Tracking Error in Index Funds

نسبة الانحراف في محافظ المؤشرات

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Abstract

The present research investigates the tracking error in UAE index funds and explores the tracking error related models. Five tracking models were used and divided into two major types. The first type is the Quadratic tracking Error Model which extensively studied by (Roll, 1992) and included one model. The second type is the Mean Absolute Deviation Tracking Error Models and covers four models. Mean Absolute Deviation Tracking Error Model is following linear programming methods (Rudolf, Hurgen, & Heinz, 1999).
The empirical data were collected from Emirates Securities Market (ESM). Four major funds have been studied and analyzed. Tracking error models have been implemented on the funds using the historical net asset values (NAVs). Each model has been implemented separately on each fund to investigate the effect on the percentage of the differences between the fund's returns and benchmark's returns.

المقدمـة

ان هذه الورقة البحثية تبحث و تعالج مشكلة نسبة الانحراف في محافظ المؤشرات المستثمرة في الامارات العربية المتحدة عبر استخدام أهم النماذج التحليلية التي عالجت نسبة الانحراف في محافظ المؤشرات.

لقد تم تطبيق خمس نماذج تحليلية لدراسة نسبة الانحراف و ايجاد أفضل الطرق لتقليل نسبة الانحراف بين محافظ المؤشرات و المؤشر الذي تتبعه لمعرفة الاداء. تم تقسيم تلك النماذج الى قسمين و ذلك حسب المعايير التحليلية التي تتبعها تلك النماذج. القسم الاول يسمى نسبة الانحراف التربيعي و الذي درس بإستفاضة من خلال (رول، 1992). هذا القسم تضمن نوذجا تحليلا واحدا.

أما القسم الثاني فقد تضمن اربعة نماذج تحليلية و قد أدرجت ضمن فئة نسبة الانحراف المطلق لعائد محافظ المؤشرات. ان نسبة الانحراف المطلق كتحليل مالي مبني على مبدأ البرمجة الخطية في تحليل عائد محافظ المؤشرات بدلا من التحليل التربيعي لنسبة الانحراف مابين أداء المحفظة الاستثمارية و المؤشر المتبع. هذه النماذج التحليلية الاربع تم دراستها و تحليلها حسب طريقة (رودولف، هيرجن، هينز،1999).

إن البيانات العملية قد تم استخلاصها من سوق دبي المالي و سوق الامارات المالي ومن خلال البيانات المنشورة للمحافظ الاستثمارية التي تتبع المؤشرات المختصة بسوق الامارات. لقد تم اعتماد صافي قيمة الاصول للمحتفظ الاستثمارية لمعرفة ادء محافظ المؤشرات و تطبيق المعادلات الرياضة لاحتساب نسبة الانحراف حسب النماذج الخمسة المذكورة أعلاه.

Chapter One
Introduction

1.1Introduction

The relationship between funds' managers and investors is identified through so many ways. Particularly, index investors have a settled goal of having a fund mimicking a benchmark or an index. In real life, it will be impossible to have a full mimic of the benchmark and then the only way is to buy the full market. Transactions cost, cash flows, and fund's manager strategies are the factors that affect the full replication of the benchmark.

To evaluate the fund's manager performance, an important tool called Tracking Error is used and calculated. This tool can give even a historical evidence or a predicting proposal of how far is the fund's return going to match the benchmark returns after deducting all fees and adding all incomes or dividends.

This research is aiming to provide a comprehensive study of tracking error analysis and the most famous models that have been used to reduce the tracking error volatility (TEV). Many researchers have been studying and analyzing the nature of the tracking error and the best reform of it. (Roll, 1992) has studied the quadratic tracking error in his study of the mean/variance analysis of the funds. Form a different angle, (Rudolf, Hurgen, & Heinz, 1999) provided a linear model to calculate the tracking error from absolute deviation perspective.

The study of the tracking error cannot be completed without studying the factors affecting it and the related areas which have an indirect impact on portfolio's tracking error. For example, the tracking error for the active management is different of the tracking error of passive management. Tracking error can be categorized by time nature such as Ex-Ante Tracking Error and Ex-Post Tracking Error.

UAE stock market is having an increased demands of funds can follow an index or a local benchmark. Many banks have provided an indexes that can be followed by fund's managers such as, MSCI UAE Index, S&P UAE Domestic Index and many else.

Such a demand will encourage the investors as well as funds' managers to add more index funds to local market and use the tracking error as one of the major tools to evaluate the fund's performance and how far mimicking the benchmark.

1.2 Research Outline

The research has been built and constructed in a way to give the maximum benefits to researchers and provide comprehensive analysis about the tracking error. Index funds market is still a new and small comparing to the index markets in USA and Europe. So there is a high need for researches specified and focused on index markets and tracking error models to expand the knowledge throughout the UAE investors.

The research is consisted of five chapters. The first chapter is giving a brief about the tracking error and the index funds and what are the connections between them. It also summarizes the research plan and the area which has been studied.

Chapter two is the literature review discussion. This chapter is the core of the research and studied the tracking error heavily and analyzed the most famous theories have been into it. Studying tracking error without the studying the direct or indirect factors that affect tracking error will take the research away from the big picture. All related fields has been put and organized in to give the full view of tracking error and its components.

To have a better understanding about how the research has been built, chapter three is explaining the methodology and the data has been used and implemented. An appropriate methodology was chosen to suit the topic of the research and the market has been studied.

The type of the research is more related to the portfolio management researches. Nevertheless, it has a strong relation with statistics and econometrics studies. Chapter four is the main part that shows these relations. Collecting real data from UAE market, analyzing it, reform it; applying the tracking error models and comparing the results are the main sub chapters were included in chapter four.

Chapter five includes the research conclusion and the recommendations raised from the research. It summarizes and analyzes the results and present the last research view about topics has been studied.

1.3 Conclusion

The objective of the research is to explore and explain the behavior of the tracking error and its related factors. This unique behavior has been studied and analyzed to have a better understanding about the path it is following.

Chapter Two

Literature Review

2.1 Tracking Error Analysis

2.1.1 Introduction

"*Index Funds Win Again*", this was the article's name published in New York Times by Mark Hulbert. The article shows how the index funds beat the other type of funds even with financial crises. Low taxes, transactions cost and management performance fees are the main advantages of Index Funds.
Simply speaking, Index Funds is one type of the mutual funds that aims to replicate on index the same proportion of the securities in a particular index. A definition was produced by SEC:

"An "index fund" describes a type of mutual fund or unit investment trust (UIT) whose investment objective typically is to achieve approximately the same return as a particular market index, such as the S&P 500 Composite Stock Price Index, the Russell 2000 Index or the Wilshire 5000 Total Market Index."

A research paper by (Shah & Fernandes, 2000) has studied the index funds industry in developed and developing countries. They analyzed the market efficiency and the impact on index funds to track its benchmark. Index funds were normal reaction from the theory of the market efficiency. Three reasons played a major role in the less developed countries led to inefficient markets. These reasons are difficulty of information access, high trained human capital and the high transaction cost as by (Shah & Fernandes, 2000). They conclude that the benchmark always beat the active fund's managers for the long term. Active managers can beat the index or benchmark only for the short term.

Sometimes the return on index funds is different than the returns on the benchmark index. These differences called Tracking Error (TE). As a type of mutual funds, a huge number of investors are included in this pool of investment vehicle, opening and closing their

positions or even increasing or decreasing their participations in the index fund. In order to compare the risk with returns from the index funds, the standard deviation of the tracking error should be calculated and henceforth called Tracking Error Volatility (TEV).

Many factors such as cash inflows, cash outflows, transaction costs and performance fees are affecting the tracking error. (Goetzmann & Massa, 2003) pointed that delaying the investors order can have a positive economic gains but in the other hand will increase the tracking error of the portfolio. The main reason of that is because have a positive or negative cash balance in the portfolio.

Some researchers have gone beyond the benchmarking and find different ways to measure the performance of the index funds or even the managed portfolio. (Winfried, Hallerbach, & Igor, 2005) has examined the Dow-Jones EURO STOXXX 50 as a benchmark and calculate the compounded returns for the 50 stocks from 1995 to 2005 (125 monthly returns). At the same time, they constructed an index with equally weighted securities (EQ) and calculated the returns on EQ. The study focused on the portfolio opportunity set which indicate a huge numbers of portfolios can be created from the same benchmark index. They argued that not only the TEV should be the only way to judge the index fund portfolio but also it should be compared with portfolio opportunity set approach.

In contrary, the relationship between the tracking error and the fund's diversification properties has been noted by (Potter, 2001). In his research, he studied the statistical distribution of the funds diversification and the funds variability of the funds diversification. His empirical sample consists of 2680 equity mutual funds. He used the Morningstar data base and eliminate the corporate and government funds, international funds, exchange-traded funds (ETF), specialty unaligned funds and global funds. All the sample funds were under single share classes group. The funds data were picked on January 2000 and the observations covered the last ten years. In his analysis of the 2680 funds, he categorized the funds into eight main categories based on the fund's objectives. The categories were Aggressive Growth Funds, Asset Allocation Funds, Balanced Funds,

Equity Income Funds, Growth Funds, Growth and Income Funds, Small Company Funds and All Specialties Funds. One of the primary objectives that he researched was the relationship between the fund's average returns and the fund's tracking error. He used the term of Category Tracking Error (CTE). The category tracking error indicates the funds' return deviation from the funds category average returns. In other word, he compared each fund's performance with its category performance. The second analysis was the Return to Tracking Error (RTE). The return to tracking error is calculated by dividing the funds category average return on the category tracking error.

(Potter, 2001) concluded that the fund's tracking error cannot remain the same over the time. This means that tracking error cannot be predicted for the next trading period. Also, tracking error differs from fund's category to other fund's category because of the fund's objective. He mentioned some factors that affect the fund's tracking error. These factors are fund's beta, turnover, fund's size, expense ratio and manager's tenure.

2.1.2 Ex-Ante versus Ex-Post Measures

Those two terms are highly used in calculating the tracking error. Ex-Ante measure is related to the predictability and the probability of what tracking error percentage could be. Ex-Ante tracking error depends on the funds managers' expectations about the future returns of their portfolio or even the benchmark returns. Ex-Post Tracking error is related to past and historical data of the portfolio returns.

(Soosung & Stephen, 2001) have studied the differences between Ex-Ante Tracking Error and the Ex-Post Tracking Error. They major differences between the Ex-Ante and Ex-Post Tracking Error were that Ex-Post Tracking Error is always larger than Ex-Ante Tracking Error. The main reason for this difference is because the weights of the portfolio and the benchmark are stochastic in nature. Furthermore, they argued that annual tracking error which depends on the daily tracking error cannot be a good estimator because of the serial correlation between the benchmark returns and the portfolio returns. The methodology (Soosung & Stephen, 2001) used depended on two measures of tracking error: Standard Deviation of the Tracking error, which calculates

the standard deviation of the differences between the portfolio's returns and benchmark returns. The second measure was the Mean Absolute deviations of the tracking error (TE MAD).The study was interested in the treatment of the calculation of the portfolio as well as the benchmark stocks weight. It argues that a fix weight for calculation tracking error will underestimate the ex-post tracking error as the weight of the stocks in the market will keep changing.

The results were that the actual tracking error under standard deviation approach (TE_{SD}) will have larger value than the forecasted tracking error. The assumption cannot be applied for the realized tracking error under the mean absolute deviation (TE_{MAD}) and the expected tracking error. It is all because of the stochastic of the differences in weights between the portfolio and benchmark as it can be full or non replication index fund.

