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INVESTMENT RISK, ANALYSIS AND DECISION

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ABSTRACT: Time adjusted measures of risk is useful for management in order to estimate how much risk is allowable with a given project while still meeting the desired return standard. In this paper I have presented two such measures : present value payback and annualized net present value and I have also presented the ranges of estimates and their application in probabilistic simulation.

The estimates used to analyze capital investments are projections of future conditions. Therefore capital investments involve risk because of the uncertainties surrounding the key variables involved in the analysis. Consequently, the analyst making the investment calculations and management using these results for decision purposes must allow for a whole range of possible outcomes. Even the best estimates can go wrong as events unfold, yet the decisions have to be made ahead of time.

As a result, the risk inherent in the variations must be ascertained. Such risk analysis can take many forms. One of them is sensitivity analysis as a formal means of testing the impact of changes in key assumptions. This can be very informal, back-of-the-envelope reasoning, or it can involve systematically working through the impact of assumed changes in revenues, operating savings, costs, size of outlays, recovery of capital, and so on, either singly or in combination. We also discuss ranges of estimates, either for the total result or for individual key variables. These allow management to examine the most optimistic and pessimistic cases as well as the most likely figures, and are superior to single-point estimates.

Time-adjusted measures help management ascertain how much risk is allowable with a given project while still meeting the desired return standards. In this paper we will discuss two such measures, present value payback and annualized net present value, both of which are related to the net present value criterion discussed earlier. We will also discuss the use of ranges of estimates, and their refined application in probabilistic simulation. Finally we will touch on risk adjusted rates.

1. PRESENT VALUE PAYBACK

This measure derives the minimum life necessary for an investment to operate as expected to meet the earnings standard of the present value analysis. In other word the present value payback is achieved in the period in which the cumulative sum of the positive present values equals the present value of the outlays. It is the point in the project’s life at which the original investment and sequential outlays have been amortized and a return equal to the earnings standard has been achieved on the declining balances / the point at which the project becomes economically attractive.

The minimum time needed to recover the investment and earn the return standard on the declining balance, when compared to the economic life, is an overall expression pot potential risk. The measure does not specifically address the nature of the risk, but rather serves as a risk allowance. Management can then judge whether the risk entailed in the combined elements of the project, or in any one key variable in particular, is likely to outweigh the cushion of safety implied in the additional time the project may operate once it has passed the present value payback point. It is important to remember, however, that the measure focuses on the life of the project, with the implicit assumption that the estimated operating conditions will hold.

If uneven and complicated cash flows are projected, a condition we will examine later, the minimum life or present value payback requires a year-by-year accumulation of the negative and positive present values.

We are looking for the condition under which the present value of the outflows is exactly equal to the present value of the inflows. Inasmuch as net investment (outflow) must be recovered by the inflows, we can change the formula to:

$$\text{Net investment} = \text{Factor x Annuity} \quad (1)$$

Because we know the annuity which is represented by the annual operating cash inflows, we can find the factor that satisfied the condition:

$$\text{Factor} = \text{Net investment / Annuity} \quad (2)$$

The test for present value payout or minimum life with any given return standard thus becomes one more factor in assessing the margin for error in project estimates. It sharpens the analyst's understanding of the relationship between economic life and acceptable performance, and is a much improved version of simple payback. The measure is a useful companion to the net present value criterion. It does not, however, address specific risk elements and in fact leaves the assessment of any favorable difference between the minimum standard and economic life to the judgment of management.

2. ANNUALIZED NET PRESENT VALUE

Another approach to making an allowance for risk involves estimating how much of an annual short fall in operating cash inflows is permissible over the full economic life of the project while still meeting the minimum return standard. The net present value calculation normally results in either a cumulative excess or deficiency of represent value benefits vis-à-vis the investment outlays. If the net present value is positive, the amount can be viewed as a cushion against any error in estimating future cash inflows. Unless a project has highly irregular annual flows, it is often useful to transform this net present value cushion into an equivalent annuity over the project's economic life. These annual equivalents, which express the allowable margin of error, can than be directly compared to the raw estimates of annual operating cash inflow. This is possible because the overall net present value cushion has in effect been "reconstituted" into equivalent annual cash flows on the same basis as the estimates themselves, that is, in terms of annual flows unadjusted for time value.

