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Consumption and Market Beta: Empirical Evidence from India

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Abstract : *This paper compares the consumption Capital Asset Pricing Model to the traditional Capital Asset Pricing Model. Both versions of the CAPM relate the expected return on an asset to its systematic risk. Traditionally, the tests of the CAPM use covariance with an index of stock market to measure the systematic risk whereas; the consumption CAPM uses covariance of aggregate consumption ratio with the stock market index. The consumption CAPM suggests that covariance with aggregate consumption is a better measure of the systematic risk. This paper examines198 companies (listed A) in the Bombay Stock Exchange (BSE) to find that stock market beta outperforms consumption beta*
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Key Word: *CAPM, Consumption CAPM (CCAPM), systematic risk*

1. Introduction

There are two approaches of calculating the volatility of a security in the CAPM. Traditionally, the beta is calculated using regression analysis, where beta can be thought of as the tendency of a security's returns to reciprocate to the changes in the stock market. Secondly, the beta for Consumption CAPM is calculated using covariance between an investor's consumption of goods and services from investments and the returns from the stock market index. Practically, the Consumption CAPM is used less frequently than the CAPM.

N. Gregory Mankiw & Matthew D. Shapiro (1984) compared the two formulations beta measured using market index and consumption. They found that a stock market’s beta contains much more information on its return than its consumption beta. Narayana R. Kocherlakota (1990, 1997) assessed the validity of common tests of the consumption CAPM and tested the consumption CAPM with heavy-tailed pricing errors.

Works by Breeden (1979), Grossman and Shiller (1981, 1982), and others emphasizes the joint nature of the consumption decision and the portfolio allocation decision. This integration is natural, since the economic agents who make consumption decisions are also deciding how to allocate their savings among the various assets in the economy. The implied model, which is often called the "consumption CAPM," provides an intuitive and empirically tractable framework for examining the interaction between asset returns and the macro economy.

Tests of the traditional CAPM produce mixed results. Fama and MacBeth (1973), for example, examine the returns on a cross-section of stocks and conclude that the data confirm the theory. Other researchers, such as Douglas (1969), Miller and Scholes (1972), Levy (1978), and Gibbons (1982), report evidence contradicting the model. One possible objection to these cross-sectional tests is that the true market portfolio is much larger than the one used in practice. Most studies use a stock market index as the market portfolio. In the theoretical model, however, the market portfolio includes all assets: bonds, land and, most important, human capital. It is possible that any empirical failure of the theory is attributable to the exclusion of many relevant assets from the market portfolio.

This paper empirically tests the suitability of the two models in the Indian stock market. For the study, 198 companies having BSE flag listing A have been incorporated in the data set. For regression a cross-sectional data set, which has been formed using these 198 companies across the time period 1998 – 2012, has been considered. This paper addresses two basic questions: if high consumption beta stocks earn a higher return andif the consumption CAPM outperforms the traditional CAPM in explaining the cross-section of stock returns. This study will help in establishing the superiority of one model over another.

2. Methodology

2.1. Traditional CAPM

The traditional CAPM relates the expected return of an asset to its systematic risk.

$$E(r_{it}) = r_{ft} + \left(E(r_{mt}) - E(r_{ft})\right) * \beta_{mit} \quad (1)$$

where E denotes expectation operator, and

$$\beta_{mit} = Cov(r_{it}, r_{mt})/Var(r_{mt}) \quad (2)$$

The term β_{mit} is a measure of the systematic risk of asset i. For a risk free asset with a certain real return, $\beta_{mit} = 0$. For the market portfolio, $\beta_{mit} = 1$. In general, β_{mi} can take any positive or negative value.

As in many previous studies it has been assumed all the variables to be constant through time. Thus equation (i) can be written as $r_i = \alpha_0 + \alpha_1\beta_{mi} + \varepsilon_i$ (3)

where $\alpha_0 = r_f$: Risk Free Rate

$\alpha_1 = E(r_m) - r_f$: Risk Premium

r_i : the realised return on asset i over our sample
ε_i : error = $r_i - E(r_i)$

The model thus relates the return on asset i to its systematic riskβ_{mi}.

Although, β_{mi} for every stock is not directly observable, the data available on the BSE website has been used to solve equation (3).