From another side, (Frantisek, 2010) reviewed the concept of the ex-ante tracking error with the respect to time projection of underlying factors. He argued that the tracking error returns or other portfolio risk measures should be calculated on linear or total returns instead of continuously compounded returns. Providing a hypothetical example of international mutual investing in 4 equity markets are as follow: 40% US equities, 30% EU equities, 20% BRIC equities and 10% CEE equities. 50% of the USD investment is covered by hedged. 2% of the mutual fund investment is in Cash to cover any investors' daily redemption. The domicile of the mutual fund was in Euro. The methodology has been used is that time projection as the normally distributed continuously compounded returns. The results showed that this methodology is more efficient to the index or passive funds.

2.1.3 Tracking Error of Passive and Active Funds

Studying the tracking error cannot be done without exploring the trading strategies of Index Funds. A study by (Alex, David, & Teddy, 2003) shows the differences on tracking error between the Passive Index Funds and Enhanced Index Funds. The study extremely presents the benefits from the rebalancing the equity portion of the index funds during the revision on the benchmark index. The index funds are more likely to mimic the benchmark and follow the market in revision, which means that a very few orders can be

made during the revision. On the other hand, the enhanced index funds try to generate a higher return and lower transaction cost through a multiple orders during the revision as resulting in a higher tracking error.

The study contained 5index funds and 3 enhanced index funds. Those 8 indexes' size was almost equal to 76.2% from the total Australian index funds assets. The study data used a multiple index providers for its examination, 5 out of 7 passive index providers and 3 out of 5 for enhanced index funds providers. The sample period for the study was from 2 January 1999 to 31 December 2001. The period has been conducted as the entire index funds traded in the market. Trade, quote and stock information are obtained from the ASX Stock Exchange Automated Trading System (SEATS) provided by the Securities Industry Research Centre of Asia-Pacific (SIRCA).

A descriptive analysis for the 8 passive index and enhanced index funds showed the difference in the value of the tracking error. Two measures of the tracking error have been conducted, Absolute Tracking Error and Standard Deviation of the Tracking Error. Enhanced index funds used to have a high absolute tracking error and a high standard deviation of tracking error. This high tracking error occurs because the rebalancing strategies that are used in enhanced index funds. Some researchers gave more attention to the trading strategies in the active funds.

This active management is always under accountability by investors. A good percentage of the investors believe that fund's manager cannot beat the benchmark. This percentage can be figured from the huge number of passive fund's investors. (Gilli & K¨ellezi, 2001) analyzed the problem of the passive fund when it has a semi benchmark replication. Semi replication means that the passive index fund using a number of stocks less than the number of the benchmark's stocks. They used an optimization model based on Threshold Accepting Heuristic (TAH). Their empirical test collected stocks from Hang Seng index (31 stocks), the DAX 100 index (85 stocks), the FTSE 100 index (89 stocks), the S&P 100 index (98 stocks) and the Nikkei index (225 stocks). The total number of assets was 528 assets.

Other researchers studied the active management style such as (Nadima & Paul, 2003) who applied active portfolio strategy using (Jorion, 2002) tracking error efficient frontier methodology. The market test was the Australian Stock market. The market data covered the period from January 1999 to November 2002. The benchmark was a 'reduced benchmark' using Australian All Ordinaries Index (XAO). The reduced index consists of top 30 stocks which contribute 62% from the main index. They reweighted the top 30 to equal 100% of the portfolio. In their empirical study of the time-variation in weights and testing the ex-post tracking error, they proved that short selling constraint can be a safeguard on ex post while reducing the cost of the portfolio rebalancing. On the other hand, short selling constraint moves the active portfolio to be closer to the passive index funds.

The relationship between the investors' goals and the nature of the stochastic market has been studied by (Browne, 1999). This relationship was analyzed from two angles. The first angel is the strategy that maximizes the return of the portfolio in a way to beat the benchmark's return. The core of the active management is to reach to the maximum benefit for the investor wealth before the shortfall started.
The second angle is minimizing the time of achieving the outperformance of the benchmark's return. He applied a model based on continuous-time framework. The main consumption of the continuous-time framework based on that the prices of the equities are correlated geometric Brownian motions. The second part of the model has built the stochastic hypothetical benchmark.

In this subject, many researchers are interested in analyzing time serious and the nature of the stochastic benchmark. (Dose & Cincotti, 2005) has studied the tracking error and excess return for the index funds and enhanced index funds using the time series analysis implementing a Clustering Analysis in their model to analyze the time serious and the stochastic nature of S&P 500 Index. The Clustering Analysis consists of tow analysis. The first analysis was the Hierarchical Clustering which gathers and segments the stocks under the S&P 500 index because of their similarity nature. The second analysis was the

K-Mean Clustering Analysis. The sample data was the daily prices of particular stock listed in S&P 500 and traded in NYSE and NASDAQ markets. The sample period was from 2-Jan-2001 to 2-Jan-2004. The total observations 487 time series and 753 long. The benchmark used was a hypothetical benchmark based on S&P 500. The sample has being divided into sixteen sub sample's periods. Each period lasts for forty trading days. The model concluded that strategies on passive index funds cannot be applicable for the enhanced index funds. For example, passive index funds benefits for high capitalized stocks as using the Trivial Strategy. This strategy can be suitable for the enhanced index funds. Enhanced index funds benefits more from investing in low capitalized stocks.

The previous analysis can highlight another important aspect which is the long only index funds. (Clarke, Silva, & Thorley, 2001) has an interesting findings about the relationship between the tracking error and the transfer coefficient under long-only portfolio's constraints. The findings state that a high tracking error percentage will lead to a small coefficient transfer. In contrast, a smaller tracking error percentage will lead to a higher coefficient percentage. The model used tested a portfolio with S&P index as a benchmark using Monte-Carlo simulation for ten thousands observations.

But not only long-only constraint can be applied to index funds. One of the major constraints is Asset Allocation Constraint. (Ammann & Zimmermann, 2001) have employed a descriptive statics analysis model to identify the effect of the restrictions on tactical asset allocation on statistic tracking error.
A hypothetical benchmark consists of equally weighted assets classes was built. The asset classes consists of US bonds, Canadian bonds, US equities, Japanese equities and European Equities. A historical data were used for the sample period from January 1985 to June 1998. The first finding was that the Japanese stocks were having the lowest return with highest returns volatility. The hypothetical benchmark has a return of 13.5% combined with 10% volatility. General restrictions were applied on the sample such as short selling and the assets classes should add up to unity. Regarding the tactical asset allocation, a pre specified deviation's range of 5%, 10% and 20% has been used for the study. These restrictions will reduce the fund's manager active management. Three

dynamic asset allocations have been used in the study. The first dynamic asset allocation strategy is Random Portfolio re-Balancing. This strategy allows a random portfolio rebalancing during the sample period under the pre specified tactical asset allocation. The second strategy is the Trend-Following Portfolio Re-Balancing Strategy. It is similar to the previous strategy but it will follow tow more constraints. The weight of the highest asset's return for the previous month will not be reduced and must be the highest weight for the existing month. The last strategy is called the Tracking Error maximization Strategy. The findings were that applying a fairly large tactical assets range will reduce the statistic tracking error. This find were generated from the sample as tracking error was 2.31% for the 5% tactical range, 4.61% for the 10% range, 9.32% for the 20% range, and 21.12% for the unconstrained portfolio. The second finding was that lowest attainable correlation coefficients between the tactical portfolios and the benchmark are surprisingly high. The third finding was the relationship between correlation's coefficients of the tactical portfolios and the tracking accuracy of the individual asset is very sensitive. They recommend a tracking accuracy of individual asset along with tactical asset allocation range.

All previous researches were studying the normal index funds. There is another type of index funds called Exchange Traded Funds (ETF). Exchange traded Fund (ETF) market is very attractive and well diversified in USA and Europe markets. ETF is very similar to index funds with some differences in the trading style. The first ETF was issued in 1993 as per (Investment Company Institute, 2007). ETF aims to invest in indexes as a one stock. ETF is traded daily like normal stocks. This is the main difference between the index funds and the ETF. In February 2011, total ETF reached to 956 ETFs and valued 1.035 trillion USD as reported by Investment Company Institute.

(Rompotis, 2006) tested the replication of the ETF to its benchmark through the analysis of the tracking error. He used the single regression model to test the relationship between the ETF and the benchmarks. The empirical data consist of 30 ETFs listed in NASDAQ and the American Stock Exchange (AMEX). 20 ETFs follow US indices and divided to 17 ETFs following normal indices and 3 following sector indices. The rest 10 ETFs

following international indices. The sample period was from 3 March 2001 to 7 August 2002. The sample consisted of 313 historical daily prices except for four ETFs that have 238, 236, 273 and 248 observations. This difference in those four ETFs occurred because of the lack of the extended historical data. The average alpha coefficient of the single regression analysis valued at 0.272. Beta coefficient has an average value at 0.084 and it was statistically significant at 1%. R-squared were slightly high and it has an average of 8.4%. ETFs have a low volatility percentage. The standard deviation has an average of 1.6% among the 30 ETFs. The tracking error was negative and was equal to -0.029%. Tracking error was almost zero which indicate that the average of the ETFs returns were close to their benchmarks' returns. (Rompotis, 2006) has implied the single regression analysis on the tracking error data also.

2.1.4 Portfolio Optimization under Tracking Error Constraint

In an insightful paper, (Jorion, 2003) studied the relationship between the portfolio optimization and tracking error constraints. Taking into the consideration the Value at Risk (VaR), he noted that the active funds manager who used the ex-post to calculate the tracking error should have a forward looking risk measures in an ex-ante for a portfolio VaR. Tracking error and value at risk are working in a same matter to make sure that the portfolio performance is similar to the benchmark performance. Jorion argued that funds managers who are depending on tracking error only will face bad consequences in regard with portfolio risk. Funds Managers should consider the total portfolio risk and add more constraints if it is necessary to control the deviation from the benchmark index.

At the same point of (Jorion, 2003), an interesting study by (Riadh, Didier, & Roland, 2007) brings the attestations to the tracking error and weights constraints in Index Funds. As the fund's managers have a ceiling of tracking error or a benchmark tracking error that they have to perform under it. The research has studied the relationship between the tracking error and the information ratio (IR). The information ratio is the excess returns above the benchmark index in relative the tracking error. In other words, the higher (lower) the tracking error will generate lower (higher) the information ration ratio.

Tracking error constraint and weights constraints can be combined together in a matter for portfolio optimization and efficient frontier. A numerical example of a portfolio consists of 3 assets (2 domestic assets and 1 foreign asset) and a ceiling of tracking error 5% has been provided in the study explains three scenarios: the first scenario shows a regulatory weight constraint that not less than 90% of the portfolio weight should be domestic. The second scenario shows a free weight for the assets. The third scenario shows the effect of increasing the tracking error constraint from 5% to 8%. The study examines two other related matters between the tracking error and the weight constraint; the first case studied tracking error with equally weight constraint. In this case an equal proportion for each asset is given no matter the origin market of the asset. The second case is considering an inequality weight constraint which gives the gives the portfolio manager more flexibility for tracking error constraint.

