TACTICAL ASSET ALLOCATION WITH RETURN GENERATING MODEL: THE ALPHA STRATEGY

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ABSTRACT

This paper explores the measurement of performance for asset portfolios composed of significantly positive alpha securities in a 95% confidence interval in emerging markets. Four different estimating strategies were used to evaluate portfolio performance. These strategies are: traditional Mean-Variance or Markowitz, Single Index Model (SIM), Capital Asset Pricing Model (CAPM), and the Three Factor Model. Each of these strategies was compared with its initial and subsequent period. The results showed that among the four alternative strategies, the Mean-Variance model outperformed the other portfolio selection strategies, suggesting that the Mean-Variance methodology is the most appropriate for portfolio selection strategy.

In beating the benchmark, portfolio managers who employed Single Index Model strategy were the most skillful managers. However, most portfolio managers had a ratio of less than 0.5, which is considered a performance level below that good managers.

KEY WORDS: ALPHA / SINGLE INDEX MODEL / CAPM / PORTFOLIO OPTIMIZATION / MULTIFACTOR MODEL

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CHAPTER I
INTRODUCTION

There are many ways in evaluating the performance of a portfolio. Evaluating the performance based on average returns is not useful because returns should be grouped regarding to their risk classes before they can be evaluated. The easiest way to measure portfolio performance is to compare the returns with other group of investment with the same risk characteristic. For example, high-yield bond portfolios and growth stock equity funds should be grouped in each different universe. Then the average returns in each universe are ranked to indicate percentiles for each portfolio manager. Friend, Blume and Crockett (1970) had used the same methodology mentioned above, they grouped portfolios into similar risk classes based on variance of return and compared rates of return within these risk classes. Kritzman (1990) used returns from a universe of investors and then the ranking returns are divided into percentile to compare manager's performance. However, such ranking could be misleading because in one universe, a manager may concentrate on a particular sub-group. For example, in equity universes, the managers may concentrate on high beta or low beta securities and in high-yield bond universes, duration may be different across managers. Therefore, portfolio characteristics may not be comparable and it is suggested that a more precise means for portfolio performance measurement is desirable.

Methods of risk-adjusted performance evaluation were introduced by some of these authors; e.g., Treynor (1966), Sharpe (1966), Jensen (1968, 1969), Goodwin (1998), Grinold and Kahn (2000) for rating the performance of portfolio managers. The assessment studied by Treynor (1966) and Sharpe (1966) measured the portfolio's reward-to-variability which Treynor concern on systematic risk and Sharpe focus on total risk. Goodwin (1998), and Grinold and Kahn (2000) studied the manager's skills in beating the benchmark portfolio. Moreover, Friend and Blume (1970) examined the relationship between one-parameter performance measures and risks. They used

Treynor, Sharpe and Jensen risk-adjusted performance to measure the relationship against portfolio systematic risk and standard deviation. They found that the performance measures were dependent on risk. Moreover, Lehman and Modest (1985) studied the robustness of various risk-adjusted models in ranking mutual fund performance. Friend et al (1970) Jensen (1968) and Sharpe (1966) studied the ability of manger's skill in predicting the asset price; they found that the mutual funds do not earn enough rates of return to pay back the cost of their operations.

This paper attempts to investigating and suggesting the appropriate portfolio formation strategy in 20 emerging markets. The portfolios are constructed by selecting significant positive abnormal returns in a 95% confidence interval. Single Index Model by Fama and Macbeth (1973), Capital Asset Pricing Model by Sharpe (1964), Mean-Variance by Markowitz (1952, 1959) and the Three Factor Model by Fama and French (1993) will be used as portfolio selection strategy.

The remainder of this paper is organized as follow: chapter 2 provides literature review and chapter 3 describes the data and methodology. Descriptive statistics and empirical findings are presented in chapter 4 and chapter 5 offers concluding remarks.

CHAPTER II
LITERATURE REVIEW

In this section, relevant papers on portfolio performances and risk-adjusted returns will be discussed and explored. The theory and concept of each performance measurement will give the idea of how portfolios are evaluated. Therefore, it is important to understand the parameters of each measurement and how it is applied. Moreover, the asset pricing models are presented in the methodology part, thus portfolio theory, Capital Asset Pricing Model, Single Index Model, and Multi-factor Model will be mentioned to support the framework of the study.

2.1 Risk-adjusted Return

2.1.1 Treynor measurement

Treynor (1966) developed the first portfolio performance that includes risk. There were two kinds of risk that he postulated, risk of the market volatility and risk of non-market volatility (diversifiable risk). Risk of the market volatility, can be identified by the characteristic line. The slope of the line is the Beta coefficient of the security or portfolio.

Treynor ratio is the relation between the excess of expected return and stock's beta derived from capital asset pricing model. By letting both side of the equation includes systematic risk in the denominator we will have the following equation:

$$\frac{E(\tilde{R}_i) - R_f}{\beta_i} = \frac{\alpha_i}{\beta_i} + [E(\tilde{R}_m) - R_f] \quad (2.1)$$

Where: $E(\tilde{R}_i)$ = Expected return on the i[th] stock

R_f = Return on riskless rate

$E(\tilde{R}_m)$ = Expected market return

Stock's beta coefficient exposure to the market factor

$$\beta_i = \frac{cov(R_i, R_j)}{var(R_m)}$$

On the left hand side of the equation (2.1) where the average excess return on the security divided by its systematic risk is also known as the slope of the line connecting risky and riskless asset. If market is equilibrium, where the alpha is zero then Treynor ratio is equal to market risk premium. It shows the portfolio's risk premium return per unit of risk. The ratio is defined that risk-averse investors would prefer deepen counterclockwise line of the slope.

2.1.2 The Sharpe ratio

Sharpe (1966) developed the Sharpe measure to evaluate the portfolio performance of mutual fund[1]. Sharpe's idea is similar as Treynor but instead Sharpe used total risk in the denominator. From the capital asset pricing model concept, each side has the standard deviation of stock returns as follows:

$$E(\tilde{R}) - R_f = \alpha_i + \frac{\rho(\tilde{R}_i, \tilde{R}_m)\sigma(R_i)}{\sigma(\tilde{R}_m)}[E(\tilde{R}_m) - R_f] \qquad (2.2)$$

Equation (2.2), the systematic beta is rewritten where correlation is involved. Then the standard deviation is deployed in the equation as follows:

$$\frac{E(\tilde{R}) - R_f}{\sigma(\tilde{R}_i)} = \frac{\alpha_i}{\sigma(\tilde{R}_i)} + \frac{[E(\tilde{R}_m) - R_f]}{\sigma(\tilde{R}_m)} \qquad (2.3)$$

Where: $E(\tilde{R})$ = The expected return of a portfolio

R_f = The average rate of return on risk-free rate

$\sigma(\tilde{R}_i)$ = The standard deviation on a portfolio

The ratio on the left hand side of equation (2.3) is Sharpe ratio. This measurement of portfolio performance is similar to Treynor measurement. However, the difference is the risk that is associated, in which Treynor seeks to measure only the

[1] See more details of this measure, Sharpe (1994) and Lo (2002)

non-diversifiable risk, but Sharpe ratio seeks to measure the total risk of the portfolio. The Sharpe ratio indicates the risk premium return earned per unit of total risk. It evaluates the portfolio manager on the foundation of both portfolio rate of return performance and diversification.

2.1.3 Jensen's Alpha

The Jensen measure (1968) is based on the capital asset pricing model (CAPM) where the alpha is concentrated in the equation.

$$R_{jt} - R_{ft} = \alpha_j + \beta_j [R_{mt} - R_{ft}] + e_{jt} \quad (2.4)$$

Where:

Where:	R_{jt}	=	Rate of return on portfolio/security j at time t
	R_{ft}	=	Riskless rate
	α_j	=	Jensen's alpha or the abnormal return
	β_j	=	The systematic risk for portfolio/security j
	R_{mt}	=	Rate of return on the market at time t
	e_{jt}	=	Error term on portfolio/security j at time t

In equation (2.4), the intercept value (α_j) shows whether the manager of portfolio is superior or inferior in stock selection or market timing. Superior managers are the one that have significant positive alpha. Oppositely, a manager that has a significant negative alpha is known as inferior manager. Therefore, the α_j indicate how managers are good at in either market timing and/or stock selection.

The convenient usage of Jensen's alpha has several advantages over Treynor and Sharpe ratios. First, the alpha is easy to interpret, if the alpha value is 0.03 indicates that the manager has generated additional 2% more than what expected. Secondly, because the alpha is estimated from a regression, the level of manager's skill can be stated according to the level of statistical significance. Thirdly, Jensen measure is flexible to allow additional factors to be incorporated in the model besides one market factor CAPM.

Jensen's empirical work was mainly focusing on mutual fund performance of 115 funds covered entire period of 1945-1964. By estimating the intercept from the capital asset pricing model where alpha is assumed to be valid in the regression, the average value of alpha was negatively 0.011 which indicates that the funds performed poorly about 1.1% less than predicted. The distribution is negatively skewed with 76 funds having negative alpha and 39 funds having positive alpha. Jensen interpret the distribution of alpha that the funds are not systematically predicting the price of future securities accurately and therefore are not able to pay back manager's expenses i.e. research expenses, management fees and operation cost respectively. He explains that the negatively skewed of the distribution is probably true according to the frequency distribution of the t-values are all significantly negative at 5% level with 14 of the funds were less than negative 2.

2.1.4 Information ratio

Whether to know how the portfolio performs better than a benchmark, the information ratio also known as appraisal ratio is used to measure portfolio performance against risk and return relative to targeted index. The benchmark is a selected reference portfolio assigned for active mangers to beat. Therefore, active managers should hold some level of risk (tracking error) in order to the performance of the benchmark. The ratio requires portfolio average return excess a benchmark return divided by the standard deviation of its excess return.

$$IR_j = \frac{\bar{R}_j - \bar{R}_b}{\sigma_{ER}} = \frac{\overline{ER}}{\sigma_{ER}} \qquad (2.5)$$

Where:	IR_j	=	The information ratio for portfolio/security j
	$\bar{R}_j$	=	The expected return for the portfolio j during the specified period
	$\bar{R}_b$	=	The expected return for the benchmark during the specified period
	σ_{ER}	=	The standard deviation of the excess return

To understand the logic of IR, the numerator indicates how investors can generate an outstanding return that deviate or differ from the average return of the benchmark. If the deviation is considerably large, the better the investor is beating the index portfolio. However, the denominator measures the residual risk between the two portfolios and in active management term, is called tracking error.

The previous ratio equation (2.5) is looking back at historical term (ex post). The information ratio can also compute manager's skills in forward term (ex ante). By estimating in future period, the regression approach is applied. Goodwin (1998) showed that if the single index model is used by using historical excess portfolio returns to compute Jensen's alpha, the IR simplifies to

$$IR_j = \frac{\alpha_j}{\sigma_e} \qquad (2.6)$$

Where: IR_j = The information ratio for portfolio/security j

α_j = Estimated Jensen's alpha or intercept coefficient regression

σ_e = Standard error of regression

If a manger wants to know how well he has been performed over the period, equation (2.5) is the suitable one to apply. On the other hand, equation (2.6) is appropriate if a manager want to make predictions on how well he will perform in the future.

