CORPORATE FINANCE AND OPTION THEORY: AN EXTENSION MODEL OF RAO AND STEVENS (2007)

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UNIVERSITAT ROVIRA I VIRGILI

Doctoral Thesis

Corporate Finance and Options Theory: An Extension Model of Rao and Stevens (2007)

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此书献给我的父母：

没有你们，就不会有我今天所有的一切

你们的爱，时刻在我身边，给予我困境中前行的力量

我爱你们！

A mamá española con afecto y agradecimiento

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Contents

Introduction

The real voyage of discovery consists not in seeking new landscapes, but in having new eyes. (Marcel Proust)

In firms, events and their causes or motives do not always happen consecutively, or in certain pre-logic order. They could happen simultaneously and in a chain. However, whenever we decide to study them, to investigate them, all we can is to do it in a way as to proceed reading a book without ending: one word after another, one page after another, one chapter after another. It seems like this way is not that convenient, but it has one advantage which is to avoid dispersion, so that we can concentrate time and effort in order to win intensity and obtain the depth in research.

Learning new relationships between things and phenomena can harvest fruits. Sometimes we embrace huge amount of information or just keep our eyes open for those phenomena, which might drown us so that we are not able to see them through deeply. The ideal to reach would be to impose a way to make distinctive science work together for a great global theory although we haven't achieved a rigid framework yet. The British philosopher Shaftesbury (1671—1713) in his book *Moralists* (1709) and *Teodicea* (1710) stated that all the things in the world indicate connection or unity. Totality can be seen in big things and small things with "active relation and sympathy in order to reach a common goal"; however, Shaftesbury also said that every part has its own space to adapt to survive.

Naturally, the goal to discover the unity, globally and the flexibly can be a very slow process. From this point of view, it could be a strange paradox: the goal of getting to know more deeply the whole is a slow process (improvement is slow) but we also want this knowledge which is obtained from this relative 'slow' research to be applicable and dynamic in a global vision. From the globality point of view, this requires the resign from simultaneous observation of the movements. For us, in order to present the doctoral thesis, we will participate in the quoted slow improvement so as to contribute the formation of a more global vision referring the firm valuation.

However, what are our purposes for this research? We will further explain them by showing three basic assumptions of this research:

1) We locate this investigation in the field of the market valuation of relatively large firms.

2) We refer some markets with "normal" behavior for this research. This means that those involved firms have some such as social, political, economical or financial environments, which could allow the development and evolution of the business activities take place with rationality and dynamical stability. Those firms are relatively stable and predictable, although with the existence of 'normal risks'.

3) Our interest is the firm's value creation in the sense of who created them and what part of value goes to whom in the end.

Since our attention sheds light on the value creation, which means that we have to chop off some important and tempting approaches which already exist. One of the approaches which we paid major efforts, at the beginning, was a stochastic model of firm growth rate related to the firm size based on the work of the French economist Gibrat (1931) whose mathematical expression is: $Y = KX^{\alpha}$ where X and Y are economic variables, K and α are parameters determined statistically for each population. The greatest merit

to spread this law today is Sutton (1997), who made lots of contributions and motivated many other researchers to investigate in this field.

Why do we abandon this approach of investigation?

a) The analytical simplicity of this model althought it allows to introduce new important factors by:

$$Y = \sum_{j=1}^{n} K_j X_j^{\alpha}$$

It has the big disadvantage of not intervening in the possible interactions.

b) The ambiguity of the concept of "firm size". This concept is still under controversial discussion.

c) Most development and contribution of previous work are only worried about statistics or econometrics instead of analyzing entrepreneurial phenomenon as value creation itself and for us this is a point of our interest.

This abandon was not easy due to the magnetic idea to use the following equation:

$$Value\,Creation\,in\,(t,\,t+1) = Size(t+1) - Size(t)$$

We can show the purpose of our research: Conceive, elaborate and develop (in an initial way) one conceptual system which connects factors like clients and employees with remuneration to other stakeholders (shareholders, debtholders, government). Based on all those viewpoints of value creation for the firm, it would be possible to show some formulations in cost of capital

and firm valuation which also reflects the part of value created by employees (or clients) in comparison with total salaries or other social benefits which employees obtain from the firm. From this lens, we suppose that we are under the condition of comparing value creation to shareholders as measured today with the one that includes measuring the portion of value creation for employees and/or with factor of clients which has reflection in market value of the firm. Therefore, how can we present this in the formulation of firm value?

The conquest of clients is very important, but the retention, fidelity and the satisfaction of the clients (index of satisfaction of clients) concedes the value of client. However, the director board, the general managers and those shareholders (all of the stakeholders) are accustomed to margin, benefits, stock price, ROE, EBITDA, etc. Financial magnitude can drive a bias version of clients (to treat clients and employees just as numbers). This might benefit the firm in short term, but a loss in the long run. Therefore, we need to design a conceptual and sustainable frame to analyze quantitatively the relation, which links the growth of satisfaction of clients (or employees) with, holding other variables constant, one annual sustainable growth in firm's margins of benefits value which can be expressed by the following function:

$$\Delta V = f(\Delta X_1, \Delta X_2)$$

For each of the two groups of stakeholders that we mentioned (ΔV = growth in market value of the firm; ΔX_1, ΔX_2 are growth in index of the satisfaction of clients and employees respectively). From this way, we can see that:

1) If there is a relationship between the working climate and value creation of the firm;

2) How can we justify investments determined in favor of this climate;

3) How can we include this part of investment into calculation of the value creation.

Therefore, the realized task is not that simple since we are obliged to respect certain norms and principles in accounting which might not sufficiently correspond to real practice like clients. For example, if the firm has a relationship with a group of faithful clients for "many years", is it still a good measure today to calculate expenses and investments independently from the factor of "many years"?

Till now, we believe that we should formulate three questions successfully and linkably:

1) Is it possible to measure, establish appropriate firm valuation metrics, which are necessary for business activities associated with different group of stakeholders?

2) Is it possible to summarize these metrics into one unique metric, a metric of the metrics, which is capable of explaining the market value of the firm with major detail in formulations started by M&M theorem?

3) Departing from "a metric of metrics", is it possible to provide elements which allow to incorporate the dynamics in time (or to think about a strategical model to dynamical one) and add risk and flexibility?

The following pages are the consequences that we accept the affirmative answers of these three questions. Unfortunately, this does not imply that the research we present here is at the height of an ambitious aim which stems from those three raised questions. We would rather think the complexity which exceeds us, although we are encouraged to confront those difficulties. Since this is still not a well-investigated field, the challenge of obtaining some results is sufficient incentive for us just like to explore the adventure of investigation.

The investigation can start describing synthetically (perhaps not quantifying) the global effects of all the relevant factors which influence firm valuation from the market point of view (*synthetic method*). However, even this procedure is undeniably useful if it could work out successfully, it will not be able to isolate different factors so as to quantify its individual influence. Consequently, another form of procedure could be used to study the individual influence of each factor based on known "ceteris paribus" (all other things being equal) (*analytical method*). This is the way to apply in parallel problems of some factors we consider relevant for our purpose of investigation, and also to study synthetically the global effects with its interactions (*Analytical-synthetic method*). However, the research method requires a base to build further on. This base is provided by the contributions of M&M theorem. For the first time, Modigliani and Miller (1961) permit to establish precise conceptual metrics with financial characters referring to the magnitude of cost of capital and market value of the firm.

The theories of Modigliani and Miller (1961) have influenced dramatically the development of the corporate world. The competence of firms also obliged the extending of the old mould of M&M theorem (Merton 1987). Actually, the paradigm of real option[1] allows us to go further on introducing the measurement of flexibility for decision making (Trigeorgis 1996; Guivernau 2004). After all, to face the risk needs certain degree of *adaptive flexibility*.

From the other lens, metrics have been developed from different financial areas which achieved in investigating the satisfaction of clients, some consumers in general, employees and also with respect to ecological, social responsibility of the firm, etc. All of those factors have one character of great specialization by itself. Therefore, interactive influences and even more possible impacts on cost of capital, market value of the firm and value creation are too far away to be analyzed. Perhaps for this reason, the majority of

[1]Thanks for the great development of financial options, standard and exotics, as well as the valuation methods which led us in this research.

those metrics are not only disconnected, but also contradictory among themselves within one field (for example, within the field of marketing). We can quote the affirmation as follows:

> Those metrics of marketing are very difficult to combine. In all of those big companies, different measurements disperse in areas, unity of investment, different periods of time, clients and they also depend on each of the firm. (Domínguez and Hermo 2008: 20)

If we add diversity of metrics on human resources and other fields, it might end up with chaos. It is necessary to get out of the huge amount of "metrics swamp" which is quite popular nowadays (there exists "quantimania", usually on irrelevant things from the viewpoint of our research). Therefore, we should try to choose the important and relevant metrics and create necessary aspects to relate them in a unique model if it is possible (although we believe that, unfortunately, the unique model can only be used for one firm). However, to achieve such a general result requires an appropriate and flexible framework so as to adapt the concrete necessities of each firm.

From another way, even having so many metrics with information, many index of satisfaction, we are still grieving from the non-satisfaction that we can not find something which goes deeply and globally. Therefore, we totally agree with the prospective of Kevin Roberts, the CEO of the worldwide advertising agency *Saatchi & Saatchi* who introduced one system of analysis in human group called *Xploring*. He said in a recent interview that:

> ...[it is necessary] to go from the simple task information to the deep knowledge and to the capability of foresight [...] Today we are drown in the information and we do not have any knowledge about almost anything. (El País, 6 april 2008)

This absence of deep knowledge, this absence of capability of foresight are what Roberts required to overcome urgently; Just like we are able to ap-

proach the essential thing without falling down in the temptation of the irrelevant thing. "I measure it like this because in the company we always do it like this", or "I measure it like this because this measure is very easy to understand". We should not forget *if we use a bad set of metrics, it will continuously result errors in decision making, which will lead the loss of value.*

We remember the reflection of Spinoza (1632-1677), "Everything, in so far as it is in itself, endeavors to persist in its own being". We think the quantitative way of thoughts are not enough. In order to go deeply towards a detail in the universe, it bears the risk of seeing only this unit but not the universe as a whole. Today we have shown hundreds of quantitative research works related to firm, but very few intend to study in depth as what it is, the whole qualitative vision. Perhaps we have reached the moment of possessing too much and too heavy quantitative work and now the space is left for other approaches related to investigating for what it is, and what needs quantification based on a global vision. This aspiration can answer the question brought up by the wife of Niels Bohr, another great physicist, to Einstein: "Do you think one day science can model in equations of symphonies of Beethoven? Einstein who was very affectionate to music answered, "Yes, I have no doubt about it, but everything essential of the symphonies will stay out of the models". The problem is serious, because in rigor we are lack of a criterion which allows us:

1) To judge the "fitness" of each metric, with what one would be in conditions to propose metrics to cover informative absences;

2) To assemble a set of metrics as a whole, and to make it complete and efficient.

We think firmly that this criterion must be the value creation related to the cost of capital and the market value of the firm. This guides our investigation in a way that value creation will be quantified in accordance with the joint

result (*global result*) across the applied metrics.

The idea of a global result, which allows us to have expectation to look for a kind of "full performance index" so that we can formulate the corporate purpose and objectives related with this index. The eventual optimal presence could take place in the creation of real options, which we consider as a valid instrument.

Previously, we have mentioned decision making. With respect to this, we have to bear in mind that managerial activity needs three levels: strategic decision making; tactical decision making and operative decision making

What we are interested here, our current investigation with strategic characters allows us to select metrics and suggest absences in the field. One task for us is to search in the literature and business practice to choose a subgroup in the first phase for the field of finance, marketing and in general stakeholders. The number of metrics is very huge (Domínguez and Hermo 2008: 227) so that the final selection would be a very demanding work.

We would like to refer three references which we have studied a lot for our investigation:

1) Rao and Stevens (2007) established one theory about cost of capital based on analysis of relations to debt with risk and firm value, like the tax rate and how government is behaved as stakeholders.

2) Mercer and Harms (2008) intended to formulate one integrated firm valuation theory, although their work drifted away from our viewpoint in the sense of underestimating excessively the role of the cost of capital, but in return they considered many factors habitually which are not taken account by the literature.

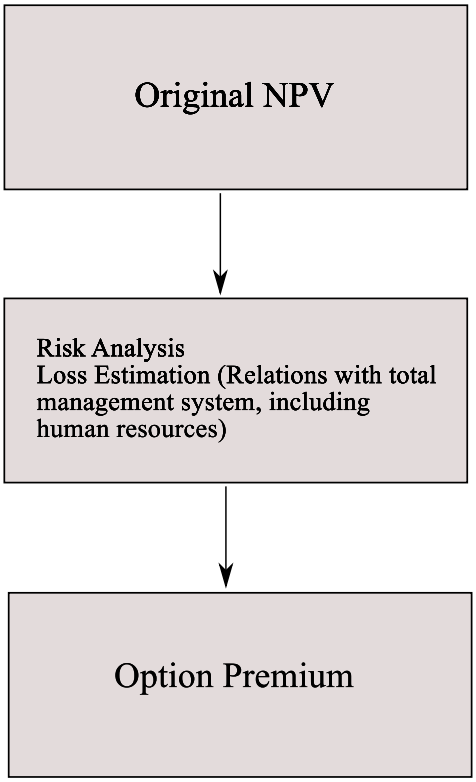
3) Baron and Armstrong (2007) dedicated to the human capital management and from the name "*Achieving Added Value Through People*" we can see that it indicates clearly the pretension that we can apply for.

In the end, unfortunately, it is not possible to jump with rapidity, precision and clarity of the observation at the first global principle explanatory or capable of offering the possibility of constructing convincingly the model. Therefore, we are optimistic with limitations respect to this investigation, especially, if we compare the distance of where we are right now to the global view we would like to achieve. Laozi used to say that heavy is the root of the light, and tranquility is the master of the agitation. In our case, the "heavy" is the difficult task of this investigation, and every step we make is like to climb a mountain. When we reach the peak of the mountain by each step we make forward, when the contribution of many researchers improve the process to advance and we can see the whole, simple view from the peak of the mountain, we achieve the "light" as Laozi mentioned. The unity will exist within the multiplicity and all will be visible with an idea originated from invisibility. With this, we can pass through the details of erudition to knowledge.

The previous reflections regarding value creation and metrics have led us to focus our research supported by the aforementioned three references. These reflections have been frutis of searching and reading numerous works which we will further indicate those which are more useful for us in the following parts.

We further investigate the affiliation between value creation and the satisfaction of clients due to the inspiration from the work of Anderson et al. (2004) who developed a theoretical framework which relates the clients' satisfaction and behavior with shareholders' value (measured by Tobin's q).

The work of Roemer (2004) is quite important in the field of applying option theory for clients in marketing. Roemer (2004) made a valuable reflection without quantitative support to justify that real options' logic is applicable to view the value of customers. Katoh (2005) contributed in the same line of research work with greater depth and details. She commented on the Real Options (ROs) approach to evaluate thin clients: "Real options



Source: Katoh (2005)

Figure 1: Real options approach

approach is enlargenment of NPV and is consistent with other investment merit appraisal." Her scheme of analysis can be described as Figure 1, which is considered to be applicable for clients and also employees of different categories.

The work of Kato (2009) was based for the first time the application of real options logic in the field of marketing:

> From the definition of marketing, marketers need capture the change of mind. Through using real options, marketers get not only ability of forecasting but also ability of management which

> includes the evaluation of change of mind. [...] The center of discussion is the definition of marketing. (Kato, 2009)

Previously, there were some partial works relating to a single type of real options, but they are more concerned with the modelling and implementation rather than analyzing if the application of real options are truly justified from the viewpoint of intrinsic marketing. Therefore, to our judegment, it is worthy to consider and mention the work of Haenlein, Kaplan and Schoder (2006) and Hogan, Lemon and Libai (2003). Another approach which has reflected the real options logic in marketing rests on the field of brand and patents. The work of Dias and Ryals (2002) and Bloom and Reenen (2002) provided some assistance in this regard.

- Relationship between the firm and employees: A sociological reflection

The employee management in an economic unit has been changed from the perspective of social relationship between different groups of the population, such as the slavery time or the model of capitalism. In respect to capitalism, it was described "modern" based on different histories. Marx said that it is historically possible for two conditions considered to be important:

1) There exists a huge number of workers, who are legally free but do not have sufficient life resources, and they master skills to work. (Actually we should add/complete the meaning of this capacity which is improved or increased by learning and innovated knowledge.)

2) Those instruments and resources of production (currently should complete distribution means, commercialization and financing) can be processed by a particular social class which acts as work buyers (firms). Today we might say someone who rents human capital.

This is to say, from the root of this vision, we find separation between the firm and employees and means of production, distribution. In consequence, this implies that the beginning of the period we had determined the social,

legal and economic condition. Like today, with changing evolution of the social, legal and economic system, our conception of this evolutionary view of seeing things will be positive. Following the great saying, "The present contains the future and lots of past..." Those reflections we will explain were born from this idea.

Now we have a democratic tendency in social relations which influence the firms in a different consideration of employees. Following decreasing tendency, employees are seen as individuals with very few rights inside the economic unit or simply 'obey' because they are the cost of the firm. (now it is not the case). In contrary, employees now tend to be considered as a main strategic asset when more rights and obligations are given by the firm; they can generate new ideas and leadership instead of only 'obey' without thinking. It is a strategic asset which is able to influence crucially in the activity of all firms; including the environment. Therefore, even though employees obviously generate a cost, but also they can be value creator. Based on this understanding, we would rather prefer the concept of "human capital" instead of "human resources".

From here we can talk about the value creation for employees, because they have right of part of this value created by the firm. Therefore, it is very important to find qualitative or quantitative measures (we have to know that in social science there are variables, magnitudes and measurements as much qualitative as quantitative). This metric eventually allows us to compare wages of employees with monetary value like wages/value created, some employees will decrease their wages and others might increase. According to what we mentioned, we understand human capital, firms should try to catch talents, which is to identify, attract, develop and maintain the best employees as the same way they do with clients.

In concrete expression of these routines to conquer and maintain human capital is actually the concept of *employer brand*. A set of activities and actions which one firm has to start or maintain in order to manage the brand

which is perceived as an attractive one by the current and potential employees (it would be really absurd to spend loads of money in catching talents and meanwhile ignore or neglect the one you captured; or similar behaviors as we mentioned with the clients). We think that to build a brand as employer is even more difficult than building a brand among clients.

Following the reflection we did, one fact we are interested with surprise: in the balanced situation, independent of the criteria which you used to value, there is no place for employee at all. They are implicit as cost in other documents; like machine is a cost, but it is included in the balance sheet. From the other way to say, in a society of slavery, in order to manage our balance sheet, we must be sure that slaves are fixed assets. This is also to say, the path has changed to a legal free man who is employed in a firm which the cost is actually ignored from the balance sheet.

If one of the motivations of being proud of balance sheet and accounting is to show the reality (real situation) of the firm, this allows us to carry out innovation in accounting of the firm. Therefore, our perspective is to modify the classical structure of accounting in order to include human capital as strategic asset which can add value. This perspective has been started to investigate already. In consequence, we consider traditional balance sheet as a sociological past and it could be a mistake to accept that we only need to make a modification or combination so as to solve the problem in order to catch the value of this strategic asset. In all cases, it could be seen as a fine first approach when we haven't obtained other ideas. We should not forget it is a mistake to accept the present based on all the information in the past. To the opposite, we accept the part of past which contains elements that are in the present (in another way, ideas which are developed yet). Until now, we have to reconsider t*he traditional way of accounting, as they treat employee as costs without showing them in the balance sheet.* An interesting reflection regarding this issue can be found in Mazarracín (1998), Vallverdú (2000), Gutiérrez (1990) and Vallverdú (2003) published by the Department

of Economia Fianciera de la Universidad de Murcia.

In this field of human capital, we started our ideas based on the findings of Fister and Seth (2007). Van den Berg (2002) pointed out that "Real Option theory provides an approach which values the opportunities arising from intellectual capital." Wang and Lim (2008) centered their work in applying real options to analyze the role of employee incentives to make specific knowledge investments:

> Employees' investments in specific human capital are often critical to the success of a real optin project, but the very flexibility that allos a firm to change course in response to new information also affects employees' incentives to make such specific human capital investments. We develop a model of real option investment in a real option project on employee incentives. [...] The model suggests that the effect of [*such*] investment may be positive. Therefore, firms and managers should take into consideration the role of employee incentives when applying real options logic to investment decision making.

We are motivated by the aforementioned work to introduce the analysis of ROs, however we would not follow the models proposed by Katoh (2005) and Kato (2009) since for us those models seem to be too far away from the forms of real options valuation and too close with the traditional ways in risk estimation. Those two authors proposed the expression "real options logic" to relate with decisions in Human Capital. The contribution of Badders, Clark and Wright (2007) and Bhattacharya and Wright (2005) are also indispensable within this respect. The application of real options logic in the field of career options for employees has been studied in a very interesting way by Ruffino and Treussard (2007) (although this question of investigation finally stays too far away from our target of the Thesis).

Previously, we have mentioned that we would like to encompass the field of finance, marketing and stakeholders. With this big objective, we intend

to start by the following stages:

1) An overview of firm valuation (Chapter 1).

2) Study the model of Rao and Stevens (2007) (Chapter 2).

3) Introduce the option theory so as to reformulate the model (Chapter 2).

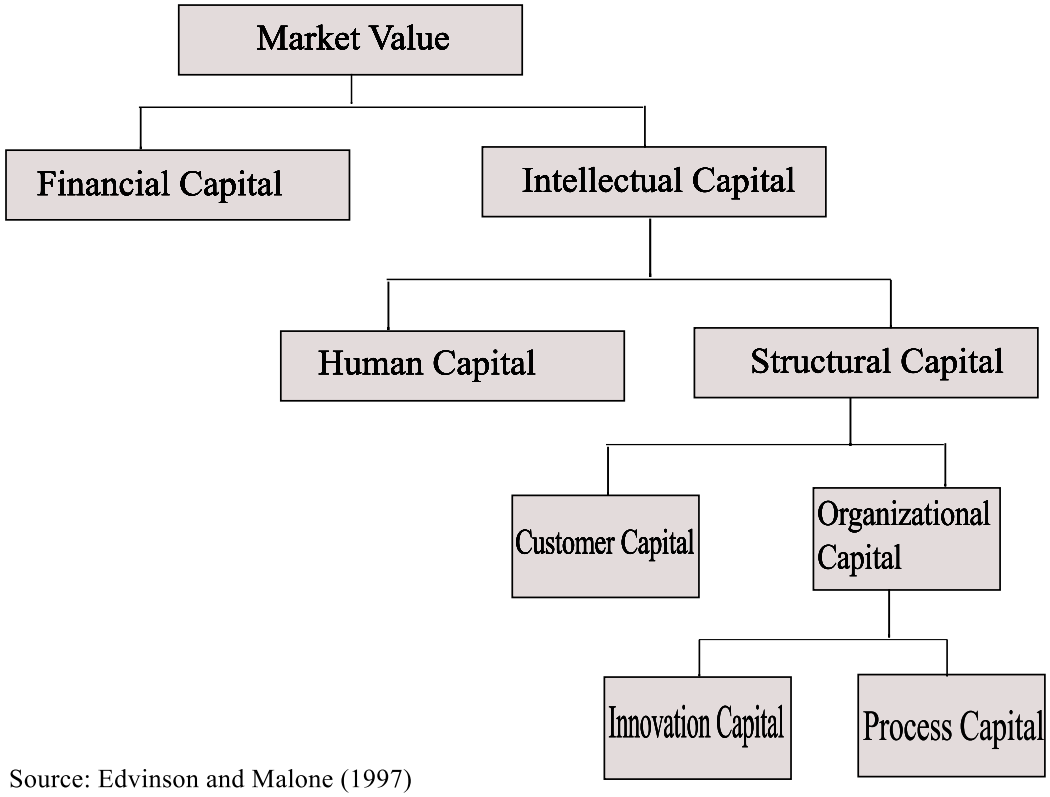
4) Review the literature regarding the ordinary options and real options in order to (Chapter 3):

- **a)** Justify if it is convenient and adequate to apply in the field of corporate firms;
- **b)** Understand the real options logic which allows us to formulate an extension model of Rao and Stevens (2007) later on;

4) Reflect specifically in the field of clients and employees and revise the literature regarding metrics applied in such fields (Chapter 4). The possibility to include an unique model of those two fields is helped by *The Skandia Market Value Scheme* (Edvinson and Malone 1997:185) which is shown by Figure 2:

5) Apply the ROs theory and exclude the habitually so called *employees stock options*[2], in order to propose a valuation model which we name *option of modification* (Chapter 5).

[2] This type of option can be read from the work of Spatt, Alexander, Dubofsky, Nimalendran and Oldfield (2005) which states: "Questions about possible difficulties in obtaining reliable estimates of the value of employee options under FAS 123 (R) often appear to arise from misconceptions about modern financial economics and valuation methods. Below we address key questions and misconceptions."



Source: Edvinson and Malone (1997)

Figure 2: The Skandia Market Value Scheme

6) Extend the Rao and Stevens (2007) model including the model obtained in 5). This extension drives us to rethink CAPM[3]. As indicated in 5), we have introduced the cost of information which is not considered by CAPM. This reconsideration will help us to establish the quantity of increasing firm's market value, which is a consequence of the option of modification. (Chapter 5)

After Chapter 5, the *Conclusion* will be shown under criterion for distinguishing:

a) Those conclusions directly come from the facts of the research;

b) Those conclusions arise from the consequence of the realized research which we call *Future Research*.

Finally we will give further details regarding the *Bibliography* in respect to the carried out research.

The final comment regarding this research is that it has a theoretical character, whose ultimate objective is based on passing on one fact to the investors: with investments in clients and employees, an increase in firm's market value will take place so that investors can first recognize and then evaluate such an increase. Till now, an empirical contrast is still not possible. Indeed the study of Rao and Stevens (2007) also doesn't include an empirical contrast but only one invented example with illustrative character. Nevertheless, in *Future Research* we will intend to obtain a scheme to tackle the empirical contrast.

[3]The inspiration for this is based on the model of CAPMI by Merton (1987).

Chapter 1

Firm Valuation: An Overview

1.1 Valuation Framework

1.1.1 Firm valuation and decision-making

1.1.1.1 How to define and measure the value of a firm?

In competitive terms, value is the amount buyers are willing to pay for what a firm provides them. Value is measured by total revenue, a reflection of the price a firm's product commands and the units it can sell. A firm is profitable if the value it commands exceeds the costs involved in creating the product. Creating value for buyers that exceeds the cost of doing so is the goal of any generic strategy (Porter 1985:38):

> Every major resource allocation decision a company makes lies some calculation of what that move is worth (...) how a company estimates value is a critical determinant of how it allocates resources. And the allocation of resources is a key driver of a company's overall performance. (Luerhman 1997)

We can see the meaning of Luerhman more clearly by Figure 1.1:

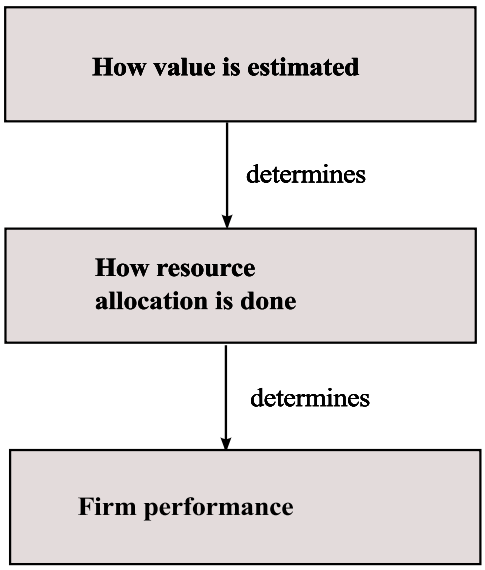


Figure 1.1: How value is estimated

Damodaran (1994) stated some key factors in firm valuation and decision making:

> 1) Knowing the value of an asset and what determines that value is a prerequisite for intelligent decision making—in choosing investments for a portfolio, in deciding on the appropriate price to pay or receive in a takeover, and in restructuring corporations.
>
> 2) The premise [...] is that reasonable estimates of value can be made for most assets and that the same fundamental principles determine the value of all assets, real as well as financial. Some assets are easier to value than others, the details of valuation vary from asset to asset, and the uncertainty associated with value estimate is different for different assets; but the core principles remain the same.
>
> 3) The role of valuation in portfolio management, in acquisition analysis and in corporate finance.

