Nat. Volatiles & Essent. Oils, 2021; 8(4): 16429-16448

NVEO
Natural Volatiles & Essential Oils

Validating The Capital Asset Pricing Model (CAPM) In Context Of BSE Stocks Using Sectorial Indexes Vs Sensex As Benchmarks

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Abstract – Capital Asset Pricing Model by Sharpe (1964) and Lintner (1965) is a globally utilized model for calculation of expected rate of risk adjusted returns by scholars. The present work present the various perspectives with respect to the validity of this model in deriving the desired results and tests an alternative approach towards calculation of returns using different proxy measures. The results have shown that sectorial indexes can serve as a better measure of proxy for the market portfolio in normal market conditions. The study covers the comparison of Alpha calculated using the CAPM equations derived from Sensex and Sectorial indexes respectively as benchmark portfolios. The study provides an important contribution guiding scholars about the significance of selecting appropriate proxy measures while using CAPM.

Keywords – Capital Asset Pricing Model (CAPM), beta, alpha, required rate of return, proxy measures, sectorial index, benchmark portfolio

Introduction

The modern times are fraught with an unprecedented amount of uncertainty, every person wants to secure their future by creating wealth. This requires investment in value creating and value maximizing assets so as to get good returns.

In order to attain better returns, it is required to assess the value of the asset in which one wants to invest. The asset may be a bond, a stock, a derivative or even a business. There are multiple connotations of the term value such as, book value, realizable value, relative value etc. But, the most popular connotation of the term value in investment context is intrinsic value which represents the present value of benefits measured in term of cash flows arising in future, emerging from the investment.

The basic model used to calculate the intrinsic or fair value is a function of two elements: first is the actual or expected returns (measured in the terms of cash flows) from the investment and secondly, the required

return (k) on investment, which is used to discount the cash flows. The generic model which can be used to calculate the fair value is as follows

$$\sum_{i=1}^{n} \frac{CFn}{(1+K)^{n}}$$

There is no difference in this basic model of valuation for the different types of assets whether we are estimating the value of a Bond, an individual stock, or even a firm; the basic valuation model is applicable to all of them, the only difference, is the calculation of the various inputs and the assumptions underlying the different models used for estimation

So most of the investment valuation problems require estimation of two main components as input for valuation model:

1) The benefits from an investment measured in terms of estimated cash flows
2) The estimated hurdle rate for discounting the cash flows.

The cash flow estimation process is a relatively simple one as it is required to define the correct interpretation of the meaning of the term itself. While this also becomes simple as most of the texts give the following guidelines for the same:

a) The cash flow in terms of bonds are the coupon payments and the maturity value payments
b) In case of project/business valuation the cash flows are the post-tax net earnings adjusted by adding back the amortizations and depreciations on the same.
c) For equity it can be cash flows in form of dividends or free cash flows, depending on assumptions of the investor.

The process of cash flow estimation in any of the above cases will give a reliable accuracy in the forecasted cash flows depending on the inputs used for the purpose. The basic principles and methodology of cash flow estimation depend upon the asset in question (financial or real).

The second and more crucial estimation to be done is the estimation of the hurdle rate or the required rate of return. This hurdle rate, which serves as the minimum expected rate of return by an investor, based on the expected risk, is another important input to be estimated. The hurdle rate in case of Bonds is based on various factors such as the market interest rate, inflation, duration of the bond etc.

In case of a firm valuation the WACC (weighted average cost of capital) is used as the hurdle rate.

The complication increases while valuing equity stock. CAPM is by far the most popular model across the globe. (citation required). The reason being the ability to relate the required rate of return to the systematic risk of the security.

CAPM is a basic model associating the security price movements with the market price movements, culminating into a relationship between the security returns and market returns.

CAPM has been used in various situations to estimate the expected equity returns from any equity investments.

CAPM or single index model tries to associate the security returns to a single index (market) returns. Thus bringing more certainty in the expected returns estimation, which can be used as the hurdle rate for security valuation.

The validity of such estimate depends upon two factors

1) The risk free rate proxy
2) The proxy chosen for market portfolio (also called as benchmark portfolio)

The representative of risk free rate has been established as the government securities rate (rate of return on zero – beta securities).

What assumes importance is the benchmark rate chosen for calculating the risk premium. Now we have several choices for this proxy

1) A leading index like SENSEX (BSE) or NIFTY (NSE). Such index offers the benefit of being the overall market representative as these index contains the price of securities representing various sectors.
2) A sectorial index for example: Bankex (for banking stocks)

The current study is an endeavor to find the reliability of sectorial indexes over in estimation of expected returns for a sector specific stock.