Consumption CAPM

Breeden in 1979 derived a simple expression on how rates of return on assets depend on aggregate consumption. The result of his paper is:

$$r_i = \alpha_0 + \alpha_2\beta_{ci} + \varepsilon_i \quad (4)$$

where $\beta_{ci} = Cov\left(r_{it}, \frac{c_{t+1}}{c_t}\right) / Cov\left(r_{mt}, \frac{c_{t+1}}{c_t}\right)$ (5)

where $c_t$is consumption in t period

As in the traditional CAPM, the model thus relates the return on asset i to its systematic risk β_{ci}. For a risk free asset with a certain real return, β_{ci} = 0. In general, β_{ci} can take any positive or negative value.

Since, the CCAPM is not frequently used for pricing one's security, the value of β_{ci} is not available easily. For calculating β_{ci}, the Annual Household Consumption of India from 1998-2012 as a proxy for individual's consumption and BSE Sensex returns as r_{mt} has been used.

The two models (equation 3 and 4) have been clubbed to regress the return on asset i on both market beta as well as consumption beta. Therefore, return on asset i can be estimated as:

$$r_i = \alpha_0 + \alpha_1\beta_{mi} + \alpha_2\beta_{ci} + \varepsilon_i \quad (6)$$

The usefulness of the two models in the Indian market context can be interpreted using the above regression.

In all the above regressions (equations 3, 4 and 6) the constant term (α_0) has the same interpretation. For a risk free asset all the risk measures are equal to zero. The coefficients of systematic risks can also be easily interpreted. Each CAPM implies that the coefficient of each of the beta is the spread between the market return and the risk-free return $(E(r_m) - r_f)$.

3. Data sources

For the study, a cross-section of 198 flag A companies listed on the BSE index has been considered from the year 1998-2012 to calculate returns on each stock. The return is from the end of the previous year to the end of the year for which the return is being calculated. The return on a stock is not available readily. The basic definition of return on stock has been used for calculations.

$$r_i(\text{in }\%) = [(p_t - p_{t-1} + y_t * p_{t-1}) / p_{t-1}] * 100 \quad (7)$$

where, $p_t - p_{t-1}$: change in stock prices in year t

y_t: yearly dividend yield on a stock

The data on stock prices and yield for all the companies is readily available on the BSE website from which the returns on stocks for a particular year have been computed. For computing the average return for the 15 year time period simple compounding has been considered:

$$(1 + r_{i1998})(1 + r_{i1999}) \ldots (1 + r_{i2012}) = (1 + r_{iavg})\text{^}15 \quad (8)$$

The data on market beta is easily available on the BSE website. Simple algebraic mean over our time period has been used to calculate average market beta β_{miavg} of a stock i.

For calculating β_{ci}, the data on Annual Household Consumption for the concerned time period is taken from Index Mundi website, and market returns (return on BSE Sensex) over the years is taken from BSE website. The factor $\frac{c_{t+1}}{c_t}$ is computed; its covariance with r_{it} is calculated for the numerator of equation (5), and its covariance with R_{mt} is calculated for the denominator of the same equation.All these calculations have been performed using Microsoft Excel.

4. Results

On obtaining the data and compiling the excel sheet, various regressions of different models are performed using STATA 13.

4.1. The mean, median and standard deviation of all the variables, i.e., returns (r_i), market beta (β_{mi}) and consumption beta (β_{ci}) are computed. Correlations of different variables with each other are also computed. Summary of the data is present in Table 1.1. It can be clearly observed that while stock market beta is positively correlated with the returns, the consumption beta is negatively related. This suggests that stocks that tend to be risky from one model do not tend to be risky from the other model. Also, we observe that risk measures aren't highly correlated (-0.2).

4.2. A primary implication of any CAPM is that a stock with higher systematic will give a higher average return. To analyze this, we regress equation (3) to find OLS estimates. From data in Table 2 we can see that the Breusch-Pagan / Cook-Weisberg test and the White's test gave significant values of the test statistics (Prob > $\chi 2$ = 0.5922 and Prob > $\chi 2$ = 0.8050 respectively) thus failing to reject the null hypothesis. Thus, we can conclude that there is no Heteroskedasticity is present in the model. Since no heteroskedasticity is present, OLS estimates will be unbiased and consistent. The important values of the regression is give in Table 2 from which, a positive relation is observed between returns and market beta (Coefficient of β_{mi} (α_1) = 15.87972). Further, the estimated constant, which is the risk free rate, is insignificantly different from 3-4 percent risk free rate in India. From the t-values, it can be seen that α_0 is not significant and α_1 is quite significant. Also, the F-test (Prob > F = 0.0252) shows that the model is also significant. The results from the traditional CAPM model are consistent with the theory, which shows that it is a good model.

