

QUANTIFICATION OF SECURITY MARKET RISK

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ABSTRACT

At the time of investment an investor should think of the degree and nature of risk involved in the investment. Risk in investment can be classified in two, viz. systematic risk and unsystematic risk. Unsystematic risk is sometimes named as irrelevant risk as it can be avoided by careful diversification of the investment selection. The systematic risks, which are uncontrollable, are the significant risks and should be considered vigilantly. A statistical test *beta* is able to quantify the systematic risk. This analysis may give a good picture of risk involved in a particular security provided the relation between the market return and the chosen security remains same in future as well.

When we earn income we use it to purchase goods and services to satisfy our present need. In addition to satisfying our current or present need, we try to save a part of our income for satisfying our needs for future, as and when they arise. This savings for future may be range from a very short period to a very long period. We know that the purchasing power of money reduces in long run. In other words, for purchasing same item after a year we need to pay more amounts due to inflation. This means that when we save money for future, we lose its value. To compensate with this loss we should manage our savings in such a way that it may yield some income as well. The simplest way it to keep our additional income into saving bank accounts or fixed deposit accounts. If we opt for liquidity (savings bank account) we get very low interest and if we choose comparatively higher interest (fixed deposit accounts) we lose liquidity of the amount. But, whatever we choose, the return (interest) is not enough to meet the loss of purchasing power of the money so invested; in other words, the interest so earned is less then prevailing rate of inflation. The good thing in such instruments is that these are able to maintain liquidity and are virtually risk-free. But, on other hand, these are unable to beat the inflation. Thus, these investments are not right choice.

We may define an investment as a commitment of funds made in the expectation of some positive rate of return (Fisher & Jordan, 1994, p.2). As per this definition, investment requires employment of funds with the aim of achieving additional income. In this process investment involves waiting for a reward. The expected return realizes in future, thus, there is a possibility that the return actually realized is different than the return expected to be realized.

There are three possible cases of return, viz.

- i. when $AR = ER$
- ii. when $AR > ER$
- iii. when $AR < ER$

where, AR is actual return and ER is expected return

In the process of investment, we cannot be sure that which condition we are going face. This unsurety of return in investment may be termed as risk. Thus, every investment involves return and risk. We may identify three major objectives of investment, viz.

- (i) Security against inflation
- (ii) Maximisation of return
- (iii) Minimisation of risk

The first objective of beating inflation aims at searching an avenue of investment which, over the time, may yield returns which is more than or equal to the average inflation during the period of investment. Usually people aim at second objective, i.e. maximization of return, which is not simple, and needs through research and analysis of different investment opportunities in the market. It is a well accepted fact that a higher return involves higher risk as well. Thus, while trying to maximize the return, one should try to minimize the risk also. Taking too much risk may end-up in lower return or even loss of the capital itself. In this light an analysis of risk is very important.

A risk-free investment is one about which the investor is certain of the amount and also the timing of the expected returns. In other words, a risk-free investment is one where $AR = ER$ (or, actual return = expected return). A very few investments comes under this category, moreover, the rates of return is also low. Most of the investments in this category fail to fulfill first objective of beating note of inflation.

When sensible investment strategies are compared with one another, risk and return tend to go together. This is securities that higher average returns tend to have greater amount of risk (Sharpe, Alexander & Bailey, 2005). Most of the investors expect higher return on investment, but it involves risk. We may call such return as Risk Premium. If we talk of risk involved in holding securities, viz. company shares, debentures etc, we may classify all risks in broadly two categories. The first categories of risks are those uncontrollable and affect a very large number of securities across different industries. The second categories of risk are those which are internal to the companies. These risks affect securities of only few specific companies of select industries only. These risks are controllable to a large extent. The risks under first category are not company or industry specific and are caused by the system itself. Thus, such risks are known as systemic or systematic risk. On the other hand, second category of risk is company or industry specific and known as unsystemic or unsystematic risk.

Review of Related Studies

Ball and Brown (1969) made an attempt to establish relation between portfolio theory and accounting information and concluded that co-movements in the accounting incomes of select 261 firms during 1946-66 appears to predict moderately well the estimated degrees of association between the returns on firm's securities and the market return. They are better predictors of the estimated systematic risks of firms. Co-movements in accounting incomes explain approximately 20% to 25% of the cross-sectional variability in estimated degrees of association with market and 35% to 40% in systematic risks.