We examine the fundamental principles of valuation based on the work of Damodaran (2001: 116-117). In general, the value of any asset is the present value of the expected cash flows on the asset, and it is determined by the magnitude of the cash-flows, the expected growth rate in these cash-flows, and the uncertainty associated with receiving these cash flows. Almost everything we do in corporate finance relies on valuation in one form or the other. The objective in corporate finance is stated, most broadly, as the maximization of the firm value and, more narrowly, as the maximization of the stock price. To make good investments, financing and dividend decisions, managers need to understand what determines firm value and how markets assess that value.

The purpose of this investigation is to help current and prospective managers make better investment and financing decisions. If a choice is better, it must be better by some standard. Other, one alternative is as good as the

next. That standard is wealth maximization. An action increases wealth if the benefits gained exceed the benefits given up. We will measure benefits primarily as money gained and money given up. Money is a uniquely convenient benefit because it can be exchanged for virtually any other product. The wealth criterion is so general that it fits a vast range of decisions. In single-period business decisions, wealth is created if cash inflows exceed cash outflows more than we could have earned by investing the money somewhere else during that period. The net present value of an investment or course of action is the present value of all cash inflow minus the present value of all outflows. Thus, NPV is the economic profit or wealth created by a multi-period investment (Seitz and Ellison 1999:5).

Sometimes growth opportunity can not be valued—there are too many assumptions, too many poorly defined components, and lots of risk. In other cases, underneath the complexity there's just not a lot of value; there is no long-term sustainable competitive advantage (Amram 2002:185).

1.1.1.2 What is it that determines firm value?

At one level, it can be argued that the value of an asset is what you paid for. Accountants often use this as their measure of value and call it *book value*. There are two problems with this definition. The first is that what you paid for an asset, especially if the asset was acquired or developed well in the past, may not reflect what that asset is worth today (past is not an accurate reflection for the future). The second is that this definition misses the value that will be created by future investment (*synergy effect*). We will argue that the value of the assets of the firm and, by extension, of the firm itself, is determined by the cash flows that these assets are expected to generate and the uncertainty associated with these cash flows. These expectations might change from day to day as new information comes out about the firm and the macroeconomic environment changes. We can name this measure of value the *market value*. Since the firm is financed with a combination of debt and

equity, the value of the equity will not generally be equal as the firm's value, except in the case where a firm has no debt outstanding. We determine the value of a firm not only by how well it manages its existing assets, but also by how well it invests in new assets. Investors base expectations about the firm's future on the quality of firm's project and the amount of its earnings it reinvests.

1.1.2 How firm valuation is related with decision-making?

In studying strategy, we are interested in analyzing why firms make their decisions and what distinguishes good decisions from poor ones, given the opportunities and the constraints firm will face:

> Business decisions require the measurement of the economic profits, which are based on the concept of opportunity of cost. This concept says that the economic cost of deploying resources in a particular activity is the value of the best forgone alternative use of those resources. [...] Economic profit is closely related to the concept of NPV from finance. (Besanko et al. 2000:20)

Given the basic premise that the financial objective of the corporation is to maximize the wealth of the investors in the corporation, investment project analysis is synonymous with investment project valuation (Brennan and Trigeorgis, 2000). Investment projects should be accepted if and only if their value exceeds their costs, so that their acceptance increases the wealth of investors. It is useful to distinguish three stages in the evolution of the valuation models used in the project analysis.

What is the right measure of the value of a project? The answer from corporate finance is emphatic: Investment should be carried on if it could make a firm more valuable. By extension, this will make its stockholders wealthier, with the stock price reflecting this wealth. The objective of maximizing firm value applies also for private businesses and small firms.

The financial objective of an individual should thus be to choose between alternative patterns of consumption and investment opportunities so as to achieve the greatest satisfaction. The financial goal of a firm should be to help its owners achieve their objective—to maximize the utility of each of its owners. The usual focus in finance is on the residual owners of the firms, its stockholders. It would be impossible for a firm to directly maximize the utilities of a variety of individual stockholders having different levels of wealth, different preferences for current versus future consumption and different attitudes toward risk.

> However, a firm can avoid such conflicts of interest [...] by adopting as its goal the maximization of its owners' wealth. In a perfect and complete market, the individual owners can then adjust their income flows and investment portfolio by borrowing and lending, selling and buying in the market the amounts that would maximize each owner's particular satisfaction. (Trigeorgis 1996:24)

According to Trigeorgis (1996), in finance it is customary to adopt the position that biggest objective of the firm is to maximize the economic welfare of its residual owners for the following reasons:

- We are interested in a normative model of how managers should behave, as opposed to attempting to describe their actual behavior (Which might be suboptimal)
- Top management incentives are tied to the welfare or the firm's owners to whom top management is eventually responsible. Management maintains some degree of discretion in deviating from that objective, but it serves under the threat of being replaced or being taken over by another firm if it repeatedly neglects the welfare of its owners.
- Within certain constraints guaranteeing a stable competitive equilibrium, the pursuit of self-interest by firms in a free market economy tends to enhance the general economic welfare.

- Pursuing the welfare of other publics can serve in many cases as a means consistent with the goal of maximizing the residual owner's welfare in the long term.

Maximizing the market price of a firm's stock does not always necessarily lead to maximization of shareholders' wealth. Therefore it is necessary to assume perfectly competitive markets in which the market price of the share of one firm is independent of the actions of other firms; otherwise management might improve its owners' wealth by acting sub-optimally:

> Other measures of owners' welfare have also been proposed. Profits and earnings per share are accounting measures that invariably depend on the particular income-reporting conventions. Return on investment suffers from the reliance on accounting numbers and the danger of deliberate manipulation of the numerator denominator of the ratio. (Trigeorgis 1996:24)

How does the capitalist system really work? Marx used a remarkably simple equation to answer this question: M-C-M. In words, the capitalist system starts with money, converts it into capital, and ends up with more money than he had originally (for more details see Bernstein 2001:xi).

Like investors in the stock of a firm, we need to understand *what creates the value* and, by extension, *what causes the stock price to change from period to period*. On the other side of the equation, as managers in these firms, their compensation is tied to how well or badly the stock price does. As what Amram (2002) said, an improved valuation model, a better number, is now the goal. The success payoff to new tools for valuing growth opportunities is to change decisions, to increase choices, and to smooth the way for faster and more valuable growth. The valuation results from improved tools are simply the means to the end.

> The goal of strategy is clear—to make investment decisions that lead to greater shareholder value. But when it comes to actu-

> ally achieving that goal, things get fuzzy. In uncertain markets, where prices and demand are always in flux, it's hard to predict how a particular investment will ultimately influence a company's value. [...] in fact, in the long run there is only one right answer of the financial markets. [...] By applying the discipline of markets, managers can avoid basing important decisions on subjective judgments about the future.(Amram and Kulatilaka 1999:1)

1.1.3 Value of flexibility

The flexibility has value: These days many organizations arguing the debates about the concept of flexible firm, the systems of flexible manufacture, the adaptability to the change and the capacity of learning. In the process of making managerial decision related to allocations is to look for solutions to make a firm more flexible. As response to the need to evaluate the flexibility every day, the managerial literature, and in particular the financial literature, the validity of the instruments used till now in the valuation has been still questioned. Flexibility is an ingredient of value in the managerial decisions.

1.1.3.1 Concept of flexibility and its dimensions

In literature there are lots of references about flexibility, especially about flexibility in production. Authors that work in this field have their reasons: First the extent of the concept; flexibility is a capacity to reach all the corners of the organizations from the most hidden to the most exterior of the organization. We can say that the one *interior dimension of the flexibility* is related with the internal capacity of the organization; the flexibility in production is one example more evident in this type of flexibility. Another external dimension of the firm is to be perceived by the agents that they interact with the company, as that capacity of adaptation to the needs of the clients. To

this extent, we find that the concept flexibility does not have a well established limit, and the aptitude to manage escapes to the proper limits of the organization. Finally, the evaluation of the flexibility is a complicated task.

Slack (1988) used a two-level flexibility hierarchical criterion. Slack wrote, "the hierarchy defines the relationships between the various elements which, taken together, form the decision set of operations flexibility". These two levels defined were *resource flexibility* and *system flexibility*. Slack classified the flexibility of *processes*, *labor*, *supply* and *controls* as resource flexibility; and he classified the flexibility of *product, mix, volume and delivery* as system flexibility (for more details see Sawhney and Piper, 2002).

The notion of strategic flexibility, according to Sanchez (1995), it is stated as follows:

> Strategic flexibility, thus, depends jointly on the inherent flexibilities of the resources available to the firm and on the firm's flexibilities in applying those resources to alternative courses of action. (Sanchez 1995:138)

Based on the understanding of strategic flexibility, Sanchez (1995) also comments on the key challenges for those strategic managers as follows: Key challenges to strategic managers in dynamic product markets are:

1) to identify and acquire the use of flexible resources that can give a firm strategic options to pursue alternative courses of action in responding to developments in its competitive environment.

2) to develop flexibility in coordinating the use of resources to maximize the flexibilities inherent in the resources available to the firm (Sanchez 1995:138).

1.1.4 Valuation framework

There are a number of ways to analyze the valuation of a firm. Some of the methods are more theoretical, while others are more empirical. Based on

the relevant literature, different authors who are working on analyzing the valuation of firms showed various point of views in categorizing valuation approaches.

- Modigliani and Miller (1961)

The intellectual source of modern valuation models is the classic article by Modigliani and Miller (1961). They demonstrate that the same basic valuation model can be derived using four different approaches. The discounted cash flow approach (DCF) is essentially the basic capital budgeting approach. The stream of dividends approach is a modified version of the dividend growth valuation model. The earnings approach is equivalent to the current earnings plus future investment opportunities approach. In addition to representing the intellectual foundation of the best valuation models in use, the Modigliani and Miller approach also reveals some useful insights.

First it highlights the critical relation between profitability and the cost of capital. If profitability is exactly equal to the cost of capital, which means if the firm can earn no more than its cost of capital, then it will not be a growth firm. This gives us the definition of a growth firm. The growth firms is one which is able to attain at least for a limited period of time a profitability rate which exceeds its cost of capital. Second, the Modigliani and Miller formulation emphasizes that each firm is indeed a no-growth firm unless it has favorable investment opportunities. For the above reasons, Modigliani and Miller (1961) article is not only the classic writing on the subject but continues to be as applicable and modern today as it was when first published.

- Stern (1974, 1977)

Later on in the academic valuation literature, Stern (1974, 1977) shows how the Modigliani and Miller article provides the foundations for analytic approaches to financial planning. He argues that the valuation approach of Modigliani and Miller provides the basic theme work for planning most types

of fundamental financial policy decisions. In Stern's extended explanation of the correct procedures for valuation, basically he builds on the original Modigliani and Miller (1961) article, especially the verbal discussion. However in his numerical calculations, he included interest factors. His version of value of the firm is the sum of value of supernormal growth period plus the value at end of growth period discounted to present.

- Rappaport (1986)

Rappaport (1986) elaborated a model to use a personal computer for valuing a firm. One of the advantages of Rappaport's approach is that he demonstrates how the use of a financial model can be helpful in strategic planning and in improving returns for shareholders. Rappaport approach also has some limitations. It is unnecessarily cumbersome because the model is essentially verbal in nature so that it requires a relatively complicated computer program to work through to solutions.

- Damodaran (2002)

Damodaran (2002) summarized that there are generally three approaches to valuation. The first one is discounted cash flow (DCF) valuation (see 1.2.1), which relates the value of an asset to the present value (PV) of expected future cash flows on that asset. The second one is relative valuation, which estimates the value of an asset by checking the pricing of comparable assets relative to a common variable such as earnings, cash flows, book value or sales. The third one is the contingent claim valuation, which uses option pricing models to measure the value of assets that share option characteristics. Damodaran also categorized these three approaches further into subcategories.

DCF approach literally has thousands of models in existence. Some investment banks or consulting firms in the real world often claim that their valuation models are better or more complicated than those used by others. However discounted cash flow models can vary only a couple of dimensions

such as equity valuation, firm valuation and adjusted present value (APV) valuation.

In terms of relative valuation, some analysts compare multiples across firms while others compare the multiple of a company to the multiples it used to trade in the past. Most relative valuations are based on comparables, and there are also some relative valuations which are based on fundamentals.

The contingent claim valuation could be one of the most recent developed and revolutionary approaches for firm valuation. Option pricing models are frequently used for this approach and it can be categorized based on whether the underlying asset is a financial asset or a real asset.

- Pereiro (2002)

Pereiro (2002) explained the value of a firm can be estimated by two main approaches: Intrinsic and extrinsic. In intrinsic valuation, the firm value is determined by a precise net cashflow analysis generated by the business over time. The word "intrinsic" actually indicates to select a business (project) or firm similar compared with the target as reference for valuation. Usually extrinsic valuation uses value multiples for comparable firms quoting in the public markets, or multiples for comparable transactions which can be observed in the private markets. Intrinsic valuation could have various branches.

DCF approach is one of the most commonly used methods for acquiring the firm value by analyzing free cashflow to the firm and the opportunity cost of capital. Another branch of intrinsic valuation method is the real options valuation technique which makes the investment decisions much more flexible. Asset accumulation approach can also be accounted into intrinsic valuation.

The asset accumulation approach implied the value of the firm is defined by aggregating the singular market values of its assets and liabilities. This method is quite complicated in reality since it requires a complete appraisal involving an analysis of lifetime curves for each and every asset and liability.

It also requires specialists in the appraisal of different fields of assets. However, Pereiro also pointed out that it is nevertheless preferable to distinguish between intrinsic and extrinsic approaches for valuation, since each term can reflect a dominant style in the valuation exercise.

- Copeland, Koller and Murrin (1996)

Copeland et al. (1996) introduce the whole valuation framework from a more practical lens. Based on this book, DCF approach is one of the most popular methods of valuation. Under the umbrella of DCF, two branches of application will be explained in detail: the enterprise DCF model and the economic profit model. The enterprise DCF model is the most widely used model in practice and the economic profit model is also gaining in popularity. The advantage of economic profit model (see 1.3) is that it emphasizes whether a company is earning its cost of capital. It is crucial to point out that both models result in exactly the same value, so the choice is mostly driven by the instincts of the user.

There are also other methods which will be explained for firm valuation. The adjusted present value (APV) model is also broadly used in the real world. The APV model is very helpful for valuing companies with changing capital structures, such as cases of leveraged buyouts, since APV model separates the value of operations into two components: the value of operations as if the company were entirely equity-financed and the value of tax benefit arising from debt financing.

The equity DCF model is frequently applied for financial institutions such as banks and insurance companies. Other valuation models such as multiples or option pricing valuation models are also applied by analysts due to certain limitations. Using multiples for valuation could double check other calculations and especially for terminal value calculations. However it is too affected by one-time events and it is also difficult to account for future events so that it is not very realistic for the hypothesis. Option-pricing models are variations on standard discounted cash flow models that

adjust for management's ability to modify decisions as more information becomes available. However option-pricing models are too numerical so that it might be more difficult for analysts or investors who do not have much mathematical background. Generally we use different rulers to value firms and the best method of valuation is the one which is the most suitable to its valuation aim.

1.2 A Rough Draft of the DCF Methods

1.2.1 The Enterprise Discounted Cash Flow Model

The enterprise DCF model values the equity of a firm as the value of a firm's operations minus the value of debt and other investor claims that are superior to common equity. The value of operations and debt are equal to their respective cash flows discounted at rates that reflect the riskiness of these cash flows. The enterprise DCF model is very helpful when a firm is extended to a multi-business company. There are some benefits of applying the enterprise DCF model:

- The model actually values the components of the business which add up to the enterprise value. This is very useful in identifying the separate investment and financing sources of value for the equity holders.
- The model can be applied consistently at different levels of aggregation and is consistent with the capital budgeting process that most firms are already applying.
- The model is sufficient to deal with the complexity of different situations and easy to carry out with computer software.

As the name "Enterprise Discounted Cash Flow Model" indicated itself, the value of operations of the firm equals the discounted value of expected future free cash flow. Free cash flow equals to the net operating profit less adjusted

taxes, plus non-cash charges, less investments in operating working capital and other capital expenditures. Free cash flow is the correct cash flow for this valuation model because it reflects the cash flow generated by a firm's operations that is available to all the firm's capital providers, both debt and equity. In order to be consistent with the definition of cash flow, the discount rate applied to the free cash flow should reflect the opportunity cost to all the capital providers weighted relatively to the company's total capital. This discount rate is called weighted average cost of capital (WACC). The opportunity cost for investors is the rate of return that the investors could expect to earn on other investments of equivalent risk. The cost to the firm is equivalent to the investors' costs less any tax benefits received by the firm. The value applying the enterprise discounted cash flow model can be briefly expressed in equation 1.1:

$$Value = \sum_{t=1}^{t=n} \frac{CF_t}{(1 + WACC)^t} \tag{1.1}$$

The procedures of applying the enterprise DCF model can be interpreted as following:

1) Forecast free cash flows[1] (FCF_t) during forecast horizon.

2) Estimate the cost of capital (weighted average cost of capital-WACC).

3) Estimate continuing value (value after forecast horizon).

4) Discount all to the present.

5) Add the value of excess cash and other non-operating assets.

6) Deduct financial debt to get market value of equity.

[1]In corporate finance, free cash flow (FCF) is cash flow available for distribution among all the securities holders of an organization (see P. 40)

The key factors for economic growth of an enterprise are the Return on Invested Capital (ROIC) and the growth rate. If the return on invested capital exactly equals the WACC, then additional growth neither creates nor destroys value.

$$ROIC = WACC \quad Perfect\,competition$$

However, if the return on invested capital is bigger than WACC, then the additional growth will create value.

$$ROIC > WACC \quad Firm\,is\,profitable$$

If the return on invested capital is smaller than WACC, then the additional growth will destroy value.

$$ROIC < WACC \quad Value\,destruction$$

Therefore, WACC could be defined as:

$$WACC = K_E \cdot \frac{E}{(D+E)} + K_D \cdot (1-\tau) \cdot \frac{D}{(D+E)} \tag{1.2}$$

Where K_E and K_D are returns in equity and debt; D and E are the value of debt and equity relatively; τ is the corporate tax rate. From Figure 1.2, we could see clearly how a firm is valued by enterprise DCF model and how key value-driving factors are interpreted.

1.2.2 Capital Asset Pricing Model (CAPM)

CAMP is usually discussed in all modern finance texts (Brealey and Myers 2006; Copeland and Weston 1992). CAPM may be used to estimate the

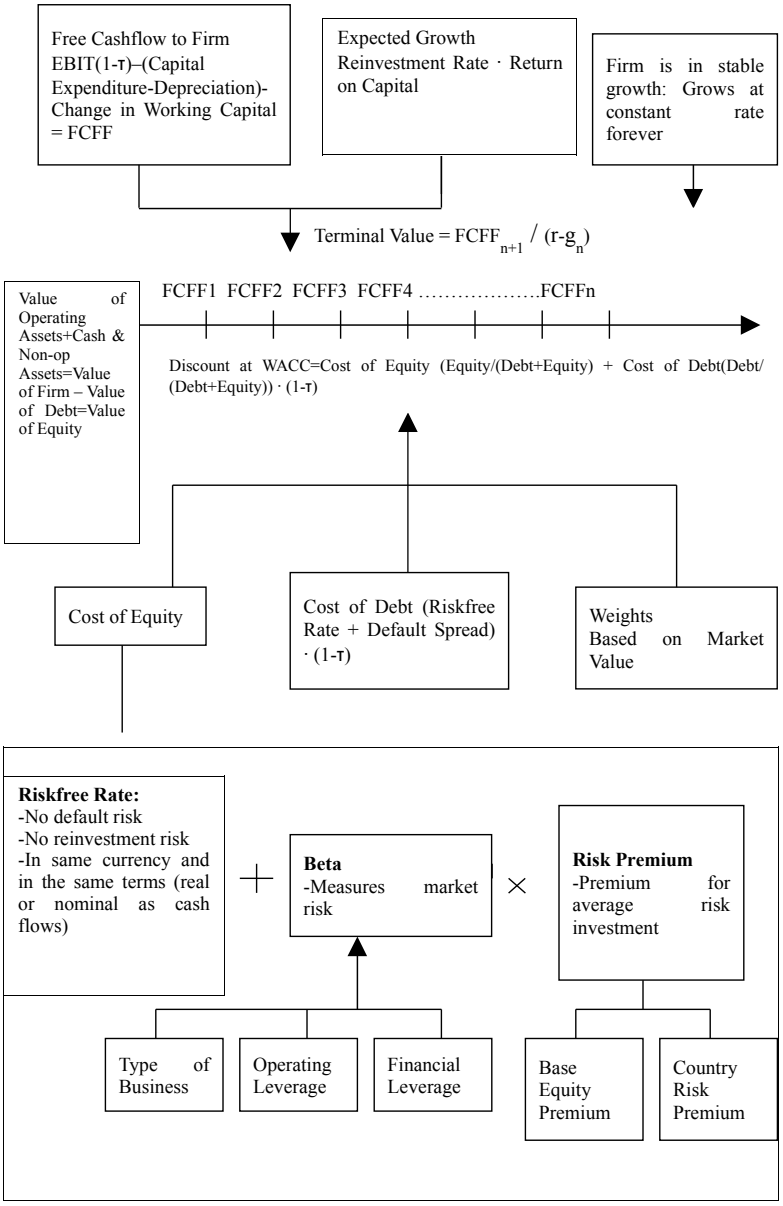


Figure 1.2: Valuing a firm

historic cost of equity for the target. In reality, investors are usually risk-averse, therefore the riskier the project, the higher the expected return they require.

$$Required\,Expected\,Return = Risk - free\,Interest\,Rate + Risk\,Premium$$

Actually required expected return is the opportunity cost of capital which investors could invest in some alternative asset with the same risk.

CAPM estimates the investor-required return as the sum of a risk-free rate and a risk premium based on the overall market risk premium and the risk of the stock in relation to the market. This risk is known as systematic risk, and a measure of that risk is known as beta. Suppose we have an asset A, CAPM relates the expected return on the asset A to the expected return on the market portfolio M by a linear relationship:

$$r_A = r_f + \beta_A \cdot (r_M - r_f) \tag{1.3}$$

r_f**:** risk-free interest rate such as 90 days government Treasure bill rate.

r_M**:** The expected return on market portfolio, such as a value-weighted portfolio on the NYSE, or Footsie 100.

β_A**:** is a measure of risk. It is the sensitivity of stock return to market return.

- Critiques of the CAPM

Sometimes the assumptions are also the limitations of the model. CAPM assumes that there are no transaction costs, no information costs[2], all assets

[2]The inclusion of information costs is carried out by Merton (1987).

are traded, and investments are infinitely divisible. It also assumes that everyone has access to the same information and that investors therefore can not find any under or overvalued assets in the market. However in the real world, investors actually limit their diversification to holding only a few assets. When the marginal benefits might not be able to cover the marginal costs of diversification, which may due to transaction costs and monitoring costs, investors or mutual fund managers will then stop diversifying. Also many investors believe that they can find undervalued assets and therefore they choose not to hold those assets that they believe to be fairly valued or overvalued. In the recent academic literature, Fama and French (1992) in their paper of ¨The Cross-Section of Expected Stock Returns¨ questions the usefulness of CAPM in achieving what it was constructed for. Banz (1981) and Reinganum (1981) suggested that there was a size effect, so betas can not explain everything. Basu (1983) found a seasonal effect which is the January effect. Bhandari (1988) demonstrated that the degree of financial leverage was also crucial. Roll's critique also emphasized that the market portfolio is unobservable so you have to use a proxy and CAPM is not testable.

1.2.3 Adjusted Present Value Approach

Some of these disadvantages of WACC can be compensated by using a different rate value for every period of the cash flow. This alternative is not very popular applied by conventional investments, where the D/E ratio can be assumed constant; however it is advisable where D/E ratio strongly varies over time, as the case of high-risk technology startups which start with low or no debt and progressively take on debt as the firm stabilizes and matures. Moreover, the necessity of recalculating the cost of capital for each period eliminates part of the WACC´s simplicity, which is the main attraction of the method—Adjusted Present Value approach. Adjusted Present Value (APV) is somehow similar to the enterprise DCF model. The APV approach divides the value of operations into two components: the value of operations as if

the firm was totally equity financed and the value of tax benefit arising with debt financing. There are three steps to apply the APV approach:

1) Calculate unlevered cash flows.

2) Discount these cash flows assuming that the project is all-equity financed.

3) Add the present value of tax shield.

For the second step we need to calculate the required expected return for an unlevered firm (with no debt outstanding). Therefore we have to consider two cases:

a) Constant amount of risk-free debt.

b) Constant debt-equity ratio and riskless debt.

Suppose the project or firm generates operating income *(EBIT)* of X_t in year t.

- If the project has a constant amount of risk-free debt, its APV is given by:

$$APV = \sum_{t=1}^{T} \frac{(1-\tau)\cdot X_t}{(1+r_{UA})} + \sum_{t=1}^{T} \frac{r_f \cdot \tau \cdot D}{(1+r_f)\cdot t} \tag{1.4}$$

- If the project has a constant debt-equity ratio, its APV is given by:

$$APV = \sum_{t=1}^{T} \frac{(1-\tau)\cdot X_t}{(1+r_{UA})^t} + \sum_{t=1}^{T} \frac{r_f \cdot \tau \cdot D}{(1+r_{UA})^t}$$

Where $r_{UA} = r_f + \beta_{UA}\cdot(r_m - r_f)$ for both cases and $\beta_{UA} = \frac{\beta_E}{[1+(1-\tau)\cdot\frac{D}{E}]}$ and τ = tax rate for the firm.

$$\sum_{t=1}^{T} \frac{(1-\tau)\cdot X_t}{(1+r_{UA})^t} = the\,value\,of\,the\,firms\,without\,leverage$$

$$\sum_{t=1}^{T} \frac{r_f \cdot \tau \cdot D}{(1+r_f)^t} = the\,present\,tax\,shiedl\,with\,constant\,amount\,of\,risk-free\,debt$$

$$\sum_{t=1}^{T} \frac{r_f \cdot \tau \cdot D}{(1+r_{UA})^t} = the\,present\,tax\,shield\,with\,constant\,\frac{D}{E}\,ratio\,and\,riskless\,debt$$

1.2.4 Mutiples

Generally there are three types of multiples being applied in both theoretical and empirical world: earnings multiples; book value or replacement value multiples; revenue multiples.

The most commonly used earning multiple is the P/E ratio, which examines the market value of equity divided by earnings for equity. When people are buying stocks, it is common check the price paid as a multiple of the earnings per share generated by the company. Therefore earnings multiples become one of the most intuitive ways of measuring the value of a firm.

