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The Company Fundamental Analysis and the Default Risk Ratio

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Abstract

The default risk ratio (DRR) proposed in this paper tries to define a novel alternative approach to analyze the company capability to face debt obligation by deriving it on the basis of fundamental analysis of the firm rather than the volatility of the asset's value on the market.

The DRR is defined on the basis of the relationship between debt level and the economic and financial dynamics with regard the Operating and Net Income, Capital Invested and Capital Structure and Free Cash-Flow from Operations and to Equity.

The DRR does not define directly the default probability, but it is able to monitoring at a definite time the relevance of the debt level of the firm's capability to face it, on the basis of its effects on the economic and financial dynamics of the firm. Since the DRR is based on the firm's fundamental analysis, it can be used also in the structured-form models.

Keywords: capital structure, debt level, default risk, cost of debt

1. Introduction

In literature, it is possible to distinguish two main types of study about the default risk of the firm also if they are strictly related: *i)* studies on structural-form model and reduced- form model and *ii)* studies on accounting models.

The structural-form models and the reduced-form models try to modelling the credit risk. These two classes of studies are characterized by their own advantages and disadvantages. In general terms, while the reduced-form models have a lot of room for calibrating to historical data, but they lack the financial elements for the mode parameters, the structural models are rather intuitive and they have a nice explanation in financial terms, but they lack measuring in particular the short-term credit risk and they are much harder to apply whenever there is more than one debt instrument (Gupta, 2014).

In other terms, while the structural models have the advantage to explicitly model a firm's assets by assuming that the firm's assets follow a geometric Brownian motion, reduced models do not formally link a firm's assets to the corporate credit issued by it. They are based on exogenously specified parameters, such as recovery rates, to value corporate credit (Rajaratnam *et al.*, 2017).

Structural-form models originated with the study of Merton (1974), Black and Scholes (1973). In general terms, with Merton's work that postulates that firm's value follows a diffusion process with constant volatility as described by the Geometric Brownian Motion, the volatility of share prices and debt values exhibit plays a key role in the modern financial literature.

The approach of structural-form models assume that the bankruptcy process is explicated. It defines the both the event able to trigger the default and the payoffs to the bondholders at default state in terms of the firm's assets and liabilities. Therefore, this approach has only able to produce price under extremely simplistic assumptions about capital structure. However, these models require a certain level of abstraction about the bankruptcy in order to its tractability. The main problem is that the asset volatility employed in structural models is not directly observable and it has to be estimated indirectly by using different indicators such as equity volatility. Several recent studies show that the difficulty of structural models explain yield spreads (Huang and Huang, 2012; Bao, 2009; Cremers et al., 2008; Eom et al., 2004; Schaefer and Strebulaev, 2008; Chen et al, 2007).

The reduced-form models (or statistical approach) originated with the study of Jarrow and Turnbull (1992, 1995),

Duffie and Singleton (1999) among others, are based on a statistical approach and they are abstracted away completely from the economic definition of bankruptcy and default treats that are considered as exogenously specified process. This approach is tractable and it is usually used in pricing default risk. In this perspective, any default free term structure model can be used to price bonds with default risk.

Despite these two approaches are in competition in order to define, which of these is the best in the forecasting performance around the default prediction, several studies try to find a convergence among these two approaches. In this perspective, among the other studies, it can be useful the approach based on the available information (Jarrow & Protter, 2004). In this sense, the main difference between these two approaches is due to the information assumed known: *i)* structural-form models assume to have the same information as the firm's management with regard assets and liabilities with consequence of a complete knowledge of the firm's condition. This assumption about the information implies that the firm's default time is predictable; *ii)* reduced-form models assume to have the same information on the market with the consequence of incomplete knowledge of the firm's condition. This assumption about information implies that the firm's default time is inaccessible. Based on this perspective in which key role is played by the available information, the debate about the two approaches change the focus by shifting from the model that is the best in terms of forecasting performance to the model that is the best on the basis of the information available (Jarrow & Protter, 2004).

