A time-varying beta approach to measuring New Zealand's country risk

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Abstract

Purpose – The purpose of this paper is to estimate New Zealand's country level risk using a time-varying country beta market model. Country beta is allowed to vary as a function of several macro-economic variables, including the net government overseas borrowing, 90-day bill rate, ten-year bill rate, wool price, trade-weighted index, manufacturers' price index, retail trade, current account balance, and money supply.

Design/methodology/approach – Multivariate regression analysis is used to test the relation between country volatility and the macro-economic variables for the period September 1985 to March 2000.

Findings – It is found that the US dollar exchange rate (USD) and the monetary conditions index (MCI) have a significant impact on New Zealand's country beta. The temporal variance of New Zealand's country beta displayed a great deal of volatility prior to and immediately following the 1987 stock market crash. The beta was far less volatile during the 1990s.

Research limitations/implications – The variable set is restricted by the availability of data concerning the key macro-economic statistics.

Practical implications – Risk at the country level is of increasing importance in the evaluation of offshore investments. Practical implications relate to the evaluation of investments in foreign markets, specifically the appropriate cost of capital, given increased integration of financial markets.

Originality/value – The study provides a better appreciation of the relationship between the country beta and several macro-economic variables that has not been applied to the New Zealand economy before.

Keywords International investments, Risk analysis, New Zealand

Paper type Research paper

1. Introduction

A significant volume of recent finance literature has focused on the globalisation of the world's financial markets. The implications of this increased integration have only recently begun to be explored. One such implication relates to investments in foreign markets, specifically the appropriate cost of capital calculation given increased integration. Risk at the country level is of increasing importance in the evaluation of offshore investments. The valuation of offshore projects requiring cost of capital estimates is an area where companies would consider such country risk. Rightly or wrongly, offshore projects are generally viewed as being of greater risk than comparable local investments, consequently contributing less to shareholder value.

Risk at the country level has been extensively covered in the literature. Harvey (1991), Harvey and Zhou (1993), Erb *et al.* (1996a, 1996b), and Bekaert *et al.* (1996) all propose varying country level risk approaches for evaluating costs of capital in foreign

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markets. Erb *et al.* (1996a, 1996b) assert that country risk can be captured by country credit ratings, which are dependent on a combination of financial, political, and economic variables. Gangemi *et al.* (2000) model Australia's country risk using the country beta approach for the period 1974 to 1994. Country beta is allowed to vary as a function of several macroeconomic variables. Their variable set includes net government overseas borrowing, 90-day bill rate, ten-year bill rate, wool price, trade-weighted index, manufacturers' price index, retail trade, current account balance, and money supply. It was found that only the trade-weighted index had a significant impact on Australia's country beta over the sample period. From their analysis a time-varying country beta model was developed revealing that a single unit increase in the trade-weighted index resulted in a 0.0586 increase in Australia's country beta.

This paper examines New Zealand's country risk from a country beta approach similar in nature to that of Gangemi *et al.* (2000). New Zealand offers an interesting opportunity to apply the country beta methodology. It represents a small open market economy and as such is significantly affected by macroeconomic variables of both domestic and international origin. The financial reforms of the 1980s have meant that the New Zealand market is highly integrated with other foreign markets, with tendencies to react sharply to news from the US and other major equity markets.

To give New Zealand's country beta increased explanatory power it is allowed to vary according to a set of open economy macroeconomic variables. The set of macroeconomic variables examined encompasses major domestic and international influences on the New Zealand economy, including factors representing inflation, exchange rates, interest rates, and monetary policy. Consistent with efficient markets theory that publicly available information is immediately priced into securities, only the unanticipated components of the variables are modelled. The primary contribution of this paper is to examine country risk using the country beta approach in the New Zealand context. This type of analysis has not been applied to the New Zealand economy before. The period under study is from September 1985 to March 2000. Adjustments are made to the model in order to account for the influence of the October 1987 stock market crash, which was particularly severe in New Zealand.

