Performance of New Zealand Exchange Traded Funds

Yi Chen

A dissertation submitted to

Auckland University of Technology

in partial fulfilment of the requirements for the degree of

Master of Business (MBus)

2015

Faculty of Business and Law

Abstract

This study examines the performance of the New Zealand Exchange Traded Funds (hereafter ETFs), especially focusing on how well the ETFs' returns can replicate those of their underlying stock indexes. The results show that, on average, there does exist a significant tracking error between the New Zealand ETFs and the corresponding indexes. Furthermore, we find that the tracking error increases with three properties, including management fees ratio (MFR), ETF return-risk (ERR), and daily volatility ($D_{volatility}$). Meanwhile, the tracking error decreases with an increase in the liquidity of these ETF markets, measured by trading volume (L_{volume}). This study also contributes new evidence to the literature on the liquidity of the New Zealand ETFs, which are driving by the factors such as the previous and contemporaneous numbers of ETFs sold on the market. Therefore, our findings provide important implication of how to strengthen New Zealand ETFs as a perfect substitution of the specific indexes preferred by local New Zealand investors, for example, making New Zealand ETF markets more liquid.

TABLE OF CONTENTS

1. Introduction 7
2. Literature Review 10
2.1 ETF definition 10
2.2 ETF literature review 11
3. Methodology 15
4. Data 20
5. Empirical Results 24
5.1 Co-integration test and error correction model 24
5.2 Jensen's model 29
5.3 Determinants of tracking error 31
5.4 Determinants of ETF trading volume 43
6. Conclusion 45
Reference: 47

List of Tables

Table 1: list of Exchanged traded Funds 20
Table 2: Descriptive Statistics return of 5 ETFs.. 22
Table 3: Sharpe Ratio 23
Table 4: Cointegration and error correction model 27
Table 5: Jensen's model 30
Table 6: tracking error 31
Table 7: Tracking error factors.. 37
Table 8: Determinant of Trading volume of ETFs 43

Attestation of Authorship

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

Signature:

31/08/2015

ACKNOWLEDGEMENT

I am very thankful to Dr. Jun Chen and Professor Bart Frijns at Auckland University of Technology (AUT) for useful suggestions and comments from the beginning to the completion of this dissertation. Besides, the support of the Finance Department at AUT is also acknowledged.

1. INTRODUCTION

An Exchanged-traded Fund (ETF) is an investment fund that tracks a particular index, and is publicly traded on stock exchanges, sharing the common properties with other financial assets such as stocks. In 1993, the first ETF was launched as S&P Depository Receipts (SPDR), which is tracking the S&P 500 index. Since then, the global ETF markets have grown dramatically. Although a standard ETF consists of a set of normal financial assets such as common stocks, the trading mechanism of ETF is different from the underlying assets. For instance, Bernstein (2002) indicates that ETF is an investment vehicle like the hybrid of an exchange-listed corporate security and an open-ended mutual fund. In other words, it enables investors to buy a single ETF share, and trade single ETF shares on secondary markets during trading hours.

Prior literature has documented that ETFs are attractive due to low costs, tax efficiency, and stock-like features. Bansal and Somani (2002) argue that ETFs have several characteristics to attract investors, including (1) increasing cost efficiency of mutual funds, (2) allowing easy trading during the trading hours, and (3) offering creative solution to investment. Poterba and Shoven (2002) propose two reasons for why the ETF market is growing so rapidly around the world. First, ETFs are described as prototypes for the future evolution of mutual fund industry. Second, ETFs are being more “tax efficient” than traditional equity mutual funds. Moreover, Bowman (2012) finds that ETFs are passive investments, because no fund managers make changes inside their portfolios. That is, the component stocks of ETFs never change. The author also concludes that ETFs are different from mutual funds in terms of transparency, i.e. investors know what stocks are held by an ETF, but not about a mutual fund.

Given the attractive properties of ETFs mentioned above, most of the previous studies have found that ETFs underperform similar financial assets. For instance, Chang and Krueger (2012) compare ETFs and Closed-end funds, using an international dataset during the last 10 years. They find that, although ETFs have lower expense ratio, the closed-end funds provide higher annual returns and risk-adjusted returns than ETFs, and attribute such ETF underperformance to the lower turnover ratio.

Smartshares Limited, a subsidiary of NZX Limited established in 1996, is the pioneer of ETFs in New Zealand. Currently, it is the only ETF issuer in New Zealand, with more than 9000 unit holders and managing the funds more than $380 million. The five ETFs include smartTENZ (TNZ), smartMIDZ (MDZ), smartFONZ (FNZ), smartMOZY (MZY) and smartOZZY (OZY). Each is tracking a different index, and charges different management fees. The ETF market in New Zealand is growing dramatically during the last years, and becomes an important investment vehicle for the investors in New Zealand, especially the institutional investors such as the providers of KiwiSaver products.

However, to date, very limited study has been implemented on the ETF market in New Zealand. Our study is aiming to fill this gap by the following analysis. Specifically, we investigate how well the returns of the New Zealand Exchange Traded Funds (ETFs) replicate the returns of their corresponding indexes. It is an important issue for portfolio management. In this study, we examine this issue by regressing the ETFs returns on the returns of their underlying indexes. Moreover, we implement three approaches to measure the tracking errors and then attempt to identify what factors are driving the tracking errors, including management fees ratio, ETF return-risk (ERR) calculated as the standard deviation of ETF returns over previous 2 weeks (10 trading days), daily volatility, trading volume of ETFs, and foreign exchange rate. Furthermore, we conduct time series regressions using the factor that may affect the trading volume of New Zealand ETFs. By doing so, our study contributes to the literature by providing new evidence about the New Zealand ETF market, and identifies what are the factors that drive the tracking error of New Zealand ETFs, Also, the study has important implications for the participants in New Zealand financial markets, depending on how well the ETFs can replicate the returns of their corresponding indexes.

There are three main findings in this study. First, our evidence shows that all the five New Zealand ETFs are underperforming their underlying indexes during the sample period, consistent with the literature. Differently speaking, the New Zealand ETFs were unable to replicate the corresponding index returns perfectly. Second, we find that the tracking error increases with three variables, including management fees ratio (MFR), ETF return risk (ERR), and daily volatility ($D_{volatility}$), whereas it decreases as the liquidity of the ETF, measured by trading volume (L_{volume}) increases. Third, we find that the daily volatility ($D_{volatility}$) and the contemporaneous number of ETFs traded on the market can increase the trading volume. Meanwhile, the lagged ETF return risk (ERR) can reduce the liquidity of the ETFs in New Zealand. Our evidence shows that the lagged number of ETFs may also affect the liquidity of some New Zealand ETFs, even after controlling for the contemporaneous value.

The dissertation is organized as follows. Chapter 2 reports the existing literature. Chapter 3 describes what the methodology should be used. Chapter 4 presents New Zealand ETF data. Chapter 5 presents the empirical results. Conclusion is shown in chapter 6.

2. LITERATURE REVIEW

2.1 ETF DEFINITION

An exchange traded fund is an investment fund that tracks a particular index. ETFs can be a valuable component for any investor's portfolio. ETF trades like a stock on a stock exchange and share some common properties with a mutual fund. Specifically, an ETF is attempting to replicate the returns earned on an underlying index. Instead, the securities in an ETF portfolio are simply a basket of securities designed to replicate an index as closely as possible. The different investing characteristics between an ETF and a mutual fund can be explained by their different structure, in addition to their different types of management style. For example, ETFs are passively managed because they are designed to track an index, meanwhile most mutual funds are actively managed.

According to McGuire and Helmrich (2008), ETFs have certain characteristics that have made them attractive to investors. Many have lower expense ratios and greater tax efficiencies than traditional mutual funds, and they allow investors to buy and sell shares at intra-day market prices. Moreover, many of the newer ETFs are based on more specialized indexes, including indexes that are designed specifically for a particular ETF. Originally marketed as opportunities for investors to participate in tradable portfolio or basket products, ETFs are held today in increasing amounts by institutional investors (including mutual funds) and other investors as part of sophisticated trading and hedging strategies. Investors can short sell ETF shares, write options on them, and set market, limit, and stop-loss orders on them.

2.2 ETF LITERATURE REVIEW

The prior literature has studied intensively the global ETF markets, and finds that the majority of the ETFs have significant tracking errors. That is, most of them have been underperforming the corresponding underlying financial assets. Several factors such as daily returns on exchange rates have been proposed to explain the existence of tracking error. For example, Rompotis (2006) studies the performance of Swiss ETFs, and finds that the Swiss ETFs are underperforming their benchmark. The author concludes that non-full replication of benchmark's components restricts ETFs to replicate the performance of the underlying market index accurately, and increases in expense or risk will also result in an increase in the tracking error. Moreover, he argues that the trading volume of Swiss ETFs is determined by the price volatility, number of trades and trading frequency. Another example is Harper, Madura, and Schnusenberg (2006), who compare the risk and return of exchange-traded funds and closed-end country funds in US. In their study, there are three major findings. One, the ETFs generate a higher return than the closed-end funds due to the lower expense ratio. Two, the ETFs have higher Sharpe ratio than closed-end funds. Three, the passive investment strategy is superior to active one. Blitz, Huij and Swinkels (2010) find that the European ETFs underperform their benchmark by 50 to 150 basis points per annum and suggest that the funds expense ratio and dividend tax can help explain the underperformance.

The ETF markets in Emerging countries also receive intensive attention from researchers. For example, Shin and Soydemir (2010) study the performance of Asian ETF market using Jensen's model, by examining the persistence of tracking error and information dissemination. In their paper, a tracking error model was developed to use the factors to forecast tracking error. Consequently, they found that investment in the Asian ETFs does not provide significant benefit when comparing to the corresponding index. They argue that the Asian ETF markets are less efficient in disseminating information, and depreciation of US dollar will cause a larger tracking error. Jiang, Guo and Lan (2010) investigate the price efficiency of Shanghai 50 ETFs in China, and found that the ETF and the underlying index are co-integrated. They also found ETFs price is not close to underlying index in second half of 2007 due to Chinese stock market financial turbulence.

Contrary to other markets, Prasanna (2012) evaluates the performance of the India ETFs, and finds that India ETF market is consistently outperforming the market index and has generated higher return. The volatility of ETF returns was also found to be less than that of the underlying index. On average, the Indian ETFs generate 3% return per year more than corresponding index. In sum, the empirical results on how well the ETFs are tracking their corresponding indexes are mixed around the world. Most of them show that the ETFs are underperforming the indexes, with the exception of India.

Recently, several approaches have been developed to measure the tracking error between ETF and underlying assets. For example, Baş and Sarıoğlu (2015) use three different methods to estimate tracking error and find tracking errors are significantly different from zero. After analysing ETF price efficiency, they found that Turkish ETF prices are close to net asset value, and no arbitrage opportunity exist. Similarly, employing the same measures of tracking error, Chu (2011) finds a significant the tracking errors for the ETFs trading in Hong Kong exchanges. He finds that the tracking error is positively related to some factors such as expense ratio, but negatively related to the size.

Another line of literature on the ETF markets focuses on the role of ETFs for the price efficiency of the global financial markets. For example, Wang, Hussain, and Ahmed (2010) study the Chinese gold ETFs and future prospects, and show that the launch of gold ETFs will significantly improve China's ability to deal with problems, including diversification, inflation protection and currency hedging. Rompotis (2011) examines the weak-form efficiency of Swiss ETF market, using the unit root test and Augmented Dicky-Fuller test. The author finds that the developed capital market is basically weak-form efficient. Agapova (2011) examines the substitutability of conventional index mutual funds and ETF, and shows that conventional index mutual funds and ETF are substitute, although not perfect one. He suggests that ETF can offer new features which conventional index does not have. Hilliard (2014) analyses ETF premiums and discounts, it shows high efficiency of the ETFs arbitrage pricing mechanism. International equity ETFs and bond ETFs face more barriers to arbitrage, leading to a higher long-term mean premiums and lower speeds of adjustments.

The prior literature also focuses on the link between the ETF and other financial assets. A recent study by (Corbet and Twomey, 2014) investigates how US ETFs are influencing commodity market volatility, using an EGARCH model. They find a significant difference of volatility between large and small commodity markets after the introduction of ETFs. Moreover, their results show that large commodity markets are directly influenced by large holdings of ETFs, whereas small commodity markets benefit from the investment in ETFs.

