Testing the conditional and unconditional CAPM for Sri Lankan stock market

Sooriyakumar. K[1], Sivanathan. V. P[2], and Kandeepan. V[1]

[1]Department of Agricultural Economics, University of Jaffna
[2]Department of Economics, University of Jaffna

Abstract

This paper examines the conditional and unconditional Capital Asset Pricing Model (CAPM) for Sri Lankan stock market. Using CAPM as an appropriate model to predict the price or returns of assets is still controversial. This paper investigates whether conditional and unconditional CAPM is the useful method for estimating the cost of equity capital and making rational decision to invest on Sri Lankan stock market. The sample of this study includes 13 stocks listed in the S&P SL 20 index in the Colombo Stock Exchange. Weekly data for closing price of these stocks from 1st week of 2010 to 5th week of 2015 is used for this study. The return on ASPI index is used as the proxy for the return on the market portfolio, while the short term Treasury bill rate is used as the proxy for the risk free return. The empirical evidence shows that there is a significant conditional relationship between beta and returns and also it indicates that shares with higher beta have higher returns when the market excess return is positive and lower returns when the market excess return is negative. These results suggest that CAPM is one of the useful methods for estimating the cost of equity capital and beta is a useful measure for investors and portfolio managers in making investment decision.

Key Words : Asset Pricing, Conditional Capital Asset Pricing Model, Cost of equity capital, beta, Risk premium

1. Introduction

Since Sharpe (1964) and Lintner (1965) developed the Capital Asset Pricing Model (CAPM) to examine the relationship between the expected return and the systematic risk, it was considered as one of the major models to price equity or a bond portfolio, thus it is getting attention in the recent empirical studies. The CAPM states that there is a positive linear relationship between the expectedreturn of an asset and its systematic risk. The empirical evidence from the developed equity markets generally shows only a weak relationship between betas and returns (Fama and French 1992). A different methodology has been proposed by Pettengill et al. (1995) to estimate the relationship between betas and returns. Their

argument is that since the CAPM is estimated with realized returns as proxies for expected returns, it is likely that negative realized risk premium will be observed in some periods. The model of Pettengill et al. is conditional on the realized risk premium, whether it is positive or negative. A positive relationship between the beta and return should be observed when the realized risk premium is positive and the relationship between the beta and return should be negativewhen the realized risk premium is negative. The reason is that the high beta stocks will be more sensitive to the negative realized risk premium and have a lower return than low beta stocks. Their empirical results based on estimation conditional on the signs of the market excess returns indicate that betas and returns are positively related in the US capital market. This conditional positive relationship is observed in the UK (Fletcher, 1997) and Germany as well (Elasa, 2000).According to Pettengill et al (1995), in order to have a positive relationship between risk and return from the conditional CAPM, the distribution of the up market period (positive risk premium) and down market period (negative risk premium) should be symmetric.

Share market in Sri Lanka is one of the growing capital markets.Colombo Stock Exchange (CSE) is licensed by theSecurities & Exchange Commission (SEC) to operate as aStock Exchange in Sri Lanka. It is the onlyauthorized market for securities listed for public transactions.The CSE provides an active secondary market to determine the price of the assets listed in CSE andattracts the investors to invest on these assets. Until now, 297 companies from 20 industry sectors have been listed in this stock exchange.CSE announces the value of beta of each company listed in CSE. These betas values are used by the investors in making rational investment decisions. Since rational investors choose to hold diversified portfolios, diversifiable risk is more or less eliminated. Thus, non-diversifiable risk or systematic risk of an investment becomes the relevant measure of a risk. Many factors cause variations in non-diversifiable risk among securities. The sensitivities to variations in market returns differ from one security to another security. It is very important to state that the beta is mostly accepted measure of the fluctuation of the return ona financial asset with the return on marketportfolio. The beta value for market portfolio isequal to 1.Investors compare thisvalue with individual beta values of companies to foresee the magnitude of the returns of a chosen company. It is important for an economy to attract investors to invest in share market. If an investor is in a position to predict theprices or returns into certain extent, it helps him to make rational decisions toinvest on the stock market.CSE announces the value of unconditional beta of each company listed in CSE. If there is a conditional relationship between beta and return, the unconditional beta will not be a better estimation for the systematic risk. Therefore, investors face difficulties in making rational decisions to invest on the stock market.

