THE EFFECTIVENESS OF ARBITRAGE PRICING MODEL IN MODERN FINANCIAL THEORY

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ABSTRACT
The Arbitrage Pricing Model (AP) is a famous model used to determine the factors such as market portfolio which influences expected returns on individual asset prices in the financial markets. Many investors believe that the stochastic returns of capital assets are consistent with a factor structure. One of the benefits on the Arbitrage Pricing Model is taking the benefit of the mispriced securities as profit by arbitrageurs. In this study AP is compared with CAPM and also how AP is used in other parts of the globe.
Keywords: The Arbitrage Pricing Model, Capital Asset Pricing Model (CAPM), Common Stock.

INTRODUCTION

Asset prices are universally believed to react sensitively to economic news. Every day experience seems to carry the view that individual asset prices are influenced by a broad variety of unpredictable events and that some events have a more pervasive outcome on asset prices than o others (Chen et al., 1986). Thus, various asset pricing models can be used to determine equity returns.

Investopedia.com defines arbitrage pricing model as an asset pricing model using one or more common factors to price returns. It is called a single factor model with only one factor, representing the market portfolio. It is called a multifactor model with more factors. Primarily, Ross (1976a, 1976b) developed the Arbitrage Pricing Theory (APT). It is a one-period model in which every investor believes that the stochastic properties of returns of capital assets are consistent with a factor structure. Ross argues that if equilibrium prices offer no arbitrage opportunities over static portfolios of the assets, then the expected returns on the assets are approximately linear related to the factor loadings. The factor loadings or betas are proportional to the returns' co-variance with the factors.

According to Azhar Bin Zakaria (2006), the equilibrium-pricing model using Arbitrage Pricing Theory (APT) has developed into one of the modern financial theory. However, the use of APT in determining the factors which influences expected returns is too general. APT often viewed as a substitute to the capital asset pricing model (CAPM). Market's expected return is used in the CAPM formula, whileAPT uses risky asset's expected return and the risk premium. APT model are used by arbitrageurs to profit by taking benefit of mispriced securities (Azhar Bin Zakaria, 2006). A mispriced security will have a price which is different from the model prediction hypothetical price. By going short an overpriced security, while in going long the portfolio the APT calculations were based on the arbitrageur to make a risk-free turnover.

BACKGROUND RESEARCH

The Arbitrage Pricing Theory (APT) Model The return on a stock can be calculated by the following APT formula stated by Ross (1976):
Expected Return = rf + b1 x (factor 1) + b2 x (factor 2)... + bn x (factor n)
Where:

- rf= The risk free interest rate (interest rate the investor would expect to receive from a risk free investment)
- b =The sensitivity of the stock to each factor

- factor = the risk premium associated with each factor

The following two factorsthat influence the risk premium in the APT model:-

I. The risk premiums associated with each of the factors described above
II. The sensitivity of stock to each of the factors - similar to the beta concept
Risk Premium = r -rf = b(1) x (r factor(1) - rf) + b(2) x (r factor(2) - rf)... + b(n) x (r factor(n) - rf)
Ross (1976) added that theinvestor would sell the stock if the expected risk premium on a stock was lesser. Thepatron would buy the stock if the risk premium was higher, until both sides of the equation were in balance. Investors could go about getting this formula back into equilibrium, by using the arbitrage term.

Arbitrage Pricing Theory Assumptions

According to Rodney Boehme(n.d) there are 2 assumptions for the model. Firstly, only the systematic risk is relevant in determining expected returns which is similar to CAPM.However, there may be several non-diversifiable risk factors (different from CAPM,since CAPM assumes only one risk factor) that are systematic or macroeconomic innature and thus affect the returns of all stocks to some degree. Secondly in relation to firm specific risk, since it is easily diversified out of any well-diversified portfolio, is notrelevant in determining the expected returns of securities (similar to CAPM).

