

Hillier's Model of Risk Analysis in Investment Decisions

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Abstract

Risk is defined as the probability of deviation in the expected result and actual result of any activity. If the outcome of any activity is known and if there is no deviation expected in expected and actual result of any activity, this is called as certainty. The simple understanding is that the actual result of the activity would be as per the expected result and there would be no deviation. Just opposite to it, there is the situation of uncertainty where the outcome is not at all known and in between these two situations, there is the situation of risk. In risk, there is probability attached to each known outcome of the activity. Risk is not the situation of unknowingness. Here, the outcomes of the activity are known and probabilities are attached to specific outcomes. Risk is also defined as the probability of loss due to happening of an event. The loss can be financial, physical, social etc. Risk is that in want of earning higher profit, there may be loss of money. The probability of gap between expected result and actual result of any activity is the risk. Risk cannot be eliminated completely but to manage risk, there are a number of ways. Diversification is the simplest technique of risk management being followed since time immemorial. It is based on the principle of not keeping all eggs in one basket.

Risk analysis is the process of measuring the degree of risk associated with various financial and investment activities. In most of the circumstances, when a corporate entity arranges funds, there is creation of investor who bears the risk while parting with his money. The investor bearing the risk of losing his money or may face the danger of not earning any penny out of his investment applies various techniques of analyzing the risk involved in that particular investment opportunity. Hillier's Model is one such technique of risk analysis.

Keywords: Hillier's model, risk, risk analysis.

Introduction

Each business venture needs money. Firstly, money is required to establish itself and secondly, to run the business affairs. There are many short term and long term sources of finance available to the organizations. The persons or organizations providing funds to the companies are broadly divided into two categories namely debt and equity. In the class of debt, loan providers become the investors and in the class of equity, equity share holders become the investors. It is to be decided by the company that through which source it wants to raise money. Each source has its pros and cons. The most important consideration is the degree of control going into the hands of funds provider. On the other side, the investor is looking for safety of invested amount and the returns from the investment made. In achieving these objectives, investors apply a number of techniques for the analysis of the investment opportunity. These techniques range from very simple ones to really complex ones. Just to name a few, these techniques are percentage method to calculate rate of return or return on investment, capital budgeting techniques like payback period, net present value, internal rate of return, profitability index, adjusted payback period, terminal value method and techniques to analyze risk in investment like risk adjusted return or cash inflows, attaching probabilities to the cash inflows, considering more than one cash inflow from the same investment, sensitivity analysis, simulation, ascertaining the degree of optimism and pessimism, coefficient of variation, risk adjusted discount rate, certainty equivalents, decision tree, Hillier's model etc. Some of these are investment analysis techniques while others are risk analysis techniques. Hillier's model is also such a technique of risk analysis. It is a model which deals with the variation in the expected cash inflow from an investment. The probable

variation in the expected return from the investment is the reason for risk. The risk is defined as the probability of difference between expected earning and actual earning from an investment. The risk may, however arise due to various reasons, foreseen or unforeseen. Certain type of risk is faced by all investments while a few are faced by specific investments. The component of risk that an investor can manage or eliminate at his own is called as diversifiable risk and the other component of risk is called as non diversifiable risk.

Risk defined

In statistics there are three situations related to the outcome of any activity. When the result of any activity is known with cent percent assurance, it is known as the situation of certainty. In this situation the actual end result of any activity is cent percent similar as per the expected result of that activity. There would be no difference between the expected and actual outcome of the activity. In terms of investment, if the example of fixed deposit in public sector bank is taken, it is pre decided that the investor would get a return at the rate of risk free rate prevailing in the economy, around 7% to 9%. Now, this is a situation of certainty as the investor knows that he would be getting 7% return on his investment for specified days and he actually gets it. There is no gap between the expected return and the actual return. On the other end, is the situation of uncertainty, where the end result of an activity cannot be predicted. In simple words, uncertainty is when there is no certainty. The individual is uncertain about the outcome of the activity. In between these two situations, is the region of risk. Risk is the situation when there is possibility of deviation of actual returns from the expected returns. There can be more than one outcome of an investment avenue, with probabilities attached to each outcome. For example, the return from certain equity share can be estimated at 15% with 30% probability, 18% with 25% probability, 20% with 20%

probability, 22% with 15% probability and 24% with 10% probability. The gap between these expected returns with attached probability and the actual return is the risk of loss of return. The larger number of possible outcomes increases the risk. An investor taking the risk increases only the chances of earning higher returns and actual returns may vary. The amount of risk taken and the probability of earning higher returns, go hand in hand. Risk arises due to many visible and hidden factors. A particular business may be risky by its own nature or the managers of a business may be more aggressive, taking undesirable business risk. The government may change policies which may adversely affect the returns from certain investments. Reserve Bank of India may change its banking policies which may reduce prevailing interest rate in the economy. Even a particular product may become obsolete due to technological advancements. Emergence of competitors in the market may also pose risk. Introduction of new or substitute product may introduce risk, which may have not been there previously. Risk can be broken into two components. One would be the specific component and another would be the market component. The Specific one would relate to that particular investment opportunity while the market risk component would affect almost all the investment equally. The first component can be diversified but the second one is non diversifiable. It would be interesting to note that each investor has his own risk appetite and the amount of risk one can take, varies from individual to individual.

