MULTI-INDEX CAPM vs. APT: A COMPARISON OF TWO ASSET PRICING MODELS FOR MALAYSIA

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ABSTRACT

This study compares the relative validity of the two multi-index models of asset pricing, viz. the multi-index Capital Asset Pricing Model and the Arbitrage Pricing Theory. The monthly return data on the 213 stocks listed on the main board of the Kuala Lumpur Stock Exchange, Malaysia for the period September 1988 to June 1997 are used for the purpose. The comparison is performed along the lines of Chen (1983), and Ch'ng, Sanda and Gupta (1999) as well as the attributes of a good model as per Harvey (1981), and Hendry and Richard (1982). The results suggest that the neither model is better than the other. Thus, either of these two models could be used to explain the variations of returns across stocks in Malaysia.

1. INTRODUCTION

The stock market has always been volatile and its volatility has only increased over time. This is true globally. In Malaysia, the most popular stock price index is the Kuala Lumpur Stock Exchange (KLSE) index, which with a base of 100 in 1977 went-up to as high as 1314.5 on January 5, 1994, plunged to 262.7 on September 1,1998 (in the face of the South Asian Crisis), and it currently hovers around 750. This behaviour has rendered the stock pricing a highly difficult task. Nevertheless, efforts have been made to explain this variable and there is a vast literature on the subject. Since the work of Markowitz (1952) and particularly that of Sharpe (1964), it is generally (though not universally) believed that the market rewards for the systematic risk only, as the unsystematic risk can be diversified away by all prudent investors. Towards this approach, the Capital Asset Pricing Model (CAPM) (vide Sharpe 1964) and the Arbitrage Pricing Theory (APT) (vide Ross 1976) have been advanced. However, the empirical findings of Fama and French (1992) have proved the significance of even the unsystematic risk in stock returns. In consequence, we have the multi-index model of a variety different from the multi-index APT

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model of Stephen Ross. Under the new version, stock returns are explained both through the economy wide macro economic indices as well as the company specific micro variables. We have experienced with all these models to explain the behaviour of stock returns in Malaysia and our findings have been published elsewhere (vide Ch'ng and Gupta 2000, 2001a, and 2001b).

Further, a comparison of the performances of the CAPM and APT model was also attempted and the results are available in Ch'ng, Sanda and Gupta (1999). In this paper, we present the empirical results on the relative performance of the multi-index CAPM and APT models for Malaysia. Needless to say, Malaysia happens to be a fast developing capital market and the country is striving hard to go for the latest technology and globalisation. To cite a couple of examples, the KLSE introduced the concept of Universal Brokers in the early 2000 and its Securities Industry Development Centre (SIDC) has introduced the Continuing Professional Education (CPE) for all its licensed dealers in early 2001. Although the number of listed companies in Malaysia is not large, in terms of the Market Capitalization, Malaysia happens to be among the large ones, particularly among the developing countries. To cite some numbers, as on December 31, 2001, the market capitalization in Malaysia, for the Main (First) Board at KLSE stood at RM 435.89 billion, and for the second Board at RM 19.00 billion (RM 3.80 = US$1).

2. LITERATURE

The Markowitz (1952) portfolio theory marked a significant development in the pricing of marketable financial assets. Since an optimum portfolio would always be well diversified, it would be free from the unsystematic risk. Sharpe (1964) thus advanced the capital asset pricing model (CAPM), under which, stock return varies directly and linearly with the stock beta (β), a single (market) index model. However, the empirical verification of this model was challenged by Blume (1971), Roll (1977), and Pettengill, Sundaram and Mathur (1995). Blume pointed out that the beta is unstable and that the stock beta is more unstable than the portfolio beta. To take care of this error in variables' issue, Fama and Macbeth (1973) resorted to testing the CAPM on portfolios of stocks rather than stocks per se. This methodology led to the loss of degrees of freedom, which they avoid through using the over-lapping sample periods, among other techniques. Chen (1983) came out with an alternative method to handle the error in variables' problem, where he suggests to divide the sample into even and odd periods, and to use one sample for the estimation of beta(s) and the other sample for testing the model. The empirical literature contains results for several countries using both these approaches.