Factors Used In Arbitrage Pricing Theory

There is no formal theoretical guidance in choosing the appropriate group of economic factors to be included in the APT model (AzeezandYonoezawa, 2003).Paavola (2006) explains further that this is both its strength and its weakness. It is strength in empirical work since it permits the researcher to select whatever factors provide the best explanation for the particular sample at hand; it is weakness in practical applications because, in contrast to the CAPM, it cannot explain variation in asset returns in terms of limited and easily identifiable factors, such as equity's beta. (Groenewoldand Fraser, 1997).

Berry et al. (1988) gave good and simple instructions of what kind of variables qualify as legitimate risk factors in the APT framework. They state that legitimate risk factors must possess three important properties:

I. At the beginning of every period, the factor must be completely unpredictable to the market.
II. Each APT factor must have a pervasive influence on stock returns.
III. Relevant factors must influence expected return; i.e. they must have non-zero prices.

There had been a lot of tests of the APT (Chen et al., 1986; Burmeisterand McElroy, 1988) for the United States, (Beenstockand Chan, 1988; Poon & Taylor, 1991; and Clare and Thomas, 1994) for the United Kingdom. It is well known that the macroeconomic variables chosen by Chen et al. (1986) have been the foundation of the APT. According to Paavola (2006), its worth pointing out, why these variables could affect equities' returns:

1. Inflation

Inflation impacts both the level of the discount rate and the size of the future cash flows.

2. The term structure of interest rates.

Differences between the rate on bonds with a long maturity and a short maturity affect the value of payments far in the future relative to near-term payments.

3. Risk premium.

Differences between the return on safe bonds (AAA) and more risky bonds (BAA)

are used to measure the market's reaction to risk.

4. Industrial production.

Changes in industrial production affect the opportunities facing investors and the real values of cash flows (Elton et al., 2003).

Objective of the Study

1. To review the arbitrage pricing model
2. To look at the alternative model
3. Global evidence

Literature Review

General Disagreements and Contradictions of The Arbitrage Pricing Model (APT)

Paavola (2006) argued that the APT naturally out-performs the CAPM in a statistical sense for two reasons: the APT permits more than a single factor and the APT constructs the factors to best fit data whereas the CAPM uses a single factor clearly defined by the theory. If a researcher includes another variable to explain returns, R^2 can never be smaller with the added variable (Groenewold and Fraser, 1997).

Morel (2001) added the most disappointing feature of the APT is that it does not identify the commonfactors (nor even their number). It is not also supported by the theoretical foundationsof the CAPM that describes the investors' behavior. Gilles andLeRoy(1990) state that the APT contains no useful information about prices, because theythink that the APT does not include any clear restrictions and it can be thought as atoo general asset pricing model. They also state that many economists have all alongbeen skeptical about the content of the APT, because they believe that the APTshould depend on the validity of assumed restrictions on preferences and technology.One of the main weaknesses of the factor analysis of the APT is that the numberof relevant factors in empirical APT models increases with the number of securitiesbeing factor analyzed (Dhrymes et al., 1984).Furthermore, the tendency of factors to increase cannot be explained by "priced"and "non-priced" risk factors. This problem arises because the theory in itself doesnot identify relevant factors.

The major assumption of the APT model is that assetreturns are linearly related to a set of unspecified common factors and that there areno arbitrage opportunities. This generality of the theoretical APT has turned out to bea major weakness for the empirical APT (Koutmos et al., 1993). There is also a greatdeal of skepticism about the test methods of the APT. Cheng (1996) states that themethod of Chen et al. (1986) is very sensitive to the number of independent variablesincluded in the regression. Cheng (1996) also noted that when a researcher is testingthe APT, a factor may be significant in one multivariate analysis and then will not besignificant when testing in a univariate model. The multicollinearity among economicvariables presents another drawback of this approach (Paavola, 2006).

The alternative asset pricing model which is the Capital Asset Pricing Model (CAPM)

The APT along with the capital asset pricing model (CAPM) is one of two influential theories on asset pricing. The APT differs from the CAPM in that it is less restrictive in its assumptions. It allows for an explanatory (as opposed to statistical) model of asset returns. It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to the identical "market portfolio.