The studies on accounting models focus on the firm's fundamentals. They were born with the pioneering works Beaver (1966, 1968) that applied a univariate statistical analysis for the prediction of corporate failure, and Altman (1968) that developed the Z-Score model in order to identify accounting variables and financial ratios to measure the company's default risk. Following several models are developed. The same Z-score model has been revised by giving the start of the second generation of the model with several enhancements (Altman, Haldeman and Narayanan, 1977). After, the Z-score model has been modified in order to its application in the context of corporations in emerging markets (Altman, Hartzell, & Peck, 1995).

By following a similar approach Ohlson (1980) developed its O-Score Model with the identification of nine ratios able to predict the bankruptcy, Taffler (1983, 1984) developed the UK-based Z-Score model that is one of the eminent and commonly used Z-Score model, Zmijewski (1984) developed the Probit Analysis and Bandyopadhyay (2006, 2007) developed a hybrid logistic model. Also, Bathia (1988), Shaoo et al. (1996) and Jaydev (2006) examined the predictive power of accounting ratios on a sample of sick and non-sick firms by using the multiple discriminant analysis and Lennox (1999) in his study showed that profitability, leverage and cash flows have relevant effects on the probability of the company's default.

Over the time several empirical tests have shown the relevance of the models developed (Agarwal & Taffler, 2007; Baninoe, 2010; Kumar & Kumar, 2012; Shumway, 2001).

Finally, several studies show the effect of debt on the competitive strategy of the firm and its profitability over time. There are two main theories that contrast: the first argues that the high debt level is given to the firm the opportunity to invest many resources in the business by acquiring increasingly share market (Brander & Lewis, 1986); the second argues that a high debt level leads the firm to increase the prices in the short-term period in order to secure short-term profits. It is due to the higher discounting rate associated with the higher default probability of the levered firm (Chevalier & Scharfstein, 1996; Dasgupta & Titman, 1998). Several empirical studies have found support for each of these theories (see Parson & Titman, 2008).

The paper tries to give a contribution to this debate by following the studies on accounting models. The focus of the paper is to define a default risk ratio (DRR) of the company on the basis of its fundamentals. Specifically, the DRR is defined on the basis of the relationship between debt level and the economic and financial dynamics of the firm with main regard to the Operating and Net Income, Capital Structure and Capital Invested and Free Cash-Flow from Operations and to Equity.

The analysis of the company's fundamentals is one of the most relevant fields of study in the business theory, as well as the volatility of modelled parameters is for the modern financial theory. Starting from the work of Graham (1940), the investors with a long-range planning of investment, tend to be more tolerant to the volatility. Also, to refer to the same time period, the investor in debt tends to be more tolerant than the investor in equity.

Therefore, the DRR proposed in this paper tries to define a novel alternative approach to analyze the company capability to face debt obligations by deriving it from the analysis of the firm's fundamentals with regard its economic and financial dynamics over time rather than the volatility of the asset's value.

Two are the main interesting contributions of the paper: first, it tries to define new measurement (DRR) of the firm's capability to face debt obligations with regard both the reimbursement of debt at maturity and the interests

on debt, on the basis of the fundamental analysis of the firm with regard the Operating and Net Income, Capital Structure and Capital Invested and Free Cash-Flows from Operations and to Equity; second, the DRR developed can be used to monitoring in discrete time the relevance of the debt level on the firm's economic and financial dynamics by giving the opportunity to measure the default risk probability, as well as it can be used in the structural-form model because it is based on the firm's fundamentals.

2. Economic and Financial Dynamics

The fundamental analysis of the firm can be realized by analyzing the economic and financial dynamics over time. It requires investigating three main pillars (for more accurate details about this analysis, see De Luca, 2017):

- Operating and Net Income,
- Capital Invested and Capital Structure,
- Free Cash-Flow from Operations and Free-Cash-Flow to Equity.

A) Operating and Net Income

The Operating and Net Income of the firm can be analyzed by using an analytical scheme structured in four main sections as follows:

- *Section 1) Operating area:* it refers to the operating revenues and costs due to the activities of the company's core business. In this section, it is relevant to distinguish between operating costs cash and operating cost non-cash (such as amortizations, depreciations, accruals);
- *Section 2) Non-Operating area*: it refers to two different types of revenues and costs. The first is the revenues and costs due to the realization of activities out of the company's core business; the second is the revenues and costs related to the core-business but non-recurring in time and thus considered one-off. It is worth noting that the definition of the company's core-business is a strategic valuation only independently of the accounting rules;
- *Section 3) Financial area*: it refers to the financial revenues and costs. The first refers mainly the dividend received and interest on financial credit while the second refers mainly to the interest on debt and other financial costs linked to it. For non-financial company, the financial revenues is low and the entire financial area usually refers to the cost of debt;
- *Section 4) Tax area*: it refers to corporate taxes due to the company's activities. Usually, taxes are considered entirely in this section. However, more appropriately, they should be divided among the three sections: Operating, Non-Operating, Financial. Often, in practice tax splitting is difficult to realize and thus, the corporate taxes are considered entirely in this specific section.

