The Effect of Historic Phase on the Efficient Frontier for Volatile Market

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Abstract: - Over the years, Malaysia’s economy has performed remarkably well due to the country’s political stability, the sound financial and economic policies adopted by the government, and the efficient management of its natural resources. Even more impressive is the fact that economic growth in Malaysia is achieved within an environment of relatively low inflation. However, Malaysia has to face a lot of obstacles in order to achieve such accomplishment. As the changes in economy also influenced the stock prices movement, and at the same time, alters the efficient frontier. The argument arises on the method of constructing the efficient frontier. Two efficient frontier methods, MV efficient frontier [14],[15] and resampled efficient frontier [17],[18], has been compared based on Malaysia’s equity portfolio [23]. It is found that the resampled efficient frontier has outperformed MV efficient frontier. Based on the same method, this study is aim to see the effects of economic environment on the construction of portfolios’ efficient frontier. The comparison of the historical period’s length used for generating the efficient frontier is also discussed in this study. Illustrated in the results, historical period do influenced the short term investment in Malaysia and it is surpass to use shorter historical data to construct the best efficient frontier reflecting the Malaysia’s market.

Key-Words: - Efficient frontier, optimum portfolio, estimation error, resampled frontier, Malaysia market

1 Introduction

On a prior basis, one would expect a developing stock market to become more efficient as it develops. Developing securities markets are characterized by low liquidity, unsophisticated investors, inadequate disclosure requirements and some non-trivial barriers to entry. It is therefore critical that appropriate test of market efficiency on these markets take into account these characteristics. The efficiency of the emerging markets assumes greater importance as the trend of investments is accelerating in these markets. There is enough evidence on market efficiency in the develop market; however, the same is not true for the Asian emerging stock market. Poshakwale (1996) prove it with the empirical evidence using Bombay Stock Exchange over a period of 1987 to 1994.

Studies on testing of market efficiency of Asian emerging stock markets are also surprisingly few. Los (1998) tests the market efficiency of six Asian countries: Hong Kong, Indonesia, Singapore, Malaysia, Taiwan, and Thailand in the period June 1986 to July 1996. He used Sherry’s non-parametric methods, developed to analyze the information processing efficiency of nervous systems. It was appeared that, all six Asian stock markets are inefficient. A tentative ranking in order of stock market efficiency is: Singapore, Thailand, Indonesia, Malaysia, Hong Kong, and Taiwan. Malaysia stock market efficiency is ranked fourth after Singapore, Thailand and Indonesia.

The key of any asset allocation strategy is to determine, as accurately as possible, the combination of assets that will produce the best outcome for investors. This is where Mean-Variance (MV) optimization pioneered by Markowitz (1952) is being applied. MV optimized portfolios have potentially many attractive investment characteristics [16]. Optimized portfolios may reduce risk without reducing expected return. MV optimization also enables tailoring portfolios to various risk and return preferences. Although the MV approach is widely accepted among practitioners, it is also widely
accepted that failures have been found [7][24],[6], and that there is an urgent need to correct them.

Frankfurter et al. (1971) shows the effect in estimating means, variances and covariances of security returns. They conduct an empirical analysis on estimators that have entered into actual portfolio selection decisions by using means from three securities. The study found that inefficient portfolio designated using true parameters appeared efficient in a large proportion of the time. In general, both seem to appear on the efficient frontier with relative frequencies that would not differentiate them. This may cause the efficient frontier being dominated by inferior portfolio with high proportion. Even the security offers reputable returns, the variance are quite high. These result to the presence of error in estimating the required parameters, in which MV model do not accounted for.

Moreover, Stefanski (1985) presented a general formulation of the errors-in-variables problem, which includes both linear and nonlinear models, functional and structural cases and dependent measurement errors. He also showed the way to assess the asymptotic bias in the estimator when error is present, and to construct an estimator with smaller bias. Chopra and Ziemba (1993) showed that it is important to distinguish the relative impact of errors in means, variances, and covariances as investors rely on limited data to estimate the parameters of the distribution and estimation errors are unavailable.