Other researchers have a different opinion about tracking error under portfolio optimization. (Roll, 1992) conducted a mean/variance analysis with a concern about the relationship between the funds sponsor and funds manager. Lowering the tracking error is one of the main goals that should be achieved by funds managers for at least two reasons. First, lower the tracking error volatility (TEV) to zero by beating the benchmark and have an excess returns over the index. Second reason, the fund's manager performance is annually reviewed by the fund's sponsor. Fund's sponsors are checking all other alternative in matter of returns attached with risk. The core of the mean/variance analysis has two dimensional approaches. Having a positive tracking and reducing the tracking error volatility by reducing the differences between the portfolio's return and benchmark's return. (Roll, 1992) used a definition of TEV Criterion which implies that fund's manager should minimize the tracking error volatility with an expected tracking error. (Roll, 1992) examined the Tracking error frontier separate and with adding new constraint on tracking error; Beta. Portfolio beta can be higher than 1.0 if the standard deviation of the portfolio returns is higher than the benchmark standard deviation of returns. In contrast, if the portfolio standard deviation as well as returns is lower than benchmark standard deviation the portfolio beta will be less than 1.0. Another look on portfolio beta is equal to the weighted betas of all asset that portfolio contains. Adding

beta constraint is a useful way to control the portfolio market risk by putting a sealing for beta i.e. 1.1 or a ground i.e. .90.

(BERTRAND, 2008) looked at portfolio optimization and tracking error frontier from another angle. Instead of giving a constant tracking error frontier, he allowed the tracking error to vary but with a fix risk aversion. The optimized portfolios lie in what he call "iso-aversion frontier". Some other restrictions can be added while minimizing tracking error. Extending (BERTRAND, 2008) research, (Coleman, Yuying, & Jay, 2004) added the number of assets restrictions. The methods used was building a portfolio consists of 25 stocks fowllowing S&P 500 as a benchmark. First, running the quadratic linear programming to find the best weight for the 500 stocks in S&P 500 to minimize the tracking error. second, remove 25 stocks that have the smallest weight and run the quadratic linear programming on 475 stocks to find the best wieghts that minimizing the tracking error. Repeat the second part till reach the a portfolio consists of 25 stocks only follow the S&P 500 as a benchmark.

2.1.5 Tracking Error and Portfolio Risk Management

Funds managers are using several techniques in evaluating and analyzing portfolios' (Dynamic or Passive) risk. Portfolio values at risk (VaR), Shortfall and tracking error are some, not all, of the most important measures to the investors as well as funds managers. Facing the problem of underperforming the marked benchmark can put the portfolio performance in a face of downside risk. (Basak, Alex, & Lucie, 2005) suggested to cover the downside risk with hedging. The analysis used was closed to (Jorion, 2003) and (Roll, 1992) of tracking error minimization in portfolio optimization. The study approached the problem in combining tracking error constraints with the utility maximizing behavior. The investors' goal of buying index funds (Dynamic or Passive) is to have a portfolio returns mimcing the benchmark returns. But the realised results can not be exsiting in the real market.

(Dembo & Rosen, 2000) has shown the relationship between the company investing its capital in index funds and the Enterprise-Wide Risk Management (EWRM). Enterprise-Wide Risk Management (EWRM) is referring to the set of policies and procedures put in place to monitor, control and manage all financial risks of an institution in a unified way as per (Dembo & Rosen, 2000).

It is clear as it is that the deviation in returns is the main index fund's risk. (Edwin, Martin, & Jeffrey, 2002) gave two reasons for such deviation between the portfolio returns and benchmark returns. First, the portfolio beta doesn't equal one. The beta differs because of the cash outflows and inflows which are not covered by derivatives such as futures. Second, a full benchmark replication was not made. Some types of index funds, specially the active funds, are using a partial replication of the benchmark. It can have better returns or outperform the benchmark but on the other hand will have higher tracking error volatility. Trading Risk Profiles (TRPs) can give an explanation about the relationship between tracking error, risk contributions, expected returns and trading activities (Burmeister, Helmut, & Rafael, 2005). Marginal Tracking Error (MTE) of a trading strategy is derivative of tracking error. It gives an indication about the impact of the trading strategies on tracking error and about the sensitivity about tracking error to it.

(Burmeister, H., & R., 2005) provided another measure of the portfolio risk is Portfolio Value at Risk (VaR). The definition of portfolio value at risk is the maximum loss the fund's manager expects to suffer at the confidence level by holding it over at the time period (Gordon & Alexandre, 2008). The research adds the portfolio value at risk and study the effect on tracking error volatility. (Manuel & Jurg, 2000) used three models to analyze the tracking error variance and the effect of the trading strategies on major seven funds in US markets. The benchmark used was S&P 500. The first model was regression model. The regression model studied the average deviations returns between the portfolio returns and benchmark returns through its alpha and beta. The second model was multifactor model which analyze the exposure of the excess returns to some of the systematic risk. The systematic risk analysis can be found in Capital Asset Pricing Model, Merton Model and Arbitrage Pricing Theory (APT). Timing and Selection model

was the third model. Selection means that the fund's managers can rebalance the weight of the portfolio assets in matter to increase the portfolio returns. It will be by giving more weight to assets outperformed the benchmark and less to assets the underperformed the benchmark. The Timing means changing the exposure to the benchmark returns with rebalance the portfolio (Manuel & Jurg, 2000). The importance of the tracking error incurs in delta-gamma Option Hedged portfolios (James, 2006). (BERTRAND, 2008) has studied the relationship between the risk-adjusted performance of the portfolio and the portfolio optimization under tracking error constraint.

Moving deeper in Portfolio Value at Risk (VaR), (Velichko & Nurminskii, 2003) provided a portfolio's risk model using Forward-Dual Decomposition analysis while replicating a benchmark. The analysis based on the Conditional Value at Risk (CVaR) Analysis. Conditional Value at Risk (CVaR) is an extended term of the Value at Risk (VaR). The Conditional Value at Risk (CVaR) is also called Tail VaR, Mean Excess Loss and Mean Shortfall (Uryasev, 2000). The Conditional Value at Risk (CVaR) can be used as a constraint in valuation the fund's performance. (Krokhmal, Palmquist, & Uryasev, 2002) have explained the effect of the conditional Value at Risk (CVaR) on portfolio optimization. They studied the effect on S&P 500 Index as a one portfolio. They exclude six stocks from the portfolio because of lack of historical data related to them. The six stocks are Citigroup Inc., Hartford Financial Svc GP., Lucent Technologies, Mallinckrodt Inc., Raytheon Co. and U.S. Bancorp. They used the stocks' return for 14 calendar days which is equal to 10 traded days. The portfolio examined risk has been put for 10% with a confidence level of 95%. The benefit of the model emerges from that it can be very useful for a portfolio consists of high number of stocks. The model was an extension of the study by (Rockafellar R. T., 2000) and studied by (Rockafellar, Uryasev, & Zabarankin, 2004).

The model of (Velichko & Nurminskii, 2003) has studied 10 stocks from Dow Jones Industrial Index (DJI). The stocks are Alcoa Inc. (AA), General Electric Company (GE), Johnson & Johnson (JNJ), Microsoft Corporation (MSFT), American Express Company (AXP), General Motors (GM), JP Morgan Chase & Co. (JPM), Procter & Gamble

Company (PG), Boeing Company (BA) and Home Depot, Inc. (HD). The observations based on the daily closed prices for the ten socks. The sample period was from 3 February 2003 to 14 April 2003 which gave sixty one observations. They concluded that the use of the forward-dual truncation is more cost affected compared to the standard simplex model.

2.1.6 Models for Tracking Error Minimization

It is one of the main targets for an index fund is to minimize the tracking error. As the investors comparing their portfolios returns with other opportunities, also investors evaluate their returns with the risk attached. (Ludwig & Daehwan, 2006) in studying the portfolio weights gave an insightful analysis of minimizing tracking error. There are two approaches in order to solve this problem. First, portfolio manager should minimize the tracking error for an expected return over the benchmark. Second, maximizing portfolio returns over a benchmark under tracking error constraint. The tracking error constraint can be with a minimum of 5% per annum and 10% per annum. (Ludwig & Daehwan, 2006) defined the Tracking Error (TE) as the standard deviation of differences between the portfolio returns and benchmark returns:

$$TE = S\left(r_p - r_B\right) = \sqrt{V(\mathrm{r_p} - \mathrm{r_B})} \qquad 2.1$$

Where:

$TE = Tracking\ Error$

$S = Standared\ Deviation$

$r_p = Return\ on\ Portfolio$

$r_B = Return\ on\ Benchmark$

Applying the first method that portfolio manager should minimize the tracking error for an expected return over the benchmark, the variance of the differences between the portfolio returns and benchmark returns can formulated as follow:

$$V\left(r_p - r_B\right) = V\left(r_p\right) - 2C\left(r_p, r_B\right) + V\left(r_B\right) \qquad 2.2$$

Where

V: is the variance of the difference in returns between the portfolio and benchmark returns.

C : is the correlation between the portfolio and benchmark.

From the previous formula, portfolio manager cannot control the variance of the benchmark returns; $V\ (r_B)$. In order to reach to the desired tracking error rate, portfolio manager should add a target return above the benchmark returns as follow:

$$\mu_p = \mu_B + \varepsilon \qquad 2.3$$

As Ɛ indicate the excess return above the benchmark returns.

(Barro & Canestrelli, 2005) have studied tracking error in a multistage models in stochastic programming framework. The models were concerning the dynamic fund's management more than the passive fund's management. Two models were applied. The first model was considering a penalty condition and related to the portfolio turnover. The second model is extending the first model in considering the transaction costs and cash. The second model is considering the transaction cost as a percentage of the trading transactions and allow for having cash as a part of the portfolio assets. In testing the models, they used the MSCI Euro index as a benchmark. The portfolio assets used from Euro, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain. The sample period was from October 15, 1998 to October 16, 2003.

On the other side, (Rudolf, Hurgen, & Heinz, 1999) has employed four linear models for tracking error minimization with a comparison with quadratic tracking error model used by Roll (1992). Rudolf (1999) has implied the models on national equity markets; USA, Japan, United Kingdome, Germany, France and Switzerland. The benchmark that he used was Morgan Stanly Capital International Index (MSCI World). The empirical study was creating a portfolio consists from the equities from the all six countries and the sample period was from March 1987 to April 1996 which is equal to 110 observations. Rudolf (1999) split the sample period to two sub periods. The first period was from March 1987

to April 1992 (62 months) and the optimized portfolio data was created from the first period. The second period was from May 1992 to April 1996 (48 months) which have been used to test the persistency of the portfolio weights. The analysis calculated the portfolio returns in US dollar and on a monthly basis. The main constrain about the test was the short selling was not allowed and excluded. Rudolf (1999) used the absolute deviation of the portfolio returns in his four linear models.

The comparison between the quadratic model and linear model for based on the argument that linear deviation will give more appropriate indication about the portfolio performance rather than the squared deviations analysis. Roll (1992) examined the quadratic model in his mean variance analysis. The problem was to minimize the sum of the squared deviation from the portfolio returns, in other word, minimizing the tracking error volatility. The problem with quadratic analysis that is difficult to be explained to the investors. The linear model or the absolute deviation is more relevant and easy to interpret to the funds sponsors.

Portfolios managers tend to apply the linear model because of a lot of benefits and advantages. The portfolios managers deserve performance fees when their portfolio returns exceed the benchmark returns. These fees have a linear property. At the same time, portfolios managers should exceed a limit of deviation from the benchmark returns to keep the tracking error volatility below the targeted tracking error ratio. Portfolio managers think about linear tracking error more than thinking of quadratic tracking error as per (Rudolf, Hurgen, & Heinz, 1999). The absolute deviation of the portfolio returns is more convenience to the investors as they are focusing on tracking error volatility rather than the positivity or negativity of tracking error.
The five models for tracking error minimization were as follow:

1. **Quadratic Tracking Error**

The quadratic tracking error model is famous because of its simplicity and easy to interpret. For an index fund, the fund's manager should find the most suitable weights to minimize the funds tracking error. The tracking error formula can be as follow:

$$Tracking\ Error\ (TE) = (Y - wX)\,, \qquad 2.4$$

$Y \in R^T$, Where the T is the number of observations.