The remainder of this paper is organised as follows. Section 2 outlines the data sources. Section 3 examines the macroeconomic factors influencing the New Zealand country beta. Section 4 looks at the anticipated impact of these factors on the country beta. Section 5 explains the methodology employed. Section 6 discusses the results of the empirical analysis and Section 7 concludes the paper.

2. Data

Monthly data for all variables were collected for the sample period from September 1985 to March 2000. The sample period begins at a time after the New Zealand currency was floated and also avoids much of the economic and financial restructuring that occurred in New Zealand during the early 1980s. The proxy used for the return on the New Zealand stock market is the Barclays index, which is a capital adjusted size weighted index representing the forty largest companies listed on the New Zealand stock exchange. The Barclays index was abandoned in 1992 in favour of the New Zealand Stock Exchange (NZSE) 40 capital index. Thus this index is used in the latter half of the sample period. The two indices are virtually identical, i.e. there is no break in the return series during the time of the change over. The world stock index is represented by the Morgan Stanley capital international (MSCI) global stock index, which is also a capital index.

Data concerning the macroeconomic variables were collected from a variety of sources. The ANZ commodity price index was obtained from the ANZ Bank website[1]. The net trade balance, exchange rate, money supply, food price index, trade-weighted index, and the monetary conditions index were all sourced from Statistics New Zealand. Short-term and long-term interest rates were taken from the Reserve Bank of New Zealand website[2]. Current account balances and GDP statistics for countries other than New Zealand were obtained from World Bank tables. Information on New Zealand trade activity was sourced from Statistics New Zealand via the dx PCINFOS database. The figures used for the trade-weighted index and both long- and short-term interest rates are month-end averages for the specified period.

3. Economic variables influencing country beta

There is a significant volume of literature regarding how equity returns are affected by macroeconomic announcements. Reviewing the relevant literature provides us with a broad array of potential variables. Ultimately the precise selection of variables is somewhat arbitrary and dependent to a degree on the availability of data. The variable set chosen should be representative of both domestic and international influences. The variable set is restricted by the availability of data concerning key macroeconomic statistics. With these restrictions in mind, Table I presents the macroeconomic variables examined in this study.

The ANZ commodity price index is a weighted index of 16 key export products in New Zealand. Prior studies have identified individual export variables, including the price of wool for Australia and crude oil prices for the US. The commodity price index used in this study includes a wide range of export products and is weighted according to their importance. Given that to a large extent New Zealand is still a commodity-based economy this index predominantly features dairy, meat, and forestry prices. It is considered that this variable will better represent the contribution of export price volatility to New Zealand's country beta than any single commodity price index. In a similar vein, the seasonally adjusted trade balance indicates how much more New Zealand exports than it imports. Thus, negative figures are indicative of a net outflow of funds in the trade sector. The trade balance is a broad indicator of New Zealand spending patterns and may also relate to foreign debt levels.

Monthly mid rates for the New Zealand dollar against the Australian and US dollars are included as these two countries are New Zealand's two most significant export markets. Exchange rate fluctuations are of significant concern to New Zealand exporters despite the presence of a well-established forward exchange market.

Symbol	Macroeconomic variable
COMM	ANZ commodity price index
TRADE	Net trade (fob-cif)
USD	USD/NZD exchange rate
AUD	AUD/NZD exchange rate
MONEY	M3 money supply
BILLS	90-day bill yield
BONDS	10-year government bond yield
FPI	Food price index
MCI	Monetary conditions index
TWI	Trade-weighted index

Table I.
Potential macroeconomic influences on country beta

Longer-term exchange rate trends tend to reflect differences between inflation in New Zealand and inflation in key export markets. The impact of exchange rate volatility on country risk will depend on how domestic and foreign investors in the New Zealand equity market react to currency fluctuations. The trade-weighted index (TWI) is a basket of currencies weighted according to their importance in the New Zealand export/import market. Gangemi *et al.* (2000) found that the Australian TWI was an explanatory variable in their country beta model. It is anticipated that the same will apply in the New Zealand economy.

