Study On Asset Prices And Arbitrage Pricing Theory

Asset prices are commonly believed to react sensitively to economic news. Daily experience seems to support the view that individual asset prices are influenced by a wide variety of unpredictable events and that some events have a more pervasive effect on asset prices than do 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. With two or more factors, it is called a multifactor model. The Arbitrage Pricing Theory (APT) was developed primarily by Ross (1976a, 1976b). 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 linearly related to the factor loadings. (The factor loadings, or betas, are proportional to the returns' co-variances with the factors.)

According to Azhar Bin Zakaria (2006), the equilibrium-pricing model using Arbitrage Pricing Theory (APT) has become one of the central models of modern financial theory. However, the APT is too general in determining the factors which influences expected returns. It is often viewed as an alternative to the capital asset pricing model (CAPM), since the APT has more flexible assumption requirements. Whereas the CAPM formula requires the market's expected return, APT uses the risky asset's expected return and the risk premium of a number of macro-economic factors. Arbitrageurs use the APT model to profit by taking advantage of mispriced securities (Azhar Bin Zakaria, 2006). A mispriced security will have a price that differs from the theoretical price predicted by the model. By going short an overpriced security, while concurrently going long the portfolio the APT calculations were based on, the arbitrageur is in a position to make a theoretically risk-free profit.

BACKGROUND RESEARCH

The Arbitrage Pricing Theory (Apt) Model

Ross (1976) stated that the return on a stock must follow a very simple relationship that is described by the following APT formula:

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 APT model also states that the risk premium of a stock depends on two factors:

The risk premiums associated with each of the factors described above

The stock's own sensitivity 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 if the expected risk premium on a stock were lower than the calculated risk premium using the formula above, then investors would sell the stock. If the risk premium were higher than the calculated value, then investors would buy the stock until both sides of the equation were in balance. Arbitrage is term used to describe how investors could go about getting this formula, or equation, back into balance.

Arbitrage Pricing Theory Assumptions

According to Dr. Rodney Boehme (n.d) there are 2 assumptions for the model. Firstly, only the systematic risk is relevant in determining expected returns (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 in nature and thus affect the returns of all stocks to some degree. Secondly, firm specific risk, since it is easily diversified out of any well-diversified portfolio, is not relevant 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 (Azeez&Yonoezawa, 2003; MauriPaavola, 2006).

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. (Groenewold& Fraser, 1997; MauriPaavola, 2006)

Berry et al. (1988) ; MauriPaavola, 2006 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:

At the beginning of every period, the factor must be completely unpredictable to the market.

Each APT factor must have a pervasive influence on stock returns.

Relevant factors must influence expected return; i.e. they must have non-zero prices.

There have been a lot of tests of the APT (Chen et al. (1986); Burmeister& McElroy (1988) for the United States, Beenstock& Chan (1988); Poon & Taylor (1991); and Clare & 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), it's worth pointing out, why these variables could affect equities' returns:

Inflation

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

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.

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.

Industrial production.

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

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& Fraser, 1997)

Paavola (2006) added the most disappointing feature of the APT is that it does not identify the common factors (nor even their number). It is not also supported by the theoretical foundations of the CAPM that describes the investors' behavior (Morel, 2001). Gilles & LeRoy (1990) state that the APT contains no useful information about prices, because they think that the APT does not include any clear restrictions and it can be thought as a too general asset pricing model. They also state that many economists have all along been skeptical about the content of the APT, because they believe that the APT should 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 number of relevant factors in empirical APT models increases with the number of securities being 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 does not identify relevant factors. The major assumption of the APT model is that asset returns are linearly related to a set of unspecified common factors and that there are no arbitrage opportunities. This generality of the theoretical APT has turned out to be a major weakness for the empirical APT. (Koutmos et al., 1993) There is also a great deal of skepticism about the test methods of the APT. Cheng (1996) states that the method of Chen et al. (1986) is very sensitive to the number of independent variables included in the regression. Cheng (1996) also notes that when a researcher is testing the APT, a factor may be significant in one multivariate analysis and then will not be significant when testing in a univariate model. The multicollinearity among economic variables presents another drawback of this approach (Paavola, 2006).

THEORY

Alternative Asset Pricing Models

Capital Asset Pricing Model (CAPM)

The capital asset pricing model (CAPM) of William Sharpe (1964) and John Lintner (1965) marks the birth of asset pricing theory. Four decades later, the CAPM is still widely used in applications, such as estimating the cost of capital for firms and evaluating the performance of managed portfolios (F.Fama, 2004). It is the centerpiece of MBA investment courses. Indeed, it is often the only asset pricing model taught in these courses (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: 1) minimize the variance of portfolio return, given expected

return, and 2) maximize expected return, given variance. Thus, the Markowitz approach is often called a “mean-variance model.”

Intertemporal Capital Asset Pricing Model (ICAPM)

The limitations of CAPM lead to the development of Intertemporal Capital Pricing Model (ICAPM) by Merton (1973), where holding periods are allowed to change through time. ICAPM assumes that investors aim to maximize their expected consumption utility over the period of their lifetime, and that they are able to trade continuously. Merton shows 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 complaints about the CAPM:

Evidence that it takes more than one factor to explain the shared, or systematic, risk in securities discredits the CAPM (Paavola, 2006).