Regarding to Grinold and Kahn (2000) information ratio is similar to a normal distribution curve where IR = 0 as the mean of the distribution. While information is larger than zero reveals that, the level of manager's performance is in the top 50% of the whole population and if below zero, is in the level of bottom half of the active portfolio managers. They have argued that a proper information ratio level have to be in between 0.50 to 1.00 such that a manager having an IR of 0.50 is considered good and having 1.00 is being exceptional. Table 2.1 shows the level of mangers skills.

Table 2.1 Information ratio percentile level

Percentile	Information Ratio
90	1.00
75	0.50
50	0.00
25	-0.50
10	-1.00

Goodwin (1998) studied the performance of 200 securities and fixed income portfolio managers. He grouped them into six investment style over the period 1968 of Q1 to 1995 of Q4 (10 years). He conclude that the median manager in each investment style group was positive in IR but the value was not greater than 0.50. Hence, the manager did not qualify as good.

2.1.5 One-Parameter Measures

Friend and Blume (1970) examined the relationship between one-parameter performance measures and risks. They pointed out that the performance measure should be independent to risk. Thus, the analysis of the relationship between one-parameter measures and risk is examined. The performance measures were of Sharpe ratio (1966), Treynor ratio (unpublished), and Jensen alpha (1968). The focus of the study was to examine the relationship of the portfolio's three performance measures relative to its two common risks (portfolio's beta and standard deviation). They used monthly data of 788 common stocks listed in NYSE covered in the period of January 1960 through 1968 and were randomly selected to attain 200 random portfolios. The random portfolios were categorized of 25, 50, 75 and 100 of equally weighted securities. Sharpe ratios, Treynor ratios and Jensen alphas were estimated from the 200 portfolios and were all regressed with the two corresponding measure of risk. The result from the regression in the period 1960 to 1968, the two risks were greatly significant in explaining the performance measurement and were negatively related, which the portfolio's performances are dependent upon its risk.

Continuously, the researcher divides the period into two equally sub-period Jan 1960 to March 1964 and April1964 to June 1968. Similarly, the first sub-period found to be the same result as the whole period. Surprisingly, in the second sub-period April 1964 – June 1968, the regression between one-parameter performance measures and the two risks were empirically significant which the positive relationship of portfolio's systematic risk can capture the variation of portfolio's performance measure.

Now that the risk-adjusted return and portfolio measure performance have been explored to give ideas about how managerial investors measure their risky portfolio. In next section, we will be discussing about the definitions of Markowitz (traditional mean-variance), capital asset pricing model, singe index model and the multifactor index model.

2.2 Markowitz theory

Modern Portfolio Theory (MPT) started in 1952 when Markowitz documented his paper called "Portfolio selection". The simplistic of his conceptual approach is to deal with mainly on the single period probability distribution of investor's mean and variance preference by holding various securities in one portfolio instead of a single asset.

MPT posits two rules for building an efficient frontier; first, investors have to believe that the historical prices can be used to predict the present and future return. Secondly, investors are risk haters and they will at some point be choosing highest possible expected return with a given level of risk. Explicitly, the two conditions are the key to ensure that particular investors maximize their expected return while holding its given risk.

Nevertheless, this presumption of allocating large numbers of securities in a portfolio is misinterpreted. If the correlations between securities have strong relationship in common, diversification is useless. Therefore, covariance of each asset in a portfolio should be priory concerned.

To form a portfolio by using Markowitz approach, the parameters and equations are needed as follows:

$$E(R_i) = \sum_{i=n}^{n} X_i \mu_i \tag{2.7}$$

$$\sigma_i^2 = \sum_{i=1}^{n}\sum_{i=1}^{n} X_i X_j \sigma_{ij} \tag{2.8}$$

$$\sigma_{ij} = E\left[(R_i - \mu_i)(R_j - \mu_i)\right] \tag{2.9}$$

$$\sum_{i=1}^{n} X_1 = 1 \tag{2.10}$$

$$X_i \geq 0 \; for \; i = 1,2,3 \ldots n$$

Where:	$E(R_i)$	=	Expected return of a portfolio
	σ_i^2	=	Variance of a portfolio
	σ_{ij}	=	Covariance between two assets i and j
	μ_i	=	Expected return on asset i
	X_i	=	The weight assigned to asset i

In equation (2.7) the expected return of each securities are averaged. Equations (2.8) and (2.9), the variance and covariance of each asset are estimated. Equation (2.10) is the sum of weights given to the each asset restricted to.

2.3 Single-index model

The Markowitz model needs to acquire extremely data inputs for generating the efficient portfolio. Such limitations, Sharpe (1963) developed a simplified technique referred to as the single index model (SIM). The theory of the SIM is intuitive; it assumes that the variation in stock returns is captured by the market index return. The basic regression equation is as follows:

$$R_i = a_i + \beta_i(R_m) \quad (2.11)$$

$$R_i = \alpha_i + \beta_i(R_m) + e_i \quad (2.12)$$

Where:

Where:	R_i	=	Excess return on the ith stock
	a_i	=	Component of security i's that is independent of market factor
	β_i	=	Stock's beta coefficient exposure to the market factor
	R_m	=	Return on the market index
	e_i	=	The random disturbance error
	α_i	=	The intercept or abnormal return

The term a_i in equation (2.11) is decomposed into two components which is the expected residual return irrelevant to market factor term a_i and e_i which is the random disturbance error which is random normally distributed variable and has expected value of zero. Therefore, the single index model becomes equation (2.12) where α_i is called the abnormal return where the markets are normally assume that it behaves in disequilibrium conditions.

2.4 Capital Asset Pricing Model

The model that assumes abnormal return in market equilibrium to be zero is the capital asset pricing model (CAPM) developed by Sharpe (1964) and Lintner (1965) extended from the one period mean-variance portfolio models of Tobin (1958) and Markowitz (1959). Sharpe deeply postulates that if market is in equilibrium, market portfolio will reflect to the availability of information immediately. Therefore, rational investors have privilege in holding their assets along the capital market line. Theoretically, Sharpe (1964) explains that the returns of individual asset in the efficient portfolio have its own special linear relationship with systematic risk (beta) or simply the variation of the market portfolio captures the variations in particular stock return in a single period with the following assumptions:

1. Risk-averse investors are one-period wealth maximizers who are eligible to have alternatives combination of securities based on each asset expected return and standard deviation.
2. All investors are homogenous in terms of capital market estimation, that is, they accept the same estimation of expected stock returns, variances and covariance of all securities that will contribute to their portfolio.
3. Investors incur no cost in capital transaction (no taxes) and investors are free to borrow and lend unlimited amount at given risk free rate of interest with no restriction on short sales of any asset.
4. All assets are perfectly divisible and perfectly liquid all assets are marketable.
5. All investors are price takers (assumes that their own buying and selling activity will not affect stock prices).
6. Taxes are excluded.
7. The quantities of all securities are given.

With its practical and simple model have encouraged financial practitioners used in predicting future portfolio returns.

The simple derivation of the CAPM model is also known as the security market line as follows:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \tag{2.13}$$

Where: $E(R_i)$ = Expected return on the ith stock

R_f = Risk free rate return

$E(R_m)$ = Expected return on the market index

β_i = Stock's beta coefficient exposure to the market factor $\frac{cov(R_i,R_j)}{var(R_m)}$

Comparing with equation (2.12) with (2.13), CAPM assumes that every α_i or the abnormal return is significantly zero in market equilibrium, that is, no opportunity to gain abnormal profit. The CAPM equation (2.13) shows that expected return and systematic risk share their linear relationship therefore, variation in market factor determines an expected rate of return on a risky asset. The model is very intuitive given that investors are risk-averse, high risk stocks should have higher expected return than low risk stocks.

2.5 Empirical test of the CAPM

Some empirical studies had been compared and debated over validity power of the standard form of CAPM model. Major studies by Black, Jensen, Scholes (1972), Fama and Macbeth (1973) and Friend and Blume (1970) found consistent result in supporting the CAPM power.

2.5.1 Test of Black, Jensen, and Scholes

Black, Jensen, Scholes (1972) tested CAPM by using cross-sectional method, primarily regression on the historical mean excess return over set of observations of securities with estimates of the systematic risk of each securities to see whether the properties of the security market line proves CAPM validity. The period covers January 1926 to March 1966 of the New York Stock Exchange (NYSE). They form portfolios by ranking the estimated betas from five years of previous monthly data 1926 though 1930 for all securities in NYSE then the ranked betas were grouped into ten portfolios which the first 10% group were the largest beta and so on to the lowest. Then, in the next following 12 months, they compute the rates of return to each of the portfolios of year 1931. The betas were estimated again in the subsequent 5 years period from 1927 through 1931 and reformed ten portfolios again based on ranked betas and portfolio returns of the next 12 months were prepared. They repeat the process in each of the years 1931 – 1965 having 35 years monthly returns to each of the ten portfolios. The basic grouping procedures of B-J-S were to avoid selection bias of the portfolio's coefficient errors dependently on previous ranking beta. They stated that if the grouping selection bias is not treated, then the high risk portfolio will tend to have positive measurement errors in their beta and thus would have positive bias beta of portfolio and moreover, the alpha coefficient estimate will have negative bias and vice-versa for low risk portfolios.

The regression results were summarized in 8 components as follows, the estimated beta, the intercepts, t-values of alpha, correlation between stock's return and the market returns, autocorrelations of the residuals, the standard deviation of the residuals, the average monthly excess return and the standard deviation of the monthly excess returns were calculated. They conclude that results performed a strong support to CAPM, the betas were highly significant and positively related to the market factor ranging from 1.56 for high beta portfolios to 0.49 for low beta portfolios. Moreover, high risk portfolios tend to have negative alpha, whereas low risk portfolios exhibit positive alpha. Thus, the high beta portfolios were over performed and earned less than predicted, and oppositely low beta portfolios were underperformed and earned high than predicted. There was no evidence that nonlinearity in the security market line occurred and approximately, nearly 100% variation in market returns can capture the variation in the portfolio returns.

2.5.2 Test of Fama and McBeth

Regarding to the CAPM support above, Fama and MacBeth (1973) extended the B-J-S work by forming a four-factor random coefficient model to test the CAPM reliability. They hypothesized three common testable implications about CAPM's characteristics:

1. (C1) The relationship between the security's expected return must be linearly related to the market beta.
2. (C2) Systematic risk of an asset is the only variable to explain the returns on stock and no other factor is involved in the explanation.
3. (C3) In a market of risk-averse investors, higher risk should give higher expected return that is the market risk premium should be greater than zero or there is a positive price of risk in the capital market.

