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MODELS AND INDICATORS FOR RISK VALUATION OF DIRECT INVESTMENTS

Abstract. *Classical techniques for the valuation of direct investments projects take risk into account only incidentally. In these models, the risk is taken into account by the discount rate: higher is the risk, higher is the discount rate. As long as the discount rate is right estimated, indicators – Net Present Value (NPV), payback period, profitability index, etc. – will be relevant. Modern techniques eliminate some of the inconveniences. The purpose of this study is to make a comparative analysis between the results obtained based on classical techniques and modern techniques of valuation.*

Keywords: Direct Investments, Net Present Value, Traditional techniques, Monte Carlo Technique, NPV frequency distribution.

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1. Introduction

It can be noticed that a right evaluation for investment project is often crucial for economic development. Many of the failure investments projects should be avoided based on an appropriate analysis. This is the reason for taking into account risks in direct investments projects valuation.

Classical techniques for the valuation of direct investments projects take risk into account only incidentally. Maybe for this reason, some Romanian economists define these techniques to be "in free risk environment" (see Stancu, 2002). In these models, the risk is taken into account by the discount rate: higher is the risk, higher is the discount rate. As long as the discount rate is right estimated, indicators – Net Present Value (NPV), payback period, profitability index, etc. – will be relevant. Modern techniques eliminate some of the inconveniences. The purpose of this study is to make a comparative analysis between the results obtained based on classical techniques and modern techniques of valuation.

The rest of this paper is organized as follows. In Section 2 there are presented the classical techniques for direct investments valuation, with a focus on Net Present Value. In Section 3 there are presented some alternative techniques, called modern techniques for valuation, with a focus on Monte Carlo analysis. The results obtained using these classical and modern techniques are comparatively analysed in Section 4. Section 5 concludes this study.

2. Classical techniques for direct investments valuation

Classical techniques for the valuation of direct investments use financial indicators as Net Present Value (NPV), Internal Rate of Return, Modified Internal Rate of Return, Payback Period Rule or Profitability Index. As long as NPV is recognized as the most appropriate indicator in order to quantify the performance of investments projects (see Ross, Westerfield, and Jaffe, 1999, for an explanation), in this study we will make our judgements mainly based on this indicator. Obviously, we will not insist on basic issues, presented in every Corporate Finance Handbook (see Ross, Westerfield, and Jaffe, 1999).

Net Present Value is calculated based on the equation:

$$NPV = -I_0 + \sum_{t=1}^{n} \frac{CFD_t}{(1+k)^t} + \frac{VR_n}{(1+k)^n} \qquad (1)$$

with: I_0 = the amount invested;
CFD_t = the cash flow produced in the year t;
VR_n = residual value (in the last year, n);
n = the number of years in which the project will produce cash flows;
k = the discount rate.

For a presentation of the main issues, see Dragotă, Ciobanu, Obreja and Dragotă (2003). This equation can be written as:

$$NPV = NPV(I_0, n, k, CFD_{t,t=1\ldots n}, VR_n) \qquad (2)$$

Generally, the risk is taken into account through the discount rate. The discount rate represents the rate of return required by the investors, or, in other words, the opportunity cost. As long the cash flows would be certain, the discount rate would be equal to the risk free rate (R_f). In these conditions, a higher level of risk will induce a higher risk premium (π), respectively:

$$k = R_f + \pi \qquad (3)$$

However, the level for risk premium is very subjective as long as it is the result of the analysts' intuition. In these conditions, the levels of NPV can very in very large limits. Moreover, the risk premium is calculated as a sum of some partial risk premium, for each risk factor. A risk factor is defined as a factor that can determine a decrease in cash flows. Such factors that can be taken into account are: an entry on the market of a new competitor, a change in the structure of solvable demand, some incidents with an impact on company's image, a decrease in clients'

revenues, an increase in prices for the products offered by suppliers, a key person loss, etc. Each company is affected by its own risk factors. For example, a restaurant will be affected by a decrease of the clients' revenues, an increase of prices for food and beverage, etc., but also by losing the chief.

