

Waiting to Invest in the New Zealand Stock Market

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Abstract

Waiting to invest exists because the stock market needs more time to reflect new information in share prices (Tang 1996). It might be optimal for investors to wait to invest when they are faced with large enough uncertainty (Pindyck 1988 and Dixit 1989). In the New Zealand stock market the exchange rate movement is a major source of uncertainty. This paper investigates the linkage between the exchange rate uncertainty and waiting to invest through a GARCH framework. We find that the stock volatility decreases when the exchange rate is volatile enough. Given the large enough exchange rate uncertainty, we argue that waiting to invest exists in the NZ stock market.

1. Introduction

Waiting to invest has become an important topic in recent finance literature. The waiting to trade hypothesis states that the return variance in the stock market comparing can be smaller than that in the futures market while the stock market needs more time to reflect information in the price and the volatility is caused by the arrival of new information (Tang, 1996). Some researchers argue from the perspective of an investor behaviour that waiting to invest might be an optimal choice of three decisions of ‘invest-wait-do not invest’ when investors face large enough uncertainties (Pindyck 1988 and Dixit 1989). For both situations, a stock-market based measure is not suitable to test the waiting to invest because the use of stock-market based measures is unable to indicate future economic shocks and policy changes in representing the uncertainties faced by investors (Carruth et al., 2000). Byrne and David (2002) argue that, among the uncertainty measures based on the volatility of exchange rates, long-term interest rates, inflation, share prices, and industrial production, only the uncertainty measure based on the exchange rate outperforms all the rest. We thus investigate in this paper the linkage between the exchange rate uncertainty and waiting to invest in the stock market.

Recent research studies, however, can only provide empirical evidence that the exchange rate uncertainty has negative effects on investments. Using a rolling standard deviations method, the single-equation estimation, and a GARCH model respectively, empirical results show the effects of exchange rate uncertainty on investments are often negative (Goldberg, 1993, Darby et al., 1999, and Carruth et al., 2000). More importantly, Serven (2003) finds that the exchange rate effects on investments are highly significant and negative under a GARCH framework. Because the recent study of Buhr, Rose, and Li (2005) also confirm that a GARCH (1,1) model can do a great job in capturing the exchange rate uncertainty and well fit the exchange currency data, this paper investigates the linkage between the exchange rate uncertainty and waiting to invest under a GARCH framework.

The exchange rate uncertainty itself is a source of new information for the stock market. Once the exchange rate fluctuation becomes volatile enough, the NPV of the firm is influenced. Chen et al. (2004) argue that in a small market like New Zealand (NZ), both domestic firms and companies with foreign sales and operations are affected. While the efficient market hypothesis argues that the new information should be priced into the stock prices immediately, the empirical results of Chen et al. (2004) show a delayed market reaction. In other words, the stock market needs more time to reflect the new information resulted from the exchange rate uncertainty. This is consistent with the suggestion of Tang (1996) that waiting to trade exists in the stock market. As Tang (1996) argues that the volatility is caused by the arrival of new information, a latter development of Tang and Lui (2002) argues that the changes in volatility can represent whether waiting to trade exists in the Hong Kong stock exchange. While their paper focuses on comparing the volatility movements or patterns of the stock market and of the futures market to test the waiting effect, this paper also investigates waiting to invest in the NZ stock market, but we examine the uncertainty from the foreign currency market. In particular, we focus on how the stock volatility reacts when there is large enough exchange rate uncertainty as the arrival of new information. While the stock market and the futures market can trade the same underlying assets, the foreign currency market provides with exchange rate-based securities and comes up with exchange rate uncertainties. As the relationship between the stock market and the futures market is different from that between the stock and the foreign currency market, a simple volatility pattern comparison is not suitable in this study because the usage of the pattern comparison is to understand how volatilities in two markets change while the same new information arrives in both markets. This paper intends to find out how the stock market reacts when stock market investors face exchange rate uncertainties generated by the foreign currency market. We find that a GARCH framework is very necessary in our testing because of its effectiveness in capturing the return variance of both stock returns and measure of exchange rate uncertainties as macroeconomic variables (Huizinga 1993, Episcopos 195, and Price 1995).