Several studies have examined the liquidity of ETFs as well as the underlying assets, and the link between the two. Chau, Deesomsak, and Lau (2011) investigate the feedback trading of US Exchange traded Funds and find that the level of feedback trading tends to increase when investors are optimistic, and that the influence of sentiment on feedback trading varies across market regimes. Caginalp, Desantis and Sayrak (2014) investigated the price of dynamics US equity exchange-traded funds, they found that highly liquid ETFs can deviate from the daily net asset value. And traders are not only aware of the under-reaction of others, but also self-optimize by anticipating others' reaction. Winne, Gresse and Platten (2014) examines ETF replicates a stock index impact on liquidity of underlying stock when

ETF involve liquidity providers. They found trading the ETF is less costly than trading the index in the market for index components, ETF liquidity providers are respond for this relative advantage. Marshall, Nguyen and Visaltanachoti (2013) analyse the trading condition for the S&P 500 ETFs, when mispricing allows arbitrage opportunities to be created. The authors argue that although these ETFs are not perfect substitutes, investors view them as close substitutes to the underlying indexes. Spreads increase just before arbitrage opportunities, consistent with a decrease in liquidity.

The predictability of return and volatility of ETFs has also been intensively examined by the prior studies. Yang, Cabrera and Wang (2009) examines daily return predictability for eighteen international stock index ETFs, using linear and various popular nonlinear models and both statistical and economic criteria for model comparison. They shows evidence of predictability for six of eighteen ETFs. DeFusco, Ivanov and Karels (2011) examine Spider Diamond and Cubes these three ETFs price deviation, they found the price deviation is predictable and nonzero. Specific price discovery process and dividend accumulation are the factors to make price deviation is predictable and nonzero. Tseng, Lee and Chen (2015) examines weather the sequential information is support in single country ETF market, and also forecast of ETF’s volatility. The result shows the sequential information arrival hypothesis in the single country ETF market, by which lagged volume is available to predict current volatility. Krause and Tse (2012) examine Volatility and return spillover in Canadian and US industry ETF, price discovery flows consistently from the U.S to Canada for the securities, while volatility spillovers are largely bi-directional. Negative US return spillover and asymmetric volatility creates bi-directional volatility feedback effects.

3. METHODOLOGY

In this study, we employ the same methodologies as in Shin and Soydemir (2010) and Rompotis (2006). First, we want to examine the properties of all five New Zealand ETF and their corresponding indexes, in terms of their daily returns and volatilities. The daily returns are calculated for ETFs and indexes, using the following equations respectively.

$$R_{ETF,\,t} = \ln\left(P_{ETF,\,t} / P_{ETF,\,t-1}\right) \quad (1)$$

$$R_{INDEX,\,t} = \ln\left(P_{INDEX,\,t} / P_{INDEX,\,t-1}\right) \quad (2)$$

Here, $R_{ETF,\,t}$ is the daily return of ETF and $P_{ETF,\,t}$ is the price of ETF at time t. $R_{INDEX,\,t}$ is the daily return of corresponding index and P_{INDEX} is the price of index at time t. The risk of these ETFs and underlying indexes then is expressed as the standard deviation of the corresponding daily return. Also, the risk/return ratio is calculated by dividing the standard deviation of return by the average return over a rolling window over last two weeks or ten trading days, which measures the risk per unit change of return. Rompotis (2006) finds that such risk characteristic has a significant impact on the ETFs' performance.

Second, following Engle and Granger (1987), I test whether there exists a significant long-run relationship between the returns of New Zealand ETFs and their underlying indexes, especially checking whether two returns are cointegrated or not. The Engle-Granger test is performed in two steps. The first step is running a linear regression between L_{Indext} and $L_{ETF\,t}$, as below.

$$L_{Index,\,t} = \alpha + \beta * L_{ETF,\,t} + u_t \quad (3)$$

Once we obtain the residuals of the regression above, an Augmented Dickey-Fuller test is implemented to test whether the residuals are stationary or not. In this part, the returns are computed as the natural logarithm of the price of ETF and underlying index. We estimate the error correction model with focus on the modelling of residuals equation (3) with the difference of L_{index} and difference of L_{ETF}.

$$D(L_{Index,\, t}) = \alpha + \alpha_1 * D(L_{ETF,t}) + \alpha_2 * U_{(t-1)} + \varepsilon_t \quad (4)$$

Third, Jensen's model is used to measure performance of the New Zealand ETFs, comparing to theirs underlying indexes. Specifically, this approach employs the following equation.

$$(R_{ETF\ i,\, t} - R_{ft}) = \alpha + \beta(R_{INDEX\ i,\, t} - R_{ft}) + \varepsilon_{i,\, t} \quad (5)$$

Where R_{ETF} denotes the daily return of ETF, R_{INDEX} denotes the daily return of the corresponding underlying index, and R_{ft} presents the risk free rate, using the yield of 1-year New Zealand government bond. The coefficient β measures the relationship between ETF return and index return. A unity beta indicates that the ETF can perfectly track its underlying index. Otherwise, there might be tracking error. The intercept α is used to describe the performance of ETFs. A significant and positive α indicates that the ETF outperformances its underlying index, and verse vice. If α is found insignificant, we can conclude that there is no significantly different performance between the ETF and its underlying index.

Fourth, the prior literature has found that in most financial markets, ETFs fail to replicate their underlying index accurately. The deviation between ETF and underlying index is define as "tracking error". In this section, three approaches are used to measure tracking error. The first measure is based on a linear regression between the ETF returns and their corresponding underlying index returns, and especially to see whether there is any tracking error.

$$R_{ETF\ i,\, t} = \alpha + \beta R_{INDEX\ i,\, t} + \varepsilon_{i,\, t} \quad (6)$$

Then, the residuals from the regression (6) will be used to compute the tracking error for each individual ETF. Two alternative approaches will be used to compute the tracking errors (hereafter TE). The second is to calculate the TE as the average of the absolute difference between ETF returns and index returns as the following equation.

$$TE = \frac{\sum_{t=1}^{n} |R_{ETF} - R_{INDEX}|}{n} \quad (7)$$

The third is to measure TE as the standard deviation of the absolute difference between ETF returns and index returns. The third is to measure TE as the standard deviation of the difference between ETF returns and index returns.

$$TE = \sqrt{\frac{\sum_{t=1}^{N} [(R_{ETF} - R_{INDEX}) - (\overline{R_{ETF} - R_{INDEX}})]^2}{N-1}} \quad (8)$$

Once we obtain the measures of tracking error for the New Zealand ETFs, regression analysis will be performed to identify the factors, which have significant influence on the tacking error. As mentioned in Shin and Soydemir (2010), many factors can affect and predict the average tracking error, including expense fees ratio, daily volatility, natural logarithms of volume, and exchange rate. Among other, Qadan and Yagil (2012) investigate tracking ability of the US ETFs and find that tracking error is correlated with daily volatility of the US ETFs, and trading volume can reduce tracking error. Meanwhile, Elia (2012) investigates the determinants for the tracking errors of Europe ETFs, and find that total expense ratio and tax are the significant factors to explain the tracking error in the European ETF markets. Following these studies, I include the risk of ETF return, daily volatility, natural logarithms of ETF trading volume, and foreign exchange rate in the model to identify the factors, which are significantly related to the tracking errors of the New Zealand ETFs in the following regression

$$TE_t = \alpha_1 + \alpha_2 MFR_t + \alpha_3 ERR_t + \alpha_4 Dvolatility_t + \alpha_5 Lvolume_t + \alpha_6 Excharate_t + \varepsilon_t \quad (9)$$

Where TE denotes tracking error, MFR means management fees ratio, ERR denote the ETF Return Risk. As defined in Section 1 (Introduction), the ERR is calculated as the standard deviation of ETF returns over the previous 2 weeks (10 trading days). $D_{volatility}$ denotes the intraday daily volatility, L_{Volume} represents natural logarithms of volume, Exchrate represents exchange rate, and ε_t is error term. Since the prior literature implies that higher management fees may cause the ETFs not able to replicate underlying index perfectly, the coefficient estimate of management fees ratio is expected to be positive. The riskiness of ETFs return, measured by ERR, can help explain how well the ETFs are tracking their underlying index. Intraday daily volatility is calculated as (highest price – lowest price)/closing price. Volatility measures daily market price changes which will affect the tracking error. Natural logarithms of volume measures liquidity of ETF. Change in the exchange rate measures how changes in exchange rate affect tracking error. Since, in our sample, two New Zealand ETFs with Australian underlying index (OZY, MZY) are traded in the shares dominated in Australia dollars, the foreign exchange rate could has significant impact on these tracking error. Given the tight link between New Zealand and Australia, we believe that exchange rate should also be considered as a determinant for the other 3 ETFs (MDZ, FNZ, and TNZ) with New Zealand underlying indexes. Including the exchange rate in the model can help make the model specifications consistent across all five NZ ETFs, then contribute to a better understanding the impact of exchange rate on the tracking error of these ETFs in this study.

Last, I like to investigate the determinants of the daily trading volume of the New Zealand ETFs. The previous studies have shown that ETF trading volume is affected by several factors. For example, Elton, Gruber, Comer, and Li (2002) find that the trading volume of the US ETFs are determined by two factors, the percentage daily ETF price spread, and the deviation of ETF daily prices. Also, Lin and Chou (2006) study the trading volumes of Taiwan ETFs and find that ETF daily volatility is the only significant factor to affect the trading volume in Taiwan ETF market. They argue that the arbitrage opportunity of ETF daily price exists, leading to the ETF daily volatility as the only factor to determine trading volume of Taiwan ETF markets. The number of traded ETF shares on that day is suggested by prior literature as another factor, which can affect the ETF trading volume. Both buying and selling of ETFs can increase the volume size. I also consider the lagged number of ETFs traded on previous trading day as a potential factor to affect ETF trading volume. It is because the ETF trading volume based on the previous trading day can affect the current trading volume, i.e. more number of ETFs traded at previous day implies more volume issued. Here, our hypothesis is that past period ETF return risk negatively related to the ETF volume, higher ETF return volatility induce less investor to buy ETF shares. Size of ETF volume reduced. The data I use for the regression of the determinants of ETF trading volume covers the period between 1st January 2001 and 31st December 2014. The dependent variable is the trading volume, while the set of explanatory variables include daily volatility, the contemporaneous number of ETF shares traded, and the lagged number of shares traded on the previous trading day, and last period ETF return risk. The regression is shown as below.

$$L_{volume,\,t}=\alpha_1+\alpha_2 D_{volatility,\,t}+\alpha_3 Traded_t+\alpha_4 Traded_{t-1}+\alpha_5 ERR_{t-1}+\varepsilon_{,t} \qquad (10)$$

Where L_{volume} is the natural logarithm of daily ETF share volume, Dvolatility denotes the ETF daily price volatility, which is highest price minus lowest price divide closing price, $Traded_t$ measures the number of ETF traded on time t, $Traded_{t-1}$ measures number of ETFs traded on time t-1, ERR_{t-1} measures ETF return risk on t-1.

4. DATA

In this study, I use the daily data for all the five ETFs that are listed in New Zealand, collected from multiple databases. First, the daily prices of New Zealand ETFs and their underlying indexes are obtained from DataStream of Thomson Reuters. Then, other information, including highest daily price, lowest daily price, closing price, and daily volume, is obtained from NZX database. The expense ratio is calculated by total funds cost divided by total funds asset, obtained from the DataStream and NZX database. Last, the information on foreign exchange rates is collected from DataStream as well. Our sample period starts from 1st January 2001. The sample period varies across ETFs due to individual establishing time. There is no data before the establishment date. More specifically, the data for Smartmidz (MDZ), Smartozzy (OZY) and Smarttenz (TNZ) is collected between 1st January 2001 and 31st December 2014. We collect the data for Smartmozy (MZY) between 27th September 2004 and 31st December 2014, Smartfonz (FNZ) between 15th December 2004 and 31st December 2014, respectively. Table 1 reports the fund name, code, inception date, total fund value, daily average volume and index traced of the five New Zealand ETFs included in our sample. These data was collected from the website of Smartshares.

TABLE 1: LIST OF EXCHANGED TRADED FUNDS

Fund name	Code	Inception date	Total Fund	Annual Fees	Daily AVG VOL	Index tracked
Smartmidz	MDZ	16/06/1997	$54,279,576	0.75%	9404	NZ MidCap Index
Smartozzy	OZY	27/02/1997	$91,513,023	0.60%	8479	S&P/ASX 20 Index
Smarttenz	TNZ	11/06/1996	$56,737,153	0.60%	22,576	NZX 10 Index
Smartmozy	MZY	27/09/2004	$53,496,384	0.75%	9,088	S&P/ASX MidCap 50 Index
Smartfonz	FNZ	10/12/2004	$176,049,959	0.75%	504,057	NZX 50 Portfolio Index

Note: This table reports the name, code, inception date, total funds, daily average volume and index tracked of the five New Zealand exchanged traded funds.