Literature Review

There have been numerous studies discussing the validity and applicability of CAPM model in different economic and market conditions.

Capital Asset Pricing Model (CAPM)

The CAPM was introduced by Jack Treynor (1961, 1962), William F. Sharpe (1964), John Lintner (1965a, b) and Jan Mossin (1966) independently, building on the earlier work of Harry Markowitz's (1952, 2959) modern portfolio theory which postulated diversification as the risk reduction mechanism. The development of the primary version of the static Capital Asset Pricing Model is attributed to the Mean – Variance portfolio theory of Markowitz (1952, 1959). Since last four decades, the CAPM has been the hallmark of asset pricing models, and scholars utilize it to calculate the required returns on assets and estimation of the cost of capital.

CAPM is one of the major tools utilized across the globe to measure and test the risk- return relationship of market traded investments. The main contribution of William Sharpe (1964) is the postulation of a linear relationship between asset returns and the systematic risk of the asset, statistically measured in terms of covariance of asset returns and market portfolio returns, which is referred to as Beta (slope). In this single factor equation, it is the systematic risk only which functions as a risk measure as well a risk determinant. (Black, 1972; Lintner, 1965). An efficient market portfolio is one of the significant implication

of the CAPM, expanding the mean – variance efficiency hypothesis is the implication of a linear relationship between expected returns on a stock and the stock beta, as well as the explanatory power of market beta while testing returns on various stocks (Alexander et al., 2001).

The CAPM equation which relates the risk and return of a security is:

$$E(r) = Rf + \beta(E(Rm) - Rf)$$

Where: E (r) is the expected return on the asset in question also referred to as the risk adjusted required rate of return or just the required or expected rate of return.

Rf is the rate of return realized on a risk free asset. In this case Sharpe (1964), mentioned a zero beta asset as a risk free asset. The proxy used in this regard is the return on sovereign bills or bonds.

E (Rm) is the expected return on a market portfolio usually measured through a proxy in form of a prominent stock market index,

B is the beta coefficient, representing the non-diversifiable systematic risk of an asset (Sharpe, 1964)

Numerous studies have established CAPM as a tool to estimate the required rate of return in most of the situations, but another argument by Roll (1977) postulates that if the definition of market portfolio is based on inclusion of only equity assets, then this approach can render a stock market index as an appropriate proxy to be used as market portfolio in various performance evaluation studies. But such an approach can also restrict the utility of CAPM as a model focused solely on ordinary stock and can be invoked for pricing of ordinary shares only. Another argument by Roll (1977) discards the notion of using proxies for mimicking market portfolios. Such proxies can be efficient despite inefficiency in the “true” market portfolio thereby leading to wrongful acceptance of CAPM or these proxies can be inefficient and lead to rejection of CAPM even when the “true” market portfolio is efficient.

So the selection of a misappropriate proxy composition can result in incorrect calculation and interpretation by a practitioner. This raises queries with the abilities of CAPM.

Another study in the U.S. Stock Market, Kothari, Shanken and Sloan (1995) have rejected the notion about the ability of CAPM in explaining required rate of return.

In a longitudinal study from 1931 through 1965 by Black, Jensen and Scholes (1972) and Miller and Scholes (1972), it was found that the low beta stocks in the USA had yielded higher returns than those estimated using CAPM, while the high beta stocks yielded lower returns.

Some of the more recent studies attempt to establish the utility of the standard CAPM in the emerging capital markets in estimation of the cost of equity capital in these markets.

Since the individual emerging market has its unique market structure, institutional background, history, level of the market integration, local risk-free return, etc., the answer may differ across countries.

The beta-return relationship study in Istanbul Stock Exchange by Karacabey (2001) shows the presence of a conditional relationship holds. Thus, beta is still a useful risk measure in this emerging market.

Contrary to this result, a study on the Greek market as one of emerging markets by Michailidis et al., (2006) contradicted the main hypothesis of the model of a higher (beta) yielding higher yields. Choudhary and Choudhary (2010) reached the same conclusions researching the Indian capital market.

Another study in Tokyo Stock Exchange by Lau et al., (1974) using the annual data of 103 first section stocks of the exchange, acknowledged the linear relationship between risk & return but their data didn't supported the validity of CAPM.

Another research in the context of emerging markets (Hong Kong, Malaysia and Singapore) by Clare and Priestley (1998) has found out a positive and significant relationship between the beta and average stock returns in these markets.

Theriou et al.,(2010) suggest that the CAPM studies failed to take into account the fact that the postulated relationship between beta and realized returns of a stock is conditional on the relationship between the realized market returns and the risk-free rate.

