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THE POWER OF TWO-PASS REGRESSION TEST OF THE CAPM: A SIMULATION ANALYSIS OF THE COLOMBO STOCK EXCHANGE

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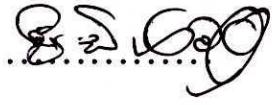
The work described in this thesis was carried out by me under the supervision of Dr. P.D. Nimal and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree/Diploma.

10/03/2010

Signature Date

I certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the university for the purpose of evaluation.



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ABSTRACT

Being the hallmark of modern finance, the Capital Asset Pricing Model (CAPM) has been subjected to extensive testing in both international and local contexts. However, the results of these tests are generally unfavourable. Nevertheless, little attention has been paid on testing reliability of these tests. Thus, the unfavourable evidence of the test against the theory is due to its non-existence or/and the low power of the testing mechanisms. In the real world, it is impossible to isolate the reason or reasons for the unfavourable evidence, as the existence or absence of either reason is unknown. Therefore, artificial (simulated) stock markets are created where the CAPM holds true and apply the widely used CAPM test, the two-pass OLS test to ascertain its power. Further this study elaborates, two power determinants, which have theoretically conflicting roles on the power, but not yet explored in detail; the standard deviation of market risk premium and the number of portfolios formed in the test.

The initial parameter values for the simulations are extracted from the Colombo Stock Exchange (1996-2006) as to exemplify the Sri Lankan context. By the power curve in response to changes in the standard deviation of market risk premium, it is demonstrated that rejecting the CAPM in a lesser volatile market is highly probable, in contrary to common understanding that it is easy to detect the CAPM in such markets. On the other hand, the power curve in response to changes in the number of portfolios formed is almost flat as conflicting forces created in forming portfolio set off each other. Further, the results show there is less than 7% possibility of detecting the CAPM even when it exists in the Sri Lankan context when the two-pass OLS test is applied. Thus, a need is there, for a more powerful test to validate or invalidate the CAPM in Sri Lankan context.

1 INTRODUCTION

1.1 Background

Developing the Capital Asset Pricing Model (CAPM) (Sharpe, 1964; Lintner, 1965; and Black, 1972) is a hallmark of modern finance theory. Thus, it was awarded the Nobel Prize in 1990 in economic sciences. According to the CAPM, return for a risky asset is linearly related to the systematic risk associated with an asset. The CAPM is rooted in Markowitz (1952) portfolio theory, which explains that volatility of return for any risky asset is due to either macro level or micro level forces. Further, the volatility of return created by micro level changes (unsystematic risk) can be eliminated by investing in a large number of assets, called diversification. Thus in a well-diversified portfolio, return is related only to macro level changes (systematic risk). This concept paves the path to the CAPM. Hence, the CAPM considers only the systematic risk of an asset when deciding payment for bearing the risk. The theory has been used for different purposes ranging from explaining risk and return relation, estimating cost of equity capital, to performance measurement of fund managers. However, these applications are valid only if the theory exists in the real world.

1.2 Significance of the Study

Does the CAPM exist? This is the question, which absorbed significant research effort in the field of asset pricing (as per Google Scholar compiled, there are 5532 and 3388 articles cited Sharpe (1964) and Lintner (1965) respectively by June 27, 2009). The empirical evidence on the CAPM can be categorized into supportive evidence and evidence against the CAPM. The supportive evidence basically comes from Black et al (1972); and Fama and MacBeth (1973) where they conclude in favour of the CAPM.

The evidence against the CAPM should be due to either risk-based or non risk-based reasons (MacKinlay, 1995). Advocates of risk-based reason for invalidity of the CAPM claim that other factors/ variables exist, that cannot be captured by the CAPM. Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973) and Arbitrage Pricing Theory (APT) of Ross (1976) are early explanations on this kind of reasons where they discuss the necessity of risk measures other than the beta in the CAPM. In addition to that Banz (1981); Rosenberg, Reid, and Lanstein (1985); and Basu (1983) cited in Fama and French (1992) report that size (market capitalization), book to market ratio (B/M) and earnings to price ratio (E/P) are as significant explanatory variables of average returns of assets, respectively. Together with these findings, Fama and French (1993) come up with an empirical model, which is supposed to better explain cross-sectional return variations of stocks than the CAPM. The Fama and French model consists of market beta, size (market capitalization), and book equity to market equity (B/M). The empirical model of Fama and French is tested in the Sri Lankan context by Samarakoon (1997); Nanayakkara (2008) and they find supportive evidence.