It can be seen that Smarttenz (TNZ) was established in 11 June 1996, which was the first ETF traded in the New Zealand Exchange. Among the five NZ ETFs in the sample, Smartfonz (FNZ), which was established latest 10th December 2004, has been in charge of the highest fund ($176,049,959). Recently, fourteen new ETFs were issued in New Zealand through December 2014 to July 2015, including US 500 (USF), Europe (EUF), Asia Pacific (APA), Emerging Markets (EMF),Total World (TWF), US Large Value (USV), US Large Growth (USG), US Midcap (USM), US Small-cap (USS), Australian Dividend (ASD), New Zealand Dividend (DIV), Australian Property (ASP), Australian Resources (ASR), Australian Financials (ASF). Since we require that ETFs should have information available for at least one year to be included in our analysis, these new ETFs are excluded from my data through this dissertation.

Table 2 presents the summary descriptive of daily returns for the five New Zealand ETFs and their underlying indexes during the sample period. The abnormal returns are defined as their difference and computed as $R_{INDEX} - R_{ETF}$. It can be noted that all the five New Zealand ETFs have negative abnormal returns, showing that these New Zealand ETF outperformed their underlying indexes within the sample period. For example, MDZ has the highest average daily return of 0.018%, compared to that of its underlying index (0.016%). In the contrary, FNZ and MZY have the lowest one of 0.01%, with an underlying index average return of 0.004% and 0.007%, respectively. Table 2 also shows the standard deviation of returns for the ETFs and underlying indexes. It can be found that the returns of OZY was most volatile with a highest standard deviation of 0.01312%, whereas MDZ is least volatile with a lowest standard deviation of 0.00934%. The maximum and minimum values are also included in this table. Table 2 that OZY has highest range of 0.2659% and FNZ has a lowest range of 0.1611%. The skewness for ETF is varying from -1.166 to 0.047, while the range of skewness for index is between -0.795 and -0.266. Negative skewness measures that the returns are more likely to be positive. On the other side, positive skewness indicates that the returns are more likely to be negative. Range of Kurtosis for the five New Zealand ETFs is 7.445 to 20.642, and the Kurtosis of the corresponding index is varying from 3.131 to 9.236. All the kurtosises are greater than 3, implying that the ETF returns are peaked relative to normal distribution than the corresponding index returns.

TABLE 2: DESCRIPTIVE STATISTICS RETURN OF 5 ETFS

Panel A: MDZ							
# of Obs: 3652	Mean	STD	Kurtosis	Skewness	Min	Max	Range
R_{ETF}	0.00018	0.00934	11.679	-0.396	-0.0953	0.0889	0.1843
R_{INDEX}	0.00016	0.00636	9.236	-0.794	-0.0535	0.0613	0.1148
R_{INDEX} - R_{ETF}	-0.000018	0.00963	13.256	-0.625	-0.1311	0.0638	0.1949
Panel B: OZY							
# of Obs: 3652	Mean	STD	Kurtosis	Skewness	Min	Max	Range
R_{ETF}	0.00011	0.01312	13.262	0.196	-0.1073	0.1586	0.2659
R_{INDEX}	0.00011	0.01218	6.607	-0.339	-0.1148	0.0788	0.1936
R_{INDEX} - R_{ETF}	-0.000009	0.014283	5.508	0.005	-0.1298	0.0998	0.2296
Panel C: TNZ							
# of Obs: 3652	Mean	STD	Kurtosis	Skewness	Min	Max	Range
R_{ETF}	0.00011	0.01076	9.199	-0.354	-0.1236	0.0839	0.2075
R_{INDEX}	0.00010	0.00842	3.131	-0.266	-0.0528	0.0547	0.1075
R_{INDEX} - R_{ETF}	-0.000007	0.01018	4.822	0.050	-0.0685	0.0795	0.1479
Panel D: MZY							
# of Obs: 2677	Mean	STD	Kurtosis	Skewness	Min	Max	Range
R_{ETF}	0.00010	0.01218	20.642	-1.166	-0.1423	0.1210	0.2633
R_{INDEX}	0.00007	0.011707	5.458	-0.672	-0.1051	0.0553	0.1603
R_{INDEX} - R_{ETF}	-0.00003	0.013625	4.097	0.036	-0.0949	0.0932	0.1881
Panel E: FNZ							
# of Obs: 2620	Mean	STD	Kurtosis	Skewness	Min	Max	Range
R_{ETF}	0.00010	0.01161	7.445	0.047	-0.0695	0.0916	0.1611
R_{INDEX}	0.00004	0.00703	5.389	-0.395	-0.0494	0.0581	0.1075
R_{INDEX} - R_{ETF}	-0.00006	0.01175	6.879	-0.120	-0.0910	0.0728	0.1637

Note: Table 2 presents the mean, standard deviation, Kurtosis, Skewness, minimum, maximum, range of the returns of five New Zealand ETF, the returns of their underlying indexes, and their differences, for each year through whole sample period respectively.

The descriptive summary of Sharpe ratio for ETFs and index is shown in Table 3. In this table, we use one year New Zealand government bond yield as the risk free rate. First, it should note that the mean returns of ETFs and indexes are very close whereas significant difference among the corresponding standard deviations. Second, it can see that the average Sharpe ratio of all the ETFs is 0.22825, which is larger than index Sharpe ratio (0.000067). All ETF have positive Sharpe ratio. It seems that the New Zealand ETFs provide a higher risk-adjusted returns than the corresponding underlying indexes given a risk level, implying the greater value of New Zealand ETF's Sharpe ratio. In other words, the New Zealand ETFs are more attractive than index, in terms of risk-return relation.

Table 3: Sharpe Ratio

		Return		Risk		Sharpe ratio	
ETF	Track index	ETF	Index	ETF	Index	ETF	Index
MDZ	NZXMIDCAP	0.00018	0.00016	0.00012	0.11999	0.67593	0.00055
MZY	ASX/S&P midcap	0.0001	0.00007	0.00035	0.3619	0.01673	-0.00008
OZY	ASX 20	0.00011	0.00011	0.00018	0.1809	0.10783	0.00006
TNZ	NZX 10	0.00011	0.0001	0.00004	0.04409	0.30852	0.00014
FNZ	NZX 50	0.0001	0.00004	0.00009	0.15616	0.03223	-0.00034
Average		0.00012	0.00009	0.00016	0.17261	0.22825	0.000067

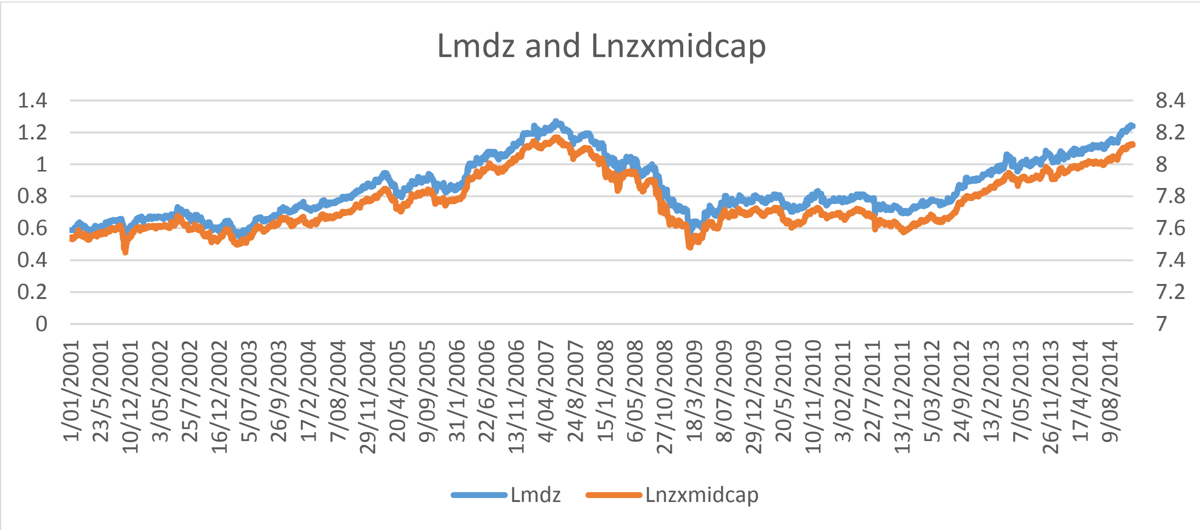
Note: Table 3 represents the Sharpe ratios for all the five New Zealand ETFs and their underlying indexes. The standard deviation is calculated as $\sigma^2 = \frac{\sum_{i=1}^{N}(R-\bar{R})^2}{N-1}$ and $\sigma = \sqrt{\sigma^2}$ with the daily data. The Sharpe ratio is computed as $\frac{R-Rf}{\sigma}$ where R is return of ETF and R_f is daily risk free rate.

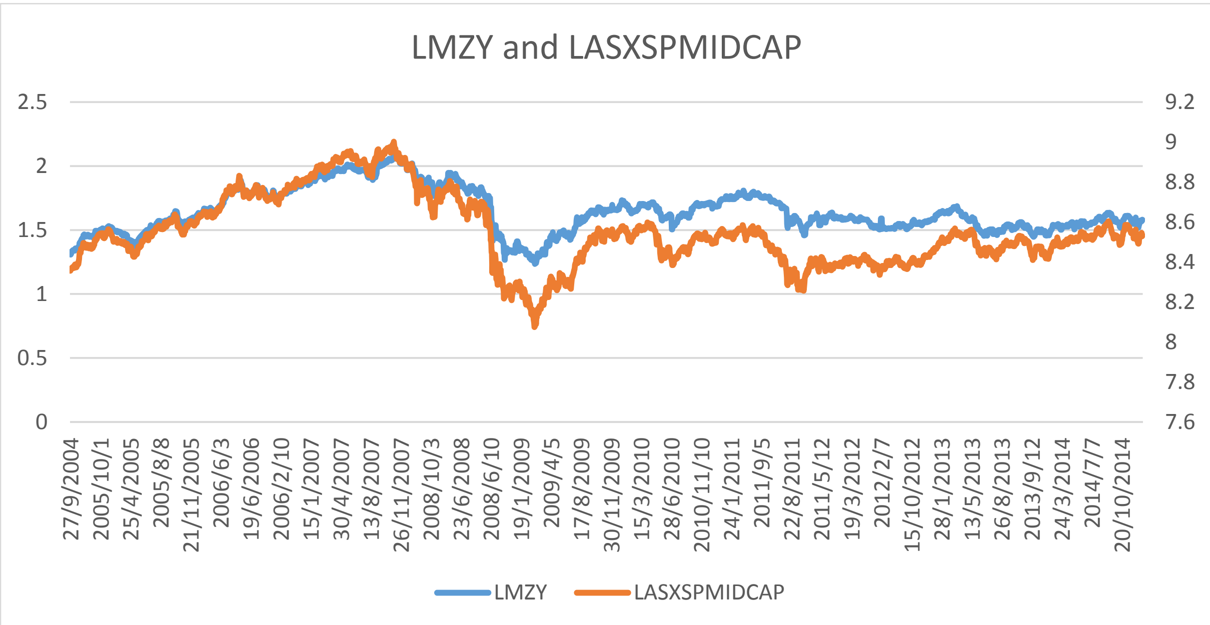
5. Empirical results

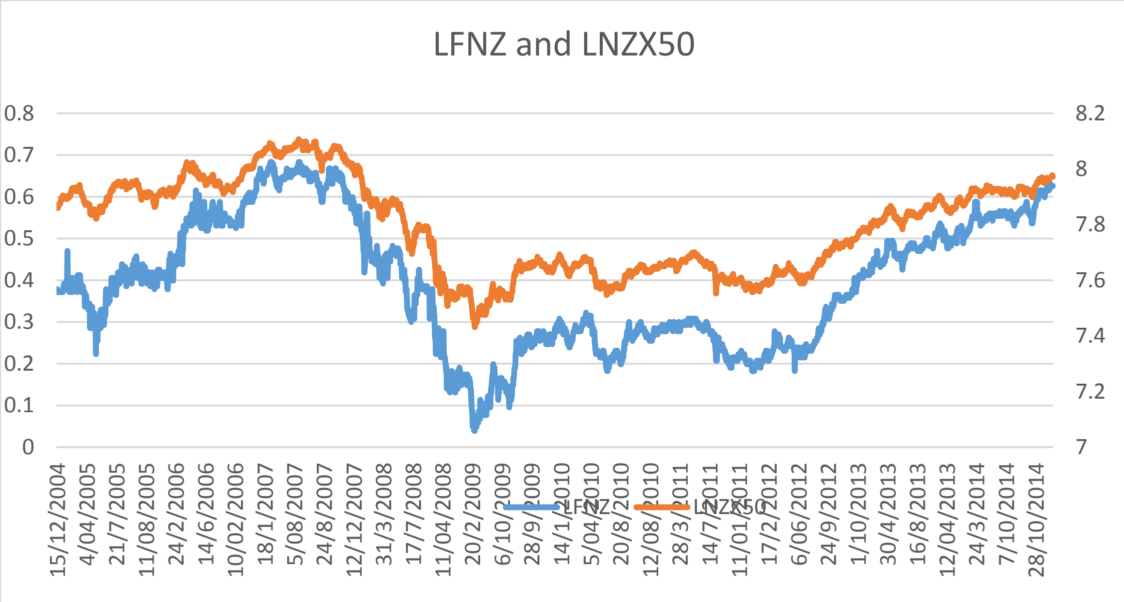
5.1 Co-integration test and error correction model