The analytical scheme is indicated in *Table 1 (note that the bracket indicates a negative value).*

Table 1. Analytical scheme of the operating and net income

Net Sales Revenues
Other Operating Net Revenues
Net Operating Revenues
(Costs of Materials)
(Costs of Industrial, Commercial and Distribution Services)
(Costs of Administration and Leasing and Rent)
(Costs of Employees)
(Other Operating Costs)
Operating Costs (Cash)
EBITDA
(Amortization of Intangible and Tangible Assets – Operating and Surplus Assets)
(Accruals for Employees)
(Accruals for provision for Risks, Charges and Taxes)
(Credits write-off)
(Reduction value)/Revaluation of Assets
Operating Costs (Non-Cash)
EBIT

Financial Revenues
(Interests on Debts)
(Other Financial Costs)
Financial Profit / (Loss)
EBT – Operating
Non-Operating Revenues and Non-Current Operating Revenues
(Non-Operating Costs and Non-Current Operating Costs)
Non-Operating Profit / (Loss)
EBT
(Current Operating and Corporate Taxes)
NET INCOME

The EBITDA (*Earnings Before Interest Tax Depreciation and Amortization*) is equal to the difference between Operating Revenues and Operating Costs (Cash) due to the realization of the core-business activities. It is the *Operating Income before depreciation, amortization and accruals.*

The EBIT (*Earnings Before Interest and Taxes*) is the *Net Operating Income* because it incorporates the non-cash operating costs such as amortization, depreciation, accruals. These non-cash operating costs define the difference between the EBITDA and the EBIT.

Two are the main elements about the difference between EBITDA and EBIT to keep in mind:

– *Amortization and depreciation*: the distance between EBITDA and EBIT can be a measurement of the investment policy of intangible and tangible assets of the company. The higher the investments in assets, the greater the amortizations and depreciations, and then the higher the distance between EBITDA and EBIT. In a dynamic perspective, the reduction of this distance over time due to lower amortization and depreciation indicates the reduction of the company's investments in the business. In the time, the reduction of investments in assets generates the reduction of the company's capabilities to compete in its business and thus, reduction of the expected income, both operating that net, and consequent reduction of the company's value creation;

– *Accruals for risk and charges*: the distance measures the risks assumed by the company in time. In a dynamic perspective, the relevance is mainly due to the probability that they are not enough to cover the future costs if they will be realized. Generally, the greater the provision for risk and charges, the higher the probability that the events referenced may be realized, and thus, the higher the risk that they will not be enough. Therefore, the real problem is to understand if the provisions are enough to cover the costs derived from the realization of the future events assumed possible to realize.

It is worth noting that the difference between EBITDA and EBIT is relevant in the economic perspective only. Indeed, in the financial perspective EBITDA and EBIT are equal because non-cash operating costs do not have effects on the cash flows.

Finally, it is worth noting that by using the tax splitting, and thus by distinguishing between operating and corporate taxes (the first is due to the operating activities, while the second are due to the non-operating and financial activities), EBIT is equal to NOPAT (Net Operating Profit After Taxes). Otherwise, if it is not used the tax splitting, and in the tax area are considered jointly the operating taxes and corporate taxes, EBIT is the operating income before taxes while the NOPAT is the operating income after taxes.

The EBT (*Earnings Before Taxes*) defines the income before corporate taxes. If there are non-operating revenues and costs, it could be interesting to highlight the components of EBT that refers to the operating revenues and costs only by defining the *EBT-Operating*.

If there are not non-operating revenues and costs, the difference between EBIT and EBT are due to the financial revenues and costs. Generally, the difference is mainly due to the costs of debt. Therefore, the distance between EBIT and EBT measures, indirectly, the relevance and the riskiness of the debt in the capital structure: the greatest this distance, the higher the cost on debt, and thus the higher the amount and the riskiness of debt in the capital structure.

