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Portfolio Construction in Enhanced Index Tracking Modelling

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ABSTRACT

A stock market index is composed of stocks with high capitalization. In stock market investment, it is the aim of investors and fund managers to generate returns similar to the stock market index. The simplest way to track an index is by purchasing all of the component stocks of the particular index in the same proportions as in the index. However, this investment strategy is not practical for it incurs high capital and transaction costs. Investors thus, aim to generate similar or higher returns than the stock market index without having to purchase all of its component stocks. Enhanced index tracking has been introduced to achieve this objective. Enhanced index tracking is the portfolio management in stock market index. In enhanced index tracking, a portfolio is constructed to track the performance of the stock market index and generate excess return over the return of the market index without having to purchase all of its component stocks. The objective of this study is to construct an optimal portfolio and determine the portfolio performance by employing the weighted model of enhanced index tracking. Weighted model focuses on the trade-off between maximizing the excess return and minimizing the risk. The results of this study show that the optimal portfolio for the weighted model is able to outperform the Malaysian market index which is FTSE Bursa Malaysia Kuala Lumpur Composite Index with only selecting 40% of the index component stocks.

Keywords: Optimal portfolio, Return, Risk. Tracking error, Weighted model, Portfolio performance, Benchmark index.
PACS: 80.

1. Introduction

Investment is a process of committing funds to one or more assets in order to generate positive income or increase value. Portfolio is a collection of investments assembled to meet one or more investment goals (Lawrence *et al.*, 2011). Diversification is the concept of forming a portfolio using different investment vehicles to reduce risk and increase return. This concept is important in constructing an effective portfolio. Investors thus should benefit from holding portfolios of investment rather than a single investment in order to reduce investment risk. Different investors have different objectives for their portfolios. The art of selecting the right investment policy for the individuals in terms of minimizing risk and maximizing return is called portfolio management.Portfolio management has been applied in passive management in the stock market. The goal of passive management is to achieve returns identical to a specific benchmark (Treynor and Black, 1973). Index tracking is a popular form of passive management in stock market. The simplest way to track an index is full replication, where all of the component stocks of a particular index are purchased in the same proportions as in the index. However, this strategy is not practical since it incurs high capital and transaction costs. Roll (1992) introduced tracking error in index tracking to reproduce the performance of the market index without purchasing all the stocks consist in the index. In portfolio management, this can be done by establishing an optimal portfolio that minimizes tracking error. Tracking error is a risk measure of how closely a portfolio follows the market index (Roll, 1992). Beasley (2003) introduced enhanced index tracking by considering the trade-off between minimizing the tracking error and maximizing the excess return. Enhanced index tracking aims to

construct an optimal portfolio to generate higher portfolio mean return than the stock market index return at minimum risk without purchasing all of the component stocks. Beasley (2003) proposed weighted model to determine the trade-off between the excess return and the tracking error in enhanced index tracking. The objective of this paper is to construct an optimal portfolio using weighted model and comparing it to the benchmark index. The rest of the paper is organized as follows. The next section describes the data and methodology. Section 3 discusses about the empirical results of this study. Section 4 concludes the paper.

2. Data and Methodology

FTSE Bursa Malaysia Kuala Lumpur Composite Index (FBMKLCI) is the leading indicator of the performance of the Malaysia stock market and economy which consists of 30 stocks listed on the Malaysian Main Market. In this study, the data are weekly prices of 24 stocks (as listed in table 1 below) in FBMKLCI from January 2010 until December 2012. These 24 stocks are selected in this study for they consistently remain as components of FBMKLCI within the study period.

2.1. Weighted Model

Beasley (2003) proposed the weighted model in enhanced index tracking. The optimal portfolio is constructed using the weighted model which focuses on the trade-off between minimizing the tracking error and maximizing the excess return. The model is formulated as below:

$$\text{Minimize } F = \lambda(TE) - (1-\lambda)\alpha \tag{1}$$

$$\text{where } TE = \sqrt{\frac{1}{T}\sum_{i=1}^{T}\left(R_{Pt} - R_{It}\right)^2} \tag{2}$$

$$\alpha = \sum_{i=1}^{T}\left(\frac{R_{Pt} - R_{It}}{T}\right) \tag{3}$$

Subject to

$$0 \le \lambda \le 1 \tag{4}$$

$$Z_i \in \{0,1\} \tag{5}$$

$$\sum_{i=1}^{n} Z_i \le K \tag{6}$$

$$L_i Z_i \le x_i \le U_i Z_i \tag{7}$$

$$0 < L_i < U_i < 1 \tag{8}$$

$$\sum_{i=1}^{n} x_i = 1 \tag{9}$$

where *TE* is the tracking error, *T* is the number of periods, R_{Pt} is the mean return of the portfolio at time *t* and R_{It} is the mean return of the market index at time *t*. x_i is the weight of each stock invested, *K* is the number of stocks selected to track the stock market index. L_i and U_i are the lower and upper bounds of the investment proportion respectively on stock *i*. α is the excess return and λ represents an implicit trade-off between the risk and excess return.