The APT has the potential to overcome CAPM weaknesses: it requires less and more realistic assumptions to be generated by a simple arbitrage argument and its explanatory power is potentially better

since it is a multifactor model. However, the power and the generality of the APT are its main strength and weakness: the APT permits the researchers to choose whatever factors provide the best explanation for the data but it cannot explain variation in asset return in terms of a limited number of easily identifiable factors. In contrast, CAPM theory is intuitive and easy to apply.

a. Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) by William Sharpe (1964) and John Lintner (1965) symbols the birth of asset pricing theory. The CAPM is still widely used in applications, such as estimating the cost of capital for firms and evaluating the performance of managed portfolios four decades later (F.Fama, 2004). It is the attraction of MBA investment courses. It is often the only asset pricing model taught in these courses in fact (Sharpe, 1964;Lintner, 1965; and Black, 1972).

The model assumes investors are risk averse and, when choosing among portfolios, they care only about the mean and variances of their one-period investment return (Markowitz, 1959). As a result, investors choose "mean-variance-efficient" portfolios, in the sense that the portfolios firstly toreduce the discrepancy of portfolio return, given expected return, and secondly to maximize expected return, given the variance. Thus, the Markowitz approach is often called a "mean-variance model."

b. Inter-temporal Capital Asset Pricing Model (ICAPM)

The limitations of CAPM lead to the development of Inter-temporal Capital Pricing Model (ICAPM) by Merton (1973), where holding periods are allowed to change through time. ICAPM assumed that investors aimed to maximize their expected consumption utility over the period of their lifetime, and that they are able to trade continuously. Merton showed that investors will take into account not only their wealth, but also the uncertainty of the future economy in their current investment decisions. This suggests that they will hedge against possible economic shocks that are likely to reduce the expected utility of their consumption. The major implication of the model is that multiple betas are needed to explain expected return; and that the number of the betas equal one (i.e. the broad market factor) plus additional state variables which affect investors' investment opportunities and consumption preferences (and hence their expected utility) over time (Merton 1973).

The comparison between the APT and CAPM

Many textbooks and articles repeat two common limitations about the CAPM:

I. Evidence that it takes more than one factor to explain the shared, or systematic, risk in securities discredits the CAPM (Paavola, 2006).
II. In demonstrating that the risk premium on an asset depends only on its systematic factor loadings, the APT provides investors with a result of great practical value that the CAPM does not provide (Treynor, 1993).

According to GurHuberman et al. (2005), the APT is commonly put forward as a superior alternative to the criticized but widely-used CAPM. The alleged weakness of the CAPM, its baggage of "unrealistic assumptions" and its empirical shortcoming, are well known. Test of the CAPM typically display poor explanatory power as well as overestimating the risk-free rate and underestimating the market risk premium. The main criticism is particularly the use of betas to predict an asset's return – returns on high-beta stocks will tend to be overestimated and vice versa for low-beta stocks (Groenewoldand Fraser, 1997). The advances of the APT over the CAPM are widely discussed in

the literature and we will sum up a few of the main notes that have been discussed. First, in favor of the APT is that the APT makes no assumptions about the empirical distribution of asset returns. Second, the strong assumptions made about utility theory in deriving the CAPM are not necessary. The APT also admits several risk sources and therefore can be more operational and has a better forecasting ability than the CAPM. There is no special role for the market portfolio in the APT, whereas the CAPM requires that the market portfolio is efficient. The APT is also easily extended to a multi-period framework (Elton et al., 2003; Morel, 2001).

Several rigorous assumptions have to be made when deriving the CAPM such as there are no market frictions, e.g., short selling is unrestricted, investors can borrow and lend at risk-free rate and there are no taxes.There are numerous securities so that idiosyncratic risk can be diversified away and Investors are risk-averse and seek to maximize their wealth (Lofthouse, 2001).

Studies comparing the APT and the CAPM have used both factor or principal component analysis and selecting macroeconomic variables a priori (Yli-olli et al., 1990). Connor andKorajczyk (1986) used principal components analysis and found five factors that could explain the size and January effect better than the CAPM. Berry et al. (1988) concluded that the APT model is better explaining equities returns than the CAPM and that at the 0.01 significance level the CAPM model can be rejected in favour of the APT model. Josev et al. (2001)conclude for Australian industry equity portfolios that "the results showed that there was strong evidence in favour of the APT model" in a recent study from the Indian stock market by Dhankar andEsq (2005) concludethat "APT provides a better warning of asset risk and estimates of required rate of return compared to CAPM which uses beta as the only market of risk." Elton et al. (2003) that the APT remains the newest and most promising explanation of relative returns. The APT promises to supply as with a more complete description of returns than the CAPM model.

