modelling can be regarded as one of attempting to solve a conflict between the distinct desires that a model should be both theoretically and empirically coherent."

-Pagan (2003)

This thesis gave an econometric insight into the dynamic interrelationships between the New Zealand sharemarket and exchange rates of NZ's five largest trading partners. Its approach split the NZSXALL up to detail these dynamic relationships for the NZSX10, MidCap30 and NZSX50. The methodology attempted to improve upon many general setbacks of past approaches, highlighted in Chapter 3, and Sections 4.2-4.4.

Interest rates were included within each model to account for the problem of omitted variable bias. After the short run and long run relationships were found via estimation of cointegrating vectors and ECMs, weak and strong exogeneity results further investigated causality. To the author's knowledge, this latter approach is a pioneer effort in the research in this field.

Results indicate the NZ SM held fairly robust to exchange rate fluctuations between 1999 and mid-2005. ECM results indicate the NZD/AUD to negatively impact all four indexes in the short run, but no other exchange rate had any significant short run effect on the SM's performance. All SM indexes were weakly or strongly exogenous, substantiating this argument. Hence, only marginal evidence of the Goods Market approach existed between the NZ SM and the NZD/AUD, but for no other exchange rate.

The NZD/AUD sustained a relationship with the NZSX10 over the long run, however switched to become positive. An inverse long run relationship held between the NZSX10 and the NZD/JPY. The

MidCap30, NZSX50 and NZSXALL held no long run relationship with exchange rates or BB yields.

Only the NZSX10 converged toward a long run equilibrium, however this rate was only 2.4 per cent per week. Increasing BB rates were generally found to appreciate all exchange rates in the short run. Generally the SM was a comparably more significant short run force to appreciate the NZD.

ECM results indicate that all four SM indexes had a significant and positive short run impact to BB rates, but no exchange rate did. Only the NZSX10 had a long run relationship with BB yields.

GIRFs suggest a positive, one-standard deviation shock to the SM causes the NZD/USD, NZD/JPY, NZD/GBP and NZD/EUR to appreciate. ECM results complement this is positive association. Following a one-per cent increase to each SM, GIRF results suggest these four exchange rates to appreciate by a maximum rate of between 0.7 and 1.3 per cent overall, and dissipate thereafter. These peak responses generally eventuated two weeks after the shock. No exchange rate converged back towards its initial value, meaning the overall shock was characterised by hysteresis.

The significant, positive short run impact of the SM on each exchange rate, and insignificant long run association between the two markets, both indicate foreign investment are characterised by the favourable scenario (Figure 1.1). The unfavourable scenario (Figure 1.2) seems a closer fit for the NZD/AUD in the short run, however cointegration results suggest Australian long term investment in the NZSX10 to be attractive.

These results favour portfolio investors from the US, Japan, Great Britain and Europe to invest in the NZ SM. Results may also provide reason for the substantial proportion of foreign ownership characterising the NZ SM. Associations between the SM and these currencies are not found to be negative, so NZ investment is unlikely to hold substantial currency risk. Japanese investors should be weary of the negative long run relationship NZ's ten largest companies have with the yen.

Two explanations are now given to explain the minimal association between exchange rates and the NZ SM. The first is an explanation of how the PB approach and Goods Market approach may offset each other, softening extant relationships. The second explanation notes other influential variables unaccounted for under each model.

6.1: Explanation 1: Offsetting Theories

Shareholders seek to maximise their rate of return among competing investments, and companies strive to maximise shareholder wealth by maximising profits. According to the Goods Market and PB approaches, the two groups may complement, or counter each other depending on the circumstances.

Take an example of a shock to the NZ economy dampening performance of the NZSX. Such a scenario is termed a bear market, and the opposite scenario a bull market.

The PB approach suggests a bear market to put downward pressure on money demand, interest rates and therefore the value of the NZD. In such

a case, the Goods Market approach suggests this domestic depreciation to catalyse further declines to importers within the SM, but improve the conditions for domestic exporters.

The opposite incident is similar to this in the event of a bull market. In such a case, the NZD would appreciate according to the PB approach, harming the performance of exporters, but catalysing importer purchasing power. Table 6.1 below summarises such shocks.

Table 6.1: Potential Scenarios from Theoretical Shocks to the Sharemarket

Type of Shock	Effect on the economy[80]	Effect on Importer SP	Effect on Exporter SP
Bull market	↑SM → r↑ → NZD↑	↑then ↑	↑then ↓
Bear market	↓SM → r↓ → NZD↓	↓then ↓	↓then ↑
↓NZD with export-dominant SM	↓NZD → ↑SM → r↑ → NZD↑..	↓then ↑	↑then ↓
↓NZD with import-dominant SM	↓NZD → ↓SM → r↓ → NZD↓..	↓then ↓	↑then ↑
↑NZD with export-dominant SM	↑NZD → ↓SM → r↓ → NZD↓..	↑then ↓	↓then ↑
↑NZD with import-dominant SM	↑NZD → ↑SM → r↑ → NZD↑..	↑then ↑	↓then ↓

[80] These effects are very simplified, and only look into the overall effects on the economy from the point of view of both the PB and Goods Market approaches. The diagram is by no means a complete picture of the economy.

Assume for simplicity, that the initial shock affects all companies comprising the SM equally, and ignore interest rate effects on the SM.

As well as shocks to the SM, Table 6.1 describes possible scenarios following a shock to the domestic currency. The table also splits the effect of an appreciating/depreciating NZD between a theoretical export- and import- dominant SM. Following the last scenario, a positive shock to the domestic currency increases the SM, creating a wealth effect and increases money demand and interest rates. The currency therefore appreciates more, which advantages importers further, but disadvantages exporters again.

The third and last columns highlight a possible explanation why empirical evidence over causality is mixed. Such shocks happen often, varying in type, magnitude and frequency. Referring to Section 2.5.2, the NZ SM has, since 1999 witnessed several shocks: the aftermath of the Asian financial crisis, the summer 1998/1999 droughts, America's Cup, and the burst of the technology bubble. All shocks create fluctuations to both the SM and NZD. These fluctuations influence various groups (and therefore companies) differently. Relationships are therefore empirically inconsistent.

Further complicating the modelling of such effects is the potential for companies to hedge exposures. This is a certain contribution for why each SM index lacked substantial exposure in NZ. Almost 30 per cent of NZ exporters hedge in the currency market.[81]

---

[81] Gibson, T. (2004). DHL Export Barometer: New Zealand Export Trends: New Zealand Trade and Enterprise.

