VALUE AT RISK - CORPORATE RISK MEASUREMENT

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The notion of "risk" is used in a number of sciences. The Faculty of Law studies the risk depending on its legality. The Accident Theory applies this term to describe the damage and the disasters. One can find studies on the risks in the works of psychology, philosophy, medicine and within each of these areas the study of the risk is based on the given science subject and, of course, on their methods and approaches. Such a variety of risk study is explained by the diversity of this phenomenon.
Under the market economy conditions, the risk is an essential component of any economic agent management policy, of the approach developed by this one, a strategy that depends almost entirely on individual ability and capacity to anticipate his evolution and to exploit his opportunities, assuming a so-called "risk of business failure."
There are several ways to measure the risks in projects, one of the most used methods to measure this being the Value at Risk(VaR).
Value at Risk (VaR) was made famous by JP Morgan in the mid 1990s, by introducing the RiskMetrics approach, and hence, by far, has been sanctioned by several Governing Bodies throughout the world bank. In short, it measures the value of risk capital stocks in a given period at a certain probability of loss. This measurement can be modified for risk applications through, for example, the potential loss values affirmation in a certain amount of time during the economic life of the project- clearly, a project with a lower VaR is better.
It should be noted that it is not always possible or advisable for a company to limit itself to the remote analysis of each risk because the risks and their effects are interdependent and constitute a system .In addition, there are risks which, in combination with other risks, tend to produce effects which they would not have caused by themselves and risks that tend to offset and even cancel each other out.

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1. Introduction

There are several ways to measure the risks in projects. These include:
- *The Probability of Occurrence*. This approach is simplistic, yet effective. As an example, there is a 10 percent probability that a project may even fail (it will restore a negative net present value indicating losses) within the next five years. Moreover, suppose two similar projects have identical implementation costs and expected returns. Based on a single-point evaluation, managing between them would be insignificant. However, if the risk analysis such as Monte Carlo simulation is carried out, the first project might indicate a 70 percent loss probability compared to only a 5 percent probability of loss of on the second project. Clearly, the second project is better when the risks are assessed.

- *Standard Deviation and Variation*. Standard Deviation is a measure of the average deviation of each data point from the mean value. This is the most popular measure of risk, where a higher standard deviation implies a wider distributional width and therefore carries a higher risk. The drawback of this measure is that both upside and downside variations are included in calculating the standard deviation. Some analysts define the risk as the potential losses or downside; thus, the standard deviation and variance will penalize both the upsides and the downsides (disadvantages).
- *Semi-Standard Deviation*. The semi-standard deviation only measures the standard deviation of risks and ignores the upside fluctuations. Modifications of the semi-standard deviation include calculating only the values below the mean or values below a threshold (e.g., negative profits or negative cash flows). This provides a better picture of the risk, but is more difficult to estimate.
- *Volatility*. The concept of volatility (change) is widely used in the applications of real options and can be briefly defined as a measure of uncertainty and risks. Volatility can be estimated using several methods, including simulation of the uncertain variables impacting a given project and estimating the standard deviation of the yields logarithmic asset over time. This concept is more difficult to define and estimate, but is more powerful than most other risk measures in that this single value includes all sources of uncertainty contained in a single value.
- *Beta*. Beta is another common measure of risk in the investment finance arena. Beta can be defined simply as the systematic market risk of a financial asset. This concept is made famous through the CAPM, where a higher beta means higher risk, which in turn requires a higher expected return on the asset.
- *Coefficient of Variation*. The coefficient of variation is simply defined as the ratio of standard deviation to the mean, which means that the risks are common- sized. For example, the distribution of a group of students' heights (measured in meters) can be compared to the distribution of students' weights (measured in kilograms). This measure of risk or dispersion is applied when the variables' estimates, measures, magnitudes, or units differ.
- *Value at Risk.* Value Risk (VaR) was made famous by JP Morgan in the mid-1990s through introducing the RiskMetrics approach, and has thus far been sanctioned by several bank governing bodies around the world. In short, it measures the amount of risk capital stocks in a given period at a particular probability of loss. This measurement can be modified to risk applications by stating, for example, the amount of potential losses a certain percent of the time during the economic life of the project- clearly, a project with a smaller VaR is better.
- *Worst-Case Scenario and Regret*. Another simple measure is the value of the worst-case scenario and catastrophic losses. Another definition is regret. That is, if a decision is made to pursue a particular project, but if the project becomes unprofitable and suffers a loss, the level of regret is simply the difference between the actual losses compared to doing nothing at all.
- *Risk-Adjusted Return on Capital.*. Risk-adjusted return on capital (RAROC) is the ratio of the difference between the 50th percentile (median) return and the 5th percentile return on a project's standard deviation. This approach is used mostly by banks to assess profitability at risk by measuring only the potential negative effects and ignoring the positive gains.