Roll argued that the CAPM is valid for the expected returns only and not for the past actual returns. However, this criticism has received a little weight as the historical long-run returns are considered as good estimates for the expected returns. Pettengill, Sundaram and Mathur (PSM) suggest that the CAPM is valid only when the excess market returns (return on market index minus the return on risk free asset) is positive. To handle this issue, they suggest that the sample period should be divided into two parts, one part having the period during which the excess market return was positive and the other when the said return was negative.

Black, Jenson and Scholes (1972) (BJS)'s study was among the first to test the validity of CAPM for the US capital market. The study upheld the CAPM in explaining the cross-section variation in stock returns. Fama and MacBeth (1973) endorsed the BJS results. For the Malaysian stock market, Ch'ng and Gupta (2000) among others, have casted doubts on the validity of CAPM in explaining the variation in return across stocks. It has been argued by several researchers that the CAPM is afflicted by several problems, generally referred to as "anomalies". These include its inability to account for the differences in returns between the small and large firms (size effect), across days of the week (week-end effect) and months of the year (January effect), and the differences in returns due to the anlaysts' following (neglected firm effect). To consider these anomalies, Fama and French (1992) tested the multi-index CAPM for the US data and found the evidence in favour of this model over the single index CAPM. In particular, they found that the firm size variable and the market to book value ratio are the more powerful factors than the beta in explaining the variation in returns across stocks. Banz (1981) also rejects the CAPM as his study found the negative and significant effect of the firm size on stock return. For Malaysia, our own study (vide Ch'ng and Gupta 2001a) finds the negative and significant effect of earnings per share on the stock return, and thus rejects the single index CAPM.

There are several empirical studies on the validity of the APT as well. These studies use either of the two approaches. One, the multiple indices are not identified and thus the factor analysis is applied. Two, the indices are identified from amongst the macro-economic variables and then the usual two-step regression technique is applied. Roll and Ross (1980) in their classic study of APT, applied the factor analysis to 42 groups of 30 stocks using daily the US data for the period July 1962 to December 1972. They find at least three factors that are significant. Cho, Elton and Gruber (1984) repeat the Roll and Ross methodology, and find still more factors to be significant in this regard. Connor and Korajczyk (1986) provide a test of the multi-index model using the asymmetric principal component technique proposed by Chamberlain and Rothschild (1981). They find that with the five factors, they can explain the extra return on small firms and in January better than the single-index CAPM based on a value-weighted index. On Japan data, Elton and Gruber (1988, 1989) find that the five factor multi-index model does a better job of explaining and predicting expected return than does a single-index CAPM.

There are studies questioning the validity of the use of the factor analysis technique, which can accommodate only a limited number of securities for analysis. Chen (1981) has described a procedure, which involved forming a small number of portfolios of securities based on an initial factor solution that allows the multi-index model to be estimated and tested across a large number of securities. However, Dhrymes, Friend and Gultekin (1984) have criticized his procedure. The incoherent picture leads to the next approach, which assumes that the factors are known before hand.

Sharpe (1982) uses the USA data on 2,197 stocks on a monthly basis from 1931 to 1979 to test his model. He starts with the hypothesis that equilibrium returns on a stock should be affected by its following characteristics:

- Beta with the S&P index
- Beta with the yield on long term bonds
- Alpha (intercept of the regression of return on the S & P index)
- Dividend yield
- Firm's size
- Sectoral belonging

Chen, Roll and Ross (1986) (CRR) have hypothesized and tested a set of macro-economic variables. They reason that return on stocks should be affected by any influence that affect either the future cash flows from holding a security or the value of these cash flows to the investor. They construct sets of alternative measures of unanticipated changes in the following influences:

- Inflation
- Term structure of interest rate
- Risk premia
- Unexpected inflation
- Industrial production.

They examined these measures or indices to see if they

(a) were correlated with the set of indices extracted by the factor analysis used by Roll and Ross.

(b) explained the equilibrium returns.