6.2: Explanation II: Two Financial Markets but an Infinite Number of Influential Factors

It is superficial to suggest causality to only run from one market to the other. The interconnections between the two, and the world economy are numerous and complex.

Eisner (1974) commented on the difficulties a researcher faces when estimating general investment functions: "Estimation of investment functions is a tricky and difficult business and the best position for any of us in that game is one of humility." Although Eisner (1974) was describing investment of physical capital, his remark has stubbornly persisted among all investment-related literature fields, including this one.

To isolate exchange rate and SM relationships with precision, one must incorporate more facets than only the foreign exchange and money market. GDP, terms of trade, domestic and foreign growth rates (see de Roos and Russell, 1996), and business fixed investment (see Keynes, J.M., 1936, p.151)[82] are among the infinite number of influential factors that may also need consideration.

---

[82] "...daily revaluations of the Stock Exchange...inevitably exert a decisive influence on the rate of investment. For there is no sense in building up a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased..." (J.M. Keynes, 1936, p.151).

BIBLIOGRAPHY

Abdalla, I. S. and Murinde, V. (1997). Exchange rate and stock price interaction in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. *Applied Financial Economics, 7*, 25-35.

Adler, M., and Dumas, B. (1984). Exposure to currency risk: definition and measurement. *Financial Management, 13*, 41-50.

Aggarwal, R. (1981). Exchange rates and stock prices: a study of the US capital markets under floating exchange rates. *Akron Business Economic Review, 12*, 7-12.

Aggarwal, R., and Soenen, L. (1989). Managing persistent real changes in currency values: The role of multinational operating strategies. *Columbia Journal of World Business, 24*(3), 60-67.

Ajayi, R. A., and Mongoue, M. (1996). On the dynamic relation between stock prices and exchange rates. *Journal of Financial Research, 19*, 193-207.

Ajayi, R. A., Friedman, J., and Mehdian, S. M. (1998). On the relationship between stock returns and exchange rates: tests of Granger causality. *Global Finance Journal, 9*, 241-251.

Akaike, H. (1973). Information theory and the extension of the maximum likelihood principle. In B. N. Petrov and F. e. Csali (Eds.), *Proceeding of the Second International Symposium on Information Theory* (pp. 267-281). Budapest.

Alexander, T. BNZ Weekly Overview, various issues.

Allayannis, G. (1996). Exchange rate exposure revisited. *Working paper (DSWP-97-06), Darden Graduate School of Business Administration, University of Virginia.*

Allen, P.R., and Kenen, P. B. (1976). Portfolio Adjustment in Open Economies: A Comparison of Alternative Specifications. *Weltwirtschaftliches Archive, 112*(1), 33-72.

Amihud, Y. (1993). Evidence on exchange rates and the valuation of equity shares. In Y. Amihud and R. E. Levich (Eds.), *Exchange Rates and Corporate Performance*: Business One, Homewood: Irwin, IL.

Amihud, Y., and Levich, R. M. (1994). *Exchange Rates and Corporate Performance.* Washington, D.C.: BeardBooks.

Ang, Ghallab, A. (1976). The impact of U.S. devaluations on the stock prices of multinational corporations. *Journal of Business Research, 4*, 25-34.

Bahmani-Oskooee, M., and Sohrabian, A. (1992). Stock prices and the effective exchange rate of the dollar. *Applied Economics, 24*, 459-464.

Baldwin, R. (1988). Hysteresis in Import Prices: The Beachhead Effect. *Working Paper No. 2545, National Bureau of Economic Research.*

Baldwin, R., and Krugman, P. (1989). Persistent Trade Effects of Large Exchange Rate Shocks. *The Quarterly Journal of Economics, 104*(4), 635-654.

Banerjee, A., and Hendry, D. F. (1992). Testing integration and cointegration: An overview. *Oxford Bulletin of Economics and Statistics, 54*, 225-255.

Banerjee, A., Dolado, J., Galbraith, J. W., and Hendry, D. F. (1993). *Cointegration, error correction, and the econometric analysis of non-stationary data*. New York: Oxford University Press.

Bartov, E., and Bodnar, G. M. (1994). Firm valuation, earnings expectations, and the exchange-rate exposure effect. *The Journal of Finance, 49*, 1755-1786.

Beckford, G. (2005, March 9). High Kiwi Set For A Fall, But Not Yet. Cited from: *http://xtramsn.co.nz/business/o,,5011-4178828,00.html*. Retrieved March 9, 2005.

Bernhofen, D. M., Xu, P. (2000). Exchange Rates and Market Power: Evidence from the Petrochemical Industry. *Journal of International Economics, 52*(2), 283-297.

Blanchard, and Watson. (1986). *Are Business Cycles All Alike?* (Vol. 25). Chicago and London: University of Chicago Press.

Bodnar, G. M., Gentry, W. M. (1993). Exchange rate exposure and industry characteristics: evidence from Canada, Japan, and the USA. *Journal of international money and finance, 12*, 29-45.

Bollard, A., and Cullen, M. (2002). Policy Targets Agreement 2002. *Cited from www.rbnz.co.nz*. Retrieved January 19, 2006.

Branson, W. L. (1976). The Dual Roles of the Government Budget and the Balance of Payments in the Movement from Short-Run to Long-Run Equilibrium. *Quarterly Journal of Economics, 90*(3), 345-367.

Branson, W. L. (1977). Exchange Rates in the Short Run: The Dollar-Deutschemark Rate. *European Economic Review, 10*(3), 303-327.

Branson, W. L. (1984). The Specification and Influence of Asset Markets. *National Bureau of Economic Research, Inc, NBER Working Papers: 1283*.

Brookes, A., Hargreaves, D., Lucas, C., and White, B. (2000). Can hedging insulate firms from exchange rate risk? *Reserve Bank of New Zealand: Bulletin, 63*(1), 21-34.

Burke, S. P., and Hunter, J. (2005). *Modeling Non-Stationary Economic Time Series: A multivariate Approach*. New York: Palgrave Macmillan.

Campa, J. M. (1993). Entry by foreign firms in the United States under exchange rate uncertainty. *Review of Economics* and *Statistics, 75*(4), 614.

Caporale, G., and Pittis, N. (1997). Causality and Forecasting in Incomplete Systems. *Journal of Forecasting, 16*(425-437).

Caton, C. (2002, February). A rise to follow the fall: Expect the US economy to recover later in the year. *The New Zealand Investors' Monthly, 94*, 45-46.

Chamberlain, S., Howe, J. S., and Popper, H. (1997). The exchange rate exposure of U.S. and Japanese banking institutions. *Journal of Banking and Finance, 21*, 871-892.