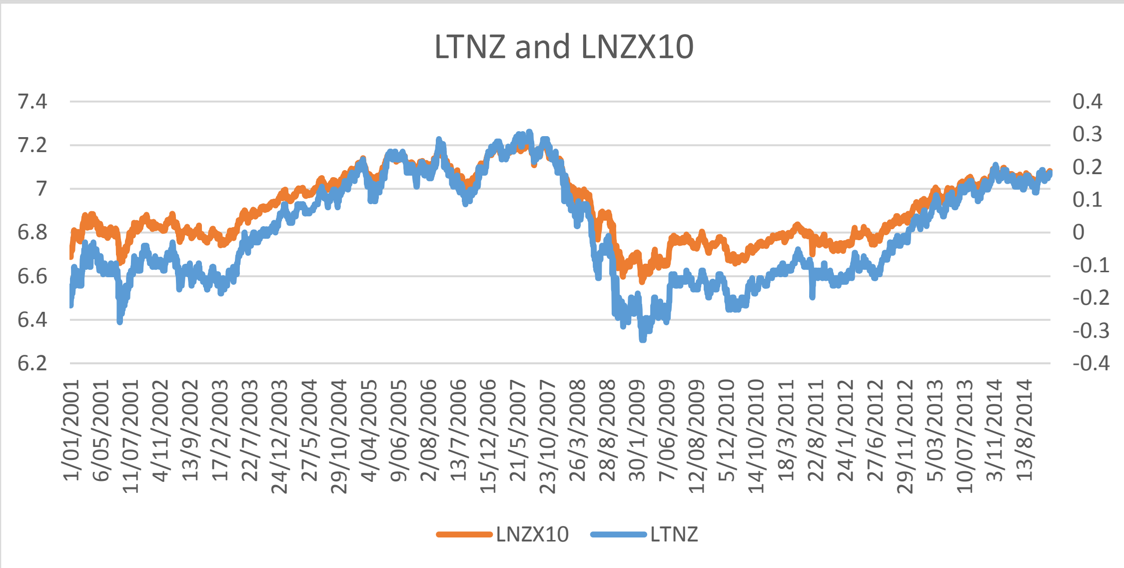
First, I visually examine the temporal pattern of the historical returns for each pair of individual New Zealand ETF and its corresponding underlying index, during the sample periods when the data is available. The patterns are shown in Figure 1, with each pair per panel.

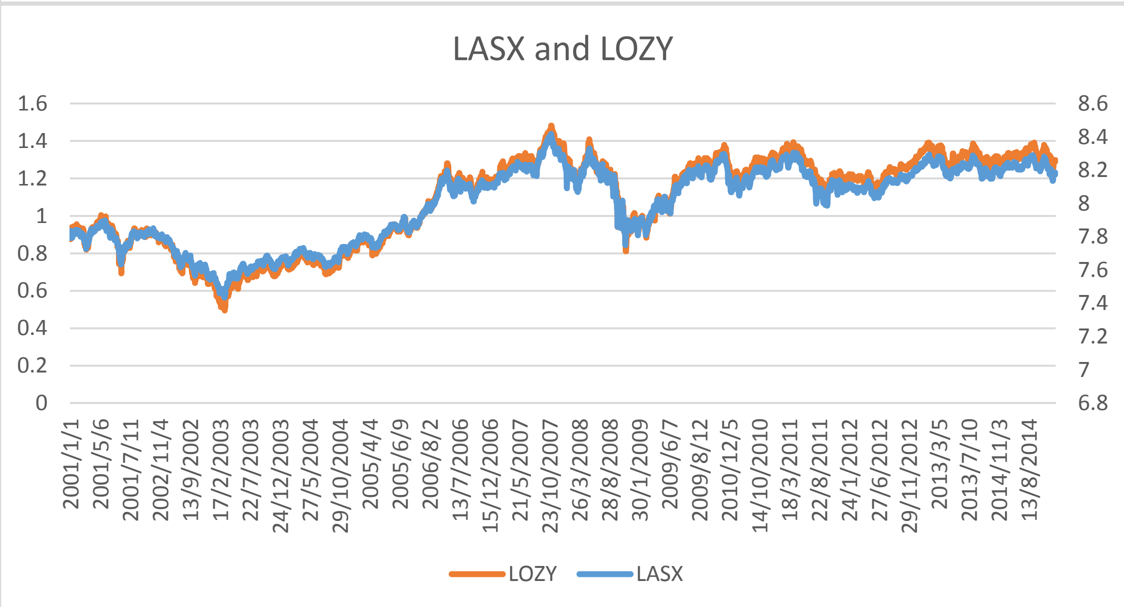
Figure 1: Logarithms of Returns of Five New Zealand ETFs and the Underlying Indexes






LFNZ and LNZX50
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8.2
8
7.8
7.6
7.4
7.2
7
15/12/2004
4/04/2005
21/7/2005
11/08/2005
24/2/2006
14/6/2006
10/02/2006
18/1/2007
5/08/2007
24/8/2007
12/12/2007
31/3/2008
17/7/2008
11/04/2008
20/2/2009
6/10/2009
28/9/2009
14/1/2010
5/04/2010
20/8/2010
12/08/2010
28/3/2011
14/7/2011
11/01/2011
17/2/2012
6/06/2012
24/9/2012
1/10/2013
30/4/2013
16/8/2013
12/04/2013
24/3/2014
7/10/2014
28/10/2014
LFNZ
LNZX50


LTNZ and LNZX10
7.4
7.2
7
6.8
6.6
6.4
6.2
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1/01/2001
6/05/2001
11/07/2001
4/11/2002
13/9/2002
17/2/2003
22/7/2003
24/12/2003
27/5/2004
29/10/2004
4/04/2005
9/06/2005
2/08/2006
13/7/2006
15/12/2006
21/5/2007
23/10/2007
26/3/2008
28/8/2008
30/1/2009
7/06/2009
12/08/2009
5/12/2010
14/10/2010
18/3/2011
22/8/2011
24/1/2012
27/6/2012
29/11/2012
5/03/2013
10/07/2013
3/11/2014
13/8/2014
LNZX10
LTNZ


LASX and LOZY
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
8.6
8.4
8.2
8
7.8
7.6
7.4
7.2
7
6.8
2001/1/1
2001/5/6
2001/7/11
2002/11/4
13/9/2002
17/2/2003
22/7/2003
24/12/2003
27/5/2004
29/10/2004
2005/4/4
2005/6/9
2006/8/2
13/7/2006
15/12/2006
21/5/2007
23/10/2007
26/3/2008
28/8/2008
30/1/2009
2009/6/7
2009/8/12
2010/12/5
14/10/2010
18/3/2011
22/8/2011
24/1/2012
27/6/2012
29/11/2012
2013/3/5
2013/7/10
2014/11/3
13/8/2014
LOZY
LASX

In Figure 1, it seems that the returns of all the five New Zealand ETFs show similar pattern to their corresponding underlying stock indexes. Two (MDZ and OZY) are following the indexes very closely, whereas the others (MZY, FNZ and TNZ) have gaps with their index. Such gap implies that tracking error might exists. Especially in case of FNZ, the gap with index is greater than the others.

All the five New Zealand ETFs have similar pattern with their indexes, implying a co-integration between each pair of returns. Next, the Engle-Granger test is performed to test whether such co-integration is significant or not, and we also estimate the error correction model on the residuals. As mentioned in the previous section, the equations (3) and (4) for this test are shown as below. The Augmented Dickey-Fuller test on the residuals from the regression can help determine whether these two returns are co-integrated. The difference of L_{Index} and L_{ETF} can also help determine the error correction model.

$$L_{Index,t} = \alpha + \beta * L_{ETF,t} + u_t \qquad (3)$$

$$D(L_{Index,\, t}) = \alpha + \alpha_1 * D(L_{ETF,t}) + \alpha_2 * U_{(t-1)} + \varepsilon_t \qquad (4)$$

Table 4 reports the results of the co-integration tests mentioned above. More specifically, Panels A presents the result of the above regression for Equation (3), with t-test on the null hypothesis whether the Beta is significantly different from zero or not. Panel B repeats the same regressions, except testing a different null hypothesis whether the Beta is significantly different from one or not. The results of unit root tests on the consequent residuals and the error correction models are shown in Panels C and D of Table 4, respectively.

TABLE 4: COINTEGRATION AND ERROR CORRECTION MODEL

Panel A

Null Hypothesis: beta = 0

Dependent variable	Intercept	beta
LNZX 50	7.3917**	1.0288**
	(0.0051)	(0.0108)
LASX20	6.9469**	0.9701**
	(0.0027)	(0.0026)
LNZX10	6.9066**	1.0087**
	(0.0007)	(0.0036)
LNZXmidcap	6.9581**	0.9499**
	(0.0040)	(0.0042)
LASXSPMIDCAP	7.0301**	0.9245**
	(0.0368)	(0.0218)

Note: Panel A presents the intercept and beta for the regression equation: $L_{Index,t} = \alpha + \beta^* L_{ETF,t} + u_t$. The dependent and independent variable are shown in table, with standard errors in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

Panel B

Null hypothesis: beta = 1

Dependent variable	Beta
LNZX 50	1.0288**
	(2.6676)
LASX20	0.9701**
	(-11.5185)
LNZX10	1.0087*
	(2.3857)
LNZXmidcap	0.9499**
	(-11.8696)
LASXSPMIDCAP	0.9245**
	(-3.4664)

Note: Panel B present the null hypothesis: beta=1 for the regression equation: $L_{Index,t} = \alpha + \beta^* L_{ETF,t} + u_t$. The dependent and independent variable are shown in table, with standard errors in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

Panel C:

Augmented Dickey-Fuller test statistic

Dependent variable	Independent variable	P-value
LNZX 50	LFNZ	0.014*
LASX20	LOZY	0.00**
LNZX10	LTNZ	0.00**
LNZXmidcap	LMDZ	0.00**
LASXSPMIDCAP	LMZY	0.0302*

Note: Panel C presents the results of residual unit root test, showing the p-values. *and **denote the test statistic significant at 5% and 1% levels, respectively.

Panel D:
Error correction model

Dependent variable	Intercept	D(LETF)	U(-1)
LNZX 50	0.00002	0.1743**	-0.0062*
	(0.00013)	(0.0245)	(0.0025)
LASX20	0.00006	0.4098**	-0.1274**
	(0.00018)	(0.0294)	(0.0151)
LNZX10	0.00006	0.3985**	-0.0902**
	(0.0001)	(0.0172)	(0.0098)
LNZXmidcap	0.0001	0.2160**	-0.0312**
	(0.0001)	(0.0264)	(0.0079)
LASXSPMIDCAP	0.00003	0.3388**	-0.0031
	(0.0002)	(0.0390)	(0.0023)

Note: Panel D presents the intercept and beta for the regression equation: $D(L_{Index,t}) = \alpha + \beta * D(L_{ETF,t}) + u_{(t-1)}$. The dependent and independent variable are shown in table, with standard errors in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

We test two types of null hypotheses on the Betas for the New Zealand ETFs, including (1) the Beta equals to zero and (2) the Beta equals to one. The results are shown in Panels A and B, respectively. It shows the result all the tests are significant at 1% level, except L_{NZX10} test for Beta equals one significant at 5% level. Therefore, we reject the both null hypotheses. In sum, the five ETFs are moving together with their underlying indexes, but not able to perfectly replicate the index returns.