Regarding to investing, investors also look at the relationship between the price they pay for a stock and the book value of equity as a measure of how over- or under-valued a stock is, therefore the price-book value can be applied here. Instead of using the book value, the replacement cost can also be used as an estimation of the total assets. This way of asset-based valuation is often called Tobin's q valuation.

In terms of revenue multiples, we can divide them based on the value of equity or the whole firm value. For only equity value, price-sales ratio can

be applied using the market value of equity divided by the revenues.

Based on Damodaran (2002), there are basic four steps for applying multiples in the valuation of firms:

- To define the multiple consistently and ensure that it is measured uniformly across the firms being compared.
- To be aware of the cross-sectional distribution of the multiple.
- To analyze the multiple and understand not only what fundamentals determine the multiple but also how changes in these fundamentals translate into changes in the multiple.
- To find the right firms for comparison.

1.2.4.1 PER—Price/Earnings ratio

Price/Earning ratio is known as earnings multiple, which reveals the relationship between a firm's earnings for equity and its equity market capitalization. PER can be defined as following:

$$Price/Earnings\,ratio = \frac{Market\,value\,of\,equity}{Earnings\,for\,equity} = \frac{Share\,price}{Earnings\,per\,share(EPS)}$$

Procedures in applying PER model

1) Examine the most recent profit performance and the expected future performance of the target firm.

2) Identify those elements of revenue and costs which will be raised or lowered under the acquirer management.

3) Re-estimate the target's future, post-acquisition earnings for equity shareholders on a sustainable basis. This kind of earnings is known as sustainable earnings.

4) Select a benchmark PER.

5) Multiply the sustainable earnings by the benchmark PER to reach a value for equity.

Limitations of PER model

1) PER model can only estimate the post acquisition earnings for a single period, and assumes that this level will be maintained. Therefore there is no clear pattern of earnings growth in terms of time.

2) PER model does not explicitly consider the investor-perceived risk of the target firm's earnings.

3) Selection of the benchmark can easily be manipulated for certain results.

Despite these limitations, the PER model provides a valuation based on the capital market consensus view of the value of earnings. It is widely used by the investment community and makes for ease of communication during a bid.

1.2.4.2 Book Value Multiples

The price-book value ratio is popularly used by investors to measure their portfolios. Stocks selling for well below the book value of equity have generally been considered good candidates for undervalued portfolios, while those selling for more than book value have been estimated as overvalued portfolios.

The price-to-book ratio is defined by dividing the market price per share by the current book value of equity per share:

$$Price - to - book\, ratio = \frac{Price\, per\, share}{Book\, value\, of\, equity\, per\, share}$$

Book value of equity is defined as the difference between the book value of assets and the book value of liabilities, a number that is largely determined

by accounting conventions. We have to be careful with the consistency so that the numerator and denominator are both equity values. Price-to-book ratio can also be computed using the total market value of equity and book value of equity, rather than per share values:

$$Price - to - book\, ratio = PBV = \frac{Market\, value\, of\, equity}{Book\, value\, of\, equity}$$

1.2.4.3 Revenue Multiples

A revenue multiple measures the value of the equity or a business relative to the revenues that it generates. Firms that trade at low multiples of revenues are viewed as cheap relative to firms that trade at high multiples of revenues if other multiples remain equal. There are generally two basic revenue multiples in practice. The first one is also the more popular one—the multiple of the market value of equity to the revenues of a firm—is also known as price-to-sales ratio. The second which is more robust, is the multiple of the value of the firm (including both debt and equity) to revenues and it is known as value-to-sales ratio. These two multiples can be computed as following:

$$Price - to - sales\, ratio = \frac{Market\, value\, of\, equity}{Revenues}$$

The enterprise value to sales ratio (EVS) can be expressed as follows:

$$EVS = \frac{(Market\, value\, of\, equity + Market\, value\, of\, debt - Cash\, and\, cash\, equivalents)}{Revenues}$$

We might notice, EVS is more robust multiple than the price-to-sales ratio because it is internally consistent. It is a firm multiple dividing total value of the firm by the revenues generated by the firm. However, the price-to-sales ratio divides an equity value by revenues that are generated for the

firm. Therefore generally price-to-sales will yield lower values for more highly levered firms and might lead misleading conclusions if the compared firms in a sector have different degrees of leverage.

1.2.4.4 Tobin's q – Asset-based valuation

Tobin's q is one of the best known methods for asset-based valuation models. Tobin's q is the ratio of the market value of a firm to the replacement cost of its assets. The replacement cost of an asset is the cost of acquiring an asset with identical characteristics. Therefore Tobin's q can be defined as:

$$Tobin's\, q = \frac{Market\, value\, of\, a\, firm}{replacement\, cost\, of\, its\, assets}$$

If the q-value is bigger than one, which indicates that the market value of a firm is greater than the replacement cost of its assets, it suggests that the firm is actually in possession of certain intangible assets, such as future growth opportunities. The excess value might also due to the value of option to exploit these opportunities. Therefore the value of the firm can be seen as:

$$Firm\, Value = Replacement, cost\, of\, assets + Value\, of\, growth\, options$$

Tobin's q has been applied mainly in acquisition context to spot undervalued companies. If the companies were selling at q-values below one, it indicates that the firm was sold at a discount to their assets at replacement cost. Tobin's q can also be used as a valuation tool in the same way as the PER. Selection of benchmark q is relatively more difficult than PER. First it is difficult to find firms with similar asset structures even within the same industry. Second, evaluation of the underlying growth options is not very easy so that it is hard to find firms with identical growth options as references.

Besides the difficulties of selecting the benchmark q-values, there are also other limitations of Tobin's q valuation method. One of them is related to the replacement cost of the assets. Based on different accounting rules in various countries, replacement cost is not always reported in firm's accounts but historic cost might be reported instead.

Market value of the firm might be also be a limitation of applying this valuation method since if the debt of some corporate is not publicly traded; it is more difficulty to obtain the market value of debt. Therefore some analysts use the sum of the market value of equity and the book value of debt, but this is only an approximation to the firm's market value. Many practitioners are applying q-valuation using the ratio of the market value of equity to the net asset value of the firm. This ratio is also known as market to book value.

1.3 The Economic Profit Model and the Market Value Added

1.3.1 The Economic Profit Model

Another branch developed by DCF approach is the economic profit (EP) model. In this model, the value of a firm equals the amount of capital invested, plus a premium equal to the present value of the value created each year. In economics, a firm is said to be making economic profit when its revenue exceeds the total (opportunity) cost of its inputs. Early in 1890, the economist Alfred Marshall wrote: ¨What remains of his (the owner or manager's) profits after deducting interest on his capital at the current rate may be called his earnings of undertaking or management.¨ What Marshall said about the value created by a firm during any time period (its economic profit) should take into account not only the expenses recorded in the accounting records but also the opportunity cost of the capital employed in the business.

> Economic profit is used by management as one of the measures to decide where to allocate resources so that they will be most productive. (HSBC Holdings)[3]

The advantage of the economic profit model over enterprise discounted cash flow model is that economic profit is an important measure for understanding a company's performance in each single year. Using enterprise discounted cash flow model, analysts would not track a firm's progress by comparing actual and projected free cash flow because free cash flow in any year is determined by investments in fixed assets and working capital so that management could easily improve free cash flow in a given year at the expense of long-term value creation by simply delaying investments.

Based on the definition of EP, the value created in a firm in a single period is shown as follows:

$$EP = Total\,revenues\,from\,capital - Costs\,of\,capital = Invested\,capital \cdot (ROIC - WACC)$$

Where $ROIC$ = Incremental return on invested capital

$WACC$ =Weighted average cost of capital

We can see clearly that EP equals the spread between the return on invested capital and the cost of capital times the amount of invested capital.

1.3.2 Market Value Added

Market value added (MVA) is a measure that captures the relative success of firms in maximizing shareholder value through efficient allocation and management of scarce resources. MVA is calculated as:

$$MVA = Market\,value - Capital$$

[3]HSBC Holdings. 2002 *Annual Report. Economic Profit.* P.53. www.hsbc.com

Where market value refers to the equity market valuation of the company and capital refers to the debt and equity invested in the company. MVA is simply the difference between the cash that both debt and equity investors have contribued to a company and the value of the cash that they expected to get out of it. Thus, MVA is unique in its ability to capture shareholder value creation because it captures both the valuation (the degree of wealth enrichment for the shareholders) and performance (the overall quality of capital management) (*Stern and Stewart & Co.*, 1997).

1.4 Economic Value Added (EVA)

1.4.1 The concept of EVA

Marshall in the *Principles of Economics* concluded, "The gross earnings of management which a man is getting can only be found after making up a careful account of the true profits of his business, and deducting interest on his capital". The desirability of quantifying 'economic profit' as a measure of wealth creation was operationalised by Solomon (1965) "as the difference between two quantities, net earnings and the cost of capital". This measure of 'residual income' is then defined in terms of after-tax operating profits less a charge for invested capital which reflects the firm's weighted average cost of capital. Close parallels are found by related concepts such as 'abnormal earnings', 'excess earnings', 'excess realizable profits' and 'super profits' (Biddle et al., 1997). Drucker described it in his *Harvard Business Review* (1998:14) article:

> EVA is based upon something we have known for a long time: What we call profits, the money left to service equity, is usually not profit at all. Until a business returns a profit that is greater than its cost of capital, it operates at a loss. Never mind that it pays taxes as if it had a genuine profit. The enterprise still

> returns less to the economy than it devours in the resources [...] Until then it does not create wealth; it destroys it.

Other metrics are also adopted by consultants. *Chicago-based Boston Consulting Group*, *Price Waterhouse* and *HOLT Value Associates* employ variations of Cash Flow Return on Investment (CFROI). CRFOI is typically calculated in two steps. First the inflation-adjusted cash flows available to all capital owners in the firm are measured and compared with the inflation-adjusted gross investment made by the capital owners. Second, the gross cash flow to gross investment is translated into an internal rate of return by adjusting for the finite economic life of depreciating assets and the residual value of non-depreciating assets (such as land and working capital). Besides CRFOI, other value-based metrics that are even more related with EVA. The legal conflict between Stern Stewart's EVA and KPMG's 'Economic Value Management' over the proprietary nature of EVA suggests even closer, less discernible differences in these products (Leiber 1998). Myers (1996) concluded "The fact is, EVA, CFROI, and all the others are premised on fundamental economics that 20 years ago was called residual income".

The value added (VA) concept originated from Europe (Bao and Bao 1998). Value added can be defined as value added to bought-in materials and services in converting them into finished products (Greene and Cornwell 1964). It measures the contribution of a firm to the society. The value added statement is useful because it shows how the benefits of the effort of a firm were shared among its stakeholders including stockholders, creditors, management, employees, and government. The theoretical justification of the statement is the extended enterprise theory developed by Purdy (1983). The theory views the profit of a firm as the result of a collective effort of all the participating groups, including stockholders, creditors, employees, management, and government; it does not just benefit the stockholders. The development of the abnormal earnings concept in accounting can be traced back to Edwards and Bell (1961), Edwards, Bell and Johnson (1979), Peasnell

(1982), and Ohlson (1995). Edwards, Bell and Johnson (1979) claimed that a firm's objective is to beat the market. Ball and Brown (1968) investigated the relation between the sign of abnormal earnings and the sign of abnormal rate of return. They concluded that abnormal earnings and abnormal rate of return are positively related. Beaver, Clark and Wright (1979) investigated the relation between the magnitude of abnormal earnings and abnormal rate of return and they also claimed a positive relation.

1.4.2 EVA calculation

According to Bao and Bao (1998), abnormal economic earnings information is not disclosed by financial statements, and can only be replaced by economic value added (EVA) which is a registered trademark by its developer, *Stern Stewart & Co.* It is defined (Stewart 1991) as:

$$EVA = (Return\,of\,Capital - Cost\,of\,Capital) \cdot Average\,Total\,Capital$$

Crowther, Davies and Cooper (1998), however, applied the concept of economic value added to *Severn Trent plc*, compared the results to those of the traditional accounting measures, and concluded that economic value added is not as promising as *Stern Stewart & Co.* have claimed.

Since *EVA* is a measure that focuses on firm performance over a specific period, it has a similar time perspective to the set of firm performance measures such as earnings before extraordinary items *(EBEI)*, net cash flow from operations *(NCF)* and residual income *(RI)*.

EBEI is usually defined as an indicator of the firm value:

$$EBEI = NCF + ACC \tag{1.5}$$

Where *EBEI* is the sum of net cash flow from operations *(NCF)* and ac-

cruals *(ACC)*. *ACC* is defined as total accruals relating to operating. *ACC* is composed of depreciation, amortization, changes in non-cash current assets, changes in current liabilities, and changes in the non-current portion of deferred taxes.

Net operating profit after tax *(NOPAT)* is calculated by adding after-tax interest expense *(ATI)* to *(EBEI)*:

$$NOPAT = EBEI + ATI = NCF + ACC + ATI \tag{1.6}$$

NOPAT separates operating activities from financing activities by including the after-tax effect of debt financing (interest expense). Since *NOPAT* is more of a measure of operating profit, no allowance is therefore made in *NOPAT* for the financing activities (both debt and equity) of the firm. Residual Income *(RI)* therefore can be applied:

$$RI = NOPAT - (WACC \cdot CAP) = NCF + ACC + ATI - CC \tag{1.7}$$

Where *WACC* is an estimate of the firm's weighted average cost of capital, and capital *(CAP)* is defined as assets (net of depreciation) invested in going-concern operating activities, or contributed and retained debt and equity capital, at the beginning of the period.

EVA can adjust both *NOPAT* and *CAP* for purported 'distortions' in the accounting model of performance (Worthington and West 2001). *EVA* could reflect adjustments to *GAAP* in terms of both operating and financing activities. EVA can be calculated as:

$$EVA = NCF + ACC + ATI - CC + ADJ \tag{1.8}$$

Where *ADJ* is the total *EVA* accounting adjustment and it can be ex-

pressed as net figure of adjustments to $NOPAT(NCF + ACC + ATI)$ less the adjustment to capital in determining $CC(WACC \cdot CAP)$.

According to Young (1997), *EVA* can be calculated as follows:

$$EVA = NET\,SALES - OPERATING\,EXPENSES(including\,tax)$$

$$= OPERATING\,PROFIT - CAPITAL\,CHARGES \qquad (1.9)$$

Where capital charges are the company's invested capital (also called capital or capital employed) times the weighted average cost of capital *(WACC)*. In the unadjusted form, *EVA* is equivalent to net income minus the cost of equity capital, which equals Marshall's economic profit or what accountants usually call 'residual income'. When no adjustments are made to company's GAAP based financial statements, *EVA* and residual income are the same.

The cost of capital, or WACC equals the sum of the cost of each of the components of capital—short-term debt, long-term debt, and shareholders' equity—weighted for their relative proportions in the company's capital structure.

Economic value added, a surrogate for abnormal economic earnings, received much attention recently as another measure of performance. It has even been predicted that it will replace earnings per share as the most important financial measure (Zarowin 1995). Bao and Bao (1998) did an empirical examination about the usefulness of value added and abnormal economic earnings. They tested the usefulness of the two of the alternative measures of performances: value added and abnormal economic earnings. The conclusion from this empirical investigation showed that value added is the most statistically significant explanatory variable taking the valuation, levels, and changes analyses as a whole. However, they also mentioned that the poor results for abnormal economic earnings may mean that economic value added

developed by *Stern Stewart & Co.* is not a good surrogate since they might depend on the fact that time series properties of abnormal economic earnings are not known.

1.4.3 Why do we need EVA?

Stewart (1991) claimed that an economic measure is needed, because from the shareholder's points of view accounting earnings measure is seriously flawed for three main reasons. First, it is subject to earnings management and a decrease in earnings does not necessarily mean a decrease in stock price. Second, earnings are subject to manipulation and an increase in earnings does not necessarily cause an increase in stock price. Third is the problems inherited from GAAP. For example, Stewart (1991:28) Claimed that R&D cost has potential contribution to firm value and should be capitalized. Earnings calculation, according to GAAP, however, does not reflect the contribution of R&D cost to the stock price. Stewart (1991) also claimed that management's decisions always relate to the efficient allocation of capital.

Managers have to do three things to fulfill their task: improve the efficiency of existing capital; commit new capital to projects where the return on capital exceeds the cost of capital; divert capital from underperforming operations. These three things are all captured by concept of abnormal economic earnings. Abnormal economic earnings can be the linked to the intrinsic market value of the company. If the return on capital is greater than cost of capital, then there are positive abnormal economic earnings that increase firm value. If return on capital is less than cost of capital, then there are negative abnormal economic earnings that decrease firm value. Therefore in theory, abnormal economic earnings should be positively associated with firm value.

According to Young (1997), *EVA* measures the difference between the return on a company's capital and the cost of that capital. A positive *EVA* indicates that value has been created for shareholders; a negative *EVA* sug-

gests value destruction. Compared with the conventional accounting measures of profit, EVA considers the cost of all capital, and it is not constrained by GAAP. The net income reported in statements of income usually consider only the most visible cost of capital but ignore the cost of equity finance. Although estimating the cost of equity is a highly subjective exercise, supporters of *EVA* argue that measures of performance that ignore such costs simply cannot reveal how successful a company has been in creating value for its owners. Young (1997) mentioned the unique advantage of *EVA* measurement which is that *EVA* represents a company's profits net of the cost of both debt and equity capital.

Biddle et al. (1997) mentioned that EVA has become a new buzzword in the corporate movement toward emphasizing shareholder value. Many consultancies now market EVA-type metrics, but *Stern Stewart & Co.* is generally acknowledged as the industry leader. Stern Stewart has claimed concerning the merits of EVA as:

> EVA is almost 50% better than its closest accounting-based competitor in explaining changes in shareholder wealth. (Stewart 1994)
>
> The adoption of EVA is a proven and potent way to increase corporate performance, motivation and market value. (*Stern Stewart & Co.*, 1997)

Kimball (1998) stated that successful bank operation requires managers to weigh complex trade-offs between growth, return and risk. EVA is one of the innovative performance metrics which assist managers in making difficult and complex decisions. According to Kimball (1998), EVA is based on the concept of economic profit rather than accounting earnings.

1.4.4 Influence of EVA

EVA is used to measure corporate financial performance. It can also encourage managers to increase shareholder wealth. The traditional role of managers is to maximize the wealth of shareholders by the efficient allocation of resources. However, recent empirical literature suggests that there is no single accounting-based measure upon which one can rely to explain changes in shareholder wealth (Chen and Dodd 1997; Riahi-Belkaoui 1993; Rogerson 1997; Lehn and Makhija 1997). Lee (1996:32), for example, argues that the search for a superior measure of firm valuation is a, if not the, key feature of contemporary empirical finance:

> For years, investors and corporate managers have been seeking a timely and reliable measurement of shareholders' wealth. With such a measure, investors could spot over- or underpriced stocks, lenders could gauge the security of their loans and managers could monitor the profitability of their factories, divisions and firms.

One recent innovation in the field of internal and external performance measurement is a trade-marked variant of residual income (net operating profits less a charge for the opportunity cost of invested capital) known as economic value-added *(EVA)*. Its developer and principal advocate, US-based business consultants *Stern Stewart & Co.* claimed that:

> Earnings, earnings per share, and earnings growth are misleading measures of corporate performance [and that] the best practical periodic performance measure is economic value-added. [EVA] is the financial performance measure that comes closer than any other to capturing the true economic profit of an enterprise. EVA is also the performance measure most directly linked to the creation of shareholder wealth over time. (Stewart 1991:66)

Stewart (1994:75) further suggests that "*EVA* stands well out from the crowd as the single best measure of wealth creation on a contemporaneous basis

[and] is almost 50% better than its closest accounting-based competitor [including *EPS*, *ROE* and *ROI*] in explaining changes in shareholder wealth". Based on those findings, *Stern Stewart & Co.* has occupied great share in the highly-competitive value-based performance consulting market with "literally hundreds of firms adopting *EVA* to some degree, among them *Coca-Cola Co.*, *Eli Lily and Co.*, and the *Postal Service* in the US" (Biddle et al. 1997).

EVA measurement is widely applied in the UK, Australia, Canada, Brazil, Germany, Mexico, Turkey and France, amongst others (*Stern Stewart & Co. 1997*), and also used to provide published rankings of managerial performance (Ferguson 1997). Several international companies have adopted EVA for performance measurement and/or incentive compensation packages. Fortune has called *EVA* "today's hottest financial idea", "The Real Key to Creating Wealth" (30 September 1993) and " A New Way to Find bargains" (9 December 1996) [and has printed *EVA* performance rankings since 1993], and Drucker (1995) in the *Harvard Business Review* suggests that *EVA*' s growing popularity reflects, amongst other things, the demands of the information age for a measure of 'total factor productivity'(Worthington and West, 2001). *EVA* is also adopted widely by security analysts since "instead of using a dividend discount approach, these models measure value from the point of the firms' capacity for ongoing wealth creation rather than simply wealth distribution" (Herzberg 1998:45).

Limited empirical studies on value added to date have shown that value added is a useful measure of performance. Bao and Bao (1998) empirically demonstrated that value added is positively associated with firm value in certain industries.

1.5 The Scheme of a more General Model

Suppose the market value of a firm is denoted as V. According to Modigliani and Miller, value V is the sum of the equity market value E and debt market

value D. Therefore we can say that $V = E + D$. However we believe that the market value of the firm should be:

$$V^* = V + \alpha \tag{1.10}$$

Where α represents the value created by applying the loyalty and capture policies on employees and/or clients. Further decompose α , we can get:

$$\alpha = \alpha_{Employees} + \alpha_{Clients} \tag{1.11}$$

$\alpha_{Employees}$ might be obtained by certain metric or by application of option theory. $\alpha_{Clients}$ might also be obtained by certain appropriate metric or by the application of option theory (see Chapter *4* and Chapter *5*).

We can denote α as a function as following:

$$\alpha^* = f(external\,variable,\, internal\,variable,\, internal - external\,variables) \tag{1.12}$$

External variables are those variables which are exogenous so that the firm has very little influence on them, such as macro-economic factors like unemployment rate, market related variables, industry or sectors variables or the law determined variables. Internal variables are those variables which are endogenous to the firm, such as factors determined by the director board, human capital management (index of the satisfaction for the employees), level of satisfaction of the clients (index of the satisfaction of the clients) or the ethical behavior of the firm (such as ethical auditing). Internal-external variables are those variables which can be seen as exogenous within certain period of time but also might be endogenous afterwards, such as competition of certain industry or sector (e.g. through mergers and acquisitions, firms can change their market share in the industry and have competitive advantages

so that the variable can be seen as endogenous); satisfaction or fidelity of clients for the industry or the sector, etc.

In order to develop this more general model, we continue with the following process:

1. Analyze the value V basing the model of Rao and Stevens (2007) which we call the 3-Model of Rao and Stevens (2007).

2. Reformulate the model applying option theory, which is affirmed by Rao and Stevens (2007) inaplicable in the models before.

3. Consider the application of Real Options (ROs) theory in order to evaluate associated options in the general firm valuation as well as policies applied to employees and clients.

4. Relate the result in applying ROs theory in order to evaluate α as a whole without taking the function (1.12) into account.

Chapter 2

The Model of Rao and Stevens (2007)

2.1 Introduction

From the perspective of capital markets, valuation models of big corporates have built exclusively on the capital structure and the approach of M&M and its followers. The logic has followed in valuing firms financially according to the financial optics, which we assume:

- It admits the hypotheses that everything happens to the assets of the balance sheet somehow remain collected by right hand side of the balance sheet.
- Time as a crucial factor has not been introduced in a more adapted way. It has imposed, in an involuntary way and perhaps without full consciousness. It is admitted implicitly that principal decisions about assets are transmitted into an immediate, complete form without distortions to financial market.
- The decision on assets have its root, its origin, in the right hand side of the Balance Sheet.

These implicit assumptions have had consequences that transcendent aspects such as satisfaction and fidelity of suppliers, clients and employees are not, in fact, part of the former valuation models mentioned. However, the reality has induced researchers to treat complementarily some of the valuation problems which are beyond the frame of M&M, such as the issue of due diligence and the above mentioned aspects.

We have also indicated that we intend to extend the framework of M&M in order to be able to incorporate the influence of other stakeholders different from the equityholders or debtholders and for this we might go further exploring the model of Rao and Stevens (2007) so as to amplify, modify and adapt to our own model.

The model of Rao and Stevens (2007) is based on the hypotheses which are further explained in section 2.2 and we will use the symbols indicated here: Suppose there was an investment project for firm F (see Figure 2.1). Where $C(0)$ = input of the investment in monetary unit which materializes in current assets (tangible or intangible) of any class (exception: amounts of money with *extraordinary* characteristics, as explained in section 2).

$C(1)$ =output of the investment in monetary unit (it can be a random variable).

In the end of the investment, we allow the firm to transform from F_0 to F_1; so we can see F_1 as a new firm, proceeding from F_0, independent from any political changes in the society.

Therefore, $C(1)$ = Gross margin on a cash flow basis + Liquidation value[1] of $C(0)$

Objective of the investment

In order to maximize the equity of the firm, F invests $C(0)$ and manages all current assets (old and new) in the firm so as to obtain equity from $E(0)$ to $E(1)$.

[1]Liquidation value is calculated taking account of depreciation.

Figure 2.1: Investment project for firm F

Instruments to achieve the objective

The quantity $C(0)$ can proceed the auto-financing and/or the issue of debt. In order to maximize $E(1)$, the firm has to use its total current assets in an efficiently optimal way. When the 3-model is extended, the efficiently optimal way implies that a portion of $C(0)$ can be appointed to improve the labor climate and satisfaction of the clients in accordance with the specific sub-objective for these groups. We refer depreciation and obligations of other stakeholders (shareholders, creditors, suppliers, tax authority, environment obligations, etc.) remain the same at the state F_0.

2.2 Hypotheses of the Model

In order to develop the model, we build the following hypotheses:

H1: The firm runs in a normal, somehow predictable market (capital market as well as other markets such as labor market are predictable).[2]

H2: The firm is solvent all the time, since we do not consider the insolvency (there is no bankruptcy costs).

H3: C(1) is distributed, at t=1 or between t = 0 and t = 1, among five parties:

- Tax authority
- Debtholders
- Shareholders

[2]The model of Rao and Stevens did not treat other stakeholders differently from shareholders, debtholders and tax authority (therefore we call this 3-model). It admits the hypothesis that "Capital markets are perfect (frictionless) except for corporate taxes". (Rao and Stevens 2007:5). Other related factors such as employees and clients are our own ideas.

- Clients (capture and fidelity of clients)
- Employees (capture and fidelity of talents)[3]

Therefore, in order to simplify our task, we will suppose that the firm's tax shield does not retain in any portion of the output nor the net profit; this simplification is based on what Rao and Stevens (2007) had done, which they only focus on the amounts regarding the shareholders but not necessarily the amounts retained. We will construct the 3-model based on this hypothesis.[4]

H4: The Net Present Value (NPV) of $C\,(1)$ is V_0:

$$V_0 = NPV(C(1)) = V(C(1)) - C(0) = V_1 - C(0)$$

Where $V(C(1)) = V_1 = NPV$of $C\,(1)$ adjusted with risk, which means it is deducted at the rate which reflects the risk of the project invested.