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; Paavola, 2006)

According to Paavola, (2006), 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 (Paavola, 2006). 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 (Groenewold& Fraser, 1997; Paavola, 2006). 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; Paavola, 2006)

There has to be made several rigorous assumptions when deriving the CAPM. When deriving the APT there has to be made only three assumptions:

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 (Paavola, 2006).

There are numerous securities so that idiosyncratic risk can be diversified away (Paavola, 2006)

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 (Paavola, 2006). Connor &Korajczyk (1986); Paavola, (2006) used principal components analysis and found five factors that could explain the size and January effect better than the CAPM. Berry et al. (1988); Paavola, (2006) 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); Paavola, (2006) conclude for Australian industry equity portfolios that "the results show that there is strong evidence in favour of the APT model". In a recent study for Indian stock markets Dhankar&Esq (2005); Paavola, 2006 conclude that "APT with multiple factors provides a better indication of asset risk and estimates of required rate of return than the CAPM which uses beta as the single market of risk." Elton et al. (2003); Paavola, (2006) stated 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 (Paavola, 2006).

LITERATURE REVIEW

Determination of Arbitrage Pricing Factors in Stock Market.

Stock market plays an important role in stimulating economic growth of a country. It helps to channel fund from individuals or firms without investment opportunities to firms who have them and thus improves the country's economic efficiency. It is the lifeblood of the economy of a nation that concerns 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 stock markets often reflect the direction of any economy. Srivastava (2009) suggests that since the inception of stock markets researchers are making attempts to establish relationship between change in macroeconomic factors and stock market returns. According to Srivastava (2009) there are various models developed so far by scholars globally for establishing the relationship between stock returns and these factors of arbitrage-pricing model (APM).

4.1.2 Global Evidences

Chen, Roll and Ross (1986) was the first study to 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, consumption and oil prices in the period of Jan 1953-Nov 1984. In their research, they found a strong relationship between the macroeconomic variables and the expected stock returns during the tested period. They note 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 are highly volatile, are significant explaining expected returns. They found that consumption, oil prices and market index are not priced by the financial market. They conclude asset prices react sensitively to economic news, especially to unanticipated news.

Burmeister and Wall (1986) continued down a similar path of research laid down by Chen, Roll and Ross (1986). Having conducted previous research suggest 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 suggest more research was needed. In addition, Abdullah and Hayworth (1993) observed that the U.S. stock returns are related positively to inflation and growth in money supply, yet negatively to budget and trade deficits, and also to short and long term interest rates.

Poon and Taylor (1991) parallel the Chen, Roll and Ross (1986) study on the United Kingdom market. Their results show that macroeconomic variables do not appear to affect share returns in the United Kingdom as they do in the U.S. They suggest that either different macroeconomic factor have an influence on share returns in the United Kingdom or the methodology employed by Chen, Roll and Ross (1986) is inefficient. On the other hand, Clare and Thomas (1994) investigate the effect of 18 macroeconomic factors on stock returns in the U.K. They find oil prices, retail price index, bank lending and corporate default risk to be important risk factors for the U.K. stock returns. Priestley (1996) prespecified the factors that 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.

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.

Maysami and Koh (2000) tested the relationships between the Singapore stock index and selected macroeconomic variables over a seven-year period from 1988 to 1995 and they found that there existed 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.

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, while 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.

Mahmood and Dinniah (2009) examined the dynamics relationship between stock prices and economic variables in six Asian-Pacific selected countries of Malaysia, Korea, Thailand, Hong Kong, Japan and Australia. The monthly data on stock price indices, foreign exchange rates, consumer price index and industrial production index that spans from January 1993 to December 2002 are used. In particular, they focused their analysis on the long run equilibrium and short run multivariate causality between these variables. The results indicate 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 interactions. The Hong Kong shows relationship only between exchange rate and stock price while the Thailand reports significant interaction only between output and stock prices.

Tan, Loh and Zainudin (2006) look 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 indicate 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.

Bailey and Chung (1996), examine the impact of macroeconomic risks on the equity market of the Philippines. Findings of the study show that, financial fluctuations,

exchange rate movements and political changes on owners of Philippine equities cannot explain Philippine stock returns.

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.

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.

Niarchos and Alexakis (2000) investigated whether it is possible to predict 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 investigation 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.

A research by Kandir (2008) can be considered an example of the APT testing in Istanbul Stock Exchange. He investigates the role of seven macroeconomic factors in explaining Turkish stock returns in the period from July 1997 to June 2005. Macroeconomic variables used in his study are growth rate of industrial production index, change in consumer price index, growth rate of narrowly defined money supply, change in exchange rate, interest rate, growth rate of international crude oil price and return on the 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 all of the portfolio returns, while inflation rate is significant for only three of the twelve portfolios. On the other hand, industrial production, money supply and oil prices do not appear to have any significant affect on stock returns. His findings also suggest that macroeconomic factors have a widespread effect on stock returns, since characteristic portfolios do not seem to be influenced in a different manner by the macroeconomic variables.

CONCLUSION

The APT is based on a simple and intuitive concept. Ross's (1976) basic insight was that a linear factor model of asset returns, in an economy with a large number of available assets, implies that particular risk is diversifiable and that the equilibrium prices of securities will be approximately 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 [see 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.