Blume (1971) examined the empirical behaviour including statistical properties of the beta coefficient, the widely accepted measure of risk in the market model. The rationale of beta as a measure of risk has been explained as per the portfolio approach and equilibrium approach. The researcher mathematically shown that the larger the value of beta, the more will be the security's contribution to the portfolio risk.

Bowman (1979) made an attempt to provide a theoretical basis for empirical research into the relationship between systematic risk and financial variables. Systematic risk has been defined as the beta parameter from capital asset pricing model (CAPM). The researcher took the assumptions of the CAPM and an additional assumption that corporations can also borrow and lend at the risk-free rate of interest. Many of the assumptions have been found to be violating the real world conditions. However, he further concluded that the violations have not been observed to be necessarily negating the theory.

Chaudhuri (1989) put forth some empirical evidence on the association between accounting variables and systematic risk in an India context. The researcher examined various accounting variables like growth in assets, growth in sales, dividend payout, asset size, sales size, leverage and liquidity. He concluded that among all above accounting variables, dividend payout was the only one for which rank correlation had been consistently significant over the period of the study (July 1976 to June 1986). Further dividend payout and leverage appeared to some extent to offer promising alternatives for dealing with systematic risk.

Mallik and Ghosh (1996) conducted a study to examine empirically the ability of the accounting information to predict the equity risk of the firm. The study focused if the major financial management decisions by the firm which are reflected through its financial reports, can play vital roles to determine the systematic risk of its common stocks. The study concluded that the leverage and growth in fixed assets, jointly, may be a potential alternative to the market determined risk measure beta by showing significant association. He further concluded that financial leverage and growth have been the most significantly associated variables with the market-determined risk measure.

Duan & Wei (2009) made an attempt to demonstrate the impact of systematic risk on the prices of individual equity options. The option prices are characterized by the level and slope of implied volatility curves, and the systematic risk is measured as the proportion of systematic variance in the total variance. The study concluded that after controlling for the underlying asset's total risk, a higher amount of systematic risk leads to a higher level of implied volatility and a steeper slope of the implied volatility curve. Thus, systematic risk proportion can help differentiate the price structure across individual equity options.

Patton and Verardo (2009) made a study on intra-daily data and recent advances in econometric theory to obtain daily firm-level estimates of beta for all constituents of the S&P 500 index over the period 1995-2006 and tried estimate the behavior of beta around the dates of over 22,000 quarterly earnings announcements. The study concluded that the systematic risk (or "beta") of individual stocks increases by an economically and statistically significant amount on days of firm-specific news announcements, and reverts to its average level two to five days later. Further, the increase in beta is larger for more liquid and more visible stocks, and for announcements with greater information content and higher ex-ante uncertainty. However, the authors find important differences in the behavior of beta across different industries. The analysis revealed that changes in beta around news are mostly driven by an increase in the covariance of announcing firms with other firms in the market.

Systematic Risk:

The price of a security is being affected by many factors like economic instability, social changes, political disturbance, market policy and regulations, which are not controllable by the concerned companies. Such factors cause fluctuations in the security prices of different companies across the industries. A single cause may positively affect one security while negatively affect another security. Some securities may remain untouched. Such system generated and uncontrollable causes are known as systematic risk.

The systematic risk may be broadly classified into three, viz. inflationary risk, volatility risk and interest rate risk.

- i. **Inflationary Risk**: Inflation, as we know, is an economic condition under which the purchasing power of money decreases, or in other words, prices of commodities increases. This risk is all about variation in the returns caused by inflation.

When an investor makes any investment, he postpones his current consumption. But if the rate of inflation increased by the time his investment matures he will face a decline in the purchasing power of the investment. To meet this uncertain risk investors want higher return. If an investor invests Rs. 1000 today by postponing his current consumption for one year and is entitled to a return of 7.5% p.a. for the period. During the period if general price level increases by 8% his expected return of Rs. 1075 (Rs. 1000 principal + Rs. 75 interest) would be worth of Rs. 989 only. Considering this risk investors want higher return.