Tests show that MV efficiency in the presence of estimation error has very poor out-of-sample investment performance characteristics [10],[3],[4]. MV optimized portfolios “error maximized” the optimization inputs leading to portfolios that are typically investment unintuitive and have little investment value. For the rest of us, the message is that portfolio optimization used without the proper statistical framework could actually generate portfolios that are dangerously far from optimal. Dealing with the problem, many works have focused on correcting the estimation error [10],[8],[12],[17],[13]. A study completed by Siti Nurleena (2006), shows the relative performance of the Markowitz’s MV efficient frontier and the Michaud’s resampled efficient frontier [23]. Comparison between these two methods using empirical evidence based on the portfolios from Malaysia market, suggests that the resampled efficient frontier have outperformed the MV efficient frontier.

The developed securities markets, such as Malaysia, Thailand, Indonesia and other Asian countries, generally conform to the expectation of efficiency, and are characterized by active trading, a large turnover, a large number of utility maximizing investors, no entry barriers and efficient dissemination of relevant information. In Malaysia, the Bursa Malaysia itself is relatively small in size and thinly traded compared to the developed market like US and Europe. Test of efficiency on Asian market always generate full of loopholes results [21],[1],[2]. Much of the evidence suggests that the actively traded stocks tend to be efficiently priced.

With the purpose to provide further evidence on Malaysia stock market efficiency, Muzafar (1998) tests the informational efficient market using the macroeconomic variables, money supply and national output to predict the stock prices in Malaysia. His result suggests that Malaysia stock market is informationally inefficient. Pandey (2002) investigates the existence of seasonality in Malaysia stock market as it shows inefficient of the market. Monthly closing price data of the Kuala Lumpur Stock Exchange’s Index, called EMAS were used for the period from January 1992 to June 2002. The results of the study confirmed the monthly effect in stock returns in Malaysia.

The main focus of this study is to scrutinize the effects of economic environment on the construction of portfolios’ efficient frontier. Historical data used for the estimation is known to associate with the economic history based on the length of the period. The comparison of the historical period’s length used for generating the efficient frontier is being discussed in this study.

2 Methodology

2.1 Data Analysis

There are two types of data collected from the trading day of Bursa Malaysia for the process of analysis in this study. First, the daily closing prices of 100 selected stocks traded on the main board from 3 January 2000 until 29 July 2005; we name it Data A, which has 1370 trading days. The second type is also has the same 100 selected main board stocks, but with only for the duration from 2nd January 2003 to 29 July 2005 with shorter historical period (637 trading days) called Data B. The aim is to compare whether the differences of data period give any effect on the portfolios frontier for these set of data, Data A and Data B. Changing the length of the observation will change these variance ratios for many assets [5],[22]. The idea is to compare a situation where we have the same portfolios with different historical period (different economic environment).
2.2 The Markowitz Mean-Variance Model

Probably the most universally accepted approach to portfolio selection today is the MV optimization approach introduced by Harry Markowitz (1959). In the basic Markowitz model, portfolio selection is represented by the following optimization problem:

Minimize $\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_{ij} x_i x_j$  \hspace{1cm} (1)
subject to

$\sum_{i=1}^{n} R_i x_i = R_p$  \hspace{1cm} (2)

$\sum_{i=1}^{n} x_i = 1$  \hspace{1cm} (3)

$x_i \geq 0, i = 1, \ldots, n$  \hspace{1cm} (4)

Where $n$ is the number of available securities, $x_i$ is the fraction of the portfolio held in security $i$, $R_i$ is the expected value of return on security $i$ and $R_p$ is a target level of expected return on the portfolio. The covariance of returns of securities $i$ and $j$ is given as $\sigma_{ij}$, and $\sigma_p^2$ is the variance of the portfolio’s return.

2.3 Traditional Monte Carlo Approach to MV Optimization

A Monte Carlo measure called portfolio resampling can be used to illustrate the effect of estimation error. By resampling process, we will get optimization inputs that are statistically comparable to the historical sample means and variances. Evaluating these simulated portfolios helps to show the variability inherent in efficient frontier estimation. In a Monte Carlo simulation experiment, the proportion mean vector, $\mu$, and covariance matrix, $\Sigma$, are computed for the set of assets in the MV optimization. Under the assumption of multivariate normal returns, a large number of samples of size $T$ are drawn from the distribution:

$R^{(k)} \sim N_k (R, \Sigma) \hspace{1cm} k = 12, \ldots, K$  \hspace{1cm} (5)

Based on the true distribution parameters mean return vector, $R_0$ and covariance matrix, $\Sigma_0$, we generate a random sample based on the same distribution with $T$ observation as the original sample. Repeating this procedure $k$ times. Each time we got a new set of optimization input. For each of these inputs we can calculate a new efficient frontier by using the J sets of optimal weights.