Chan, F., Marinova, D., and McAleer, M. (2003). Modelling the Asymmetric Volatility of Electronics Patents in the USA. *CIRJE Discussion Papers, CIRJE-F-208*, 1-22.

Chatterjee, S., and Birks, S. (2001). *The New Zealand Economy: Issues and Policies, (fourth edition)*. Palmerston North: Dunmore Press.

Chen, J., Naylor, M., and Lu, X. (2004). Some insights into the foreign exchange pricing puzzle: Evidence from a small open economy. *Pacific-Basin Finance Journal, 12*, 41-64.

Chen, N., Roll, R., and Ross, S. A. (1986). Economic forces and the stock market. *Journal of Business, 59*, 383-403.

Cheung, Y.-W., and Ng, L. K. (1998). International evidence on the stock market and aggregate economic activity. *Journal of Empirical Finance, 5*, 281-296.

Choi, J. J., and Prasad, A. M. (1995). Exchange Risk Sensitivity and Its Determinants: A Firm and Industry Analysis of U.S. Multinationals. *Journal of Financial Management, 24*(3), 77-88.

Chow, E. H., Wayne, Y. L., and Solt, M. E. (1997). The Economic Exposure of U.S. Multinational Firms. *The Journal of Financial Research, 20*(2), 191-210.

Clements, M. P., and Hendry, D. F. (1995). Forecasting in cointegrated systems. *Journal of Applied Econometrics, 10*, 127-146.

Copeland, L. S. (2005). *Exchange Rates and International Finance, fourth edition*. Harlow: Addison-Wesley Publishers Ltd.

Dalziel, P., and Lattimore, R. (2000). *The New Zealand Macroeconomy: A Briefing on the Reforms, third edition*. Greenlane: Oxford University Press.

de Roos, N., and Russell, B. (1996). Towards an understanding of Australia's co-movement with foreign business cycles. *Research Discussion Paper 9607, Reserve Bank of Australia*.

DHL Export Barometer: New Zealand Export Trends. *Various Issues*.

Di Iorio, A., and Faff, R. (1999). An analysis of asymmetry in foreign currency exposure of the Australian equities market. *Journal of Multinational Financial Management, 10*, 133-159.

Dickey, D. A., and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of American Statistics Association, 74*, 427-431.

Dickey, D. A., Jansen, D. W., Thornton, D. L. (1991). A Primer on Cointegration with an Application to Money and Income. *Federal Reserve Bank of St. Louis*

Dominguez, K. M. E., Tesar, L. L. (2001). Exchange rate exposure. *NBER Working Paper Series Number 8453.*

Dornbusch, R. (1975). A portfolio balance model of the open economy. *Journal of Monetary Economics, 1,* 3-20.

Dornbusch, R. (1976). The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy. *Scandinavian Journal of Economics, 78*(2), 255-275.

Eisner. (1974). Econometric Studies of Investment Behavior: A Comment. *American Economic Review, 12,* 91-104.

Eitman, D. K., Stonehill, A. I., and Moffet, M. H. (2001). Multinational Business Finance (ninth edition).

Enders, W. (1995). *Applied Econometric Time Series.* New York: John Wiley & Sons, Inc.

Engle, R. F., Granger, C. W. J. (1987). Cointegration and error correction: representation, estimation and testing. *Econometrica, 55,* 251-276.

Engle, R. F., Hendry, D. F., and Richard, J.-F. (1983). Exogeneity. *Econometrica, 51*(2), 277-304.

Ericsson, N. R. (1992). Cointegration, Exogeneity, and Policy Analysis: An Overview. *Journal of Policy Modeling, 14*(3), 251-280.

Evans, L., Wells, G. (1983). Pierce and Haugh on Characterizations of Causality: A Re-examination. *Journal of Econometrics, 23*(3), 331-335.

EViews. (2004). *EViews 5 User's Guide.*

Fama, E. F. (1990). Stock returns, expected returns, and real activity. *Journal of Finance, 45,* 1089-1108.

Fleming, J. M. (1962). Domestic Financial Policies under Fixed and Floating Exchange Rates. *IMF Staff Papers, 9*(3), 669-679.

Franck, P., Young, A. (1972). Stock price reaction of multinational firms to exchange rate realignments. *Financial Management, 1,* 66-73.

Gavin, M. (1989). The stock market and exchange rate dynamics. *Journal of international money and finance, 8,* 181-200.

Geweke, J., Meese, R., and Dent, W. (1982). Comparing alternative tests of causality in temporal system. *Journal of Econometrics, 21,* 161-194.

Gibson, T. (2004). DHL Export Barometer: New Zealand Export Trends: New Zealand Trade and Enterprise.

Global Financial Data. Cited from: *http://www.globalfinancialdata.com* First retrieved March 30, 2005.

Girton, L., and Henderson, D. W. (1976). Financial Capital Movements and Central Bank Behaviour in a Two-Country, Short-Run Portfolio Balance. *Journal of Monetary Economics, 2*(1), 33-61.

Graham, P. (2005, June 27). Industry eager for clues in CHH sale. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3326150a13,00.html*. Retrieved June 27, 2005.

Granger, C. W. J. (1969). Investigating causal relations by econometrics models and cross spectral methods. *Econometrica, 37*, 424-438.

Granger, C. W. J. (1981). Some properties of time series data and their use in econometric model specification. *Journal of Econometrics, 16*, 121-130.

Granger, C. W. J. (1988). Models that generate trends. *Journal of Time Series Analysis, 9*, 329-343.

Granger, C. W. J., and Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics, 26*, 1045-1066.

Granger, C., Huang, B.-N., and Yang, C.-W. (2000). A bivariate causality between stock prices and exchange rates: evidence from recent Asian flu. *The Quarterly Review of Economics and Finance, 40*, 337-354.

Grant, D. (1997). *Bulls, Bears and Elephants: A History of the New Zealand Stock Exchange*. Wellington: Victoria University Press.

Grant, R., and Soenen, L. A. (1991). Conventional hedging: An inadequate response to long-term foreign exchange exposure. *Managerial Finance, 17*(4), 1-4.

Groenewold, N. (2004). Fundamental share prices and real aggregate output. *Applied Financial Economics, 14*, 651-661.

Gross, D. M., and Schmitt, N. (2000). Exchange Rate Pass-Through and Dynamic Oligopoly: An Empirical Investigation. *Journal of International Economics, 52*(1), 89-112.

Guttmann, S., and Richards, A. (March 2005). Australia's Trade Openness (Vol. Article 1).

Harvey, A. C. (1997). Trends, Cycles and Autoregressions. *Economic Journal, 107*, 192-201.