$X \in R^{T*n}$, Where the n is the number of assets.

$w \in R^n$,

$TE \in R^T$

The tracking error variance is the squared difference between the benchmark return and the portfolio return. In accordance to minimize tracking error variance, the fund's manager should select the optimum weight as follow:

$$\min \text{ Tracking Error Variance} = (Y - wX)'\,(Y - wX) \qquad 2.5$$

The next four models are using the absolute methods to minimize the tracking error for the index funds. Those models have been studied by Rudolf (1999) in his comparison with mean square model for tracking error minimization. A number of restrictions can be added when running the models. Some of the main restrictions are the forbidden of the Short-Selling and the unity of the stocks weights. Whole model based in finding the optimum stock weight that consisting the portfolio and apply the model to find the best one to reduce the tracking error volatility.

The four models are:

1. <u>Mean Absolute Deviation Model (MAD)</u>

The model minimizes the absolute difference in returns between the funds and benchmark through adjusting the portfolio weights. In other word, the model chooses the optimum stock weight to minimize the sum of the absolute deviation as well as, the

tracking error. A relative research by (Hiroshi & Hiroaki, 1991) has pointed the Mean Absolute Deviation and applied it on Tokyo Stock market. The market test was has been divided into three periods and descriptive and statistical analyses have been conducted. He used two benchmarks, TOPIX Index and NIKKEI 225 Index. The first period was from 1981 to 1985 (6o month's data). The second period was from 1982 to 1986. The third was period from 1983 to 1987. Comparing with quadratic model, (Hiroshi & Hiroaki, 1991) showed that the mean absolute deviation can be more useful for studying huge number of stocks (1000 stock and above). The formula is:

$$TE\ MAD\ =\ min\ (w)\ 1'\ (\ |wX - Y|\ ) \qquad 2.6$$

2. Minimizing the Maximum Deviation (MinMax)

In this model, funds manager is focusing on minimizing the maximum deviation in fund's returns from the benchmark and finds the optimum weight to reduce it. Comparing to mean absolute deviation (MAD), (MinMax) is giving less attention to the deviations outliers. In Contrast, because using the square deviation in the quadratic model, the maximum deviation plays a major role and less in mean absolute deviation (MAD).
The formula of MinMax is:

$$TE\ MinMax\ =\ max\ |wXt\ -\ Y| \qquad 2.7$$

3. Mean Absolute Downside Deviation Model (MADD)

The previous models were focusing on tracking error minimization without giving attention to the positivity or negativity of tracking error. Positive tracking error indicates that portfolio's return is more than benchmark return. In contrast, negative tracking error indicates that portfolio return is less than benchmark return. Mean absolute downside deviation is concerning on minimizing the tracking error in accordance to the negative deviation between the portfolio returns and the benchmark returns. The mean absolute downside deviation (MADD) is more related to the mean absolute deviation (MAD).

The performance of the fund's manager is more evaluated in this model comparing to others. The mean absolute downside deviation model formula is:

$$TE_{MADD} = min(w)\ 1'(|W\bar{X} - \bar{Y}|), \qquad where\ w\bar{X}_t < \bar{Y}_t \tag{2.7}$$

4. Downside Maximum Deviation Model (DMinMax)

The weight of the portfolio is used to minimize the maximum negative deviation between the portfolio returns and benchmark returns. It is similar to MADD in the way of interesting in minimizing the negative tracking error. MinMax aim to finds the optimum weight to reduce the maximum deviation without noticing the positivity or negativity of the returns differences. DMinMax concerning only about the maximum negative deviation between the portfolio returns and benchmark returns.
The formula of tracking error under Downside Maximum Deviation model is:

$$TE_{DMinMax} = max_t\ |w\bar{X} - \bar{Y}|, \quad where\ w\bar{X}_t < \bar{Y}_t \tag{2.8}$$

2.1.7 Linear Programming

To get more understanding about how models work, linear programming will be applied on each model. (Renata, Wlodzimierz, & M. Grazia, 2006) brought to the attention the conditional Value at Risk (CVaR) or Tail VaR. the conditional value at risk represent the mean shortfall at a specified confidence level (Renata, Wlodzimierz, & M. Grazia, 2006). Following Rudolf (1999) methods when using the linear programming models, the character of each model will be as follow:

1. **Mean Absolute Deviation (MAD)**

As the model applies the sum of the absolute deviations of the portfolio returns from the benchmark returns, the basic components will be the negative and positive deviations. We need to fix a ceiling or upper limit which deals the highest positive deviation and ground or lower limit which deals with the lowest negative deviation. Let $Z_t^+ \geq 0$ be the positive deviation and $Z_t^- \leq 0$ be the negative deviation. The formula will as follow:

$$wX_t - Y_t > 0 \quad \leftrightarrow \quad wX_t - Z_t^- = Y_t \qquad 2.9$$

$$wX_t - Y_t < 0 \quad \leftrightarrow \quad wX_t + Z_t^+ = Y_t \qquad 2.10$$

The objective function will be:

$$\sum_{t=1}^{T} (z_t^+ + z_t^-) \qquad 2.11$$

Adding the tow formulas:

$$wX_t + Z_t^+ - Z_t^- = Y_t \qquad 2.12$$

2. Mean Absolute Downside Deviation (MADD)

As discussed previously, the model applied for the negative deviation between the portfolio returns and benchmark returns. So, will not be dealing with positive deviations Z_t^+. The situation will be:

$$min \ \sum_{t=1}^{T} z_t^- \quad s.t. wX_t + Z_t^+ \geq Y_t \qquad 2.13$$

3. MinMax Model

The MinMax model minimizes the absolute maximum deviation between the portfolio returns and benchmark returns. The maximum deviation can be positive or negative

before taking applying the absolute method. If consider the maximum deviation is Z; then we can state that:

$$Z \geq | wX_t - Y_t | \qquad t \epsilon \{1, \dots, T\}. \tag{2.14}$$

If the portfolio has a positive deviation in returns from the benchmark then:

$$Z \geq wX_t - Y_t \geq 0 \qquad \leftrightarrow \qquad wX_t - Z \leq Y_t \tag{2.15}$$

In contrast, if the portfolio has a negative deviation in returns from the benchmark:

$$-Z \leq wX_t - Y_t \leq 0 \quad \leftrightarrow \quad wX_t + z \geq Yt \tag{2.16}$$

Adding the two formulas together;

$$min\ z \ \ s.t. wX_t - z \leq Y_t\ ,\ wX_t + z \geq Y_t. \tag{2.17}$$

4. Downside MinMax Model

The concern in this model is only the maximum negative deviation between the portfolio returns and benchmark returns. It only the second part from MinMax model is to be solved. The formula can be stated as follow:

$$min\ z \qquad s.t. wX_t + z \geq Y_t. \tag{2.18}$$

2.2 UAE Market

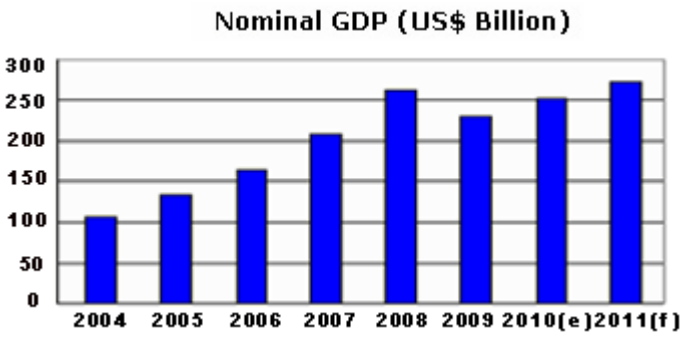
2.2.1 Economic Overview

United Arab Emirates is a part of The Cooperation Council for the Arab States of the Gulf (CCASG) and has one of the most growth rates in the Middle East. The UAE has an open economy with a high per capita income and a sizable annual trade surplus. Successful efforts at economic diversification have reduced the portion of GDP based on oil and gas output to 25%. Since the discovery of oil in the UAE more than 30 years ago, the UAE has undergone a profound transformation from an impoverished region of small desert principalities to a modern state with a high standard of living[1].

The UAE is the second largest economy in the region, recording one of the highest economic growth rates in the Arab region because of its growing oil and gas exports and on-going economic diversification programs. During 2004 to 2008, the UAE economy more than doubled (increased by 145%) to $261.4 billion, fueled by a strong growth of oil, hydrocarbon and non-oil sectors. Nominal GDP however shrank by -12% to $230 billion due to a slump in the world oil market. Nominal GDP is expected to rebound and grow by 9.9% and 7.4% to $252.7 billion and $271.5 billion in 2010 and 2011, respectively in view of the global economic recovery. Real GDP decreased by (-0.7%) in 2009 compared to an increase of 5.1% in 2008, which is expected to rebound and grow by 1.3% and 3.1% in 2010 and 2011, respectively, supported by relative stability in oil and non-oil sectors, and the expected global economic recovery[2].

[1] https://www.cia.gov/library/publications/the-world-factbook/geos/ae.html#Econ
[2] http://www.gulfbase.com/site/interface/thegcc/gcc.aspx?c=uae

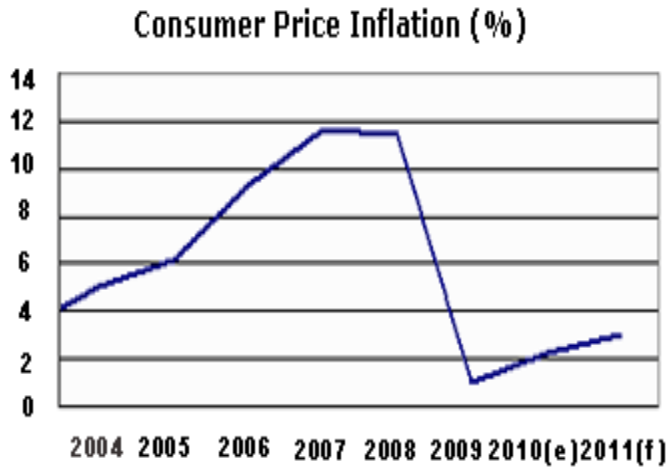
Figure 1



Source: GulfBase.com

The official currency is dirham and it is pegged with US dollar. During the period of 2000-2003 and because of the currency depreciation against the major currency such as sterling pounds and Euro the imports prices has increased rapidly. The inflation for the same period arranged between 1.3% and 3.2%. Figure (2) shows the movement of the of the consumer price inflation.

Figure 2



Source: GulfBase.com

2.2.2 UAE Stock Market

The United Arab Emirates stock market is consists of two major markets; Abu Dhabi Security Exchange (ADX) and Dubai Financial Market (DFM). The tow indexes are working separately under Emirates Securities and Commodities Authority (ESCA). On January 29, 2000 HH UAE President issued a federal decree to set up a public authority in the UAE's capital, which was called "Securities and Commodities Authority"[3]. Securities and Commodities Authority has provided a hybrid market consists of the Abu Dhabi Security Exchange and Dubai Financial market and thereafter called Emirates Security Market (ESM).