In Panel C, It can be seen that three of five unit root tests are significant at the confidence level of 1%, with 5% confidence level $L_{ASXSPMIDCAP}$ and L_{FNZ}. More specifically, the residuals of L_{FNZ}, L_{OZY}, L_{TNZ}, L_{MDZ} and L_{MZY} are stationary. It shows that all the five New Zealand ETFs with their corresponding underlying indexes are moving together in the long run, i.e., they do not drift apart during the time. This shows that these ETFs are likely to tracks their underlying market indexes closely. We find that the New Zealand ETFs are not only moving together (co-integrating) with their underlying indexes, but also are linearly related to the indexes, indicating that no arbitrage opportunity exists in the New Zealand ETF markets. Therefore, all the five New Zealand ETFs are fairly priced relatively to their underlying indexes, excluding any arbitrage opportunity from this market. It confirms the results from Panels A and B.

Results of the error correction models are shown in Panel D, where $U_{(t-1)}$ denotes error correction term, which is guiding the ETF and index returns to restore back to equilibrium. That is, this term corrects disequilibrium. The result suggest that four of five error correction terms are significant at the confidence level of either 1% or 5%, with the exception of LMZY and its underlying index LASXSPMIDCAP. For example, the most significant error correction term is for LOZY with index LASX20. Its magnitude is -0.1274. In other words, this ETF (LOZY) and underlying index (LASX20) are correcting disequilibrium of the systems from the previous period at an adjustment speed of 12.74%. That is, if LOZY and LASX20 are deviating away from each other in long-run, investors can affect both prices by requiring compensation for the previous mispricing between OZY and ASX20 by 12.74%. The arbitrage opportunity will exist due to the previous day deviation until OZY and ASX20 come back to equilibrium. Again, the results of the above error correction models indicate that the New Zealand ETF markets are effective in terms of preventing any long-run deviation between the ETFs and the underlying indexes, to avoid any arbitrage opportunity.

5.2 Jensen's model

Jensen's model is used to measure performance of the New Zealand ETFs, comparing to theirs underlying indexes. Specifically, the coefficient β can help describe the relationship between ETF return and index return. On the other side, a significant and positive α indicates that the ETF outperformances its underlying index, and vice versa. The Table 5 Panel A present the alpha and beta for Jensen's model.

Table 5 Panel B shows the result of betas test for Jensen's model are significant. It reject null hypothesis that beta equal to 1, indicating that all five New Zealand ETFs cannot perfectly replicate their underlying indexes. Panel A shows that all five New Zealand ETFs in our sample have a significantly negative α, the measure of the ETF performance. It means that all these ETFs are underperforming their corresponding underlying stock indexes. That is, there exists a significant tracking error in the New Zealand ETF markets. The OZY have lowest alpha which is -0.0092 meaning that OZY have highest deviation from ETF replicate to index. In contrary the FNZ have highest alpha which is -0.0026 meaning that FNZ have lowest deviation from ETF replicate to index. Apply for the ETF replication policy that the average R squared is 0.7167, this measures the regression is applied efficiently, however the deviation of R squared to 1 measure New Zealand ETF cannot fully replicate for underlying index. Jensen's model has the difference result from ETF and underlying index return, Jensen's model result shows 5 ETFs are underperformance of underlying index.

TABLE 5: JENSEN'S MODEL

Panel A:

ETF	Alpha (α)	Beta (β)	R^2
MDZ	-0.003**	0.9353**	0.7736
	(0.0005)	(0.0096)	
MZY	-0.0075**	0.8316**	0.6829
	(0.0006)	(0.0125)	
OZY	-0.0092**	0.8046**	0.6154
	(0.0006)	(0.012)	
TNZ	-0.0036**	0.9246**	0.7662
	(0.0004)	(0.0081)	
FNZ	-0.0026**	0.9404**	0.7456
	(0.0003)	(0.0081)	
Average			0.7167

Note: Panel A presents the alpha and beta from Jensen's model ($R_{ETF\,i,t} - R_{ft}) = \alpha + \beta(R_{INDEX\,i,t} - R_{ft}) + \varepsilon_{i,t}$. R_{ETF} denote the return on ETF and R_{INDEX} denote the return on underlying index, R_{ft} denote the risk free rate which is one year government bond yield. β measure risk and α measures the performance of ETF. Standard error are shown in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

Panel B
Null hypothesis test: beta =1

	Beta
MDZ	0.9353**
	(-6.7546)
MZY	0.8316**
	(-13.5125)
OZY	0.8046**
	(-16.2385)
TNZ	0.9246**
	(-9.3100)
FNZ	0.9404**
	(-7.3577)

Note: Panel B presents the null hypothesis: beta=1 for the regression equation :$(R_{ETF\ i,t} - R_{ft}) = \alpha + \beta(R_{INDEX\ i,t} - R_{ft}) + \varepsilon_{i,t}$, The dependent and independent variable are shown in table, with standard errors in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

5.3 Determinants of tracking error

Three approaches are implemented to measure the tracking errors of five NZ ETFs in this study. As mentioned in section 3, TE1, TE2, and TE3 denote the tracking error calculated by method 1, method 2, and method 3, respectively. The average TE column takes the average of three measures as TE = (TE1 +TE2 + TE3)/3. Table 6 presents the results of tracking errors estimation in three different methods over the sample period between 2001 and 2014 when the data is available for individual ETFs.

TABLE 6: TRACKING ERROR

	MDZ				MZY		
	TE 1	TE 2	TE 3		TE 1	TE 2	TE 3
Mean	0.0056	0.0065	0.0088	Mean	0.0073	0.0099	0.0128
STD	0.0070	0.0032	0.0047	STD	0.0087	0.0045	0.0060
Kurtosis	22.979	5.327	14.256	Kurtosis	28.764	2.994	4.083
Skewness	3.365	1.721	2.552	Skewness	3.929	1.356	1.556
Minimum	0.0000	0.0012	0.0012	Minimum	0.0000	0.0023	0.0030
Maximum	0.1070	0.0281	0.0500	Maximum	0.1114	0.0395	0.0503
Average	0.0070			Average	0.0100		

OZY	TE 1	TE 2	TE 3
Mean	0.0081	0.0102	0.0133
STD	0.0091	0.0052	0.0067
Kurtosis	25.093	13.665	13.962
Skewness	3.436	2.716	2.745
Minimum	0.0000	0.0022	0.0028
Maximum	0.1472	0.0570	0.0709
Average	0.0105		

TNZ	TE 1	TE 2	TE 3
Mean	0.0066	0.0073	0.0095
STD	0.0069	0.0037	0.0047
Kurtosis	16.836	13.353	11.833
Skewness	2.830	2.654	2.538
Minimum	0.0000	0.0012	0.0019
Maximum	0.0978	0.0418	0.0493
Average	0.0078		

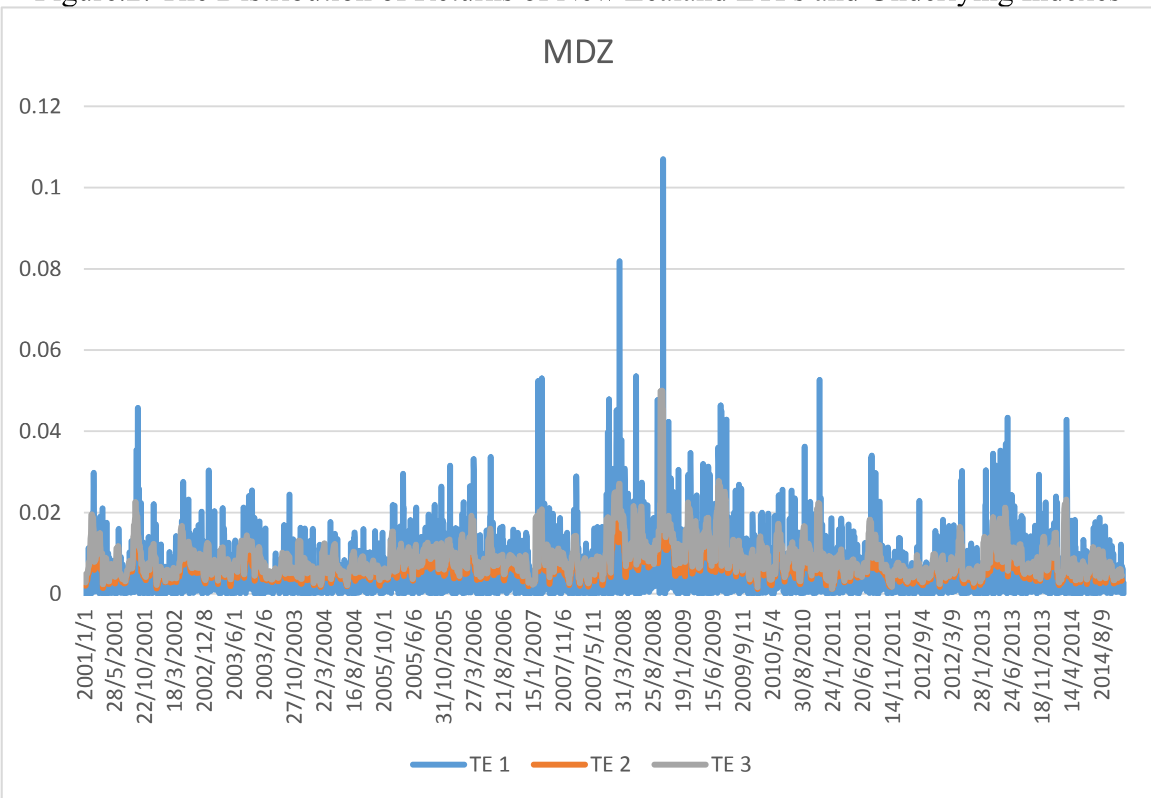
FNZ	TE 1	TE 2	TE 3
Mean	0.0070	0.0078	0.0106
STD	0.0086	0.0043	0.0062
Kurtosis	13.518	3.851	4.761
Skewness	2.973	1.706	1.882
Minimum	0.0000	0.0019	0.0028
Maximum	0.0912	0.0343	0.0454
Average	0.0085		

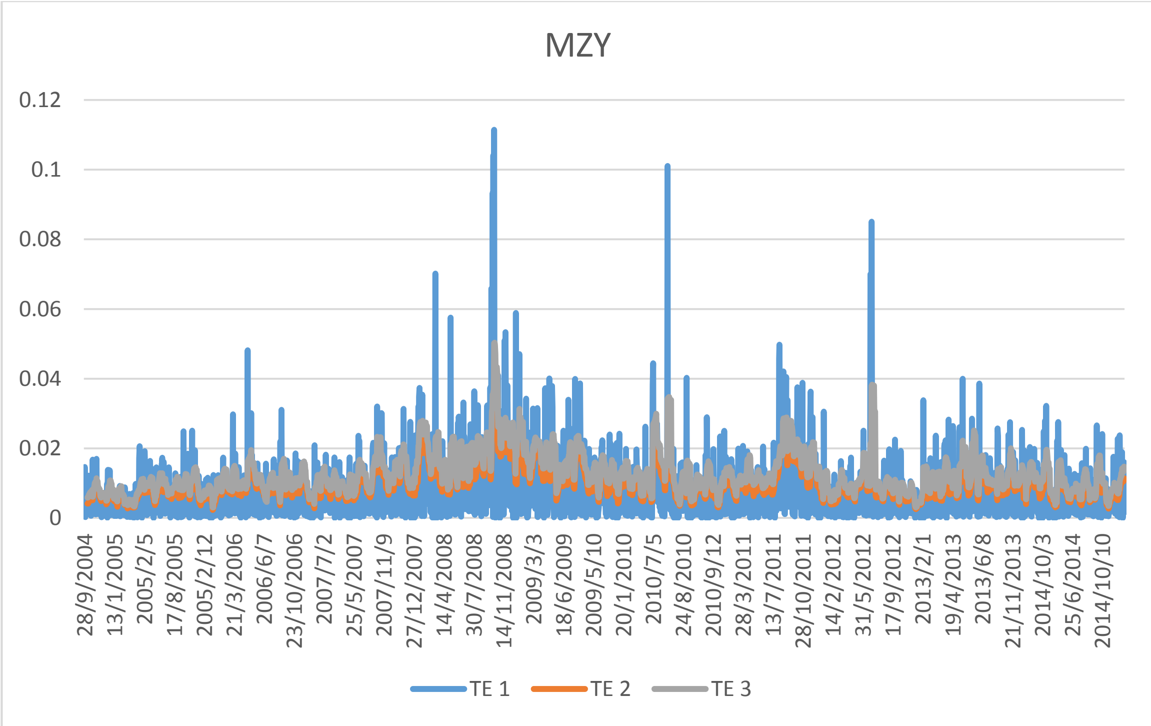
Note: The table 6 presents the descriptive statistics of tracking error for the five New Zealand ETFs. The measures are calculated as the methods described in the section 4.4. TE1 measures tracking error 1, residuals of regression (4). TE 2 measures tracking error 2, the average absolute difference between ETF and index return. TE 3 measures the tracking error 3, standard deviation of difference between ETF and index return. Average TE measures the average of three different tacking errors. Average TE = (TE1 +TE2 + TE3)/3