H5: The firm is self-financed at $t = 0$ with equity P_0 (We do not use E_0 in order to avoid the confusion with $E\,(0)$). Therefore, $P_0 \in (0,\, C(0)]$ or $0 < P_0 \leqslant C(0)$:

- If there is no debt nor extraordinary factors related to employees and clients, we can have: $P_0 = C(0)$

[3]The amount of money that are necessary to improve the capture and fidelity of talents. In order to manage the characteristics of technical preparation, commitment and team work quality are considered essential to achieve the aim of the business. We understand that such amounts of money are far beyond those compulsory factors to meet the corresponding juridical and economic obligations. Base on this motivation, we will simplify and quantify them as so called *extraordinary*factors. Regarding social obligations (social responsability of the firm), we think it is appropriate to quote the opinion of Cao Peixi, the present of *China Huaneng Group* referring to the construction of a power plant with low pollution and high efficiency: "this project should not pose a purely financial perspective, it represents the future." (*New York Times*, 5, 28, 2009)

[4]The expression of 3-model we suppose that $C\,(1)$ is distributed among the tax authority, debtholders and shareholders only.

- If there is debt but no extraordinary factors we could have: $P_0 < C(0)$; $Debt = D_0 = C(0) - P_0$

  In this case, we allow the firm to have sufficient capacity in obtaining debt so as to finance for D_0.

- If there is debt (D_0) and extraordinary factor like clients (A_0) only, we can have: $C(0) = P_0 + D_0 + A_0$

- If there is debt (D_0) and extraordinary factors like clients (A_0) and employees (B_0), as the same simplification as before, we can have: $P_0 < C(0)$; $C(0) = D_0 + P_0 + A_0 + B_0$

  Where B_0 = importing extraordinary factor of employees.

In case if there exist extraordinary factors and the firm is financed through equity or a mix of equity and debt, the possibility of the particular cases will be wider, but it did not change what we indicated conceptually. In this work, we model the debtholders, shareholders and tax authority. Then, as we mentioned, we can extend the model to incorporate the extraordinary factors such as clients and employees into the model.

H6: Proceeding the investment, at $t = 1$, the firm obtains a volume of equity equals to P_1, where the present value at $t = 0$ is $V(P_1)$.

H7: The debt is issued at the same time by means of straight bonds, which is in accordance with the amortization structure of fixed coupon as Figure 2.2:

The face value of debt at $t = 0$ would be D_0, and at time t it will be:

$$D_t = V(D_t) \quad (or\, t = 0,\, D_0 = V(D_0))$$

From now on, the following hypotheses only serve for modeling the case with debt holders, tax authority and shareholders.

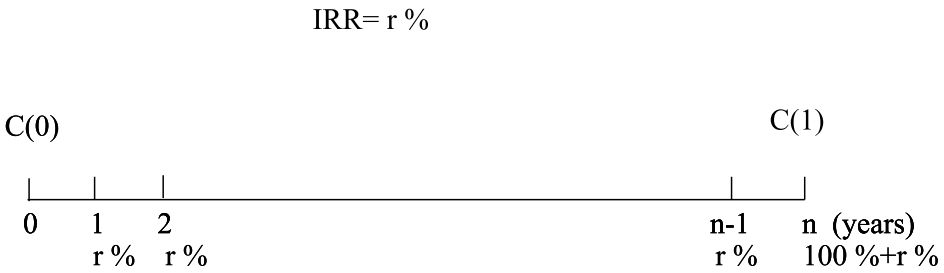


Figure 2.2: Straight Bonds

Hypotheses **H1** to **H7** are common for both 3-stakeholders model and extended model (3-Model plus clients and employees) whereas **H8** to **H10** only serve for 3-stakeholders model.

H8: The present value of tax claim is $V(\tau)$, where τ = tax rate on corporate income = tax rate on the capital gain on the liquidation value of $C(0)$ when $t = 1$.

H9: If the equity increase of the investment project is:

$$\Delta E = E(1) - E(0)$$

If we have $\Delta E > 0$, the shareholders have right to receive the dividend as: $d_1 = \lambda \cdot \Delta E$

Where $\lambda \in [0, 1]$ is the rate of dividend approved for the period of $(0, 1]$.

H10: The overheads and depreciations in fixed assets corresponding to investment and economic period will increase to M monetary units ($m.u.$ is considered at $t = 1$).

H11: There is neither inflation nor deflation during the life of the project.

2.3 Formulation of 3-Model

2.3.1 The problem of financial solvency consequence

We are under the conditions as follows:

- $0 < P_0 \leqslant C(0)$
- $D_0 = C(0) - P_0 \geqslant 0 \Rightarrow C(0) = P_0 + D_0$
- Firm solvency

- r and τ are fixed with $r > 0$, $0 < \tau < 1$

Therefore, benefits (B) after tax will be[5] :

$$B = [C(1) - r \cdot D_0 - C(0) - M] \cdot (1 - \tau)$$

$$B = [C(1) - D_0 \cdot (1 + r) - P_0 - M] \cdot (1 - \tau)$$

$$B \lesseqgtr 0 \Leftrightarrow C(1) - D_0 \cdot (1 + r) - P_0 - M \lesseqgtr 0$$

Suppose we have: $C(1) - P_0 - M = Q$, then $Q \gtreqless D_0 \cdot (1 + r)$. Under the condition that the firm is "solvent all the time" (**H2**) we can obtain:

$$Q \geqslant D_0 \cdot (1 + r)$$

Therefore at the breakpoint when $Q = Q^*$, we have:

$$Q^* = D_0 \cdot (1 + r)$$

It means that when $C(1) = C^*(1)$, we could have:

$$C^*(1) = D_0 \cdot (1 + r) + P_0 + M$$

Therefore in order to maximize the equity value we can have:

$$Max(E(1)) \Leftrightarrow Max[B \cdot (1 - \tau)] \Leftrightarrow Max(B)$$

[5]All the values in the formulation of B are referring to the moment of $t = 1$ except P_0; If we agree with the hypotheses **H11**, we can accent that P_0 is a correct value since there is no inflation nor deflation.

Since Q^* is a known value at $t = 0$, we can conclude that:

$$Max(E(1)) \Leftrightarrow Max(Q - D_0 \cdot (1 + r)) \Leftrightarrow Max(Q - Q^{*)}$$

$$Max(E(1)) \Leftrightarrow Max(Q) \Leftrightarrow Max(C(1) - P_0 - M)$$

This result is consistent with the practical business.

Consequently, $Max(E(1))$ could be achieved through the minimization of P_0 and M. However, value P_0 depends on r (P_0 is bigger and r is smaller). On the other hand, since there is a limit maxim years of depreciation, which perhaps would demand a temporary perspective different from the contemplated one in our studies. It should also be decided if a linear depreciation or other type of depreciation is more convenient, however, different types of depreciation leverage rate are not further discussed here. We allow that M to be fixed, consequently, we should study the mix of self-financing and out-source financing which is a topic of controversy and it is beyond the purpose of our study. Thus, we will accept that the decision-makers choose P_0 based on their own judgment (discretionary) in accordance with those concrete circumstances which is submitted.

The analysis that we just finished shows us that the maximization of $E(1)$ is built on the maximization of $C(1)$. In order to further continue the study, we have to accept, as indicated by Rao and Stevens (2007), two types of solvency:

a) Solvency with negative taxable income.

b) Solvency with positive taxable income.

This enforces another definition of solvency, the *financial solvency* (from the investors' point of view), which is the situation that does not consider P_0 and M[6], we have to allow $C(1)$ to be able to:

[6]Rao and Stevens (2007) did not justify its definition of this issue and for this reason, we have turned out to be pushed to carry out the previous analysis; our judgment is based

- Pay interest
- Return principal
- Pay corporate taxes for its profit

Therefore, if we use symbol J to represent the *taxable income*, we can get:

$$J = C(1) - r \cdot D_0 - C(0)$$

$$C(1) - Corporate\,Tax \geqslant D_0 \cdot (1 + r)$$

Hence the firm will only pay tax when there are positive profits, which is:

$$Corporate\,Tax = [Max(J;\, 0)] \cdot \tau$$

If $J > 0$, there is positive tax income and if $J < 0$, the taxable income is negative. This notation is used for those who are familiar with option theory so as to know by intuition the possibility of applying this theory. With this indicated notation, the condition of financial solvency can be formulized as:

$$C(1) - \tau \cdot Max[J;\, 0] \geqslant D_0 \cdot (1 + r) \tag{2.1}$$

Where $J = C(1) - r \cdot D_0 - C(0)$

The breakpoint of $C(1)$ would be a^* which converts the inequality (2.1) into one equation such as:

$$a^* - \tau \cdot Max[a^* - r \cdot D_0 - C(0);\, 0] = D_0 \cdot (1 + r)$$

on a good foundation. From a theoretical point of view, we intend to extract consequence thinking *only* from the essential optics of the investor: if it was in this case, could I recover at $t = 1$ the principal and interest? Our analysis indicates the limits and perspectives in application of this concept financial solvency.

When $C(1) = a^*$,we can further discuss two possibilities depending on if D_0 is bigger or smaller than $C(0)$:

1. There exists a financial solvency even with a negative taxable income ($J \leqslant 0$) which indicates that $D_0 \leqslant C(0)$. We can continue to demonstrate this inequality as:

$$if\ J \leqslant 0,$$

$$a^* - r \cdot D_0 - C(0) \leqslant 0 \Rightarrow a^* \leqslant r \cdot D_0 + C(0)$$

Since the financial solvency requires the fulfillment of (2.1), we also have:

$$a^* \geqslant D_0 \cdot (1 + r)$$

Based on these two conditions, we can show in Figure 2.3:

Therefore we can obtain:

$$D_0 \cdot (1 + r) \leqslant r \cdot D_0 + C(0) \Rightarrow D_0 \leqslant C(0)$$

with this we can obtain that $Max(J;\, 0) = 0$. Therefore inequality (2.1) can be expressed as:

$$a^* - \tau \cdot 0 = D_0 \cdot (1 + r) \Rightarrow a^* = D_0 \cdot (1 + r)$$

2. There exists financial solvency only when there is a positive taxable income (bear in mind we mention 'income' instead of 'profit') which means that $D_0 > C(0)$ and $J > 0$. Therefore we have:

$$\tau \cdot (a^* - r \cdot D_0 - C(0)) > 0 \Rightarrow$$

$$a^* > r \cdot D_0 + C(0) \Rightarrow from\,(2.1)$$

$$a^* - \tau \cdot (a^* - r \cdot D_0 - C(0)) = D_0 \cdot (1 + r) \Rightarrow$$

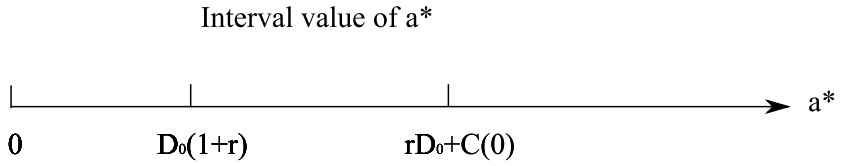


Figure 2.3: Interval value of a*

$$a^* = \frac{D_0 \cdot (1+r) - [r \cdot D_0 + C(0)] \cdot \tau}{1-\tau}$$

These two expressions can be united into one[7]:

$$a^* = \begin{cases} D_0 \leqslant C(0), & D_0 \cdot (1+r) \\ D_0 > C(0), & \frac{D_0 \cdot (1+r) - [r \cdot D_0 + C(0)] \cdot \tau}{1-\tau} \end{cases} \tag{2.2}$$

Now we could ask what is the obtained profit from equation (2.2). This question is not mentioned in Rao and Stevens (2007). To continue, we will answer this question in the following part of this section. The profit after tax referred to positive taxable income (B^*) is associated with the value of a^*, when $D_0 > C(0)$:

$$B^* = [a^* - D_0 \cdot (1+r) - P_0 - M] \cdot (1-\tau) \Rightarrow$$

$$B^* = [\frac{D_0 \cdot (1+r) - [r \cdot D_0 + C(0)] \cdot \tau}{1-\tau} - D_0 \cdot (1+r) - P_0 - M] \cdot (1-\tau)$$

Based on a simple algebra manipulation, we could obtain:

$$B^* = [D_0 - C(0)] \cdot \tau - (P_0 + M) \cdot (1-\tau)$$

$$Since\, C(0) = D_0 + P_0,\, we\, will\, have:\; B^* = -P_0 \cdot \tau - P_0 - M + P_0 \cdot \tau + M \cdot \tau \Rightarrow$$

$$B^* = -(P_0 + M) + M \cdot \tau \Rightarrow B^* < 0$$

Consequently, the solvency and the situation of positive taxable income itself are not enough to guarantee that the firm has $B > 0$ without debt tax shield. This idea drives us to the conclusion that the *threshold of profits* is different from B^*.

[7]In case of managing P_0, we have to bear in mind that for $D_0 > C(0)$, we will have $P_0 < 0$.

Therefore, we can have:

$$B = [C(1) - r \cdot D_0 - C(0) - M] \cdot (1 - \tau)$$

The threshold of profits can be symbolized by $B^{**} = 0$ which is corresponding to a^{**} as follows:

$$B^{**} = [a^{**} - r \cdot D_0 - C(0) - M] \cdot (1 - \tau) = 0$$

$$a^{**} = r \cdot D_0 + C(0) + M = r \cdot D_0 + D_0 + P_0 + M$$

Finally we could get:

$$a^{**} = D_0 \cdot (1 + r) + (P_0 + M) \tag{2.3}$$

To continue, we would like to have:

$$C(1) > a^{**}$$

The result is consistent with the managerial common sense. The analysis we just carried out intended to avoid mistaking B^* for the threshold of profits: They are different concepts (B^* is not the threshold of profits).

The other question we are interested in, which is also not further discussed in Rao and Stevens (2007), is the influence of a^* caused by the changes in D_0, r, τ when $D_0 > C(0)$. Under the condition of *ceteris paribus*, this question also means to ask what sign of partial derivatives of a^* would be with respect to every variable:

$$\frac{\partial a^*}{\partial D_0} = \frac{1 + r - r \cdot \tau}{1 - \tau} > 0 \; (since\, r > r \cdot \tau \, and \, 1 - \tau > 0)$$

$$\frac{\partial a^*}{\partial r} = D_0 \geqslant 0$$

$$\frac{\partial a^*}{\partial \tau} = \frac{D_0 - C(0)}{(1-\tau)^2} = \frac{D_0 - (D_0 + P_0)}{(1-\tau)^2} = \frac{-P_0}{(1-\tau)^2} \leqslant 0$$

Therefore we can conclude that (assuming that $P_0 > 0$), for the threshold output a^*:

1. a^* increases with the level of out-financing; if it is appealed to this one, it increases also with the interest rate in debt.

2. In the measurement which is appealed to the self-finance, a^* diminishes when the self-finance level increases if $D_0 \leqslant C(0)$. However if $D_0 > C(0)$, then the a^* increases when self-finance level diminishes.

2.3.2 The tax shields and division of output

2.3.2.1 Symbols

Now we study this question by organizing the mathematical formulation (2.3.2.2 and 2.3.2.3) of the model. We will apply the following symbols:

- i =subindex; $i = 1, 2, 3$ which correspond to:

  $i = 1$, tax claimant

  $i = 2$, debtholders

  $i = 3$, equityholders

- $C_i(1)$ =portion of output correponding to stakeholders i.

- j =subindex; $j = 1, 2$ which correspond to:

  $j = 1$, debt

  $j = 2$, depreciation of the investment

- TS_j =precedent cash flow from the j-tax shield

With these symbols we can write the corresponding expressions to those different tax shield like different portions of output corresponding to stakeholders.

2.3.2.2 Study of Tax Shields

2.3.2.2.1 Debt tax shield We will start with a numerical example given as:

$C(0) = 1000\,m.u.$ $D_0 = 300\,m.u.$ $P_0 = 700\,m.u.$ $r = 5\%$

$C(1) = 1200\,m.u.$

In order to determine the associated cash flow of this tax shield, we will do as follows:

1) Difference between $C(1)$ and $C(0)$ which is $200\,m.u.$

2) Multiply τ $(e.g.\,40\%)$ by $[C(1) - C(0)]$ which is $200 \times 40\% = 80\,m.u.$

3) Multiply $(r \cdot D_0)$ by τ which is $(5\% \times 300) \times 40\% = 6\,m.u.$

4) Choose the minor quantity obtained from step 2) and 3) which is $6\,m.u.$

5) If the result in step 4) is negative, the debt tax shield is zero; if it is positive, the debt tax shield is equal to this positive value $6\,m.u.$

We observe that if for one investment is $D_0 = 0$, which means that it is totally financed by equity $(P_0 = C(0))$, therefore, debt tax shield is 0; meanwhile, in contrast, the investment could be financed totally with debt $(D_0 = C(0))$, therefore the debt tax shied would be $20\,m.u.$ Consequently, the tax shield impels the use of out-financing. The mathematical formalization of the procedure can be expressed as formula (2.4):

$$TS_1 = Max\left\{Min\left[(C(1) - C(0)) \cdot \tau,\, r \cdot D_0 \cdot \tau\right],\, 0\right\} \tag{2.4}$$

In the end, Figure 2.4 might be more helpful. In order to construct Figure 2.4, we see if:

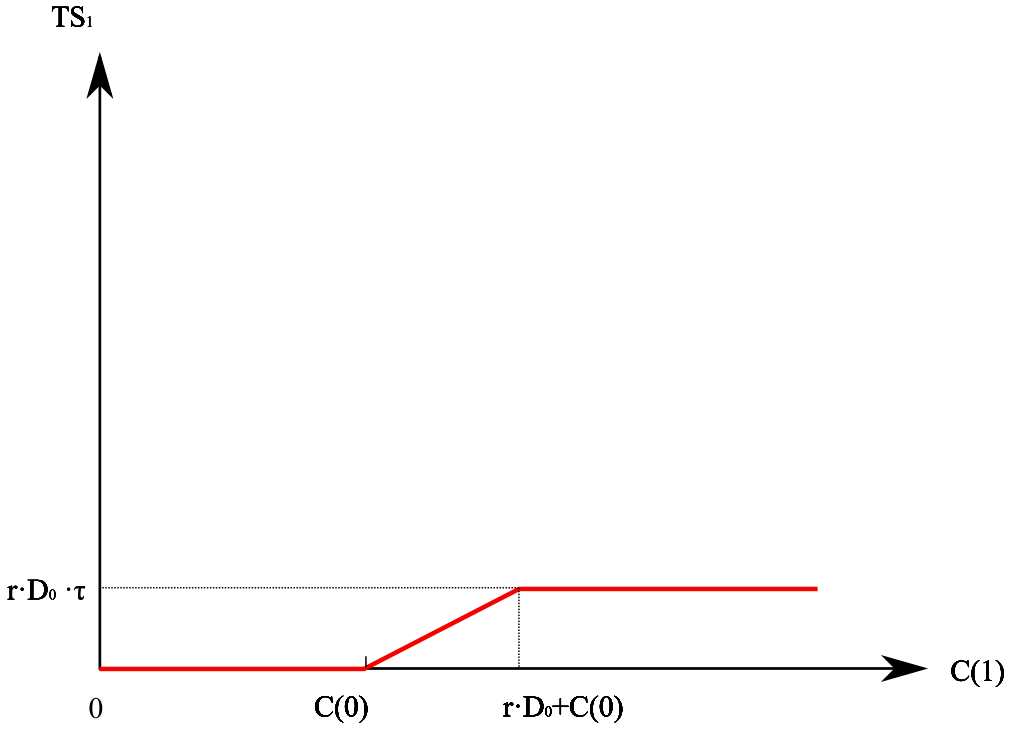


Figure 2.4: Debt tax shield

- $C\,(1) \leqslant C(0) \Rightarrow TS_1 = 0$
- $C\,(0) < C(1) \leqslant C(0) + r \cdot D_0 \Rightarrow 0 < C(1) - C(0) \leqslant r \cdot D_0 \Rightarrow TS_1 \leqslant r \cdot D_0 \cdot \tau$
- $C\,(1) > C(0) + r \cdot D_0 \Rightarrow C(1) - C(0) > r \cdot D_0 \Rightarrow TS_1 = r \cdot D_0 \cdot \tau$

2.3.2.2.2 Depreciation tax shield Now we start from a fresh new numerical example given by:

$C(0) = 1000\,m.u.$ $C(1) = 1200\,m.u.$

In order to determine the precedent cash flow of this tax shield we proceed as follows:

1) Determine the result of $C(1)$ multiply by τ (e.g. $\tau = 40\%$) which is $1200 \times 40\% = 480\, m.u.$

2) Determine the result of $C(0)$ multiply by τ which is $1000 \times 40\% = 400\, m.u.$

3) Choose the smallest one of the two values above which is $400\, m.u.$

Observe if in case the investment ends up with loss, $C(1) = 0$, the result for total depreciation will be $TS_2 = 0$. This result continues to be inferior to $400\, m.u.$ Meanwhile $C(1)$ is less or equal than $C(0)$ and it is a frustrating investment due to excessive risk, with big possibility depreciating the present investment. On the other hand, if $C(1) > C(0)$, the value would be $TS_2 = 400\, m.u.$ The mathematical formalization of this simple calculation procedure can be expressed as formula (2.5):

$$TS_2 = Min\left[C(1) \cdot \tau,\, C(0) \cdot \tau\right] \tag{2.5}$$

The corresponding graph is shown as Figure 2.5. Therefore, the total tax shield would be:

$$TS = TS_1 + TS_2$$

We can formulate it based on the Figure 2.4 and Figure 2.5:

From Figure 2.4 we can get:

$$TS_1 \begin{cases} C(1) \in [0,\, C(0)] & = 0 \\ C(1) \in (C(0),\, C(0) + r \cdot D_0] & \leqslant r \cdot D_0 \cdot \tau \Rightarrow TS_1 = [C(1) - C(0)] \cdot \tau \\ C(1) > C(0) + r \cdot D_0 & = r \cdot D_0 \cdot \tau \end{cases}$$

From Figure 2.5 we can get:

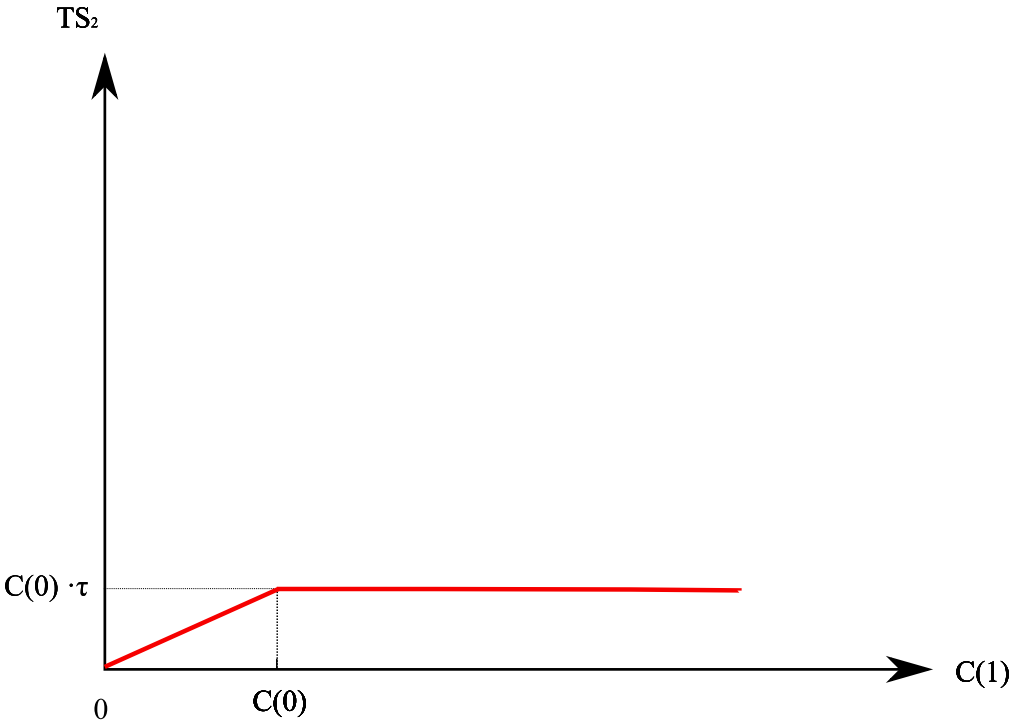


Figure 2.5: Depreciation tax shield

$$TS_2 \begin{cases} C(1) \in [0,\, C(0)] & \leqslant C(0)\cdot\tau \Rightarrow TS_2 = C(1)\cdot\tau \\ C(1) > C(0) & = C(0)\cdot\tau \end{cases}$$

If we sum up the intervals we can obtain:

$$TS = TS_1 + TS_2 = \begin{cases} C(1) \in [0,\, C(0)] & C(1)\cdot\tau \\ C(1) \in (C(0),\, C(0) + r\cdot D_0) & C(1)\cdot\tau \\ C(1) > C(0) + r\cdot D_0 & [C(0) + r\cdot D_0]\cdot\tau \end{cases}$$

By combining the first two branches we can obtain:

$$TS = TS_1 + TS_2 = \begin{cases} C(1) \in [0,\, C(0) + r\cdot D_0] & C(1)\cdot\tau \\ C(1) > C(0) + r\cdot D_0 & [C(0) + r\cdot D_0]\cdot\tau \end{cases}$$

We can express TS in another way similar to (2.4) and (2.5) and the corresponding graph would be Figure 2.6:

$$TS = Min\,[C(1)\cdot\tau,\, [C(0) + r\cdot D_0]\cdot\tau] \tag{2.6}$$

2.3.2.3 Study of division of output

2.3.2.3.1 Tax claim in the taxable income Naturally, we only focus on cash flow in case of $J > 0$; Consequently, the tax claim can be expressed as:

$$C_1(1) = Max\,[(C(1) - C(0) - r\cdot D_0)\cdot\tau,\ 0] \tag{2.7}$$

We can represent it by Figure 2.7:

- $C\,(1) \leqslant C(0) + r\cdot D_0 \Rightarrow C_1(1) = 0,\ since\, J \leqslant 0$
- $C\,(1) > C(0) + r\cdot D_0 \Rightarrow C_1(1) = J\cdot\tau,\ since\, J > 0$

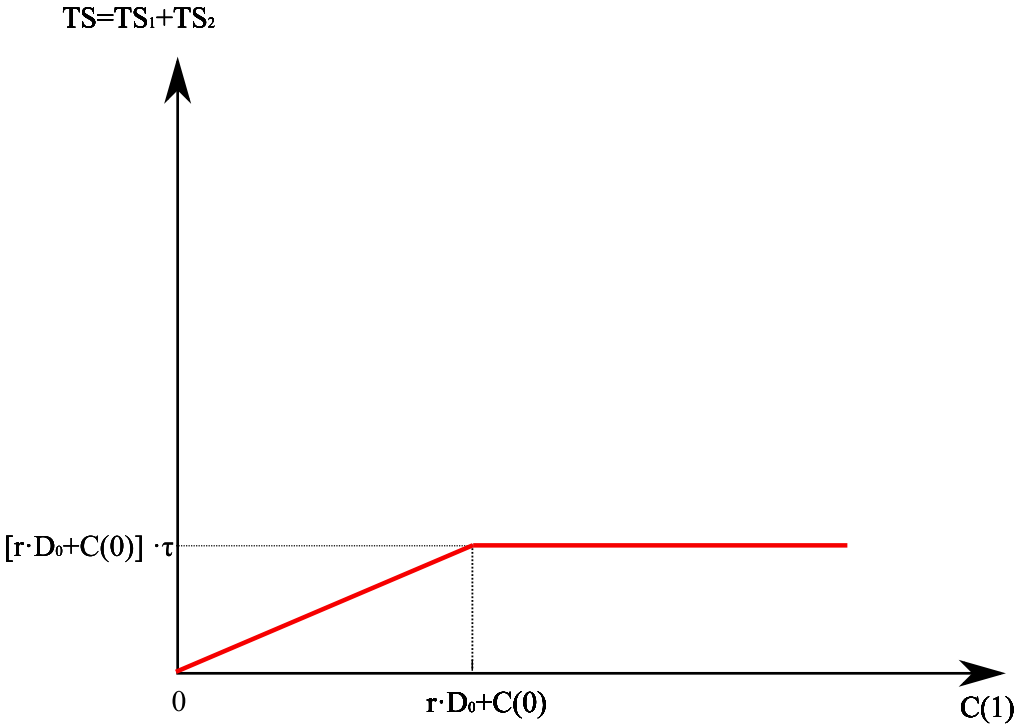


Figure 2.6: Total tax shield

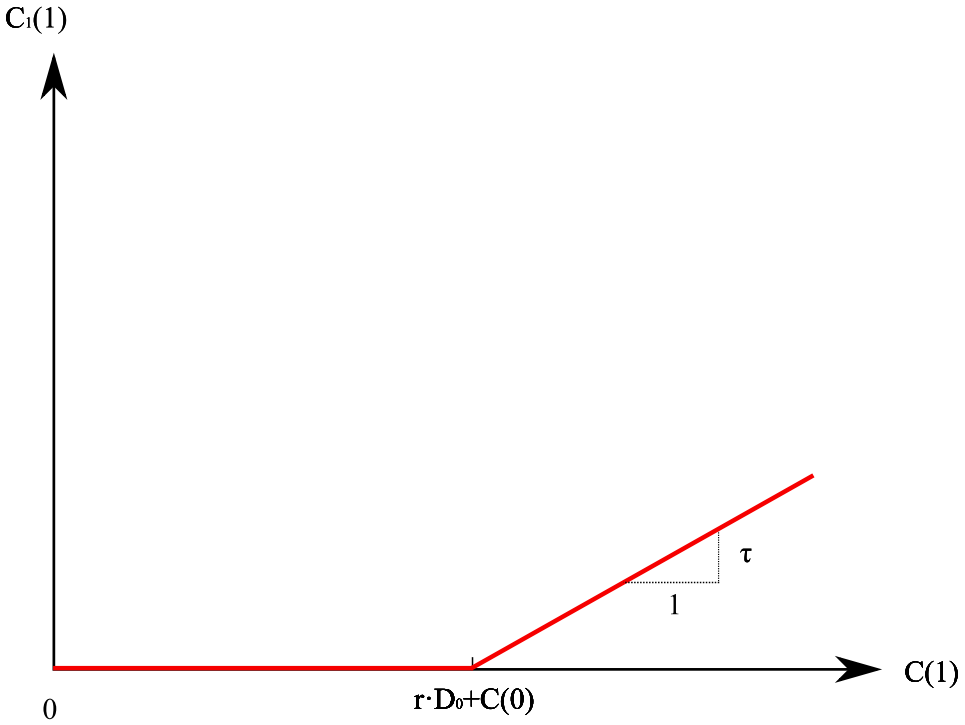


Figure 2.7: Tax claim

2.3.2.3.2 Debtholders In order to study debtholders, we apply two cases with $D_0 \leqslant C(0)$ and $D_0 > C(0)$ respectively. We might understand the distinction of these two cases immediately if we connect financial insolvency with those two possibilities of D_0:

A) $D_0 \leqslant C(0)$

Suppose it is given that $C\,(0) = 1000\,m.u.$ $C\,(1) = 1200\,m.u.$ $D_0 = 300\,m.u.$ $r = 5\%$ $\tau = 40\%$.