Equation (1) is the objective function of the model which determines a trade-off between the tracking error and excess return based on λ. In this study, the excess return and risk are equally important and thus, λ is set to be 0.5 (Beasley, 2003). For constraint (5), Z_i (i = 1,2,…..,n) is introduced to indicate the stock selection problem with Z_i = 1 indicates the ith stock is included in the optimal portfolio or otherwise for Z_i = 0. Constraint (6) ensures that the number of stocks in the optimal portfolio are equal or less than K. The number of stocks in the optimal portfolio is targeted to be less than or equal to 40% of the actual number of stocks in the stock market index (Jansen and Dijk, 2002). Constraint (7) shows that if stock i is not selected in the optimal portfolio (i.e., Z_i = 0), then x_i = 0, and if stock i is selected in the optimal portfolio (i.e., Z_i = 1), then $x_i \neq 0$. Constraint (8) indicates that the value of x_i is limited in the interval $[L_i, U_i]$. Constraint (9) ensures that the total weight of stocks invested is equal to one. The optimal portfolio is constructed by using LINGO software.

2.2. Portfolio Performance

Markowitz (1952) proposed mean-variance model for portfolio construction. Variance is the most commonly used risk measure in portfolio optimization. Roll (1992) applied variance as a risk measure for tracking error in index tracking. Tracking error is the standard deviation of the difference between the returns of the portfolio and the returns of the stock market index (Meade and Salkin, 1990). Tracking error measures the deviation of the portfolio's return compared to the stock market return. The formula for the risk is as follows.

$$TE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(R_{Pt} - R_{It}\right)^2} \tag{10}$$

whereTE is the tracking error at time t, T is the number of periods, R_{Pt} is the mean return of the portfolio at time t and R_{It} is the mean return of the market index at time t.

Excess return is the difference between the portfolio return and the stock market index return. There exits excess return if only the return of the portfolio is higher than the return of the stock market index. Excess return is formulated as below:

$$\alpha = r_P - r_I \tag{11}$$

where α is the excess return, r_p is the mean return of the portfolio and r_I is mean return of the market index.

The performance of the optimal portfolio is compared to the stock market index in terms of mean return and tracking error.

3. Results

Table 1 presents the optimal portfolio composition of the weighted model.

Table-1. Optimal portfolio composition of weighted model

	Stock	**Weights (%)**
1	Ammb Holdings	8.05
2	Axiata Group Bhd	11.90
3	British American Tabaco	-
4	Cimb Group Holding	-
5	Digi.Com	7.49
6	Genting	9.00
7	Genting Malaysia	-
8	Hong Leong Bank Bhd	-
9	Hong Leong Financial Group	4.82
10	Ioi Corporation	-
11	Kuala Lumpur Kepong	5.18
12	Malayan Banking	14.03
13	Maxis Bhd	-
14	PetronasDaganganBhd	-

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15	Petronas Gas Bhd	5.11
16	Public Bank	11.70
17	Public Bank Bhd	-
18	Rhb Capital Bhd	-
19	Sime Darby	11.53
20	Telekom Malaysia Bhd	-
21	TenagaNasional	7.04
22	Umw Holdings	-
23	Ytl Corporation	4.17
24	Ytl Power International	-

Based on table 1, only 12 stocks out of the total sample of 24 stocks are selected in the optimal portfolio employing the weighted model. This optimal portfolio consists of 12 stocks with different weights to track FBMKLCI index which comprises 30 stocks. MALAYAN BANKING (14.03%) is the most dominant stock in the optimal portfolio. YTL CORPORATION (4.17%) has the smallest component in the optimal portfolio. Table 2 displays the comparison of performance between the optimal portfolio of weighted model and FBMKLCI index.

Table-2. Comparison of performance between the optimal portfolio of weighted model and FBMKLCI index.

Portfolio	**Number of stocks**	**WeeklyMean Return (%)**	**Tracking Error (%)**	**Weekly Excess Return (%)**
FBMKLCI Index (Benchmark)	30	0.1802	-	-
Optimal Portfolio (Weighted Model)	12	0.2589	0.2960	0.0787

As shown in table 2, the optimal portfolio generated using weighted model consists of only 12 stocks to track FBMKLCI index comprising 30 stocks. This implies that only 40% of FBMKLCI components are required to construct the optimal portfolio. Based on the study period, the weekly mean return for FBMKLCI index is 0.1802%. Contrarily, the weekly mean return for the optimal portfolio of weighted model is 0.2589% which is higher than the weekly mean return for FBMKLCI index. This indicates that the optimal portfolio of weighted model outperforms the FBMKLCI index with excess weekly return of 0.0787%. In summary, the optimal portfolio of weighted model outperforms FBMKLCI index providing higher mean return with only 40% of FBMKLCI components selected.

4. Conclusion

This paper discusses on the determination of an optimal portfolio composition and performance using weighted model. In conclusion, the optimal portfolio of weighted model outperforms FBMKLCI index giving higher mean return and lower tracking error without having to purchase all of the component stocks in the index, selecting only 40% of FBMKLCI components. This implies that the weighted model is an appropriate model to be employed by the investors in Malaysia.

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