We use each allocation vectors $x_i, i = 1, \ldots, J$ back to the original mean return vector, $R_0$, and variance–covariance matrix, $\Sigma_0$, and get the new efficient frontier which plot below the original efficient frontier. This is because any weight vector optimal for $R_k$ and $\Sigma_k$, $k = 12, \ldots, K$ can not be optimal for $\mu_0$ and $\Sigma_0$. The result of the sampling procedure is that estimation error in the inputs parameters is transformed as the uncertainty of the optimal weight vector.

2.4 Michaud’s Method

Michaud stimulates for a statistical understanding of MV optimization. Portfolios on the resampled frontier are composed of assets weight vectors which are the average of the MV efficient portfolios weight vectors given a level of portfolio return. It is to guaranty that the weight vector sum up to one after averaging.

First, using the same estimated mean vector and variance matrix of the historical inputs, we calculate $K$, MV optimal portfolios by varying the expected return from the minimum variance to the maximum return portfolio, and by incorporating the constraints. Divide the difference between the minimum and maximum return into $m$ ranks. The resampled weight for a portfolio of rank $m$ is given by

$x_{\text{resampled}}^m = \frac{1}{n} \sum_{i=1}^{n} x_{im}$  \hspace{1cm} (6)

where $x_{im}$ denotes the weight vector of the $m$th portfolio along the frontier for the $i$th resampling for a number of $n$ portfolios. Next, we draw $T$-times for each asset from this distribution (returns are, again, assumed to be multivariate normally distributed), obtain a new set of optimization inputs from this statistically equivalent sample, and again calculated $K$ efficient frontier portfolios. Calculate average portfolio weights for each return point. Repeat this step many times. Evaluate a frontier of averaged portfolios with the variance matrix from first step to plot the resampled frontier.

3 Results and Discussion

Estimation error is defined as the difference between the estimated distribution parameters and the true parameters when samples are not large enough. The impact of estimation error on portfolio could be very serious. In Figure 1, we show the estimation error which occurred for all the portfolios.
Fig. 1: Estimation error occurred between MV efficient and Simulated MV

The distance between MV efficient frontier and the simulated MV shows the estimation error occurred for each data set. Comparing the estimation error, we can see that the estimation error in Data A is greater than Data B. In addition, we also extract the values from the graphs into the Table 1 and Table 2, so that we can see and discuss the values clearly.

Table 1: Distance comparison of return between data sets

<table>
<thead>
<tr>
<th></th>
<th>MV Efficient</th>
<th>Simulated MV</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data A</td>
<td>Min. 0.0018</td>
<td>-0.0143</td>
<td>0.0125</td>
</tr>
<tr>
<td></td>
<td>Max. 0.0135</td>
<td>0.0107</td>
<td>0.0028</td>
</tr>
<tr>
<td>Data B</td>
<td>Min. 0.0049</td>
<td>-0.0168</td>
<td>0.0119</td>
</tr>
<tr>
<td></td>
<td>Max. 0.0279</td>
<td>0.0262</td>
<td>0.0017</td>
</tr>
</tbody>
</table>

Table 1 shows the distance for all data sets for return values. The distance is the differentiated value of MV efficient frontier and simulated MV. We divide it to two distance values, minimum and maximum. First we present the range value for returns. Based on Data A, we can see that the MV efficient frontier annualized returns range approximately from 0.1% to 1.4%, while the simulated MV annualized returns range approximately from -1.4% to 1.1%. Data B has MV efficient frontier annualized returns range approximately from 0.4% to 2.8%, while the simulated MV annualized returns for Data B range approximately from -1.6% to 2.7%.