Dubai Financial market (DFM) has 78 listed companies as of the end of 2010[4]. In September 2005, a third stock market has been opened in Dubai and call NASDAQ Dubai. It is formally known as Dubai International Financial Exchange (DIFX). NASDAQ Dubai is a stock market that aims to deal and include the international stocks. It is a key chain between the western and eastern stock market.

Investors can trade on NASDAQ Dubai through a unique mix of regional and international brokers. In July 2010, NASDAQ Dubai outsourced its trading and other key operational functions for equities to Dubai Financial Market (DFM). This has brought the DFM's more than 550,000 individual investors together with NASDAQ Dubai's international institutional investors in a deep liquidity pool[5].

[3] http://www.sca.ae/English/sca/Pages/establishment.aspx
[4] http://dfm.ae/pages/default.aspx?c=1010
[5] http://www.nasdaqdubai.com/aboutus/index.html

2.2.3. UAE Funds

United Arab Emirates Market has been an attractive to local and international investors. Flexibility, Low Taxes and developed regulations has encouraged international capital inflow to Abu Dhabi Exchange Security (ADX) and Dubai Financial Market (DFM). Types of funds can be classified as Open End Funds or Close End Funds. Emirates Security & Commodities Authority (ESCA) has identified Open End fund as a fund with a variable capital that increases by new units issued and decreases by redeeming existing units. It is permissible, subject to the approval of the Authority, to trade its units in the market after listing therein. Close End Fund has been identified as a fund with a fixed capital, unredeemable units except by the end of its life cycle unless otherwise provided for in its articles of association and its investment policy. The units of such Fund may also be traded in the market after listing in accordance with controls approved by the Authority and those included in its articles of association and its own prospectus. Another classification has been used as Local Fund or International fund. This classification depends upon the origin of the fund.

The third classification has been set on the type of the funds trading. Exchange Traded Fund (ETF) is the main example. Emirates Security & Commodities Authority (ESCA) has identified the Exchange Traded Fund (ETF) as open investment Fund established to invest the majority of its Funds in an investment combination that is fully compatible with the combination of a market price index or a combination of an investment portfolio defined by its investment policies, allowing for trading the Fund's units in one market or more. Table (1) outline the open end funds listed in Abu Dhabi Exchange Securities (ADX). The total is 9 open end fund. The index doesn't have a close end funds.
The only Exchange Traded Fund is traded in Abu Dhabi Securities Exchange and called NBAD OneShare Dow Jones UAE 25 ETF.

Table 1

	Abu Dhabi Security Exchange (ADX)	
	Number	**Title**
Open End Fund	1	NBAD UAE GROWTH FUND - UGF
	2	NBAD UAE TRADING FUND - UTF
	3	MSCI UAE Index
	4	Al Nokhitha
	5	MSCI Arabian Markets
	6	MAKASEB
	7	NBAD UAE ISLAMIC FUND - UIF
	8	NBAD UAE DISTRIBUTION FUND - UDF
	9	NBAD GCC OPPORTUNITIES FUND - AJAJ

Source: Abu Dhabi Securities Exchange (ADX)

Dubai Financial Market (DFM) has 16 investment funds listed in its exchange. Table (2) shows the names of the funds and fund's managers' name. The total funds are trading in the Emirates Securities Market is 25 investment funds and 1 Exchange Traded Funds (ETF). These funds are diversified between Open End and Close End Funds and as well as International and Local Funds.

A Draft Decision on Investment Funds has been released from Securities & Commodities Authorities (SCA) in 2011[6]. The draft has outlined the guidelines and conditions to list the investment funds in UAE market. Forty Five articles have built the draft and cover the Funds activity, Listing, Local Funds, Foreign Funds, Investment Manager Tasks, the relationship between Funds Manager and Investors and the Disclosure & financial report of the investment fund.

[6] http://www.sca.ae/English/Documents/Investment_Fund_Regulation_EN.pdf

Table 2

Number	Fund Name	Manager Name
1	(AMCUAE) AL Mal UAE Equity Fund	Al Mal Capital
2	(DAMAN) Al Daman UAE Value Fund (Matured)	Daman Asset Management
3	(EFF) Emirates Flagship Fund	Emirates Financial Services (PSC)
4	(EFG-TELECOM) EFG-Hermes Telecom Fund	EFG-Hermes Financial Management (Egypt) Limited
5	(MAKASEBUAE) Makaseb Emirates Equity Fund	Mashreqbank psc
6	(MEDA) EFG-HermesMiddle East & Developing Africa Fund Limited	EFG-Hermes Financial Management (Egypt) Limited
7	(MENA) NBD MENA	National Bank of Dubai
8	(NBD GULF) NBD Gulf Balanced Fund	National Bank of Dubai
9	(SGF) Saudi Gateway Fund	SHUAA Capital
10	(SHUAA AGF) Arab Gateway Fund Limited	SHUAA Capital
11	(SHUAA THIQA) Emirates Gateway Fund	SHUAA Capital (PSC)
12	(TNIUAEBCF) TNI UAE BLUE CHIP Fund	The National Investor
13	(UDF) NBAD UAE Distribution Fund	National Bank of Abu Dhabi
14	(UGF) NBAD UAE Growth Fund	National Bank of Abu Dhabi
15	(UIF) NBAD UAE Islamic Fund	National Bank of Abu Dhabi
16	(UTF) NBAD UAE Trading Fund	National Bank of Abu Dhabi

2.3 Conclusion

Chapter two which include the literature review has the core value of the research. Literature review included two main subjects. The first main subject was the tracking error analysis. This subject aimed to provide comprehensive information about the tracking error calculations and theories.

Seven topics were included in the tracking error analysis. A comparison between the Ex-Post tracking error and Ex-Ante tracking error has been made. The uses of each analysis and its benefits to both fund's manager and index investors have been pointed and discussed. Index investors can be exposed to two type of index funds management. These types of management are Passive Index Funds or Active Index funds. Logically, tracking error of the active index funds will have a high percentage compared to the tracking error of the passive index funds. This difference in the tracking error appears from the high number of rebalancing the portfolio and the high number of the transaction costs appears of the active funds. It doesn't mean that active management is bad but it means that high income will be generated as the fund's manager will have to use the opportunity to overweight the undervalued stocks.

One of the most argued topics, especially after 2008 crises, was the Portfolio Risk Management. Tracking error itself can be an indicator of a portfolio risk and it can be joined with other risk factors. Literature review has studied the tracking error from risk management point view and provided analysis of the Portfolio Value at Risk (Portfolio VaR) and Portfolio Conditional Value at Risk (Portfolio CVaR). The last two measures are interested in the worst cases or scenarios that could happen to the value of the portfolio using the normal distribution and different confidence levels.

Tracking error can be used as a constraint condition to control the fund's manager from a high deviation from the benchmark's returns. This constraint has been studied in index funds portfolio optimization. Many examiners and researchers analyzed models for tracking error minimizations. In literature review, five tracking error models have been

studied. The first model called the Quadratic Tracking error which was comprehensively analyzed by (Roll, 1992) in his mean/variance analysis of the index funds. The last four models have used the absolute deviations between the portfolio's returns and the benchmark's returns. Those four model has been studied by (Rudolf, Hurgen, & Heinz, 1999) using the linear programming.

The second main subject in the literature review was the concerned in the index funds in UAE Markets. UAE economic are one of the most growth economic in the region and it has high variety of direct and indirect investments. It has main four financial markets dealing with stocks (local stocks), international stocks, derivatives and commodities. The main local stocks are Abu Dhabi Security Exchange (ADX) and Dubai Financial Market (DFM). There a hybrid market consists of Abu Dhabi Security Exchange (ADX) and Dubai Financial Market (DFM) called Emirates Securities Market (ESM). Those two major markets has been studied and researched. The stocks markets in UAE are working under one regulation body called Emirates Securities & Commodities Authority (ESCA). Abu Dhabi Securities Exchange (ADX) has 9 mutual funds and Dubai Financial Market (DFM) has 16 mutual funds. The total funds in UAE market are 25 mutual funds.

Four highly rated index funds have been studied and analyzed. The five tracking error models has been conducted and implemented in the funds. Not because of the high rating the four funds has been collected but because of the availability of the historical data of the net asset value of the funds.

Index funds are having more concern by the Emirates Securities & Commodities Authority (ESCA) and UAE Central Bank. This concern appears from the draft regarding the regulations of the investment funds in United Arab Emirates that has been released in early 2011.

Chapter Three

Methodology

3.1 Introduction

Funds managers can use the tracking error (TE) interpretation to their existing or expected clients showing their funds strategy. Two main approaches can be use for the interpretation; Ex-Ante Tracking Error which is a predicted tracking error in the future based on the historical prices and the fund's manager planned strategy. The second approach is the Ex-Post Tracking Error which calculates the tracking error based on the past historical fund's prices and net asset values. The two approaches were studied earlier and extensively researched by (Soosung & Stephen, 2001).
The methodology used in the research is the Ex-Post Tracking Error. Based on the historical data of the funds, the standard deviation of the differences in return between the benchmark's return and the find's return is calculated.

3.2 Empirical Data and Data Analysis

The data resource is from The Emirates Securities & Commodities Authority (ESCA) which consists of Abu Dhabi Securities Exchange (ADX) and Dubai Financial Market (DFM).
The Emirates Securities & Commodities Authority (ESCA) has been founded based on the Federal Law no. (4) of 2000, that has stipulated on establishing the Emirates Securities & Commodities Authority & Market. Accordingly, the ESCA laid out its administrative and technical structures and subsequently took the initiative to set up the Emirates Securities Market ESM[7].

The Research Sampling Method is based collecting major funds in UAE market which have a clear and high quality data presentation in their fact sheet. The sampling method used to allow the five models used for data analysis to be implemented and calculate the different tracking error accurately.

[7] Emirates Securities & Commodities Authority (ESCA).

Sample period was used for only the year of 2010. It is important to provide the reason of the short period used. Index funds are new type of investments in the GCC region and needs more developments. Many index funds are issued recently and have short historical data. The second reason was the lack of many index funds fact sheets in public. The funds used in the research have provided comprehensive fact sheets with updated net asset value as well as it was highly rated in the UAE market.

Four active index funds were studied. The index funds are Al Mal UAE Equity Fund, Makaseb Emirates Equity Fund (MEEF), ADCB MSCI UAE Index Fund and Invest AD-UAE Total Return Fund. Three benchmarks were indexed; MSCI UAE Index, S&P UAE Composite Index and MSCI UAE Domestic Net Total Return Local Index.
Al Mal UAE Equity Fund and Makaseb Emirates Equity Fund (MEEF) where index to MSCI UAE Index till September 2010 then have been changed to S&P UAE Composite Index. ADCB MSCI UAE Index Fund, from the fund's title, where indexed to MSCI UAE Index. Invest AD- UAE Total Return Fund was indexed to MSCI UAE Domestic Net Total Return Local Index. The MSCI United Arab Emirates Domestic Net Total Return Local Index is a free float adjusted market capitalization index designed to measure equity performance, including price return and dividends, in the UAE
The sample period was during 2010. Monthly net asset values (NAVs) of the four funds were gathered and analyzed.

3.3 Methodology Outline

The research's methodology is based on applying five tracking error minimization models on four mutual funds following benchmarks. Each model is applied separately on each fund for the sample period of 2010. The monthly historical net asset value (NAV) of each fund is used to calculate the tracking error. Interpretation each model using the historical data and net values for the funds and calculating the standard deviation of the differences of the returns between the fund's return and the benchmark's return.