These findings have prompted researchers testing CAPM to look for alternative measures with respect to the proxies suggested.

An approach by Aulerich (2004) suggests development of portfolio performance measures using multiple benchmarks.

The argument in favour of category-based benchmarks are advocated in theory and practice. Such a comparison is shown by the research of Jain and Wu (2000), which compared the performance of a subject group of mutual funds to other funds of the same stated objective classification, as well as other traditional benchmarks. In this study, category-based benchmarks are developed to adjust for systematic risk, category risk, and sector risk, and the category-based benchmarks can be generalized for any investment.

Statement of the problem and Objectives

There have been numerous researches which try to find the efficiency of the CAPM. Although theoretically the CAPM model is simple and rational, there are some significant limitations to the model which make it not work in practice, as it has been highlighted in many empirical studies. While some studies showed is a positive linear relationship between beta and the expected return, while later research, has shown that the relationship between systemic risk and expected return is not always significant.

This made the security analysts all over the world think about a model which takes into consideration only the systematic risk.

There is no doubt that the CAPM has been one of the parent models which had given rise to many asset pricing theories later, but the major limitations of this model which the author is looking at are u**se of proxies for various inputs such as return on market portfolio and the risk free rate of return**.

If we look at the proxies used for these two variables in Indian Context by various researchers, we came up with following conclusions:

1) For risk free rate of return the researchers are extensively and exclusively using the rate of interest on the 91day T – Bill issued by RBI on behalf of Central Govt. – The use of this proxy is not questionable as in the model itself the definition of risk free rate of return is "The theoretical rate of return of an investment with zero risk. The risk-free rate represents the interest an investor would expect from an absolutely risk-free investment over a specified period of time" (Investopedia.com). So this definition makes the T- Bills rate as a clear cut winner to be used as the proxy for risk free rate of return.
2) For calculating return on market portfolio we need to define the meaning of market portfolio first. According to Sharpe "Market portfolio is the portfolio containing the riskiest securities of the market". In Indian circumstances and also world over it is practice to use the leading stock index as a benchmark for this purpose. For e.g. in India the return on SENSEX is used as the proxy for returns on market portfolio.

This raised a doubt in our mind as using such a blanket figure for all analyses may be reason that is hampering the effectiveness of the model in the Indian context. For example, if SENSEX which is a 30 scrips market capitalization weighted index is used to calculate Beta, it is necessary that the movement in SENSEX should actually reflect the movement in the price of not only all the scrips as general but also it should trace the movements in individual securities. If in case the securities of a particular sector are not included in calculation of SENSEX, will it be a good representative of price movement in the securities of that sector?

So the problem that comes out of this discussion is to compare the performance of Beta calculated keeping SENSEX as a benchmark and the one calculated by keeping the sectorial index as a benchmark.

The major objectives of this empirical study are as follows

1) To assess the effectiveness of Beta calculated using market benchmark index against the sector specific index
2) To calculate Beta for different securities using both SENSEX as well as the specific sectorial index as benchmark.
3) To calculate required rate of return from the CAPM equation using the Betas calculated in (2). For this two separate CAPM equations have to be developed.
4) Comparison of required rate of return and actual rate of return to calculate Alpha for the securities in question from both equations.
5) Calculation of the Alphas calculated from different benchmarks and testing of differences between these Alphas in term of significance to assess the commonality/difference between the two approaches.

Research Methodology

Research Design

The primary research design used in this study is applied descriptive research as this study has used the already well - established model to find out if the CAPM is valid in assessment of required rate of return, by using the sectorial indexes as benchmarks for respective securities of same industries and comparing them with the CAPM equation using Beta calculated using Market Benchmark (in this case SENSEX) as the market portfolio proxy.

Scope and Sources of Data

The data related to only BSE stocks and Indices is taken for analysis. This is done as BSE is one of the oldest and biggest exchange of India. The time period of study covers 3 years (May 2016 to May 2019), considering that this was a fairly normal time (not too much volatility or random movements) in the market. Due to its nature, the study is based on secondary data.

Secondary Data

The data for this study has been collected from following sources

a) Research articles for literature review.
b) For data related to Risk Free Rate (RBI Website – 91 Days - T Bill Rates)
c) Stock Prices and background information (BSE website – archived data)
d) Values of sectorial index (BSE Website – archived data for indexes). These values will also help us to calculate return on market portfolio using sectorial index average returns as market portfolio returns.
e) Values of Benchmark index (SENSEX values – BSE Website). These values will also help us to calculate return on market portfolio using benchmark index average returns as market portfolio returns.