At time 1, maturity of debt, debtholders can receive $D_0 \cdot (1+r) = 315\,m.u.$ Therefore, there are always (see (2.2)) two conditions:

- $D_0 \leqslant C(0)$
- $C\,(1) > a^* = D_0 \cdot (1 + r)$

The financial solvency is always fullfilled.

B) $D_0 > C(0)$

We allow D_0 to be bigger than $C\,(0) = 1000\,m.u.$ If financing interest is 5% and we suppose D_0 equals to: B1) $D_0 = 1050\,m.u.$, B2) $D_0 = 1087.38\,m.u.$

B1) $D_0 = 1050\,m.u.$

- Quantity to pay at the maturity $= 1050 \times (1 + 5\%) = 1102.50\,m.u.$
- Available cash flow after tax $= 1200 \times (1 - 0.4) = 720\,m.u.$
- Cash flow perceived from the depreciation of the leveraged investment is $(C(0) + r \cdot D_0) \cdot \tau = (1000 + 0.05 \times 1050) \times 0.4 = 421\,m.u.$
- Total available cash flow at the maturity of debt $= 720 + 421 = 1141\,m.u. > 1102.50\,m.u.$ Therefore the debt can be paid.

B2) $D_0 = 1087.38\,m.u.$

- Quantity to pay at the maturity $= 1087.38 \times 1.05 = 1141.75\, m.u.$
- Avaliable cashflow after tax $= 1200 \times (1 - 40\%) = 720\, m.u.$
- Cashflow perceived from the depreciation of the investment $= (1000 + 0.05 \times 1087.38) \times 40\% = 421.75\, m.u.$
- Total cash flow available at the maturity of debt $= 72 + 421.75 = 1141.75\, m.u.$

Therefore, the debt could be paid but it is clear that we are at the threshold of debt: if it is more than $1087.38\, m.u.$, the debt can not be paid. It means that the financial solvency with $D_0 > C(0)$ establishes a limit level of leverage.

Given the procedure of calculation we developed with previous examples, we can formalize it mathematically as follows:

$$C_2(1) = \begin{cases} D_0 \leq C(0) & Min\left[C(1), a^*\right] \\ D_0 > C(0) & Min\left\{C(1), \left[C(1)\cdot(1-\tau) + (C(0) + r\cdot D_0)\cdot\tau\right], D_0(1+r)\right\} \end{cases} \tag{2.8}$$

In the section 3.1, in order to analyze the problem of financial solvency, it was indicated that a top level of indebteness existed as what we have shown in the B2). However, what is this top level? The formulation (2.8) made the answer much easier. We call D_0^* the threshold level of debt, therefore the result would be:

$$C(1) \geq D_0 \cdot (1+r) \Rightarrow C(1)\cdot(1-\tau) + (C(0) + r\cdot D_0^*)\cdot\tau = D_0^*\cdot(1+r)$$

$$D_0^* = \frac{C(1)\cdot(1-\tau) + C(0)\cdot\tau}{1 + r - r\cdot\tau} \tag{2.9}$$

If we apply (2.9) in the B2) we can obtain precisely $1087.38\, m.u.$ From this viewpoint, we are going further than Rao and stevens (2007) by replacing the expression (2.8) into (2.10):

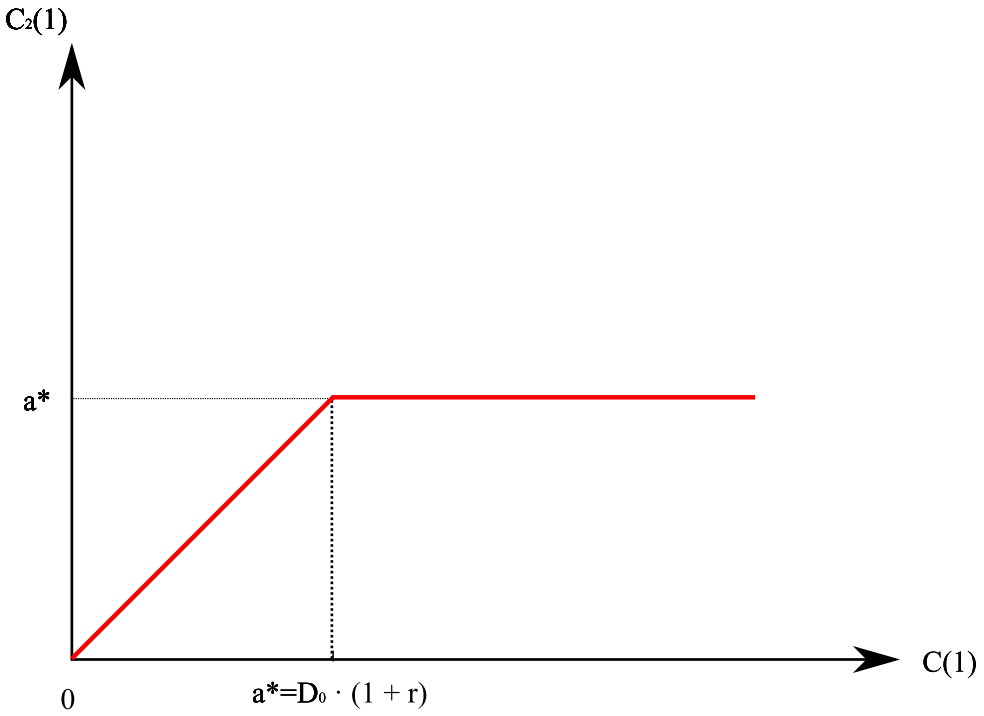


Figure 2.8: Debt holders $D_0 \leqslant C(0)$

$$C_2(1) = \begin{cases} D_0 \leq C(0) & Min\left[C(1), a^*\right];\ a^* = D_0 \cdot (1+r) \\ D_0 \in \left[C(0), D_0^*\right] & Min\left\{C(1), \left[C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau\right], D_0 \cdot (1+r)\right\} \end{cases} \tag{2.10}$$

We can further describe those formulas above by Figure 2.8, Figure 2.9 and Figure 2.10:

The Figure 2.8 can be explained easily. While $C(1)$ is smaller than $D_0 \cdot (1+r)$, $(C(1) < a^*)$, we tend to have the Min range superior than (2.10)

which can result $C(1)$. This is to say, we are under the bisector $C_2(1)$=$C(1)$ and when $C(1) > a^*$, the minimum value would be a^*. In order to explain the Figure 2.10, we have to present the following:

$$a^* > C(0) + r \cdot D_0$$

in fact, based on (2.2), we could have:

$$a^* = \frac{D_0 \cdot (1+r) - (C(0) + r \cdot D_0) \cdot \tau}{1-\tau} > C(0) + r \cdot D_0$$

A simple algebra manipulation with "$>$" can satisfy the inequality if and only if $D_0 > C(0)$, which is the condition for a^* to have such expression like (2.2). By establishing this inequality, we can subdivide it by horizontal intervals as Figure 2.9:

- First interval

  $0 \leqslant C(1) \leqslant C(0) + r \cdot D_0$ In this case, we could see:

  a) $C(1) \leqslant C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau$

  With algebra manipulation we can obtain the implication of $C(1) \leqslant C(0) + r \cdot D_0$

  b) From the other part, $C(0) + r \cdot D_0 < D_0 \cdot (1+r)$which can be driven into $D_0 > C(0)$

Therefore, combine a) and b) we could obtain:

$$C(1) \leqslant [C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau] < D_0 \cdot (1+r)$$

With the Min of the second branch of (2.10) is $C(1)$, we can see that the first interval of Figure 2.9 is the equation:

$$C_2(1) = C(1) \tag{2.11}$$

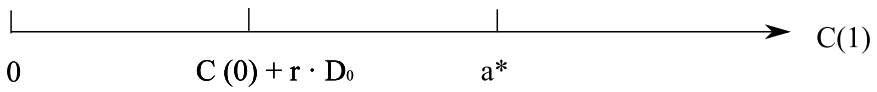


Figure 2.9: Intervals of $C\,(1)$

- Second interval

  $C(0) + r \cdot D_0 < C(1) \leqslant a^*$ In this case, we could see:

  a) $C(1) > C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau$

  With the algebra manipulation we can drive this inequality into $C(1) > C(0) + r \cdot D_0$

  b) $C(1) \cdot (1-\tau) + [C(0) + r \cdot D_0] \cdot \tau \leqslant D_0 \cdot (1+r)$

  With the algebra manipulation we can obtain: $D^* \leqslant D_0$, therefore D_0 can not be bigger than $D_0{}^*$ to accept the equality.

We can conclude that the Min of the second branch of (2.10) could result as:

$$C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau$$

With the second interval of Figure 2.9 we can have the second linear as (2.12):

$$C_2(1) = C(1) \cdot (1-\tau) + (C(0) + r \cdot D_0) \cdot \tau \tag{2.12}$$

- Third interval

  $C(1) > a^*$ In this case, we could see:

  a) $C(1) > D_0 \cdot (1+r)$ which is an obvious result.

  b) $C(1) \cdot (1-\tau) + [C(0) + r \cdot D_0] \cdot \tau > D_0 \cdot (1+r)$ which is equal to $D_0{}^* > D_0$ so as to satisfy this inequality.

  Based on the Min of the second branch (2.10), we can obtain the result of $D_0 \cdot (1+r)$.

Based on what we analyzed, we could construct the Figure 2.10.

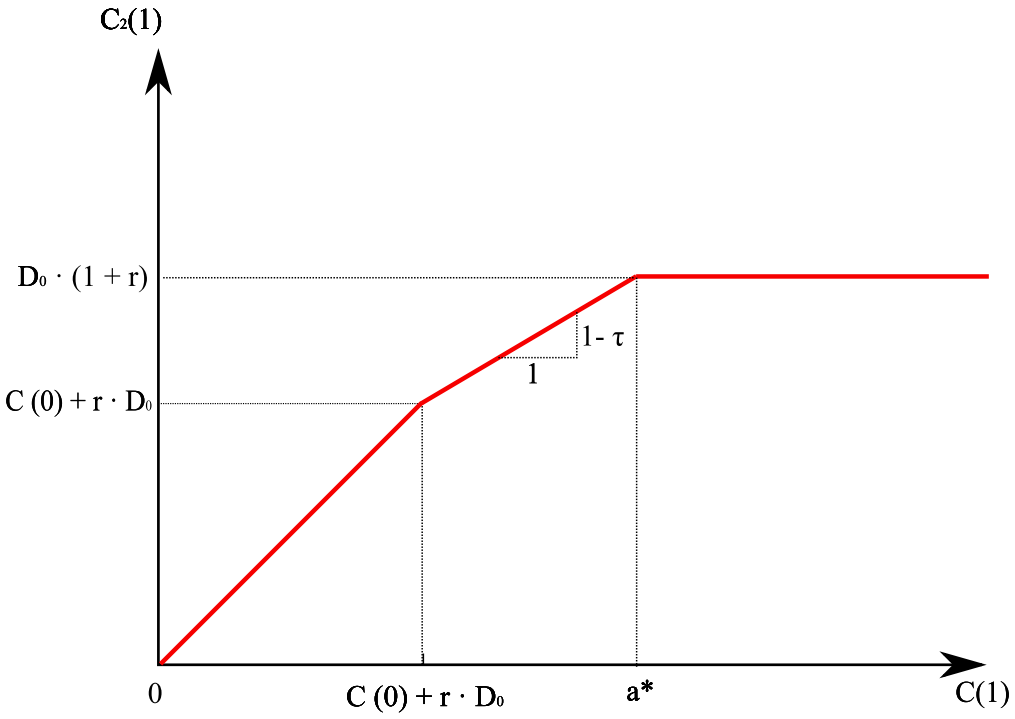


Figure 2.10: Debtholders $D_0 > C\,(0)$

2.3.2.3.3 Equityholders The key of the analysis builds on the fact that when there is no retention of profits (**H4**), the equityholders can only claim the rest of the amount of $C(1)$ after the deduction of interests, return of debt and payment of taxes plus cashflows which come from fiscal regulations on interests and depreciations.

We also have to distinguish between $D_0 \leqslant C(0)$ and $D_0 > C(0)$. We will give two examples in order to help the mathematical formulations so as to construct the corresponding figures.

- $D_0 \leqslant C(0)$

  $C(0) = 1000 m.u.$ $D_0 = 300\, m.u.$ $\tau = 40\%$ $r = 5\%$ Under the common conditions, we can further discuss three cases A1) $C(1) = 1200\, m.u.$ A2) $C(1) = 500\, m.u.$ A3) $C(1) = 315\, m.u.$

  A1) $C(1) = 1200\, m.u.$

  - Pay debt and interest $1200 - 300 \times (1 + 5\%) = 885\, m.u.$
  - Pay debt and interest plus cash flow from fiscal legislation minus taxes paid: $1200 \times (1 - 40\%) + 1000 \times 40\% - 300 \times (1.05 - 0.05 \times 40\%) = 811\, m.u.$
  - Between $885\, m.u.$ and $811\, m.u.$, the smaller quantity of those two, being positive, will be dedicated to equity holders.
  - Therefore, equityholders can claim $811\, m.u.$

  A2) $C(1) = 500\, m.u.$

  - Pay debt and interest $500 - 300 \times 1.05 = 185\, m.u.$
  - Pay debt and interest plus cash flow from fiscal legislation minus taxes paid: $500 \times (1 - 40\%) + 1000 \times 40\% - 300 \times (1.05 - 0.05 \times 40\%) = 391\, m.u.$

- The smaller quantity between 185 and 391 is the corresponding quantitly for equityholders, which is $185\,m.u.$

A3) $C(1) = 315\,m.u.$

- Pay debt and interest $315 - 300 \times 1.05 = 0\,m.u.$
- Pay debt and interest plus cash flow from legislation minus taxes paid: $315 \times (1 - 40\%) + 1000 \times 40\% - 300 \times (1.05 - 0.05 \times 40\%) = 100\,m.u.$
- Since $0 < 100$, equityholders will not claim anything.

- $D_0 > C(0)$

  $C(0) = 1000 m.u.$ $C(1) = 1200\,m.u.$ $r = 5\%$ $\tau = 40\%$ Under the common conditions, we can further discuss two cases: B1) $D_0 = 1050\,m.u.$ B2) $D_0 = 1087.38\,m.u.$

  B1) $D_0 = 1050\,m.u.$

  - $1200 \times (1 - 40\%) + 1000 \times 40\% - 1050 \times (1.05 - 0.05 \times 40\%) = 38.5\,m.u.$ This is the part obtained by equityholders.

  B2) $D_0 = 1087.38\,m.u.$

  - $1200 \times (1 - 40\%) + 1000 \times 40\% - 1087.38 \times (1.05 - 0.05 \times 40\%) = 0\,m.u.$ This zero value shows that we are at the breakpoint of debt so that equityholders do not correspond to the negative values.

Based on the condition of mathematical formulations with those two cases, we have to remember the expression of a^* from (2.2), since it is useful for the formalization and explanation through graph. In order to summarize, we can have:

$$C_3(1) = \begin{cases} D_0 \leqslant C(0) & Max\{0, Min[C(1) - a^*,\ C(1)\cdot(1-\tau) + C(0)\tau - D_0(1+r-r\tau)]\} \\ D_0 > C(0) & Max[0,\ (C(1) - a^*)\cdot(1-\tau)] \end{cases} \tag{2.13}$$

Now we are going to continue with two representations by graphs corresponding to those two branches of (2.13).

- $D_0 \leqslant C(0)$

  In the positive value of $C(1)$ we can consider three intervals (See Figure 2.11). Under the condition of (2.2) we have:

  - $a^* = D_0 \cdot (1+r)$
  - $C(1) - a^*$
  - $C(1)\cdot(1-\tau) + C(0)\cdot\tau - D_0(1+r-r\cdot\tau)$
    $= C(1)\cdot(1-\tau) + (r\cdot D_0 + C(0))\cdot\tau - D_0\cdot(1+r)$
    $= C(1)\cdot(1-\tau) + (r\cdot D_0 + C(0))\cdot\tau - a^*$

We can consider the line $C(1)$ to be divided into three intervals in Figure 2.11:

1. First interval, $0 \leqslant C(1) \leqslant a^*$ and there are two conditions can be further discussed:

   a) $C(1) - a^* \leqslant 0$

   b) $C(1)\cdot(1-\tau) + C(0)\cdot\tau - D_0\cdot(1+r-r\cdot\tau)$
   $=[C(1) - a^*] + [r\cdot D_0 + C(0) - C(1)]\cdot\tau$
   in (1), $J = C(1) - r\cdot D_0 - C(0)$ and in case of $D_0 \leqslant C(0)$ we have $J \leqslant 0$, we could have:

$$[C(1) - a^*] - J\cdot\tau$$

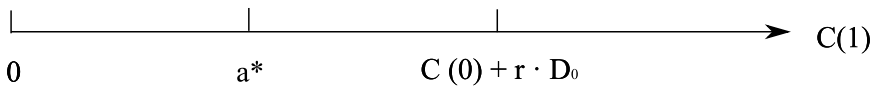


Figure 2.11: Equityholders: $D_0 \leqslant C(0)$

Where $-J \cdot \tau$ is positive value which can drive us into: $[C(1) - a^*] - J \cdot \tau > [C(1) - a^*]$. Consequently, the Min value would be $[C(1) - a^*]$ and therefore $Max[0,\, C(1) - a^*] = 0$ with $[C(1) - a^*] \leqslant 0$. We can conclude:

$$0 \leqslant C(1) \leqslant a^* \Rightarrow C_3(1) = 0$$

2. Second interval, $a^* < C(1) \leqslant r \cdot D_0 + C(0)$ and there are three conditions can be further discussed:

   a) $C(1) - a^* > 0$

   b) $[C(1) - a^*] - J \cdot \tau > C(1) - a^* > 0$ Like we have mentioned before, $J \leqslant 0$, therefore $Min = C(1) - a^* \Rightarrow Max[0,\, C(1) - a^*] = C(1) - a^*$

   c) $C(1) - a^* = C(1) - D_0 \cdot (1 + r) = X$
   If $C(1)$ was equal to $D_0 \cdot (1 + r)$, X would be 0. However, every additional unit on $C(1) = D \cdot (1 + r)$ will give an additional unit on X. Therefore, $C_3(1)$ will increase with $C(1)$ until the latter comes to the value $[r \cdot D_0 + C(0)]$, with X also grows up to reach the value: $[r \cdot D_0 + C(0)] - D_0 \cdot (1 + r) = C(0) - D_0 > 0$
   In conclusion,

$$a^* < C(1) \leqslant r \cdot D_0 + C_0 \Rightarrow C_3(1) = C(1) - a^* > 0$$

3. Third interval $C(1) > r \cdot D_0 + C(0)$

   The expression of $C_3(1)$ could be obtained easily from the following: In case of $C(1) = r \cdot D_0 + C(0)$, we just see $C_3(1) = C(0) - D_0$; Therefore based on this value, the quantity $C(1) - r \cdot D_0 - C(0)$ would be taxable and the quantity after tax payment would be corresponding to equityholders, which is added to $C(0) - D_0$. In summary,

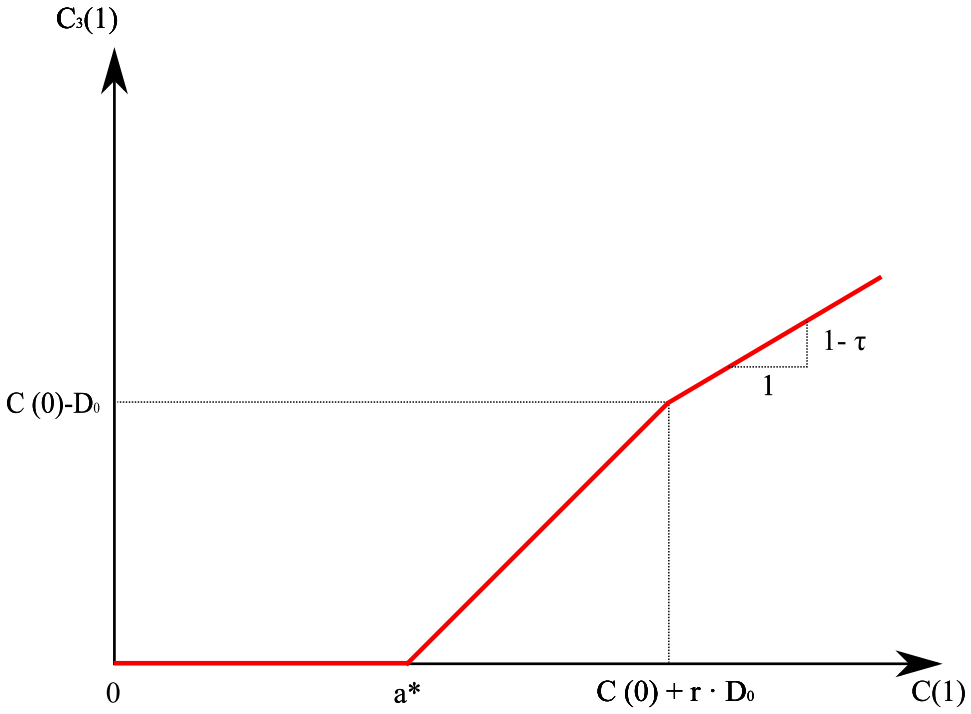


Figure 2.12: Euqityholder: $D_0 \leqslant C(0)$

$$C(1) > r \cdot D_0 + C(0) \Rightarrow (14)$$

$$C_3(1) = C(0) - D_0 + [C(1) - r \cdot D_0 - C(0)](1 - \tau) \qquad (2.14)$$

We agree with the study before about the intervals with Figure 2.12:

- $D_0 > C(0)$

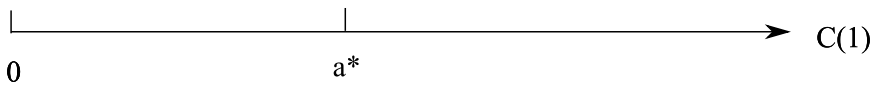


Figure 2.13: Equityholder: $D_0 > C\,(0)$

As deducted from (2.13), the positive straight line can be shown as intervals in Figure 2.13:

1. First interval $0 \leqslant C\,(1) \leqslant a^*$

   since $C\,(1) - a^* \leqslant 0 \Rightarrow Max[0,\, [C\,(1) - a^*]\,(1-\tau)] = 0$ Which is to say, $0 \leqslant C\,(1) \leqslant a^* \Rightarrow C_3\,(1) = 0$

2. Second interval $C\,(1) > a^*$

   $C\,(1) - a^* > 0 \Rightarrow Max\,[0,\, [C(1) - a^*]\,(1-\tau)]$, Consequently $C_3\,(1)$ would be:

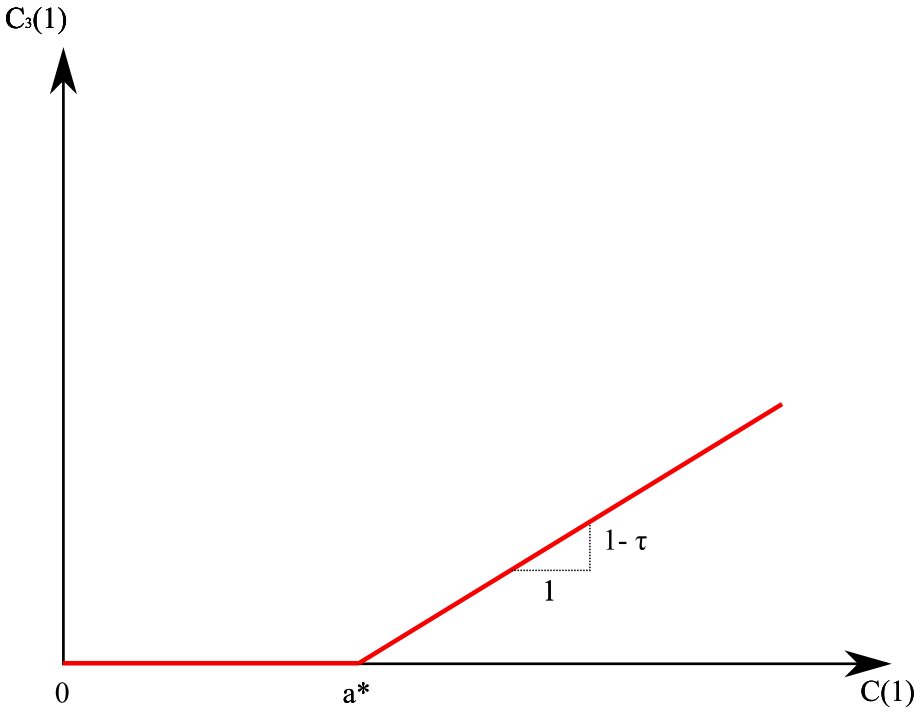


Figure 2.14: Equityholder: $D_0 > C(0)$

$$C_3(1) = (C(1) - a^*)(1 - \tau) \tag{2.15}$$

The analysis of the two intervals could be shown by Figure 2.14:

2.3.2.3.4 Debt plus Equityholders The sum of $C_{2,3}(1) = C_2(1) + C_3(1)$ can be obtained by the Figure 2.8, Figure 2.10, Figure 2.12 and Figure 2.14; For the case of $D_0 \leqslant C(0)$, we have Figure 2.8 and Figure 2.12 and for the case of $D_0 > C(0)$, we have Figure 2.10 and Figure 2.14.