Both models assert that every asset must be compensated only according to its systematic risk. In the CAPM, the systematic risk is the co variation of the asset with the market portfolio and in the APT it is the co variation with a number of factors.

Prior Work

CAPM has been tested extensively, for over three decades, in various forms primarily in developed capital markets and to some extent in developing markets. Early work in this area including Black, Jensen and Scholes (1972), Fama and MacBeth (1973) and Blume and Friend (1973) supported the standard and zero beta model of CAPM. However Banz (1981), Reinganum (1981), Gibbons (1982), Shanken (1985a) and Fama and French (1992), highlighted the danger of focusing exclusively on mean-beta space. These studies found that the return generation process also depends on other variables like size, book to market ratio and earnings price ratio.

Others, such as Maheshwari&Vanjara (1989), Madhusoodanan (1997), Sehgal (1997), Vipul (1998) and Dhankarand Singh (2005b) found CAPM was not suitable for describing the Indian market.

A great deal of research work on APT has been undertaken in developed markets, particularly in the U.S. market using two approaches. Roll and Ross (1980), Chen (1983) and Dhrymes, Friend and Gultekin (1984) used the first approach, namely factor analysis. The drawback of this approach is that it is difficult to interpret

the statistically derived factors in economic terms.

Chen, Roll and Ross (1986) found four macroeconomic factors have a significant explanatory influence on returns. Yield differential between long and short term treasury bonds, inflation rate, yield differential between bb rated corporate and treasury bonds, and growth rate in industrial production. Burmiester and McElroy (1988) concluded that CAPM can be rejected in favour of their APT model which included factors like default premium and time premium.

In another study of CAPM vs. APT using principal component analysis, Dhankar and Singh (2005a) found that monthly and weekly returns gave almost similar results, but weekly results showed APT in a more favorable light than monthly results. A study by Singh (2008 b) showed that beta varies considerably from year to year and also varies with the interval between data points (daily, weekly, monthly). Singh (2008a) also found some evidence of non-stationarity of beta between bull and bear periods and stationarity between bull periods. For these reasons, both weekly and monthly returns were examined, and the twelve year period was divided into four sub periods to check for changes over time.

Review of APT In Relation To Common Stock Return

Stock market plays an important role in stimulating economic growth of a country. It helps to channel funds from individuals or firms without investment opportunities to firms who have them and thus improve the country's economic efficiency. It is the lifeblood of the economy of a nation that is concerned about individuals, firms as well as government (Md Isa, 2008).

They are often defined as barometer of any economy because they reflect the change and direction of pressure on the economy(Srivastava, 2009). The movement and volatility in the stock markets often reflect the direction of any economy. Chen, Roll and Ross (1986) suggested that since the inception of stock markets, researchers have made attempts to establish relationship between change in macroeconomic factors and stock market returns. According to Maheshwari andVanjara (1989) there are various models developed so far by scholars, globally for establishing the relationship between stock returns and factorsof arbitrage-pricing model (APM).

Global Evidences

Chen, Roll and Ross (1986) was the first to study select macroeconomic variables to estimate U.S. stock returns and apply the APT models. They employed seven macroeconomic variables, namely: term structure, industrial production, risk premium, inflation, market return, and consumptionand oil prices in the period of Jan 1953-Nov 1984. During the tested period in their research, they found a positive relationship between the macroeconomic variables and the expected stock returns. They noted that industrial production, changes in risk premium, twists in the yield curve, measure of unanticipated inflation of changes in expected inflation during periods when these variables were highly volatile related to expected returns. Consumption, oil prices and market index are not priced by the financial market has been discovered. They concluded that asset prices reacted sensitively to economic news, especially to unanticipated news.