The inclusion of the broad M3 money supply reflects importance of monetary policy to the New Zealand government. Short-term and long-term interest rates are indicative of this monetary policy and can also be affected by national debt through the current account deficit. The food price index is included as a measure of inflation. The consumer price index is only available on a monthly basis, however quarterly FPI figures are almost perfectly[3] correlated with quarterly CPI figures. Inflation affects long-term exchange rate trends and is thus considered important in this study.

The monetary conditions index (MCI) is released by the government and is designed to give the public and financial markets a broad indication of the anticipated impact of interest rates and exchange rates on medium-term inflation.

4. Anticipated impact of macroeconomic variables

Prior to examining the results of the empirical analysis, some predictions will be formulated regarding the anticipated signs on the macroeconomic variables. This is a difficult task as this research is somewhat exploratory in nature in the New Zealand context at least. This difficulty is highlighted by the fact that both Abell and Krueger (1989) and Groenewold and Fraser (1997) avoid the prediction issue. The degree of linkage between New Zealand's macroeconomic environment and equity markets is not known. Whilst the impact of these variables on the general economy is relatively simple to predict, the consequent effect on the equity markets and beta in particular is a far more difficult process. Some general comments are possible however.

With regard to the exchange rate variables USD, AUD, and TWI, any prediction is contingent on the role of importing/exporting activity across the country. As a means of evaluation, Figure 1 displays the growth in the New Zealand trade sector over the sample period. The figure highlights the increasing value of the traded goods sector in New Zealand during the period under study. The apparent trend is that New Zealand's

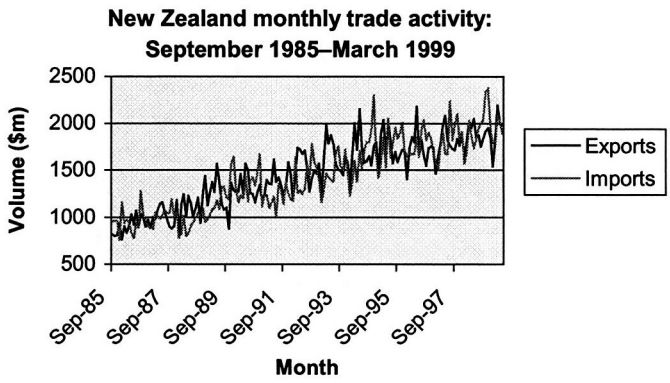

Figure 1.
New Zealand's monthly trade activity 1985-1999

trade activity has steadily increased over the sample period. However, in order to gauge the relative importance of the trade sector to the New Zealand economy additional comparisons must be made.

Figure 2 illustrates the openness of selected developed economies over the sample period. Openness is naively defined as the value of exports plus imports over total GDP.

Figure 2 confirms earlier statements regarding the openness of the New Zealand economy relative to other developed economies. New Zealand is the most open of the five countries reported over the majority of the sample period. Additionally, there is an upward trend through the 1990s for New Zealand, suggesting that the trade sector is becoming increasingly important. The key implication of Figures 1 and 2 is that trade related macroeconomic variables should have a significant impact on New Zealand's country risk.

Formulating a single prediction for the role of trade related variables is problematic given the increasing importance of the trade sector over the sample period. Compounding the difficulty further is the fact that the exchange rate sensitivity of firms will be of opposite signs depending on whether the firm is a net exporter or importer. An appreciation of the home currency has a positive effect for importers and a negative effect for exporters. In this study these effects are supposed to be captured by a beta risk measure generated by a country index, therefore, they are likely to become confounded. However it is expected that the TWI, USD, and AUD variables will all yield positive coefficients, in line with the significantly positive result found by Gangemi *et al.* (2000) for the Australian TWI. This implies that an appreciation in the New Zealand dollar leads to an increase in New Zealand's country risk as measured by country beta.