Another method for estimating the risk premium is the average cost of capital. In this case, the main challenge is to estimate the cost of equity, and one solution is CAPM (Dragotă, 2007). However, as long as cost of equity is not the result of contractual issues, usually this is not an effective cost, but only estimation. In these conditions, again, the subjectivism of the analyst can determine large variations for indicators.

For example, suppose an investments project with a cost of 900 mil. Euro, which produces equal cash flows of 300 mil. Euro each of four years it is functioning (the residual value is considered equal to 0). In this case, a discount rate of 12% will generate a positive net present value ($11.20 > 0$, so the project can be adopted), as long as a discount rate of 13%, will generate a negative NPV ($-6.78 < 0$) and the project must be rejected. Obvious, the difference from 12% to 13%, which can be minor for an analyst, determines the distance between acceptability and rejection of the project! Certainly, a practitioner often comes to a decision somehow in large extent. In other words, as long as the required rate of return is approximately 12-13%, the project would be hardly adopted, because it is very possible to generate a negative NPV.

This seems to be not a satisfactory explanation, especially for a public investment project (for an alternative interesting application, see Moşteanu and Semenescu, 2009). In these conditions, it seems obvious why the financial theoreticians tried to propose better techniques, which are presented in the next section.

3. Modern techniques for direct investments valuation

One problem related to the NPV calculation is mainly related to the estimation methodology for the discount rate. The risk premium is taking into account different risk factors, but the impact of these factors are sometime acting in opposite directions. Adding a risk premium does not mean that each of risks quantified by partial risk premiums will occur; some risk will happen, but some risks will not. For example, adding a risk premium of 5% for the risk factor "price of materials will increase" will artificially increase the discount rate, so will artificially decrease the NPV if this risk will never occur. Moreover, the law of distribution for these different factors will affect the law of distribution for NPV.

Suppose a short example (from Dragotă, Ciobanu, Obreja and Dragotă (2003)). An investor analyzes the opportunity to buy equipment for a Dentist Cabinet. This cabinet is owned by a very appreciate dentist, which can have a very important influence on the firms' performances. In order to measure the

performances for the investment project, the cash flows and the risk for this project will be influenced in a large extent by the employment of this dentist. Indeed, if this key-person leaves the firm, the expected cash flows will decrease. In this case, traditional techniques for valuation will take into account this risk adding one more partial risk premium for loosing a key person. This risk premium has to take into account the probability of loosing this key person (let's suppose this probability is 30%). However, in practice, the performance of this project will be affected or not by this situation, respectively:

- In the case the dentist will leave the company, the cash flows will decrease. In this case the risk premium is too small to take into account this phenomenon.
- In the case the dentist will remain employed in the Cabinet, the risk premium will be too high, and so some investments project would be artificially rejected.

The main problem is the probability distribution for NPV is not normal. This is one reason for taking into account other modern techniques for investments valuation, like sensitivity analysis, decision tree, scenario technique, Monte Carlo technique, real options, etc.

The **sensitivity analysis** takes into account the level for NPV if some variables are changed. In this case, the investor will decide if an expected change in the determinant variables is important enough in order to reject the project. However, in fact, this analysis, even it can be very useful, remains in fact a qualitative analysis. Relative similar, even if take into account the way management have to react in different scenarios, is the **decision tree analysis**.

The **scenario analysis** represents a particular case of Monte Carlo analysis. For this reason, here we will present **Monte Carlo analysis** (see, also, in a different context, Ştefănescu and Ştefănescu, 2007).

This method take into account, for each of the variables that influence NPV an interval in this variable can take values, and also, a law of distribution probability. For these variables, there are generated random values, and finally, NPV for each of these cases is calculated.

Let's analyse the same example from Section 2. We will consider the cost of investment to remain at the same level (900). In an Excel for Windows application, for each cash flow (years 1 to 4), were generated random values, between 250 and 350. Also, were generated random values for discount rate (between 10% and 14%). These values were chosen in order to be adapted to the real economic conditions. From this point of view, a variation in cash flows of +/- 16.66% or a variation in discount rate of +/-2% seem to be reasonable.