B) Capital Invested and Capital Structure

The aim of the analysis about the Capital Invested and Capital Structure is to investigate the sources of capital and the use of these sources.

The Capital Invested defines the amount of capital invested in the firm's activities, while the Capital Structure

defines the sources of capital used to finance them.

The analytical scheme proposed is based on separation between financial and non-financial assets-liabilities and, with regard this second category between operating and surplus assets-liabilities with regard those that are not linked to operating activities. Two are the main implications of these separations:

– First, they allow determining the investments directly in the firm's assets, both operating that surplus, and the relative capital sources;

– Second, they allow valuating the variances of the assets-liabilities directly in term of variances of cash-flows.

The analytical scheme proposed to investigate the Capital Invested and Capital Structure of the firm is represented in the *Table 2 (note that the bracket indicates a negative value)*.

Table 2. – Analytical Scheme of the Capital Invested and Capital Structure

Net Intangible and Tangible Assets – Operating
Financial Assets – Operating
Inventory stable over time – Operating
Net Operating Capital Expenditures (CAPEX)
Trade Receivables net
(Trade Payables)
Trade Working Capital (TWC)
Inventory
Other Operating Receivables net
(Other Operating Payables)
Net Working Capital (NWC)
NET OPERATING CAPITAL INVESTED (NOCI)
Net Intangible and Tangible – Non-Operating
Financial Assets – Non-Operating
Other Non-Operating Receivables
(Other Non-Operating Payables)
SURPLUS ASSETS (SA)
CAPITAL INVESTED (CI)
(Provision for Employee)
(Provisions for Risk and Charges and Taxes)
(PROVISIONS)
NET CAPITAL INVESTED (NCI)
Share capital
Reserve of realized earnings
(Treasury shares)
Net Profit / (Loss)
EQUITY (E)
Long-term Financial Debts
(Long-term Financial Credits)
Long-term Net Financial Position (L-NFP)
Short-term Financial Debts
(Short-term Financial Credits)
(Marketable Assets)
(Liquidity)
Short-term Net Financial Position (S-NFP)
NET FINANCIAL POSITION (NFP)
CAPITAL STRUCTURE (CS)

The Net Capital Invested (CI) is composed by the Capital Invested in CAPEX, Net Working Capital, Surplus Assets, less Provisions. The Capital Structure (CS) is defined by equity and net financial debt.

Specifically, the sum of CAPEX and Net Working Capital (of which the Trade Working Capital is the difference

between Trade Receivables and Trade Payables only) defines the Net Operating Capital Invested (NOCI). It is the capital invested in the operating assets fixed and working. The sum of NOCI and Surplus Assets (that is the amount of capital invested in non-operating assets fixed and working) defines the Capital Invested (CI). It is the capital invested in all assets of the company both operating and non-operating. The difference between the CI and the Provisions defines the Net Capital Invested (NCI).

Also, if the Provisions can be considered a debt, in this context are considered in the Capital Invested with a negative sign in order to define the Capital Structure based only on the two main capital sources: equity and financial debt.

This analytical scheme allows to define the capital invested that it requires financing costly in terms of debts and equity.

The CAPEX (*Capital Expenditures*) refers only to the operating investments. Therefore, it can be defined as *Net Operating Capital Expenditures* and it represents the investments needed for the realization of the Operating Income.

They refer mainly to the operating investments in fixed asset (tangible and intangible) by the company necessary to realize the products sold on the business net to their amortization and depreciation funds.

The investments in Financial Assets are included in the CAPEX only if they have an industrial strategic relevance. Otherwise, the investments for the realization of financial income are included in the Surplus Assets that groups the non-operating investments.

Sometimes, in the CAPEX are included also the inventory. If the company needs a constant and stable stock of inventories in order to guarantee the production activity (stocks of raw materials, semi-finished and finished products) and to cover timely the customer needs (stocks of goods to be sold), it represents a stable investment. Therefore, the part of inventories that in monetary value must be stable in the company for the needs of the business can be approximated to an investment in tangible assets, and thus it is included in the CAPEX.