The likely signs of the interest rate variables, BILLS and BONDS, depend on the likely reaction of the stock market to changes in short and long-term interest rates. Consistent with the notion that downside risk is of considerably more concern to investors than upside risk, it is predicted that only increases in interest rates will have an effect on country risk. This is related to the perceived link between interest rates and inflation and the high-risk environment apparent during the latter half of the 1980s, when high interest rates were the result of an ever increasing inflation rate. Therefore, the signs of the interest rate variables should be positive meaning that an unanticipated increase in interest rates will result in an increase in country beta. Similarly, the sign of the FPI variable should also be positive on the premise that unexpected increases in inflation are likely to increase New Zealand's country risk.

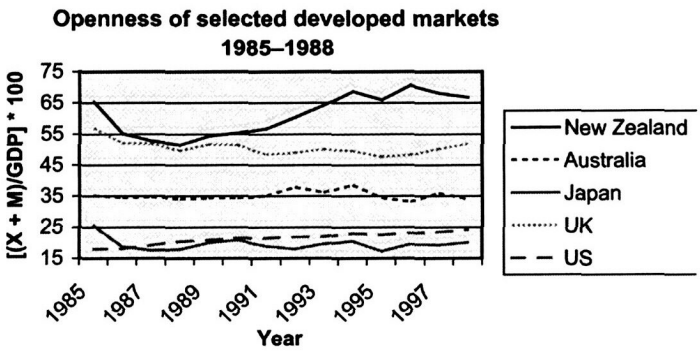

Figure 2.
Openness of selected developed nations 1985-1988

Making a prediction about the anticipated impact of the MCI variable is daunting task given the wide array of influences contributing to this indicative statistic. Equally difficult to predict are the expected signs of the TRADE and MONEY variables. Therefore, as in Abell and Krueger (1989), these variables are left unspecified rather than attempting to make unfounded predictions.

5. Methodology

Unanticipated components of variables

The efficient market hypothesis implies that the stock market will only react to the unanticipated components of economic variables. If the concept of an efficient financial market, in the semi-strong form at least, is accepted then this study must identify the unanticipated components of the time series economic data. In order to isolate this unexpected component, autoregressive integrated moving average (ARIMA) models are fitted to each of the economic variables. The software forecast ProXE is used and all series are first differenced and the TRADE series are adjusted for seasonality.

The use of unanticipated macroeconomic variables, as discussed by Gangemi *et al.* (2000) has the additional advantage of minimising multi-collinearity among certain highly correlated macroeconomic variables. Indeed, the highest correlation coefficients are between BILLS and BONDS, and USD and AUD, 0.58 and 0.55, respectively. Of the 45 pairs of correlations, only four are more than three.

Constant country beta market model

The process of measuring country risk begins with a standard unconditional country beta market model as represented by:

$$R_{NZ,t} = a + bR_{WOR,t} + e_t \tag{1}$$

In this model $R_{NZ,t}$ is the return on the New Zealand stock market index, a and b are constatns, $R_{WOR,t}$ is the return on the global stock index, and e_t is the residual error from the model. The sample period for this study includes the October 1987 stock market crash. Such a significant event requires an adjustment to the proposed model. The New Zealand market was hit particularly hard and subsequently recovered very slowly from the crash. Roll (1988) investigates the impact of the crash on 23 developed equity markets. For the whole of 1987 the New Zealand market exhibited the poorest returns out of the sample countries. For the month of October 1987, New Zealand exhibited the seventh and sixth worst performance in New Zealand and US currency respectively. It is expected that the crash would have had a significant impact on country beta. Equation 1 is thus modified to remove the crash influence. Accordingly, equation 2 is presented.

$$R_{NZ,t} = a + bR_{WOR,t} + c\delta R_{WOR,t} + e_t \tag{2}$$

where c is a constant and δ is a dummy variable assuming a value of one in October 1987 and zero otherwise.