They suggest the following stochastic generalization of equation (2.14):

$$\tilde{R}_i = \tilde{\gamma}_{0t} + \tilde{\gamma}_{1t}\beta_i + \tilde{\gamma}_{2t}\beta_i^2 + \tilde{\gamma}_{3t}s_i + \tilde{\eta}_{it} \qquad (2.14)$$

Where: $\tilde{\gamma}_{0t}$ = Coefficient intercept, in Sharpe-Lintner term, should equal to risk-free rate

$\tilde{\gamma}_{1t}$	=	Coefficient of betas to measure C3 hypothesis
$\tilde{\gamma}_{2t}$	=	Coefficient term to measuring C1 hypothesis
$\tilde{\gamma}_{3t}$	=	Coefficient term to measure C2 hypothesis

The model is likely to fit the data better than B-J-S has tested. The F-M constructed 20 portfolios from all monthly securities on the NYSE covering entire period January 1935 – June 1968. The monthly data were estimated from cross-sectional regressions in equation (2.14) for each month[2]. From the result, they empirically found that the data satisfies with the three implications mentioned above where the average values of $\tilde{\gamma}_{2t}$ (C1) and $\tilde{\gamma}_{3t}$ (C2) are particularly small and insignificantly different from zero. Therefore, it is proven that there is no non-linearity relationship and the market beta is the only factor explains the variation of the stock returns in market equilibrium.

2.5.3 Test of Arbitrage Pricing Theory

The single index model (2.12) and CAPM (2.13) can be generalized to multiple factors by adding additional factors to capture the stock's return movement. Arbitrage Pricing Theory (APT) is based on three presumptions. First, capital market is played in perfect competition. Secondly, investors prefer possible wealth they can have under certainty and lastly, the stochastic process-generating asset returns can be presented with k factors, equation (2.15) is

$$R_i = \alpha_i + \beta_i y_1 + \ldots + \beta_{ik} y_k + \epsilon_i \tag{2.15}$$

Where:	R_i	=	Excess rate of return on asset i
	y_k	=	Risk premium of each factor
	β_{ik}	=	Beta of asset i
	α_i	=	Abnormal return uncorrelated to the independent factors
	ϵ_i	=	The disturbance term

[2] See Fama and MacBeth (1973) "Risk, Return, and Equilibrium, Empirical Test for more detail

Equation (2.15) is called arbitrage pricing theory (APT) originally developed by Ross (1976) and basically extended from the equilibrium model, when the market is disequilibrium or mainly CAPM does not hold, APT can be performed to test additional factor exposure to reduce idiosyncratic risk. There are two major advantages that APT has over CAPM. First, APT enables investors to have more preferences than the CAPM's expected return and standard deviation and allows more than one explanatory factor. Secondly, APT assumes that in market equilibrium, there would be no gap for arbitrage profit and the market beta is the only one that has relationship. The model can be proven empirically and not fixed to the single market factor to returns.

The Empirical test initially constructed by Roll and Ross (1980). The methodology is partly similar to B-J-S's CAPM testing. First, the expected returns and the K's factor coefficients were estimated from series of data on individual daily asset returns of NYSE from 1962 – 1972 and these estimates were used to test the basic cross-sectional pricing regression between security betas and average rates of return. As a result, Roll and Ross empirically found at least three and probably four significant factors in explaining the variation of NYSE stocks from 1962 to 1972 period. However, there was not adequate economic interpretation of these factors and pledge that their initial test was weak.

2.5.4 Banz controversial

Recall that CAPM is one-dimensional and its capability in explaining return is only the market factor. However, the concept of CAPM was borderless when recent researchers have found multidimensional that CAPM has more than a market factor. Banz (1981) examined the CAPM by checking whether the size of the firms involved can capture the variation in average returns across assets that are not explained by the CAPM's beta. Banz challenges the CAPM by showing that size does explicitly explains the cross-sectional variation in average returns on a particular collection of assets better than the beta.

He finds that during the 1936–75 periods, the average return to stocks of small firms was significantly higher than the average return to stocks of large firms after adjusting for risk using the CAPM. This examination is known as the "size effect". Banz (1981) uses a procedure similar to the portfolio grouping procedure of Black, Jensen, and Scholes (1972). The assets are first assigned to one of five subgroups, based on their historical betas. Stocks in each of the subgroups are then assigned to five further subgroups, based on the market value of the firm's equities. This produces total of 25 portfolios. Portfolios are updated at the end of each year. Banz uses firms on the NYSE and estimates the cross-sectional relation between return, beta, and relative size. Then Banz would conclude that the CAPM is miss-specified. In his finding, Banz concludes that the size effect is large and statistically significant. Thus, the CAPM seems to be missing a significant factor: firm size.

2.5.5 The Three Factor Model

Majorities of researchers have been testing and debating over the CAPM's validation. Fama and French (1992) found capital asset pricing model performed poorly in explaining the returns in pre-1968 period. They tested the joint roles of market beta, size, Earning/Price (E/P) ratio, and leverage and book-to-market equity ratio in the stock returns of NYSE, Ames and NASDAQ stocks covering period of 1963-1990. The empirical work concludes that the market beta had less power to capture the stocks return, if the variables are used alone; market equity and book-to-market ratio equity have significant power to explain the cross-section of average returns and absorbs the role of E/P ratio and the leverage ratio. Anyhow, when the variables are used jointly together, size and book-to-market ratio equity are statistically significant and they seem to have a major role in capturing the returns more than the other variables. Thus, risk is multidimensional when stocks are priced rationally.

In addition, Fama and French (1993) furthered their findings in FF (1992) by using the three factors model regression approach. FF adds additional factors in explaining the stock return, the model was developed to capture more risk in explaining the variation of the returns. They constructed a three-factor model, which assumes that the variations of stocks excess returns are explained by the excess return of market portfolio, the returns of SMB and HML[3]. The model is as follows:

[3] SMB: the difference between the returns on a small stock portfolio and large stock portfolio.

$$R_{pt} - R_f = R_f + \beta_p\left[(R_{mt}) - R_f\right] + s_p(SMB) + h_p(HML) + \epsilon_{pt} \tag{2.16}$$

Where:

Where:	R_{pt}	=	The weighted return on portfolio p in period t.
	R_f	=	The risk-free rate
	β_p	=	The coefficient for excess return of the market portfolio
	s_p	=	The coefficient for excess average return of portfolios with small equity portfolio over big equity portfolio
	h_p	=	The coefficient for the excess average return of portfolios with high book-to-market equity portfolio over low book-to-market equity portfolio.
	ϵ_{pt}	=	The error term

FF formed six portfolios from sort of stocks on market equity and book-to-market equity ratio of monthly returns of NYSE, Amex and NASDAQ, therefore the portfolios were purpose to proxy for risk factors related to size and book-to-market equity. The monthly stocks and bonds return were regressed on five factors: market returns, size portfolio, book-to-market portfolio, term premium and default premium. The three factor model was significant in explaining stocks return and also for bonds. The authors concluded that the extended three factor model captures much of the variations of the US stocks. The size effect is regularly found with small market capitalization firms generate average return more than large market capitalization firms[4]. The book-to-market equity effect empirically posits that the average return have a positive relationship with boot-to-market-equity the higher the average return, the higher the book-to-market increases.

HML: the difference between the returns on a high book-to-market stocks portfolio and the low book-to-market stocks portfolio.

[4] Researchers stated that small firms stock are more illiquid and are costly to trade. Information is not freely available and is expensive to monitor them. Their shares are trade less frequently and betas are not reliable.

CHAPTER III
DATA AND METHODOLOGY

In this section, the methodology of the study will be described below. The approach of the data selection, screening, return calculation, asset allocation strategy and portfolio formation of each model is precisely explained.

3.1 Data

The data used for this study are monthly rate of returns including dividends and capital gains adjusted for stock transactions through splits and stock dividend for all common stocks traded in 20 countries in emerging markets. The securities are classified by Morgan Stanley Capital International (MSCI) retrieved from Thompson Reuters DataStream system including alphabetically: Argentina, Brazil, Chile, China, Colombia, India, Indonesia, Israel, Malaysia, Mexico, Pakistan, Peru, Philippines, Russia, South Africa, Sri Lanka, Taiwan, Thailand, Turkey and Venezuela during the entire period of January 1995 through September 2009 (177 monthly observations).

The risk-free rate is the Thai long-term government bond and the market index is Emerging Market Price Index retrieved from the Datastream. Moreover, we have collected the market value and book-to-market equity. Our main purpose of the study is to evaluate the portfolio performance in two measurements which is the Sharpe measure and information ratio by selecting estimated positive significant alpha securities in the level of 95% confidence interval estimated from Single Index Model regression. The security's price, market value and book-to-market are initially retrieved from the local price with its corresponding United State cent currency.

3.2 Procedure

The examination period will be divided into four equally sub-periods. Each of the periods of the portfolios will be formed in four different strategies as follows: the Single Index Model (SIM) of Fama and Macbeth (1973), the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and John Lintner (1965) and Mossin (1966), the Three Factor Model found by Fama and French (1993) and the traditional Mean-variance.

3.2.1 Data screening

Total asset in the twenty emerging countries are 8966 securities. According to table appendix A, China contains the largest securities in about 1896, came along with Taiwan 1315 securities and the third is India of 1046 securities. There are several problems in dealing with returns when delisted company exists. Reasons for delisting are bankruptcy, merger and acquisition, liquidation which is very complicated in calculating returns when there are large numbers of assets Vaihekoski (2000). To avoid this error, we first simply screened in local currency price to secure that delisted returns that are dead in three consecutive trading days are removed.

After the dead stocks are deducted, the stocks in US currency are replaced as the actual price.

3.2.2 Period selection

After the screening procedure is correctly adjusted, we then divide the assets into four equally sup-period, 44 observations. First period from January 1st 1995 to August 1st 1998, second period from September 1st 1998 to April 1st 2002, third period from May 1st 2002 to December 1st 2005 and fourth period from January 1st 2006 to August 1st 2009.

There are two major periods: Initial period and subsequent period. The first, second and the third sub-period will be the “initial period”. The subsequent period of sub-period one, two and three will be called “subsequent period” that is period two, three and four. The Sharpe ratio and information ratio will be compared to these two major periods.

3.2.3 Return calculation

The returns are calculated in percentage term as follows:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (3.17)$$

Where: R_t = Monthly return on a stock in period t

P_t = Current stock price in period t

P_{t-1} = Stock price at the end of the preceding month

3.2.4 Market return calculation

The market returns are computed as follows

$$R_{mt} = \frac{M_t - M_{t-1}}{M_{t-1}} \quad (3.18)$$

Where: R_{mt} = Monthly return on the market index in period t

M_t = Current market price in period t

M_{t-1} = Market price at the end of the preceding month

3.2.5 Risk-free return calculation

Thai government long-term bond returns are computed as follows

$$R_{ft} = \frac{RF_t - RF_{t-1}}{RF_{t-1}} \quad (3.19)$$

Where: R_{ft} = Monthly risk free return in period t

RF_t = Current riskless rate in period t

RF_{t-1} = Riskless rate at the end of the preceding month

3.2.6 Asset allocation

Selecting appropriate assets in the portfolio formation is based on single index model regression from equation (2.12), specifically selecting securities that are positively significant alpha in 95% confidence interval. This asset allocation is to prohibit securities in short selling.

After the regression is done and the alphas of each security are known, we then collect the securities based on the alpha into the portfolio formation procedure. Thus, the assets with negative estimated intercepts are excluded in the portfolio formation. The procedures are presented as follows.