Sampling Technique

The sampling methodology used is convenience sampling wherein the data was collected for both the indexes as well as companies listed in BSE belonging to different sectors on the basis of pre-defined parameter i.e. turnover.

The sectorial index data is listed on the index page of BSE website www.bseindia.com under sectors and industries tab. We have collected data of indices and companies under these indices for the following sectors:

1) Consumer durables (S&P BSE Consumer Durables)
    a. Company chosen – Voltas Ltd. (Stock Symbol- Voltas)
2) Automotive (S&P BSE Auto)
    a. Company chosen – Tata Motors Ltd. (Stock Symbol – TATAMOTORS)

3) FMCG (S&P BSE Fast Moving Consumer Goods)
    a. Company chosen – ITC Ltd. (Stock Symbol – ITC)
4) Information Technology (S&P BSE Information Technology)
    a. Company chosen – Infosys Ltd. (Stock Symbol – INFY)
5) Banking (S&P BSE Bankex)
    a. Company chosen – State Bank of India (Stock Symbol – SBIN)
6) Real Estate (S&P BSE Realty)
    a. Company Chosen – DLF Ltd. (Stock Symbol – DLF)
7) Oil & Gas (S&P BSE Oil & Gas)
    a. Company chosen - Reliance Industries Ltd. (Stock Symbol – RELIANCE)

The selection of sectorial indices is based on their representativeness in term of market capitalization. The company chosen from index was the first company listed according to parameter "top turnover", usually the first company contributing to the index based on information available on BSE website was picked up for the purpose of analysis.

The data collected was for last three years. (From May 2016 to May 2019). The selection of aforementioned period is made as this period was a quite stable period in term of macroeconomic movements as well as the stock and index value movements, as evidenced from the value of Benchmark index of BSE (SENSEX), this is required as this will help us separate the impact of index on stock value as compared to other macroeconomic factors.

Other than the sectorial index and stock values we have also collected data for SENSEX for the same period. We are restricting ourselves to monthly returns/price data as daily data will be quite hard to compile. So we are collecting data for all above mentioned variables for monthly closing values only.

Data Handling and Analysis

The study involved the following analytical stages after data collection

a) Calculation of monthly returns using the following equation

$$\frac{\text{Closing Price of current month} - \text{closing price of previous month}}{\text{closing price of previou month}} \text{ X } 100$$

The aforementioned calculation has to be done for stock data, sectorial index data and SENSEX data. The data related to average returns is compiled in Table 1 and the same returns are then annualized and reported in Table 2

b) Using the returns data calculated in previous step we have calculated regression Betas for different stocks using
    a. SENSEX data as independent variable and
    b. Sectorial index data as independent variable.

    These Beta values are compiled in Table 3.

c) Framing of CAPM equation using risk free rate and market return data. Calculation of the expected CAPM returns after calculating the Beta of the securities selected taking the respective indexes as benchmarks. These equations are summarized in Table 4
d) Comparison between expected returns as per CAPM and actual returns and expressing the same in the form of Alpha of respective securities (Alpha returns = Actual or Average Returns – CAPM Returns).
e) Repeating the same process as mentioned in (d) using SENSEX as benchmark. The Alpha returns calculated in both the scenarios are reported in Table 5
f) Testing the Hypothesis

Statistical tools used

We have used regression as the statistical tool to calculate Beta. The software used was MS Excel with analytics tool pack. The MS Excel function Slope was used to calculate the various Beta values.

After framing the CAPM equation from the data calculated and retrieved as mentioned in forgoing section is used to calculate expected returns and Alpha returns, which are then used for testing the research hypothesis. The statistical tool used in this case is the Student's t – test. The reason for using this test is that we do not know about the population standard deviation. The alpha returns are being taken as average values.

Hypothesis Testing

The project was intended to test the following hypothesis. For which we employed the Student's t – test with 5% level of significance

H0: The Alpha of returns calculated from sectorial index and SENSEX are not significantly different

H1: there is a significant difference between Alpha of returns calculated using sectorial index and SENSEX

The results of hypothesis testing are produced in Table 6

Data Analysis and Interpretation

Table 1 Findings:

We can clearly see from the above table that the Auto stock as well as Auto sector has given negative returns during this period. We can connect this performance of auto sector to its economic performance, wherein there has been a consistent concern being raised about the worsening economic performance of the sector. Other than this, two more stocks, ITC and Infosys have also shown negative average returns. This also shows that on the sectorial level the performance has been satisfactory, but the stocks have shown a negative return. This performance can also be attributed to Demonetization, which happened in November 2016, and has impacted the performance of many sectors and companies in the economy.