- $D_0 \leqslant C\,(0)$

$$C_2(1) = \begin{cases} C\,(1) \in [0,\, a^*] & C\,(1) \\ C\,(1) > a^* & a^* \end{cases}$$

$$C_3\,(1) = \begin{cases} C\,(1) \in [0,\, a^*] & 0 \\ C(1) \in (a^*,\, r \cdot D_0 + C\,(0)] & C\,(1) - a^* \\ C(1) > r \cdot D_0 + C(0) & C(0) - D_0 + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau) \end{cases}$$

(For the last branch of $C_3(1)$, we can see (2.13)).

Consequently, we can construct $C_{2,3}\,(1)$ as the following piecewise continuity function:

- For interval $[0,\, a^*]$ we have $C_{2,3}(1) = C(1) + 0 = C(1)$
- For interval $(a^*,\, r \cdot D_0 + C(0)]$ we have $C_{2,3}(1) = a^* + C(1) - a^* = C(1)$
- For interval $C\,(1) > r \cdot D_0 + C(0)$ we have:

$$C_{2,3}(1) = a^* + C(0) - D_0 + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau)$$

Since $a^* + C(0) - D_0 = D_0 \cdot (1 + r) + C(0) - D_0 = r \cdot D_0 + C(0)$, we can drive $C_{2,3}(1) = r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau)$

Therefore we can obtain the result as

$$C_{2,3}(1) = \begin{cases} C(1) \in [0,\, r \cdot D_0 + C(0)] & C(1) \\ C(1) > r \cdot D_0 + C(0) & r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau) \end{cases} \tag{2.16}$$

- $D_0 > C\,(0)$

$$C_2(1) = \begin{cases} C(1) \in [0,\, r \cdot D_0 + C(0)] & C(1) \\ C(1) \in (r \cdot D_0 + C(0),\, a^*] & r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1-\tau) \\ C(1) > a^* & D_0 \cdot (1+r) \end{cases}$$

The second branch of $C_2(1)$ can be referred from (2.12) and the expression of a^* can be referred from (2.2).

$$C_3(1) = \begin{cases} C(1) \in [0,\, a^*] & 0 \\ C(1) > a^* & [C(1) - a^*] \cdot (1-\tau) \end{cases}$$

Consequently, we can construct the following functions:

a) For interval $[0,\, r \cdot D_0 + C(0)]$, we have $C_{2,3}(1) = C_2(1) + 0 = C(1)$

b) For interval $(r \cdot D_0 + C(0),\, a^*]$, we have $C_{2,3}(1) = r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1-\tau)$

c) For interval $C\,(1) > a^*$, we have:

$$\begin{aligned} C_{2,3}(1) &= D_0 \cdot (1+r) + (C(1) - a^*) \cdot (1-\tau) \\ &= D_0 \cdot (1+r) + [C(1) - \tfrac{D_0 \cdot (1+r) - [r \cdot D_0 + C(0)] \cdot \tau}{1-\tau}] \cdot (1-\tau) \\ &= D_0 \cdot (+r) + C(1) \cdot (1-\tau) - D_0 \cdot (1+r) + [r \cdot D_0 + C(0)] \cdot \tau \\ &= C(1) \cdot (1-\tau) + [r \cdot D_0 + C(0)] \cdot \tau \end{aligned}$$

Therefore we can have:

$$C_{2,3}(1) = r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1-\tau)$$

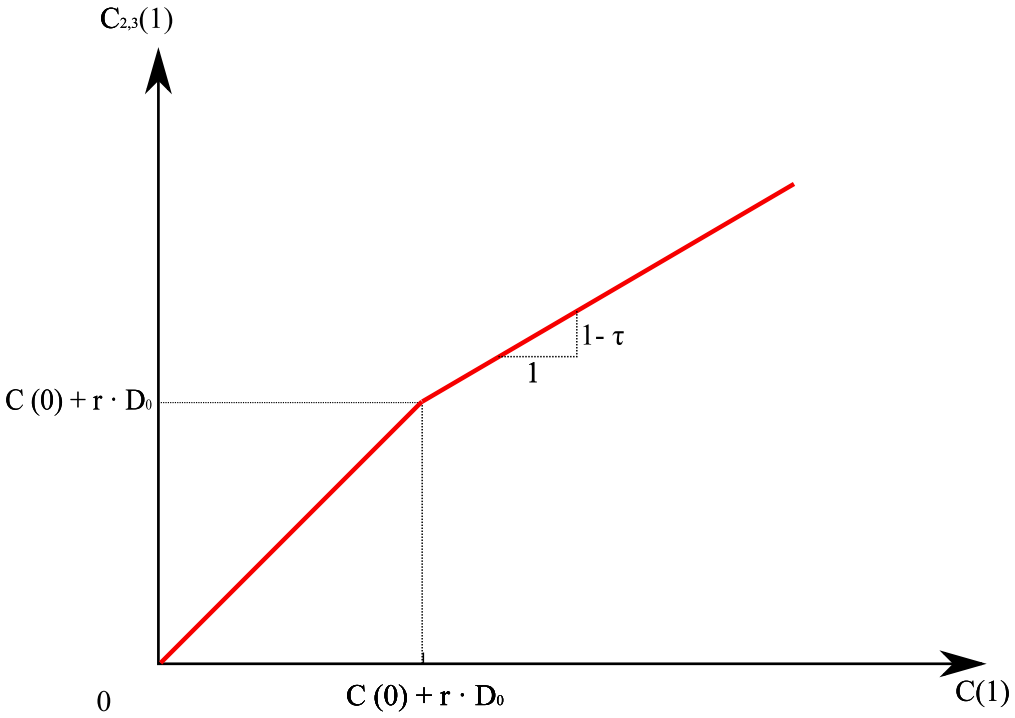


Figure 2.15: Debt- and Equityholders

When $D_0 > C(0)$, we can write:

$$C_{2,3}(1) = \begin{cases} C(1) \in [0,\, r \cdot D_0 + C(0)] & C(1) \\ C(1) > r \cdot D_0 + C(0) & r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau) \end{cases}$$

The expression above is identical with (16), therefore the mathematical graphs are also the same for analyzing value of D_0 (see Figure 2.15):

The effects of a simple cross-check that eliminates the possibility of error in the previous results, let's find the sum:

$$C_1(1) + C_2(1) + C_3(1) = C_1(1) + C_{2,3}(1)$$

For $C_1(1)$ (See Figure 2.7)

$$C_1(1) = \begin{cases} C(1) \in [0,\, r \cdot D_0 + C(0)] & 0 \\ C(1) > r \cdot D_0 + C(0) & (C(1) - C(0) - r \cdot D_0) \cdot \tau \end{cases}$$

Based on $C_1(1)$ and (2.16) , we see:

- For $C\,(1) \in [0,\, r \cdot D_0 + C(0)]$, we have $C_1(1) + C_{2,3}(1) = C(1) + 0 = C(1)$
- For $C_1(1) > r \cdot D_0 + C(0)$, we have:

$$C_1(1) + C_{2,3}(1) = [C(1) - C(0) - r \cdot D_0] \cdot \tau + r \cdot D_0 + C(0) + [C(1) - r \cdot D_0 - C(0)] \cdot (1 - \tau) = C(1)$$

Therefore, in all cases we have analyzed, $C_1(1) + C_2(1) + C_3(1) = C(1)$. This result confirms that **H4** is consistent.

2.3.2.4 The result of analysis from the view of options

2.3.2.4.1 Introduction We intend to establish the connection between the study of tax shield and the division of the output in an investment with option theory. For those who are quite familiar with option theory, it is evident that those figures suggest the possibility to interpret the study in terms of financial instruments and carry out the quantitative valuation. This connection is already discussed by the authors of the model:

> The option approach, as noted, does not adequately handle tax effects. Thus, neither the CAPM nor the options theory is adequate for estimating the after-tax cost of capital for the (typical) firm with risky and potentially redundant debt and non-debt tax shield. For this reason, [...], we invoke the approximate APT. (Rao and Stevens 2007:17).

We do not aggree that option theory is unable to capture the tax effects (which means the aforementioned graphs can not be translated in terms of options). It seems to us that Rao and Stevens (2007) have limited themselves strictly to consider options (in particular, the European Calls) as financial instruments and they haven't gone further when options failed to achieve the question they raised. From the first moment, we had the intuition that the option approach might be applied in the managerial environment, though that we have to investigate not only the calls themselves but also its applications in the field of firms.

This application, as well as a procedure of analysis which were established in the seminal work of Black and Scholes (1973) have driven us to the conclusion that we could be able to completely interpret new graphs as indicated before basing on the graphs of intrinsic value of a call and applying the methodology of Black and Scholes (1973) in the formulations of market value of an European warrant.

2.3.2.4.2 The intrinsic value of a european call and its interpretation in the ambience of corporate valuation As it says in any mannual options[8], the intrinsic value of an option at the time t is the value that it would have if it is exercised at t. In case of a call, it is:

IV =intrinsic value

t =time

K =exercise price (or strike price)

S =value of equity

We have: $IV\,(t) = Max\,(S(t) - K;\, 0)$

This expression can be shown by Figure 2.16 which also includes the speculative value that option has at $t < T$.

[8]For example, Cox and Rubinstein(1985).

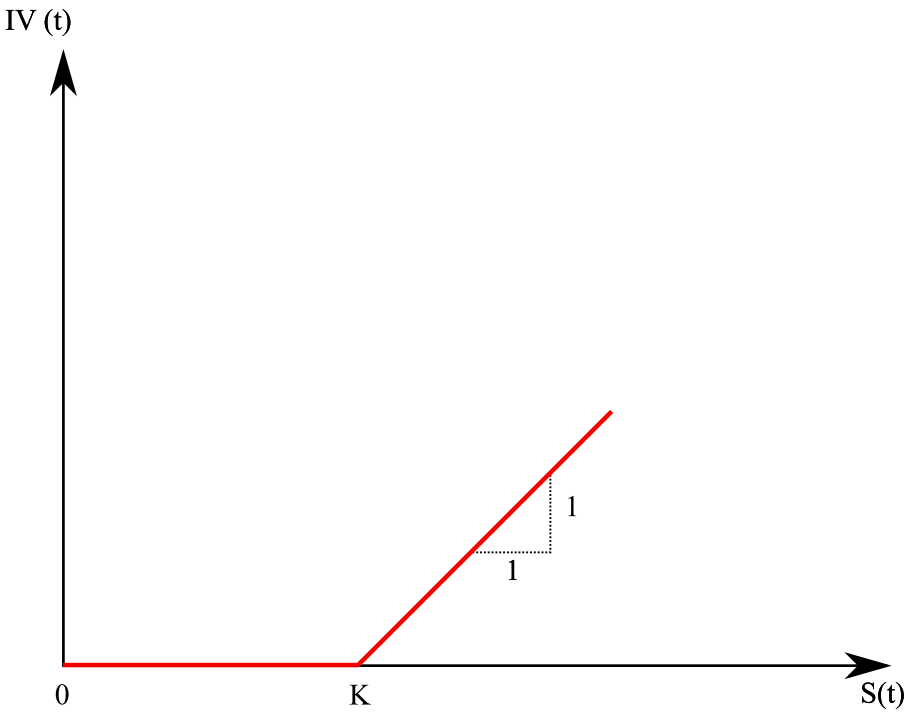


Figure 2.16: Intrinsic value of a call

In the work of Black and Scholes (1973), the reasoning is carried out by following the financial structure of the firm in an invested project:

Balance
n shares
m bonds

moment of analysis: t

Market value of the equity[9]$= S(t)$
Market value of the bonds$= B(t)$
Market value of the firm$= V(t) = S(t) + B(t)$

The characteristics of the bond can be considered as:

- Zero coupon
- Expiration $= T$
- Nominal (or face) value $= N$

If we suppose $t = T$, different situations can occur so that we can synthesize them in a table:

	$V(T) \leqslant N$	$V(T) > N$
$B(T)$	$B(T) = V(T)$	$B(T) = N$
$S(T)$	$S(T) = 0$	$S(T) = V(T) - N$

Those possibilities can be gathered in Figure 2.17:

Consequently, Figure 2.17 indicates that we are facing the intrinsic value of a call. Since the expiration of the bonds is at T and this is the date

[9]Here we suppose ordinary shares.

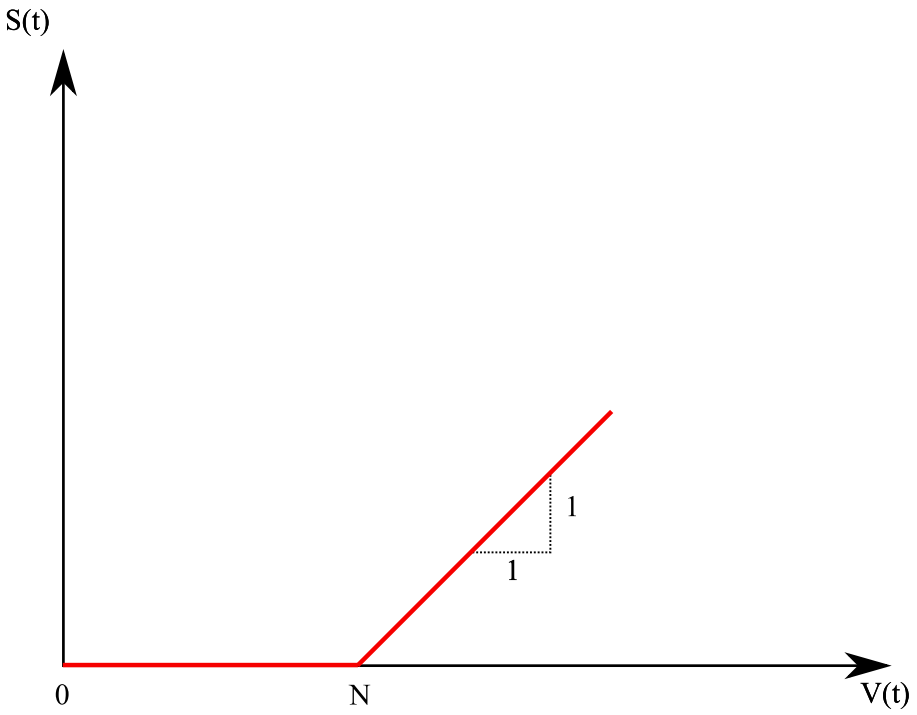


Figure 2.17: Market value with ordinary shares

in which, if the firm is insolvent, the bondholders will be able to claim the property of the firm (due to the priority than those shareholders). We can confirm that:

$$S(T) = IV(T)$$

And in a general way, at any time t, we have:

$$S(t) = C_t(V(t);\, K = N)$$

Where the $C_t(V(t);\, K = N)$ means value of european call at t, whose underlying value is the value of the firm and whose price of exercise is the face value of debt and the value of call includes the speculative value. Consequently, according to this approach, we can not only know the market value of S at the expiration T of debt, but also at any moment before the expiration of debt T. We extract a consequence that will be useful to us due to our intention; when we study a managerial phenomenon, sometimes we could represent it in figures and one of those figures could be detecting a call option as Figure 2.18.

We can be sure that we detect a call, whose value is given as the following expression:

$$Y = C(X;\, K = A)$$

Where X, Y, A are data which are from the analyzed phenomenon. The concrete way to calculate a call depends on if it is an European (in our case always) or American call, being able to apply the valuation formula of Black and Scholes (1973) (if treated as an European call) or, always from binomial method, naturally meanwhile the phenomenon in the study does not push back the hypothesis which rest on the forms of valuation.

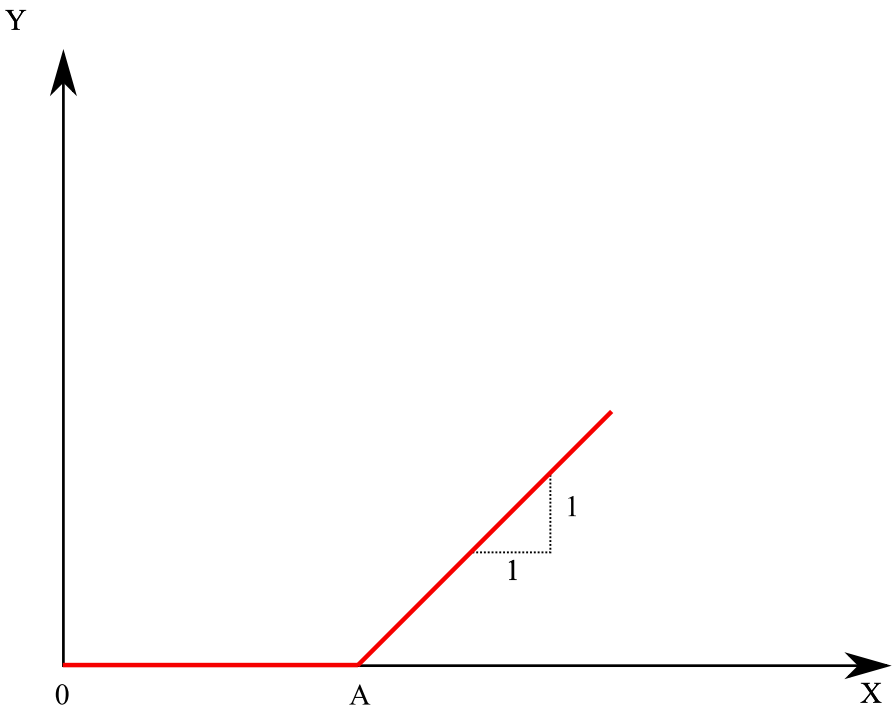


Figure 2.18: Detect of a call option

2.3.2.4.3 Valuation of an European Warrant If a firm issues an European call on its equity, we have a financial product denominated as European warrant[10]. When warrants are exercised, the set of warrant-holders pay the firm at global strike price[11] K and, in return, they receive shares, whose global value is superior to K (otherwise it is not exercised). This way, the exercise of warrants leads to a dilution because the exercise is equivalent as selling shares of the firm for an amount lower than the same one in the market.

Therefore the problem we face is how to value warrants. The simple use of the ordinary formula of options is not enough since an essential difference exists which makes it invalid to proceed: the ordinary options are negotiated by third parties since its exercise does not influence the value of firm issued shares, whereas, like we just argued, it is not like this in the case of warrants. By the context of managerial valuation of assets, the reasoning that it leads to the specific formulation we claim can be consulted in the relevant literature[12]. Therefore we will only give a continuity of the mathematical formula which can lead us to the corresponding Figure 2.19:

We suppose that the firm has n shares outstanding (in circulation) and the set of warrants constitute globally one European call of m new shares, whose strike price is K. After the exercise of warrants, the value of firm assets is equal to (at date T of exercise):

$$S(T) + K$$

Whereas each of the exercised warrants cost, referring an instant t is:

[10]In practice, the term *warrant* includes different categories of options, but for our proposal, it will be enough to consider the most restricted case of options: European calls without dividend.

[11]The value K comes habitually established across a conversion ratio indicated at the moment of the issue.

[12]For example, Damodaran(2002); Fernandez(2002); McDonald(2006); Whaley(2006:439-444).

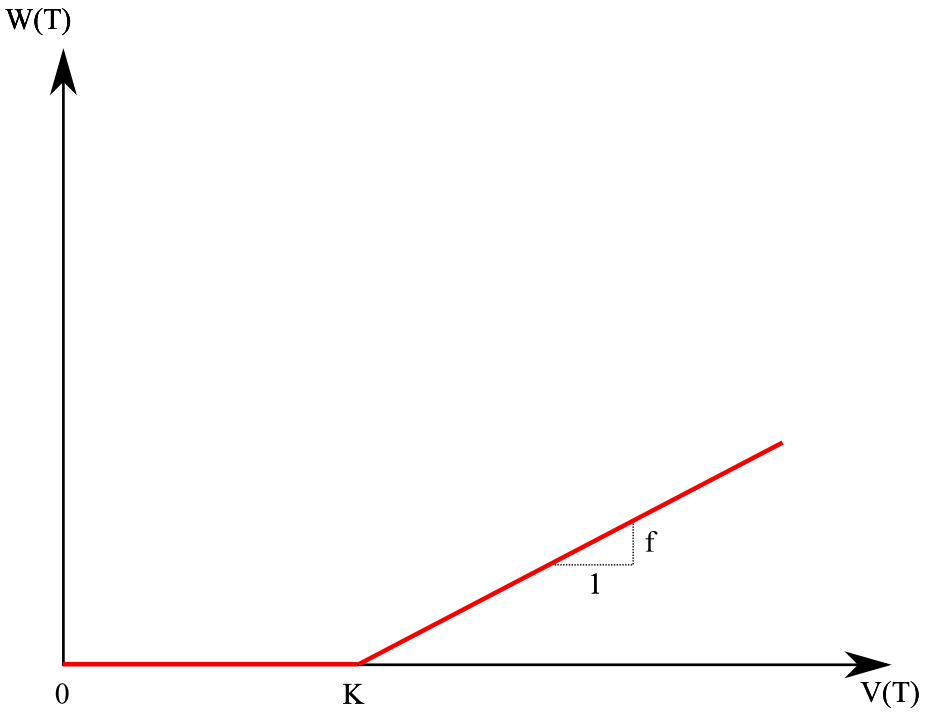


Figure 2.19: Market value of the warrant (European call)

$$w(t) = Call(\frac{S(t)}{n};\ \frac{K}{m})$$

Nevertheless, for us it is more comfortable to use the formulation of Whaley (2006:441) which directly provides the joint value of the totality of warrants, applying the formulation of Black and Scholes:

$$W(t) = f \cdot V(t) \cdot N(d_1) - (1-f) \cdot K \cdot e^{-rT} \cdot N(d_2) \tag{2.17}$$

$$d_1 = \frac{Ln(\frac{f \cdot V(t)}{(1-f) \cdot K} \cdot e^{rT}) + \frac{1}{2}\sigma^2 \cdot T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Where r = type of interest free of risk

$V(t)$ = value of set $(n+m)$ of shares' price at t.

f = factor of dilution = $\frac{m}{m+n}$; $0 < f < 1$

The figure which corresponds to this formlation is Figure 2.19 (at T).

This way, whenever we are facing the managerial phenomenon, the study leads us to Figure 2.20:

We will know the valuation of Y comes from the given expression:

$$Y = f \cdot X \cdot N(d_1) - (1-f) \cdot A \cdot e^{-rT} \cdot N(d_2)$$

with d_1, d_2 defined like (2.17) . The second part of the equation can be presented as:

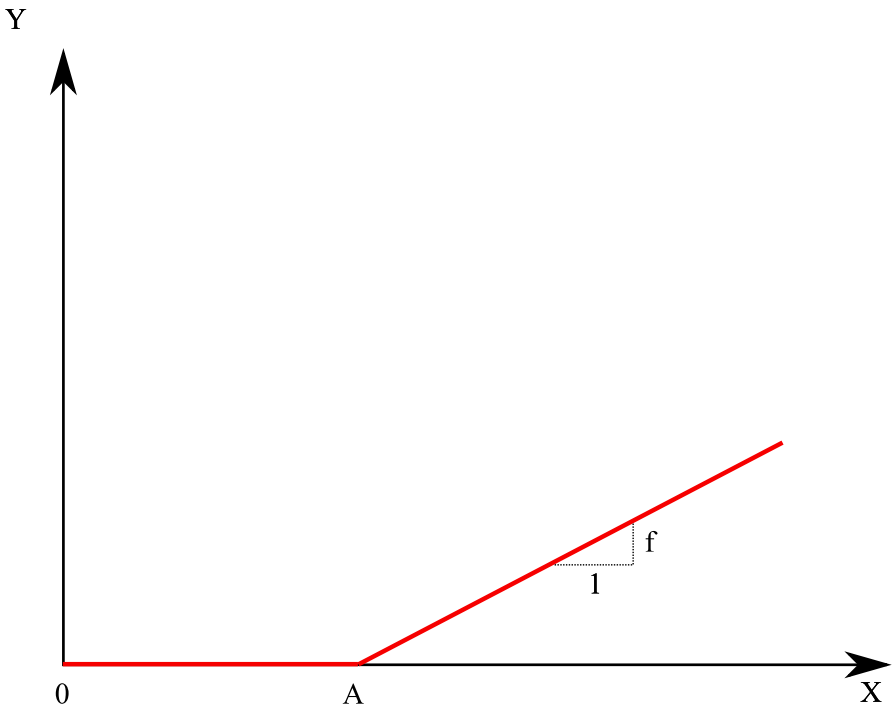


Figure 2.20: Detect of a warrant (European call), $0 < f < 1$

$$W(X,\, K = A;\, f)$$

2.3.2.4.4 Application of valuation of tax shield and division of output We locate in graphs $(X,\, Y)$:

- Figure 2.18 $\Rightarrow Y = C(X;\, K = A)$ ..... European call
- Figure 2.19 $\Rightarrow Y = f \cdot C(X;\, K = A)$ ..... Warrant (European call)
- $Y = X$

We combine them appropriately (the way is indicated later) and we can obtain Figure 2.21, Figure 2.22, Figure 2.23, Figure 2.24, Figure 2.25, Figure 2.26.

$TS_1 = (Value\, of\, Warrant\, 1) - (Value\, of\, Warrant\, 2)$
$Value\, of\, Warrant\, 1 = \tau \cdot Call(C(1);\, K = C(0))$
$Value\, of\, Warrant\, 2 = \tau \cdot Call(C(1);\, K = C(0) + rD_0$

Therefore, we can obtain:

$$TS_1 = W(C(1);\, K = C(0);\, f = \tau) - W(C(1);\, K = C(0) + rD_0;\, f = \tau)$$

This expression is corresponding with (2.4).
Therefore, $TS_2 = \tau \cdot C(1) - (Warrant\, value) \Rightarrow$

$$TS_2 = \tau \cdot C(1) - W(C(1);\, K = C(0);\, f = \tau) \tag{2.18}$$

This expression is corresponding with (2.5).