United States

Burmeister and Wall (1986) continued down a similar path of research laid down by Chen, Roll and Ross (1986). Having conducted that previous research suggested that the variability of stock returns could be explained by unanticipated changes in certain macroeconomic variables mainly:

unanticipated change in term structure, unanticipated change in inflation, unanticipated change in the risk premium and unanticipated change in asset return but they suggested more research was needed. In addition, Abdullah and Hayworth (1993) observed that the U.S. stock returns wererelatively positive to inflation and growth in money supply, yet negatively to budget and trade deficits, and also to short and long term interest rates.

United Kingdom

Poon and Taylor (1991) study also showed similar outcomes as Chen, Roll and Ross (1986) on the United Kingdom market. According to the results, macroeconomic variables do not affect share returns in the United Kingdom but affected in the U.S. They suggested that either different macroeconomic factors have an influence on share returns in the United Kingdom or the tactic employed by Chen, Roll and Ross (1986) is inept. On the other hand, Clare and Thomas (1994) investigate the effect of 18 macroeconomic factors on stock returns in the U.K. They found that oil prices, retail price index, bank lending and corporate default risk to be important risk factors for the U.K. stock returns. Priestley (1996) pre-specified that thesefactors may carry a risk premium in the U.K. stock market. Seven macroeconomic and financial factors; namely default risk, industrial production, exchange rate, retail sales, money supply unexpected inflation, change in expected inflation, terms structure of interest rates, commodity prices and market portfolio. For the APT model, with the factor generating from the rate of change approach all factors are significant.

Japan

For Japanese stock market, Hamao (1988) replicated the Chen, Roll and Ross (1986) study in the multi-factor APT framework. He put on view that the stock returns are significantly influenced by the changes in expected inflation and the unexpected changes in both the risk premium and the slope of the term structure of interest rates. Through the APT, Brown and Otsuki (1990) explore the effects of the money supply, a production index, crude oil price, exchange rates, call money rates, and a residual market error on the Japanese stock market. They observe that these factors are associated with significant risk premium in Japanese equities.

Singapore

The relationships between the Singapore stock index and chosen macroeconomic variables over a seven-year period from 1988 to 1995 were experimented by Maysami and Koh (2000). It resulted in existenceof a positive relationship between stock returns and changes in money supply but negative relationships between stock returns with changes in price levels, short- and long-term interest rates and exchange rates.

South East Asia

To examine the interdependence between stock markets and fundamental macroeconomic factors in the five South East Asian countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) was the main purpose of Wongbangpo and Sharma (2002). Monthly data from 1985 to 1996 is used in this study to represent GNP, the consumer price index, the money supply, the interest rate, and the exchange rate for the five countries. Their results showed that high inflation in Indonesia and Philippines influences the long-run negative relation between stock prices and the money supply, as the money growth in Malaysia, Singapore, and Thailand induces the positive effect for their stock markets. The exchange rate variable is positively related to stock prices in Indonesia, Malaysia, and Philippines, yet negatively related in Singapore and Thailand.

Asian Pacific

The dynamics relationship between stock prices and fiscal variables in six Asian-

Pacific selected countries were examined by Mahmood and Dinniah (2009). The monthly statisticsfrom January 1993 to December 2002 on stock price indices, foreign exchange rates, consumer price index and industrial production index that spans are used. More specifically, they focused their study on the long run equilibrium and short run multivariate causality between these variables. The outcome indicated the existing of a long run equilibrium relationship between stock price indices and among variables in only four countries, i.e., Japan, Korea, Hong Kong and Australia. As for short run relationship, all countries except for Hong Kong and Thailand show some contacts. The Hong Kong portrays relationship only on exchange rate and stock price while the Thailand reports major interaction between output and stock prices only.

Malaysia

Tan, Loh and Zainudin (2006) looked at the dynamic between macroeconomic variables and the Malaysian stock indices (Kuala Lumpur Composite Index) during the period of 1996-2005. They found that the inflation rate, industrial production, crude oil price and Treasury Bills' rate have long-run relation with Malaysian stock market. Results indicated that consumer price index, industrial production index, crude oil price and treasury bills are significantly and negatively related to the Kuala Lumpur Composite Index in the long run, except industrial production index coupled with a positive coefficient.