The linkage between the exchange rate uncertainty and waiting to invest can also be interpreted from a perspective of investor's behaviour. Darby et al. (1999) argue that when investors in the stock market face exchange rate uncertainty, they wait for more information to improve their investment outcome. Effects of exchange rate uncertainties for firm's NPV are often ambiguous, especially for those domestic firms because exchange rate uncertainty can influence their input and output price linkages, or their supply and demand chains, or their competitors' prices (Chen et al. 2004). As a result, there is a time lag between the arrival of new information and the volatility changes in the exchange rate. Investors wait to invest until the volatility changes in the exchange rate are translated into new information. At the same time, it is possible that investors may choose to invest before the arrival of new information, however, this might not be the case in reality for the option value of waiting is more valuable (Joaquina and Khannab 2001). Bernanke (1983) points out that investors avoid the irreversible mistake of investing in the wrong activity. Before the exchange rate movements are fully interpreted, investors can wait to make sure that they invest in the right activity in the stock market. Another reason for them to wait to invest is because revising the investment decision is often costly, according to Bo and Sterken (2005). This can be particularly true in the stock market. Hence, waiting to invest can be an optimal option. McDonald and Siegel (1986) even argue that it is sometimes optimal to investors to defer investing until benefits are twice the investment costs.

The New Zealand stock market has provided us with a unique opportunity to study the linkage between the exchange rate uncertainty and waiting to invest. Carruth et al. (2000) argue that effects of exchange rate uncertainty can be larger when the economy is more exposed to the foreign trade. Chen, Naylor, and Lu (2004) points out that the NZ economy is unusually open to the international trading. They also argue that there exists a high level of market awareness of exchange rate fluctuations in the NZ stock market. In other words, investors in the NZ stock market pay close attention to any exchange rate movements. The new information of exchange rate fluctuation is certainly reflected in the stock market due to the high awareness of the exchange rate impacts in the stock market. We expect to find waiting to invest if the information is not priced into the share prices

immediately or it takes time for exchange rate movements to be correctly interpreted into the new information. This paper finds evidence that the stock volatility decreases when the exchange rate is volatile enough. There can not be any arrival of new information for the stock market if the exchange rate is not volatile enough. Given the large enough exchange rate uncertainty, we argue that waiting to invest exists in the NZ stock market. This makes unique and special contributions to the current literature as previous studies of waiting to trade are limited to a stock and futures market environment.

The paper is organized in the following order. Section 2 contains the literature review. Section 3 explains data and methodology. Section 4 reports the empirical results. Section 5 concludes the paper.

2. Literature review

Investors in the stock market make investment decisions in an environment with great uncertainty. However, Carruth et al. (2000) argue that the use of stock-market based measures can not indicate future economic shocks and policy changes although they may reveal cash flow uncertainty for the firm. Byrne and David (2002) thereby assess the uncertainty measures based on the volatility of exchange rates, long-term interest rates, inflation, share prices, and industrial production. Their study suggests that only the uncertainty measure based on the exchange rate is found to be significant. To investors, exchange rate uncertainty is a source of concern because exchange rate fluctuations partly determine the trading price of the outputs and therefore firms' profits and welfare are affected and become indeterminate or uncertain (Choudhry, 2005).

Researchers focus on studying the effects of exchange rate uncertainty on investment as the exchange rate is regarded as a good uncertainty measure. Zeira (1990) asserts that the overall effect of uncertainty on investment is negative. Goldberg (1993) uses a rolling standard deviations method and finds evidence from the US industry-level investment that exchange rate uncertainty has significant negative long-run effects on investment. Using the single-equation estimation, Darby et al. (1999) provide evidence of the similar

negative effects on aggregate investment from five Organization for Economic Co-operation and Development (OECD) countries. Their latter paper also shows the same effects in Germany and France. Other researchers study a few developing economies (Pindyck and Solimano, 1993; Serven and Solimano, 1993; and Bleaney, 1996). Carruth, Dickerson and Henley (2000) suggest that a reasonable consensus amongst empirical studies can be established that the effect of uncertainty on aggregate investment is negative. Byrne and Davis (2002) then investigate the similarities in behaviour between the larger European countries and present formal statistical evidence that the uncertainty has a significant negative effect on investment. Using GARCH measures of uncertainty, Carruth et al. (2000) and Serven (2003) find a highly significant negative impact from the real exchange rate uncertainty on the investment. While all these studies solely focus on the exchange rate uncertainty's effects on investment, the effects of exchange rate uncertainty on investors' decision making in the stock market are ignored.