Assuming that the aforementioned returns are stable over the year we convert these to annual returns for the purpose of CAPM equation framing.

For this purpose we are using the following formula

$AR = [(1+R)^{12} – 1] X 100$

Where R is the monthly returns. Using this formula the annual return for all components (stocks and indices) are summarized in the table below.

Table 2 Findings:

The annualized returns presented in the above table have the similar interpretations as there were in the earlier table. This reinforces about the returns data. We can see that highest stock returns are coming from the stock of Voltas. The index of this stock (consumer durable) also is the highest earner with 30.69% annualized returns. This indicates the good performance of Consumer durables as an industry in the 3 years selected for the analysis. This also helps to understand the preference of people in the economy with respect to purchases of consumer durables. The increasing trend of buying on instalment (EMI) back by a bank loan has been increasing in these products. This also shows that the impact of demonetization has been, not too much pronounced in this industry. While FMCG stock returns were negative, while the index performed fairly well. A similar trend is visible in the returns of IT industry where the stock returns have been negative but the industry index returns are positive, showing that on an overall basis the industry stock have performed well. Among the service sector the banking stock (SBI) as well as the banking index (Bankex) have performed really well. The main push factor for this phenomenon is, the increasing reliance of people on banking services, specially digitalized banking, and due to Govt.'s initiative to promote cashless economy. This trend is going to continue as the banking services are increasing in scope with a number of new and innovative products. The remaining two assets and indices (Real Estate and Oil and Gas), have performed fairly well. While the impact of demonetization was very pronounced on the real estate industry initially, the Government regulations like Rera and initiatives like PMAY can be attributed for the surge in housing demand. This also indicates the revival of economy after the shock of demonetization. Fuel needs have been quite consistent during this period, while it will be interesting to see the impact of Government push towards Electronic Vehicles (EVs) and its impact on these companies and sector. The impact of this can also be seen on the returns of Tata Motors which have been substantially negative. The sector itself is in a lot of trouble as far as its economic performance is concerned.

The performance of Sensex stocks in these 3 years has been quite consistent. With an average annual returns of 15.035%, Sensex and its constituent stocks on an overall level have been performing moderately. It will be interesting to see the performance of this index in the post- covid era.

Table 3 Findings:

The beta which is essentially a sensitivity measure showing the response in the stock returns to changes in the returns of market portfolio. The study intends to compare between the Beta values of stocks

calculated using sectorial index and Sensex as the market portfolio respectively. The table as prepared above can be interpreted in the following ways.

The highest Beta value is observed in the Stock of DLF in both sectorial and as well as Sensex. This shows the high sensitivity of this stock towards the market movements. The stock performance is responsive towards sectorial as well as overall market movements. Such a stock is typically referred to as an aggressive stock, which performs very well when the market is doing well, but has a greater downside also when the market is receding.

The second highest value of Beta is observed in Reliance stock, but we can see it to be more responsive towards movements in Sensex as compared to sectorial index. The stock is actually one of the largest contributor to Sensex itself.

As far as other stocks are concerned, most of the stocks except the stock of ITC have been quite aggressive with values of more than 1. The only stock with a defensive performance is ITC with Sensex. Further studies can be directed towards finding the performance of other FMCG stocks and checking the general tendency of these stocks towards movement in an overall market index like Sensex.

CAPM Analysis

CAPM Equations

As the study is primarily targeted towards checking the Alpha returns of stocks, we will be calculating the required/expected rate of return (risk adjusted rate of returns) of these stocks using the following CAPM equation

$R_e = R_f + \beta (R_m - R_f)$

A major input in the form of Beta has been already worked out, we also have identified the market portfolio returns in the form of Sectorial index returns and Sensex returns, but for expected returns calculation as per the aforementioned equation, we require the following additional input:

Risk Free Rate of Return (R_f)

Sharpe (1964) has asserted that the risk free asset is essentially the zero beta asset. In other words an asset which doesn't exhibits any sensitivity towards changes in market portfolio returns.

A general belief of practitioners as well as scholars is to use the rate of return on a Government security as a proxy for this measure. For this purpose we have used current year's 91 days T – Bill rate. We acquired this rate from the RBI website (www.rbi.org.in). The rate is 3.38% for the year 2021.