In 1994 it appeared within the JP Morgan's the RiskMetrics department, led by Till Guldimann, specialized only on the risk study and analysis. The risk measure chosen by RiskMetrics was the value at risk (VaR). RiskMetrics separated from the the parent company in 1998 and became RiskMetrics Group, specialized on consulting and software. The success of the value at risk was also due to the importance attributed to it within The Group of 30 (G-30) Report (1993) and in the 1996 Amendment of the Basel Agreement, which recommends that central banks use VaR to determine the required minimum capital of commercial banks to cover their market risk to which it is exposed.

As a general definition, VaR is the maximum level of loss generated by a specific portfolio structure estimated at a certain degree of trust over a reference period. The main elements of this methodology focus on:
- the period of analysis - it is associated with holding the portfolio horizon or time required to sell it. The typical VaR application periods are from one day to one year (e.g., a 10-day period of analysis is required to compute the capital adequacy of financial intermediaries in accordance with The Basel II Capital Accord, while a period of one year may be used to estimate the credit risk);
- confidence interval – is the interval in which the VaR is expected not to exceed the maximum level of loss. Usually, the intervals used are 99% and 95% respectively.
- expressing VaR level – it is usually measured in monetary units.

2. The methodology for calculating value at risk

Value at risk meets quite several criteria. In relation to the ADEH axioms it satisfies the monotonicity axiom, positive homogeneity and the translation invariance. In addition, it also has the additivity property.
As main disadvantage, VaR does not present the sub-additivity property and thus, there is not a coherent risk measure in the general case. However, for special classes of distribution VaR is consistent, for example, for the normal distributions class.
Let **z** be the reference level with wich the portfolio value is compared to at the end of time horizon considered. If x<z, then there is a loss of z-x. So, the portfolio loss is given by the random variable:

$$\tilde{l} = z - \tilde{x} \quad (1)$$

As reference levels can be used the $x_0$baseline and $E(\tilde{x})$the expected value.The probability of a loss less than or equal to l is given by the distribution function:

$$F_{\tilde{l}}\, l = P(\tilde{l} \le l) = \int_{-\infty}^{l} f_{\tilde{l}}\,(\xi)d\xi \quad (2)$$

Using the loss distribution $F_{\tilde{l}}$for a given time horizon and a particular confidence level 1-α, we get the equation:

$$F_{\tilde{l}}\ VaR = P\ (\tilde{l} \le VaR) = 1\text{-}\alpha \quad (3)$$

Applying the inverse function $F_{\tilde{l}}^{-1}$to the above equation we get a value at risk:

$$VaR = F_{\tilde{l}}^{-1}\ (1\text{-}\alpha) \qquad (4)$$

Interpreting the value at risk as the capital required to face the risk, figure(4) implies that in 100 (1 - α)% cases, this capital will not be exhausted. Applying the concept of value at risk to L-E(L) instead of L, we obtain a risk measure of the first type.
Another option for this risk measure is the conditional value at risk at confidence level α defined as:

$$CVAR_{\alpha}\ (L) = E\ [L \mid L > VaR_{\alpha}] \qquad (5)$$

On the interpretation of VaR as 100 (1-α)% from the maximum loss, CVaR can be interpreted as the average maximum loss in 100% α of cases. Conditional Value at Risk defined in figure (7) is a coherent risk measure if there is a density function, but not in general. In the general case, be considered alternative measures of risk such as the expected discovery or other equivalents, when consistency is required.
Conditional value at risk allows the decomposition:

$$CVAR_\alpha (L) = VAR_\alpha (L) + E [L\text{-}VaR_\alpha \mid L>VaR_\alpha] \qquad (6)$$

meaning the conditional value at risk is the sum of value at risk and the average excess value at risk if such an excess exists. So, the conditional value at risk will be at least as high as the value at risk.