The innovation of this paper is to investigate the exchange rate uncertainty and waiting to invest in the New Zealand stock market. In fact, waiting to invest is not a new idea in the literature. The early study of Bernanke (1983) argues that firms become reluctant to invest when facing uncertainty. The aggregate investments can be depressed as investors try to avoid the irreversible mistake of investing in the wrong activity. McDonald and Siegel (1986) suggest that the option value of waiting can be significant and timing considerations are quantitatively important. They argue for a general conclusion that for reasonable parameter values it is optimal to investors to defer investing until benefits are twice the investment costs.

The concept of waiting to invest is then introduced in a more theoretical approach of real options by more recent studies. The real options challenges some of the conventional criteria for investment decision-making by including the option value of waiting to invest, according to Sirmans and Yavas (2001). Dixit and Pindyck (1994) argue that the option value of waiting becomes part of the investment costs because, once the investors make an irreversible investment decision, they lose the option to invest later on when better information can be available. Therefore, their study develops a model in which the value

of an investment is evaluated to represent the value of waiting. Lensink and Sterken (2001) also consider an option value of waiting. They claim that considering the possibility to delay investment can change the nature of the inefficiencies of the competitive outcome fundamentally. Waiting to invest is indeed about the flexibility of when to invest. Joaquina and Khannab (2001) argue that the optimal policy can be waiting to invest even if investing immediately has a positive net present value because of the value to waiting. The pioneering works on real options agree that waiting might be optimal (Brennan and Schwartz, 1985; McDonal and Siegel, 1985 and 1986).

The intuition is that investors in the stock market have the option of waiting to invest when facing the exchange rate uncertainty. In this context, Darby et al. (1999) investigates whether investors exercise the option of waiting to invest. They conclude that waiting to invest is a proper alternative to investing or not investing. Investors hence confront with an ‘invest-wait-do not invest’ decision rather than an ‘invest-do not invest’ decision. They argue that investors in fact take the option of waiting to invest if the degree of exchange rate volatility is large enough. Further, they suggest that under a NPV approach, investors may wait until the present value is considerably higher than the expected costs when the volatility of the exchange rate is large enough. This waiting to invest process represents a process of waiting for more information. Bo and Sterken (2005) argue that once the investment is made, the opportunity of obtaining more information about uncertain variables is lost because investors give up the right to improve the outcome if necessary. This waiting to invest is thereby valuable because revising investment decision is often costly.

This paper argues that investors wait to invest as they want to obtain more information when facing exchange rate uncertainty, not only because they wait for a considerably higher stock return or price than the investment costs, but also because revising investment decisions in the stock market can be costly. Even under a payback approach, Boyle and Guthrie (2005) argue that the value of waiting to invest is an increasing function of payback period because investors take advantage of favourable movements in market conditions and avoid costly mistakes while they wait to invest in

order to obtain more information. Further, even in a hedging situation, Boyle and Guthrie (2005) argue that the additional value of hedging is to allow investment to be delayed while firms can improve the timing of investment. Therefore, it is optimal for investors in the stock market to wait to see the investment decisions of the firms when they face the exchange rate uncertainty. Those hedging firms can even make the waiting time longer as investment decisions may be delayed. This paper is the first to provide direct evidence that investors wait to invest in the stock market when there is large enough exchange rate uncertainty. This finding contributes to the literature by revealing the negative impact of exchange rate uncertainty on the stock volatility.

3. Data and methodology

The Generalized Autoregressive Conditional Heteroscedastic (GARCH) model of Bollerslev (1986) is applied in this paper to obtain the conditional covariance of exchange rate volatility and to investigate the waiting to invest in the New Zealand stock market. Therefore, daily total market index data are collected from the Datastream in order to monitor the volatility changes of the whole stock market. Daily exchange rate data are also downloaded from the official Reserve Bank of New Zealand website. Two exchange rates of NZD/AUD and NZD/USD and the trade-weighted index (TWI) are applied in the GARCH model. Since NZD is often closely patched against AUD, the exchange rate uncertainty of NZD/AUD can be small. However, the NZD/USD and the TWI exhibits larger volatility while US dollars are used as international currency for international trading and TWI represents the general performance of New Zealand dollars in the international currency market. The sample period is from the January of 1990 through the December of 2004 including 3866 observations after adjusting for holidays. Miss data or non-trading problems are not much relevant in this study as index and exchange rate fluctuations are continuous.