Time varying country beta model

The presence and impact of business cycles caused by a variety of macroeconomic influences is a key reason behind the notion of a time varying country beta as opposed to a static beta. The effects of business cycles on the risk/return relationship are

highlighted in the literature by Fama and French (1989), Ferson and Harvey (1991), and McQueen and Roley (1993). These ideas can easily be extended to an international setting. It is argued here that a set of macroeconomic factors, thought to represent the influence of business cycles, may induce a time varying country beta in New Zealand. The time varying beta model used in this study is expressed as equation 3.

$$\beta_t = b_0 + b_1 COMM_t + b_2 TRADE_t + b_3 USD_t + b_4 AUD_t + b_5 MONEY_t + b_6 BILLS_t + b_7 BONDS_t + b_8 FPI_t + b_9 MCI_t + b_{10} TWI_t + u_t \quad (3)$$

All variables in equation 3 are defined as their unexpected components. The variables represented by b_k explain the sensitivity of a specific macroeconomic factor to the overall country beta. The time varying model of beta cannot be directly estimated because β is unable to be directly observed. However, returning to the form of equation 2, a general time varying beta model can be proposed.

$$R_{NZ} = a + \beta R_{WOR} + c\delta R_{WOR} + e_t \quad (4)$$

If equation 3 is substituted for β in equation 4, equation 5 results:

$$\begin{aligned} R_{NZ} = a &+ b_0 R_{WOR} + b_1 COMM \cdot R_{WOR} + b_2 TRADE \cdot R_{WOR} \\ &+ b_3 USD \cdot R_{WOR} + b_4 AUD \cdot R_{WOR} + b_5 MONEY \cdot R_{WOR} \\ &+ b_6 BILLS \cdot R_{WOR} + b_7 BONDS \cdot R_{WOR} + b_8 FPI \cdot R_{WOR} \\ &+ b_9 MCI \cdot R_{WOR} + b_{10} TWI \cdot R_{WOR} + c\delta \cdot R_{WOR} + \varepsilon_t \end{aligned} \quad (5)$$

Equation 5 is now entirely in terms of observable variables. The estimation of this equation will indirectly determine the parameter estimates in equation 3.

6. Empirical findings and discussions

The results for the simple regression of the return on the New Zealand stock market vs the return on the world index as given in equation 1, are presented in Table II, Panel A. This shows that the simple model was found to be significant in explaining New Zealand country returns. New Zealand's estimated world beta of 1.0450 is statistically significant at the one per cent level. This figure compares relatively well with Erb *et al.* (1996b), who found a five-year historical beta for New Zealand of 0.89 for the period 1990-95 using monthly data. The difference can be explained by the extended sample period used in the current paper.

As discussed previously, in an effort to improve the explanatory power of the model a dummy variable is included to account for the October 1987 stock market crash. Table II, Panel B presents the results of the regression of equation 2. When the dummy for October 1987 is included the estimated model improves significantly. The coefficient for the dummy variable is highly significant and the coefficient for the world return also remains highly significant. Similar to the previous case the CUSUM test is indicative of stable parameters.

Table II, Panel C reports the results for the comprehensive specification of the economic variable market model given in equation 3. The estimated regression of the model including all ten macroeconomic variables produces no significant coefficients on the explanatory variables. The coefficient for the world return remains significant, however the rest are not, including the crash dummy. The model passes the CUSUM