When they examined the relationship between the macroeconomic variables and the factors (indices) over the period to which the factors were formed, they found a strong relationship. Furthermore, when the relationship was tested over a holdout period (a period following the estimation period), it continued to be strong. They used the time series regression to estimate betas for each stock, which they used for estimating the sensitivity to each macroeconomic variable (the β_{ik}'s of Equation 1).

$$R_i = \beta_{i0} + \beta_{i1}f_{i1} + \beta_{i2}f_{i2} + \beta_{i3}f_{i3} + \beta_{i4}f_{i4} + \beta_{i5}f_{i5} + \varepsilon_i\ldots\ldots (1)$$

Where:

R_i = return on asset i,

E_i = expected return on asset i,

b_{ik} = reaction in asset i's returns to movements in the common factor f_{ik}

f_k = common factors (macroeconomic variables in CRR's case), that influence the returns on all assets

ε_i = an idiosyncratic effect on asset i's return, which, by assumption, is completely diversifiable in large portfolios and has a mean of zero;

The market price of risks (the γ_{ij}'s of Equation 2) was estimated by running the cross-sectional regression each month and looking at the average market price.

$$R_i = \gamma_0 + \gamma_1\hat{\beta}_{i1} + \gamma_2\hat{\beta}_{i2} + \gamma_3\hat{\beta}_{i3} + \gamma_4\hat{\beta}_{i4} + \gamma_5\hat{\beta}_{i5} + \varepsilon_i\ldots\ldots (2)$$

Where, $\hat{\beta}_{ik}$'s are as estimated through equation (1) above.

The procedure is analogous to the two-step procedure used by Fama and MacBeth (1973). CRR found that the macroeconomic variables are significant explanatory influences on stock pricing.

Grinold and Khan (1994) found nine firm characteristics as being the relevant factors. The said characteristics are measures of volatility, momentum, size, liquidity, growth, value, earning, financial leverage, and industry membership. Elton and Gruber (1988) show that by employing a multi-index model (e.g. APT) rather than a single-index model, one allows the creation of an index, which is more closely related to the desired index.

For Malaysia, Ch'ng and Gupta (2001b) use the similar data to investigate whether the cross sectional variations in stock returns are sufficiently explained by the APT. The study is based both on the factor analysis and the macro-economic factors' technique. The results indicate that the APT model is quite robust, and that the two unknown factors are significant in the first approach and just one (expected inflation) in the second approach in explaining the cross sectional variations in stock returns.

Blin (1999) employs around two dozens factors for advanced Portfolio Technologies' (APT) software Krishnamurthy (1982) found 5 relevant factors in his study. Jeyasreedham (1989) found just four commo factors, while Ch'ng and Gupta (2001b) found six common factors that determine the returns on th KLSE. Trzcinka (1986) suggests that there is no obvious way to choose the number of factors but th first 5 factors are more distinct. Connor and Korajczyk (1993) found evidence for one to six factors i the NYSE.

The literature contains studies on the comparative efficiency of the various stock pricing models a well. For Malaysia, Jeyasreedharan (1989) used the Davidson and MacKinnon's (1981) approach t compare the APT and the single-index CAPM on the KLSE data. He analysed the weekly KLSE sectora indices from January 1974 to December 1983 and found the APT superior to the single-index CAPM Ch'ng, Sanda and Gupta (1999) applied the Chen (1983) approach to the KLSE data and found the AP to perform better than the single index CAPM in explaining the variations in cross section of returns i Malaysia. Given the findings on the relative weakness of the single-index CAPM, there is perhaps th need for an examination of this efficiency by using a multi-index CAPM in relation to the APT mode The present paper thus aims at comparing the APT and the multi-index CAPM using the Malaysia data.

3. METHODOLOGY

The methodology is presented in four parts. The first sub-section describes the sample and data source The second talks about the variables used and the estimation procedure for the multi-index CAP model. The third explains the macro-economic factors selected and the estimation procedure for th APT model. The last sub-section deals with the evaluation of the comparative strength of the tw multi-index models in explaining the return across stocks.