The GARCH model is found to be effective for the measures of macroeconomic variables when modeling investment (Huizinga 1993, Episcopos 1995, and Price 1995). According to Akhtar and Spence Hilton (1984), the variance of exchange rate is the most

commonly used definition of exchange rate variability. Recent research studies apply the GARCH model to estimate the volatility of exchange rate when investigating exchange rate effects (Choudhry, 2005; Lee, 1999; Caporate and Doroodian, 1994; and Kroner and Lastrapes, 1993). Buhr, Rose and Li (2005) find the GARCH (1,1) model well fits the data when it is applied on the NZD/USD exchange rate. In this paper, the conditional variance of exchange rate is also estimated by means of the GARCH model in the following equation:

$$\begin{aligned}
 R_t &= \mu + \varepsilon_t \\
 \varepsilon_t / \Omega_{t-1} &\approx N(0, h_t) \\
 h_t &= \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}
 \end{aligned} \tag{1}$$

Where R_t is equal to $\log(FX_t/FX_{t-1})$, FX_t is the daily exchange rate of TWI, NZD/AUD and NZD/USD, μ is the mean, h_t is the conditional variance of daily exchange rate.

The conditional variance of the first difference of the log of the exchange rate is then used in the following GARCH model to investigate whether waiting to invest exists in the stock market when there are exchange rate uncertainties at different degrees:

$$\begin{aligned}
 R_t &= \mu + \varepsilon_t \\
 \varepsilon_t / \Omega_{t-1} &\approx N(0, h_t) \\
 h_t &= \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 f_t
 \end{aligned} \tag{2}$$

Where R_t is equal to $\log(P_t/P_{t-1})$, P_t is the daily total market index price, μ is the mean, h_t is the conditional variance of daily total market index, and f_t is the conditional variance of the first difference of the log of exchange rate estimated from the equation (1) based on the GARCH (1,1) model. As the coefficient of f_t , the α_3 represents the volatility changes in the stock returns when the exchange rate becomes volatile. A negative number of α_3 indicates a decrease in stock return volatility; and a positive number indicates an increase. The equation (2) follows inequality restrictions that α_0 , α_1 , and α_2 are greater than zero to ensure that the conditional variance (h_t) is positive. The α_3 also needs to be statistically significant to indicate how stock volatility is influenced by exchange rate movements.

4. Empirical results

The GARCH (1,1) model is applied on exchange rates of NZD/AUD, TWI, and NZD/USD respectively to capture the exchange rate uncertainty. Table one contains the results of applying equation (1). The GARCH (1,1) fits the best when it is applied on the NZD/USD rates. The AIC is -7.60481 and the SC is -7.59671. The sum of α and β is 0.994020. This implies long memory persistence in the returns volatility. Since the sum is significantly less than one, the result shows the properties of mean reversion of the volatility for NZD/USD. In general, all coefficients are statistically significant at the 1% level for all three exchange rates. The GARCH (1,1) thereby is a reliable model to obtain the conditional variance of exchange rates for further investigations of waiting to invest.

Table One: GARCH(1,1) model on exchange rate returns

NZD/AUD			
	ω	α	β
Coefficient	0.000010	0.155118	0.353986
Std. Error	0.000001	0.015320	0.052700
z-Statistic	10.916690	10.125450	6.717061
Prob.	0	0	0
Akaike info criterion	-8.02856		
Schwarz criterion	-8.02046		
TWI			
	ω	α	β
Coefficient	0.000000	0.029008	0.967034
Std. Error	0.000000	0.002271	0.002723
z-Statistic	4.555468	12.771380	355.077700
Prob.	0	0	0
Akaike info criterion	-7.94839		
Schwarz criterion	-7.94029		
NZD/USD			
	ω	α	β
Coefficient	0.000000	0.068232	0.925788
Std. Error	0.000000	0.004678	0.005172
z-Statistic	7.004394	14.586870	179.015600
Prob.	0	0	0
Akaike info criterion	-7.60481		
Schwarz criterion	-7.59671		

It is necessary to look at the volatility of three different exchange rates before investigate the waiting to invest. Darby et al. (1999) argue that investors in fact wait to invest when facing the exchange rate uncertainty if the degree of exchange rate volatility is large enough. Table two shows the statistical summary of three exchange rates. The exchange rate of NZD/AUD exhibits the smallest volatility while the volatility of NZD/USD is almost one time larger. Since the NZD is closely patched against the AUD, the volatility is relatively small and it might not be large enough to produce any exchange rate effects to stock volatility. In other words, New Zealand investors may not consider the waiting to invest option when facing the small uncertainty from the volatility of NZD/AUD. However, the volatility of NZD/USD is much larger. The exchange rate uncertainty of NZD/USD can produce more significant impacts to investors in the stock because US dollars are the most common currency used for international trading. While the investors wait for more information about how the NZD/USD exchange rate uncertainty affect stocks' future cash flows or firms' profits and welfare, the volatility in the stock market should decrease due to the waiting to invest. Although the volatility of TWI index is not the same as that of the NZD/USD exchange rate, the waiting to invest can still happen for TWI contains information of New Zealand dollar's value in relative to five other currencies. Therefore, the uncertainty of TWI produces greater effects to investors in the stock market.