Variables	Panel A	Panel B	Panel C	Panel D
Constant	−0.0038	−0.0020	−0.0019	−0.0020
	(−2.1160)*	(−1.1787)	(−1.1067)	(−1.2313)
R_{WOR}	1.0450	0.7853	0.7862	0.7630
	(10.0783)**	(7.4547)**	(7.1852)**	(7.3850)**
δR_{WOR}		1.4862	−0.3263	
		(5.7550)**	(−0.4025)	
COM R_{WOR}			0.4421	
			(0.1109)	
TRADE R_{WOR}			0.0008	
			(1.0003)	
USD R_{WOR}			16.5784	11.7912
			(1.6097)	(3.1638)**
AUD R_{WOR}			−1.2469	
			(−0.1810)	
MONEY R_{WOR}			0.0001	
			(0.8142)	
BILLS R_{WOR}			2.1228	
			(0.6311)	
BONDS R_{WOR}			0.0034	
			(0.0097)	
FPI R_{WOR}			0.0011	
			(0.1464)	
TWI R_{WOR}			0.4329	
			(0.3047)	
MCI R_{WOR}			−0.0038	−0.0024
			(−1.4648)	(−4.4425)**
Adjusted R^2	0.3676	0.4671	0.4652	0.4861
D-W	1.6181	1.7400	1.8033	1.7794
White-Heteroskedasticity test	76.2508	0.2982	0.4097	0.3987
(p-value)	(0.0000)**	(0.5850)	(0.5220)	(0.5280)

Notes: 174 observations used for estimation from 1985M10 to 2000M3[4]; * and ** denote statistical significance at 5 per cent and 1 per cent respectively

Estimated models are:

Panel A: $R_{NZ,t} = a + bR_{WOR,t} + e_t$

Panel B: $R_{NZ,t} = a + bR_{WOR,t} + c\delta R_{WOR,t} + e_t$

Panel C: $R_{NZ} = a + b_0 R_{WOR} + b_1 COMM \cdot R_{WOR} + b_2 TRADE \cdot R_{WOR} + b_3 USD \cdot R_{WOR} + b_4 AUD \cdot R_{WOR} + b_5 MONEY \cdot R_{WOR} + b_6 BILLS \cdot R_{WOR} + b_7 BONDS \cdot R_{WOR} + b_8 FPI \cdot R_{WOR} + b_9 MCI \cdot R_{WOR} + b_{10} TWI \cdot R_{WOR} + c\delta \cdot R_{WOR} + \varepsilon_t$

Panel D: $\beta_t = b'_0 + b'_3\, USD_t + b'_9\, MCI_t + u'_t$

Table II.
Modelling New Zealand country beta

test that is indicative of stability of parameters of the model and has a relatively high adjusted *R-squared* of 0.4652. However, given that none of the macroeconomic variables are significant this model is of little use in its current form. It is likely that some of the variables in the above regression interact with each other over time. Consequently a variable deletion process is followed in order to generate a more parsimonious model with exogenous variables of greater significance. The procedure used computes the log-likelihood ratio statistic for testing zero restrictions on the coefficients of a sub-set of deterministic or exogenous variables in the regression

equation. It simply tests the validity of deleting one or more of the exogenous variables from the equation. As the macroeconomic variables interact with each other, the final equation may not necessarily be unique. This problem was avoided by first deleting the variables that were farthest from being significant. Once those variables were eliminated a number of different permutations for deleting variables were run until the final equation emerged.

This procedure virtually ensures a unique, statistically significant model. The result from this exercise leads to a time-varying beta model presented in equation 4:

$$\beta_t = b'_0 + b'_3 USD_t + b'_9 MCI_t + u'_t \quad (4)$$

The estimated results of this model are reported in Table II, Panel D. This indicates that the two explanatory variables left following the variable deletion process are highly significant. The model passes all four diagnostic tests and the *R-squared* value indicates that this model explains 50.23 per cent of the variation in New Zealand returns. The CUSUM test reveals that the parameters are stable. Translating the results of the regression in a country beta framework, the base value for New Zealand's beta is 0.7630. This figure is modified in a positive direction by an appreciation in the USD/NZD exchange rate and in a negative direction by a positive shift in the MCI. The model indicates that an increase of one cent in the USD/NZD rate leads to an increase in beta of 0.1179 and a one hundred unit increase in the MCI leads to a decrease in beta of 0.2448.