Methodology constructed with taking into consideration the nature of UAE stock market and the forbidden of short selling. These conditions were applied with models as well. Tracking error is a highly affected by the transaction cost, management fees and funds manager strategies. These factors are included in calculating the Net Asset Value (NAV) of the fund and which will be more suitable to calculate the tracking error from the net asset value of the fund.

3.4 Models

Five models were applied to calculate and test the tracking error for the active funds. The first model is the Quadratic Tracking Error which was studies by (Roll, 1992). The four models are Linear Tracking Error models which were tested by (Rudolf, Hurgen, & Heinz, 1999). The models are:

1. **Quadratic Tracking Error**

The quadratic tracking error model is famous because of its simplicity and easy to interpret. For an index fund, the fund's manager should find the most suitable weights to minimize the funds tracking error. The tracking error variance is the squared difference between the benchmark return and the portfolio return.

2. **Mean Absolute Deviation Model (MAD)**

The model minimizes the absolute difference in returns between the funds and benchmark through adjusting the portfolio weights

3. **Minimizing the Maximum Deviation (MinMax)**

In this model, fund's manager is focusing on minimizing the maximum deviation in fund's returns from the benchmark and finds the optimum weight to reduce it.

4. **Mean Absolute Downside Deviation Model (MADD)**

Mean absolute downside deviation is concerning on minimizing the tracking error in accordance to the negative deviation between the portfolio returns and the benchmark returns.

5. **Downside Maximum Deviation Model (DMinMax)**

The weight of the portfolio is used to minimize the maximum negative deviation between the portfolio returns and benchmark returns.

The reason of using those models is their popularity and they are easy to be interpreted by asset manager as well as index funds' investors.
A second reason was suitability of the models to be implemented in passive (2 funds) and active index (2 funds).

3.5 Conclusion

The methodology has been put to suit the character of the tracking error of the index funds. The main purpose of the designed methodology is to simplify the tracking error calculation and present the data in a way to get the best results and understanding of the models used to minimize the tracking error. The five models applied allow the researchers to study the effect of the fund manager strategies from a different angle. Each model satisfies a part of the index funds' investors depending upon their risk appetite and their investment plan.
Some factors were affecting the build of the research methodology such as the type of sample, forbidden of the short selling and the availability of historical daily net asset values of the fund. Also, the four funds are active funds not passive funds which give the widening the tracking error and also the returns.

Chapter Four

Data Analysis and Results

4.1 Introduction

UAE Stock Market one of the most growing market in the region. It covers not only the companies' equities but also mutual funds. Index funds, one type of the mutual funds, are well known in the market and it has a major role to play.

Four major funds are Al Mal UAE Equity Fund, Makaseb Emirates Equity Fund (MEEF), ADCB MSCI UAE Index Fund and Invest AD- UAE Total Return Fund. Monthly historical net asset value of each fund is collected for the sample period of 2010.

4.2 Models

Five models of tracking error minimization will be applied on each fund and interpret the model.

4.2.1 Al Mal Capital UAE Equity Fund

4.2.1.1 Quadratic Tracking Error Model

This model is calculating the standard deviation between the fund's return and benchmark's return.

Table 3

Serial	Date	Change in Fund NAV	Change in Benchmark	Active Return
1	Dec-10	-1.39%	-2.22%	0.83%
2	Nov-10	-4.30%	-3.15%	-1.15%
3	Oct-10	2.80%	4.10%	-1.30%
4	Sep-10	11.20%	11.62%	-0.42%
5	Aug-10	-2.40%	-2.52%	0.12%
6	Jul-10	3.80%	5.00%	-1.20%
7	Jun-10	-5.20%	-9.39%	4.19%
8	May-10	-8.90%	-9.68%	0.78%
9	Apr-10	-3.70%	-4.23%	0.53%
10	Mar-10	17.70%	17.89%	-0.19%
11	Feb-10	-1.50%	0.60%	-2.10%
12	Jan-10	-6.10%	11.82%	-17.92%

Tracking Error	**5.19%**			

Table 1 shows the calculation of the quadratic tracking error model which is derived from the active returns. Active returns are the differences between the fund's return and benchmark's return. It will cover the negative and the positive differences in returns and give a sign how the fund manager strategy to mimic or beating the benchmark. Tracking error is 5.19% which is positive tracking error. This active management will have a higher tracking error and for sure high returns.

4.2.1.2 Mean Absolute Deviation Tracking Error Model

The model is calculating the tracking error on the absolute deviation between the fund's return and benchmark's returns.

Table 4

Serial	Date	Change in Fund NAV	Change in Benchmark	Mean Absolute Deviation
1	Dec-10	-1.39%	-2.22%	0.83%
2	Nov-10	-4.30%	-3.15%	1.15%
3	Oct-10	2.80%	4.10%	1.30%
4	Sep-10	11.20%	11.62%	0.42%
5	Aug-10	-2.40%	-2.52%	0.12%
6	Jul-10	3.80%	5.00%	1.20%
7	Jun-10	-5.20%	-9.39%	4.19%
8	May-10	-8.90%	-9.68%	0.78%
9	Apr-10	-3.70%	-4.23%	0.53%
10	Mar-10	17.70%	17.89%	0.19%
11	Feb-10	-1.50%	0.60%	2.10%
12	Jan-10	-6.10%	11.82%	17.92%
Tracking Error	**4.96%**			

Mean absolute deviation has been applied instead of active returns. Tracking error has been reduced as a result of the absence of the negative differences between the fund's return and benchmark's returns. Mean absolute deviation is important for the investors looking for funds mimic the benchmark returns.

4.2.1.3 Minimizing the Maximum Deviation (MinMax)

In this model, fund's manager is focusing on minimizing the maximum deviation in fund's returns from the benchmark and finds the optimum weight to reduce it.

Table 5

Serial	Date	Change in Fund NAV	Change in Benchmark	MAD
1	Dec-10	-1.39%	-2.22%	0.83%
2	Nov-10	-4.30%	-3.15%	1.15%
3	Oct-10	2.80%	4.10%	1.30%
4	Sep-10	11.20%	11.62%	0.42%
5	Aug-10	-2.40%	-2.52%	0.12%
6	Jul-10	3.80%	5.00%	1.20%
7	Jun-10	-5.20%	-9.39%	4.19%
8	May-10	-8.90%	-9.68%	0.78%
9	Apr-10	-3.70%	-4.23%	0.53%
10	Mar-10	17.70%	17.89%	0.19%
11	Feb-10	-1.50%	0.60%	2.10%
12	Jan-10	-6.10%	11.82%	17.92%
Tracking Error	**17.92%**			

The maximum deviation was in March 2010 and equal 17.89%. Table (3) shows the maximum absolute deviation between the fund's return and benchmark's returns. This model will help to identify the optimum weight to reduce the maximum deviation or the worst scenario that could happen no matter was it a negative or positive returns.

4.2.1.4 Mean Absolute Downside Deviation Model (MADD)

Mean absolute downside deviation is concerning on minimizing the tracking error in accordance to the negative deviation between the portfolio returns and the benchmark returns.

In Table (4), more attention and weight is giving to the negative returns. Tracking error is positive 5.93%. It is closer quadratic and MAD tracking error model in value. This model

will be satisfying the investors who they are interested to mimic or beat the benchmark returns.

Table 6

Serial	Date	Change in Fund NAV	Change in Benchmark	Active Return	Negative Returns
1	Dec-10	-1.39%	-2.22%	0.83%	-1.15%
2	Nov-10	-4.30%	-3.15%	-1.15%	-1.30%
3	Oct-10	2.80%	4.10%	-1.30%	-0.42%
4	Sep-10	11.20%	11.62%	-0.42%	-1.20%
5	Aug-10	-2.40%	-2.52%	0.12%	-0.19%
6	Jul-10	3.80%	5.00%	-1.20%	-2.10%
7	Jun-10	-5.20%	-9.39%	4.19%	-17.92%
8	May-10	-8.90%	-9.68%	0.78%	
9	Apr-10	-3.70%	-4.23%	0.53%	
10	Mar-10	17.70%	17.89%	-0.19%	
11	Feb-10	-1.50%	0.60%	-2.10%	
12	Jan-10	-6.10%	11.82%	-17.92%	
Tracking Error	**5.93%**				

4.2.1.5 Downside Maximum Deviation Model (DMinMax)

The weight of the portfolio is used to minimize the maximum negative deviation between the portfolio returns and benchmark returns.

Table 7

Serial	Date	Change in NAV	Change in NAV	Active Return	Negative Returns
1	Dec-10	-1.39%	-2.22%	0.83%	-1.15%
2	Nov-10	-4.30%	-3.15%	-1.15%	-1.30%
3	Oct-10	2.80%	4.10%	-1.30%	-0.42%
4	Sep-10	11.20%	11.62%	-0.42%	-1.20%
5	Aug-10	-2.40%	-2.52%	0.12%	-0.19%
6	Jul-10	3.80%	5.00%	-1.20%	-2.10%
7	Jun-10	-5.20%	-9.39%	4.19%	-17.92%
8	May-10	-8.90%	-9.68%	0.78%	
9	Apr-10	-3.70%	-4.23%	0.53%	
10	Mar-10	17.70%	17.89%	-0.19%	
11	Feb-10	-1.50%	0.60%	-2.10%	
12	Jan-10	-6.10%	11.82%	-17.92%	
Tracking Error	**17.92%**				

The maximum negative return is 17.92%. This model show the worst negative returns between the fund's returns and benchmark's returns. The optimum weight is set to avoid the worst scenario happened.

4.2.2 Makaseb Emirates Equity Fund (MEEF)

4.2.2.1 Quadratic Tracking Error Model

Table 8

Sri	Date	Change in Fund NAV	Change in Benchmark	Active returns
1	Dec-10	-0.87%	-0.16%	-0.72%
2	Nov-10	-6.36%	-5.42%	-0.94%
3	Oct-10	4.96%	5.50%	-0.54%
4	Sep-10	12.21%	13.88%	-1.68%
5	Aug-10	-1.44%	-2.12%	0.68%
6	Jul-10	2.55%	4.91%	-2.36%
7	Jun-10	-3.55%	-8.31%	4.76%
8	May-10	-4.58%	-11.34%	6.76%
9	Apr-10	-4.02%	-3.60%	-0.42%
10	Mar-10	12.55%	18.75%	-6.20%
11	Feb-10	-2.89%	-1.94%	-0.95%
12	Jan-10	-9.84%	-9.38%	-0.46%
Tracking Error	**3.14%**			

4.2.2.2 Mean Absolute Deviation Tracking Error Model

Table 9

Sri	Date	Change in NAV	Change in NAV	MAD
1	Dec-10	-0.87%	-0.16%	0.72%
2	Nov-10	-6.36%	-5.42%	0.94%
3	Oct-10	4.96%	5.50%	0.54%
4	Sep-10	12.21%	13.88%	1.68%
5	Aug-10	-1.44%	-2.12%	0.68%
6	Jul-10	2.55%	4.91%	2.36%
7	Jun-10	-3.55%	-8.31%	4.76%
8	May-10	-4.58%	-11.34%	6.76%
9	Apr-10	-4.02%	-3.60%	0.42%
10	Mar-10	12.55%	18.75%	6.20%
11	Feb-10	-2.89%	-1.94%	0.95%

12	Jan-10	-9.84%	-9.38%	0.46%
Tracking Error	**2.24%**			

4.2.2.3 Minimizing the Maximum Deviation (MinMax)

Table 10

Sri	Date	Change in Fund NAV	Change in Benchmark	MAD
1	Dec-10	-0.87%	-0.16%	0.72%
2	Nov-10	-6.36%	-5.42%	0.94%
3	Oct-10	4.96%	5.50%	0.54%
4	Sep-10	12.21%	13.88%	1.68%
5	Aug-10	-1.44%	-2.12%	0.68%
6	Jul-10	2.55%	4.91%	2.36%
7	Jun-10	-3.55%	-8.31%	4.76%
8	May-10	-4.58%	-11.34%	6.76%
9	Apr-10	-4.02%	-3.60%	0.42%
10	Mar-10	12.55%	18.75%	6.20%
11	Feb-10	-2.89%	-1.94%	0.95%
12	Jan-10	-9.84%	-9.38%	0.46%
Tracking Error	**6.76%**			

The tracking error is the maximum deviation between the fund's return and the benchmark's returns regardless the positivity or negativity of the differences.