The Net Working Capital (*NWC*) refers to the investments in working capital of the firm arising from the repetitive operations (cycle of buying, processing, sales). It is equal to the difference between current assets and current liabilities arising from the company's operating activities. Therefore, it does not include financial and surplus assets and liabilities (with regards non-operating company's activities). Specifically, the NWC is composed by:

– *Trade Working Capital* (TWC): it is the difference between Trade Receivables and Trade Payables arising from the trade activities of the business with customers and suppliers. The trade receivables are net of the allowance for doubtful accounts and bad debt;

– *Inventories*: it is the value of the inventory in a time *t*. They can valuate based on FIFO (first in, first out), LIFO (last in, first out) and the Weighted Average.

– *Other operating receivables less the other operating payables*: they refer to the receivables and payables arising from the operating activities of the company different from the strictly trade (grouped in Trade Working Capital) and the financial receivables and payables (grouped in Net Financial Position).

The NWC entity is a function of the operating income with regard the operating revenues and costs on the one side, and the time of cash-in and cash-out of the operating revenues and costs on the other side. Therefore, the higher the NWC, the greater the receivables and inventories than payables, and thus the lower the cash-in. Otherwise, the lower the NWC, the lower the receivables and inventories that payables, and thus the higher the cash-in.

The NWC measures the resources used in the operating current activities. Thus, assumed equal revenues, the greater the NWC the higher the financial needs. In this case, the receivables increase and the lack of cash-in with their displacement in the future time, increases the financial needs to cover the cash-out.

The Surplus Assets (*SA*) refer to the investments in non-operating area. It is composed by:

– Tangible and Intangible assets for the realization of the non-operating activities that leading to the non-operating income;

– Financial assets, such as shares and financial credits, that leading to the financial income;

– Receivables and Payables due to the time of cash-in and cash-out related to the non-operating revenues and costs.

The Provisions refer to the funds accrued for risk and charges, for employees and for taxes. They refer to the

amount of costs accrued but not paid, that will be paid in the future to the realization of the reference event. In this contest, they are reported in the Capital Invested (CI) with a negative sign. They can be interpreted as obligations derived directly from the operating area.

In order to allow a clear representation and not to dirty the NWC, the provisions can be presented separately from this and from the surplus assets.

The introduction of the provisions in the Capital Invested (with negative sign) allows defining the Capital Structure based only on the two main capital sources: equity and net debt. Nevertheless, they can be considered as debt for the company and thus as financial sources. In this case, they are considered in the Capital Structure (CS).

The Equity (*E*) refers to the own sources of the company. Two are the main types:

– the capital invested by the stockholders;

– the self-financing of the company due to the cash-flows generated and not distributed in dividends form, by increasing the reserves.

The Net Financial Position (*NFP*) refers to the net financial debt of the company. It is equal to the difference between financial debts only (both long that short terms) and the liquidity, marketable assets and financial credits. The NFP can be divided in two parts:

– *Long-term NFP*: it is equal to the difference between long-term financial debt and long-term financial credit;

– *Short-term NFP*: it is equal to the difference between short-term financial debt and the sum of short-term financial credits, marketable assets and liquidity.

The non-financial debts are included in the NWC. Therefore, the NFP's construction requires the NWC's construction jointly. It is not possible to define the NFP without defining jointly the NWC.

C) Free Cash Flow from Operations and Free Cash Flow to Equity

The aim of the analysis of the Free Cash Flow from Operations (FCFO) and Free Cash Flow to Equity (FCFE) is to investigate the way by which are defined the operating cash-flows and the dividends over time.

It is based on the analysis of the cash-in and cash-out arising from the company's activities leading to the Free Cash Flow from Operations and Free Cash Flow to Equity.

For the determination of cash-flows the items relate to the Operating and Net Income on the one side, and the items relate to the Capital Invested and Capital Structure on the other side must be considered in a different way.

The items of Operating and Net Income must be considered with regard their value in the same year of the cash-flows determination and with the same sign. Therefore, for the definition of cash-flow in time t_1 it must be considered revenues and costs at the same time. Specifically, all different types of revenues (operating, non-operating and financial) generate a cash-in; all types of costs (operating, non-operating, financial and taxes) generate a cash-out; only the non-cash operating costs (amortization, depreciation and accruals) must not be considered because they do not generate cash-flow movements.