Investor-The potential risk taker

Investment is defined as the postponement of present consumption of money, in want of having increased amount of money at a future date for consumption. This surfaces three important features of investment. Firstly, there is deferment of present consumption. Secondly, the individual has to depart from his money. Thirdly, there should be increased

amount in hand for consumption at a future date. In this whole process of investment, the investor takes risk, in want of earning higher return. The amount of risk taken by any investor depends upon the investor's risk appetite. It is however a fact that the return is also correlated with the amount of risk taken by the investor. If the investor does not take any risk, he is bound to receive risk free rate of return only. This risk free component of return is received by all investors and the next component of return is according to the level of risk taken by the individual investor. Thus, there are two parts in return, one is risk free and another is premium for risk taken. The increase in return is actually the enhancement in premium for risk taken by the investor. So, if the prevailing interest rate in market is the required rate of return of the investor, the investor is risk averse by nature, otherwise the investor is risk taker. Investment is also made by banks and financial institutions in capital budgeting projects of companies. Even companies invest their retained earnings for expansion of production facilities, entering into newer markets, research and development, new product development or new business development etc. The typical nature of capital budgeting projects makes these different from other investment avenues. First of all, the capital budgeting projects are of longer duration. And secondly, such projects are of irreversible nature. The longer is the duration of any investment, the greater is the risk borne by the investor.

Techniques of risk analysis

The whole investment game revolves around two dimensions. These are, either to maximize return at a given level of risk or to minimize risk for the given amount of return. This applies to all types of investments where there are chances of variation in cash inflows as the degree of variation is the source of probable risk in investment. Thus, in order to avoid or to at least minimize the risk investors adopt a number of techniques. Viewing the

investment opportunities for individuals, corporate, banks and financial institutions, there are several techniques adopted by these investors to analyze such opportunities. A few of these are as follows:

Add margin to required rate of return

The simplest way is to add margin to the required rate of return. This way the required rate of return is increased and the associated risk is covered in the margin. For example, if the required rate of return is 12% and if the investor observes that there is sufficient risk associated with the project and 3% margin should be added to the required rate of return, the required rate of return becomes 15%, for the purpose of analysis of investment opportunities.

Discounted payback period

Another simple technique for risk adjustment is to calculate payback period after discounting the cash inflows. This technique is superior to the simple payback technique as the cash flows become time adjusted and the incorporated risk is covered by the reduced cash inflows and the payback period, in fact increases which makes the comparison of investment opportunities easier.

Adjusted rate of discount

The required rate of return is used as the rate of discounting the cash flows. When the cash inflows are discounted with the required rate of return, to incorporate effect of time on the value of money, the discount rate can be adjusted for risk. Adjusting discount rate would mean to increase it a little bit so cash flows are adjusted accordingly. This technique is an extension of adjusted required rate of return technique. In this technique, the discounted cash inflows get reduced and this also affects the net present value of the cash flow streams and

further analysis can be done by the investor. Then on the basis of calculated net present value of the return from the investment opportunity, the decision regarding investment can be made.

Increased internal rate of return

Internal rate of return is the rate a particular cash inflow stream is going to earn by itself. At internal rate of return, net present value is zero. Where the investor considers internal rate of return as the yardstick to select or reject the investment opportunities, the internal rate of return for consideration of the project is increased according to the level of risk. In this way, the investment opportunities having lower internal rate of return would automatically get eliminated from the race.

Sensitivity analysis

Another technique is the sensitivity analysis of the investment opportunity. Sensitivity analysis is the technique where estimates of cash inflows change on the basis of the expected risk. It is a technique of asking 'what if' questions related to critical factors which can change the returns in future. The sensitivity of returns to such factors is analyzed. Sensitivity analysis is a technique used to forecast the impact of changes in variables on the end result of the investment opportunity. This technique is a measure to avoid rash predictions of return from investment.