3.1 Sample and Data

The study is based on the Malaysian data. The sample consist of 213 companies (n=213) and the perio of September 1988 through June 1997 (t = 106). All companies that were listed before September 19 and whose data for the full period were available were selected. Thus, all the companies under th Second Board of KSLE have been excluded. A period of about ten years was selected to provi adequate data and the post-Asian crisis period was excluded so as to avoid the effects of structu changes. The data on the month-end stock prices were considered and those were obtained from th Pusat Komputer Professional (PKP), a company based in Pahang, Malaysia. The data -base contains th closing prices, high and low prices, and the volume of transactions on the daily basis. Adjustments were made to take into account stock splits, rights and dividends. The other data, particularly on macro-economic variables, were obtained from the various issues of the Bank of Negara Report and KLSE publications. The rate of return on the security i was calculated as follows:

$$R_{it} = \ln \frac{P_{it}}{P_{i(t-1)}} \qquad (3)$$

Where,

R_{it} = rate of return on security i in period t

P_{it} = closing price of security i at time t

3.2 *Multi-Index CAPM*

In the multi-index CAPM model, the company-specific variables are added to the market index of the single-index CAPM to make it a multi-index CAPM. Since most of the researchers find 3 to 6 factors as significant in their studies, this study uses 5 factors for the estimation. Two alternative multi-index CAPM models are estimated. In all respects, the two models are the same except that in the second model, the independent variable, viz. the net book value used in the first model, is replaced by the market capitalization. Earlier studies have used the market capitalization for the size variable but, in practice, many investors are keen to know about the net book value of companies before making investments in their stocks. Thus, this study, unlike the earlier studies, considers the net book value as well. The problem, however, is that the net book value as a measure of size, may correlate highly with the market capitalization, an alternative measure of the size. This necessitates the estimation of the two separate models, one containing market capitalization and the other containing, among others, net book value.

There are a total of six independent variables in the two-multi index models. Each of the two models has four common independent variables. The four common independent variables are: return on the KLSE Composite Index (KLSE CI), return on the Dow Jones Industrial Average, percentage change in EPS, and percentage change in the divided yield. The fifth independent variable is either the percentage change in the net book value (model 1) or the percentage change in the market capitalisation (model 2).

KLSE Composite Index (KLSE CI)

The return in the KLSE CI is used as a proxy for the market portfolio. In theory, the market index should comprise of all assets. But in practice, only a proxy is employed. The KLSE CI is considered the best proxy for our purposes because the EMAS index (all share index) came into being only in the 1990s, while the sample for this study begins in 1988. The coefficient for the risk arising from the variations in the KLSE is expected to be positive.

Dow Jones Industrial Average

The Dow Jones industrial average is also included in the model because the index is the most closely followed index amongst the hard-core stock indices such as the Nikkei and the Hang Seng. It is employed as a proxy for the world market. Because of the growing levels of globalisation in which investment flows across boarders with relative ease, it is expected that positive events in the Dow Jones may, during normal conditions, be transmitted to other markets such as the KLSE. Also negative events in the Dow Jones may also get quickly transmitted to the KLSE during normal conditions. Thus, the risk arising from variations in the Dow Jones is expected to have a positive coefficient.

Market Capitalisation

Market capitalization is a measure of size. Previous studies have included a measure of size to ascertain whether or not there are differences between small and large firms. In theory, small firms have been found to have higher returns than large firms. Thus, the coefficient of risk arising from changes in size is expected to be negative.

Net Book Value

Net book value is also employed as a proxy for size. That is why the two measures of size cannot all be used in one regression, hence necessitating two regressions each of which contains either of the two measures of size. Many studies in the west have stressed the importance of small-firm effects as an important irregularity. For example, Basu (1977), Reignanum (1981) and Banz (1981) have shown that an important weakness of the single-index CAPM is its inability to explain firm size effect. The issue of firm-size effect has also been investigated in the Malaysian context by Mansor Md. Isa and Ong Yew Jin (1992). However, Mansor and Ong did not conduct an explicit test of the multi-index model, so the exact effect of the firm size is unclear from their study. For the New York Stock Exchange, the effect of firm size has been investigated by Chan, Chen and Hsieh (1985) under the framework of the multi-index model. The failure of the single-index CAPM to explain the firm size effect and the shortage of local research investigating its effect within the framework of the multi-index model is the main motivation for our choice of this variable in the tests for the multi-index CAPM.

Earning Per Share

Earnings per share is included as previous studies have found share price to respond to changes in earnings. It is expected that risk arising from changes in earnings per share would have a positive coefficient because, ceteris paribus, the higher the earnings per share, the more likely that investors would make an investment into a particular stock.