The items of Capital Invested and Capital Structure must be considered with regard their changes between two different years. Therefore, for the definition of the cash-flow of time t_1 it must be considered the change of item between t_0 and t_1. For the cash-flow determination, each item of Capital Invested and Capital Structure must be considered in order of the movements in terms of cash-flow independently of their nature.

The analytical scheme uses to investigate the Cash-Flow from Operations and Free Cash-Flow to Equity is presented in Table 3 *(note that the bracket indicates a negative value)*.

Table 3. Analytical scheme for free cash flow to company and free cash flow to equity

EBITDA
(Increase) / Decrease – Trade Receivables net
Increase / (Decrease) – Trade Payables
(Increase) / Decrease – Trade Working Capital (TWC)
(Increase) / Decrease – Inventory
(Increase) / Decrease – Other Operating Receivables net
Increase / (Decrease) – Other Operating Payables
(Increase) / Decrease – Net Working Capital (NWC)
(Increase) / Decrease – Net Intangible and Tangible Assets Operating
(Increase) / Decrease – Financial Assets Operating
(Increase) / Decrease – Inventory stable over time operating
(Increase) / Decrease – Capex
(Decrease) – Provisions for Employees
(Decrease) – Provision for Risk and Charges and Taxes
(Decrease) – Provisions
(Current Operating Taxes)
(Operating Taxes)
FREE CASH FLOW FROM OPERATIONS (FCFO)
Increase / (Decrease) – Share Capital in money
Increase / (Decrease) – Equity
Increase / (Decrease) – Long-term Financial Debts
(Increase) / Decrease – Long-term Financial Credits
Increase / (Decrease) – Long-Term Net Financial Position
Increase / (Decrease) – Short-term Financial Debts
(Increase) / Decrease – Short-term Financial Credits
(Increase) / Decrease – Marketable Securities
(Increase) / Decrease – Liquidity
Increase / (Decrease) – Short-Term Net Financial Position
Increase / (Decrease) – Net Financial Position (NFP)
Financial Revenues
(Interest on Debts)
(Other Financial Costs)
Financial Profit / (Loss)
Non-Operating Revenues and Non-Current Operating Revenues
(Non-Operating Costs and Non-Current Operating Costs)
Non-Operating Profit / (Loss)
(Increase) / Decrease – Net Intangible and Tangible Assets Non-Operating
(Increase) / Decrease – Financial Assets Non-Operating
(Increase) / Decrease – Other Non-Operating Receivables
Increase / (Decrease) – Other Non-Operating Payables
(Increase) / Decrease – Surplus Assets
(Current Corporate Taxes)
(Corporate Taxes)
FREE CASH FLOW TO EQUITY (FCFE)

The Free Cash Flow from Operations (FCFO) are the *Free Cash-flows from Operating Area* as derived by the company's operating activities and they are designed to pay all investors both in equity that debt. They represent the monetary component of the Operating Income of the company. Therefore, the FCFO is a function of the Operating Income (there is no difference between EBITDA and EBIT because the non-monetary costs are not considered) and dynamics in the NWC and CAPEX. They are defined "free" because they represent the cash that the company is free to distribute to debt holders and shareholders by having already covered the needs for investments in CAPEX and NWC.

The Free Cash Flow to Equity (FCFE) are the remaining free cash flows after the cover of all company's needs,

including payments on debt, and thus they are designed to pay the shareholders only. Therefore, they are the operating cash-flows and they represent the monetary component of the net income. They show as the FCFF are divided between bondholders, stockholders and taxes. If the FCFE are negative, they represent the company's capital need to continue its business. Therefore, it is the amount of the capital required for the recapitalization.

3. Default Risk Ratio

The default risk ratio (DRR) proposed in this paper is a composite index based the firm's fundamental analysis with regard its economic and financial dynamics. Items used are selected in order their relevant capability to highlight the default risk of the company due to the debt level. Specifically, they reflect the Capital Invested and Capital Structure of the firm and its profitability in terms of Operating and Net Income and Free Cash-Flow from Operations and to Equity.