Simulation analysis

Simulation analysis as a technique of risk analysis in investment decisions is the assumption of existence of the mom existing thing through modeling. Simulation analysis is experiencing the situation which is not real. It is creation of the dummy environment having

all attributes of the real one. The decision maker has to forecast the end result using a model. Monte Carlo technique of simulation analysis is popular due to its simplicity of applicability. The conditions need to be generated in order to find out answers for the questions, using simulation analysis technique.

Optimistic – Pessimistic Estimates

In investment decisions, the investor usually considers best estimate of the return from investment. In order to combat risk in investment opportunities, the investor can take optimistic and pessimistic estimates of the future return. There can be another category also of most likely return. Being optimistic is nothing but to expect the best possible return in future and being pessimistic implies to worst possible end result should be considered. Optimistic situation is considered by the investor as favourable situation while pessimistic situation means to face the rough weather. This technique helps in analyzing the full range of possible end result from an investment opportunity.

Deviation and variation

Study of deviation and variation in the possible future return from the investment opportunities helps in selecting the best possible investment opportunity. The deviation is analyzed through standard deviation and variation is studied by calculating coefficient of variation. The investor would select that investment opportunity which has lesser variation in the return. It is obvious that the investment opportunities having greater variation need to be rejected.

Decision Tree

This is a technique of developing a branched diagram of the investment opportunity, considering different possible alternative end results. It is developed according to the series of activities in sequential order. It represents the pay offs associated with different course of action. It is diagrammatic representation of the possible performance options of the investment opportunity. Decision tree enhances the understandability of the degree of risk associated with under different situations and their impact on the return from that particular investment opportunity.

Hillier's model of risk analysis

Hillier's model was proposed by F. S. Hillier. Hillier had the point of view that in investment decisions, the risk associated is determined by the variation in the expected future cash flows. In case of less risk involved in the investment, the deviation of actual income from expected income would be least. It is the gap between predicted return and actual return from an investment which makes the investment risky. The lesser gap enables the investment to qualify as less risky investment opportunity. Hillier's model of risk analysis actually calculates the standard deviation of the cash inflows and argues that while calculating the standard deviation, the risk incorporated is also covered. On the basis of his theory, Hillier developed his model. Hillier's model determines the feasibility of the investment via calculating the deviations of the cash inflows from the mean of expected cash inflows. Hillier's model analyzes the cash inflows in two situations. First one is that when the cash inflows are correlated and second one is when these are not correlated. Hillier's model calculate the net present value and standard deviation in both the cases.

Specific formulae for calculation of net present value and standard deviation under both conditions are as follows:

Correlated Cash Flows:

$$NPV = \sum_{t=1}^n [C_t / (1+i)^t] - I$$

$$\partial(NPV) = \sum_{t=1}^n [\partial_t / (1+i)^t]$$

Uncorrelated Cash Flows:

$$NPV = \sum_{t=1}^n [C_t / (1+i)^t] - I$$

$$\partial(NPV) = \sum_{t=1}^n [\partial_t^2 / (1+i)^{2t}]^{1/2}$$

where, C_t = Expected cash flow of the year “t”

∂_t = standard deviation of cash flow for the year “t”

i = risk free rate

I = initial investment

Hillier's argument was that the risk associated with the cash inflows is visible in the calculated standard deviation of the cash inflows. He argued that the lesser the deviation of cash flows from the mean value, the lesser would be the risk in that investment opportunity. The lower value of standard deviation reflects that higher degree of certainty is there in relation to the investment opportunity being considered.

Conclusion

In general, the future is unknown. In the world of investment, future is highly unpredictable. The risk involved with investment has two significant dimensions. First is the earning on the investment and second is the receiving the invested amount back. The peculiar thing about investment is that the investor has to depart from his money which makes the whole process risky. Any type of investment need to be analyzed in terms of the risk involved

regarding the safety of principle and return on investment. It is by nature that the investor yearns for maximum return. In real world, there can be optimum return only and also that the probability of earning higher returns is correlated with the amount of risk taken by the investor. In order to analyze the risk involved in the investment opportunities, several techniques are adopted by the investors like adding margin to the required rate, adjusting the discount rate, sensitivity analysis, increase in internal rate of return as a yardstick to reject investment opportunities, discounted payback period, analysis of deviations and variations, decision tree, simulation analysis, estimating cash inflows in the pessimistic and optimistic situation, Hillier's model etc. Hillier's model of risk analysis gains importance due to the fact that it considers deviation as the indicator of risk. Hillier developed his model on the basis of his theory that the least is the deviation of cash inflows from the mean value, the higher would be the degree of certainty in the investment opportunity. Hillier's model is helpful in analyzing the risk associated with the investment opportunity in relation to the standard deviation of the cash inflows.

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