Like what we have done with Figure 2.22, we could have:

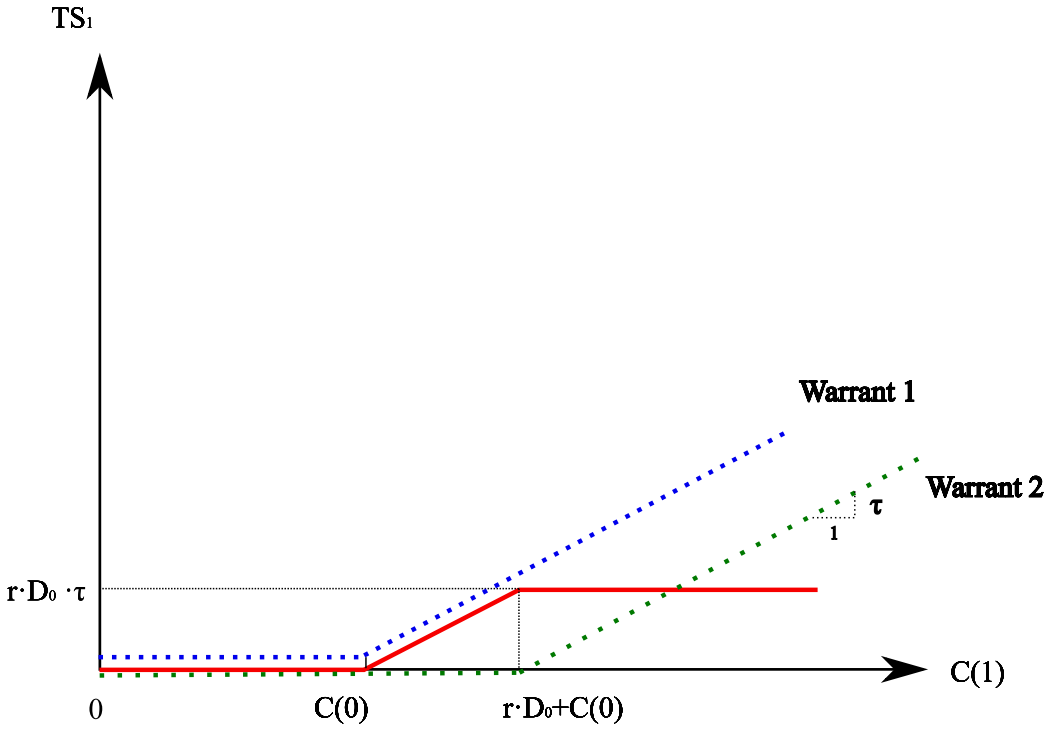


Figure 2.21: Warrant 1 and Warrant 2

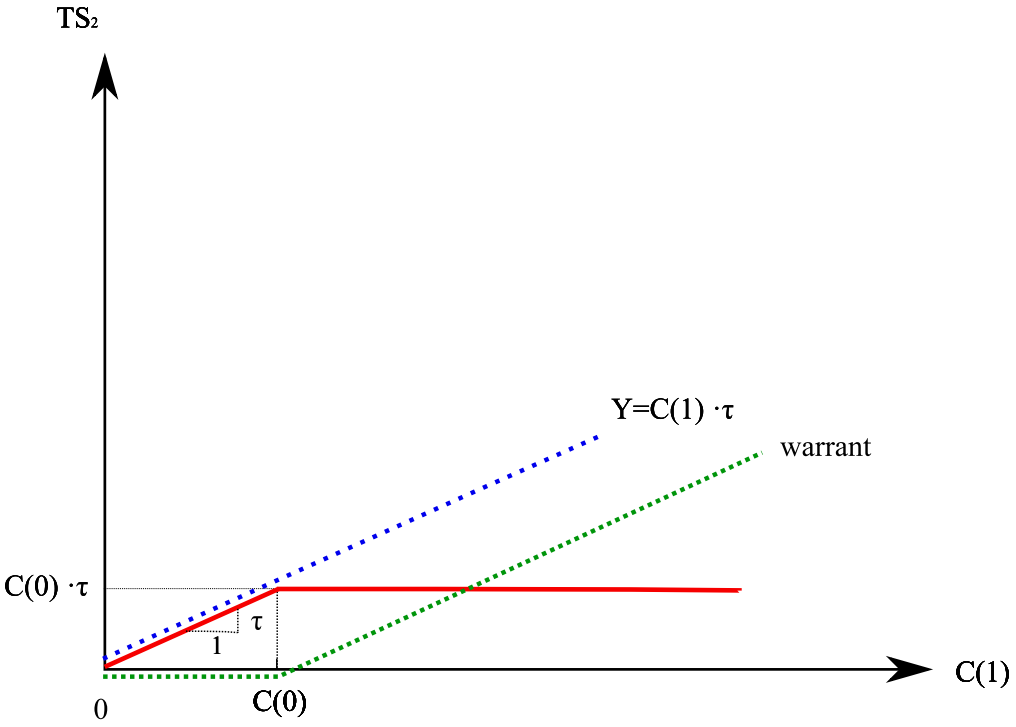


Figure 2.22: TS_2 and warrant

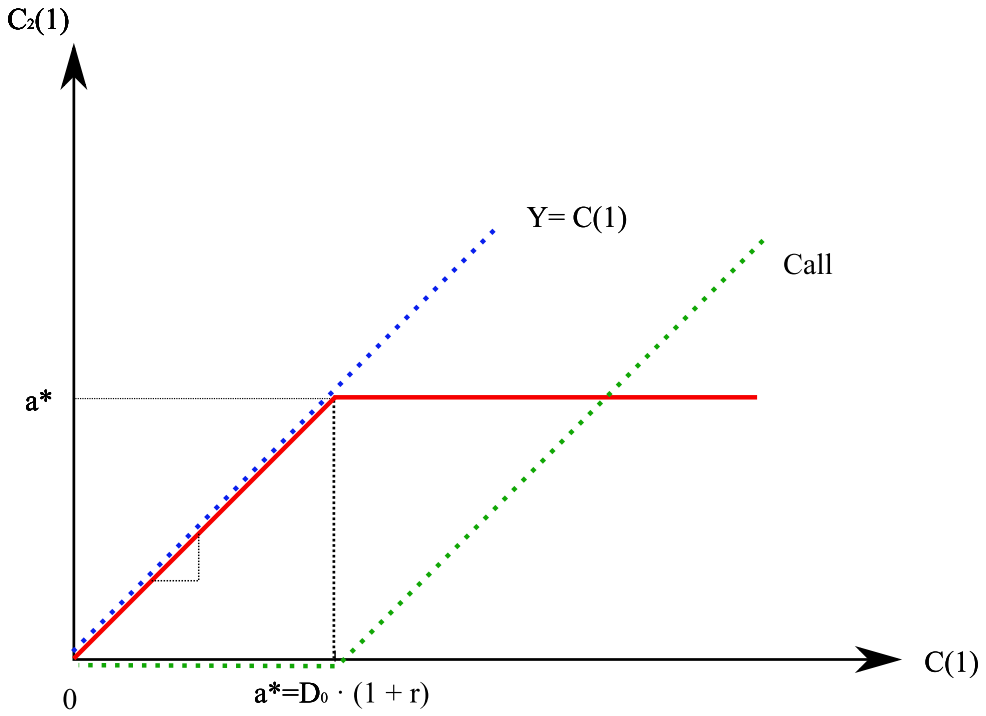


Figure 2.23: $C_2(1)$ and call

$$TS = TS_1 + TS_2 = \tau \cdot C(1) - W(C(1);\ K = C(0) + rD_0;\ f = \tau) \quad (2.19)$$

This expression is corresponding with (2.6) .
Therefore we can obtain:

$$C_1(1) = W(C(1);\ K = C(0) + r \cdot D_0;\ f = \tau) \quad (2.20)$$

This expression is corresponding with (2.7) .

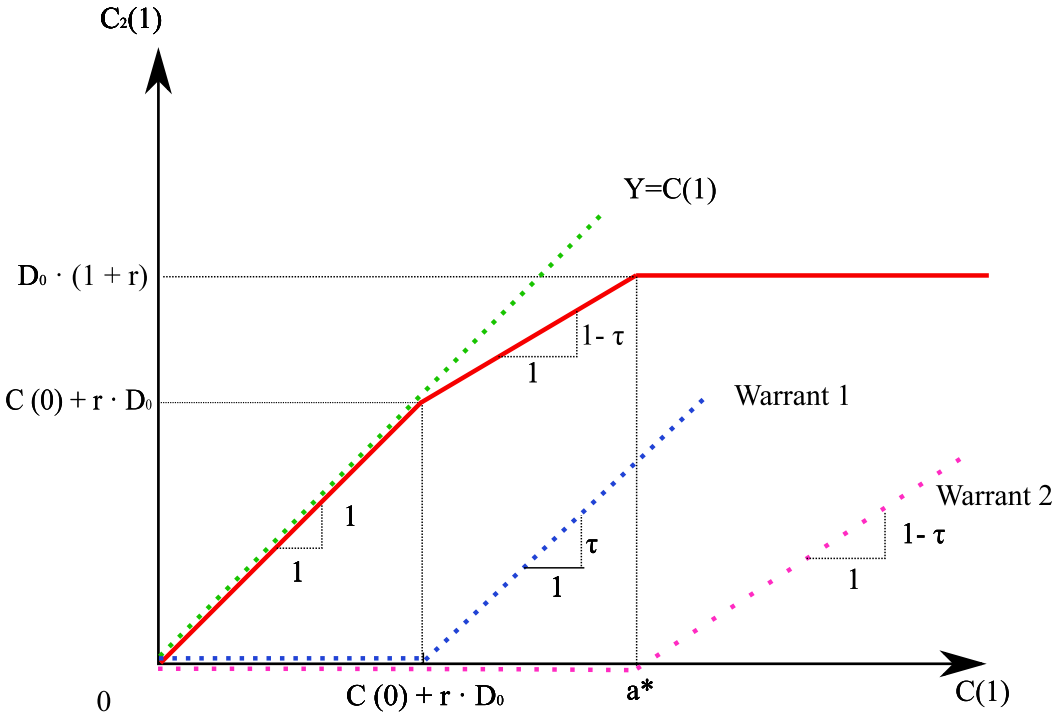


Figure 2.24: $C_2\,(1)$, Warrant 1 and Warrant 2

Therefore, $C_2(1) = C(1) - (Value\,of\,the\,call) \Rightarrow$ see Figure 2.23

$$C_2(1) = C(1) - Call(C(1);\, K = a^* = D_0 \cdot (1 + r) \qquad (2.21)$$

This expression is corresponding with the superior branch of formula (2.10).

Therefore, $C_2(1) = C(1) - Value\,of\,warrant\,1 - Value\,of\,warrant\,2 \Rightarrow$

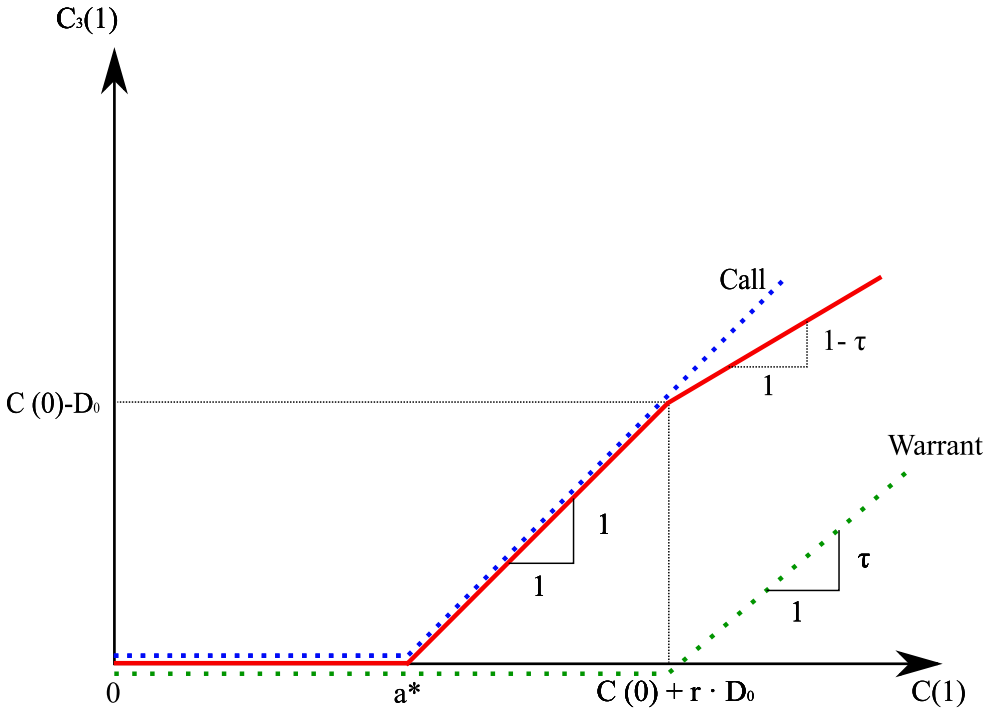


Figure 2.25: $C_3\,(1)$, Call and Warrant

$$C_2(1) = C(1) - W(C(1);\ K = C(0) + rD_0;\ f = \tau) - W(C(1);\ K = a^*;\ f = 1 - \tau) \tag{2.22}$$

$$with\ a^* = \frac{D_0 \cdot (1 + r) - [C(0) + rD_0] \cdot \tau}{1 - \tau}$$

This expression is corresponding with the inferior branch of formula (2.10) .

Therefore, $C_3(1) = (Value\,of\,Call) - (Value\,of\,Warrant) \Rightarrow$

$$C_3(1) = Call(C(1);\, K = a^*) - W(C(1);\, K = C(0) + rD_0;\, f = \tau) \quad (2.23)$$

This expression is corresponding (in the case of $D_0 \leqslant C(0)$) with (2.14) .

Since it is a warrant, we can have:

$$C_3(1) = W(C(1);\, K = a^*;\, f = 1 - \tau) \quad (2.24)$$

$$With\, a^* = \frac{D_0(1+r) - [C(0) + rD_0] \cdot \tau}{1 - \tau}$$

This expression is corresponding (in the case of $D_0 > C(0)$) with formulas (2.15) and (2.16).

Therefore, $C_{2,3}(1) = C(1) - (Value\, of\, Warrant) \Rightarrow$

$$C_{2,3}(1) = C(1) - W(C(1);\, K = C(0) + rD_0;\, f = \tau) \quad (2.25)$$

We can check if those expressions we obtained are correct or not by a simple sum as:

$$C_1(1) + C_2(1) + C_3(1) = C_1(1) + C_{2,3}(1)$$

which is:

$$W(C(1);\, K = C(0)+rD_0;\, f = \tau)+C(1)-W(C(1);\, K = C(0)+rD_0;\, f = \tau)\ (t \leqslant T)$$

We can conclude that 3-Model of Rao and Stevens (2007) is completely solved by applying the option valuation theory.

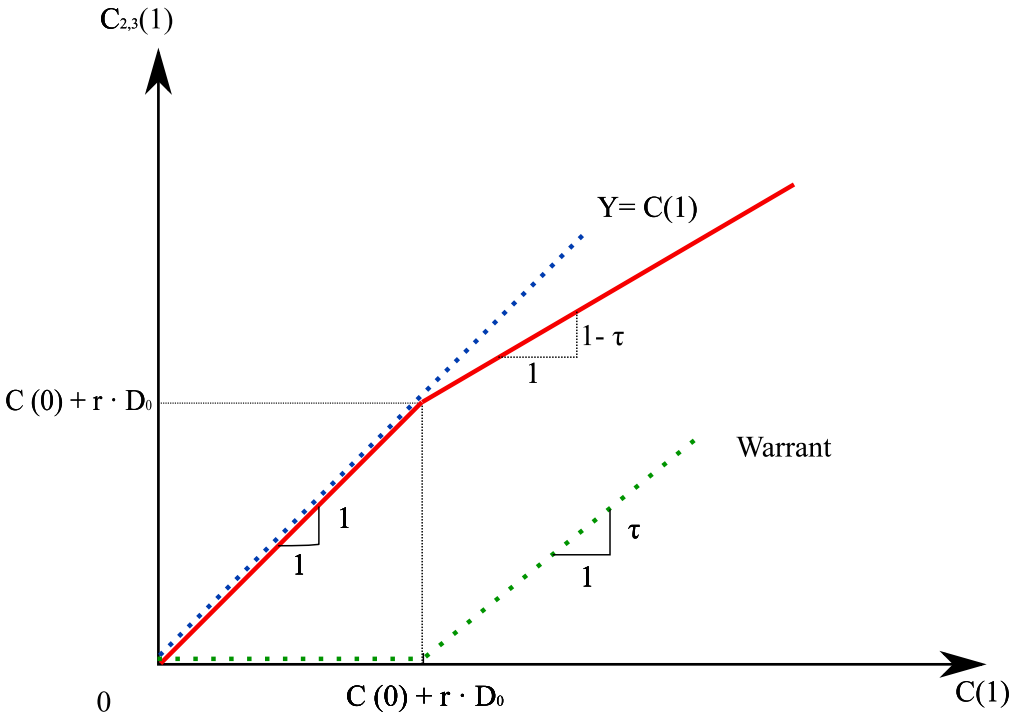


Figure 2.26: $C_{2,3}(1)$ and Warrant

Chapter 3

The Approach of Option Theory and the Entrepreneurial Reality

3.1 Introduction

From the quantitative valuation point of view, we have just concluded that we can apply option theory to the 3-Model of Rao and Stevens (2007). However we can apply this theory through formulation doesn't mean that the existing difficulties in reality can be concealed. In fact, we have to question if the application of option valuation method is based on the set of hypothesis and also if it verifies the reality of corporate world with sufficient approximation. Then we could decide to accept the aforementioned method to be the most convinced one.

The answer for the formulated question can drive us to:

- consider real options in our investigation.
- intend to extend the 3-Model.

Therefore, the considerations to continue is to construct a bridge between the current study and the extension of 3-Model.

3.2 Comments in Applying Option Theory

The hypothesis can be used when the standard options are applied within an organized market, like what was indicated by Black and Scholes (1973) as follows:

- Perfect market
- Frictionless market, which means, there is no transaction costs and there is restriction on short sell; all projects are infinitely divisible; borrowing and lending are at the same rate and unrestricted
- The risk-free interest rate (short term) is constant over the life of the option (or known over time)
- Any dividends are known in site and date of payment
- The underlying asset follows a known stochastic process (diffusion process)
- Investors are rational and prefer more to less

The fundamental hypothesis in the option valuation theory is the perfect financial market. This hypothesis is not exclusive for options but also for DCF method. Since we are so familiar with DCF method so that we might ignore its limits in hypotheses:

- We use practical routines without being aware of the limitations T
- To ignore the frame of conditions which is necessary for the correct application of the aforementioned methods
- To apply the methods in the uncorrected situations

However, in order to apply the option valuation theory, it is not necessary to foresee the future value of the underlying assets. The reason of this is

because the process must be formulated in the best possible stochastic process which follows the underlying price. Therefore we have to capture the present uncertainty by deviation σ in standard options[1].

The introduction of σ in the valuation model and the possibility of applying risk-neutral valuation (risk-free interest rate) give option approach opportunity to incorporate *flexibility* in the model (see Chapter 1, subsection 1.1.3). This is one essential characteristic for the entrepreneurial reality in a way that flexibility is the capability to give alternative actions in decision making for entrepreneurs (to acquire or merge a firm; to start an incentive policy so as to improve the level of satisfaction of employees or clients; to start the exploration of a mine; to open a local branch in another country; to start a new product launch, etc.). It is also necessary to capture flexibility under other situations, for example, in a carried out investment the possibility or availability to abandon it.

In such cases, the option approach is superior to the DCF method since DCF methods can not give those alternative options required by the reality. In fact, the managerial valuation of DCF is based on (see section 1.2):

a) The determination of expected free cash flows (FCF).

b) Adjusted cost of capital with risk of FCF, which is WACC.

Consequently, the aforesaid DCF valuation (with characteristics of monoperiodic horizon) does not include the dynamic factor which contingents on future and might influence the expected FCF at the moment of the decision.[2]

We can argue that the DCF method might be completed by the decision tree technique, which is possible as:

1) An extension by various periods and decisions method;

[1]Option valuation theory does not require us to foresee the future value of the underlying assets since the process of formulation follows a stochastic process for estimation of the price of underlying assets. The standard deviation can capture the present uncertainty in standard options.

[2]See Pindyck and Dixit (1994).

2) To incorporate the systematic risk allows us to deduct each individual cash flow to its particular cost of capital.

This is a good argument but it is not practically convenient in its application for the following reasons:

- It requires a probability structure associated with every period and decision (real option approach implies a stochastic process).
- It requires the structure corresponding with the expected cash flows.
- It also requires that adjusted discount rate for every branch of the decision tree truly corresponds with the information (risk) which is original disposition to realize the analysis.
- Therefore based on all the points mentioned above, the resources and information to carry out the analysis are usually excessive.

All this drives us to apply the option valuation method in managerial issues (corporations) regarding those important strategic decisions. Nevertheless, the option theory has reproduced a "daughter" as Real Option Theory (ROT) which we will discuss further more.

3.3 Real Option Theory (ROT)

3.3.1 A Panoramic View

From the general point of view, an option is the right but not obligation (or freedom to choose the most optimal result according to the circumstances advised in the future) to carry out an action (approximately defined in origin, or establish the option) in certain moment in the future.

The accomplishment of the action is the option of the underlying assets, such as:

- To buy or sell a financial asset, like stocks, bonds etc.
- The opening or closing of a delegation in a zone or place perfectly needed by establishing option
- The initiating of the company through advertising
- Make certain plans predetermined to improve the working climate
- The beginning of some predetermined improving process in favor of the communication with clients

After the seminal article of Black-Scholes in 1973, they set the pioneer in applying formulas in the corporate world and introduced the standard option valuation theory. It was Myers, who observed this existing analogy between the financial options and the options which present financial activities for corporations and suggested for the first time that the market value of the firm consists of the current value of the expected cash flow plus the opportunity value for growth of the firm.[3] The work of Myers in 1977 means the intellectual transit from the Theory of Capital Market to the Theory of Corporate Finance and it was also Myers who brought up the expression "real option" in his article in 1977. He affirmed in the other article[4] in 1984 that:

> Strategic planning needs finance. Present value calculations are needed as a check on strategic analysis and vice versa. However, standard discounted cash flow techniques will tend to understate the option value attached to growing profitable lines of business. Corporate Finance Theory requires extension to deal with "real options".

Actually ROT is a tool almost indispensable for analyzing the managerial flexibility quantitatively when we have to face uncertainty in the future.

[3]Myers (1977).
[4]Myers (1984)

ROT can quantify better the added value which a corporation can achieve to make decisions regarding its irreversible investment expenditures taking into account the possible development in the future from a foreseeable way.

In order to achieve the current maturity of Real Option Theory, the work of great investigators who accepted Myers' point of views is vital and necessary. Those four authors who built the essential doctrines of ROT are Brennan and Schwartz (1985) and McDonald and Siegel (1985).

In their respective articles, those authors evaluated investment projects with concrete options (different from one to another). Within the contributions of the article by Brennan and Schwartz (1985), we have to mention that the advantages of application in Real Options they have shown to the valuation for non-financial assets based on the scenery of a copper mine which was not activated when the cooper price was low and reactivated when the copper price went up.

Foot stoned with the works mentioned above, the actual base of the application of ROT was founded in the model of McDonald and Siegel (1986).

During the eighties and nineties of the last century, the ROT expanded rapidly and today it is applied in numerous fields such as:

- Strategic alliances
- Valuation Insurance
- Investment or disinvestment
- Manufacturing
- R&D
- Electric utility industry
- Principal-agent problem
- Regulated firms

- Leases
- Joint venture
- Real Estate
- Corporate strategy
- Game theory
- M&A
- Etc.

In order to appreciate the potency of ROT as well as adopting a panoramic vision in its applications, we can consult numerous works related; for example:

- Alegre and Borrell (1989)
- Amram and Kulatilaka (1999)
- Baecker (2007)
- Berger, Ofek and Swary (1996)
- Beliossi and Smith (1999)
- Brennan and Trigeorgis (editor) (2000)
- Copeland and Antikarov (2001)
- Gunnelin (2000)
- Hommel, Scholich and Baecker (2003) (in German)
- Kester (1984)
- Lander and Pinches(1998)

- Lee (1997)
- Mauer and Ott (2000)
- Mun(2006)
- Myers and Majd (1990)
- Pindyck and Dixit (1994)
- Schulmerich (2004)
- Trigeorgis (1986)
- Trigeorgis(1996)
- Trigeorgis (1995)
- Vollert (2003)
- Ziegler (2004)

The existence of powerful information softwares (MATLAB, MAPLE, MATHEMATICA, MATHCAD, MUPAD, VBA, etc.) and programming languages in C, C ++, C# have helped us to expand Real Options Theory.

Under certain circumstances, we are able to integrate all into the process shown as Figure 3.1:

From different ways we intend to reinforce our modeling. Here two quotations are very interesting to persuade us the importance of ROT:

> Three complementary tools will outperform WACC – based DCF that most companies now use as their work horse valuation methodology: Valuing Operations (Adjusted Present Value), Valuing Opportunities (Option Pricing), Valuing Ownership Claims (Equity Cash Flows). (T. A. Luehrman, *Harvard Business Review*; May 1997)

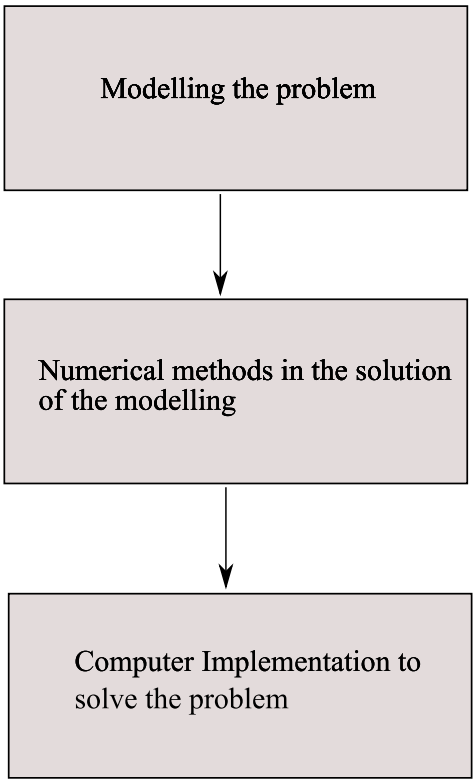


Figure 3.1: Problem-solving process

> Investors can use the concept of real options to explain part of the difference in market value and the intrinsic value as calculated using traditional methods. Real options represent what is possible beyond the current business operations. (Z. Ashton, Motleyfool.com; Feb 2001)

Today ROT is used in the field which seems to be not so appropriate for quantitative valuation such as intellectual property. We refer the comments from Stroud as:

> Creating a standardized way of valuing intellectual property and patents, and then allow them to be bought and sold over the web. Black-Scholes equation is used [...] replacing a call option variable with the price and volatility of its underlying technology, the development costs and time remaining, and baseline capital costs. (M. Stroud, *Business 2.0;* April 2000)

Our intention to extend the 3-Model is independent from the successful result with this proposal. However we do not have any doubts that ROT can allow us to study and quantify ex-ante cases such as: to improve the satisfaction of the employees, and to improve the satisfaction of clients.

3.3.2 Types of Real Options from the Perspective of Corporate Valuation

The main problem presenting Real Option in valuation, in spite of what it seems like at the first sight, is not the fulfillment or non-fulfillment of the hypothesis given by Black and Scholes, but the fundamental hypothesis of the perfect market. The difficulty is to identify (if exists) an asset which is negotiated in a market as perfect as possible and whose characteristics relating to risk are very similar to those underlying assets of Real Options. Such assets are identified as *twin assets*.

Under the conditions of Real Option and perfect market, the assumption of the infinite divisibility of underlying assets is denominated as *spanning condition* (Vollert 2003:20-21), which can be expressed from the following way:

The underlying asset of a Real Option can replicate or duplicate, which reflects the double facets in reproducing the cash flows and the same risk structure with the original asset; certainly, without sufficient liquidation this would not be possible in general. Consequently, it would not be possible to identify the twin assets, and it would be very complex to determine the value they possess.

During certain time, the facet of liquidity and the possible non-existence of twin assets or inability to identify it could block the progress of ROT. However, based on the work of Sick and Jarrow (1995) and Sick (1999), the problem can be considered to be overcome essentially. The key solution is based on the *theory of martingales* and the two extremely important articles are written by Harrison and Kreps(1979) and Harrison and Pliska (1981).