Once again, we converted these returns to annualized return using the following formula

$$\frac{\text{Rate}}{100-\text{Rate}} \text{ X } \frac{365}{91} \text{ X } 100$$

So the annualized returns on the 91 day T Bill is

$\frac{3.38}{96.62}$ X $\frac{365}{91}$ X 100 = 0.03498 X 4.011 X100 = 14.03%

So with the information obtained from the Beta as calculated and reported above as well as return on market portfolio calculated from sectorial data and Sensex data we form the following equations as reported in table 4. Also given is the resulting CAPM returns using both sectorial index as well as Sensex as the market portfolio.

The CAPM returns as calculated above shows the consistency of returns in Stocks especially when Sensex is taken as a benchmark. The expected returns of each stock is about 15% – 16%, irrespective of Beat value. While we cannot give any statistical reasoning for the same, this phenomenon reinforces the reasoning, that why most of the studies on CAPM done in the Indian context use Sensex as the benchmark or proxy of market portfolio. Sensex is optimum in case to be used as well defined market portfolio due to its coverage and nature.

On the other hand the expected returns from Sectorial Indices exhibit high degree of variability and even the stocks with low Beta have got high expected rate of return. The only value which is negative is the expected returns of Tata motors, when using Sectorial index as the market portfolio. The CAPM returns of ITC and Infosys are also positive even when Sectorial index has been used as the Benchmark. Indicating that these stocks can actually give good returns in tandem with market movements, so their bad performance can be attributed largely to their fundamental or their earnings performance. As already stated that their fundamental performance is largely impacted by macroeconomic events such as demonetization during the period of study.

Findings

The result of the final exercise has been quite interesting. Other than Reliance and DLF, none of the stocks can post a positive alpha in either of the two benchmark measures or both of them. A negative alpha is usually understood as an indicator of overvaluation of a stock. It has been a matter of discussion and research that Indian stock markets are largely overvalued and these findings reinforce this notion. The primary reason for this can be the prevailing positivity induced by reform measures and revival of economy. Some sectors have performed exceptionally well and the same is evident in these findings. Stocks like Tata Motors and Infosys have registered the highest negative Alpha. This shows the perception of investors towards these companies even when their economic performance is not up to the mark. Both of these companies were recently in the news for feuds between their promoters and Top management. Can this explain this phenomenon, we are not sure about the same. This is something which can be taken up as a separate research agenda.

Hypothesis Testing

As stated earlier based on our research objective and the availability of data, we are using the student's t – test statistic with 5% level of significance as our hypothesis testing measure. The test subject is the Alpha values calculated from two perspectives i.e. using sectorial indices and Sensex as the benchmark. The objective is to understand if the alpha calculated from the two perspectives is significantly different or the difference is just due to random factors. The test is a two tailed test with rejection on both sides of the

curve. Use of t – statistic is made as we do not possess information regarding the population standard deviation (σ)

Reiterating our hypothesis

H0: The Alpha of returns calculated from sectorial index and SENSEX are not significantly different

H1: There is a significant difference between Alpha of returns calculated using sectorial index and SENSEX

Statistical notation of the hypothesis

H0 : $\mu_d = 0$

H1: $\mu_d \neq 0$

For this purpose we will be calculating the difference between the two values of Alpha. As both of these values are taken for same set of stocks, we are using this method of calculating t – statistic. The following table summarizes the t – test procedure

Findings

The aforementioned test statistic reveals that if Beta and subsequently Alpha are calculated using Sectorial indices or Sensex the results may be very different. So selection of a proper benchmark is very important for a practitioner using CAPM for expected returns calculation.

Another important finding is the upward bias of Sensex. The negative value of t statistics reinforces this fact as we have subtracted the values of Alpha calculated from Sensex from the values of Alpha calculated from Sectorial Indices. So a practitioner must remember the fact that using a market benchmark like Sensex will lead to an upward bias in Beta, expected returns as well as Alpha returns.

Results

The main findings of the study can be summarized as follows:

1) The stock market performance of a company cannot be isolated from the macroeconomic factors. The various risk factors which have a bearing on the economic performance also have an impact on stock market performance.
2) The three years selected for study were affected by the demonetization reform. The economic performance of FMCG, IT and Auto sector were negatively influenced by the aftereffects of this move.
3) The performance of Sensex in terms of returns has been far more consistent as compared to the sectorial indices. This may be a reason why Sensex is one of the primary choice for benchmark in similar studies.
4) The beta calculated shows the most of the stocks are aggressive in nature, i.e. they respond more to the changes in return performance of the market portfolio selected.