Hatemi-J, and Irandoust, M. (2002). on the causality between exchange rates and stock prices: a note. *Bulletin of Economic Research, 54*(2), 197-203.

He, J., and Ng, L. K. (1998). The foreign exchange exposure of Japanese multinational corporations. *The Journal of Finance, LIII*, 733-753.

Henderson, D.(1996, August) Economic reform: New Zealand in an International Perspective, New Zealand Business Roundtable

Hendry, D. F., and Juselius, K. (2000). Explaining Cointegration Analysis: Part 1. *The Energy Journal, 21*(1), 1-42.

Hjelm, G., and Johansson, M. W. (2005). A Monte Carlo Study of the Pitfalls in Determining Deterministic Components in Cointegrating Models. *National Institute of Economic Research: Stockholm, 27*, 691-703.

Hickey, B. (2005, April 20). Property preferred as shares slump. Cited from: *http://www.stuff.co.nz/stuff0,2106,3253878a13,00.html*. Retrieved April 20, 2005.

Hickey, B. (2005, July 16). The power of cash. *The Dominion Post,* p. C1.

Hodder, J. E. (1982). Exposure to exchange rate movements. *Journal of International Economics, 13*, 375-386.

Hume, D. (1741). Of the balance of trade. In *Essays: Moral, Political and Literary*. Oxford: Oxford University Press (reprinted 1963).

Hussain, H., and Liew, V. K.-S. (2004). Causal relationships between exchange rates and stock prices in Malaysia and Thailand during the 1997 currency crisis turmoil. *Economics Working Paper Archive, International Finance* (0405015), 1-20.

Ibrahim, M. H. (2000). Cointegration and Granger Causality Tests of Stock Price and Exchange Rate Interactions in Malaysia. *ASEAN Bulletin, 17*(1).

Ihrig, J. (2001). Exchange-rate exposure of multinationals: Focusing on exchange-rate issues. *International Finance Discussion Papers, Board of Governors of the Federal Reserve System. International Finance Discussion Papers Number 709*.

Investment Year Book Publications of New Zealand. Lower Hutt: Investment Research Group Limited. various issues.

IRG Publication, (2005). *Investment Year Book*. Lower Hutt: Investment Research Group Limited.

Johansen, S. (1988). Statistical analysis of co-integration vectors. *Journal of Economic Dynamics and Control, 12*, 231-254.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models. *Econometrica, 59*(1551-1580).

Johansen, S. (1992). Determination of cointegration rank in the presence of a linear trend. *Oxford Bulletin of Economics and Statistics, 54*, 383-397.

Johansen, S. (1995). Likelihood-Based Inference in Cointegrated Vector Autoregressive Models. *Oxford, Oxford University Press*.

Johansen, S., and Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*, 169-210.

Jorion, P. (1990). The exchange-rate exposure of U.S. multinationals. *Journal of Business, 63*(3), 331-345.

Jorion, P. (1991). The Pricing of Exchange Rate Risk in the Stock Market. *Journal of Financial and Quantitative Analysis, 26*(3), 363-376.

Kennedy, P. (2003). *A Guide to Econometrics* (5 ed.). Cambridge, Massachusetts: The MIT Press.

Khalaf, L., and Kichian, M. (2004). Pricing-to-Market Tests in Instrumental Regressions: Case of the Transportation Equipment Industry. *Empirical Economics, 29*(2), 293-309.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. London: Macmillan.

Koop, G., Pesaran, M. H., and Potter, S. M. (1996). Impulse Response Analysis in Nonlinear Multivariate Models. *Journal of Econometrics, 74*, 119-147.

Kouri, P. J. K. (1976). The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach. *Scandinavian Journal of Economics, 78*, 280-304.

Krueger, A. O. (1983). Exchange-Rate Determination. *Cambridge: Cambridge University press*.

Krugman, P. (1987). Pricing to market when the exchange rate changes. In S. W. Arndt and J. D. Richardson (Eds.), *Real Financial Linkages among Open Economies* (pp. 49-70): MIT press.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., and Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics, 5*, 159-178.

Levi, M. D. (1994). Exchange rates and the valuation of firms. In R. M. E. Levich (Ed.), *Exchange Rates and the Value of Equity Shares*: Irwin Professional Publishing, Burr Ridge.

Loudon, G. (1993). The foreign exchange operating exposure of Australian stocks. *Accounting and Finance, 33*(1), 19-32.

Ma, C. K., and Kao, G. W. (1990). On Exchange Rate Changes and Stock Price Reactions. *Journal of Business Finance and Accounting, 17*(3), 441-449.

MacKinnon, J. G. (1991). Critical values for cointegration tests. In Engle, R. and Granger, C. (Ed.), *Long-run Economic Relationships: Readings in Cointegration* (Chapter 13). Oxford: Oxford University Press.

MacKinnon, J. G., Haug, A., and Michelis, L. (1996). Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration. *Journal of Applied Econometrics, 14*(5), 563-577.

Maddala, G. S., and Kim, I.-M. (1998). *Unit Roots, Cointegration and Structural Change*. Cambridge: Cambridge University Press.

Mallison, J. (2002). *Top New Zealand Shares*. Auckland: Reed Publishing (New Zealand) Limited.

McDermott, J., Bagerie, C., Bolsover, J., Comber, S., Edwards, S., Rosborough, L., *et al.* (January 16 2006). *Market Focus: New Zealand*: Australia and New Zealand Banking Group.

Miller, S. (1991). Monetary Dynamics: an application of co-integration and error-correction modeling. *Journal of Money, Credit, and Banking, May*(139-154).

Miller, S., and Russek, F. (1990). Co-integration and error correction models: the temporal causality between government taxes and spending. *Southern Economic Journal, January*(221-229).

Mishra, A. K. (2004). Stock Market and Foreign Exchange Market in India: Are they Related? *South Asia Economic Journal, 5:2*, 209-232.

Morely, B., and Pentecost, E. J. (2000). Common trends and cycles in G-7 countries exchange rates and stock prices. *Applied Economics Letters, 7*, 7-10.

Muhammad, N., and Rasheed, A. (2003). Stock prices and exchange rates: Are they related? Evidence from South Asian Countries. *Paper presented at the 18th Annual General Meeting and Conference of the Pakistan Society of Development Economists on January 2003,* Cited from *http://www.pide.org.pk/PSDE/Stock%20Prices%20and%20Exchange%20Rates.pdf*. retrieved April20, 2005.

Mundell, R. (1962). The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability. *IMF Staff Papers, 9*(1), 70-79.