However, the model is not free of criticisms. The main criticism is lack of theoretical explanation as to why the size and B/M explain cross-sectional returns. Further, Kim (1995) proves analytically, estimated predictors' (like beta's) explanatory power underestimates when they are used together with precisely measured variables (like the size and B/M). Also Kothari et al (1995) show that the results of Fama and French model are partly due to the sample they have selected for the study and criticize the models as "a useful pricing model must be trusted to work under a wide variety of conditions and not just for a limited set of portfolios" (Kothari et al, p. 221). Moreover, Grauer and Janmaat (2004) show due to Fama-French grouping procedure the portfolios

do not plot on the security market line even if the CAPM holds. Thus, it is clear that the risk-based evidence against the CAPM is not conclusive yet.

On the other hand, the CAPM may be incorrect due to non risk-based reasons. The non-risk based reasons are behavioural biases like herding behaviour, January effect, and other market inefficiencies. If such a macro level behavioural biases occur, the market portfolio is not mean-variance efficient. As a result, the CAPM becomes invalid. However, as Fama (1998) explains these anomalies may be chance occurrences and fade with time. For example, one such an anomaly, January effect has disappeared in the recent past as Moosa (2007) reports.

All these findings collectively prove that the non-existence of the CAPM, based on either risk-based reasons or non risk-based reasons are not conclusive. Nevertheless, empirical tests of the CAPM fail to detect the theory (Gibbons et al, 1989; Fama and French, 1992; Samarakoon, 1997; Nimal, 1997; Anuradha, 2008). Thus, a question arises, why empirical tests of the CAPM reject the theory. It should be at least due to one of the two reasons. One, the CAPM does not exist due to undiscovered reasons. Second, the tests of the CAPM are not capable enough to detect it even when it exists. Isolating the real reasons is difficult in actual market settings, since both of the above reasons are unknowns. However, reliability (power) of tests can be measured in a simulated environment. In line with this, if power (reliability) of the tests used to detect the CAPM is found to be high, the validity of the CAPM can be rejected confidently in the light of existing unfavourable empirical evidence and look forwards to alternative asset pricing models. Thus, this study measures power of CAPM tests and which is further focused in following paragraphs.

There are several methods devised to test the CAPM. As discussed in section 2.6.1, the two-pass (ordinary least squares) regression approach (the two-pass OLS approach), pioneered by Black et al (1972) (hereafter BJS); and Fama and MacBeth (1973) (hereafter FM) is a widely adopted (Shanken and Zhou, 2007). In addition, this is the widely used approach in the Sri Lankan context to test the CAPM by Samarakoon (1997); Nimal (1997); Anuradha (2008). Therefore, this study explores the reliability (power) of the two-pass OLS approach.

Such power studies of the two-pass OLS approach have been conducted by Afleck-Graves and Bradfield (1993); Elsas et al (2003); Freeman and Gruemant (2006); Shanken and Zhou (2007); Grauer and Janmaat (2009). They have identified, the market risk premium, the standard deviation of market risk premium, the standard deviation of error term (the white noise), the duration of testing period, the number of portfolios formed (NPF), and the standard deviation of beta among stocks as power determinants of the testing approach. However, studies conducted on the power of the two-pass OLS approach have not fully addressed changes of power in response to changes in the power determinants. Since markets are not static, understanding sensitivities of power to such power determinants are very important in judging reliability of the CAPM test in different contexts. In line with this, section 2.8 argues that changes in two power determinants: the standard deviation of market risk premium and the number of portfolios formed (NPF), have conflicting forces on the power of two-pass OLS approach. The power curves in response to changes in these power determinants (variables) may have power peaks and/or troughs somewhere in-between extreme values of each variable due to conflicting forces they exert on the power. Thus, the power curves (changes in power) on those variables may not be continuously