5) The aggressive nature of beta also indicates higher downside risk in the event where the markets are not performing well.
6) The expected returns for any stock using Sensex as a benchmark are quite stable, while the expected returns using sectorial indices are a reflection of volatility of stock returns to the market returns.
7) The alpha returns calculated using Sensex as a benchmark display a certain degree of downward bias.
8) The hypothesis testing indicates that the choice of benchmark for CAPM exercise is a really important factor as it has a large bearing on not only the expected returns but also the alpha returns and thus impact the process to understand, whether the given security is undervalued or overvalued.

Recommendations

The study primarily focuses on the usage of different benchmarks for assessing the validity of CAPM as a tool for calculating expected returns. The findings of the study indicates the relevance of benchmark selection for CAPM calculations. A right choice goes a long way in giving a better idea of expected returns as well as the fair valuation of the stock.

The following recommendations can be derived from the study

1) Sectorial indices can be used as a measure of market portfolio, but these indices tend to be too reflective of sectorial performance rather than overall market performance. This may lead to a myopic interpretation of stock performance.
2) Use of Sensex or other market benchmarks like Nifty is better for formulating CAPM equation as the returns calculated using these benchmarks are reflective of the impact of market movements on the stock performance.
3) Beta as a measure of systematic risk is better assessed using Sensex or overall market indices.
4) As Alpha gives a good idea of valuation of a stock, it is to be ensured that the same must be calculated using right inputs and then it must be interpreted properly.
5) For Alpha calculation usage of sectorial indices is better as Sensex induces an upward bias in the Alpha calculations. This assertion is open for testing as Indian stock market is by nature, quite overvalued.

Conclusion

The study has been done with the intention of testing the efficacy of benchmark selection and its impact on the stock returns. There have been numerous studies trying to ascertain the validity of CAPM in the Indian stock market context. This study is based on a novel approach that one must check which benchmark has been used for calculating beta as well as for market portfolio returns.

The study can be summarized with following conclusions

1) Use of sectorial indices can be done for CAPM benchmark, but their application should be more focused on Alpha calculations.
2) It can be summarized that the Beta calculations are reflecting an aggressive nature of most of the securities. This indicates a high degree of irrationality in the market. So scholars should now start focusing more on the behavioural aspects of investment and phase the theories having investor rationality as their basic premise.
3) It can be well understood that Sharpe's assertions about the stock market with respect to utility of beta as a measure of systematic risk needs to be reinvestigated. There has been number of other models like APT, which have been proposing a multi – factor approach to assess the expected returns.
4) The hypothesis testing indicates the significant difference in the alpha returns calculated using both sectorial indices as well as Sensex as a benchmark. So a practitioner may use any of the two as per their convenience, but they must make a note of the possible limitations of both the approaches.

Limitations and Further Research Directions

Given the nature of study we have used only the historical data for the purpose of this study and hence no projections have been made.

The study does not takes into consideration the returns in form of dividends, but takes the differences in prices (Capital yield) as the only source of returns.

We have restricted our study to one stock per sector. A more comprehensive study can be done with a larger number of sectors and stocks. The study can be generalized under some assumptions only.

The time frame of the study is restricted to 3 years only. Under some circumstances this period may be increased. Also as there are major events like Demonetization, pandemic and introduction of other economic reforms, the study does not explicitly take the impact of the same on the study variables.

Annexures

Table 1 Average Monthly Returns on Stocks and Indices

Sector	Average Monthly Returns of Stock	Average Monthly Returns of Sectorial Index	Average Monthly Returns of Sensex
Consumer Durables (Stock – Voltas)	1.878%	2.256%	1.174%
Auto (Stock – Tata Motors)	-2.226%	-0.0063%	1.174%
FMCG (Stock – ITC)	-0.3116%	1.0836%	1.174%

Information Technology (Stock – Infosys)	-0.783%	0.984%	1.174%
Banking (Stock – SBI)	1.86%	1.694%	1.174%
Real Estate (Stock – DLF)	1.83%	1.563%	1.174%
Oil and Gas (Stock – Reliance)	1.81%	1.6%	1.174%

Table 2 Annualized Returns on Stocks and Indices

Sector	Annualized Returns of Stock	Annualized Returns of Sectorial Index	Annualized Returns of Sensex
Consumer Durables (Stock – Voltas)	25.01%	30.69%	15.035%
Auto (Stock – Tata Motors)	-23.68%	-0.0753%	15.035%
FMCG (Stock – ITC)	-3.676%	13.807%	15.035%
Information Technology (Stock – Infosys)	-9.00%	12.468%	15.035%
Banking (Stock – SBI)	24.71%	22.343%	15.035%
Real Estate (Stock – DLF)	24.298%	20.456%	15.035%
Oil and Gas (Stock – Reliance)	24.02%	20.98%	15.035%