Several attempts have been made to investigate the nature of the anomalies associated with the standard CAPM.Fama and French (1992) in their study showedthat the inabilityof the static CAPM to explain the cross-section of average returns. Breen et al (1989) found that betas in the CAPM vary over the business cycles. Jaganathan and Wang (1996) have developed a conditional CAPM, assuming beta and the market risk premium to vary over time.A main problem with the conditional CAPMs is the choice of conditioning variables and the lack of theory about how to form the relationship between the betas and the conditioning variables.As Pettengill et al. (1995) suggested, this study has chosen a categorical variable as conditioning variable. That is whether the realized risk premium is positive or negative.

Financial economists and investment managers use beta to estimate stock's sensitivity to the overall market and to identify the mispricing of shares. There is a lack of research on conditional CAPM and time varying beta of stocks listed in the CSE. Therefore, this study attempts to fill the research gap and develop a conditional CAPM for Sri Lankan stock market.

The rest of this paper is organized as follows: section 2 describes the structure of the unconditional and conditional model and methodology adopted in this paper. Section 3 and 4 present the data and results of this study. Section 5 reports the conclusion of this study.

2. Unconditional and Conditional CAPM-Models

A positive linear relationship between the risk and the expected return of a risky asset is predicted by the CAPM model. The CAPM form is,

$$E\{R_i\} = R_f + \beta_i\big(E\{R_m\} - R_f\big) \qquad (1)$$

$E\{R_i\}$is the expected return of the asset i, $E\{R_m\}$is the expected return on the market portfolio, R_f is return on the riskfree asset, and $\beta_i$is the systematic risk of asset i. For the positive risk-return tradeoff, the expected return on the market must be greater than the risk-free return. If there is no positive return from any risky assets, no one would hold the risky asset.

Fama and MacBeth (1973)used two-passregression method to do empirical test the equation 1. In the first step, beta is estimated by,

$$R_{it} - R_{ft} = \hat{\alpha}_i + \hat{\beta}_i\big(R_{mt} - R_{ft}\big) + \varepsilon_{it} \quad (2)$$

$R_{it}$is the realized return of asset i in period t,R_{mt} is the realized the return on the market portfolio in period t; ε_{it} is an iidrandom error term, and$\hat{\beta}_i$ is the estimated beta of asset i.

In the second step, the unconditional relationship between the beta and return is estimated as

$$R_{it} - R_{ft} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t}\beta_i + u_{it} \quad (3)$$

Where β_i is estimated from Eq. (2). First, using OLS method, $\hat{\gamma}_{0t}$ and $\hat{\gamma}_{1t}$ are estimated. Then, they are averaged by the t, respectively. The average value $\bar{\gamma}_0$ or $\bar{\gamma}_1$ is tested whether they are significantly different from zero using the t-test of Fama and MacBeth (1973). The estimated variance of the Fama–MacBeth estimates is calculated as:

$$S^2(\hat{\beta}_{FM}) = \frac{1}{T}\sum_{t=1}^{T}\frac{(\hat{\beta}_t - \hat{\beta}_{FM})^2}{T-1}$$

This variance formula assumes that weekly estimates of the coefficient (β_t) are independent of each other. This is not true when there is a firm effect in the data. Thus, Fama –MacBeth variance estimate will be too small in the presence of a firm effect. In the presence of a firm effect, the true variance of the Fama –MacBeth estimate is calculated as:

$$Var(\hat{\beta}_{FM}) = \frac{1}{T^2}\,Var\left(\sum_{t=1}^{T}\hat{\beta}_t\right)$$

$$= \frac{Var(\hat{\beta}_t)}{T} + \frac{2\sum_{t=1}^{T-1}\sum_{s=t+1}^{T} Cov(\hat{\beta}_t,\ \hat{\beta}_s)}{T^2}$$

$$= \frac{Var(\hat{\beta}_t)}{T} + \frac{T(T-1)}{T^2}\,Cov(\hat{\beta}_t,\ \hat{\beta}_s)$$

According to Eq. (2), $\bar{\gamma}_0$ should be equal to zero and $\bar{\gamma}_1$ should be positive for a positive risk premium. Most of the empirical studieshave found a weak relation between the risk and return in Eq. (3).