Naka, A., and Tufte, D. (1997). Examining impulse response functions in cointegrated systems. *Applied Economics, 29*, 1593-1603.

Nath, G., & Samanta, G. (2003). Dynamic Relation between Exchange Rate and Stock Prices- A Case for India. *Unpublished manuscript,* cited from *http://nse-india.com/content/press/feb2003c.pdf* retrieved April 15, 2005.

Nelson, C. R., and Plosser, C. I. (1982). Trends and random walks in macroeconomic time series: some evidence and implications. *Journal of Monetary Economics, 10*, 139-162.

New Zealand Stock Exchange: Annual Report, *various issues*

New Zealand Stock Exchange: Sharemarket Review, *various issues*

New Zealand Stockmarket Official website: www.nzx.com

New Zealand Yearbook, *various issues*

Newman, F., and Briggs, P. (2000). *Making Money on the New Zealand Sharemarket* (third ed.). Auckland: Dollars and Sense Books.

Newstalk ZB (2005a, March 10). NZ$ Could Fly Higher. Cited from: *http://xtramsn.co.nz/business/0,,5007-4182150,00.html*.

NewstalkZB. (2005b, March 30). Fuel Tax Could See Inflation Rocket. Cited from: *http://xtramsn.co.nz/business/0,,5007-4238528,00.html*.

Nieh, C.-C., and Lee, C.-F. (2001). Dynamic relationship between stock prices and exchange rates for G-7 countries. *The Quarterly Review of Economics and Finance, 41*, 477-490.

NZIER. New Zealand Institute of Economic Research: Quarterly Predictions, Various editions.

Obstfeld, M. (1980). Intermediate Imports, the Terms of Trade, and the Dynamics of the Exchange Rate and Current Account. *Journal of International Economics, 10*(4), 461-480.

Oliver, S. (2003, October 1). Currency gyrations- with investors in the crossfire. *AMP Capital Investors*.

Pagan, A. R. (1989). Twenty Years After: Econometrics 1966-1986. In B. Cornet and H. e. Tulkens (Eds.), *Contributions to Operations Research and Econometrics*. Cambridge, MA: The MIT Press.

Pagan, A. R. (2003). Report on modeling and Forecasting at the Bank of England. *Bank of England Quarterly Bulletin, Spring*(60-88).

Pan, M.-S., Fok, R. C.-W., and Liu, Y. A. (1999). Dynamic Linkages Between Exchange Rates and Stock Prices: Evidence from Pacific Rim Countries. *Shippensburg University Working Papers*.

Panckhurst, P. (2005, February 3). High dollar reels in warning. *New Zealand Herald*, p. C4.

Pannett, R. (2005, May 27). CHH shares rise 12pc. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3327090a13,00.html*.

Park, J. Y. (1990). Testing for Unit Roots and Cointegration by Variable Addition. In T. B. Fomby and G. F. Rodes (Eds.), *Advances in Econometrics* (Vol. 8, pp. 107-133): JAI Press.

Park, J. Y., and Phillips, P. C. B. (1988). Statistical inference in regressions with integrated processes: Part I. *Econometric Theory, 4*, 468-497.

Pesaran, M. H., and Shin, Y. (1996). Cointegration and the speed of convergence to equilibrium. *Journal of Econometrics, 71*, 117-143.

Pesaran, M. H., and Shin, H. (1998). Generalized Impulse Response Analysis in Linear Multivariate Models. *Economic Letters, 58*(1), 17-29.

Phillips, P. C. (1999). A Primer on Unit Root Testing. *Cowles Foundation Paper No. 972, Cowles Foundation for Research in Economics at Yale University.*

Phillips, P. C. B., and Perron, P. (1988). Testing for a unit root in time series regression. *Biometrica, 75*, 335-346.

Phylaktis, K., and Ravazzolo, F. (2000). Stock Prices and Exchange Rate Dynamics. *Paper presented at the EFMA 2000 Meeting in Athens, Cited from http://papers.ssrn.com/so13/delivery.cfm/SSRN_ID251296_code001123600.pdf?abstracid=251296* Retrieved March 22, 2005.

Pierce, D. A., and Haugh, L. D. (1976). Causality in Temporal Systems: Characterizations and a Survey. *Journal of Econometrics, 5*(3), 265-293.

Priestley, R., and Odegaard, B. A. (April, 2004). Linear and Nonlinear Exchange Rate Exposure and the Price of Exchange Rate Risk. *EFA 2002 Berlin Meetings Presented Paper, http://ssrn.com/abstract=302409.*

Priestley, R., and Odegaard, B. A. (July, 2003). Long Swings in the Dollar and the Exchange Rate Exposure of Stock Returns. Cited from: *http://ssrn.com/abstract=430382.*

Priestley, R., and Odegaard, B. A. (October, 2002). New Evidence on Exchange Rate Exposure. *Unpublished manuscript.*

Pringle, J. J. (1991). Managing foreign exchange exposure. *Journal of Applied Corporate Finance, 3*(4), 73-82.

Qiao, Y. (1996). Stock Prices and Exchange Rates: Experiences in Leading East Asian Financial Centers- Tokyo, Hong Kong and Singapore. *Singapore Economic Review, 41*, 47-56.

Ramasamy, B., and Yeung, M. (2005). The causality between stock returns and exchange rates: revisited. *Australian Economic Papers, 44*, 162-178.

Rangan, S., and Lawrence, R. Z. (1993). The Responses of U.S. Firms to Exchange Rate Fluctuations: Piercing the Corporate Veil. *Brookings Papers on Economic Activity, 0*(2), 341-379.

RBNZ. (March, 1998). The Reserve Bank of New Zealand Act 1989: Our Accountability to New Zealanders. *Cited from www.rbnz.co.nz.* Retrieved May 23, 2005.

Reserve Bank of New Zealand: Official website. Cited from www.rbnz.co.nz .

Reuters. (2005, March 11). NZD Reflects Commodity Prices- RBNZ. Cited from: *http://xtramsn.co.nz/business/0,,5011-4187437,00.html*. Retrieved March 11, 2005.

Reuters. (2006, January 23). Japanese wary of NZ dollar. *Manawatu Standard,* p. 9.

Roberts, M. J., and Tybout, J. R. (1997). The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs. *American Economic Review, 87*(4), 545-564.

Rothschild Australia Asset Management Ltd., (2000, August). Australian sharemarket update June 2000. *New Zealand Investors' Monthly, 78,* 29.

Runkle, D. E. (1987). Vector Autoregression and Reality. *Journal of Business and Economic Statistics, 5,* 437-454.