There are basically two economic causes of inflation, viz. cost-push and demand-pull. When cost of production increases the producer forwards this additional cost of production to the buyer by increasing the selling price of the product, it is known as cost-push inflation. On the other hand when demand of a product increases and producers find it difficult to increase the supply in short run, the selling price increases, this increase in price is known as demand-pull inflation.

- ii. **Interest – Rate Risk** : Another systematic risk is being known as interest-rate risk, which affects the market in general and debt market in particular. Debt market includes fixed interest rate bearing bonds and debentures issued by corporate houses. The rate of interest on such debt instruments are fixed, as mentioned above, which is quite similar to the prevailing interest rate at the time of issue of the instruments. Over the time, the market rate of interest moves up or down, but rate of instrument remains fixed. Thus, this mismatch creates misbalance and affects the demand of the instrument in the market which, in turn, causes change in the market price of the instrument. Let us take an example to understand the effect. A corporate bond with a face value of Rs. 1000 issued with an interest rate of 8%, when the market rate is also approximately same. After the issue, the market interest rate increases to 10%, no one will purchase the corporate bond with only 8% interest, unless the holder of the bond reduces the price of the bond to Rs. 800 only. In this case the new purchaser of the bond will get Rs. 80 as interest (8% interest of the bond with face value of Rs. 1000, purchased for Rs. 800 only), where as if he invests same amount, i.e. Rs. 800 in other instruments at the market rate, he will get same amount of interest, Rs. 80 (10% interest on the instrument with investment of Rs. 800). This variation in bond prices caused due to the variations in interest rates is known as interest-rate risk.

The fluctuations in interest-rate not only affects the corporate bonds and debentures, but it also have impact on prices of shares. Many companies uses borrowed funds to invest in expansion of the business. If market rate of interest increases, companies are supposed to give higher amount as interest, which in turn reduces net profit and thus the dividend. These all have negative impact on market price of the share as well.

- iii. **Market Fluctuation Risk**: The market price of every stock keeps on fluctuating due to several controllable and uncontrollable reasons. A general upward movement (rise in price) in share prices is termed as a bullish trend, on the other hand, a general downward

movement (decline in price) in share prices is termed as a bearish phase. This bullish and bearish phases keeps in operation at some time or other. The bullish phase in the market suggests that there is expansion in the economy while a bearish phase highlights a recessionary phase of the economy. This is quite true for the market in long run, but this fluctuation is unable to explain the market in short run.

The short run fluctuation in the market is being occurred due to many reasons like political disturbances, social changes, international issues, monetary policy, investors expectations and so on, most of them are uncontrollable. The stock markets live in volatile condition, this volatility causes fluctuation in the returns to the investors and thus investors expect a higher risk premium to cope-up with the market fluctuation risk.

Unsystematic Risk

As against systematic risk, unsystematic risks are by and large controllable as this is not economy-wide and they affect only select securities. Unsystematic risk is that portion of total risk that is unique or peculiar to a firm or an industry, above and beyond that affecting securities markets in general. Factors such as management capability, consumer preferences, and labour strikes can cause unsystematic variability of returns for a company's stock. Because these factors affect one industry or one firm, they must be examined separately for each company (Fischer & Jordan 2003, p.74). This type of risk can be ignored by maintaining a portfolio of investment which may diversity the risk of violent fluctuations in a particular security by investing in other securities with reverse nature.

Such risks which are not the outcome of system or in other words, which are not system generated comes under this, two prominent examples are as under:

- i) **Business Risk**: The nature of a firm's business causes the uncertainty of the flow of income. If the income flow for the firm is uncertain, the income flow for the investors will also be uncertain. Under such circumstances of uncertainty, the investor will demand a risk premium. For example, companies producing products having seasonal demand will have less certain return as compared to companies producing products having similar demand throughout the year.
- ii) **Financial Risk**: The way companies finance their business also poses some risk. For example, if firms plough-back its own profit, there is no further cost on such investment and thus the return on this incurs only business risk. But, if a company invests borrowed funds, it requires to pay a fixed financing charges as interest prior to providing income to the equity shareholders. In addition to this the other forms of financing the investment have different costs involved. Thus, if there is any increase in uncertainty of return because of such cost of financing is known as financial risk or financial leverages and causes an increase in the risk premium of the stock.