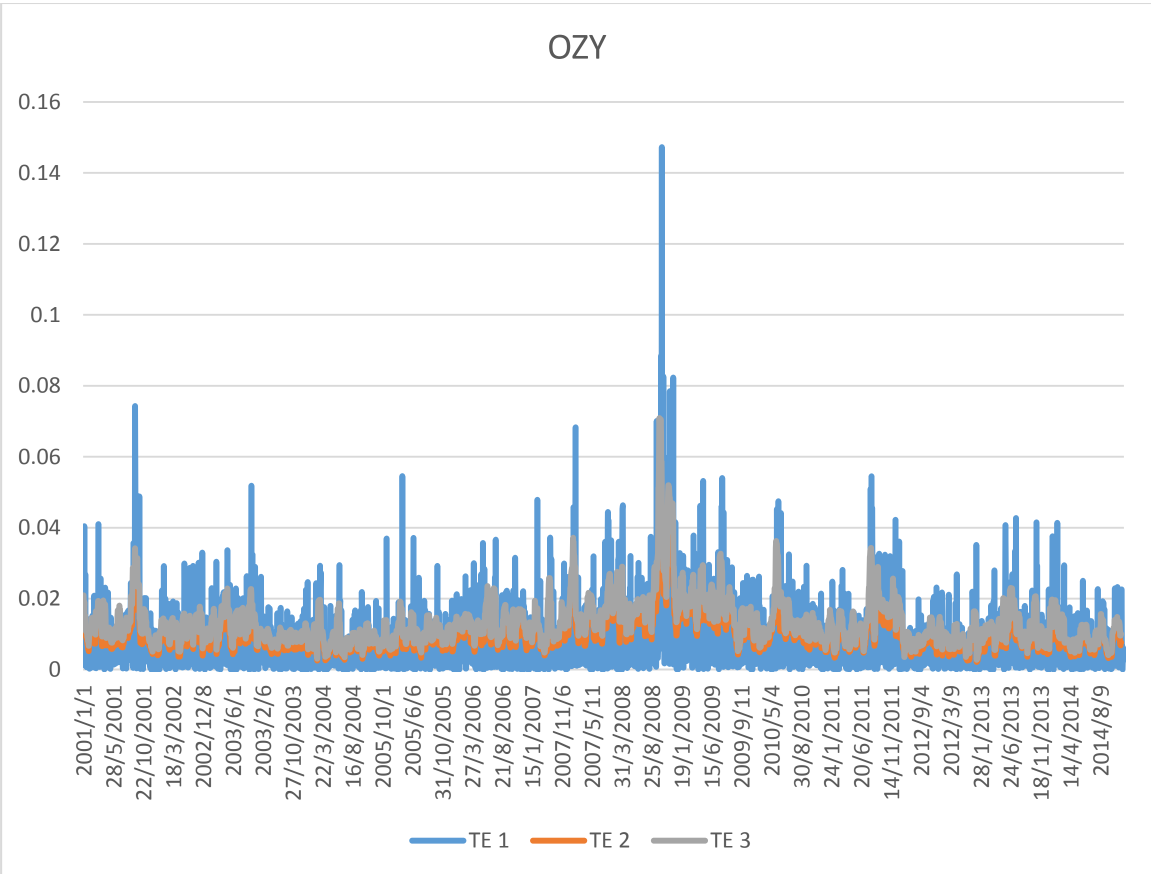
The tracking error is used to reflect the deviation between the ETF and underlying index over time. In Table 6, it can be seen that the TEs of the five New Zealand ETFs vary from 0.007 to 0.0105 with an average of 0.0088. We also find that all Skewness are positive with the range between 1.356 and 3.929, implying that most of these tracking errors are set to left of central point (negative). The range of Kurtosis is between 3.851 and 25.093. Specifically, all the kurtosises are greater than 3, indicating that the tracking errors are peaked relative to normal distribution than underlying indexes. The tracking errors patterns are also shown in Figure 2. It is easy to see the skewness and kurtosis for each tracking error. In sum, Table 6 and Figure 2 indicate that the New Zealand ETFs are fail to perfectly track their underlying indexes. That is, these ETFs appear to have difficulty in achieving the same returns as the corresponding indexes. There, the New Zealand ETFs do not provide a perfect replacement for the tracking index for local investors here.

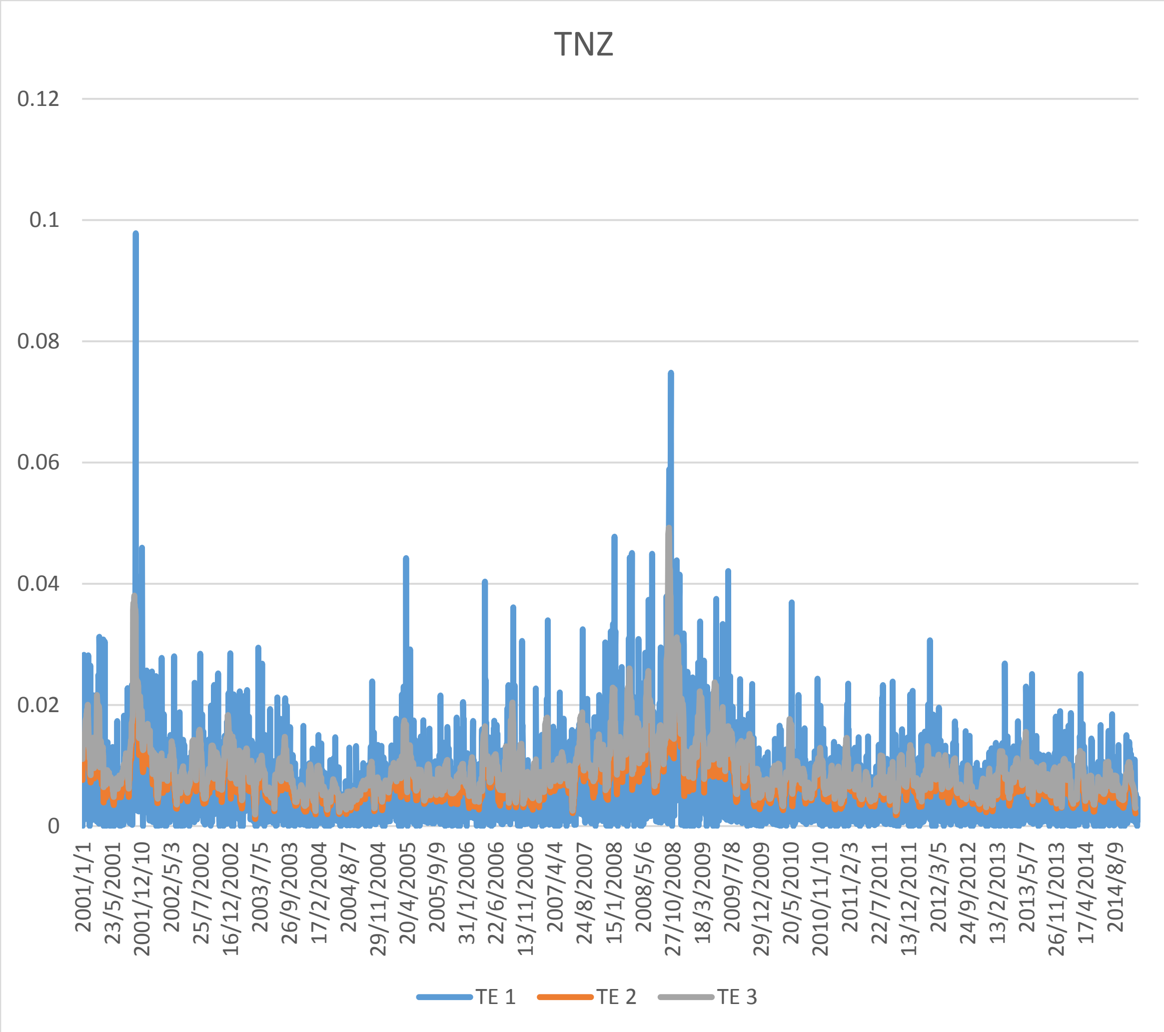
Smartmidz (MDZ) tracking NZ MidCap Index has the lowest average tracking error (0.007), implying a lowest deviation of ETF from the underlying index. In other words, it indicates that MDZ tracks underlying index more accuracy than other ETFs in New Zealand. On the other side, OZY tracking S&P/ASX 20 Index has the maximum tracking error records, with the average tracking error of 0.0105. It appears that OZY is tracking ETF worst among all five NZ ETFs in our sample. That is, the deviation between ETF and underlying index is highest.

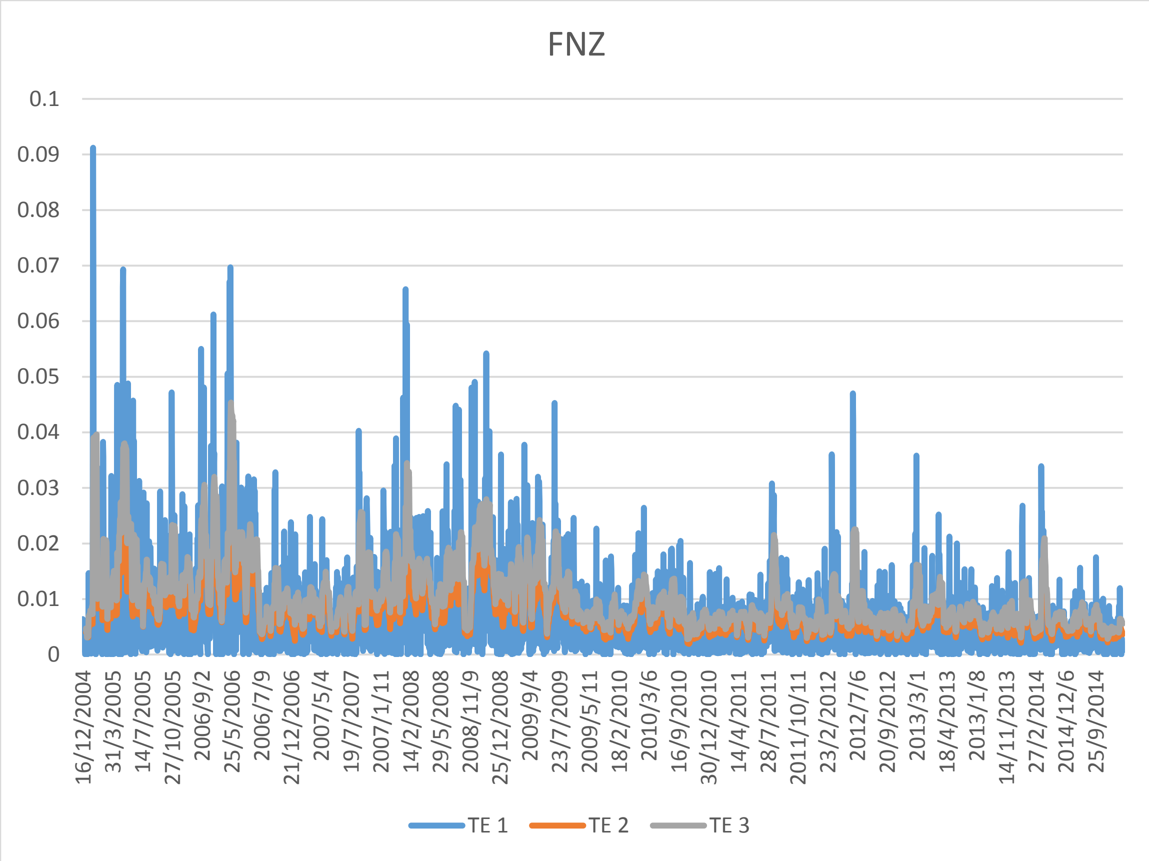
Figure.2: The Distribution of Returns of New Zealand ETFs and Underlying Indexes