Dividend Yield

The effect of dividend yield on stock returns has also received attention in recent years. For example, Keim (1985) and explored the relationship between dividend yield and stock returns. His study follows closely of Blume (1980) who finds a positive yield effect. Miller and Scholes (1982) argue that the yield-related effects associated with short-term definitions of dividends are due to information biases and not taxes. Keim's study was aimed at furthering an understanding of the yield effects. His results indicate that yield effect occurs in January and that when January is excluded, the yield effect disappears. The rationale for the inclusion of dividend yield is due the differentials in tax rates on capital gains and dividend income. The higher marginal tax rates of dividend income versus capital gains should make taxable investors prefer a dollar of pre-tax capital gain to a dollar of dividends.

Brennan (1970) shows that dividend yield, when incorporated into a multi-index model, can perform better than the single index model. Given the conflicting findings on the effects of dividend yields, there is perhaps the need for a re-examination of this effect in the Malaysian context. Hence the choice of dividend yield as an explanatory variable in the multi-index model.

The two alternative formulations of the model, for its time-series regression part, are as follows:

Model 1:

$$R_j = \beta_{j0} + \beta_{j1}KLCI + \beta_{j2}DOWJONE + \beta_{j3}NETBOOK_j + \beta_{j4}EPS_j + \beta_{j5}DIVYILD_j + \varepsilon_j \quad (4)$$

Model 2:

$$R_j = \beta_{j0} + \beta_{j1}KLCI + \beta_{j2}DOWJONE + \beta_{j3}MKTCAP_j + \beta_{j4}EPS_j + \beta_{j5}DIVYILD_j + \varepsilon_j \quad (5)$$

APT Model

This study uses the macro-economic factors' approach of Chen, Roll and Ross (1986) in estimating the APT model. The authors use five factors, but this study uses four factors because data is not available for one of the factors suggested by CRR. The variables are the percentage change in industrial production, business cycle variable (difference between the long-term and short-term interest rates), unanticipated inflation rate and the expected inflation rate.

Industrial Production

The growth rate of industrial production has been used in many studies as an explanatory variable in the APT equation. For example, Safie (1994) has incorporated industrial production in his study and found that this variable is significantly important in explaining the return on the KLSE stocks. Other researchers, such as Pesek (1999), Chaze (1999), and Nasseh (2000) also stress that industrial production is one of the important variables in all-economic activities. Several studies, including the ones on Malaysia, have found that industrial production and Gross Domestic Product (GDP) are highly correlated. Due to the non-availability of the monthly data, GDP could not be included in the study. Industrial production serves as a proxy for GDP. This choice of the variable is also good because the share of industrial production in GDP is high and growing even in emerging markets like Malaysia, and the volatility in itself is a crucial factor in stock price behaviour. An examination of data would indicate that stock prices follow fairly well the ups and downs in industrial production.

The higher the level of industrial production, the larger the profit the companies are likely to reap. During boom periods, industrial production tends to grow to keep pace with the increasing demand for it. During slumps, industrial production tends to decline in tandem with the falling demand. Thus, one would expect profits to be high during the booms and to be low during the recessions. When profits are high, dividends would also be high, so that stock returns would also be high. Thus, a positive relationship is expected between the stock returns and the percentage change in industrial production.

Inflation

The effect of inflation on stock returns has been investigated by many authors. Such empirical studies derive inspiration from the pioneering work of Fisher, Irving (1970) who argued that there is a one-to-one relationship between stock returns (nominal) and expected inflation. The effect of inflation on the common stock return has been studied by Jaffe and Mandelkar (1976), and Nelson (1976), who use US data [1953-71 in the former study and 1953-74 in the latter] to test the relation between stock

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A similar result was reported by Bodie (1976) , who used data for the US for the period January 1953 to December 1972. In contrast to these studies, Firth (1979) found a positive relationship between stock prices and inflation, supporting the view that stocks act as a hedge against inflation. Gultekin (1983) investigated the relation between the common stock returns and inflation using data for the twenty-six countries for the post-war period. Using time series regression, Gultekin found that the "regression coefficients are predominantly negative" and that "the stock return-inflation relation is not stable over time" (p. 64). He concludes that "the relation between the common stock return and inflation in other countries is as puzzling as the findings in the U.S." (p. 64).