Since CAPM models the expected returns, but in empirical studies the realized returns are used as proxies for the expected returns. Pettengill et al. (1995) proposed an alternative methodology to estimate the relationship between betas and returns. Their model is conditional on whether the realized risk premium is positive or negative. There should be a positive relationship between the beta and return when the realized risk premium is positive. There should be negative relationship between the beta and return when the realized risk premium is negative. Since high beta stock is more sensitive to the negative risk premium,it has a lower return than low beta stocks.

Pettengill et al.,(1995) estimated the conditional relationship between the beta and return, using equation (4)

$$R_{it} - R_{ft} = \hat{\gamma}_{1t} + \hat{\gamma}_{2t} D\beta_{i,u} + \hat{\gamma}_{3t}(1 - D)\beta_{i,d} + e_{it} \quad (4)$$

where D is the dummy variable that equals one if the realized premium is positive and zero if it is negative, $\hat{\gamma}_{2t}$ is the positive estimated risk premium in the up market period and $\hat{\gamma}_{3t}$is the negative estimated risk premium in the down market period. The average values, $\bar{\gamma}_1, \bar{\gamma}_2$ or $\bar{\gamma}_3$ are tested for whether they are significantly different from zero using the same t-test of Fama and MacBeth (1973). Thus, the null hypotheses can be tested $\bar{\gamma}_1 = 0, \bar{\gamma}_2 =$, $\bar{\gamma}_3 = 0$ against $\bar{\gamma}_1 \neq 0, \bar{\gamma}_2 > 0$, $\bar{\gamma}_3 < 0$. In Eq. (4), either γ_{2t} or γ_{3t}will be estimated in a given time period depending on the sign of the risk premium.

3. Data

Weekly data for closing price of randomly selected 13 stocks listed in the S&P SL 20 index in the Ceylon Stock Exchange, ASPI indexand 91 days Treasury bill rate from 1st weekof 2010 to 5th week of 2015 were collected for this study. The return on ASPI index is used as the proxy for the return on the market portfolio. The short term Treasury bill rate is used as the proxy for the risk free return. The dataset comes from two data bases, Colombo Stock Exchange and Central Bank of Sri Lanka.

4. Results

Table 4.1showsthe surveyed companies and their ticker on CSE. Table 4.2 presents the descriptive statistics of the assets surveyed, ASPI index and short term Treasury bill (91 days t-bill). Table 4.3 reports the descriptive statistics of the excess returns of the assets surveyed and excess market return. It has been observed that average of the excess returns of the many assets surveyed and excess market return is positive. The average excess return on the market portfolio is expected to be positive since investors are assumed to be risk averse. Table 4.4 presents the estimates of first parameter of the unconditional CAPM.

Table 4.1: Companies and their ticker

company	Ticker
Commercial Bank of Ceylon PLC	comb
Ceylon Tobacco Company PLC	ctc
DFCC Bank PLC	dffc
Dialog Axiata PLC	dial
Distilleries Company of Sri Lanka PLC	dist
Hatton National Bank PLC	hnb
John Keells Holdings PLC	jkh
Lion Brewery Ceylon PLC	lion
Chevron Lubricants Lanka PLC	llub

Lanka Orix Leasing Company PLC	lolc
National development bank PLC	ndb
Sri Lanka Telecom PLC	sltl
Aitken Spence PLC	spen

Table 4.2: Descriptive Statistics of the assets, ASPI and tbill.

Company	Mean	Std.Dev.	Min	Max
comb	160.03	62.53	97.5	284
ctc	696.13	333.69	200	1359.4
dffc	164.44	65.05	100	494.1
dial	9.14	1.90	5.2	14
dist	169.72	30.44	114.25	239
hnb	201.49	77.51	132	416.9
jkh	229.18	39.47	163	329.5
lion	293.06	153.07	76.75	679
llub	219.08	68.97	146.75	454.9
lolc	154.63	257.99	28.7	1422
ndb	192.55	71.10	100	378.7
sltl	45.39	6.20	35	61.8
spen	371.63	633.12	97	3301.8
aspi	6008.72	976.55	3514.63	7711.62
tbill	8.10	1.64	5.47	12.2

Table 4.3: Descriptive Statistics of the excess returns of the assets and excess market return