Concluded from Table 1, as the lengths of historical data differ, the estimation error shows different distances, and as the risk differ between the portfolios, the distances deviate. Clearly, Data A shows the highest estimation error, with the distance of minimum value for MV efficient frontier to minimum value for simulated MV is 0.0125 and the distance for maximum value is 0.0028. For Data B, the return distance for minimum value is quite high as Data A that is 0.0119, but have a lower minimum distance valued 0.0017.

Table 2: Distance comparison of standard deviation between data sets

<table>
<thead>
<tr>
<th></th>
<th>MV Efficient</th>
<th>Simulated MV</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data A</td>
<td>Min. 0.0166</td>
<td>0.0220</td>
<td>0.0054</td>
</tr>
<tr>
<td></td>
<td>Max. 0.0684</td>
<td>0.1920</td>
<td>0.1236</td>
</tr>
<tr>
<td>Data B</td>
<td>Min. 0.0120</td>
<td>0.0172</td>
<td>0.0052</td>
</tr>
<tr>
<td></td>
<td>Max. 0.1214</td>
<td>0.2889</td>
<td>0.1675</td>
</tr>
</tbody>
</table>

Next, we consider the standard deviation values from Table 2, the MV efficient frontier annualized standard deviations for Data A are ranging from 1.6% to 7%, while the simulated MV annualized standard deviations are ranging from 2.2% to 20%. Data B has MV efficient frontier annualized standard deviations ranging from 1.2% to 12%, while the simulated MV annualized standard deviations are ranging from 1.7% to 29%. Contradicted with the result from Table 1, Table 2 shows Data A perform rather well with the lower distance for standard deviation after Data B, with the distance, only 0.0054 for minimum value, and the lowest distance for maximum value, 0.1236. Data B has the lowest value for minimum distance, 0.0052, but highest distance for maximum value which is 0.1675.

Based on range of return, Data A shows higher estimation error compare to Data B. But in range of standard deviation, Data B shows higher estimation error compare to Data A. This is probably because Data A with long period tends to insert the extreme value all the way through the turbulence years which are in year 2000 and 2001, having low return and high risk. Furthermore, Data B has higher return and lower standard deviation compared to...
Data A. From the observations, Data B, with shorter estimation period, is superior to Data A, which has longer estimation periods.

Then we will look into the comparison between the MV efficient frontiers and resampled efficient frontiers graphically. The top curve represents the MV efficient frontiers with true but unknowable optimization inputs. The lower curve represents the resampled efficient frontiers. Even though shorter efficient frontier curve means more efficient, it does not appropriate to embody the choice from the optimized simulated portfolios. Data A has shorter resampled efficient frontier compared to Data B. However, resampled efficient frontier for Data B has higher return and lower risk, and the frontier also starts farther than zero compared to Data A. The result displays the improved resampled efficient frontier associated with the MV efficient frontier. By definition, the improved resampled efficient frontier lies below and within the range of portfolio risk spanned by the MV efficient frontier. The differences are relatively minimal at low risk levels but increase as risk increases.

Wrapping this study, we conclude our overall findings and relate them with the Malaysia stock market which affected by the economic changes. As our aims are to see the comparisons between Data A (long period length) and Data B (short period length), both are stocks listed main board. Firstly, in range of return, Data A shows higher estimation error compare to Data B. But in range of standard deviation, Data B shows higher estimation error compare to Data A. This is probably because Data A with long period tends to insert the extreme value all the way through the turbulence years which are in year 2000 and 2001, having low return and high risk.

4 Malaysia’s Economic Phase

The stock prices really depend on the economic changes, which are the reason why we include the discussion about the economic environment in data analysis, and the volatility of returns. We look into the two different situations stated earlier to see the effect of economic changes on our portfolios. As there were ranges of transformation in the economy for the past six years’ period, started from year 2000 to July, 2005.

We begin with year before 2000, the growth was disrupted by the severe contraction in 1997 arising from the East Asian financial crisis and affected currencies, stock markets, and other assets prices, leading to a negative growth rate of 7.4% in 1997. By end 1997, ratings had fallen many notches from investment grade to useless. The Kuala Lumpur Stock Exchange (KLSE) (known as Bursa Malaysia since 2004) had lost more than 50% from above 1,200 stocks to under 600 stocks. The ringgit had lost 50% of its value, falling from above 2.50 to under 3.80 to the dollar.