Table 1.1: Descriptive Statistics

	r_i	β_{mi}	β_{ci}
Mean	12.13624	0.965343831	-0.02307
Median	3.380197	0.963636364	-0.01048
Standard Deviation	15.78318	0.273426174	0.360205

Table 1.2: Correlation Matrix

	r_i	β_{mi}	β_{ci}
r_i	1	0.219522	-0.25131
β_{mi}	0.219522	1	-0.201325541
β_{ci}	-0.25131	-0.201325541	1

r_i = Average Return
β_{mi} = Market Beta
β_{ci} = Consumption Beta

Table 2: Summary of Regression $r_i = \alpha_0 + \alpha_1\beta_{mi} + \varepsilon_i$
OLS Estimates

Number of obs = 104 R-squared = 0.0482
F (1, 102) = 5.16 Adj R-squared = 0.0389
Prob > F = 0.0252

return |	Coef.	Std. Err.	t	Signf.
market_beta |	15.87972	6.987801	2.27	yes
constant |	-2.072545	6.435718	-0.32	no

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance chi2 (1) = 0.29
Variables: fitted values of return Prob > chi2 = 0.5922
White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity
chi2(2) = 0.43 Prob > chi2 = 0.8050

4.3. The relation between the returns and consumption beta is analysed using OLS. From Table 3,it can be seen that the Breusch-Pagan / Cook-Weisberg and the White's test results show that there is no significant evidence to reject the null hypothesis. Therefore, it can be concluded that there is no Heteroskedasticity in the model and OLS will give unbiased and consistent estimators. When estimating using OLS, the results are very different from what is expected from theory. The coefficient of constant term in Table 3 is very large (α_0 = 11.15892) as compared to risk-free rate in real world and is insignificant. Furthermore, the coefficient of consumption beta (α_2) comes out to be negative which suggests that the riskier security will lead to lower returns. Also, the F-test (Prob. > F = 0.4119) tells that the model is not okay.Unlike the results for the traditional CAPM, the results here provide no support for the theory.

Table 3: Summary of Regression $r_i = \alpha_0 + \alpha_2\beta_{ci} + \varepsilon_i$
OLS Estimates

Number of obs = 108 R-squared = 0.0064
F (1, 106) = 0.68 Adj R-squared = -0.0030
Prob > F = 0.4119

return |	Coef.	Std. Err.	t	Signf.
consm_beta |	-3.322217	4.032714	-0.82	no
constant |	11.15892	1.425514	7.83	yes

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance chi2 (1) = 0.36
Variables: fitted values of return Prob > chi2 = 0.5461
White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity
chi2(2) = 0.54 Prob > chi2 = 0.7629

4.4. Finally equation (6) is regressed using OLS estimates. The values in Table 4 compare the consumption beta with market beta. TheBreusch-Pagan / Cook-Weisberg the White's test results show that there is no Heteroskadasticity present in the model. The results from Table 4 do not support the consumption beta at all. The coefficient of Consumption beta is not significant (t=-0.47) and is negative. The coefficient of market beta is significant. Also, coefficient of market beta is positive. The market gives higher returns to more risky security, and a good proxy for systematic risk appears to be market beta as compared to consumption beta.

Table 4: Summary of Regression $r_i = \alpha_0 + \alpha_1\beta_{mi} + \alpha_2\beta_{ci} + \varepsilon_i$
OLS Estimates

Number of obs = 83 R-squared = 0.0939
F (2, 80) = 4.15 Adj R-squared = 0.0713
Prob > F = 0.0193

return |	Coef.	Std. Err.	t	Signf.
market_beta |	20.55658	7.286611	2.82	yes
consm_beta |	-2.085106	4.426675	-0.47	no
constant |	-6.530678	6.561786	-1.00	no

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance chi2 (1) = 1.00
Variables: fitted values of return Prob > chi2 = 0.3174
White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity
chi2(2) = 8.81 Prob > chi2 = 0.1167

5. Conclusion

The results from this paper show that traditional CAPM model is a good model for relating returns on stocks to its systematic risk, market beta. A stock market's beta contains much more information on its return than its consumption beta. Thus, the evidence from the study shows that traditional CAPM outperforms Consumption CAPM in the context of Indian stock market.

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