Local studies have not explicitly used inflation as an explanatory variable affecting returns. In view of the earlier works suggesting a positive relationship between stock returns and inflation, this study incorporates two measures of inflation, the first being the expected inflation, and the second the unexpected inflation. The Consumer Price Index (CPI) was used to compute the inflation rate. To obtain a measure of the expected inflation, the naive model has been used. Under the naive model, the best estimator of inflation is its value in the immediate past period. The unexpected inflation data were then obtained as the difference between the current and previous inflation rates.

Term Structure of Interest Rate (Business Cycle Risk)

The effect of business cycles on an asset's return is well known. The issue is how to measure this variable. Usually, the difference between the long-and-short-term interest rates is used for the purpose. Chen, Roll and Ross (CRR) defined this variable as the difference between the returns on the long-term and short-term government bonds. This study follows this procedure but with some modification owing to the data problem. While Chen, Roll and Ross (CRR) used long-term and short-term government bonds, this study uses the twelve-month and one-month fixed deposit rates. Long-term bonds in Malaysia are not issued on a monthly basis (they are issued at very irregular intervals) and, thus, this precludes the use of the interest rate on them[1].

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[1] *Some researchers have suggested ways to deal with the problem of missing-data. For example, the missing data could be replaced by the mean values or by the lagged value of the variable. This study does not take this option because of the preponderance of missing data for the long-term government bonds.*

Risk Premia

Since Markowitz (1952), it is well known that the returns are influenced by the degree of the risk of default in the underlying securities. Chen, Roll and Ross (CRR) used the difference between the yields on the high-grade bonds and low-grade bonds as a measure of this risk. This study does not include this variable for an unavoidable reason. In Malaysia, corporate bonds are often accompanied with warrants. A company with low future prospects could offer a very attractive warrant, but very low rate on the bond. Conversely, a company with good prospects could offer a high bond rate but poor quality warrant. In the absence of warrants, the higher the prospects of a company, the lower the bond rate. But the use of warrants in Malaysia makes the relationship unpredictable. Admittedly this variable could be represented by the difference in the yields on government bonds and company bonds. But, again, the study is unable to use this, for government bonds are not issued on a monthly basis.

Other Variables

One of the other factors that may affect the share price is the exchange rate. Foreign investors' decisions are surely affected by the movements in the exchange rate. The role of foreign investors has been very significant especially during the nineties. Fauzias and Natarajan (1999) tried to find the factors that caused the currency crisis. They found that the movements in the KLSE composite index are not highly correlated with the changes in the exchange rate. Lai, Chin and Low (1999) investigated the institutional investors and found that the movement of the exchange rate is only ranked seven (out of ten factors) in terms of the importance of the factors listed. On the same test, the unemployment rate was ranked eight. The said rate was not included in this study largely because during the period of this study (1988-97), this rate was rather low and stable. In fact, there was an acute shortage of labour in Malaysia during the period, so much so that many sectors had to rely on migrant labour.

The company-specific variables, as suggested by Fama and French (1992), have not been included in this study because the APT looks into the market factors only and the micro factors are handled through another approach, generally referred to as the multi-index models.

The APT model is identical to the multi-index CAPM barring the set of independent variables. The time-series equation for APT is given as follow :

$$R_j = \beta_{j0} + \beta_{j1}BCYCLE + \beta_{j2}INDPROD + \beta_{j3}UI + \beta_{j4}EI + \varepsilon_j \qquad (6)$$

Where,

R_j = return on asset j

β_{jk} = risk estimate for factor k in asset j

BCYCLE = business cycle variable

INDPROD = percentage change in industrial production

UI = unanticipated inflation rate

EI = expected inflation rate

ε_j = error term

The estimation procedure for the multi-index CAPM is then repeated for the APT except by replacing the time series equations 4 or 5 by equation 6. The expected returns from the APT are denoted as $E(R_{APT})$.