Philippines

Bailey and Chung (1996), examined the impact of macroeconomic risks on the equity market of the Philippines. Findings of the study showed that, financial fluctuations, exchange rate movements and political changes on owners of Philippine equities cannot explain Philippine stock returns.

Pakistan

Mohammad, Hussain and Ali (2009) examine the relationship between macroeconomics variables and Karachi Stock Exchange in Pakistan context. They have used quarterly data of foreign exchange rate, foreign exchange reserve, gross fixed capital formation, money supply, interest rate, industrial production index and whole sales price index. The result shows that exchange rate and exchange reserve and highly affected the stock prices.

Turkey

Tursoy, Gunsel and Rjoub (2008) is another example of the APT test in Turkish stock market. They tested the APT in Istanbul Stock Exchange for the period of February 2001 up to September 2005 on monthly base. They tested 13 macroeconomic variables (money supply, industrial production, crude oil price, consumer price index, import, export, gold price, exchange rate, interest rate, gross domestic product, foreign reserve, unemployment rate and market pressure index) against 11 industry portfolios of Istanbul Stock Exchange to observe the effects of those variables on stocks' returns. Using ordinary least square technique, they observed that there are some differences among the industry sector portfolios.

A research by Kandir (2008) can be considered an example of the APT testing in Istanbul StockExchange. He investigates the role of seven macroeconomic factors in explaining Turkish stock returnsin the period from July 1997 to June 2005. Macroeconomic variables used in his study are growth rateof industrial production index, change in consumer price index, growth rate of narrowly defined moneysupply, change in exchange rate, interest rate, growth rate of international crude oil price and return onthe MSCI World Equity Index and the analysis is based on stock portfolios rather than single stocks.His empirical findings

reveal that exchange rate, interest rate and world market return seem to affect allof the portfolio returns, while inflation rate is significant for only three of the twelve portfolios. On theother hand, industrial production, money supply and oil prices do not appear to have any significantaffect on stock returns. His findings also suggest that macroeconomic factors have a widespread effecton stock returns, since characteristic portfolios do not seem to be influenced in a different manner bythe macroeconomic variables.

Greece

Niarchos and Alexakis (2000) investigated if it is possible to forecast stock market prices with the use of macroeconomic variables in the Athens Stock Exchange. Macroeconomic variables include inflation, money supply and exchange rate. The time period under study was from January 1984 to December 1994 on a monthly basis. The statistical evidence suggests that monthly stock prices in the Athens Stock Exchange are positively correlated to those variables.

CONCLUSION

The APT is based on a simple and intuitive concept. According to Ross (1976), in an economy with a large number of available assets, a linear factor model of asset returns implies that particular risk is diversifiable and that the equilibrium prices of securities will be more or less linear in their factor exposures. According to Gregory Connor, (1993) this idea has spawned a literature which has pushed the scientific frontiers in several directions. It has led to new work in mathematical economics on infinite-dimensional vector spaces as models of many-asset portfolio returns, and the properties of continuous pricing operators on these vector spaces. It has led to econometric insights about what constitutes a factor model, and how to efficiently estimate factor models with large cross-sectional data sets. It has underpinned an enormous body of empirical research on asset pricing relationships, and on related topics such as performance measurement and cost of capital estimation. Lack of arbitrage opportunities implies that assets can be priced by a single random variable, variously referred to in the literature as the pricing kernel, stochastic discount factor, intertemporal marginal rate of substitution, or state price density (Ross, 1978; Dybvig and Ross, 1989;Ferson, 1993).G. Conner (1993) added one might wonder, then, what the advantage would be to using a multiple factor model. Particular asset pricing models differ in their specification of the stochastic discount factor. If there is an advantage to using multifactor models, it must be that the multifactor models provide a closer approximation to the stochastic discount factor than alternative approaches. To date, the empirical literature has tended to emphasize tests of the restrictions of a single model rather than emphasize comparisons across models. When comparisons across models have been made, the APT has tended to do well against the competing models.

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