Equation 4 is used to produce the plot in Figure 3 of New Zealand's country beta over the sample period. Figure 3 clearly shows a great deal of variance in the early part of the sample, whereas the beta from 1990 onwards is relatively stable. The October 1987 stock market crash is the largest departure from normality with a point beta of 2.2633. This compares very well with the estimate given by equation 2 of 2.2715. Figures 4(a) and (b) divide the reported betas into pre-1990 and post-1990 subsets in order to get a better picture of the variance in beta over time.

Table III displays the summary statistics for the conditional beta series produced in Figures 3 and 4.

From Table III, it can be seen that New Zealand's average time-varying beta for the full sample period is 0.7642. This is very close to the point estimate of 0.7853 reported earlier. It is apparent that the point estimate accurately represents the mean effect of beta over the sample period; it ignores the significant time variation in New Zealand's country beta. When the sample is divided into the high variance and low variance periods it can be seen that several outlier betas are the cause behind the higher average

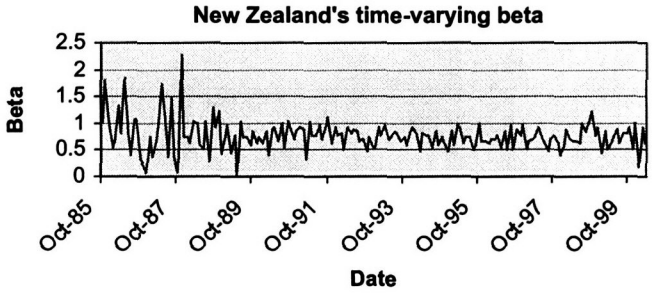

Figure 3.
New Zealand's time-varying beta

beta for the high variance period. Whilst the mean beta for the pre-1990 period is 0.8163 the median value is only 0.7424. The standard deviation of the pre-1990 beta is 0.4598 compared to 0.1744 for the post-1990 period. This difference can be attributed to the turbulent environment in the New Zealand economy in the years leading up to and immediately following the 1987 stock market crash.

As reported in the results for the regression of equation 4, the base value for New Zealand's beta is 0.7630. This is slightly lower than the beta calculated by Erb *et al.* (1996b) for New Zealand of 0.89. The betas for a sample of comparable markets are reported in Table IV. The betas given are for the 1990-1995 period. New Zealand's beta is on the low side when compared to markets of similar size though very close to that of Austria.

Following the variable deletion process explained previously, the question of why only two of the original ten variables were included in the final model arises. It must firstly be pointed out that prior authors have found the relationship between stock returns and the macroeconomic environment to be tenuous at best. The results in this paper clearly show this important link, at least in the case of the two significant variables – the USD/NZD rate and the MCI index. The fact that the MCI is representative of a variety of different macroeconomic influences reinforces the relationship in the New Zealand case. The papers that examined multiple factors either found no significant factors or just one[5]. Most recently, Gangemi *et al.* (2000) found that only the trade-weighted index had any explanatory power over Australian returns.