MZY
0.12
0.1
0.08
0.06
0.04
0.02
0
28/9/2004
13/1/2005
2005/2/5
17/8/2005
2005/2/12
21/3/2006
2006/6/7
23/10/2006
2007/7/2
25/5/2007
2007/11/9
27/12/2007
14/4/2008
30/7/2008
14/11/2008
2009/3/3
18/6/2009
2009/5/10
20/1/2010
2010/7/5
24/8/2010
2010/9/12
28/3/2011
13/7/2011
28/10/2011
14/2/2012
31/5/2012
17/9/2012
2013/2/1
19/4/2013
2013/6/8
21/11/2013
2014/10/3
25/6/2014
2014/10/10
TE 1
TE 2
TE 3


OZY
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2001/1/1
28/5/2001
22/10/2001
18/3/2002
2002/12/8
2003/6/1
2003/2/6
27/10/2003
22/3/2004
16/8/2004
2005/10/1
2005/6/6
31/10/2005
27/3/2006
21/8/2006
15/1/2007
2007/11/6
2007/5/11
31/3/2008
25/8/2008
19/1/2009
15/6/2009
2009/9/11
2010/5/4
30/8/2010
24/1/2011
20/6/2011
14/11/2011
2012/9/4
2012/3/9
28/1/2013
24/6/2013
18/11/2013
14/4/2014
2014/8/9
TE 1
TE 2
TE 3


TNZ
0.12
0.1
0.08
0.06
0.04
0.02
0
2001/1/1
23/5/2001
2001/12/10
2002/5/3
25/7/2002
16/12/2002
2003/7/5
26/9/2003
17/2/2004
2004/8/7
29/11/2004
20/4/2005
2005/9/9
31/1/2006
22/6/2006
13/11/2006
2007/4/4
24/8/2007
15/1/2008
2008/5/6
27/10/2008
18/3/2009
2009/7/8
29/12/2009
20/5/2010
2010/11/10
2011/2/3
22/7/2011
13/12/2011
2012/3/5
24/9/2012
13/2/2013
2013/5/7
26/11/2013
17/4/2014
2014/8/9
TE 1
TE 2
TE 3



Next, we want to identify what are the factors driving the tracking errors, using the time series regression, i.e. the factors that influence ETF to replicate the index performance. These factors include management fees ratio, ETF return risk, daily volatility, ETF volume, and exchange rate. Table 7 shows the results of time series regression, where MFR denotes the management fees ratio, ERR denotes ETF return risk computed as standard deviation of ETF return, Dvolatility denotes daily volatility which computed as (Highest price – lowest price)/close price, Lvolume denotes the natural logarithm of daily volume, and Exchrate denotes the exchange rate between current currency with index currency which is Australian dollar to New Zealand dollar (NZD/AUD).

TABLE 7: TRACKING ERROR FACTORS

Smartfonz (FNZ)

	Dependent variable		
	TE1	TE2	TE3
Intercept	0.0048	0.0029**	0.0011
	(0.0029)	(0.0007)	(0.0008)
MFR	-0.1426	-0.1185**	-0.1140**
	(0.0875)	(0.0210)	(0.0252)
ERR	0.5227**	0.6289**	0.9196**
	(0.0262)	(0.0063)	(0.0076)
Dvolatility	0.3481**	0.0040	-0.0009
	(0.0186)	(0.0045)	(0.0054)
Lvolume	-0.0009**	-0.00005	-0.00012
	(0.0003)	(0.000071)	(0.000086)
Excharate	0.0002	-0.00064	0.0015
	(0.0027)	(0.00065)	(0.00079)
R-squared	0.3336	0.8398	0.8856

Smartmidz (MDZ)

	Dependent variable		
	TE1	TE2	TE3
Intercept	0.0063**	0.0030**	0.0035**
	(0.0024)	(0.0006)	(0.0008)
MFR	0.0505	0.0365*	0.0447*
	(0.0564)	(0.0143)	(0.0192)
ERR	0.6163**	0.5484**	0.8298**
	(0.0278)	(0.0071)	(0.0095)
Dvolatility	0.2864**	0.0071	0.0088
	(0.0202)	(0.0051)	(0.0069)
Lvolume	-0.0005*	-0.00011	-0.0001
	(0.00025)	(0.00006)	(0.000086)
EXCHRATE	-0.0044	-0.00084	-0.0016
	(0.0026)	(0.00065)	(0.00087)
R-squared	0.2608	0.7282	0.7721

Smartmozy (MZY)

	Dependent variable		
	TE1	TE2	TE3
Intercept	0.0104**	0.0148**	0.0201**
	(0.0024)	(0.0009)	(0.0011)
MFR	-0.0608	-0.0456*	-0.0648**
	(0.0524)	(0.0200)	(0.0246)
ERR	0.3814**	0.4799**	0.6752**
	(0.0243)	(0.0093)	(0.0114)
Dvolatility	0.4683**	0.0091	-0.0013
	(0.0210)	(0.0080)	(0.0098)
Lvolume	-0.0012**	-0.00015	-0.00033*
	(0.0003)	(0.00013)	(0.00015)
Exchrate	-0.0044	-0.0105**	-0.0147**
	(0.0027)	(0.0010)	(0.0013)
R-squared	0.3334	0.5933	0.6542

Smartozzy (OZY)

	Dependent variable		
	TE1	TE2	TE3
Intercept	0.003	0.0094**	0.0111**
	(0.0025)	(0.0010)	(0.0012)
MFR	-0.1073*	-0.1417**	-0.1534**
	(0.0482)	(0.0189)	(0.0233)
EER	0.4738**	0.5648**	0.7586**
	(0.0208)	(0.0081)	(0.0101)
Dvolatility	0.3538**	0.0082	0.0112
	(0.0161)	(0.0063)	(0.0078)
Lvolume	-0.0009**	-0.00052**	-0.00071**
	(0.0003)	(0.00011)	(0.00014)
Exchrate	0.0029	-0.0027*	-0.0026
	(0.0028)	(0.0011)	(0.0014)
R-squared	0.3331	0.6565	0.6895

Smarttenz (TNZ)

	Dependent variable		
	TE1	TE2	TE3
Intercept	0.0055*	0.0041**	0.0048**
	(0.0022)	(0.0008)	(0.0009)
MFR	0.2439**	0.1763**	0.2261**
	(0.0629)	(0.0217)	(0.0265)
EER	0.5178**	0.5619**	0.7388**
	(0.0218)	(0.0075)	(0.0092)
Dvolatility	0.2498**	0.0065	0.0090
	(0.0168)	(0.0058)	(0.00705)
Lvolume	-0.0012**	-0.00038**	-0.0005**
	(0.00018)	(0.00006)	(0.000076)
Exchrate	-0.00033	-0.0014	-0.0011
	(0.0023)	(0.00078)	(0.00095)
R-squared	0.2564	0.6673	0.6986

Note: This table shows the results of regression to test the impact of these factors on three different types of tracking error. The time series regression are conducted as $TE_t = \alpha_1 + \alpha_2.MFR + \alpha_3\ ERR_t + \alpha_4.Dvolatility_t + \alpha_5.\ L_{Volumet} + \alpha_6.Exchrate_t + \varepsilon_t$. The dependent variable is tracking error of the five New Zealand ETFs. The independent variables are MFR (management fees ratio), ERR (ETF return risk computed as standard deviation of ETF return), Dvolatility (daily volatility computed as (Highest price – lowest price)/close price), Lvolume (the natural logarithm of daily volume), and Exchrate (the exchange rate between current currency with index currency which is Australian dollar to New Zealand dollar (NZD/AUD)). TE 1 is the tracking error method 1, which is standard error from the regression $R_{ETF\ i,t} = \alpha + \beta R_{INDEX\ i,t} + \varepsilon_{i,t}$. TE 2 is the tracking error method 2, which is average of the absolute difference between ETF returns and index returns as the following equation. TE 3 is tracking error method 3, which is the standard deviation of the difference between ETF returns and index returns. All the standard error is shown in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

Three types of tracking error are implemented as dependent variable of the time series regression, to determine which factors are significantly related to the tracking error. It can be seen that management fees ratio (MFR) is significant across most of the models at the significance level of either 1% or 5%, whereas insignificant for tracking error 1 (TE 1) of four ETFs, including FNZ, MDZ ,MZY and OZY. Most of significant coefficient estimates are negative ranging between -0.1514 and -0.0456, indicating that one unit increase in MFR results in a decrease of tracking error by -0.106 on average. However, we find five positive coefficient estimates for TE 2 and TE 3 of MDZ, TE 1 TE2 and TE3 of TNZ, which are range of 0.0365 to 0.2439. It means that one unit increase of MFR leads to an increase in these five tracking errors. In general, we find a negative relationship between MFR and tracking error, indicating that any reduction in management fee could help improve the role of the New Zealand ETFs as a perfect substitution for specific index preferred by local investors here.

ETF return risk (ERR) is another important factor to explain the tracking error. ERR is significant in all types of tracking error at 1% level, it is highly significant. The coefficients in all smart shares are positive. The ETF return risk positive related to the tracking error, this mean that highly ETF return volatility highly effect on ETF tracking error calculation. The value of coefficients is from 0.3814 to 0.9196, this indicate one unit of ERR increase, leading to from 0.3814 to 0.9196 tracking error increase, so the deviation of ETF and underlying index will be increase from 0.3814 to 0.9196. The coefficients value for ERR is not exceed one, this shows ERR have no probability to replicate tracking error.

Daily volatility is a factor to explain the tracking error, measures market change to effect tracking error. In my result, Daily volatility is significant at 1% level in five ETFs Tracking error method 1 (TE 1). The coefficients for all tracking error estimation are positive, it means daily ETF price change can makes ETF cannot track underlying index. The value is from 0.2498 to 0.4683. It is indicate one unit of daily volatility increase, result of tracking error increase from 0.2498 to 0.4683, the deviation of ETF and underlying index will be increase from 0.2498 to 0.4683. However, only half of the daily volatility is significant in tracking error estimation, so the daily volatility should not be an important factor to explain the tracking error.

Natural logarithm of volume measures the liquidity of the ETF share. It is a factor to explain the tracking error. Lvolume is significant in FNZ TE 1, MDZ TE 1, MZY TE 1 and TE 3, three methods of tracking error in OZY and TNZ at 1% and 5% level. All the coefficients for all tracking error estimation in Lvolume are negative; it is negatively relationship between tracking error and Lvolume. The value is between -0.0003 to -0.0012, it indicate one unit of natural logarithms volume increase, the tracking error should decrease from 0.0003 to 0.0012, and the deviation will decrease from 0.0003 to 0.0012. Natural logarithms is the factor with negative coefficients. It is different with other factor. Negative value can be decrease the tracking error estimation. It means Lvolume can be a solution to minimise the tracking error.

Exchange rate between current currencies with index currency which is Australian dollar to New Zealand dollar (NZD/AUD). The change in exchange rate measures exchange rate effect tracking error. In my empirically result in table 7, it is can easily to figure out that exchange rate is significant in MZY tracking error 2 and tracking error 3 at 1% level, the coefficients are -0.0027 and -0.0026 respectively. This means when increase one unit of exchange rate, tracking error in MZY TE 2 and TE 3 decrease 0.0027 and 0.0026, and the deviation between ETF and underlying index will decrease 0.0027 and 0.0026. However, there are only two of tracking error are significant. Other tracking error estimation are not significant. So the exchange rate cannot be a factor to explain the tracking error.

Put all together, our results show that ERR and MFR are the most significant factors that affect tracking error. The average of significant coefficient estimates for ERR is 0.6154 and the average for MFR is 0.0081, respectively. Both have positive impact on the ETF tracking error which is consistent with result documented in Rompotis (2006). One unit of ERR increase, average tracking error will increase 0.6154, average deviation between ETF and underlying index increase 0.6154. One unit of MFR increase, average tracking error will increase 0.0081, average deviation between ETF and underlying index increase 0.0081. It implying the perceiving of return risk and management fees impact on ETF replication ability, due to high risk and more management fees charged by ETF shares lead to fail replicate of index.