Annualization has a more general application as a very practical and quick preliminary test of the desirability of an investment project that has not yet been fleshed out in detail. In effect the method reverses the normal investment analysis by finding the approximate annual operating cash flow required to justify an estimated capital outlay when the specific operating benefits have not yet been established. Given an estimate of the economic life and an earnings standard, we can employ the formula:

Operating cash flow = Net investment / Factor (3)

to find the annual cash flow equivalent that will be the average minimum target. The analyst must be careful to interpret this figure properly. Because it is an aftertax cash flow, the result has to be properly modified by the assumed annual depreciation to arrive at the minimum pretax operating improvement necessary to justify the outlay. The concept is a useful tool for arriving at a first assessment of the chance that an investment will "be in the ballpark". As such it is a first crude assessment of risk. The process simply involves working "backward" through the analysis, recognizing that cash flow by definition consists of the sum of aftertax operating profit and annual depreciation.

Needless to say, annualization is quickly performed using a programmed calculator so that the present value tables are unnecessary. While a calculator makes the process "automatic", working the calculation through as we have just done, will give the reader a feeling for the reasoning behind the method.

3. RANGES OF ESTIMATES

Risk can be defined as the degree to which all possible cash benefits levels of an investment can vary. The greater the range of these possibilities, the greater the risk. Therefore, using a range of estimates is a more direct approach to investment risk analysis. This effort may not be necessary for all types of investments, however, because degrees of risk vary widely among business and financial investments.

The risk involved in holding a government bond, for example, is very small indeed, because default on the interest payments is extremely unlikely. Therefore, the range of possible benefits from the bond investment is narrowly focused on the contractual payments - in effect no range at all.

In contrast, the risk of a business investment for a product or service is a function of the whole range of possible benefit levels that may go from very positive cash flows to negative loss conditions. The uncertainty surrounding these outcomes poses a challenge to the analyst and the decision maker.

The "single point" estimates of annual cash flow projections we have used so far are the expected results based on the best judgment of the analyst and the information available. In effect, they are the average of the possible outcomes, implicitly weighed by their respective probabilities. By introducing a range of "high' and "expected" levels of annual cash inflows and outflows, the analyst can use a form of sensitivity analysis to indicate the consequences of expected fluctuations in the annual results – and thus the degree of risk. At times, past experience can provide clues to the range of future outcomes, but essentially the projection of future conditions has to be judgmental and based on specific estimates.

The decision maker must assess the likelihood that the range of outcomes estimated fairly expresses the characteristics of the project, and that the expected outcome is sufficiently attractive to compensate for the possibility that the actual results may vary as defined. Risk assessment in essence comes down to how comfortable the decision maker is with the possibility of adverse results – that is, a very personal risk preference. Stipulating a range helps the responsible person or group to visualize the possible extremes in the expected results.

4. PROBABILISTIC SIMULATION

A more refined approach involves estimating ranges not only for the annual cash flows, but also for the individual key variables making up these cash flows. Probability distributions are then assigned to the likelihood of the outcomes for each of the variables; any interdependencies between variables are defined; and the outcomes of the project can then be simulated by running many iterations on the computer.

The method is an extension of sensitivity analysis in that the possibilities of changes in many variables are simultaneously evaluated.

The result is a range of possible annual cash inflows in the form of a probability distribution, or even a range of net present values or internal rates of return arrayed by probability. Such a “risk profile” allows the decision maker to think about the relative attractiveness of a project in terms of statements such as “chances are 9 out of 10 that the project will meet the minimum standard of 10 percent”, or “there is a probability of 60 percent that the net present value of the project will be at least 1 million or better”.

The relative ease with which computer simulation can be done does not eliminate either the practical issues involved in assigning probability distributions to the individual variables in the first place or the problem of interpreting the final results. Judging both the likelihood of an event and the decision maker’s own attitude toward the risk thus expressed are highly personal and defy precise quantification.

5. RISK ADJUSTED RETURN STANDARD

Another way of adjusting for risk is to modify the return standards to include a risk premium where warranted. In a sense, the reasoning behind this is quite simple - the greater the risk, the higher the return desired from the investment. This approach is intuitively attractive to business decision makers, because the process parallels the way we think about personal investments. Thus, investments in businesses subject to wide profit swings and competitive pressures would command a premium above the return standard, while with fairly predictable businesses a less-than-average return may be acceptable. The concept rests on the assumption that a diversified company can derive a range of standards that, in combination, represent a appropriate return to the shareholders an also fairly reflect the relative risk of the individual lines.

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