3.2.7 Variance-covariance estimation: Markowitz approach

The method in forming a portfolio of Markowitz approach requires average returns of each assets and variance-covariance matrix. The average return can be computed from equation (2.7), variances are from equation (2.8) and the covariance equation (2.9).

Therefore, in figure 3.1 shows the estimated variance-covariance matrix. The diagonal values of variance-covariance matrix are the variances and the half of the off-diagonal values are covariance of each pair of assets.

Figure 3.1: Markowitz variance-covariance matrix estimation

$$\begin{bmatrix} \sigma_1^2 & cov(R_1, R_2) & cov(R_1, R_3) & cov(R_1, R_4) \\ cov(R_2, R_1) & \sigma_2^2 & cov(R_2, R_3) & cov(R_2, R_4) \\ cov(R_3, R_1) & cov(R_3, R_2) & \ddots & \vdots \\ cov(R_4, R_1) & cov(R_4, R_2) & \cdots & \sigma_n^2 \end{bmatrix}$$

3.2.8 Variance-covariance estimation: single index model approach

To form up a portfolio by using SIM approach requires expected returns and variance-covariance matrix. The matrix requires variances and covariance of each pair of assets. Hence, covariance of each pair of security in the matrix is calculated from equation (a8) in appendix B. The expected returns of each assets are estimated from equation (2.12). In figure 3.2, we will have the variance-covariance matrix that the values on diagonal line are variances of each security and the half of off-diagonal values are the covariance of each pair of asset.

Figure 3.2 Single Index Model variance-covariance matrix estimation

$$\begin{bmatrix} \sigma_1^2 & \beta_i\beta_2\sigma_m^2 & \beta_1\beta_3\sigma_m^2 & \beta_1\beta_4\sigma_m^2 \\ \beta_2\beta_1\sigma_m^2 & \sigma_2^2 & \beta_2\beta_3\sigma_m^2 & \beta_2\beta_4\sigma_m^2 \\ \beta_3\beta_1\sigma_m^2 & \beta_3\beta_2\sigma_m^2 & \ddots & \vdots \\ \beta_4\beta_1\sigma_m^2 & \beta_4\beta_2\sigma_m^2 & \cdots & \sigma_n^2 \end{bmatrix}$$

3.2.9 Capital Asset Pricing Model approach

As describe earlier, capital asset pricing model is assumed equilibrium in capital market where available information reflect stock prices immediately. Therefore, the covariance of each pair of security assumed to have no correlation. The method is the same as the single index model; however the off-diagonal values of variance-covariance matrix are restricted to zero. The expected returns are predicted from equation (2.13) and the covariance in the matrix is from equation (a7) in appendix B. Figure 3.3 shows the variance-covariance matrix where the zeros are on off-diagonal values.

Figure 3.3 CAPM Variance-Covariance matrix estimation

$$\begin{bmatrix} \sigma_1^2 & 0 & 0 & 0 \\ 0 & \sigma_2^2 & 0 & 0 \\ 0 & 0 & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_n^2 \end{bmatrix}$$

3.2.10 The Three Factor Model approach

To compute the three factor model covariance matrix, requires portfolios formed from sorting of stocks on market value and book-to-market equity. Hence we can obtain SMB and HML variable. For size, the portfolio SMB (small minus big) is the risk factor in returns related to size, that is, the difference of each month between the average of returns on the three small stock portfolios (S/L, S/M and S/H) and three big stock portfolios (B/L, B/M and B/H). For HML, the portfolio HML (high minus low) is the risk factor in returns related to book-to-market equity. HML is the difference of each month between the average returns on the two high BE/ME portfolios (SH and BH) and the low BE/ME portfolios (S/L and B/L).

Fama French (1993) ranked NYSE stocks on size and used the median value to split the whole stocks into two groups small and big because most of NASDAQ and AMEX stocks are smaller than NYSE assets, thus NYSE is appropriate for dividing down the size. They also used NYSE to break three book-to-market equity groups based on NYSE's 30% low, middle 40% medium and top 30% high of the ranked values of BE/ME. This study follows the same step as mentioned according to the Fama French (1993).

In January of each year from each sub-period, we used the median size of ranked market value of Brazil, Russia, India and China (BRIC) countries to break down to small and big portfolios. For book-to-market equity, we also break down the BRIC's ranked values of BE/ME into 30% low, 40% medium and 30% high. The reason why we chose BRIC is that it has more than 30% securities out of the emerging markets, approximately 41%. Thus, the proportion is large enough to use as a breaking point of the portfolios. Table 3.1 to 3.3 shows the break point of the market value and book-to-market equity.

Table 3.1 Period 1 January 1995 – August 1998 Split values for partition of securities by size and BE/ME in allocation of alpha 95% confidence interval level

Splits by market value

Jan 1995	Median = 16736.59
Jan 1996	Median = 13262.48
Jan 1997	Median = 16171.78
Jan 1998	Median = 17079.87

Splits by Book-to-market equity

Jan 1995	30th percentile = 0.3759	70th percentile = 0.7123
Jan 1996	30th percentile = 0.4209	70th percentile = 0.8403
Jan 1997	30th percentile = 0.3709	70th percentile = 0.8333
Jan 1998	30th percentile = 0.4444	70th percentile = 1.3514

Table 3.2 Period 2 September 1998 – April 2002 Split values for partition of securities by size and BE/ME in allocation of alpha 95% confidence interval level

Splits by market value

Jan 1995	Median = 14781.06
Jan 1996	Median = 18754.65
Jan 1997	Median = 20983.54
Jan 1998	Median = 18326.97

Splits by Book-to-market equity

Jan 1995	30th percentile = 0.6046	70th percentile = 1.7857
Jan 1996	30th percentile = 0.4673	70th percentile = 1.1765
Jan 1997	30th percentile = 0.5627	70th percentile = 1.5625
Jan 1998	30th percentile = 0.5882	70th percentile = 1.6052

Table 3.3 Period 3 March 2002 – December 2005 Split values for partition of securities by size and BE/ME in allocation of alpha 95% confidence interval level

Splits by market value

Jan 1995	Median = 13930.70
Jan 1996	Median = 17939.42
Jan 1997	Median = 37798.06
Jan 1998	Median = 78842.25

Splits by Book-to-market equity

Jan 1995	30th percentile = 1.0846	70th percentile = 2.5064
Jan 1996	30th percentile = 0.8258	70th percentile = 1.4750
Jan 1997	30th percentile = 0.5402	70th percentile = 1.1508
Jan 1998	30th percentile = 0.4502	70th percentile = 1.1656

After SMB and HML variable is calculated, portfolio formation by using the three factors model approach is estimated. Covariance of each pair of security in the matrix is calculated from equation (a12) in appendix B. The expected returns of each asset are estimated from equation (2.16). In figure 3.4, shows the variance-covariance matrix that the values on diagonal line are variances of each security and the half of off-diagonal values are the covariance of each pair of asset.

Figure 3.4 the Three Factor Model Variance-Covariance matrix estimation

$$\begin{bmatrix} \sigma_1^2 & cov(R_1,R_2) & cov(R_1,R_3) & cov(R_1,R_4) \\ cov(R_2,R_1) & \sigma_2^2 & cov(R_2,R_3) & cov(R_2,R_4) \\ cov(R_3,R_1) & cov(R_3,R_2) & \ddots & \vdots \\ cov(R_4,R_1) & cov(R_4,R_2) & \cdots & \sigma_n^2 \end{bmatrix}$$

When portfolio is formed, 101 efficient portfolios are generated along the curve. The portfolio that has the highest Sharpe ratio will be chosen for the measurement

3.3 Portfolio performance measurement

Sharpe ratio and information ratio is used in the experiment. The emerging market index is appropriate because it is the biggest index that represents the whole market in the emerging countries. Hence, it is suitable as the benchmark for the measurement.

The Sharpe ratio is calculated from equation (3.20)

$$Sh_p = \frac{\bar{R}_p - R_f}{\sigma_p} \qquad (3.20)$$

Where: Sh_p = The Sharpe ratio of a portfolio

$\bar{R}_p$ = Average return of a portfolio

R_f = Riskless rate

σ_p = Standard deviation of a portfolio

The information ratio is calculated from (3.21)

$$IR_p = \frac{\bar{R}_p - \bar{R}_b}{\sigma_{ER}} \quad (3.21)$$

Where:

Where:	IR_p	=	Information ratio of a portfolio
	$\bar{R}_p$	=	Average return of a portfolio
	$\bar{R}_b$	=	Average return of the benchmark portfolio
	σ_{ER}	=	Standard deviation of excess return between portfolio and benchmark

CHAPTER IV
EMPIRICAL RESULT

Section 4.1 presents descriptive statistic and section 4.2 discuss the results for each model regarding to Sharpe measure and Information ratio.

4.1 Descriptive statistics

Table 4.4 illustrate some summary statistics of the frequency distributions of the regression estimates of the parameters of equation (2.12) for all securities of 20 emerging countries using all sample data available for each stock in the period of 1995-2009 and for four equally sub-period of table (4.5) to (4.8). Each table presents the mean, median, extreme values, and mean absolute deviation of the available sample data estimates of E(R), α, β, and r^2.

As shown in the table 4.4 of the entire period 1995-2009, the average of monthly expected return was 0.014540 with a minimum value of -0.009913 and the maximum value of 0.641033. The average intercept was quite low 0.007954 with a minimum value of -0.016739 and maximum of 0.631927. The average value of alpha indicates that on average the stocks have earned about 0.80% per year than they should have earned given their systematic risk. It is also clear that in figure 4.5 that the distribution pattern is skilled to the right side with 873 securities having positive alpha ($\alpha_i > 0$) and 243 with negative alpha$\alpha_i < 0$. However, the average value of beta was only 0.0092, indicating that on average these securities were extremely less risky than the market portfolio. The average squared correlation coefficient r^2 was 0.149010 and shows in general that equation (2.12) does not really seem to fit the data for most of the assets quite closely.

Table 4.4 Summary of estimated regression statistic from equation (2.12) of 20 emerging country using all sample data available in entire period January 1995 – September 2009 (available 1116 assets, dead stocks are excluded)

Item	Mean Value	Median Value	Extreme Values		Mean Absolute Deviation
			Minimum	Maximum	
$\boldsymbol{E(R)}$	0.014540	0.013062	-0.009913	0.641033	0.007874
$\hat{\boldsymbol{\alpha}}$	0.007954	0.006505	-0.016739	0.631927	0.007863
$\hat{\boldsymbol{\beta}}$	0.009285	0.006541	-0.016739	1.494858	0.009406
$\hat{\boldsymbol{r}}^2$	0.149010	0.143755	0.000018	0.527382	0.076096

Table 4.5 presents the summary statistics of the sub-period 1995-1998, the average of monthly expected return was -0.005072 with a minimum value of -0.093366 and the maximum value of 2.420584. The average intercept was quite low 0.000596 with a minimum value of -0.089500 and maximum of 2.836759. The average value of alpha indicates that on average the stocks have earned about 0.06% per year than they should have earned given their systematic risk. It is also clear that in figure 4.6 that the distribution pattern is a little bit skilled to the left side with 958 securities having positive alpha ($\alpha_i > 0$) and 1118 having negative alpha$\alpha_i < 0$. However, the average value of beta was only 0.001112, on average these securities were extremely independent to market portfolio. The average squared correlation coefficient r^2 was 0.128301 and shows that the regression of equation (2.12) that the returns have a little variation relatively to the market returns.