The composite index (δ), that measures the default risk ratio (DRR) by indicating the firm's capabilities to face debt obligations, is based on the sum of three main coefficients $(\gamma_1, \gamma_2, \gamma_3)$ structured on the fundamental analysis of the firm as follows:

$$\delta = \gamma_1 + \gamma_2 + \gamma_3 \tag{1}$$

A) coefficient γ_1

The *coefficient* γ_1 is equal to the ratio between cash flows out linked to the Debt Commitment (CDC) and the current Operating Cash Flows (CFO), as following:

$$\gamma_1 = \frac{\mathrm{CDC}}{\mathrm{CFO_{(A)}}} \qquad 0 \leq \gamma_1 \leq 1 \tag{2}$$

where: CDC is equal to the interest on debt to be paid accrued to debt level at the end of previous period $\left(DK_{D(-1)}\right)$ plus the share of debt capital (principal) to be reimbursed in the period based on the debt level at the start of the period (αD). Thus, the CDC can be rewritten as follows:

$$\mathrm{CDC} = \alpha \mathrm{D} + \mathrm{DK_{D(-1)}} = \mathrm{D}\left(\alpha + \mathrm{K_{D(-1)}}\right) \tag{3}$$

The $\mathrm{CFO_{(A)}}$ is the current operating cash flows (realized in the period) and it is equal to the EBITDA plus the changes in the Net CAPEX and to the Net Working Capital (equal to the changes in inventories plus the receivables minus the payables) minus the use of the Fund.

By using the Eq. (3), the Eq. (2) can be rewritten as follows:

$$\gamma_1 = \frac{\mathrm{D}\left(\alpha + \mathrm{K_{D(-1)}}\right)}{\mathrm{CFO_{(A)}}} \qquad 0 \leq \gamma_1 \leq 1 \tag{4}$$

Therefore, the lower the distance between CDC and $\mathrm{CFO_{(A)}}$, the higher the default risk due to firm's inability to face debt obligations.

If the firm is financed by equity only, the coefficient is equal to zero. Otherwise, if the firm is financed by equity and debt, the limit of coefficient is equal to one and consequently the CDC is equal to the $\mathrm{CFO_{(A)}}$. When the value of the coefficient is greater than one, the firm is unable to face debt obligations and, thus it can be considered in default.

B) coefficient γ_2

The *coefficient* γ_2 is equal to the ratio between the Financial Debt Book Value (D) and Liquidable Assets (LA) in place, as follows:

$$\gamma_2 = \frac{\mathrm{D}}{\mathrm{LA}} \qquad 0 \leq \gamma_2 < \varepsilon \tag{5}$$

The LA is equal to liquid assets: tangible, intangible and financial assets, credit, inventors. In order to be considered as a liquid, the asset must have two characteristics: first, it is characterized by a market value; second, it must be marketable in the short-time.

If the amount of the liquid assets in place is greater than the amount of debt, they can be easily sold on the market and proceeds to use in order to satisfy bondholders; otherwise, if the debt amount is greater than liquid assets in place, even if they sold them on the market the bondholders' expectations cannot be satisfy completely.

Therefore, this coefficient measures the coverage of debt obligations in insolvency case and, thus it is a measurement of bondholders' guaranty. Many more are the liquid assets in place, the higher the bondholder's guaranty in insolvency case. Otherwise, the greater is debt than the liquid assets, the greater is the bondholders'

risk.

If the firm is all-equity financed, the coefficient is equal to zero. Otherwise, if the firm is financed by equity and debt, the coefficient can vary between zero and a value (ε) defined by the bondholders on the basis of their risk aversion. In any case, one is the coefficient value that can be considered as alert point $(\varepsilon = 1)$.

C) coefficient γ_3

The *coefficient* γ_3 is equal to the ratio between Cash Flow to Equity Net Current Debt $\left(CFNE_{(A)}\right)$ and Cash Flows to Equity Net Debt Expected $\left(CFNE_{(E)}\right)$ with regard the same time, as following:

$$\gamma_3 = \left(1 - \frac{\mathrm{CFNE_{(A)}}}{\mathrm{CFNE_{(E)}}}\right) \quad 0 \leq \gamma_3 < \varepsilon \tag{6}$$

The Cash Flows to Equity is equal the Operating Cash Flows (CFO) plus the variances in equity (only for its increase or decrease due to cash and cash-equivalent) and Net Financial Position (equal to financial debts minus cash and cash-equivalent) and minus the net interest paid on debt. It is possible that the dividends are paid by debt. In this case the increase in debt is not used to increase the investments but to pay dividends. The firm reduces the capabilities to increase the future CFO and then the future CFE. Therefore, in this context are considered the Cash Flows to Equity Net of Debt Increases (CFNE).