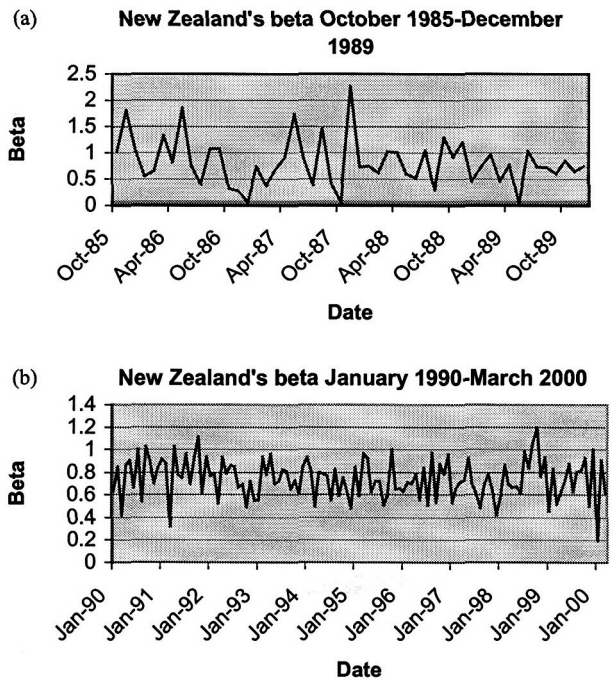

Figure 4.
(a) New Zealand's time-varying beta October 1985-December 1989; (b) New Zealand's time-varying beta January 1990-March 2000

What is of further interest is why the USD/NZD rate is a significant explanatory variable while the AUD/NZD rate and the TWI variables are not. It is a well-know empirical fact that the AUD/NZD rate and the USD/NZD rate are reasonably closely correlated. Therefore, it would stand to reason that the AUD/NZD rate would also be an explanatory variable. One possible explanation is that subtle differences in the cross movements between the two currencies are to blame for the insignificance of the AUD/NZD variable. Alternately, it could be implied that the AUD/NZD rate is more predictable than the USD/NZD rate, given that this study uses the unanticipated components of macroeconomic variables. The TWI is also highly correlated with the USD/NZD rate. This is understandable given that the main component of the TWI is the USD/NZD exchange rate. However, a similar situation to the AUD/NZD rate case arises in that the TWI may be more predictable than the USD/AUD rate.

In order to understand why the MCI is an important explanatory variable in New Zealand, the calculation method used in the creation of this index must be examined. Once every three months the Reserve Bank of New Zealand completes a comprehensive projection of the New Zealand economy and of inflation for a period of two or three years[6]. That projection takes into account all the information available to the reserve bank at that time – the official statistics covering GDP, prices, wages, employment, imports, and exports; data collected by the reserve bank on money and credit aggregates, and the path of interest and exchange rates; survey data examining business and consumer confidence; and the views expressed to the reserve bank, formally and informally, about individual businesses and the economy. At the end of this process, the reserve bank reaches a view on how firm monetary conditions need to keep inflation moving towards the middle part of the zero to three per cent inflation target agreed to with the New Zealand government. The MCI is an expression of this view.

It is evident from the above description that the MCI reflects a wide variety of macroeconomic influences. Thus, even though monthly data on GDP, wages,

	Full sample	Pre-1990	Post-1990
Mean	0.7642	0.8163	0.7426
Median	0.7420	0.7424	0.7307
Maximum	2.2633	2.2633	1.1972
Minimum	0.0288	0.0288	0.1960
Std. deviation	0.2893	0.4598	0.1744
Observations	174	51	123

Table III.
Summary statistics for conditional beta series

Country	Five-year historical beta
Austria	0.72
Denmark	0.91
Finland	1.10
Ireland	1.28
New Zealand	0.76
Norway	0.92

Table IV.
Betas of markets similar in size to New Zealand

employment, and business confidence was unavailable, the influence of these important variables is contained in the MCI. It may be the case that financial markets in New Zealand place a greater deal of importance on the interactive effect of these variables than on any particular single variable.

7. Concluding remarks

This paper sets out to establish the link between macroeconomic factors and New Zealand's country beta. It is found that the US$ exchange rate (USD) and the monetary conditions index (MCI) have a significant impact on New Zealand's country beta. The temporal variance of New Zealand's beta displayed a great deal of volatility prior to and immediately following the 1987 stock market crash. The beta was far less volatile during the 1990s.

Notes

1. www.anz.co.nz
2. www.rbnz.govt.nz
3. 0.9987 correlation for March 1960 to June 1999.
4. The sample period was reduced by one month when the variables were first differenced during the ARIMA modelling.
5. See Wasserfallen (1988), Groenewold and Fraser (1997), and Gangemi *et al.* (2000).
6. Interim changes are accounted for to produce a monthly index.

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