4.2.2.4 Mean Absolute Downside Deviation Model (MADD)

Table 11

Sri	Date	Change in Fund NAV	Change in Benchmark	Negative Returns
1	Dec-10	-0.87%	-0.16%	-0.72%
2	Nov-10	-6.36%	-5.42%	-0.94%
3	Oct-10	4.96%	5.50%	-0.54%
4	Sep-10	12.21%	13.88%	-1.68%
5	Aug-10	-1.44%	-2.12%	-2.36%
6	Jul-10	2.55%	4.91%	-0.42%
7	Jun-10	-3.55%	-8.31%	-6.20%
8	May-10	-4.58%	-11.34%	-0.95%

9	Apr-10	-4.02%	-3.60%	-0.46%
10	Mar-10	12.55%	18.75%	
11	Feb-10	-2.89%	-1.94%	
12	Jan-10	-9.84%	-9.38%	
Tracking Error	**1.74%**			

4.2.2.5 Downside Maximum Deviation Model (DMinMax)

Table 12

Sri	Date	Change in Fund NAV	Change in Benchmark	Negative Returns
1	Dec-10	-0.87%	-0.16%	-0.72%
2	Nov-10	-6.36%	-5.42%	-0.94%
3	Oct-10	4.96%	5.50%	-0.54%
4	Sep-10	12.21%	13.88%	-1.68%
5	Aug-10	-1.44%	-2.12%	-2.36%
6	Jul-10	2.55%	4.91%	-0.42%
7	Jun-10	-3.55%	-8.31%	-6.20%
8	May-10	-4.58%	-11.34%	-0.95%
9	Apr-10	-4.02%	-3.60%	-0.46%
10	Mar-10	12.55%	18.75%	
11	Feb-10	-2.89%	-1.94%	
12	Jan-10	-9.84%	-9.38%	
Tracking Error	**6.20%**			

4.2.3 ADCB MSCI UAE Index Fund

4.2.3.1 Quadratic Tracking Error Model

Table 13

Sri	Date	Change in Fund NAV	Change in Benchmark	Active Return
1	Dec-10	-0.21%	-0.13%	-0.08%
2	Nov-10	-5.48%	-5.43%	-0.05%
3	Oct-10	5.23%	5.38%	-0.15%
4	Sep-10	12.32%	12.62%	-0.30%
5	Aug-10	-1.90%	-1.84%	-0.06%
6	Jul-10	4.19%	5.78%	-1.59%
7	Jun-10	-7.34%	-7.52%	0.18%
8	May-10	-12.40%	-12.43%	0.03%
9	Apr-10	-2.81%	-2.80%	-0.01%
10	Mar-10	23.96%	24.20%	-0.24%

11	Feb-10	-4.43%	-4.28%	-0.15%
12	Jan-10	-9.96%	-9.94%	-0.02%
Tracking error	**0.44%**			

4.2.3.2 Mean Absolute Deviation Tracking Error Model

Table 14

Sri	Date	Change in Fund NAV	Change in Benchmark	MAD
1	Dec-10	-0.21%	-0.13%	0.08%
2	Nov-10	-5.48%	-5.43%	0.05%
3	Oct-10	5.23%	5.38%	0.15%
4	Sep-10	12.32%	12.62%	0.30%
5	Aug-10	-1.90%	-1.84%	0.06%
6	Jul-10	4.19%	5.78%	1.59%
7	Jun-10	-7.34%	-7.52%	0.18%
8	May-10	-12.40%	-12.43%	0.03%
9	Apr-10	-2.81%	-2.80%	0.01%
10	Mar-10	23.96%	24.20%	0.24%
11	Feb-10	-4.43%	-4.28%	0.15%
12	Jan-10	-9.96%	-9.94%	0.02%
Tracking Error	**0.42%**			

4.2.3.3 Minimizing the Maximum Deviation (MinMax)

Table 15

Sri	Date	Change in Fund NAV	Change in Benchmark	MAD
1	Dec-10	-0.21%	-0.13%	0.08%
2	Nov-10	-5.48%	-5.43%	0.05%
3	Oct-10	5.23%	5.38%	0.15%
4	Sep-10	12.32%	12.62%	0.30%
5	Aug-10	-1.90%	-1.84%	0.06%
6	Jul-10	4.19%	5.78%	1.59%
7	Jun-10	-7.34%	-7.52%	0.18%
8	May-10	-12.40%	-12.43%	0.03%
9	Apr-10	-2.81%	-2.80%	0.01%

10	Mar-10	23.96%	24.20%	0.24%
11	Feb-10	-4.43%	-4.28%	0.15%
12	Jan-10	-9.96%	-9.94%	0.02%
Tracking Error	**1.59%**			

4.2.3.4 Mean Absolute Downside Deviation Model (MADD)

Table 16

Sri	Date	Change in Fund NAV	Change in Benchmark	Negative Returns
1	Dec-10	-0.21%	-0.13%	-0.0008
2	Nov-10	-5.48%	-5.43%	-0.0005
3	Oct-10	5.23%	5.38%	-0.0015
4	Sep-10	12.32%	12.62%	-0.003
5	Aug-10	-1.90%	-1.84%	-0.0006
6	Jul-10	4.19%	5.78%	-0.0159
7	Jun-10	-7.34%	-7.52%	-1E-04
8	May-10	-12.40%	-12.43%	-0.0024
9	Apr-10	-2.81%	-2.80%	-0.0015
10	Mar-10	23.96%	24.20%	-0.00016
11	Feb-10	-4.43%	-4.28%	
12	Jan-10	-9.96%	-9.94%	
Tracking Error	**0.45%**			

4.2.3.5 Downside Maximum Deviation Model (DMinMax)

Table 17

Sri	Date	Change in Fund NAV	Change in Benchmark	Negative Returns
1	Dec-10	-0.21%	-0.13%	-0.08%
2	Nov-10	-5.48%	-5.43%	-0.05%
3	Oct-10	5.23%	5.38%	-0.15%
4	Sep-10	12.32%	12.62%	-0.30%
5	Aug-10	-1.90%	-1.84%	-0.06%
6	Jul-10	4.19%	5.78%	-1.59%
7	Jun-10	-7.34%	-7.52%	-0.01%
8	May-10	-12.40%	-12.43%	-0.24%
9	Apr-10	-2.81%	-2.80%	-0.15%
10	Mar-10	23.96%	24.20%	-0.02%
11	Feb-10	-4.43%	-4.28%	

12	Jan-10	-9.96%	-9.94%	
Tracking error	**1.59%**			

4.2.4 Invest AD- UAE Total Return Fund

4.2.4.1 Quadratic Tracking Error Model

Table 18

Serial	Date	Change in Fund NAV	Benchmark Change	Active returns
1	Dec-10	-0.77%	-0.55%	-0.22%
2	Nov-10	-6.11%	-6.14%	0.03%
3	Oct-10	6.20%	6.25%	-0.05%
4	Sep-10	12.95%	13.06%	-0.11%
5	Aug-10	-2.24%	-2.12%	-0.12%
6	Jul-10	4.48%	4.91%	-0.43%
7	Jun-10	-8.39%	-8.31%	-0.08%
8	May-10	-12.45%	-11.33%	-1.12%
9	Apr-10	-2.97%	-2.81%	-0.16%
10	Mar-10	18.96%	16.09%	2.87%
11	Feb-10	-1.34%	-1.28%	-0.06%
12	Jan-10	-9.57%	-9.38%	-0.19%
Tracking Error	**0.91%**			

4.2.4.2 Mean Absolute Deviation Tracking Error Model

Table 19

Serial	Date	Change in Fund NAV	Benchmark Change	MAD
1	Dec-10	-0.77%	-0.55%	0.22%
2	Nov-10	-6.11%	-6.14%	0.03%
3	Oct-10	6.20%	6.25%	0.05%
4	Sep-10	12.95%	13.06%	0.11%
5	Aug-10	-2.24%	-2.12%	0.12%
6	Jul-10	4.48%	4.91%	0.43%
7	Jun-10	-8.39%	-8.31%	0.08%
8	May-10	-12.45%	-11.33%	1.12%
9	Apr-10	-2.97%	-2.81%	0.16%
10	Mar-10	18.96%	16.09%	2.87%
11	Feb-10	-1.34%	-1.28%	0.06%

12	Jan-10	-9.57%	-9.38%	0.19%
Tracking Error	**0.78%**			

4.2.4.3 Minimizing the Maximum Deviation (MinMax)

Table 20

Serial	Date	Change in Fund NAV	Benchmark Change	MAD
1	Dec-10	-0.77%	-0.55%	0.22%
2	Nov-10	-6.11%	-6.14%	0.03%
3	Oct-10	6.20%	6.25%	0.05%
4	Sep-10	12.95%	13.06%	0.11%
5	Aug-10	-2.24%	-2.12%	0.12%
6	Jul-10	4.48%	4.91%	0.43%
7	Jun-10	-8.39%	-8.31%	0.08%
8	May-10	-12.45%	-11.33%	1.12%
9	Apr-10	-2.97%	-2.81%	0.16%
10	Mar-10	18.96%	16.09%	2.87%
11	Feb-10	-1.34%	-1.28%	0.06%
12	Jan-10	-9.57%	-9.38%	0.19%
Tracking Error	**2.87%**			

4.2.4.4 Mean Absolute Downside Deviation Model (MADD)

Table 21

Serial	Date	Change in Fund NAV	Benchmark Change	Negative Returns
1	Dec-10	-0.77%	-0.55%	-0.22%
2	Nov-10	-6.11%	-6.14%	-0.05%
3	Oct-10	6.20%	6.25%	-0.11%
4	Sep-10	12.95%	13.06%	-0.12%
5	Aug-10	-2.24%	-2.12%	-0.43%
6	Jul-10	4.48%	4.91%	-0.08%
7	Jun-10	-8.39%	-8.31%	-1.12%
8	May-10	-12.45%	-11.33%	-0.16%
9	Apr-10	-2.97%	-2.81%	-0.06%
10	Mar-10	18.96%	16.09%	-0.19%
11	Feb-10	-1.34%	-1.28%	

12	Jan-10	-9.57%	-9.38%	
Tracking Error	**0.31%**			

4.2.4.5 Downside Maximum Deviation Model (DMinMax)

Table 22

Serial	Date	Change in Fund NAV	Benchmark Change	Negative Returns
1	Dec-10	-0.77%	-0.55%	-0.22%
2	Nov-10	-6.11%	-6.14%	-0.05%
3	Oct-10	6.20%	6.25%	-0.11%
4	Sep-10	12.95%	13.06%	-0.12%
5	Aug-10	-2.24%	-2.12%	-0.43%
6	Jul-10	4.48%	4.91%	-0.08%
7	Jun-10	-8.39%	-8.31%	-1.12%
8	May-10	-12.45%	-11.33%	-0.16%
9	Apr-10	-2.97%	-2.81%	-0.06%
10	Mar-10	18.96%	16.09%	-0.19%
11	Feb-10	-1.34%	-1.28%	
12	Jan-10	-9.57%	-9.38%	
Tracking Error	**1.12%**			

4.3 Models' Data Summery

Tracking error models were applied and implemented separately in the previous sections of the present chapter. To have a full view of the data resulted from the models; Table (23) has summarized the data.