Ryan, L. (2001), Foreign Exchange and Derivatives Turnover Survey. Cited from: http://www.rbnz.govt.nz/news/2001/0109840.html Retrieved December 20, 2005.

Schwarz, G. (1978). Estimating the Dimension of a Model. *Annals of Statistics, 6,* 461-464.

Schwert, G. W. (1990). Stock Returns and Real Activity: A Century of Evidence. *The Journal of Finance, 45,* 1237-1257.

Sheeran, G. (2004, December 5). Taking a punt on a strong Kiwi dollar. *Sunday Star Times,* p. D7.

Sheeran, G. (2005, March 27). Dollar, economy weather- the fine days are over. *Sunday Star Times,* p. 4.

Shin, H., and Soenen, L. (1999). Exposure to currency risk by US multinational corporations. *Journal of Multinational Financial Management, 9,* 195-207.

Sims, C. A. (1972). Money, income and causality. *American Economic Review, 62,* 540-552.

Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica, 48,* 1-48.

Smith, C. E. (1992). Stock markets and the exchange rate: A multi-country approach. *Journal of Macroeconomics, 14,* 607-629.

Smith, L. (2004). *A Macroeconomic View of New Zealand.* NSW 2113: McGraw- Hill Higher Education.

Smyth, B., and Nandha, M. (2003). Bivariate causality between exchange rates and stock prices in South Asia. *Applied Economics Letters, 10*(11), 699-704.

Soenen, L. A., and Hennigar, E. S. (1988). An analysis of exchange rates and stock prices- The U.S. experience between 1980 and 1986. *Akron Business and Economic Review,* 7-16.

Solnik, B. (1987). Using Financial Prices to Test Exchange Rate Models: A Note. *The Journal of Finance, 42*(1), 141-149.

Sowell, T. (1995). Ethnicity and IQ. *American Spectator, 28*, 32. Cited from http://www.mugu.com/cgi-bin/Upstream/Issues/bell-curve/sowell.html retrieved March 2, 2006.

Srinivasulu, S. L. (1981). Strategic response to foreign exchange risk. *Columbia Journal of World Business, 16*(1), 13-23.

Statistics New Zealand: Key Statistics, Various quarterly issues

Statistics New Zealand Website: Cited from: http://www.stats.govt.nz/default.htm

Stavarek. (2004). Linkages between Stock Prices and Exchange Rates in the EU and the United States. *Economics Working Paper Archive, Finance* (0406006).

Steeman, M. (2005, November 26). Clipping the ticket. *The Dominion Post,* p. C1.

Stock, J. H., and Watson, M. (1988). Testing for Common Trends. *Journal of American Statistical Association, 83*, 1097-1107.

Stock, R. (2004, December 5). Strong dollar: NZ's learning to live with it. *Sunday Star Times,* p. D.

Story, M. (2000a). What's Driving our Dollar Down? *New Zealand Investors' Monthly, 80,* 31.

Story, M. (2000b, September). Investor news briefs. *New Zealand Investors' Monthly, 79,* 13.

Story, M. (2001a, January1). Economic Outlook. *New Zealand Investors' Monthly, 82,* 9.

Story, M.. (2001b). From wallflower to NZSE darling. Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp* Retrieved November 22, 2005.

Story, M. (2002, June 1). Why our dollar's shining. Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp.* Retrieved November 22, 2005.

Story, M. (2003a). The Return of the Economic Cycle. *New Zealand Investors' Monthly, 105,* 47-49.

Story, M. (2003b, December 1). Offshore markets for better value. Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp.* Retrieved November 22, 2005.

Story, M. (2004a, March 1). Wise-up to global exposure. Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp.* Retrieved November 22, 2005.

Story, M. (2004b, August 1). How to play the "managed" slowdown. Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp.* Retrieved November 22, 2005.

Stuff. (2005a, May 7). NZX trade totals $2.7b in May. Cited from: *http://stuff.co.nz/stuff/0,2106,3305895a13,00.html*. Retrieved May 7, 2005.

Stuff. (2005b, May 30). AIA to return up to $200m to shareholders. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3330796a13,00.html*. Retrieved May 30, 2005.

Stuff. (2005c, June 8). Shares or property? A question of balance. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3338583a13,00.html*. Retrieved June 8, 2005

Stuff. (2005d, November 25). Close: NZ dollar nears post float record. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3491368a6023,00.html*. Retrieved November 25, 2005

Stuff. (2006a, January 3). Economy losing its sparkle. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3528535a13,00.html*. Retrieved January 3, 2005.

Stuff. (2006b, January 4). NZX ebbs in year of takeovers. Cited from: *http://www.stuff.co.nz/stuff/0,2106,3529221a13,00.html*. Retrieved January 4, 2005.

Tahir, R., and Ghani, A. A. (2003). Relationship between exchange rates and stock prices: Empirical evidence from Bahrain's financial markets. *Unpublished manuscript*.

The Economist. (April 4, 1987), The Economist.

Toda, H. Y., and Phillips, P. C. B. (1993). Vector Autoregressions and Causality. *Econometrica, 61*(6), 1367-1393.

Treasury Report: Exchange Rate Developments and Implications. (2003). (Vol. T2003/109).

TVNZ. (2005a, April 1). Feltex slumps on downgrade. Cited from: *http://tvnz.co.nz/view/news_business_story_skin/482722%3fformat=html*. Retrieved April 1, 2005.

TVNZ. (2005b, April 4). Freight rates hurt exporters. Cited from: *http://tvnz.co.nz/view/news_business_story_skin/483221%3fformat=html*. Retrieved April 4, 2005.

TVNZ. (2005c, April 5). Commodity prices at new highs. Cited from: *http://tvnz.co.nz/view/news_business_story_skin/483501%3fformat=html*. Retrieved April 5, 2005.

TVNZ. (2005d, April 24). Now you can lay-by shares. Cited from: *http://tvnz.co.nz/view/news_business_story_skin/523762%3fformat=html*. Retrieved April 24, 2005.

TVNZ. (2005e, May 5). Warehouse looks beyond weak sales. Cited from: *http://tvnz.co.nz/view/news_business_story_skin/543743%3fformat=html*. Retrieved May 5, 2005.

TVNZ. (2005f, May 11). Fletcher shares rise on forecast. Cited from: *http://www.tvnz.co.nz/view/news_business_story_skin/545421?format=html*. Retrieved May 11, 2005.

TVNZ. (2005g, May 12). NZ's competitiveness improves. *http://tvnz.co.nz/view/news_business_story_skin/547742%3fformat=html*. Retrieved May 12 2005.

TVNZ. (2005h, May 28). Trade deficit blows out. Cited from: *http://tvnz.co.nz/view/page/411415/594516/*. Retrieved May 28, 2005.