3. Models for estimating the value at risk

There are a variety of methods that allow estimating VaR. Within these we can distinguish:
1. Delta-normal method (variance - covariance) implies that the variations occurring in the risk factors are always normally distributed and that variations in the portfolio value are linearly dependent on the variations of all risk factors.
2. Historical Simulation Method assumes that all the future variations will have the same distribution that they had during the previous periods;
3. Monte Carlo Simulation Method in which the variations are simulated in a (pseudo) random way.
1. The Variance-Covariance method was popularized by JP Morgan Chase in the early '90s in their own RiskMetric methodology. A simplified version of it can be built on the assumption that the only risk factor for the portfolio is induced by the variations occurring in the value of its component assets. In this situation there are the following assumptions:
The portfolio is composed of linear delta values, meaning the modifications in portfolio values (and within its returns) are linearly dependent on all the individual modifications in the assets values included in its structure;
a. The variations occurred in the portfolio assets value are normally distributed.
Based on the two assumptions, we can state that the portfolio return is normally distributed because a linear combination of normally distributed variables has itself a normal distribution.
One can make the following notations:
i - the yield on individual asset "i" an yield based exclusively on its value variation ;
ρ - the yield on the portfolio (its value variation);
N – the number of the assets in the portfolio;
μ – the expected value (average);
σ – the standard deviation;
V - the initial value (in monetary units);
ω_i - $\frac{V_i}{V_p}$ - initial allocation of capital asset "i";
$\overline{\omega}$ - the vector of all variablesω_i; ω^T, it is the transpose of the vector;
∑ - covariance matrix between the returns of N assets (NxN matrix);
All the assets are held throughout the period of analysis.

$$\mu_p = \sum_{i=1}^{N} \omega_i \, \mu_i \ (7)$$

$$\sigma_p = \sqrt{\omega^T} \sum \omega (8)$$

The main advantage of this method lies in its "compact" nature that facilitates the empirical implementation and the main disadvantage is the less plausible character of the assumption regarding the normality of the individual values modifications and of the portfolio overall value.
The Historical Simulation Method is the simplest and the most transparent method of calculation. This method involves simulating a current structure portfolio based on historical data with emphasis on the distribution in its yield and the computing of a percentile. Its main advantage is that it does not require the recourse to the normal distribution assumption and the disadvantage in its empirical application being the high computational and informational requirements.
1. Conceptually, Monte Carlo Method is relatively simple, but involves a higher simulation effort than the previous methods. This method involves:
- determining the total number of iterations of the simulation N;
- for each iteration:
    - the generation of a (pseudo) random script regarding the price developments;
    - reassessing the portfolio on the basis of this scenario;
    - computing the global profit / loss per portfolio as a difference between the market current value and the calculated value in the previous stage;
- the estimation of the simulated profit / loss distribution;
- VaR for a confidence interval is calculated as a percentile.

The method is useful for estimating the VaR in case of financial asset portfolios incorporating non-linear returns.

4. Conclusions

Value at risk is one of the most modern techniques used in measuring the risks. VaR was originally used for measuring the market risks. However, the literature emphasizes that the VAR is now increasingly used for measuring other risk categories. This is due to explicit recognition of the need for an integrated risk management. In this case, the risks management focused on the financial risks will cause the financial risks to "slide" in those areas where they are not measured (Jorion, P., 2000:467).
However, extending the use of VaR has its challenges. A major difficulty is given through data availability. VaR was first used to measure the market risk of some financial institutions. In this case, VAR is simple to calculate, with high frequency data, in many cases even daily. For other categories of risks (e.g. business) or for companies working in other sectors, data availability is a problem. In most cases there are low frequency data. Using the annual frequency data would result in a VaR that for a 99% confidence interval means the maximum expected loss in one year of a hundred years. The interpretation of this result is of little relevance given the period considered plus it would take 100 years many times to validate the results, which is impossible in practice (Stulz, R., 1996:21). The second limit of VaR consists in the assumption of a normal distribution of potential gains and losses. The literature emphasizes that in reality the losses tend to be higher than those suggested by a normal distribution. Therefore, using VaR tends to underestimate the risks a company faces. Another limit concerns defining the VaR risks. VaR identifies the maximum loss that can occur with a certain probability. But a company is more interested in the cumulative loss that can occur within one year because just the cumulation of the losses for a year may result in a difficult financial situation.
The literature suggests an alternative to VaR using Monte Carlo simulation for forecasting the cash flows over a period taking into account the risks the company faces. The probability of a negative financial situation would be measured by the proportion of distributions for which the cash flow is below a set threshold. Such a technique can also be used to estimate the impact of different hedging strategies have on the probability of a negative financial situations. In addition,

such a technique would address non - normal data and other issues specific to chronological series (mainly autocorrelations), although the latter can be solved by other specific techniques.

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