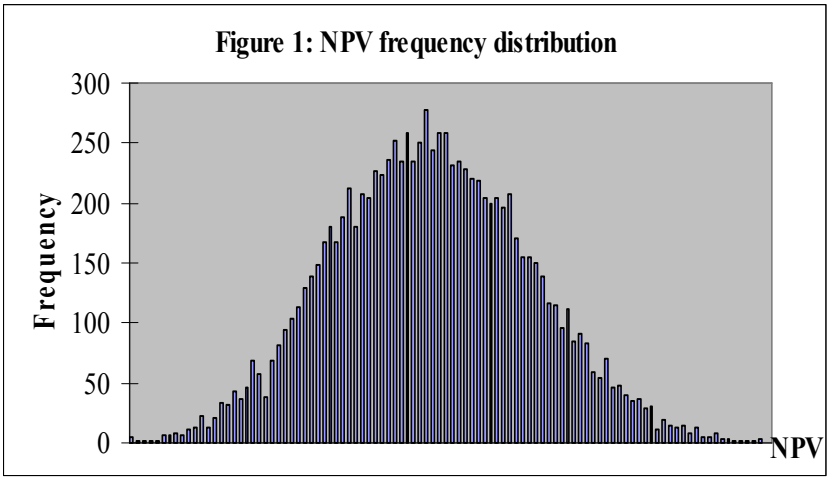
So, we generated 10000 cases for each variable[1]. Again, 10,000 cases seem to be a reasonable number for the purpose of this kind of analysis. NPV were calculated for each case. The descriptive statistics for NPV are depicted in Table 1.

[1] We used the RANDBETWEEN Excel function.

Table 1 : Results for NPV in a Monte Carlo Simulation

Average	11.53
Median	11.69
Minim	- 148.09
Maxim	184.69

The frequency distribution for this population is depicted in Figure 1.



The results are relatively similar to those obtained for the classical case (remember the NPV calculated in the classical case, for a 12% discount rate, were 11.20). Moreover, the probability distribution is normal.

4. A short comparison between the two methodologies

For a practitioner, the traditional tools and the modern techniques for analysis determine very similar results. Even the comparison seems to reveal many differences in methodology, the most important issue is the final decision, respectively to adopt or to reject the project In these conditions, it seems to be a not trivial question if the modern techniques, and especially, the Monte Carlo analysis, can be useful at all. The answer is related to the risk analysis.

For the Monte Carlo analysis case, it is very easy to calculate the average and the variance of the population, respectively E(NPV) and σ^2(NPV). As long as NPV follow a normal distribution, the probability density function can be written as:

$$f(NPV) = \frac{1}{\sigma(NPV)\sqrt{2\pi}} e^{-\frac{1}{2}\cdot\frac{(NPV-E(NPV))^2}{\sigma^2(NPV)}} \quad (4)$$

In these conditions, the probability for NPV to be lower than one specified value (NPV*), can be easy calculated:

$$p(NPV < NPV^*) = \int_{-\infty}^{NPV^*} \frac{1}{\sigma(NPV)\sqrt{2\pi}} e^{-\frac{1}{2}\cdot\frac{(NPV-E(NPV))^2}{\sigma^2(NPV)}} d(NPV) \quad (5)$$

As long as it offers a probability in order to estimate the risk, this estimation can be very useful for practitioners in risk valuation. For example, as long as E(NPV) =11.53 and σ(NPV) = 53.02, the probability that NPV to be higher than 0 will be approximately 58.6%. Practically, it is estimated the probability that the project to be acceptable. It can be noticed the similitude to the Value at Risk Approach (see Iorgulescu and Stancu, 2008, for a development).

However, it has to be considered the methodology used in Monte Carlo make some assumptions that are related to the classical analysis. For instance, there are generated 10,000 cases, but for a right estimation of cash flows they were considered to vary between 250 and 350, in order to keep an average value of 300. As a warning, if someone will take other average, the estimation probably will be biased from an economical point of view. In these conditions, the risk estimation methodology is affected by the scenario construction of the analyst.

5. Conclusion

This study compared the results for modern and classical methodologies for investments valuation. Modern techniques take better into account the risks, but their results have to be analysed somehow circumspect, as long as the scenario construction is affected in large extend by the analyst.

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