Dvolatility is the inferior factor that will affect tracking error, it is significant at FNZ, MDZ, MZY, OZY and TNZ tracking error method 1. The average significant coefficient for Dvolatility is 0.3413. One unit of Dvolatility increase, average tracking error will increase 0.3413, average deviation between ETF and underlying index increase 0.3413. It indicates the intraday ETF price changes impact on the ETF replication, due to intraday ETF price changes lead to arbitrage opportunity, investors buy and sell on ETF share, makes ETF share price changes and does not follow index.

L_{volume} is different from other factors, since it has a negative impact on the tracking error. In other words, the more liquidly an ETF is trading on the market, the less tracking error this ETF has from its underlying index. Thus, increasing trading volume could help minimise the tracking error. In other words, in order to make ETFs as a perfect substitution for preferred indexes, it is very important to increase the liquidity of the New Zealand ETF markets.

5.4 DETERMINANTS OF ETF TRADING VOLUME

In this study, we are also interested in what factors are driving the trading volume of the ETFs issued in the New Zealand, because liquidity is an essential concern to develop a financial market. The model is estimated as below with the logarithm of daily trading volume as the dependent variable. Four variables are included in the regression. More specifically, the dependent variable (Lvolume) is defined as the natural logarithm of daily ETF shares issued at a trading day, while one regressor (Traded) measures the number of ETF shares traded in the current day.

$$L_{volume,\,t}=\alpha_1+\alpha_2 D_{volatility,\,t}+\alpha_3 Traded_t+\alpha_4 Traded_{t-1}+\alpha_5 ERR_{t-1}+\varepsilon_{,t}$$

Table 8 presents the result of the regression for the determinants of the ETF volume.

TABLE 8: DETERMINANT OF TRADING VOLUME OF ETFS

	FNZ	MDZ	MZY	OZY	TNZ
Intercept	4.1488**	3.4397**	3.1881**	3.6249**	3.9540**
	(0.0252)	(0.0238)	(0.0223)	(0.0170)	(0.0223)
Dvolatility	5.2038**	2.1953	4.4754**	2.8298**	7.4804**
	(1.0736)	(1.3927)	(1.1061)	(0.7895)	(1.3567)
Traded	0.0547**	0.1654**	0.1194**	0.0928**	0.1075**
	(0.0017)	(0.0049)	(0.0036)	(0.0019)	(0.0026)
Traded(-1)	0.0046**	0.0050	-0.0001	0.0052**	0.0076**
	(0.0017)	(0.0045)	(0.0034)	(0.0018)	(0.0024)
ERR(-1)	-14.3294**	-8.5421**	-4.8279**	-4.9809**	-2.3549
	(1.4924)	(1.7512)	(1.2428)	(0.9830)	(1.7231)
R-squared	0.3802	0.3571	0.3980	0.4978	0.4368

Note: Table 8 presents the results of time-series regressions for the five New Zealand ETFs in our sample. The dependent variable is Lvolume, regressed as $Lvolume_t=\alpha_1+\alpha_2 Dvolatility_t+\alpha_3 Traded_t+\alpha_4 Traded_{t-1}+\alpha_5 ERR_{t-1}+\varepsilon_{,t}$. The independent variables are defined as: Lvolume is natural logarithm of daily ETF shares volume, Dvolatility is daily ETF price volatility, Traded is ETF shares traded in the current day, Traded (-1) is the ETF shares traded on the previous day, and ERR is one day lag of ETF return risk. Standard errors are shown in parenthesis. *and **denote the test statistic significant at 5% and 1% levels, respectively.

It can see that all the intercepts are significant at 1% level, and the value is from 3.18 to 4.14, indicating that the percentage ETF volumes are traded independently without any factors. All the coefficient estimates of the $D_{volatility}$ are significant at 1% level, with the exception of MDZ. The coefficients are positive is between 2.829 and 7.480, indicating that the ETF daily volatility is positively related to the trading volume. That is, higher price volatility leads to more arbitrage opportunity, and consequently more trading of ETF, which is consistent with Rompotis (2006).

We also check the impact of contemporaneous/lagged total shares of ETFs sold on the market on the trading volume. The coefficient estimates for the contemporaneous shares of ETFs traded (at time t) are significantly positive between 0.0546 and 0.1653. The mean magnitude is 0.1079, showing that one share of individual ETF purchased or sold today could cause this ETF to be traded more in 0.1079 share. On the other side, the coefficient estimate for the lagged number of ETFs traded on the markets at time t-1 is significant at 1% level for FNZ, OZY and TNZ, but insignificant for MDZ and MZY. Put these together, it indicates that the previous shares of ETFs traded at previous trading day have also impact on its trading volume, but not as strong as the contemporaneous one. Indicates ETF shares issued is based on the current and past shares traded, more ETF traded indicate investors interested in ETF, and more ETF shares will be issued.

As expected, the ETF return risk (ERR) is significantly negatively related to the liquidity at 1% confidence level, with the only exception of TNZ. The estimates vary between -14.32 and -4.82, with a mean value of -8.17. It means that the trading volumes of the New Zealand ETFs will decrease by 8.17% per each percentage change in ERR over past last weeks or ten trading days. This is consistent with our hypothesis. It suggests that most of investors avoid the ETFs with highly measure of ETF return risk. That is, more risky ETF becomes, less attractive it becomes to investors in here. Consequently, such ETF companies should not issue more ETF shares.

6. CONCLUSION

To date, there was very limited empirical evidence on the New Zealand ETF markets, given its rapid growth in the last decades. This study contributes to fill the gap by investigating the performance of the New Zealand Exchange Traded Funds (hereafter ETFs), especially focusing on how well these New Zealand ETFs' returns can replicate those of their underlying stock indexes. Moreover, we are aiming to identify the determinants of the tracking errors of New Zealand ETFs. Our results show that all the five New Zealand ETFs in our sample provide higher Sharpe ratios than their corresponding underlying indexes, which are attractive to investors. Similarly to the previous studies on other ETF markets around the world, we find that, on average, there does exist a significant tracking error between the New Zealand ETFs and the corresponding indexes. It implies some issues that local investors in New Zealand may be concerned when attempting to use ETFs to replicate the performance of their preferred indexes.

I also find that all the five New Zealand ETFs in this sample are moving together cointegrated with their underlying indexes but not perfectly correlated, indicating that no arbitrage exists in the New Zealand ETF markets. Furthermore, we find that the tracking error increases with three properties, including management fees ratio (MFR), ETF return-risk (ERR), and daily volatility ($D_{volatility}$), whereas decreases as the liquidity of these ETF markets increases, measured by trading volume (L_{volume}).

Put these together, in order to become a perfect substitute for specific market index available for the local investors in New Zealand, it is important to take into account several potential issues, for example lowering the fund management fees and/or increasing the liquidity of New Zealand ETF markets. This study also contributes new evidence to the literature on the liquidity (trading volumes of) the New Zealand ETFs, which is driving by the factors such as the previous and contemporaneous numbers of ETFs sold on the market. These types of study gives valuable implication for current and future investors and also provide the insights into future development and also contribute to the development of ETFs as well as to investor consciousness, introduce empirical analysis on the relationship between securities and their fundamental.

REFERENCE:

Agapova, A. (2011). Conventional mutual index funds versus exchange-traded funds. *Journal of Financial Markets*, *14*(2), 323-343.

Bansal, V. K., and Somani, A. (2002). Exchange traded funds: Challenge to traditional mutual funds. *Review of Business, 23*(3), 40.

Baş, N. K., and Sarıoğlu, S. E. (2015). Tracking Ability and Pricing Efficiency of Exchange Traded Funds: Evidence from Borsa Istanbul. *Business and Economics Research Journal*, *6*(1), 19-33.

Bernstein, P. J. (2002). A primer on exchange-traded funds. *Journal of Accountancy*, *193*(1), 38.

Blitz, D., Huij, J., and Swinkels, L. (2012). The Performance of European Index Funds and Exchange-Traded Funds. *European Financial Management,18*(4), 649-662.

Bowman, M. (2012). Exchange-traded funds: A powerful tool some advisers keep hush-hush. *Medical Post, 48*(20), 30

Caginalp, G., DeSantis, M., and Sayrak, A. (2014). The nonlinear price dynamics of US equity ETFs. *Journal of Econometrics*, *183*(2), 193-201.

Chang, C. E., and Krueger, T. M. (2012). The case for country-specific closed-end funds instead of exchange-traded funds. *International Business Research, 5*(5), 3-7.

Chau, F., Deesomsak, R., and Lau, M. C. (2011). Investor sentiment and feedback trading: Evidence from the exchange-traded fund markets. *International Review of Financial Analysis*, *20*(5), 292-305.

Chu, P. K. K. (2011). Study on the tracking errors and their determinants: evidence from Hong Kong exchange traded funds. *Applied Financial Economics*, *21*(5), 309-315.

Corbet, S., and Twomey, C. (2014). Have exchange traded funds influenced commodity market volatility? *International Journal of Economics and Financial Issues, 4*(2), 323-335.

DeFusco, R. A., Ivanov, S. I., and Karels, G. V. (2011). The exchange traded funds' pricing deviation: analysis and forecasts. *Journal of Economics and Finance*, *35*(2), 181-197.

De Winne, R., Gresse, C., and Platten, I. (2014). Liquidity and risk sharing benefits from opening an ETF market with liquidity providers: Evidence from the CAC 40 index. *International Review of Financial Analysis*, *34*, 31-43.

Elia, M. (2012). Tracking Error of Traditional and Synthetic European Exchange-Traded Funds. *Available at SSRN 2003976*.

Elton, E. J., Gruber, M. J., Comer, G., and Li, K. (2005). *Spiders: Where are the bugs?* (pp. 37-59). Springer Berlin Heidelberg.

Engle, R. F., and Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Harper, J. T., Madura, J., and Schnusenberg, O. (2006). Performance comparison between exchange-traded funds and closed-end country funds. *Journal of International Financial Markets, Institutions and Money*, *16*(2), 104-122.

Hilliard, J. (2014). Premiums and discounts in ETFs: An analysis of the arbitrage mechanism in domestic and international funds. *Global Finance Journal*, *25*(2), 90-107.

Jiang, Y., Guo, F., and Lan, T. (2010). Pricing Efficiency of China's Exchange-Traded Fund Market. *Chinese Economy*, *43*(5), 32-49.

Krause, T., and Tse, Y. (2013). Volatility and return spillovers in Canadian and US industry ETFs. *International Review of Economics & Finance*, *25*, 244-259.

Lin, A., and Chou, A. (2006). The tracking error and premium/discount of Taiwan's first exchange traded fund. *Web Journal of Chinese Management Review*, *9*(3), 1-21.

Marshall, B. R., Nguyen, N. H., and Visaltanachoti, N. (2013). ETF arbitrage: Intraday evidence. *Journal of Banking & Finance*, *37*(9), 3486-3498.

McGuire, W. J., and Helmrich, R. F. (2008). The SEC's ETF rule proposal: Key issues for the future exchange traded products. *Investment Lawyer*, *15*, 1-13.

Nguyen, V., and Phengpis, C. (2009). An analysis of the opening mechanisms of Exchange Traded Fund markets. *The Quarterly Review of Economics and Finance*, *49*(2), 562-577.

Poterba, J. M., and Shoven, J. B. (2002). *Exchange traded funds: A new investment option for taxable investors* (No. w8781). National Bureau of Economic Research.

Prasanna, P. K. (2012). Performance of exchange-traded funds in India. *International Journal of Business and Management, 7*(23), 122-143.

Qadan, M., and Yagil, J. (2012). On the dynamics of tracking indices by exchange traded funds in the presence of high volatility. *Managerial Finance*, *38*(9), 804-832.

Rompotis, G. G. (2006). The Performance of Swiss Exchange Traded Funds. *Available at SSRN 929460*.

Rompotis, G. G. (2011). Testing weak-form efficiency of exchange traded funds market. *Aestimatio,* (2), 2-33

Shin, S., and Soydemir, G. (2010). Exchange-traded funds, persistence in tracking errors and information dissemination. *Journal of Multinational Financial Management*, 20(4), 214-234.

Tseng, T. C., Lee, C. C., and Chen, M. P. (2015). Volatility forecast of country ETF: The sequential information arrival hypothesis. *Economic Modelling*, *47*, 228-234.

Wang, L., Hussain, I., and Ahmed, A. (2010). Gold exchange traded funds: Current developments and future prospects in china. *Asian Social Science, 6*(7), 119-125.

Yang, J., Cabrera, J., and Wang, T. (2010). Nonlinearity, data-snooping, and stock index ETF return predictability. *European Journal of Operational Research*, *200*(2), 498-507.