Table 4.5 Summary of estimated regression statistic from equation (2.12) of 20 emerging country using all sample data available in period 1 January 1995 – August 1998 (available 2076 assets, dead stocks are excluded)

Item	Mean Value	Median Value	Extreme Values		Mean Absolute Deviation
			Minimum	Maximum	
$\boldsymbol{E(R)}$	-0.005072	-0.009820	-0.093366	2.420584	0.025196
$\hat{\boldsymbol{\alpha}}$	0.000596	-0.002456	-0.089500	2.836759	0.023458
$\hat{\boldsymbol{\beta}}$	0.001112	-0.002455	-0.089500	2.836759	0.024013
$\hat{\boldsymbol{r}}^{2}$	0.128301	0.101108	0.000001	0.560472	0.094242

Table 4.6 present the summary statistics of the sub-period 1998-2002, the average of monthly expected return was 0.020421 with a minimum value of -0.07046 and the maximum value of 0.536981. The average intercept was quite low 0.010943 with a minimum value of -0.07656 and maximum of 0.448591. The average value of alpha indicates that on average the stocks have earned about 1.09% per year than they should have earned given their systematic risk. It is also clear that in figure 4.7 that the distribution pattern is extremely skilled to the left side with 2008 securities having positive alpha ($\alpha_i > 0$) and 995 having negative alpha$\alpha_i < 0$. However, the average value of beta was only 0.011085, on average these securities have a little variation relatively to market returns. The average squared correlation coefficient r^2 was 0.094335 and shows in general that equation (2.12) does not really seem to fit the data for most of the assets quite closely.

Table 4.6 Summary of estimated regression statistic from equation (2.12) of 20 emerging country using all sample data available in period 2 September 1998 – April 2002 (available 3003 assets, dead stocks are excluded)

Item	Mean Value	Median Value	Extreme Values		Mean Absolute Deviation
			Minimum	Maximum	
$E(R)$	0.020421	0.016526	-0.07046	0.536981	0.019486
$\hat{\alpha}$	0.010943	0.008469	-0.07656	0.448591	0.01845
$\hat{\beta}$	0.011085	0.008473	-0.07656	0.448591	0.018602
$\hat{r}^2$	0.094335	0.057553	0.0000000021	0.636262	0.080442

Table 4.7 present the summary statistics of the sub-period 2002-2005, the average of monthly expected return was 0.017343 with a minimum value of -0.05002 and the maximum value of 0.193971. The average intercept was quite low 0.002536 with a minimum value of -0.06786 and maximum of 0.260449. The average value of alpha indicates that on average the stocks have earned about 0.25% per year than they should have earned given their systematic risk. In figure 4.8, the distribution pattern is extremely skilled to the right side but having 1789 securities having positive alpha ($\alpha_i > 0$) less than 2280 having negative alpha$\alpha_i < 0$. However, the average value of beta was only 0.002807, on average these securities have a little variation to the market portfolio. The average squared correlation coefficient r^2 was 0.100688 and shows in general that equation (2.12) does not really seem to fit the data for most of the assets quite closely.

Table 4.7 Summary of estimated regression statistic from equation (2.12) of 20 emerging country using all sample data available period 3 March 2002 – December 2005 (available 4094 assets, dead stocks are excluded)

Item	Mean Value	Median Value	Extreme Values		Mean Absolute Deviation
			Minimum	Maximum	
$\boldsymbol{E(R)}$	0.017343	0.011066	-0.05002	0.193971	0.025944
$\hat{\boldsymbol{\alpha}}$	0.002536	-0.00331	-0.06786	0.260449	0.022754
$\hat{\boldsymbol{\beta}}$	0.002807	-0.0033	-0.06786	1.110688	0.023068
$\hat{\boldsymbol{r}}^{\boldsymbol{2}}$	0.100688	0.069475	0.0000000138	0.622165	0.079166

Table 4.8 present the summary statistics of the sub-period 2006-2009, the average of monthly expected return was 0.022068 with a minimum value of -0.05429 and the maximum value of 0.21288. The average intercept was 0.015581 with a minimum value of -0.06156 and maximum of 0.211429. The average value of alpha indicates that on average the stocks have earned about 1.56% per year than they should have earned given their systematic risk. In figure 4.9, the distribution pattern is extremely skilled to the right side with 3665 securities having positive alpha ($\alpha_i > 0$) and 1302 having negative alpha ($\alpha_i < 0$). However, the average value of beta was only 0.015617, on average these securities were less risky to the market portfolio. The average squared correlation coefficient r^2 was 0.258458 and shows in general that equation (2.12) does not really seem to fit the data for most of the assets quite closely.

Table 4.8 Summary of estimated regression statistic from equation (2.12) of 20 emerging country using all sample data available in period 4 January 2006 – August 2009 (available 4967 assets, dead stocks are excluded)

Item	Mean Value	Median Value	Extreme Values		Mean Absolute Deviation
			Minimum	Maximum	
$\boldsymbol{E(R)}$	0.022068	0.01884	-0.05429	0.21288	0.018328
$\hat{\boldsymbol{\alpha}}$	0.015581	0.012084	-0.06156	0.211429	0.018364
$\hat{\boldsymbol{\beta}}$	0.015617	0.012088	-0.06156	0.211429	0.018401
$\hat{\boldsymbol{r}}^{2}$	0.258458	0.249823	0.00000101	0.770755	0.151432

Figure 4.5: Frequency distribution of estimated intercept from equation 2.12 in the period of January 1995 – September 2009 (available 1116 assets, dead stocks are excluded)

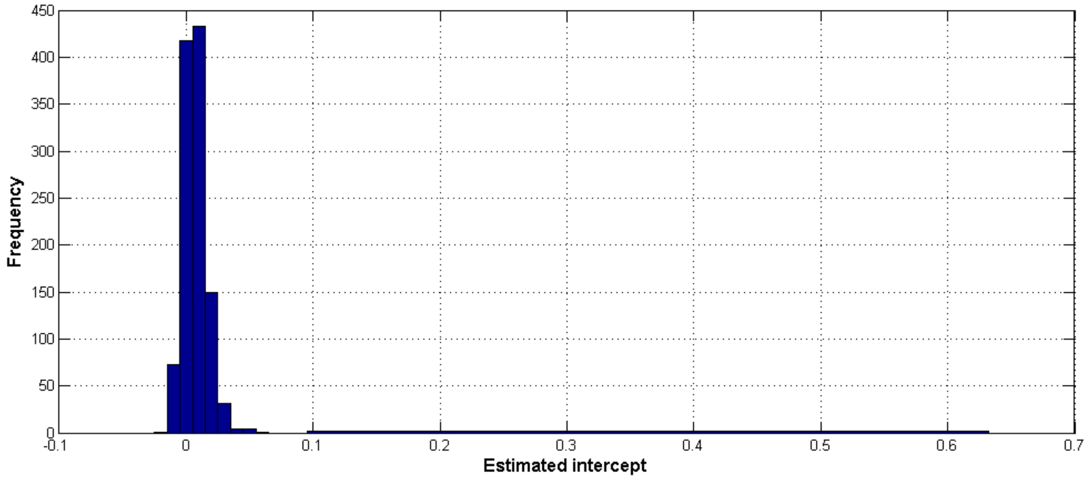


Figure 4.6: Frequency distribution of estimated intercept from equation 2.12 in period 1 of January 1995 – August 1998 (available 2076 assets, dead stocks are excluded)

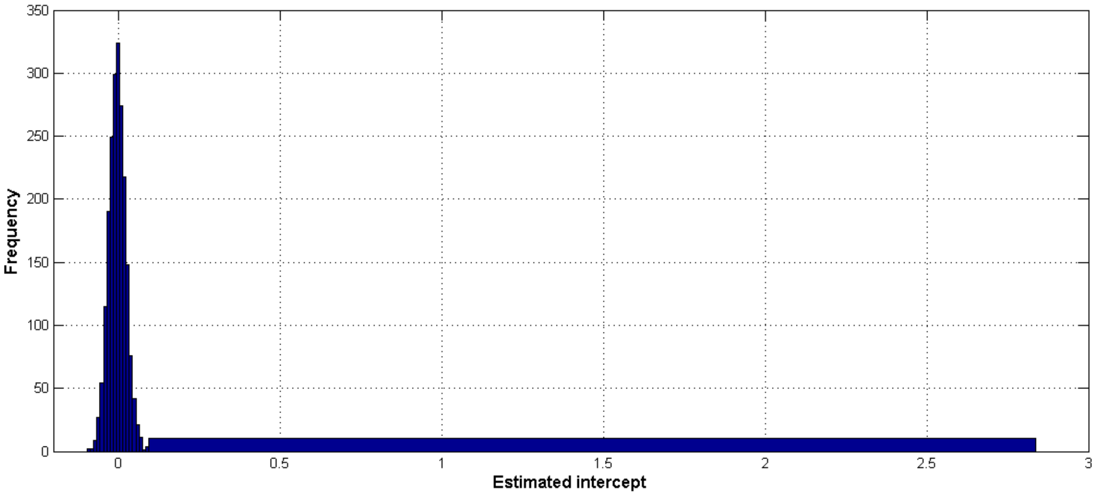


Figure 4.7: Frequency distribution of estimated intercept from equation 2.12 in period 2 September 1998 – April 2002 (available 3003 assets, dead stocks are excluded)

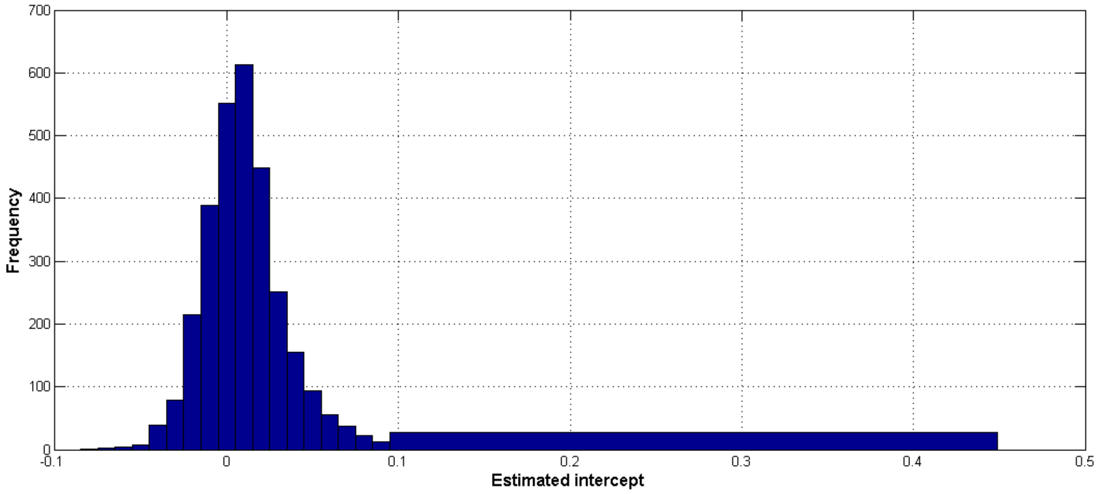


Figure 4.8: Frequency distribution of estimated intercept from equation 2.12 in period 3 March 2002 – December 2005 (available 4094 assets, dead stocks are excluded)