Company	Mean	Std.Dev	Min	Max
comb	-0.08	4.85	-49.58	21.05
ctc	0.53	4.14	-18.66	23.77
dffc	0.07	5.07	-51.66	24.94
dial	0.10	3.45	-17.15	14.07
dist	0.15	3.00	-7.17	12.77
hnb	-0.04	3.80	-34.32	13.67
jkh	-0.04	3.68	-27.59	9.90
lion	0.69	4.04	-10.18	24.11
llub	0.26	2.97	-10.57	14.07
lolc	0.43	9.00	-90.91	47.24
ndb	0.00	4.56	-51.31	11.84
sltl	-0.04	3.44	-9.54	13.43
spen	-0.35	6.95	-94.02	34.78
aspi	0.14	2.14	-5.60	8.60

Table 4.4.first-step parameter estimates of the unconditional CAPM

Company	beta
Comb	.829**
	(6.38)
Ctc	.591**
	(5.21)
Dffc	1.06**
	(8.16)
Dial	.788 **
	(9.08)
Dist	.799**
	(11.27)
Hnb	.781**
	(7.96)
Jkh	.754**
	(7.92)
Lion	.686**
	(6.34)
Llub	.516**
	(6.49)
Lolc	2.127**
	(9.51)
Ndb	.860**
	(7.15)
Sltl	.524**
	(5.60)
Spen	1.233**
	(6.66)

t value is given in parenthesis. ** - significant at 1%

Table 4.5 shows the second- step parameter stimates of the unconditional CAPM of quations (3). According to the CAPM, $_0$should be equal to zero and $\bar{\gamma}_1$should be ignificantly positive for a positive risk remium.The estimate of $\bar{\gamma}_1$ indicates that here is no relationship between beta and eturn. This result is consistent with Fama nd French (1992) and with other previous tudies. The estimate of $\bar{\gamma}_0$ is not ignificantly different from zero. This is onsistent with the prediction of CAPM.

Table 4.5. Second- step parameter estimates of the unconditional CAPM

$\bar{\gamma}_1$	$\bar{\gamma}_0$
0.118222	0.053427
(1.894557)	(0.468347)

t value is given in parenthesis.

Table 4.6 shows the second-step parameter estimates of the conditional CAPM of equation (4). In the first step, the coefficients of β_i are estimated as in the unconditional CAPM. The results in Table 4.6 indicate that there is a strong relationship between the beta and returns. The coefficient for $\bar{\gamma}_2$ is positive and coefficient for $\bar{\gamma}_3$is negative as expected.

Table 4.6 Second- step parameter estimates of the conditional CAPM

$\bar{\gamma}_2$	$\bar{\gamma}_2$
1.290771**	-1.17072**
(35.32024)	(-27.5037)

t value is given in parenthesis. ** - significant at 1%

These two coefficients are significant at 1% level. This indicates that share with higher beta has higher return when the market excess return is positive. When the market excess return is negative, share with higher beta gives lower return than shares with lower beta.

5. Conclusion

This study indicates that there exists a positive relationship between beta and returns. A conditional rather than an unconditional relationship between betas and returns exists. It indicates that shares with higher beta have higher returns when the market excess return is positive and lower returns when the market excess return is negative. These results suggest that CAPM is one of the useful methods for estimating the cost of equity capital and beta is a useful measure for investors and portfolio managers when making investment decision.

References

Breen, W. J. Glosten, L. R. and Jagannathan, R. (1989). Economic significance ofpredictable variations in stock index returns, *Journal of Finance*, Vol. 44, pp. 1177-1190.

Elsas, R., El-Shaer, M. and E. Theissen, (2000). Beta and Returns Revisited: Evidence from the German Stock Market, Working Paper Series, SSRN.

Fama, E. F. and K. R. French,(1992).The Cross-Section of Expected Stock Returns, Journal of Finance 47, pp.427-465.

.Fama, E. F. and J. D. MacBeth, (1973). Risk, Return and Equilibrium: Empirical Tests, Journal of Political Economy 81, pp.607-636.

Fletcher.J., (1977).An Examination of the Cross-Sectional Relationship of Beta and Return: UK Evidence, Journal of Economics and Business 49, pp.211-221.

Jaganathan, R, and Wang, Z. (1996). The conditional CAPM and the cross section ofexpected returns, *Journal of Finance*, Vol. 51 No. 1, pp. 3-53

Lintner, John, (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, Review of Economics and Statistics, (47), pp. 13-37

Pettengill, G. N., Sundaram, S. and I. Mathur, (1995). The Conditional Relation Between Beta and Returns, Journal of Financial and Quantitative Analysis 30, pp.101-116.

Sharpe, William F., (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk, Journal of Finance, (19), pp. 425-442