Generally, Min Max tracking error model shows the highest tracking error among the index funds. Al Mal UAE Equity Fund and Makaseb Emirates Equity Fund (MEEF) have tracking error average more than 1% from the benchmark while ADCB MSCI UAE Index Fund and Invest AD- UAE Total Return Fund have an average tracking error less than 1% from the benchmark. This difference in tracking error between the fund's

managers can be relied on the type of the fund's management style. Al Mal UAE Equity Fund and Makaseb Emirates Equity Fund (MEEF) show Active Fund Management Style. In contrast, ADCB MSCI UAE Index Fund and Invest AD- UAE Total Return Fund follow a Passive Fund's management Style. Al Mal UAE Equity Fund has 5.19% quadratic tracking error which is the highest in the model. The lowest tracking error achieved by ADCB MSCI UAE Index Fund and equal 0.44%. The highest mean absolute deviation tracking error is 4.96% which belongs to Al Mal UAE Equity Fund and the lowest is 0.42% which belongs to ADCB MSCI UAE Index Fund. The quadratic tracking error and the mean absolute deviation tracking error results were close to each others.

Min Max model refer to the highest achieved tracking error in the mean absolute deviation. The maximum deviation is 17.89% by Al Mal UAE Equity Fund on March-2010 and the lowest is 1.59% by ADCB MSCI UAE INDEX FUND on July-2010.

Table 23

Model	Mal UAE Equity FUND	Makaseb UAE Equity Fund	ADCB MSCI UAE INDEX FUND	AD Invest UAE TOTAL RETURN FUND
Tracking Error (TE)	**5.19%**	**3.14%**	**0.44%**	**0.91%**
MAD (TE)	**4.96%**	**2.24%**	**0.42%**	**0.78%**
MIN MAX (TE)	**17.89%**	**6.76%**	**1.59%**	**2.87%**
MADD (TE)	**5.93%**	**1.74%**	**0.45%**	**0.31%**
Down MIN MAX (TE)	**17.92%**	**6.20%**	**1.59%**	**1.12%**

Chapter Five

Conclusion

5.1 Summery

The research aimed to understand the mechanism of the tracking error in index funds and give full review of the main researches and papers that discussed the tracking error in index or benchmarking funds.
A smooth gradation has been applied on the research's topics which start from the basic principles of the tracking error in index funds reaching to the major statistical models that applied in minimizing the tracking error.

As a major indicator of how the funds is mimicking the benchmark or how is the fund's manager performance, the tracking error cannot be explained without explaining the nature of the index funds. The main index funds have been discussed. The first type is the passive index funds which aim to have a full replication of the benchmark performance. The second type is the active funds which allow the fund's manager to rebalance the fund and change the weight of the assets in a matter to increase the opportunity to beat the benchmark. There is a hybrid fund called enhanced index funds which are between the passive index funds and active index funds.

Optimization in Modern Portfolio Theory (MPT) played major role in the research. Tracking error has been used widely as a constraint in portfolio optimization. A papers by (BERTRAND, 2008), (Jorion, 2003) and (Roll, 1992) have analyzing the portfolio optimization under tracking error constraint. All the studies used the efficient frontier analysis in the optimization process.
Portfolio risk analysis has been discussed and provided under the tracking error umbrella. Investors are concerned about the risk their capital is exposed to and there no excuses to avoid it.

Research's methodology has been presented in a separate chapter because of its importance. Methodology has been built and constructed to suit the objective aimed in

this research and the statistical character of tracking error. The methodology has explained the way the data has been calculated and the basis of the data implementation.

5.2 Findings and Remarks

The key benefit from the research has risen from binding between the tracking error theories and the empirical data. A case study has been conducted and consists from four index funds traded in the Emirates Securities Market (ESM). These funds are Al Mal UAE Equity Fund, Makaseb Emirates Equity Fund (MEEF), ADCB MSCI UAE Index Fund and Invest AD- UAE Total Return Fund. Three benchmarks were indexed; MSCI UAE Index, S&P UAE Composite Index and MSCI UAE Domestic Net Total Return Local Index.

Five tracking error models tested each index fund using fun's historical net asset values (NAV). Each fund using a specific benchmark and it has different fund's management. Quadratic tracking error values are between 0.44% and 5.19%. The lowest quadratic tracking error was 0.44% which has been achieved by ADCB MSCI UAE Index Fund and the highest was achieved by Mal UAE Equity Fund and it was 5.19%. A high or low percentage of tracking error doesn't affect the reputation of the fund's manager.

Empirical results show that there are two types of fund's management schools controlling them. Al Mal UAE Equity Fund and Makaseb Emirates Equity Fund (MEEF) are following Active Funds Management. Tracking error are 5.19% and 3.14% respectively. ADCB MSCI UAE Index Fund and Invest AD- UAE Total Return Fund are following Passive Funds Management. Tracking error are 0.44% and 0.91% respectively.

Each type of fund's management focused on particular investors depending on the investors' risk appetite and expectations. For example, investors who believe that fund's managers cannot beat the benchmark will follow the passive fund's management style. In contrast, investors' who believe that fund's managers can beat the benchmark will follow the active or enhanced fund's management style.

5.3 Recommendations

According to results appeared from the research, important recommendations should be presented and highlighted.

The first recommendation is to implement the quadratic tracking error to the active management index funds. This model will give an appropriate indication about the deviation between the fund's performance and the benchmark performance. Quadratic model give more value to the negative active returns which have a high probability to appear as a normal result of the continuous rebalancing in active management style.

The second recommendation is to implement the Mean Absolute Deviation (MAD) in calculating the tracking error for passive management. The model is easy to interpret and will be more useful for the passive index funds investors. Mean Absolute Deviation (MAD) model ignores the sign of the active returns (Positive or Negative) and this sign has a normal value because of the low rebalancing in passive index funds.

Other models have great benefits to the portfolio managers rather than investors as enhancing the portfolio performance point view. These models will highlight the areas and periods were tracking error increased or decreased so the portfolio managers can take an action to reduce his tracking error.

Third recommendation is concerned about the whole index funds market in UAE. Index funds are growing hugely and will need more regulations and laws to control it and guide the portfolio managers as well as investors. Emirates Securities and Commodities Authority (ESCA) has already took an early action and issued a draft to regulate the investment funds (including index funds) early of 2011.

Appendix

The appendix is covering the UAE economy overview from the CIA "The World Fact Book".

Indicator	Statistics
	$199.8 billion (2010 est.)
GDP (purchasing power parity):	$194.7 billion (2009 est.)
	$200.1 billion (2008 est.)
GDP (official exchange rate):	$239.7 billion (2010 est.)
	2.6% (2010 est.)
GDP - real growth rate:	-2.7% (2009 est.)
	7.4% (2008 est.)
	$40,200 (2010 est.)
GDP - per capita (PPP):	$40,600 (2009 est.)
	$43,300 (2008 est.)
	agriculture: 0.9%
GDP - composition by sector:	industry: 51.5%
	Services: 47.6% (2010 est.)
Labor force:	3.908 million
	Note: expatriates account for about 85% of the work force (2010 est.)
	agriculture: 7%
Labor force - by occupation:	industry: 15%
	services: 78% (2000 est.)
Unemployment rate:	2.4% (2001)
Population below poverty line:	19.5% (2003)
Household income or consumption by percentage share:	lowest 10%: NA%
	highest 10%: NA%

Investment (gross fixed):	26.8% of GDP (2010 est.)
Budget:	revenues: $65.02 billion
	expenditures: $60.02 billion (2010 est.)
Public debt:	44.6% of GDP (2010 est.)
	48.9% of GDP (2009 est.)
Inflation rate (consumer prices):	2.2% (2010 est.)
	1.6% (2009 est.)
Central bank discount rate:	NA%
Stock of narrow money:	$68.76 billion (31 December 2010 est)
	$60.85 billion (31 December 2009 est)
Stock of broad money:	$228.5 billion (31 December 2010 est.)
	$201.6 billion (31 December 2009 est.)
Stock of domestic credit:	$290 billion (31 December 2010 est.)
	$263.6 billion (31 December 2009 est.)
Market value of publicly traded shares:	$109.6 billion (31 December 2009)
	$97.85 billion (31 December 2008)
	$224.7 billion (31 December 2007)
Agriculture - products:	dates, vegetables, watermelons; poultry, eggs, dairy products; fish
Industries:	
petroleum and petrochemicals; fishing, aluminum, cement, fertilizers, commercial ship repair, construction materials, some boat building, handicrafts, textiles	
Industrial production growth rate:	3.2% (2010 est.)
Electricity - production:	71.54 billion kWh (2007 est.)
Electricity - consumption:	65.98 billion kWh (2007 est.)
Electricity - exports:	0 kWh (2008 est.)

Electricity - imports:	0 kWh (2008 est.)
Oil - production:	2.798 million bbl/day (2009 est.)
Oil - consumption:	435,000 bbl/day (2009 est.)
Oil - exports:	2.7 million bbl/day (2007 est.)
Oil - imports:	192,900 bbl/day (2007 est.)
Oil - proved reserves:	97.8 billion bbl (1 January 2010 est.)
Natural gas - production:	50.24 billion cu m (2008 est.)
Natural gas - consumption:	59.42 billion cu m (2008 est.)
Natural gas - exports:	7.567 billion cu m (2008 est.)
Natural gas - imports:	16.75 billion cu m (2008 est.)
Natural gas - proved reserves:	6.071 trillion cu m (1 January 2010 est.)
Current account balance:	$3.409 billion (2010 est.)
	$7.871 billion (2009 est.)
Exports:	$195.8 billion (2010 est.)
	$192.2 billion (2009 est.)
Exports - commodities:	crude oil 45%, natural gas, reexports, dried fish, dates
Exports - partners:	Japan 17.27%, South Korea 10.49%, India 9.96%, Iran 6.82%, Thailand 5.11% (2009)
Imports:	$159 billion (2010 est.)
	$150 billion (2009 est.)
Imports - commodities:	machinery and transport equipment, chemicals, food
Imports - partners:	China 15.03%, India 14.27%, US 8.44%, Germany 5.81%, Japan 4.52% (2009)
Reserves of foreign exchange and gold:	$39.1 billion (31 December 2010 est.)
	$36.1 billion (31 December 2009 est.)
Debt - external:	$122.7 billion (31 December 2010 est.)
	$122.5 billion (31 December 2009 est.)
Stock of direct foreign investment - at home:	$76.38 billion (31 December 2010 est.)
	$70.18 billion (31 December 2009 est.)
Stock of direct foreign investment - abroad:	$54.91 billion (31 December 2010 est.)
	$51.41 billion (31 December 2009 est.)

Exchange rates:	Emirati dirhams (AED) per US dollar - 3.673 (2010), 3.673 (2009), 3.6725 (2008), 3.6725 (2007), 3.6725 (2006)

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