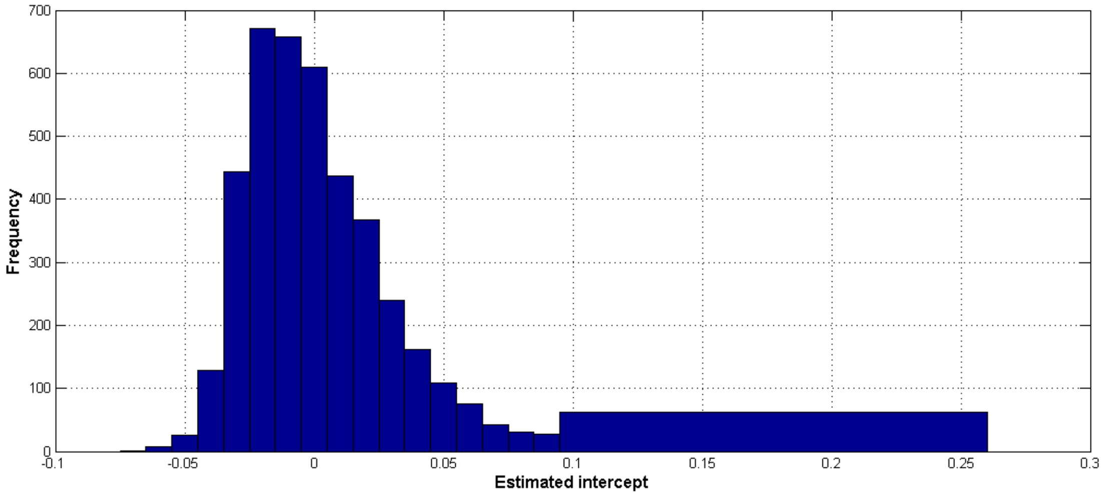
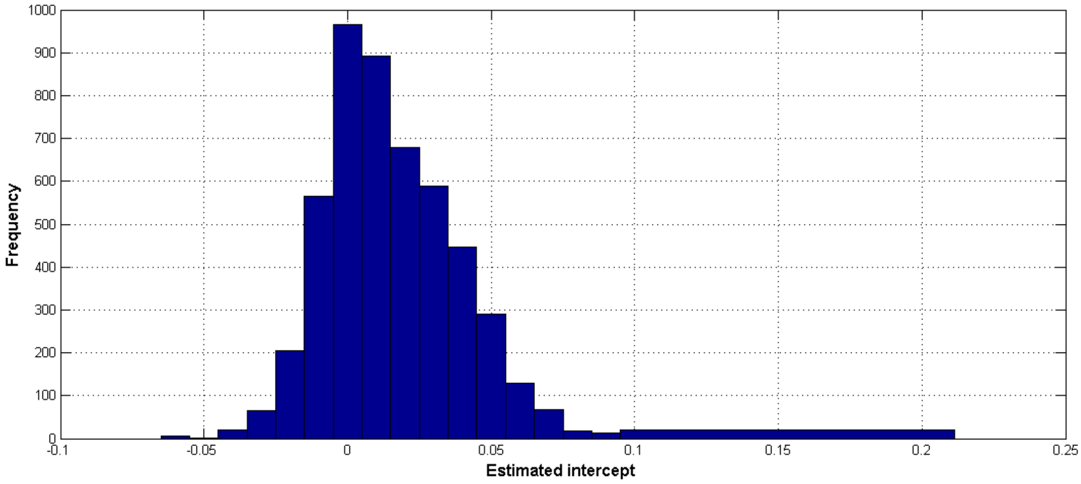


Figure 4.9: Frequency distribution of estimated intercept from equation 2.12 in period 4 January 2006 – August 2009 (available 4967 assets, dead stocks are excluded)



4.2 Results

In table 4.9, the initial period of Sharpe ratios measured by using equation (3.20) are compared with the subsequent periods in table 4.10. Table 4.11 is the initial period of information ratios from equation (3.21) compared with its subsequent period in table 4.12.

The mean-variance approach (Markowitz) performs the best on the initial period. The Markowitz produces the highest Sharpe ratios and the portfolio formed by CAPM has the lowest ratio. In the initial period, Markowitz's ratio are the largest at 0.45, 0.30, 1.12 in the sub-period of one, two and three respectively. CAPM has the lowest ratio at -0.10, -0.12, 0.06 in the sub-period of one, two and three respectively. Among all of these Sharpe's ratio measurement, it can be concluded that the Sharpe ratio of Markowitz model outperforms among other strategies. However, in table 10, there were no good strategies in the subsequent period, because in each sub-period, SIM, CAPM and Markowitz model outperforms in sub-period two, one and three respectively which there was no strategy outperform through all sub-periods.

Table 4.9: Portfolio Performance of Alternative Estimation Methods: Sharpe Ratio (initial period)

	SIM	**CAPM**	**M**	**FF**
Period 1	0.4429	-0.1026	0.45588*	0.3590
Period 2	0.2141	-0.1246	0.3010*	0.1984
Period 3	0.5215	0.0569	1.1199*	0.5661

For table 4.9-4.11**:** SIM = Single index model, CAPM = Capital asset pricing model, M = Markowitz, and FF = Fama French three factor model

* indicates the highest Sharpe's Ratio compared among other methodology

Table 4.10: Portfolio Performance of Alternative Estimation Methods: Sharpe Ratio (subsequent period)

	SIM	CAPM	M	FF
Period 2	-0.0704	-0.0173*	-0.1107	-0.0994
Period 3	0.4239*	-0.1618	0.0907	-0.1353
Period 4	0.0802	0.1057	0.1098*	0.0986

In table 4.11 presents the information in beating emerging market benchmark, the single index model approach (SIM) performs the best on the initial and subsequent periods. In the initial period, The SIM produces the highest information ratios at 0.28, 0.11, 0.28 in the sub-period of one, two and three respectively and in the subsequent period, SIM produces -0.14, 0.27 in sub-period two and three respectively.

However, CAPM has the lowest ratio at -0.15, -0.30, 0.04 in the period of one, two and three respectively and in the subsequent period CAPM has the lowest ratio at -0.25, -0.44, 0.07 in the period of two, three and four respectively. Among all of these information ratio measurements, it can be concluded that the information ratio of SIM model outperforms among other strategies in the initial and subsequent periods.

Table 4.11: Information ratio against emerging index (initial period)

	SIM	CAPM	M	FF
Period 1	0.2792*	-0.1589	0.2274	0.2008
Period 2	0.1122*	-0.3030	0.0982	0.0780
Period 3	0.2861*	-0.0439	0.2645	0.1689

For table 4.9-4.11**:** SIM = Single index model, CAPM = Capital asset pricing model, M = Markowitz, and FF = Fama French three factor model

* indicates the highest Sharpe's Ratio compared among other methodology

Table 4.12: Information ratio against emerging index (subsequent period)

	SIM	CAPM	M	FF
Period 2	-0.1438*	-0.2514	-0.2490	-0.1902
Period 3	0.2717*	-0.4435	-0.1304	-0.2654
Period 4	0.0262	0.0731	0.0811*	0.0601

CHAPTER V
CONCLUSION

This study aims to measure the portfolio performance by using Sharpe measure and information ratio. The securities were selected from significant positive alpha with a level of 95% confidence interval from 20 emerging countries. The securities were cooperated in the portfolio selection strategy by using single index model (SIM), Capital asset pricing model (CAPM), mean-variance (Markowitz) and the three factor strategy.

Empirical results indicate that the traditional mean-variance (Markowitz) model outperforms others such as capital asset pricing model, single index model and the three factor model in the initial period. However, there were no good strategies indicated in the subsequent period. In beating the benchmark, the portfolio managers by employing single index model strategy were the most skilful manager. However, in both major periods, most of portfolio managers performed less than 0.5 considering that it has performed under the level of good managers. In summary, this paper suggested that the mean-variance Markowitz approach is appropriate in portfolio selection strategy.

This paper is suggests for further study as below:

1. This paper concentrated on significantly positive abnormal return in 95% confidence interval. We suggest studying the stocks that are negatively significant alpha in 95% and 90% confidence interval to see whether the result of the portfolio performance is better from this study.
2. However, the paper measures the Sharpe ratio and information ratio of the portfolio, we suggest that other measurements such as the Treynor ratio and Jensen alpha should be tested.

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APPENDICES

APPENDIX A
EMERGING MARKET COUNTRIES

Table 1: Emerging market countries

Country	No. Stocks
Argentina	89
Brazil	643
Chile	223
China	1896
Colombia	29
India	1046
Indonesia	436
Israel	126
Malaysia	978
Mexico	184
Pakistan	125
Peru	79
Philippines	110
Russia	108
South Africa	413
Sri Lanka	37
Taiwan	1315
Thailand	811
Turkey	271
Venezuela	47

Table 2: Significantly positive alpha securities valid in 95% confidence interval of sub-period 1 (total of 48 assets, dead stocks are excluded)

Country	No. Stocks
Argentina	2
Brazil	3
Chile	1
China	7
India	4
Israel	3
Mexico	3
South Africa	11
Taiwan	11
Turkey	3

Table 3: Significantly positive alpha securities valid in 95% confidence interval of sub-period 2 (total of 37 assets, dead stocks are excluded)

Country	No. Stocks
China	17
India	2
Indonesia	3
Israel	1
Malaysia	3
Pakistan	1
South Africa	1
Thailand	9

Table 4: Significantly positive alpha securities valid in 95% confidence interval of sub-period 3 (total of 249 assets, dead stocks are excluded)

Country	No. Stocks
Argentina	4
Brazil	4
Chile	5
China	1
Colombia	7
India	131
Indonesia	1
Israel	7
Malaysia	2
Mexico	2
Pakistan	19
Peru	3
Russia	2
South Africa	50
Sri Lanka	3
Taiwan	2
Thailand	5
Turkey	1

APPENDIX B
VARIANCE-COVARIANCE MATRIX

Single Index Model covariance

Deriving a variance-covariance matrix by single index model is shown below. Recall that the return from a market model is:

$$R_i = \alpha_i + \beta_i(R_m) + e_i \tag{a1}$$

If we take expectation on both sides in equation (a) we will have:

$$E(R_i) = \alpha_i + \beta_i E(R_m) \tag{a2}$$

The variance-covariance matrix of SIM approach can be derived from the following equation:

$$COV(R_i, R_j) = E[(R_i - E(R_i))(R_j - E(R_j))] \tag{a3}$$

Thus, we can substitute equation (a1) and (a2) in equation (a3) and we will have:

$$\begin{aligned} COV(R_i, R_j) = E[(\alpha_i + \beta_i R_m + e_i - \alpha_i - \beta_i E(R_m))(\alpha_j + \beta_j R_m + e_j \\ - \alpha_j - \beta_j E(R_m))] \end{aligned} \tag{a4}$$