3.4 Comparison of Multi-index CAPM and APT Models

The literature suggests that in order to compare the two models, a regression should be run to estimate the parameters of the following cross section equation (Chen, 1983):

$$R_j = \psi_1 R_{CAPM_i} + \psi_2 R_{APT_i} + \mu_i \qquad ......(7)$$

Where,

R_i = actual returns on stock i

R_{CAPMi} = expected returns on stock i through multi-index CAPM

R_{APT} = expected returns on stock i through APT

ψ = parameters

μ = residuals

The estimates of this equation are then used to test as to which of the two models better explains the cross section variations in returns. A pair of the joint hypothesis is tested separately. The first joint hypothesis tested is of the form: ψ1=0 and ψ2=1, while the second joint hypothesis tested is: ψ1=1 and ψ2=0. If the first hypothesis is not rejected, this would be in support of the APT; if the second hypothesis is not rejected, that would be in support of the multi-index CAPM; and if neither is not rejected, this would lead to the inconclusive results. Each of the two tests imposes some restrictions on the parameters.

Gujarati (1992) gives the following formula for testing the hypothesis involving linear restrictions: [2]

$$F = \frac{(R^2 - R^{*2})/m}{(1-R^2)/(n-k)} \quad ......(8)$$

Where

R^2 = R^2 from the unrestricted regression

R^{*2} = R^2 from the restricted regression

m = number of the linear restrictions imposed

n = number of observations

k = number of parameters estimated in the unrestricted regression

4. RESULTS AND ANALYSIS

The results for the multi-index CAPM and APT begin with an examination of the simple correlations between the pairs of the independent variables. This is important as it will help shed some light on the possibility of multicollinearity, the presence of which can cause severe estimation problem. The correlation results are given in Tables 1 and 2 below:

Table 1 Correlation Results for Variables used in Multi-index CAPM

	DOWJONE	KLCI	NETBOOK	EPS	MKTCAP
KLCI	-0.02				
NETBOOK	0.04	-0.14			
EPS	-0.02	0.12	0.07		
MKTCAP	0.00	-0.02	0.21	0.00	
DIVYILD	-0.02	0.17	-0.75**	0.00	-0.55

Table 2 Correlation Results for Variables used in APT

	BCYCLE	INDPROD	UI
INDPROD	0.74**		
UI	0.01	-0.01	
EI	-0.02	0.02	0.73**

[2] *It should be noted that the statistical package used by the authors does not require separate running of the unrestricted and restricted regressions. All that was required was the estimation of the unrestricted regression followed by a test for the linear restrictions.*

From Table 1, it is noted that there is only one pair of variables (dividend yield and net book value) that appears to be significantly correlated at the 1 per cent level. From Table 2, there are two pairs of variables (business cycle variable and industrial production, and unanticipated inflation and expected inflation) which are significantly correlated at the 1 per cent level. Even in these cases, the correlation coefficients are below 0.8 so it is likely that the multicollinearity problem is not too severe to warrant a dropping of one of the variables from each of these pairs

The detail results on each of the multi-index CAPM and APT are not included here for want of space. The results obtained from the comparison of the multi-index CAPM and APT models are given in Table 3.

Table 3: Comparison Results on Multi-index CAPM and APT

	Coefficient	t-ratio	Sig t
Model 1	0.58	4.4	0
APT	0.51	3.86	0
R^2	0.5		
	Test 1	Test 2	
Model 1	0	1	
APT	1	0	
F	9.66	7.45	
Sif F	0	0	
	Coefficient	t-ratio	Sig t
Model 2	0.58	4.47	0
APT	0.51	3.94	0
R^2	0.51		
	Test 1	Test 2	
Model 2	0	1	
APT	1	0	
F	9.98	7.78	
Sig F	0	0	

The first panel shows the comparison of the APT with the variant of the multi-index CAPM model that has net book value as the measure of size. The coefficient estimate of the multi-index CAPM model is 0.58, slightly higher than that of the APT. The t-ratios are 4.40 and 3.86 for the multi-index CAPM model and the APT, respectively. This suggests that each of them is significant at the 1 per cent level. Although the coefficient of the multi-index CAPM model is found to be higher than that of the APT, the two coefficient estimates are not very different from each other. As far as the comparison of the two models is concerned, the most important part of the results can be found in the second panel. In the second column of the second panel of the table, two restrictions were imposed that the coefficient of the multi-index CAPM model is zero and that of the APT is unity. The F-ratio for these restrictions was found to be 9.66, which is significant at the 1 per cent level. The third column of the second panel of the table shows the results obtained by imposing the two restrictions, with one stating that the coefficient of multi-index CAPM model is unity and the second positing that the coefficient estimate of the APT is zero. The F-ratio for these restrictions was found to be 7.45, which is highly significant and implying that the restrictions are unfounded.