Table Two: Statistical summary of exchange rate series

	NZD/AUD	TWI	NZD/USD
Mean	0.000050	0.000030	0.000049
Median	0.000091	0.000203	0.000169
Maximum	0.034076	0.035465	0.042983
Minimum	-0.036316	-0.032143	-0.036185
Std. Dev.	0.004474	0.004808	0.006132
Variance	0.000020	0.000023	0.000038
Skewness	-0.079955	-0.325458	-0.079385
Kurtosis	7.771294	7.111554	7.113779
Probability	0	0	0

The conditional variances of three exchange rate measures are used in the GARCH (1,1) model of equation (2). This is to investigate whether there are any impacts of

exchange rate uncertainty on the stock volatility. Table three provides the empirical results of the GARCH model. As mentioned above, the volatility of NZD/AUD is unlikely to produce any exchange rate effects for the stock volatility. As the coefficient of α_3 is not statistically significant in the GARCH model, the NZD/AUD is not volatile enough for there to be waiting to invest in the stock market. However, the coefficient of α_3 in the GARCH (1,1) model is negative and statistically significant at the 1% level when the conditional variance of NZD/USD exchange rate is applied. The NZD/USD exchange rate is volatile enough so that the stock volatility decreases. The stock market needs more time to reflect the exchange rate information in share prices. This is consistent to the findings of Chen et al. (2004) that the stock market does not immediately price exchange rate information in share prices. The results also imply that investors wait to invest when facing the uncertainty of NZD/USD exchange rate. The discussion in section two shows that investors in the stock market either wait to obtain more information to make better investment decisions, or they wait for the present value of the investment or the stock return to be considerably higher than the investment cost. Because revising any investment decisions in the stock market can be costly, investors take the benefits of waiting to invest as the option value of waiting in the stock market becomes valuable. The empirical results of this paper provide evidence that the volatility of the stock decreases when NZD/USD becomes volatile and waiting to invest exists in the New Zealand stock market when investors confront with the exchange rate uncertainty.

The similar result can be also found when the conditional variance of TWI is applied in the GARCH model. All coefficients are statistically significant at the 1% level. Only the coefficient of α_3 turns out to be negative. Since the TWI index is the combination of the NZ dollar's value against to five other currencies in the foreign exchange market, investors in the stock market need additional information to interpret the source of exchange rate uncertainty. Market needs more time to price the new information. This enlarges the exchange rate effects of TWI uncertainty. As a result, there is a linkage between waiting to invest in the stock market and the fluctuation of the TWI index.

Table Three: Applying exchange rate volatility in the GARCH (1,1) model of the total market index

	α_0	α_1	α_2	α_3
NZD/AUD	0.0000 (1.4940)	0.1271 (24.5407)*	0.8662 (157.1603)*	0.0249 (0.7199)
	Akaike info criterion			-6.7467
	Schwarz criterion			-6.7370
	α_0	α_1	α_2	α_3
TWI	0.0000 (7.5795)*	0.1237 (24.2527)*	0.8699 (161.7183)*	-0.0331 (-3.9066)*
	Akaike info criterion			-6.7490
	Schwarz criterion			-6.7393
	α_0	α_1	α_2	α_3
NZD/USD	0.0000 (8.7368)*	0.1236 (24.1980)*	0.8671 (158.4797)*	-0.0152 (-5.3783)*
	Akaike info criterion			-6.7479
	Schwarz criterion			-6.7381
(.) t-statistics	* Statistically significant at the 1% level			

5. Conclusion

This paper uses the GARCH (1,1) model of Bollerslev (1986) to investigate the impact of exchange rate uncertainty on the stock volatility. While most of the studies in the exchange rate uncertainty literature are limited to effects on investment, this paper finds important evidence that the investors in the New Zealand stock market wait to invest when facing large enough exchange rate uncertainties. The unique and special empirical results based on a NZ data set in this paper can be the first attempt to establish the linkage between the exchange rate uncertainty and waiting to invest in the stock market. We hence suggest that the immediate focus of further studies based on alternative data set is necessary and important to investigate the waiting to invest in different markets.

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