The alphas are taken off and is left with

$$COV(R_i, R_j) = E[(\beta_i(R_m - E(R_m) + e_i)(\beta_j(R_m - E(R_m) + e_j)] \tag{a5}$$

$$\begin{aligned} COV(R_i, R_j) = E[\beta_i\beta_j(R_m - E(R_m))^2 + \beta_i(R_m - E(R_m))e_j \\ + \beta_j\big(R_m - E(R_m)\big)e_i + e_i e_j] \end{aligned} \tag{a6}$$

Simplifying the equation (a6) and we have the estimated covariance equals to product of systematic risk of each asset multiply with a market variance.

$$COV(R_i, R_j) = \beta_i \beta_j \sigma_m^2 \qquad \text{(a7)}$$

$$COV(R_i, R_j) = \beta_i \beta_j \sigma_m^2 + \sigma_e^2 \qquad \text{(a8)}$$

Where:

	$COV(R_i, R_j)$	=	Covariance between two individual assets
	β_i	=	The beta coefficient of security i
	β_j	=	The beta coefficient of security j
	σ_m^2	=	Variance of market portfolio returns
	σ_e^2	=	Residual variance

The Three Factor Model covariance

The traditional covariance is:

$$COV(R_i, R_j) = E[(R_i - E(R_i))(R_j - E(R_j))] \qquad \text{(a9)}$$

Thus, we substitute the three-factor model equation

$$\begin{aligned} COV(R_i, R_j) = E[(\alpha_i + \beta_i R_m + s_i SMB + h_i HML + e_i) - (\alpha_i \\ + \beta_i E(R_m) + s_i E(SMB) \\ + h_i E(HML))((\alpha_j + \beta_j R_{m+} s_j SMB + h_j HML + e_j) \\ - \left(\alpha_j + \beta_j E(R_m) + s_j E(SMB) + h_j E(HML)\right)] \end{aligned} \qquad \text{(a10)}$$

Multiply expected term into the brackets

$$\begin{aligned} COV(R_i, R_j) = E[\left(\beta_i (R_m - E(R_m)\right) + s_i\left(SMB - E(SMB)\right) \\ + h_i (HML - E(HML)) + e_i)\left(\beta_j (R_m - E(R_m)) \\ + s_j (SMB - E(SMB)) + h_j (HML - E(HML)) + e_j\right)] \end{aligned} \qquad \text{(a11)}$$

Simplify the equation and we get the estimated covariance for the three-factor model

$$
\begin{aligned}
COV(R_i, R_j) = \beta_i\beta_j\sigma_m^2 + s_is_j\sigma_{SMB}^2 + h_ih_j\sigma_{HML}^2 \\
+ COV(R_m, SMB)\left(\beta_is_j + s_i\beta_j\right) \\
+ COV(R_m, HML)\left(\beta_ih_j + h_j\beta_j\right) \\
+ COV(SMB, HML)(s_ih_j + h_is_j)
\end{aligned}
\quad \text{(a12)}
$$

APPENDIX C
LIST OF FIRMS

Table 5: Estimated intercept and t values for significantly positive alpha securities in 95% confidence interval from equation 2.12 of sub-period 1 (total of 48 assets, dead stocks are excluded)

	Firm	Intercept	t-stat
1	IMPORT&EXPORT PATAG.'B'	0.06	3.49
2	SIDERCA 'A'	0.03	2.28
3	ITAUUNIBANCO ON	0.06	2.32
4	ITAUUNIBANCO PN	0.07	2.66
5	PETROBRAS ON	0.03	2.22
6	KOPOLAR	0.03	2.28
7	CHANGCHAI 'A'	0.04	2.07
8	GUANGDONG MEIYAN HYPW. 'A'	0.04	2.42
9	GUANGXIA (YINCHUAN) IND. 'A'	0.05	2.03
10	JINAN QINGQI MTCYCL.'A'	0.06	2.13
11	QINGDAO HAIER 'A'	0.06	2.32
12	SUNDIRO HOLDING 'A'	0.06	2.07
13	TIAN JIN GLB.MAGNETIC CARD 'A'	0.06	2.49
14	HINDUSTAN UNILEVER	0.07	2.08
15	INFOSYS TECHNOLOGIES	0.06	2.07
16	SWARAJ ENGINES	0.02	2.24
17	WIPRO	0.07	3.14
18	ALONY HETZ	0.04	2.68
19	HAMLET	0.07	2.26
20	KNAFAIM	0.05	2.45
21	GISSA	0.04	2.05
22	ICH 'B'	0.05	2.48
23	SORIANA 'B'	0.04	1.97
24	AFRICAN BANK INVS.	0.04	1.98
25	BUSINESS CONNEXION GROUP	0.04	2.11
26	DATATEC	0.19	2.73
27	DIMENSION DATA HDG.(JSE)	0.06	2.99
28	FIRSTRAND	0.09	3.70
29	HOSKEN CONS.INVS.	0.06	3.94
30	INVESTEC HDG.	0.04	2.24
31	NU WORLD	0.09	2.22

32	SAAMBOU	0.03	2.28
33	SASFIN	0.03	2.02
34	TRANSPACO	0.04	2.08
35	ADVANCED SEMICON.ENGR.	0.07	2.75
36	COMPAL ELECTRONICS	0.08	2.31
37	COMPEQ MANUFACTURING	0.06	2.47
38	HON HAI PRECN.IND.	0.06	2.39
39	KUO YANG CONSTRUCTION	0.07	2.92
40	POU CHEN	0.06	2.11
41	SILICONWARE PRECN.INDS.	0.05	2.81
42	TAIWAN SAKURA	0.05	2.20
43	TAIWAN SEMICON.MNFG.	0.04	2.01
44	TAIWAN TEA SUSP	0.04	1.97
45	WUS PRINTED CIRCUIT	0.05	2.39
46	KEPEZ ELEKTRIK	0.04	2.04
47	TUPRAS TKI.PEL.RFNE.	0.05	2.04
48	VESTEL ELNK.SANVETC.	0.10	2.18

Table 6: Estimated intercept and t values for significantly positive alpha securities in 95% confidence interval from equation 2.12 of sub-period 2 (total of 37 assets, dead stocks are excluded)

	Firm	Intercept	t-stat
1	BEIJING DBLE.-CRANE PHARM.'A'	0.024	2.235
2	CHINA RESOURCES JINHUA 'A'	0.034	2.391
3	COFCO TUNHE 'A'	0.039	2.478
4	CRED HOLDING 'A'	0.038	2.798
5	FINANCIAL STR.HLDG.'A'	0.037	2.027
6	HUBEI BIOCAUSE PHARM.'A'	0.046	2.121
7	JINZHOU PORT 'B'	0.058	1.967
8	NINGBO FUDA 'A'	0.033	2.033
9	SHAI.FRIENDSHIP GROUP INCO. 'B'	0.066	2.105
10	SHAI.HIGHLY (GP.) 'B'	0.062	2.274
11	SHANGHAI MRA.TRDG.'B'	0.079	2.383
12	SHENYANG HEJIN HLDG. 'A'	0.022	2.013
13	WUHU CONCH PROFL.& SCI. 'A'	0.043	2.517
14	XCMG CON.MACHINERY 'A'	0.041	2.446
15	XIN JIANG HOPS 'A'	0.037	2.755
16	ZHEJIANG OR.HDG. 'A'	0.030	2.002
17	ZHONGTIAN URBAN DEV.GP. 'A'	0.050	2.743
18	AMTEK AUTO	0.096	2.330
19	STERLING BIOTECH	0.084	2.068

20	DANKOS LABORATORIES	0.103	2.155
21	HM SAMPOERNA	0.070	2.109
22	TEMPO SCAN PACIFIC	0.103	2.124
23	DELEK DRILLIN L	0.077	2.000
24	CIMB GROUP HOLDINGS	0.066	2.086
25	HONG LEONG BANK	0.055	2.268
26	SP SETIA	0.054	2.221
27	NEW JUBILEE INSURANCE	0.028	2.174
28	MVELAPHANDA RES.	0.086	2.588
29	GFPT	0.067	2.258
30	KIATNAKIN BANK	0.102	1.979
31	LEE FEED MILL	0.080	3.251
32	SE-EDUCATION	0.040	2.023
33	THAI PRESIDENT FOODS	0.029	2.060
34	THAI RUNG UNION CAR	0.065	1.961
35	THAI STANLEY ELEC.	0.055	1.967
36	THAI WACOAL	0.030	1.987
37	THANULUX	0.059	2.183

Table 7: Estimated intercept and t values for significantly positive alpha securities in 95% confidence interval from equation 2.12 of sub-period 2 (total of 249 assets, dead stocks are excluded)

	Firm	Intercept	t-stat
1	BANCO MACRO 'B'	0.074	2.556
2	MIRGOR 'C'	0.045	2.307
3	RIGOLLEAU 'B'	0.065	2.024
4	SIDERAR 'A'	0.048	2.154
5	GUARARAPES ON	0.051	2.550
6	GUARARAPES PN	0.054	2.487
7	LOJAS AMERIC ON	0.050	2.333
8	RANDON PARTP.PN	0.042	2.614
9	EDELNOR	0.070	2.624
10	PEHUENCHE	0.026	2.664
11	PUCOBRE 'A'	0.019	2.038
12	SQM 'B'	0.023	1.983
13	TRICAHUE	0.031	2.561
14	NETEASE.COM ADR 1:25	0.111	2.537
15	BCOLOMBIA	0.043	2.870
16	BOGOTA	0.033	2.829
17	CEMARGOS	0.035	2.199
18	CHOCOLATES	0.033	2.781

19	COLINVERS	0.062	3.428
20	GRUPOSURA	0.057	3.269
21	INVERARGOS	0.033	2.480
22	ABAN OFFSHORE	0.088	3.033
23	ABB	0.036	2.653
24	ADOR WELDING	0.076	3.124
25	AEGIS LOGISTICS	0.075	2.307
26	AHMEDNAGAR FORGINGS	0.111	2.400
27	ALFA-LAVAL (INDIA)	0.029	2.107
28	AMFORGE INDUSTRIES	0.120	2.632
29	AMTEK AUTO	0.048	2.394
30	AMTEK INDIA	0.063	2.150
31	ANSAL PROPS.& INFR.	0.098	2.358
32	APAR INDUSTRIES	0.064	2.635
33	AREVA T & D INDIA	0.101	2.062
34	ASIAN HOTELS	0.039	2.042
35	ATLAS COPCO (INDIA)	0.056	3.052
36	BAJAJ AUTO FINANCE	0.036	2.259
37	BAJAJ HINDUSTHAN	0.091	2.667
38	BALKRISHNA INDUSTRIES	0.113	3.252
39	BERGER PAINTS INDIA	0.046	2.097
40	BF UTILITIES	0.155	2.324
41	BHANSALI ENGR.POLYMERS	0.110	2.025
42	BHARAT BIJLEE	0.079	2.601
43	BHARAT FORGE	0.053	3.180
44	BHARAT HEAVY ELS.	0.037	2.358
45	BHARTI AIRTEL	0.044	2.205
46	BIRLA CORPORATION	0.068	2.165
47	BLUE DART EXPRESS	0.036	1.966
48	BLUE STAR	0.042	3.153
49	BOSCH	0.046	3.501
50	CARBORUNDUM UNIVERSAL	0.058	3.182
51	CCL PRODUCTS (INDIA)	0.090	2.651
52	CHOLAMANDALAM DBS FIN.	0.035	1.994
53	CROMPTON GREAVES	0.059	2.745
54	D C M SHRIRAM INDS.	0.092	2.016
55	DCM SHRIRAM CONSOLIDATED	0.057	2.355
56	DE NORA INDIA	0.088	2.200
57	DOLPHIN OFFSHORE	0.090	2.038
58	DONEAR INDUSTRIES	0.056	2.340
59	DYNAMATIC TECHS.	0.093	2.676
60	EID PARRY (INDIA)	0.048	2.228