Total Risk:

Risk is inherent in any investment. This risk may relate to loss of capital, delay in repayment of capital, non-payment of interest, or variability of returns. While some investments like government securities and bank deposits are almost riskless, other are more risky (Kevin 2009)The total variation in the expected return of a security may be caused by either of the two risks, viz. systematic and unsystematic risk, i.e.

$$TR = SR + UR$$

where TR – Total risk; SR – Systematic risk; UR – Unsystematic risk

Identifying the Expected Returns:

The term risk is directly related with return. It is difficult to quantify risk unless we measure the return of the investment. An aware investor is expected to calculate expected return of an investment and judge this return in contrast with the risk involved in investment. It is always advisable to compare risk and returns involved in different investment avenues before selecting a particular investment instrument.

An investor decides to invest in shares of a company for mainly two types of return. First type of return is of revenue nature, i.e. a recurring income in form dividend declared by the company, while the other type of return is of capital nature, i.e. appreciation of the market price of the share over the time. The first return he may enjoy several times by holding the share over years and the second type of return he may avail only once by selling the shares to another investor.

The expected return of a share may be calculated with the help of following formula:-

$$\text{Expected Return} = \frac{\text{Forecasted Dividend} + \text{Forecasted end of the period stock price}}{\text{Initial Investment}} - 1$$

Let us take an example to understand this calculation. If a share, with face value of Rs. 10 is being currently selling at Rs. 300. It is expected that the company will pay a dividend of Rs. 25 in the next year. Another expectation suggests that after one year the share may be sold for Rs. 425. The expected return from this investment can be calculated with the above equation:-

$$\text{Expected Return} = \frac{\text{Rs. 25} + \text{Rs. 425}}{\text{Rs. 300}} - 1 = 0.5 \quad \text{or} \quad 50\%$$

In above example an investor may expect to get 50% return on his investment. But, future is uncertain, there is a great possibility that the dividend declared may be more or less than the expected dividend, moreover, the market price of the scrip may not be approximately same as expected, it may be less or more than expectation.

Under such circumstances, an investor has to assume some other expected returns as well which may be more or less than the original expected return. Let us assume 30, 40, 50, 60 and 70 per cent return for our example. The next step is to assign the probability of getting these returns, let us assume 5, 25, 50, 15 and 5 respectively. Considering the given situation the probability of getting the expected return may be calculated with the help of following formula :

$$X = \sum X_i p (X_i)$$

Where, X = expected return; X_i = possible returns; $p(X_i)$ = probability

If we take sum of the products of all individual possible returns along with their respective probabilities, we will come to know the expected return. If we apply these steps to our example we will get an example of 49% [(30 X 0.05) + (40 X 0.025) + (50 X 0.05) + (60 X 0.15) + (70 X 0.05)].

It is not wise to take any investment decision based on only expected return, unless we expose this return to the risk involved in the investment. There are multiple ways of estimation of risk, but the most popular is the standard deviation. The standard deviation may be calculated with the following formula :-

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

Where, $\text{Variance} = \sum [(X_i - X)^2 \cdot p (X_i)]$

We calculate risk involved in the above example:

Possible Return (X _i)	Probability p (X _i)	X _i - X	(X _i - X) ²	(X _i - X) ² . p (X _i)
30	0.05	- 19	361	18.05
40	0.25	- 9	81	20.25
50	0.50	1	1	0.50
60	0.15	11	121	18.15
70	0.05	21	441	22.05
				∑ Variance = 79

Variance = 79%

$$\text{Standard Deviation} = \sqrt{\text{Variance}} = \sqrt{79\%} = 8.88\%$$

The standard deviation of 8.88% suggests that there may be a deviation of 8.88% between possible return and expected return.

The standard deviation gives an estimation of the deviation between probable return and expected return. The above steps quantify the risk involved in an investment. However, this is total risk involved in the investment, which includes two types of risks, viz. systematic risk and unsystematic risk, as already discussed above.

By this time we know that unsystematic risk is company or industry specific and does not affect whole market. In other words, unsystematic risk affects a particular company or a particular industry and not all companies or all industries as a whole. An issue which affects a company negatively may have some positive impact on some other company. Let us take an example in this regards, price hike of petroleum product may have negative impact on rail/road transportation and air lines companies but it is having positive impact on petroleum companies. Thus, the risk involved in investing in shares of Indian Airlines can be reduced by simultaneously investing in shares of Indian Oil Corporation. This approach is known as diversification of risk. Thus, instead of investing in shares of a single company, it is better to invest in a group of companies, which is called portfolio investment. One important point should be kept in mind while maintaining a portfolio to diversify the risk, that the investor should carefully choose such securities which are having different characteristics, as risk involved in holding shares of Indian Oil Corp. may not be diversified by holding shares of Hindustan Petroleum.

The above discussion highlights that the investors can minimize or almost neglect unsystematic risk involved in investment decisions by tactful diversification. A very popular statement in this regard suggests that “Do not keep all eggs in one basket”. Thus, we can say

that unsystematic risks are not very important risks or in other words it is irrelevant risks as it can be minimized. The investor should be careful of systematic risks as it cannot be diversified or, in short, cannot be minimized.

Measurement of Systematic Risk:

As discussed above, if there is any variability in the returns of a security due to changes in the uncontrollable causes, like change in expectation or market or economy or political set-up etc., this is termed systematic risk. Most of the securities, if not all, in the market got affected because of such causes. Out of the securities which got affected by such changes, few shows little while others show greater volatility than the average market volatility. Securities showing lesser variability are considered having lesser systematic risk on the other hand, securities showing greater variability in respect to market are considered having higher systematic risk. Thus, the systematic risk can be measured in comparison with some benchmark of the market, e.g. SENSEX or Nifty etc.

We can calculate the systematic risk involved in investment in a particular security by using an statistical tool popularly known as *Beta*. The beta test compares the returns of a security over a period of time with market returns for the same period of time. While using beta test to measure the risk, an investor has to consider that the relation between the particular security and the concerned market indicator (e.g. SENSEX) will continue to be same.

There are different methods to calculate beta, but most popular is the regression technique. The regression technique estimates a relation between a dependent variable and an independent variable. Along with calculation of two constants, viz. α and β . α estimates the value of the dependent variable even if the independent variable has zero value while β estimates the change in the dependent variable in response to unit change in the independent variable. The regression equation is as below:

$$Y = \alpha + \beta X$$

where, Y = Dependent variable; X = Independent variable; α and β are constants

In order to derive the above regression equation we need to estimate the values of α and β , which can be done with help following equations:

$$\beta = \frac{n \sum XY - (\sum X)(\sum Y)}{n \sum X^2 - (\sum X)^2}$$

$$\alpha = \bar{Y} - \beta \bar{X}$$

Where, n= number of items; Y = Dependent variable; X = Independent variable

\bar{Y} = Mean value of dependent variable; \bar{X} = Mean value of independent variable

In this connection, the return of the individual security is taken as the dependent variable, and the return of the market index (e.g. SENSEX) is considered as the independent variable.

An investment can have positive, negative or zero beta. The systematic risk, β , of the market is defined as 1.0. Assets with less systematic risk (or, less volatility) than that of the market would have betas of less than 1.0; more risky assets would have betas of greater than 1.0

(Gupta 2003). In other words, a security having beta value 1.0 is considered as having an average systematic risk. A security having beta positive but less than 1.0 is considered having risk below average. In other words, a security having beta less than 1.0 will observe less volatility as compared to the bench-mark index (e.g. SENSEX, Nifty etc). For example, if market moves down by 10% , a security with beta of 0.5 would experience its return moving down by only 5% (i.e. 10 X 0.5), and vice-versa.

A security having beta value higher than 1.0 is considered having above average risk. In other words, the variability of return of a security will be higher than average if its beta value is more than 1.0.

A negative beta suggests that the return of the concerned security will move in reverse direction than the movement in the bench-mark index. In other words, if there is decline in the return of the index, the security having negative beta will give positive return and vice-versa.

The intercept of the characteristic regression line is alpha (α) i.e. the distance between the intersection and the horizontal axis. It indicates that the stock return is dependent of the market. A positive value of alpha is a healthy sign. Positive alpha values would yield profitable return. According to the portfolio theory, in a well diversified portfolio the average value of alpha of all turns to be zero (Pandian 2007).

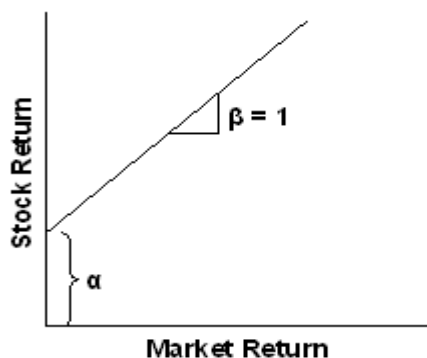


Fig 1.: Systematic Risk same as market

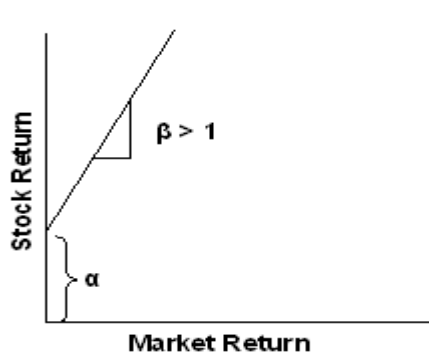


Fig 2.: High Systematic Risk

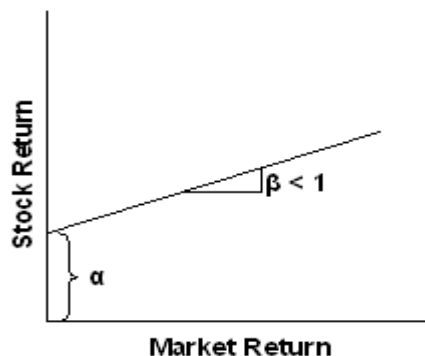


Fig 3.: Low Systematic Risk

Summing-up

When investor makes investment, he thinks of two things, viz. return and risk. An investment is a trade-off between risk and return. Higher the risk, higher the return and lower the risk, lower the return. An investor has to take moderate risk to maximize the return. It is wise to take a certain level of risk to increase the return, but one should not take excessive risk.

In the process to planning for the return an investor should think of the degree and nature of risk involved in the investment. Total risk in investment can be classified in two, viz. systematic risk and unsystematic risk. Unsystematic risk is sometimes named as irrelevant risk as it can be avoided by tactful diversification of the investment portfolio.

The systematic risks, which are uncontrollable, are the relevant risks and should be considered carefully. A statistical test *beta* is able to quantify the systematic risk, which uses the regression equation and establishes relation between the market return and a particular security.

This analysis may give a good picture of risk involved in a particular security provided the relation between the market return and the chosen security remains same in future as well.

Reference:

- Ball, R & Brown, P 1969, Portfolio Theory and Accounting, Journal of Accounting Research, pp 300-23.
- Blume, ME 1971, On the Assessment of Risk, Journal of finance, March, pp. 1-10.
- Bowman, RG 1979, The Theoretical Relationship Between Systematic Risk and Financial (Accounting) Variables, Journal of Finance, vol. XXXIV, no. 3, pp. 617-29.
- Chaudhuri, SK 1989, Empirical Determinants of Systematic Equity Risk (Beta), Indian Journal of Accounting, vol. XIX, pp. 67-75.
- Duan, JC & Wei, J 2009, Systematic Risk and the Price Structure of Individual Equity Options, The Review of Financial Studies vol. 22 issue 5, pp. 1981-2006.
- Fischer, DE & Jordan, RJ 2003, Security Analysis and Portfolio Management, 6th Edn., PHI, New Delhi.
- Gupta, A 2003, Security Market Risk, Mittal Publication, New Delhi, p. 85.
- Kevin, S 2009, Security Analysis and Portfolio Management, PHI, New Delhi, p. 11.
- Mallik, AK & Ghose, SK 1996, Financial Management Decisions and Risk: A Case with Indian Share Price Data, Finance India, vol. X, no. 3, pp. 617-32.
- Pandian, P 2007, Security Analysis and Portfolio Management, Vikas Publishing House Pvt. Ltd., New Delhi, p.152.
- Patton, AJ & Verardo, M 2009, Does beta move with news?: Systematic risk and firm-specific information flows. Discussion paper, 630; Financial Markets Group, London School of Economics and Political Science, London, UK.
- Sharpe, WF, Alexander, GJ and Bailey, JV 2005, Investments, 6th Edn. PHI, New Delhi, p. 8.