The third and fourth panels of Table 3 show the results obtained from a comparison of the APT with the second variant of the multi-index model. The results are similar in all respects to the ones presented above in the preceding paragraph on the comparison of the APT with the first variant of the multi-index CAPM.

What do the results therefore imply? They imply that neither the APT nor any of the two formulations of the multi-index CAPM model can be preferred to the other. Since the objective of this research is to investigate which of the two asset pricing models best explains the cross sectional variations, these results appear to lead us to a blind alley. The results reveal that on the statistical criteria alone, none of the two models could be preferred to the other. Thus, we have to use criteria other than those suggested by Chen (1983) to determine which of the two models, if any, may be regarded as the "best" in explaining the cross sectional variations in returns. Harvey (1981), and Hendry and Richard (1982)'s attributes of a good model are thus applied to observe which model is preferable. Table 4 provides the summary results for the comparison.

Table 4. Attributes of Multi-Index CAPM vs. APT

Criteria	APT		Multi-Index CAPM (Model 1)		Multi-Index CAPM (Model 2)	
Principle of Parsimony	4 factors		5 factors		5 factors	
Identifiably	Yes		Yes		Yes	
Goodness of Fit (R^2)*	65.95%		86.75		85.4%	
Theoretical Consistency*	BCYCLE	N S	KLSE CI	- S	KLSE CI	- S
	INDPROD	+ S	DOWJONE	- S	DOWJONE	N S
	UI	N S	NETBOOK	N S	MKTCAP	- S
	EI	+ S	EPS	+ S	EPS	N S
			DIVYILD	N S	DIVYILD	N S

N S = Not Significant at 5 per cent level
+ S = Positive Significant at 5 per cent level
- S = Negative Significant at 5 per cent level

* Source: Ch'ng and Gupta (2001a, 2001b)

The above results are taken from the authors' earlier works (See Ch'ng and Gupta, 2001a and 2001b). On the practical point of view, a fewer data are required for APT as it has only four factors in compariso to five factors in the other model. However, it gives a lower R square value as compared to th multi-index CAPM. The KLSE CI has a negative and significant coefficient in the multi-index CAP (both models). This is not surprising when we take a closer look at the KLSE CI, which is a weighte average of 100 stocks listed on the KLSE and the top 10 companies account for 58% of the weight. Th results thus again lead us to the inconclusive finding on the comparative efficiency of the two models

5. CONCLUSIONS

The results reported in this paper suggest that the neither of the two models, viz. multi-index CAPM an APT, is better than the other. However, since each of these two models explains fairly well th cross-section variations in stock returns, either of them could be used by prudent investors. This conclusi is, of course, subject to our sample as well as the choice of the independent variables. The number an choice of independent variables is rather crucial in any study on any of the multi-index models, whi include both the multi-index CAPM as well as APT. Towards this issue, Dhrymes, Friend and Gultek (1984) reports that as the number of securities included in the factor analysis increases from 15 to th the number of significant factors increases from 3 to 7. Thus, the paper leaves scope for further resea in terms of attempting to identify and incorporate new independent variables in each of the two models and then perform the comparison. Furthermore, our study has used the KLSE-CI as the proxy for market index and the Dow Jones Industrial Average (DJIA) to capture the global effect. The 100 stocks included in the KLSE-CI happens to be the most traded as well as the largest ones. They together accounted for RM 295.59 billion out of the total market capitalization of RM 435.89 billion as on Dec 31,2001 on the KLSE Main Board, and the DJIA is considered as one of the most representative indices for measuring the trend in the global capital market. Nevertheless, the use of other indices could well produce different results.

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