61	ELDER HEALTH CARE	0.144	2.063
62	ELECON ENGINEERING	0.100	2.842
63	EMCO	0.058	2.169
64	ERA INFRA ENGINEERING	0.130	2.316
65	ESAB INDIA	0.053	2.353
66	EXIDE INDUSTRIES	0.036	2.052
67	FAG BEARINGS INDIA	0.040	2.561
68	G M M PFAUDLER	0.061	2.413
69	GAMMON INDIA	0.074	3.061
70	GEODESIC	0.088	2.217
71	GODREJ CONSUMER PRODUCTS	0.040	2.567
72	GRAPHITE INDIA	0.045	2.109
73	GREAVES COTTON	0.093	3.293
74	GUJ.ALKALIES & CHEMS.	0.077	2.056
75	GUJARAT AMBUJA EXPORTS	0.056	2.648
76	GUJARAT FLOUROCHEMICALS	0.074	2.814
77	GUJARAT N R E COKE	0.099	2.161
78	HAVELL'S INDIA	0.051	2.074
79	HIMADRI CHEMS.& INDS.	0.149	2.369
80	HINDUJA FOUNDRIES	0.106	2.173
81	HINDUSTAN CONSTRUCTION	0.059	2.768
82	HOTEL LEELA VENTURE	0.059	2.319
83	ICI INDIA	0.026	2.125
84	INDIA GLYCOLS	0.055	2.002
85	IVRCL IFT.& PRJS.	0.085	2.123
86	J M FINANCIAL	0.107	2.605
87	JINDAL STEEL & POWER	0.060	2.286
88	JUBILANT ORGANOSYS	0.071	2.611
89	KAJARIA CERAMICS	0.056	2.178
90	KALPATARU POWER TNSM.	0.106	3.395
91	KANSAI NEROLAC PAINTS	0.043	3.161
92	KIRLOSKAR BROTHERS	0.105	3.639
93	KIRLOSKAR OIL ENGINES	0.068	2.932
94	KIRLOSKAR PNEUMATIC CO.	0.080	2.475
95	KSB PUMPS	0.049	1.989
96	LAKSHMI ENERGY & FOODS	0.144	2.548
97	LAKSHMI MACHINE WKS.	0.070	2.810
98	LARSEN & TOUBRO	0.040	2.061
99	LG BALAKRISNAN & BROS.	0.061	2.124
100	LLOYD ELECTRIC & ENGR.	0.134	2.413
101	LOYAL TEXTILE MILLS	0.064	2.105
102	MAHARASHTRA SEAMLESS	0.060	2.312

103	MAHINDRA & MAHINDRA	0.038	1.999
104	MAN INDUSTRIES (INDIA)	0.084	2.340
105	MANGALAM CEMENT	0.119	2.067
106	MANUGRAPH INDIA	0.091	2.901
107	MATRIX LABORATORIES	0.104	3.014
108	MERCATOR LINES	0.130	2.102
109	MONNET ISPAT & ENERGY	0.072	2.068
110	MUKAND	0.111	2.102
111	N R B BEARINGS	0.037	2.293
112	NAGARJUNA CON.	0.099	2.540
113	NAHAR INDUSTRIAL ENTS.	0.085	2.318
114	NAVA BHARAT VENTURES	0.085	2.212
115	NMDC	0.135	2.548
116	OCL INDIA	0.071	2.455
117	ORIENT PAPER & INDS.	0.079	2.069
118	PATEL ENGINEERING	0.068	2.144
119	PENINSULA LAND	0.091	2.059
120	PHOENIX MILLS	0.168	3.372
121	PRAJ INDUSTRIES	0.138	2.715
122	PUNJAB NATIONAL BANK	0.052	2.269
123	RATNAMANI METALS & TUBES	0.077	2.418
124	RSWM	0.060	2.202
125	SANGHVI MOVERS	0.112	2.560
126	SAVITA OIL TECHNOLOGIES	0.046	2.300
127	SESA GOA	0.082	2.458
128	SHANTHI GEARS	0.064	2.797
129	SHREE CEMENT	0.053	2.823
130	SHRIRAM TRAN.FIN.	0.059	2.061
131	SIEMENS	0.046	2.485
132	SIMBHAOLI SUGARS	0.086	1.994
133	SIMPLEX INFRASTRUCTURES	0.107	2.714
134	SRF	0.069	2.320
135	STAR PAPER MILLS	0.088	2.051
136	STERLING HDAY.RST.IDA.	0.101	2.028
137	SUMMIT SECURITIES	0.087	1.973
138	SUN PHARMACEUTICALS	0.025	2.169
139	SUNDRAM FASTENERS	0.033	1.974
140	TAJ GVK HOTELS & RESORTS	0.056	2.599
141	TANEJA AEROS.&AVTN.	0.115	2.302
142	TATA TEA	0.032	2.069
143	TEXMACO	0.105	2.331
144	THERMAX	0.042	2.243

145	TUBE INVESTMENTS OF IDA.	0.052	2.979
146	UNITECH	0.061	2.382
147	UNITED PHOSPHORUS	0.109	2.374
148	VARDHMAN HOLDINGS	0.084	2.235
149	VARDHMAN TEXTILES	0.068	2.101
150	VENUS REMEDIES	0.133	2.360
151	VIMTA LABS	0.091	3.078
152	VOLTAS	0.051	2.400
153	BUANA FINANCE	0.080	2.208
154	ARAZIM	0.063	2.927
155	FIBRATEC MILITARY SYSTEM	0.046	3.516
156	FRUTAROM	0.037	2.085
157	ICL	0.022	2.208
158	ITURAN	0.036	2.230
159	ORMAT	0.026	2.172
160	TEVA PHARMACEUTICAL	0.021	2.004
161	MISC BHD.	0.016	2.028
162	TRANSMILE GROUP	0.028	3.166
163	GEO 'B'	0.035	2.316
164	LAMOSA	0.030	2.440
165	ASKARI BANK	0.045	2.894
166	ATLAS HONDA	0.055	2.741
167	BANK AL HABIB	0.046	3.417
168	BANK OF PUNJAB	0.074	2.380
169	CHEARAT CEMENT COMPANY	0.047	2.323
170	DG KHAN CEMENT COMPANY	0.056	2.441
171	EFU GENERAL INSURANCE	0.054	2.496
172	FAUJI FERTILIZER	0.037	3.203
173	FAYSAL BANK	0.043	2.248
174	HABIB METROPOLITAN BANK	0.042	3.113
175	INDUS MOTOR COMPANY	0.047	2.130
176	INTERNATIONAL INDS.	0.049	2.287
177	LUCKY CEMENT	0.053	2.524
178	MCB BANK	0.052	2.847
179	NAT.BANK OF PAKISTAN	0.062	2.948
180	PAK ELEKTRON	0.078	2.531
181	PAKISTAN REFINERY	0.064	1.978
182	PIONEER CEMENT	0.069	2.198
183	SONERI BANK	0.034	2.048
184	FERREYC1	0.045	2.059
185	GLORIAI1	0.045	2.218
186	MINERA CORONA INVERSION	0.054	2.217

187	UFANEFTEKHIM	0.078	2.591
188	VIMPEL COMMS.SPN.ADR 20:1	0.079	2.354
189	ABSA GROUP	0.029	2.046
190	ACUCAP PROPERTIES	0.026	2.015
191	ADVTECH	0.025	2.220
192	ALLIED ELECTRONICS	0.046	2.176
193	AMAL.APPC.	0.026	2.241
194	ARGENT INDUSTRIAL	0.045	2.654
195	ASPEN PHMCR.HDG.	0.051	2.592
196	ASTRAL FOODS	0.035	2.469
197	BOWLER METCALF	0.043	2.861
198	BRIMSTONE INV.	0.030	2.407
199	CAPITEC BANK	0.059	2.766
200	CASHBUILD	0.053	3.236
201	CITY LODGE HOTELS	0.069	3.036
202	CULLINAN	0.031	2.332
203	DIGICORE	0.051	2.091
204	DISCOVERY	0.050	2.735
205	EOH	0.027	2.018
206	FAMOUS BRANDS	0.064	2.954
207	FOSCHINI	0.041	2.258
208	GOLD REEF RESORTS	0.057	2.649
209	GRINDROD	0.044	2.961
210	GROUP FIVE	0.048	3.219
211	HIGHVELD STL.& VNM.	0.056	3.219
212	HUDACO	0.041	2.175
213	HYPROP INVESTMENTS	0.044	2.092
214	ILIAD AFRICA	0.032	2.364
215	INVICTA	0.027	2.260
216	JD GROUP	0.058	2.905
217	KAGISO MEDIA	0.036	2.336
218	MASSMART	0.035	2.089
219	MEDI CLINIC	0.040	3.108
220	METAIR INVESTMENTS	0.035	2.170
221	MR PRICE GROUP	0.027	2.539
222	MUSTEK	0.032	2.042
223	NASPERS	0.033	2.074
224	NETCARE	0.028	1.960
225	OMNIA	0.043	2.756
226	PANGBOURNE PROPS.	0.022	2.089
227	PREMIUM PROPERTIES	0.049	2.813
228	PRETORIA PORT.CMT.	0.026	1.994

229	PUTPROP	0.036	2.409
230	REUNERT	0.038	2.562
231	SOVEREIGN FOOD INVS.	0.024	2.063
232	SPUR	0.025	2.177
233	SUN INTERNATIONAL	0.051	2.138
234	TIGER BRANDS	0.030	2.612
235	TRUWORTHS INTL.	0.026	2.349
236	WLSN.BAYLY HOLMES-OVCON	0.023	2.031
237	WINHOLD	0.036	2.536
238	WOOLWORTHS HDG.	0.048	3.428
239	AITKEN SPENCE	0.066	2.283
240	ASIAN HOTELS AND PROPS.	0.031	2.113
241	ON'ALLY HDG.	0.033	1.987
242	AWEA MECHANTRONIC	0.064	2.307
243	TAIWAN FAMILYMART	0.043	2.155
244	AIKCHOL HOSPITAL	0.030	2.083
245	BGK.DUSIT MED.SVS.	0.020	2.245
246	ICC INTERNATIONAL	0.040	2.423
247	MFC ASSET MANAGEMENT	0.062	3.125
248	PTT	0.016	1.994
249	DEVA HOLDING	0.028	2.261

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