TVNZ. (2005i, June 5). F&P moving plant to North America. Cited from: *http://tvnz.co.nz/view/page/414415/596256* .Retrieved June 5, 2005.

Vaughn, G. (2005, November 24), Hedging saves Sanford profit., Cited at http://www.stuff.co.nz/stuff/0,2106,3488988a13,00.html. Retrieved November 24, 2005.

Vaughan, G. (2006). Downturn fears may be factor in top stock picks. *The Dominion Post,* p. C1.

Watsham, T. J., and Parramore, K. (1997). *Quantitative Methods in Finance* (1st ed.). London: International Thompson Business Press.

Watson, C. (2004). *Risk, Return and Reality: An introduction to portfolio investing.* Tauranga: Bays Print Management.

Watt, L. (2002). A Good Year to Come? *New Zealand Investors' Monthly, 93,* 18-25.

Weir, J. (2005, August 6). Bull run slows to canter. *The Dominion Post,* p. C3.

White, H. (1980). Heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity. *Econometrica, 48,* 721-746.

Wilson, C. (May 2004). Coping with the pressure of the rising dollar. *Bright, 4,* 6-8.

Wooldridge, J. M. (2003). *Introductory Econometrics, A Modern Approach.* Ohio: Thompson South-Western.

Wright, C. (2005, July 16). China and India threat to ASX. *The Dominion Post,* p. C9.

Wu, Y. (2000). Stock Prices and Exchange Rates in a VEC Model- The Case of Singapore in the 1990s. *Journal of Economics and Finance, 24*(3), 260-274.

Wu, Y. (2001). Exchange rates, stock prices, and money markets: evidence from Singapore. *Journal of Asian Economics, 12,* 445-458.

Yang, S.-Y. (2003). Price and Volatility Spillovers between Stock Prices and Exchange Rates: Empirical Evidence from the G-7 Countries. *International Journal of Business and Economics, 3*(2), 139-153.

Yarwood, V. (2005). Are our capital markets dying? Cited from: *http://www.equity.co.nz/scripts/mgarchives.asp* Retrieved October 28, 2005.

Yu, Q. (1997). Stock prices and exchange rates: Experiences in leading East Asian financial centers: Tokyo, Hong Kong and Singapore. *Singapore Economic Review, 41*, 47-56.

APPENDICIES

Appendix I: Critical Values for each Stationarity Test

Test type	Lag length	Sig. level	constant and trend	constant, no trend	No constant, no trend
ADF	$0,1,2$[83]	1%	-3.986	-3.450	-2.572
ADF	0,1,2	5%	-3.423	-2.870	-1.942
ADF	0,1,2	10%	-3.135	-2.571	-1.616
KPSS	-	1%	0.216	0.739	-
KPSS	-	5%	0.146	0.463	-
KPSS	-	10%	0.119	0.347	-
PP	-	1%	-3.985	-3.450	-2.572
PP	-	5%	-3.423	-2.870	-1.942
PP	-	10%	-3.135	-2.571	-1.616

Source: Mackinnon *et al.* (1996).

---

[83] To three decimal places the critical values round to equal values, independent of lag length. These are different where the degree of accuracy is increased.

Appendix II: Chi-Square(1) Serial Correlation Results
for each VAR(2)

	Test-type	I	II	III	IV
SM	LM	0.077	0.0119	0.029	0.063
	F	0.074	0.01134	0.028	0.060
NZD/USD	LM	0.099	0.153	0.432	0.334
	F	0.094	0.145	0.411	0.318
NZD/AUD	LM	0.055	0.630	0.008	0.000
	F	0.053	0.599	0.007	0.000
NZD/JPY	LM	0.001	0.257	0.103	0.047
	F	0.001	0.244	0.964	0.045
NZD/GBP	LM	0.360	0.367	0.965	0.762
	F	0.343	0.348	0.919	0.725
NZD/EUR	LM	1.035	1.603	0.468	0.647
	F	0.989	1.529	0.445	0.615
BB	LM	2.979*	3.148*	2.758*	3.125*
	F	2.813*	2.988*	2.609*	2.995*

Appendix III: Companies within each index, as of July 1, 2005

	NZSX50 and NZSXALL	MidCap30	NZSX10
AIR	√		
AMP	√	√	
APT	√	√	
APN	√	√	
AIA	√		√
ANZ	√	√	
AXA	√	√	
BRY	√	√	
CNZ	√	√	
CAH	√		√
CAV	√	√	
CEN	√		√
FTX	√	√	
FPA	√		√
FPH	√		√
FBU	√		√
FRE	√	√	
GPG	√		
HLG	√	√	
HBY	√	√	
IFT	√		√
ING	√		
KIP	√		√
LNN	√	√	
MGP	√		
MFT	√	√	
MHI	√		
NOG	√		
NGC	√	√	
NPX	√		
POT	√	√	
POA	√	√	
PMN	√		
PFI	√	√	
PPL	√	√	

Part II	NZSX50 and NZSXALL	MidCap30	NZSX10
RBD	√	√	
RBC	√		
RYM	√	√	
SAN	√	√	
SKC	√		√
SKT	√	√	
STU	√	√	
TEL	√		√
TLS	√	√	
TEN	√	√	
THL	√		
TWR	√	√	
TPW	√	√	
WHS	√	√	
WAM	√	√	

Appendix IV: Results from the Pantula Principle[84]