The positive amount of the CFNE indicates the dividend amount for the shareholders; otherwise its negative amount indicates the increase in equity to cover the firm's needs.

The smaller the difference between CFNE Current and Expected, the greater the shareholders' satisfaction, then the higher the firm's capability to raise capital on favourable conditions in financial markets. Therefore, the coefficient γ_3 can be considered a proxy of the discipline effects of debt on the management (Jensen, Meckling, 1976; Jensen, 1986). High debt levels allow management to invest capital in positive net present value projects that increase the CFO and the CFNE with the maximization of the equity value.

In this context, it is reasonable to assume: first, CFNE Expected ($\mathrm{CFNE_{(E)}}$) is the max value for the CFNE; second, CFNE Current ($\mathrm{CFNE_{(A)}}$) cannot be higher than $\mathrm{CFNE_{(E)}}$. Therefore, $\gamma_3 = 0$ is the max value of the coefficient and represent the best condition. In this case the firm maximizes the equity value because the shareholders' expectations are realized.

Otherwise, the lower the $\mathrm{CFNE_{(A)}}$ respect to the $\mathrm{CFNE_{(E)}}$, the higher the coefficient value. In the absence of the $\mathrm{CFNE_{(A)}}$ the coefficient is equal $\gamma_3 = 1$. Note that the coefficient value is higher than 1 $(\gamma_3 > 1)$ if the $\mathrm{CFNE_{(A)}}$ is negative.

Since the CFNE is equal to the CFO minus the CDC, the Eq. [6] can be rewritten as follows:

$$\gamma_3 = \left(1 - \frac{CFO_{(A)} - D\left(\alpha + K_{D(-1)}\right)}{CFO_{(E)} - D\left(\alpha + K_{D(-1)}\right)}\right) \tag{7}$$

and thus:

$$\gamma_3 = \left(\frac{CFO_{(E)} - CFO_{(A)}}{CFO_{(E)} - D\left(\alpha + K_{D(-1)}\right)}\right) \tag{8}$$

On the basis of the Eqs. (4), (5) and (8) the Eq. (1) can be rewritten as follows:

$$\delta = \frac{D\left(\alpha + K_{D(-1)}\right)}{CFO_{(A)}} + \frac{D}{LA} + \frac{CFO_{(E)} - CFO_{(A)}}{CFO_{(E)} - D\left(\alpha + K_{D(-1)}\right)} \tag{9}$$

4. Discussion and Conclusion

The Eq. (9) shows that the default risk ratio (δ) is the function of three main ratios:

– The first, is the ratio between the debt obligations, with regard both the part of debt to reimburse and the interests to pay, and the amount of the actual operating cash flows. Lower is the distance between them, the lower the firm's capability to face debt obligations, the higher the default risk of the company. Therefore, the higher the ratio, the higher the default risk of the company;

– The second, is the ratio between debt amount and the level of liquid assets in place. If the debt amount is greater than liquid assets in place, even if they sold them on the market the bondholders' expectations cannot be satisfied completely and thus the debt holders' risk increases. Differently, the debt holders' risk decreases if the

amount of liquid assets in place is greater than the amount of debt. Indeed, in this case it is possible to sell them and to face the obligations. Therefore, the higher the ratio, the higher the default risk of the company;

– The third, is the ratio between the difference between the operating cash-flows expected and actual, and the difference among the operating cash-flows and the debt obligations with regard both the part of the debt to be reimbursed and the interests on debt. Therefore, the higher the distance between the expectation and the actual amount of the operating cash flow, the lower the firm's capability to face debt obligations. In other words, the lower is the firm's capability to realize operating cash-flows, the higher the firm's default risk.

Therefore, the higher the default risk ratio (DRR) (δ), in order to the sum of its three parts, the higher the company's difficulties to face debt obligations and thus, the higher the default risk. Then, a high level of the default risk ratio highlights the company's difficulties to support the debt level by increasing the probability of the default.

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