Table 3 Calculated Beta of stocks

Stock and Sector	Stock Beta With Sectorial Index returns as Benchmark	Stock Beta with Sensex Returns as Benchmark
Voltas (Consumer Durables)	0.937077	1.256407
Tata Motors (Auto)	1.191721	1.184294
ITC (FMCG)	1.095898	0.765385
Infosys (IT)	1.062482	1.36281

SBI (Banking)	1.337417	1.527189
DLF (Real Estate)	1.379746	2.200798
Reliance (Oil & Gas)	1.043232	1.7657

Table 4 CAPM Equation and expected returns using Sectorial Indices and Sensex as benchmarks and Market portfolios

Stock	CAPM Equation and returns – Sectorial Index as Benchmark	CAPM Equation and returns – SENSEX as Benchmark
Voltas	14.03 + 0.937077 (30.69 – 14.03) = 29.64%	14.03 + 1.256407 (15.035 - 14.03) = 15.29%
Tata Motors	14.03 + 1.19172 (-0.0753 – 14.03) = -2.78%	14.03 + 1.184294 (15.035 - 14.03) = 15.22%
ITC	14.03 + 1.095898 (13.807 – 14.03) = 13.78%	14.03 + 0.765385 (15.035 - 14.03) = 14.80%
Infosys	14.03 + 1.062482 (12.468 – 14.03) = 12.37%	14.03 + 1.36281 (15.035 - 14.03) = 15.40%
SBI	14.03 + 1.337417 (22.343 – 14.03) = 25.15%	14.03 + 1.527189 (15.035 - 14.03) = 15.56%
DLF	14.03 + 1.379746 (20.456 – 14.03) = 22.90%	14.03 + 2.200798 (15.035 - 14.03) = 16.24%
Reliance	14.03 + 1.043232 (20.98 – 14.03) = 21.28%	14.03 + 1.7657 (15.035 - 14.03) = 15.80%

Table 5 Alpha Returns using Sectorial Index and Sensex

Stock	**Alpha returns using Sectorial Index CAPM returns**	**Alpha returns from SENSEX CAPM Returns**
Voltas	25.01% - 29.64% = - 4.63%	25.01% -15.29% = 9.72%
Tata Motors	- 23.68% - (-2.78%) = -20.9%	- 23.68% -15.22% = -38.9%
ITC	-3.676% - 13.78% = -17.456%	-3.676% -14.80% = -18.476%
Infosys	-9.00% - 12.37% = -21.37%	-9.00% -15.40% = -24.4%
SBI	24.71% - 25.15% = -0.44%	24.71% -15.56% = 9.15%

DLF	24.298% - 22.90% = 1.398%	24.298% -16.24% = 8.058%
Reliance	24.02% - 21.28% = 2.74%	24.02% -15.80% = 8.22%

Table 6 Table showing calculation of differences

Stock	Alpha returns using Sectorial Index CAPM returns	Alpha returns from SENSEX CAPM Returns	Differences in Alpha	$(di - \bar{d})^2$
Voltas	- 4.63%	9.72%	-14.35	152.4167
Tata Motors	-20.9%	-38.9%	18	400.1714
ITC	-17.456%	-18.476%	1.02	9.146304
Infosys	-21.37%	-24.4%	3.03	25.34403
SBI	-0.44%	9.15%	-9.59	57.54306
DLF	1.398%	8.058%	-6.66	21.67568
Reliance	2.74%	8.22%	-5.48	12.08059
Total			∑d = -14.03	678.3778

Calculation of sample statistic

$$\bar{d} = \frac{\sum di}{n} = \frac{-14.03}{7} = -2.00$$

$$sd = \sqrt{\frac{\sum(di - \bar{d})2}{n-1}} = \sqrt{\frac{678.378}{6}} = 10.63$$

Test Statistic

$$t = \frac{\bar{d} - \mu d}{sd/\sqrt{n}} = \frac{-2.00-0}{10.63/\sqrt{7}} = \frac{-2.00}{4.018} = -0.4987$$

Degree of freedom for this test = n – 1 = 7 – 1 = 6

The calculated value of t statistic is negative which indicated that this value lies in the lower tail. The negative value does not have any impact on the significance of the test. We will compare the absolute value of calculated statistics for the purpose.

Table value of t for 6 degree of freedom at 5% level of significance = 1.943

So the calculated value is smaller than the table value which indicates that we fail to accept our null hypothesis, thus indicating that our alternate hypothesis is accepted that the Alpha values calculated from Sectorial Indices and Sensex are significantly different.

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