For the next three years until 2003, the Malaysia economy recorded a creditable performance despite the unprecedented volatility in the global economy as well as uncertainties arising from international terrorism (September, 11, 2001), wars in Afghanistan and Iraq (2001), and the outbreak of the Severe Acute Respiratory Syndrome (SARS). However, through fiscal stimulus and accommodative monetary policies, the government was able to sustain growth due to the expansion in domestic demand and promotion of domestic sources of growth. From a Gross Domestic Product (GDP) growth rate of only 0.4% in 2001, the Malaysia economy recovered strongly to register growth rates of 4.2% and 5.2% in 2002 and 2003 respectively.
In May 2003, the government introduced the Package of New Strategies to stimulate the Malaysia’s economic growth. The four strategies of the package were aimed at promoting private sector investment, strengthening the nation's competitiveness, developing new sources of growth and enhancing the effectiveness of the delivery system. The implementation of the package together with the more robust external demand and increased private sector activity in the domestic economy contributed a better than expected economic performance of 5.2% growth in 2003. Generally, foreign investors in Malaysia's manufacturing sector can hold 100% equity only in projects which export at least 80% of their production. However, effective from 17 June 2003, 100% foreign equity holding is allowed for all investments in new projects, as well as investments in expansion/diversification projects by existing companies irrespective of their level of exports.

Also with the aim of promoting active interest and participation in the Malaysia market, KLSE continued with its market promotion efforts for international and domestic investors. These efforts include participation in international roadshows and presentations to fund managers and institutional investors, participation in international publications as well as conducting investor awareness programmes throughout Malaysia. The majority of companies listed on the KLSE continue to register positive results notwithstanding challenging economic and market conditions.

Since April 2003, KLSE had commenced standardising board lot sizes of securities traded on the KLSE at 100 units of securities per lot, from the current multiple board lots 1000, 200 and 100 units. Trading in standard board lot has been implemented in stages to ensure a smooth and orderly implementation and completed by June 2003. To date, board lots of all counters on the second board and all counters in the trading services sector of the main board have been standardised. The implementation of the standard board lot has been received very positively by all market participants, including investors. Trading in standard board lot has also increased the orders and trades of shares.

The KLSE had introduced stock splits affected on 1 December 2003 to further enhance the liquidity and marketability of shares listed on the KLSE. The introduction of stock splits will result in the creation of new stocks, thereby increasing the number of stocks that each shareholder owns, albeit at a lower par value. For shareholders and investors, when a stock split is undertaken, the reduction in par value of the stocks makes the price of the stocks more attractive and affordable to a wider group of shareholders and investors. The number of stocks held by the existing shareholders will be increased and investors can diversify their portfolio as the stocks become more affordable. This had lead to more efficient price and sustained liquidity for the stocks.

The Malaysia economy has expanded by 7.1% in 2004, the fastest growth since 2000. The economy benefited from both stronger external and domestic demand. Notwithstanding some moderation in global growth in the second half of the year, the Malaysia economy remained resilient with the private sector continuing to be the principal driving force of domestic economic expansion. In 2004, the government progressed further in fiscal consolidation. The overall Federal Government deficit declined to 4.3% of GDP in 2004 (2003: 5.3%). The government, while consolidating, remained supportive of growth with policies targeted at enhancing the business environment for the economy.

In 2005, the last of the crisis measures was removed as the ringgit was taken off the fixed exchange system. The fixed exchange rate regime was abandoned in July 2005 in favour of managed floating system within an hour of China's announcing of the same move. In the same week, the ringgit strengthened a percent against various major currencies and was expected to appreciate further.

Based on the economic changes, the historical period length does give effect on the short term investment decision. Malaysia as a developing country, having unpredictable market prices, small changes in historical period may lead to huge alteration of the efficient frontier.

5 Conclusions

Investment period of a particular length is showed to correspond with a particular efficient frontier. In short term investment, the study found that it is best to use short historical period compared to long period. As in short term investment, investors are not looking forward to hold long each of the assets. It is because the high turbulence in historical period do influenced the study’s outcome. Yet, this study is limited on the single-period investment, short-term investment, and only on selected equity stocks, therefore, this conclusion may not be true for other investment conditions.

References:


