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Portfolio Theory (Part - 1) Subject:

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Lecture – 1 Portfolio Theory (Part - 1)

Academic Script

PORTFOLIO THEORY

(Part 1)

Topics: Portfolio management process, concept of risk and return, quantification of risk and return, covariance and correlation, diversification and its benefits, concept of beta

INTRODUCTION

Portfolio refers to the range of investments held by an individual. This may include a mix of financial assets such as stocks, bond and cash equivalents. It may be managed by an individual himself or by financial professionals. The base of building a portfolio solely depends on the risk appetite of an investor. It may also consider the time horizon of investments with reference to individual's goals such as retirement planning, planning for family, their education, asset building and so on. The rise in education, income and awareness about new products and market trends has definitely augmented the risk bearing capacity of individuals in lieu of faster and better returns. Thus, investment management refers to primarily assessing the risk tolerance and time horizon of investors and subsequently spreading the disposable incomes over varied assets in order to optimize the risk and return.

Meaning

Portfolio management deals with the process of selection of securities from the number of opportunities available with different expected returns and carrying different levels of risk. The selection of securities is made with a view to provide the investors the maximum yield for a given level of risk or for a given level of return. Thus portfolio management is practiced as an investment management counselling which is advised to seek assets that would grow in value in tandem with the risk element involved in it.

Portfolio management process

1. Specification of investment objectives and constraints:

The first task is to weigh the relative importance of various goals of an individual like capital appreciation, regular incomes, and safety of principal. Next is to assess the factors affecting his investment decisions like time constraints, tax constraints, liquidity etc. this will give a fair view of his risk bearing capacity.

2. Choice of asset mix

Assets broadly are mix of risk and return. It basically is concerned with proportions of stocks like equity shares or equity oriented mutual funds and bonds like fixed investment options.

3. Formulation of portfolio strategy

There are broadly two portfolio strategies:

Active strategy refers to an aggressive approach striving to earn superior risk adjusted returns by gauging the market timing, sector rotation or security selection.

Passive strategy refers to selection of an asset mix with pre-determined level of risk exposure.

4. Selection of securities

Generally stock selection is based on analysis if fundamentals of the organizations.

Bond selections are based on maturity, credit rating, liquidity and tax aspects.

5. Portfolio execution

This is the stage where actual buying and selling of securities is done.

6. Portfolio revision

The market being dynamic does not move on a pre-determined trend. Hence there may be fluctuations in prices of stocks and bonds. Hence portfolio revision may be done in order to reap the benefits of certain changes or reduce the risk affecting a said portfolio.

7. Performance evaluation

Periodic assessment of portfolio is to be done to calculate returns received with reference to the risk taken. It is a continuous activity which will not only increase the financial wisdom of an investor but also upgrade the quality of his portfolio.

Factors affecting selection of securities:

Since the task of choosing between various securities seems to be a daunting task, it is important to understand the factors affecting the same. The major factors which should be deliberated upon in selection of securities are:

1. Return

In case of stocks, the companies with stable fundamental and growth orientation should be chosen. Such stocks shall yield regular dividend incomes to investors. The bonds or fixed income vehicles should be able to produce fair returns as the risk is also narrow.

2. Capital appreciation

Aggressive investors look for short and long term gains arising out of market volatility. Conservative investors will opt for long term wealth building.

Speculative investors generally aim for short term gains where high level of risk is involved.

3. Form of return

The form of return may be expected in two ways;

Periodic receipts such as cash dividends in case of stocks and interest incomes in case of bonds, bank deposits etc.

Capital gains refers to the difference between purchase price and selling price of an asset.

4. Safety and security of funds

The funds should be safe and secure at the time of redemption.

5. Risk

Risk avoidance and risk minimization are the primary factors affecting portfolio management. By proper planning and careful vigilance over market movements, the risk factor can be controlled.

6. Liquidity

Certain portion of investments should be put in fairly liquid assets so as to face emergencies.

7. Tax considerations

Any individual's first choice of securities rests on the tax implications. The securities that minimize his tax burden would find a place in his basket of securities.

Concept of risk and return

Since portfolio management is a risk driven concept, it is important to understand the concept of risk so far investment management is concerned. Sometimes a decision can lead to more than one possible outcome, such situations are beset with uncertainty when it is not known exactly what will happen in future. Hence the actual return may be different from that of expected. This is called risk. The difference between risk and uncertainty is that uncertainty cannot be quantified but risk can be quantified on the basis of likelihood of outcomes.

Risk can be categorized into two types;

i. Systematic risk:

It refers to the variation in return caused by the factors that affect the price of all securities. They can be social, political and economic changes. Generally it has a similar impact on prices of securities and is unavoidable. Such risk can be due to following reasons;

Market risk which refers overall changes like recession, demonetization, tense political situations etc.

Interest rate risk refers to changes in general level of interest rates in the market.

Inflation risk refers to general upward movement in commodity prices reducing the purchasing power of investors.

ii. Unsystematic risk

It refers to the factors that are a unique to a firm or an industry. For e.g. if prices of rubber will increase, the tyre industry will get affected. Recently the problems in TATA group of companies may bring certain changes in the prices of TATA stocks. This risk can be hedged by portfolio diversification.

Technically, individual risk is studied as the variance or the standard deviation of its return and same is for the portfolio as well

Risk and required return

The expected rate of return of an investment reflects the return an investor anticipates receiving from an investment. The greater the risk, the greater would be the compensation expected. Investments that carry low risks generally offer lower returns in comparison to the ones which involve high risk.



Risk is measured along the horizontal axis and increases form left to right.

Expected rate of return is measured on the vertical axis and rises from bottom top.

The diagonal line illustrates the concept of expected rate of return increasing as level of risk increases.

Most of the portfolio theories assume linear relationship but in developing countries like ours such relation may not hold true.



The above figure indicates the return per unit of risk required by all investors. Highly risk averse investors would have a steeper line, and vice versa.



The above figure represents yields of different financial instruments. Certainly higher yields involve higher risk element. The investors may have a mixed bag of investments in their portfolio depending on their risk tolerance and financial acumen.

Quantification of risk and return

The mean of the probable returns gives the expected rate of return and standard deviation or variance which is the square of standard deviation measures risk.

Higher the range of likely return, higher the standard deviation and so higher is the risk meant for aggressive investors

Lower the range of likely returns, lower is the standard deviation and so lower is the risk meant for conservative investors.

So now, the key of portfolio management lies in obtaining a tradeoff wherein standard deviation is minimized without sacrificing much of return. Here the only answer is *diversification*.

For e.g. the shares of X Ltd. gives a return of 30% and share of Y Ltd. gives a return of 35%.

The standard deviation of X and Y Ltd is 0.15 and 0.2 respectively. So if we invest in X Ltd. there is a risk of 15% and return of 30% and for Y Ltd. the risk is 20% and return is 35%.

Now, thinking as a risk taking investor, if we diversify i.e. if we invest 40% of amount in X Ltd. and 60% amount in Y;

The expected return of the portfolio will be (0.4*30) + (0.6*35) = 33%

Standard deviation of the portfolio will be;

$$\sigma P = \sqrt{(0.4)2 * (0.15)2 * (0.6)2 * (0.2)2}$$

= 0.134 = **13.4%**

Thus the risk reduces to 13.4%

Spreading of investments across various assets may reduce risk and produce optimal returns but it cannot bring down the risk to zero. So the principle again is not to hold all eggs in one basket. This, itself is vital to portfolio management. It is basically a risk management strategy wherein various assets are combined to reduce overall risk whilst getting expected returns To understand the creation of an efficient portfolio i.e. one that allows the firm to achieve maximum return for a given level of risk or to minimize risk for given level of return, the concept of covariance and correlation has to be learnt.

To develop the equation for calculating portfolio risk we need information on weighted individual security risks and weighted co-movements between the returns of securities in the portfolio.

Co-movements are measured by covariance which is an absolute measure and coefficient of correlation which is a relative measure.

Covariance reflects the degree to which the returns of the two securities vary or change together. A positive covariance means that returns of the two securities move in the same direction and negative covariance means that they move in opposite direction. Covariance in this example is calculated in four steps:

Step 1: For each scenario and investment, subtract the investment's expected value from its possible outcome;

Step 2: For each scenario, multiply the deviations for the two investments;

Step 3: Weight this product by the scenario's probability; and

Step 4: Sum these weighted products to arrive at the covariance.

Scenario	Probability	Deviation	Deviation	Product	Weight *
		of	of	of the	probability
		investment	investment	deviations	
		1 from its	2 from its		
		ERR	ERR		
Boom	0.3	0.18	-0.16	-0.028	-0.00864
Normal	0.5	-0.02	-0.06	0.0012	0.00060
recession	0.2	-0.22	0.39	-0.0858	-0.01716
					Cov = -
					0.02520

Since the above calculations produce a negative covariance, there is a tendency for the returns on the portfolio to co vary in opposite directions.

Covariance Formula for 2 Assets S $P_{s}\{[r_{As} - E(r_{A})][r_{Bs} - E(r_{B})]\}$ $\sigma_{AB} = \Sigma$ s=1 σ_{AB} = Covariance of Asset A with Asset B Number Different States S = of (i.e., Boom, Normal, Recession) • P_s = Probability of Economic State s r_{As} = Return for Asset A for the sth period. r_{Bs} = Return for Asset B for the sth period. • $E(r_A) = Expected Return for Asset A$ $E(r_B) = Expected Return for Asset B$

Correlation is the statistical measure of association. If the pair of securities displays negative correlation of returns, then in circumstances where one of the securities is performing badly the other is likely to do well. So the average return on holding two securities is considered little safer than investing in one alone.

$$Correlation = \rho = \frac{\text{cov}(X, Y)}{\sigma_X \sigma_Y}$$

If the correlation coefficient is;

+1 = a perfect positive correlation between two assets' return (one return will vary in the same direction as the other's)

-1 = a perfect negative correlation between two assets' return (one return will in the opposite direction as the other's)

 $\mathbf{0}$ = no correlation between two assets' return (no relation between both the returns)

By investing in assets that are less than perfectly correlated cash flows, risk can be gotten rid of i.e. reap the benefits of diversification.

For e.g. investment E and F, the standard deviations are 5% and 3% respectively, assuming that portfolio consists of equal investments in each that is w1=w2=50%

Correlation between two	Covariance	Portfolio's standard
assets' return		deviation (%)
+1.0	+0.00150	4
+0.5	+0.00075	3.5
0.0	0.00000	2.92
-0.5	-0.00075	2.18
-1.0	-0.00150	0.00

The less perfectly positively correlated are two assets' returns, the lower the risk of the portfolio comprised of these assets

Beta Coefficient

In finance, beta of an investment indicates the measure of volatility or systematic risk. It is also called beta coefficient. Beta represents the tendency of a security's returns to respond to thumps in the market. In general, a beta less than 1 indicates that the investment is less volatile than the market, while a beta more than 1 indicates that the investment is more volatile than the market. Volatility is measured as the fluctuation of the price around the mean: the standard deviation. For example, if a stock's beta is 1.2, it's theoretically 20% more volatile than the market. Conversely, if an ETF's beta is 0.65, it is theoretically 35% less volatile than the market. Therefore, the fund's excess return is expected to underperform the benchmark by 35% in up markets and outperform by 35% during down markets.

The beta factor is the correlation coefficient between the returns of the market portfolio of investments and the returns on a particular stock or investment. So, the beta measures an investment's marginal contribution to the risk of the market portfolio. It is important because it measures the risk of an investment that cannot be reduced by diversification. It does not measure the risk of an investment held on a stand-alone basis, but the amount of risk the investment adds to an already-diversified portfolio.

Mathematically, the beta coefficient of a security is the security's covariance with the market portfolio divided by the variance of market portfolio.

A slight modification helps in building another key relationship which tells that beta coefficient equals correlation coefficient multiplied by standard deviation of stock returns divided by standard deviation of market returns. Beta coefficient is given by the following formulas:

	Covariance of Market Return	n with Stock Return
$\beta =$		

Variance of Market Return

 β = Correlation Coefficient

× Standard Deviation of Stock Returns

Between Market and Stock

Beta of a market portfolio

If the return from the market portfolio rises or falls, we should expect a corresponding rise or fall in the return form an individual share. The amount of this rise or fall depends on the beta factor of the share.

The beta of a portfolio is a weighted average of all beta coefficients of its constituent securities.

$$\beta_{\mathsf{P}} = \sum_{i=1}^{\mathsf{N}} w_i \beta_i$$

Where, w_i is the proportion of a given security in a portfolio, β_i is the beta coefficient of a given security, and N is the number of securities in a portfolio.

Assume there is Portfolio XYZ consisting of three stocks in the following proportions:

- 40% of Stock X with $\beta_A = 0.85$
- 35% of Stock Y with $\beta_A = 1.1$
- 25% of Stock Z with $\beta_A = 1.35$

The beta coefficient of Portfolio XYZ is 1.0625.

 $\beta_{XYZ} = 0.4*0.85 + 0.35*1.1 + 0.25*1.35 = 1.0625$

Interpretation

The interpretation of the key values of beta is shown below.

- 1. $\beta < 0$. Return of a security drives in the opposite direction from the market return. A negative value is very rare for long positions but is normal for short positions.
- 2. $\beta = 0$. There is no correlation between a security return and the market return. For example, zero beta coefficient has fixed income securities because the return doesn't depend on market return movements. Another example is cash under the condition of zero inflation because its value doesn't change over time unlike market return.
- 3. $0 < \beta < 1$. Return of a security moves in the same direction as market return, but its volatility is less than market volatility.
- 4. $\beta = 1$. The security return and market return move in the same direction and have equal volatility.
- 5. $\beta >1$. The return of a security moves in the same direction as the market and has higher volatility than the market return.

Use of Beta:

Apart from measuring volatility, beta is also used for stock selection. To use the beta for stock selection general market outlook for the future is assessed. If the market indicates an upswing in future, stocks having large betas would be constructed. If it shows a downswing in future, stocks with negative betas are added. But so far Indian investor's aptitude is concerned, they are not satisfied with the use of betas as neither do they hold a diversified portfolio nor do they give weightage only to systematic risk. Unsystematic risk also affects the Indian markets to great extent. a **Summary:**

In this session we learnt about the concepts of portfolio theory. Basically it is a risk driven theory, which helps the investor maximize his returns. The session also explained as to how to manage the portfolio of investments to achieve a specific financial goal. All the factors that need to be considered while selecting a security were also described. Diversification is the strategy used by majority investors and hence the technical aspects of the same were discussed. The said strategy would prove to be successful when concepts of beta coefficient, correlation and covariance are considered. The session also clarified the usage of these measures for portfolio management with the help of a few illustrations and interpretation of the results.