| Sharemarket	Coint Rank	Case 1	Case 2	Case 3	Case 4	Case 5
NZSX10	0	-55.964	-55.964	-55.935	-55.935	-55.910
	1	-56.080	-56.077	-56.048	-56.042	-56.016
	2	-56.096	-56.111	-56.087	-56.081	-56.061
	3	-56.100	**-56.118***	-56.100	-56.093	-56.076
	4	-56.084	-56.096	-56.084	-56.071	-56.061
	5	-56.038	-56.044	-56.035	-56.016	-56.010
	6	-55.961	-55.982	-55.978	-55.956	-55.952
	7	-55.879	-55.896	-55.896	-55.889	-55.889
MidCap30	0	-56.643	-56.639	-56.639	-56.643	-56.613
	1	-56.703	-56.717	-56.691	-56.697	-56.693
	2	-56.731	-56.762	-56.735	-56.740	-56.741
	3	-56.718	**-56.771***	-56.733	-56.732	-56.754
	4	-56.682	-56.750	-56.719	-56.712	-56.739
	5	-56.629	-56.707	-56.681	-56.669	-56.702
	6	-56.569	-56.643	-56.622	-56.607	-56.640
	7	-56.486	-56.569	-56.540	-56.540	-56.569
NZSX50	0	-56.348	-56.335	-56.335	-56.348	-56.310
	1	-56.411	-56.421	-56.390	-56.407	-56.396
	2	-56.439	-56.460	-56.433	-56.445	-56.440
	3	-56.425	**-56.470***	-56.438	-56.445	-56.455
	4	-56.381	-56.449	-56.423	-56.423	-56.440
	5	-56.326	-56.394	-56.373	-56.371	-56.390
	6	-56.259	-56.329	-56.311	-56.305	-56.329
	7	-56.176	-56.260	-56.229	-56.229	-56.260
NZSXALL	0	-56.502	-56.493	-56.493	-56.502	-56.469
	1	-56.563	-56.586	-56.546	-56.560	-56.562
	2	-56.589	-56.623	-56.588	-56.596	-56.603
	3	-56.573	**-56.634***	-56.589	-56.592	-56.619
	4	-56.530	-56.611	-56.572	-56.569	-56.602
	5	-56.475	-56.556	-56.524	-56.519	-56.552
	6	-56.411	-56.492	-56.462	-56.452	-56.491
	7	-56.329	-56.423	-56.381	-56.381	-56.423

---

[84] Estimation was done under EViews 5.0. Critical values (at the 5 per cent level) were taken from MacKinnon-Haug-Michelis (1999) and compared with the statistics, to find Case 2 to be the optimal case number. This also implies 3 cointegrating relationships within each system (Refer to Johansen 1995, pp. 80-84 for a description of each case number).

Appendix V: Persistence Profiles

Model I
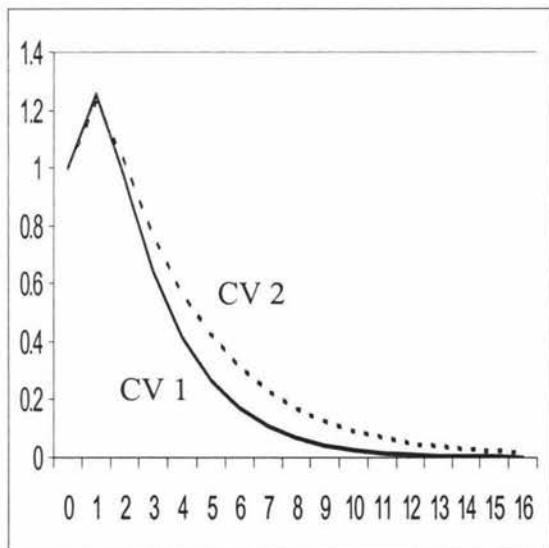
Model II
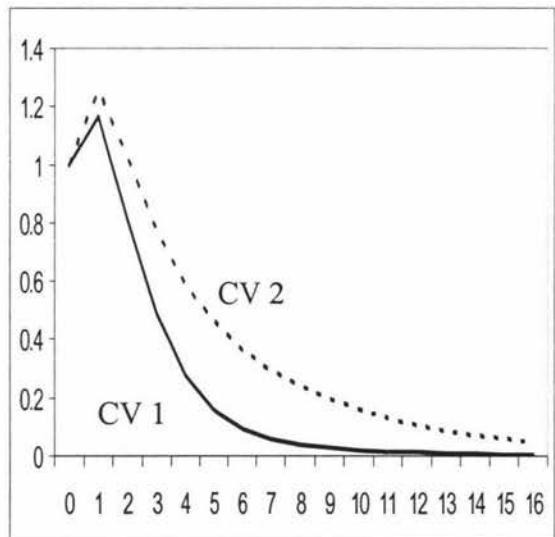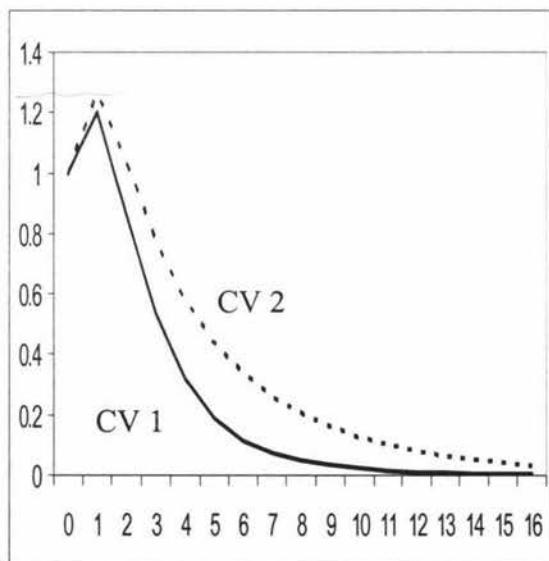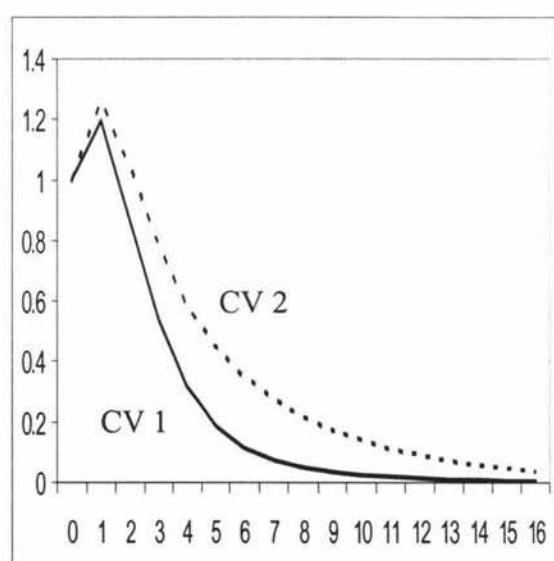
Model III

Model IV

Appendix VI: Generalised Impulse Response

Function Shock Values

	Model I		Model II		Model III		Model IV	
	NZSX10 SHOCK%	Max % Impact	MidCap30 SHOCK%	Max % Impact	NZSX50 SHOCK%	Max % Impact	NZSXALL SHOCK%	Max % Impact
USD	0.19	0.14	0.15	0.19	0.17	0.17	0.18	0.18
AUD	0.13	-0.11	0.17	-0.05	0.15	-0.03	0.12	-0.02
JPY	0.30	0.24	0.20	0.18	0.27	0.23	0.27	0.25
GBP	0.22	0.16	0.17	0.18	0.20	0.20	0.21	0.21
EUR	0.19	0.15	0.15	0.16	0.18	0.17	0.19	0.18
BB	0.16	0.10	0.07	0.18	0.13	0.13	0.13	0.16