The approach of martingale allows Sick (1999): 1) The valuation of options in those underlying assets without liquidity. 2) The valuation of options in non-existence underlying asset, in case that the twin assets are not identifiable. Based on what we mentioned before, we can get away from the doubts regarding the application of option theory in general and particularly focus on Real Option Theory. Therefore, the mathematical difficulty in the application of martingale theory is not our target since we have other objectives for this investigation.

We would like to raise two conditions: 1) Under what situations will it be convenient, even necessary to use ROT. 2) Under such situations is there anyone can be presented when we are going to carry out the extension of the 3-Model of Rao and Stevens (2007).

Following the intention to answer those questions, we have consulted various authors and their works (those we have mentioned in subsection 3.31

and others will be referred later). Regarding the first question, the literature has been able to identify those five situations which are shown as follows:

1) When there exists sufficiently high uncertainty so that the decision making can wait; in this case, instead of jumping now to the "adventure" (due to the excess of risk), the most prudent thing is to wait so that time can generate more information.

2) When there exists sufficiently high uncertainty and it is convenient to establish conditions in adaptive flexibility, so that it will reduce the consequences of excessive risk and the option of a rigid and irreversible decision.

3) When there is a contingent investment decision, which means, at present we still do not know if we should make such a decision or not.

4) When there will be project updates and mid-course strategy corrections (Amram and Kulatilaka 1999:24).

5) When the possible value increase which takes place as the consequence of the decisions that affect the growth of the firm is not an efficiently measurable method based on the current determination of the future cash flows.

Nowadays, only the situation 2) and 4) can be tackled by ROT. Respectively in the situation 1), 3) and especially 5), although DCF method might be used, those can not be obtained by the implied existing options; since they are not so efficient for the result they produce (we have not taken into account the difficulties inherent to its application).

Regarding the second question we have mentioned before, we think situations 1) and 2) can be the object of our attention since it will always be useful for decision-making, that we are under conditions which we evaluate the consequences given time before making the decisions and define those

ex-ante conditions so that it allows those decisions to depend on the result which go long the development.

Therefore it is no doubt about the ability of ROT in application for our investigation. However, the consideration of situation 5) reinforces even more the argument in favor of ROT to extend the 3-Model Rao and Stevens (2007). The situation 5), which directly drives our intention in the associated metrics with the two key stakeholders, employees and clients. We believe that there exist those aforementioned associated metrics however we think that they are not sufficiently well connected with the forecast process of future cash flows. If the DCF methodology is possible, how can we establish adapted risk premiums which allows us to determine the risk adjusted discount rate? The other difficulty is that if we would like to apply DCF in the extension of 3-Model of Rao and Stevens (2007), supposing the established time horizon, how can we find out the terminal value of the investment project that we might define the progress in the satisfaction of the groups of stakeholders such as employees and clients? Other classic approaches of the *expected liquidation value*, the *multiple approach*, and the *stable growth model* which can obtain the growth rate and WACC do not seem to be designed for this purpose. Perhaps one way of using DCF method is to apply it without the aforementioned progress in satisfaction, and then, try to foresee the increased value ($\Delta V = \alpha$) which is sufficiently representative:

$$V = V(traditional\, method) + \alpha$$

Therefore, as indicated in section 1.5, the logical line of investigation in applying DCF methodology is as follows:

a) Identify factors (perhaps index of satisfaction) which influence significantly in α.

b) Propose a mathematical model which assembles the factors in determination of the increased value.

c) Test the model.

This line of investigation which we have considered right from the beginning could possibly work well. However till this moment of the research in Corporate Finance, it is more logical to tackle the problem through Real Options which are coherent with the way dealing with 3-Model of Rao and Stevens (2007).

From the corporate valuation point of view, we agree (not one to one) with the five situations mentioned before, several fundamental types or categories of real options have already been established (Trigeorgis 1996:1-14). Those categories are usually managed in the literature:

1. *Option to defer*

This type of option can value the opportunity cost in the "waiting" of a decision. An excellent investigation for this type of option is from Jankensgard (2001). The aforementioned Thesis applied game theory with incomplete information innovatively and proposed a model which can integrate binomial model of option valuation. A typical example of this type of option is the "learning".

2. *Time-to-build option*

This type of option allows to stop a step-by-step investment within a project in case the conditions become unfavorable. One typical example is the options of R&D.

3. *Option to abandon*

The denomination indicates that this type of option allows to abandon a project, with or without the possibility in selling assets especially those used ones. In case of selling, the value obtained with salvage value has to be included in the cost of the project and the optionality could not be included in NPV (Net Present Value).

4. *Option to switch*

When conditions in developing the project become unfavorable, this type of option allows to react by means of changing input and output factors through input shifts and/or output shifts.

5. *Strategic growth options*

Strategic growth options are those options associated with corporate decisions with strategic characters, which gives priority to the adaptive flexibility. This type of option is often applied in R&D and pharmacy sector, where the original investment can lead to other applications and is capable of adding value which might not be foreseen when initiating it. These options can also be applied for the study in project of thematic park construction or the leisure sector.

During the last fifteen years, the intimate existing relation has been recognized between the real option approach and strategic management of the firm in the sense of allowing the strategic resources to be considered as options for growth which can transform the capabilities of the firm in competitive and sustainable advantages.

Those pioneers who have contributed to this approach are: Bernardo and Chowdry (2002); Foss (1998); Kogut and Kulatilaka (1994); Kogut and Kulatilaka (2001); Kulatilaka and Venkatraman (1998); Sanchez (1995); Smith and Triantis (1994); Williamson (1999).

We have to say that the essential idea behind the Real Option approach is the skill of choosing or changing the structure of firm's capital during the process of the project.

Regarding the investments with strategic characters (the extension of 3-Model will demand an investment of this class), Amram and Kulatilaka (1999:25-27) distinguished diverse subcategories as follows:

a) Non-reversing: those investments, once tackled, are only possible to be reversed with the cost of great amount of money in value. For example, start the process of M&A and then abandon it.

b) With flexibility: those investments that incorporate flexibility in the form of alternatively feasible and such an incorporation is ready to carry out in the initial design of the project. The traditional DCF method is not very efficient to be applied.

c) Limit of risk: those investments that limit significantly the level of exposure to risk or uncertainty.

d) Modulating: those investments in every module of its development depend on the result obtained from the previous one (for this reason it is possible to consider them as portfolios of options).

e) Platform investment: terminology from Amram and Kulatilaka, which is generally applied in the investment of R&D.

f) Learning: those investments which are carried out so as to obtain information which would be practically impossible to obtain by other means.

Like we can observe certain classifications in between, this is based on the impressive theoretical background which is ready for the Real Option and the Real Option Theory. It is a question of a very young discipline and it is still in the stage of establishment in concepts, classification etc.

For a panoramic exhibition and simultaneously exhaustive regarding the Real Option which is related with corporate strategy, we can see Guivernau (2004).

6. *Multiple Interacting options*

These are combinations of the integrated options in the previous five categories. Obviously, these are the most frequently applied Real Options in the complex and practical activities of corporations.

3.3.3 Who has the property of the real options in a firm?

An important practical question we must conside is the property of the real options. We have to explain: Does the firm have an exclusive property of real option? Which is to say, does the firm have rights in the total value of real option? For the answers, we have to see Kester (1984) and Perlitz, Peske and Schrank (1999:262-267).

This led us to consider another classification of options with strategic characters:

- Exclusive (or property) options: those which are an exclusive property of the firm, without the action in competitions can influence the property.
- Shared option: when the rival firms have the capacity to exercise the right to carry out the investing project, there is possibility to appropriate (share) parts of the advantages in the project.

The property option has higher value since they are resulted from a patent, which is an exclusive knowledge. On the other hand, the shared options are opportunities shared collectively by the industry and its value is relatively lower than those of property options since the competitors who enter the market can drain profits. In this sense, the action to carry out the investing project which is aimed to improve the level of satisfaction for employees and clients is a *shared option*.

Additionally to the possible property right, another one which has strategic characteristics that we have to bear in mind is the structure of multiple associated with the same project it faces. The importance of this point must be that there is no doubt if we think that in many occasions, the project of investment reverberates partially (or especially) to the corporation level. This repercussion can produce immediately some levels of simultaneous progressive forms in others (or sequential way in certain projects). Therefore it is clear that the structure of the dependency on options forces to reform those projects' analyses which are done without taken into account. From the other way to say, the joint value of two interdependent options is different from the sum of two individual values (Trigeorgis 1995:227-237); which means that there is *option synergy*.

The combined value of Real Options depends on the diverse circumstances, such as (Trigeorgis 1995:227-237):

- If they are only puts or only calls or a mix of both types.
- The order of the dependency in the combined structure.
- Probability level in exercising Real Options.
- Size of the time intervals between different dates of exercise of Real Options (for example, in the structures of put-call and call-put, with the relative dates of next exercise which means low interaction and low probability of both exercises.

3.4 The quantification of the influence in the satisfaction of employees and clients

3.4.1 General Comments

Like we mentioned before, some great practical difficulties in applying real options (RO) consist in the problem to have the appropriate model for the evaluation of volatility (although there have been notable progress which tend to reduce the magnitude of those difficulties). One of the determinants of the problem is the strategy applied to create conditions which allows to use the real option theory. In fact, when we study this phenomenon as shown from the title, the research does not usually enter the interior of the phenomenon but intend to treat it in general (like a black box), and then apply the real options theory. However, there is another appropriate approach which takes place in the following three studies of Neely and Neufville (2001); Wang and Neufville (2005); Wang (2005).

In those works, these authors distinguished ROs on those aforementioned difficulties regarding the valuation of the volatilities and ROs in managing the capacity of flexibility in the development of a project (in our case consists together with the actions to decide to establish better satisfaction for those stakeholders as cited above) and discover the present options in the interior of the project (generally the system is the object of the analysis). As the lasted cited those authors are engineers, their objective of the study is the physical system; however, as suggested, the idea can also be exploited to the firm level (see, for example, Guivernau, 2004), and in particularly in the field of personnel management and commercial management. From our viewpoint, the degree of freedom for the firm to hire or dispense employees and to manage clients so as to improve the level of satisfaction comes fully into the logic of ROs.

In this Thesis, we followed a line of research described in section 1.5 and

Chapter 5 which seems to be a simpler way for us; however, another possible route, which had previously been considered consists of the following steps:

1. Establish one quantified objective

2. Analyzing the associated flexibility of the project or the system for the investigation

3. Detect the possible associated RO and identify them precisely

4. Theoretical valuation of the RO detected and identified applying the appropriate models

5. Group the distinctive valuations of RO in a single model so that the model will allow comprehensive global evaluation of the project or the system

6. Investigate how to apply this model to expand the Rao and Stevens (2007) 3-Model

7. Test the Rao-Steven expanded model.

We will indicate some details of each step we have mentioned above. Thus, it is justified that the way we tackled this issue in the Thesis is simpler.

3.4.2 Establishment of a quantified objective

The objective (only a proposal) is to establish the relationship in terms of Net Present Value (NPV) with the time interval $(0, T]$ which we can formulate as follows:

$$f = MAX\left[\frac{NPV_T - NPV_I}{NPV\left(\Delta Q\right)}\right]$$

Where NPV_T= Net Present Value of the total future income in the time interval $(0, T]$;

NPV_I = Net Present Value of the estimated average income of the industry (or the economic sector that the firm belongs to) in the time interval $(0, T]$.

$NPV\ (\Delta Q)$ = Net Present Value of the cost increase to carry out the project.

The difficulty does not only rest on the appropriate estimation of income and future cost but also on the application of the appropriate discount rate which reflects the risk assumed of the project. Initially, an estimated unique rate can be applied qualitatively, but the analysis which continues can provide us a confirmed discount rate, or possibly, a structure of the discount rate of income and cost which can generate different level of risks in distinctive situations.

3.4.3 Analysis of flexibility

a) Actions (activities) to realize in order to carry out the project to improve the satisfaction of the employees, the process of implantation staggered in time and financial measurements assigned. This has come from the General Direction , which the study we start from a set of actions.

b) Write a list of relevant risk sources associated with the development of the project.

c) Write a list of possible key variables related with the development of the project, which is also related with the sources of risk.

d) Based on the work of other experts, experiences and previous studies, etc., establish a distribution of appropriate probability.

e) Carry out the necessary sensibility analysis in order to select the key variables.

f) Determine the break-even point, which should get the key variables so that the decisions are considered with flexibility.

g) Establish the concrete decisions which are taken to reach the break-even points.

h) Estimate the appropriate discount rate related with the assumed risks.

Naturally, flexibility (see subsection 1.1.3) can only be studied within a frame of restrictive conditions established by the fixed criteria of the Board in accordance with diverse considerations, such as budget restrictions, legal and ethical limits to the employees´dismissal, limits to the expansion of facilities, etc.

3.4.4 Detection and identification of the possible Real Options

The list of possible ROs studied in the literature, for example: Guivernau (2004); de la Fuente (2004); Mascareñas et al. (2003), can help us thinking in our own concrete project. We will give a continued list of typical ROs (from the standard options to more sophisticated exotic options) as following (some of them has been already mentioned before):

- Option to defer
- Option to expand
- Abandonment option
- Option to wait and see
- Option to delay
- Option to contract
- Option to choose
- Option to switch resources
- Option for phased and sequiential investments

- Compound option, which is the option of options
- Etc.

3.4.5 Theoretical valuation of the associated Real Options in the project

It is impossible to give in details of the distinctive techniques in valuation based on what offered by the literature. However, it is obvious that everything indicated in the previous parts will provide us essential information in order to carry out the concrete RO valuation we need.

3.4.6 Grouping previous valuations into one unique model

We could start with a simple model, and test it for the result so as to improve it as the result suggested. The simple model can be shown as follows:

$$F = f + \sum_{j} \lambda_j \cdot g_j$$

Where F = objective function; j = number of restrictive criteria established in 3.4.3; g_j = criteria in mathematical formulations; λ_j = parameters associated with those restrictive criteria. The optimization of F requires the application of multiple Lagrange technique.

The main disadvantage of this global model is that it doesn't consider the reciprocal influence which possesses the restrictive criteria. We might replace it by a more completed and complex model which also requires the application of corresponding optimization technique. Naturally, we could go on from determined optimization technique to stochastic modeling, which is more complicated with excessive consuming of time and money.

As long as the model is decided, it is necessary to test it and elaborate it into another model, which will be a model of simulation which considers stochastic relatively to some variables of the global model, such seasonality,

prices of goods and services, etc. These stochastic considerations enforce us to assume certain hypotheses regarding the evolution of implied variables (such as to allow the evolution of prices like a movement of browniano; models of volatility proportional to time mean-reverting, etc.). Once the simulation model is established, it is necessary to carry out the calculations and determine if the global model is satisfied, needs to be improved or even pushed back to be replaced with a distinctive model.

Chapter 4

Information from the Clients' and Employees' Valuation Metrics

4.1 The Firm and Clients: Marketing Metrics

4.1.1 Relationship between the Firm and Clients

4.1.1.1 General comments

Many big, medium or small firms especially those in big service sectors, treat their clients as numbers. They tend to organize clients in groups and adopt the different norms in dealing this relationship such as call centers, robot answering system etc.

These ways of dealings sometimes caused many problems for a huge number of clients. For example, the automatic answering machine provides useless replies; other firms limit the service time of the complaint from clients so as to save their 'precious' time or they only provide short time consulting for clients with their problems.

The problem is that firms spend loads of money in advertising, promotion in order to obtain more clients; meanwhile they spend very little time in solving problem for clients. This might lead a great tendency in more

complaints from clients. Recent statistics shows that big part of consumer abandons a brand because of bad service or too little attention they received. Some directors make mistakes in diagnosing the problem of 'abandon' as it is caused by price or insufficient advertising. Other directors might know this problem but they do not want to solve it completely. Instead, they spend money in creating confusing information such as:

- Creating distractive news releases
- Publishing contradictionary news
- Paying to professional consulting firms to obtain contradict opinion or to discuss the secondary problem and make it published
- Etc.

Nevertheless, now there are more new interesting solutions for this diagnosis, which is to try to find solutions to improve the relationship between the firm and the clients. In my opinion, the correct perspective of value creation of a firm, knowing this value creation has be to distributed between stakeholders, comes from the relationship between the customer relationship management and the figure of client advocate.

4.1.1.2 The Customer Relationship Management (CRM)

Firms are now surviving in a dynamic environment, supporting competitive pressures which come from diverse fields: competitor; technology; modification of the law; the changing demography; globalization; etc.

Those pressures mentioned above have great influence in the relationship of firms and clients. This allows the dynamic development of a vision in the relationship of firms and clients. Under this background, the CRM was born intending to show how the firm can build a network of relationship bilateral closely and permanently with their clients.

Just a few years ago, the dominant conception was intensive technology and database construction. As time goes by, it is not the dominant conception any more, but considered as necessary support to establish one optimal relation with the clients who are seen in different ways as individual or as a group. One consequence of this conception is for short term, the firm has to reformulate, in a cautious way of its structure, to look for: flexibility; rapid decision; coordination with other departments or firms in the same group and satisfaction and fidelity of the clients.

If the CRM model works appropriately, the firm could:

a) Improve capacity in creating or commercializing products and designing services for those groups with similar characteristics and also for each individual client inside the group.

b) Obtain or increase value for clients in a long term perspective.

c) Obtain or increase (taking account the above mentioned) satisfaction and the loyalty of the clients.

d) Identify, attract, develop and maintain the best potential clients.

In general, one portion of the profitable growth in a firm and its value creation depends on the effective design of the CRM model.

4.1.1.3 The Client Advocate

Since last few years, a perfect figure has been created that every time it is considered more important for a good performance of the relationship between the firm and its clients. Referring to Client Advocate, the main responsibility is to manage the integral relation of the bilaterally issues between the firm and the clients. The management of such a relationship depends on: communication with clients; and personal design of the service model that offers to the clients. It mainly refers to a system control followed the way that relationship goes; performance under conflict situation, complaint, etc.

Therefore the Client Advocate is basically an information management that the main contribution it attributes to value creation of the firm will be: increase the efficiency of the coordination of the service offered to the firm and consumed by the clients; and increase the reciprocal confidence between the firm and clients.

To sum up, CRM and Client Advocate, jointly help the value creation of the firm effectively.

4.1.2 Marketing Metrics: Theoretical Framework

> For years, corporate marketers have walked into budget meetings like neighborhood junkies. They couldn't always justify how well they spent past handouts or what difference it all made. They just wanted more money – for flashy TV ads, for big-ticket events, you know, getting out the message and building up the brand. But those heady days of blind budget increases are fast being replaced with a new mantra: measurement and accountability.[1](*Business Week,* December 13, 2004)

Marketing may once have been regarded as more an art than a science. Today, however, marketers have to recognize marketing as much an art as a science. They have to understand markets quantitatively so as to measure new opportunities and the investment needed to realize them. Marketing is no longer the isolated island which doesn't participate in the financial performance and strategic decision of the firm. Instead, building the connection among marketing, firms' financial performance and strategy decision-making is one of the top targets for long-run potential growth of a company. Marketing metrics are the stones to build this bridge between the island (marketing) and the mainland (financial performance and strategic decision).

[1]http://www.businessweek.com/magazine/content/04_50/b3912109.htm

Marketing Science Institute has made assessing marketing productivity its top research priority (MSI, 2002) since the great difficulty for managers to measure the impact and value of marketing (Clark, 1999; Kokkinaki and Ambler, 1999; *Marketing Week*, 2001). According to Ambler (2003), one approach regarding this issue is the adoption of 'marketing metrics' which are internal and external measurements related to marketing and market position linked to short- and long-term financial performance.

Ambler et al. (2001) list five theoretical perspectives which may account for the growing interest in marketing metrics. First, *control theory* suggests the need for ex-post information on marketing programs as an essential part of the cycle of analysis, planning, implementation, and control (Jaworski, 1988; Kotler, 2003: 684-499). The central concept of control theory is that a combination of unanticipated events (both good and bad) and stronger or weaker than expected execution cause the outcome to be better or worse than planned. Within this framework, metrics are used to evaluate past performance and also to improve future strategy and execution. Ambler et al. (2001) suggests that metrics should usually be comparative, not only with previous periods but also with plans and, where possible, competitors, especially if evaluation is an important part of the process.

Second, *agency theory* (Jensen and Meckling, 1976) fits the context of marketing metrics very well. Agency theory focuses on the contract between a principal and an agent, and specifically on the need for the terms of the contract to be structured to incentivise the agent to act in a way most likely to meet the principal's objectives. For the contract to be enforceable, it needs ex-post data on the extent to which the principal's objectives have been met – in other words, metrics. Marketing metrics have to-date been largely internal to the firm, although it has been argued that they should also be communicated to shareholders, subject to commercial confidentiality (Ambler et al., 2001).

Third, *customer-based brand equity* (Ambler et al., 2001) can also help us

to explain the recent interest in marketing metrics. Brand equity was developed as a concept in the late 1980s in response to the perceived narrowness and short-termism of financial measures of performance (Leuthesser, 1988; Barwise, 1993a). Customer-based brand equity is usually defined to include a combination of behavioral and attitudinal dimensions (Aaker, 1991; Keller, 1993; Srivastava and Shocker, 1991) and it has been argued that it can not validly be reduced to a single number (Barwise, 1993b; Ambler and Barwise, 1998). Growing recognition that intangible assets account for a large and increasing proportion of shareholder value has reinforced the interest in brand equity, leading to the need for metrics to measure its various dimensions. From this perspective of Kaplan and Norton (1996), the growth of marketing metrics is part of a wider quest for a 'balanced scorecard' of performance.

Fourth, *market orientation theory* can offer a further clue towards the application of marketing metrics. Competition is steadily forcing firms to be more market-oriented. Market orientation has been defined in many ways, but they all involve a combination of 'market sensing', and appropriate, cross-functional responsiveness to the resulting data. Metrics are part of 'market sensing' therefore many researchers suggest that market-oriented firms tend to enjoy superior performance, although the issues are complex and the patterns and causalities are not clear cut still (Jaworski and Kohli, 1993; Greenley, 1995; Moorman, 1995; Narver and Slater, 1990; Meehan, 1997).

Finally, *institutional theory* (Meyer and Rowan, 1977) suggests that the application of marketing metrics will become an institutional norm, encouraging further uptake among late-adopting business. Lehmann (2002) suggests that most marketing metrics have yet to be shown to be associated with current and future financial performance. For example, there has been extended debate on whether market share is really related to performance and, if so, on the direction of the relationship (Capon et al., 1996). However, the increasing emphasis on intangibles, a 'balanced scorecard', and market

orientation suggest that successful firms will indeed need to use metrics, even if this can not be proved empirically.

- Connecting marketing metrics to financial consequences: why do we need this connection?

There is always a translation problem between the language of marketing terminologies and the language of profitability and stock price which is the mother tongue of corporate Chief Executive Officers (CEOs). "CEOs want to know what a 5% increase in customer satisfaction will do for the bottom-line",[2] says Wharton marketing Professor Reibstein, adding that "we need to draw a connecting line" between concepts of the two languages. Reibstein pointed out that marketing metrics have been the top research priority for the past six years of corporate marketing professionals brought up by the *Marketing Science Institute*. "In this economic environment when corporate budgets are being squeezed, Chief Marketing Officers (CMOs) are kept up at night by worry, trying to justify their expenditures and their existence. They believe what they are doing has value, and they have to figure out how to demonstrate that value"[3] to skeptical CEOs and Chief Financial Officers (CFOs), Reibstein said.

- Connecting marketing metrics to company's strategic decision: why do we need this connection?

When marketing activities are tightly aligned with corporate strategy, they drive growth. But in too many companies, marketing is poorly linked with strategy. Marketing may seem to perform well according to standard metrics, like the number of repeat purchases customers make, but if the company's strategy is to build market share, simply boosting repeat purchases isn't

[2]http://knowledge.wharton.upenn.edu/article.cfm?articleid=1073, November 17, 2004, p. 1.

[3]http://knowledge.wharton.upenn.edu/article.cfm?articleid=1073, November 17, 2004, p. 1.

enough. In many companies, marketing exists far from the executive lounge and boardroom. Marketing managers are rarely held accountable for ROI and rarely expected to explain how they can support corporate strategy. "This isn't a case of dereliction; most companies are struggling to make their marketing work. Rather, it's a case of myopia. No one in the organization sees the relationship between marketing and strategy well enough to diagnose the problem and begin to fix it."[4] The existing problem is the link between marketing and strategy for the company. Marketing metrics hardly reach the boardroom so that marketing metrics are not seriously considered for the financial performance of the firm.

According to McGovern et al. (2004), there are three reasons to build this connection.

First, top-line revenue growth, especially organic growth, ultimately boosts shareholder value, so investors increasingly demand it. If you decompose the stock prices of the leading consumer product companies, you will see that future growth accounts for as much as 54% of the stock's total value. Due to the excessive focus on alliances and acquisitions, many firms face with requirement for organic growth that they are not sure how to adjust this gap between the actual revenue growth and investors' expectations.

Second, responsibility for brand equity still resides in the marketing function, which is often far removed from top management – yet brand equity has never been more volatile and important than it is today, and so it must be a concern of the board's.

Third, the fundamental nature of marketing has changed so rapidly that many companies have not kept pace capitalizing on new growth opportunities. To counter this trend, every board should have on its agenda a regular review of the company's marketing talent. For most of its history, marketing has been a creative, right-brain discipline that puts a premium on innovative, out of the box thinking. As a result, the field is chockablock with creative

[4]McGovern et al (2004)

thinkers, yet it's short on people who hew toward an analytic, left brain approach to the discipline. Expertise in the left-brain fields of IT, finance, and data analysis is no loner optional in marketing departments. Information technology has become central to the intensive and critical data gathering and analysis companies use to segment customers, track their behaviors, and calculate their lifetime values.

- Why do we quantify the value of a firm's intangible assets?

The vital key is to quantify the value of a customer and the value of brand awareness. On May 22, 2001, the *New York Times* reported that "Intangible assets are, by definition, hard to see and even harder to fix a precise value for." The interest in intangibles arises from the recognition that market value of the largest 500 corporations in the United States is almost six times the book value (the net value of physical and financial assets as stated on the balance sheet). In other words, of every six dollars in the market value of a firm, only one dollar is represented in the balance sheet (Lev, 2001). The intangible assets of a company are important determinants of its market value, be it the company's potential for acquiring and retaining customers or other stakeholders, the value of its brands or its human capital. "So it becomes really important how to value that asset,"[5] Reibstein suggested. We have to calculate the cost to acquire the customer, the amount of the company's product that the customer purchases, the profit margin of those purchases, the cost of retaining the customer, the actual retention rate, how that customer influences others and the cost of capital.

Research has shown that as much as 70% of the market value of Fortune 500 companies is derived from the assessment of these variables (Srivastava et al., 1998a, b). Investors obviously have a close look at a company's (future) performance regarding these figures when deciding how to allocate their resources. Therefore we can conclude that the market value of stock listed

[5]http://knowledge.wharton.upenn.edu/article.cfm?articleid=1073, November 17, 2004, p. 1.

companies is to a large extent attributable to investor's value estimations of intangible assets. Professor Reibstein also pointed out some studies showing that 50% of corporations' value today is composed of intangible assets, up from just 20% 40 years ago.[6] And it is primarily these intangibles, not hard assets, which dictate a company's valuation by the stock market.

Among those intangibles, intellectual property probably ranks number one in value, but Reibstein believes that the value of customers is likely number two. "A customer base represents a future revenue stream, and we sell ourselves short if we don't articulate its long-term value." And "Valuing a customer base is something a straightforward financial statement doesn't do, and that's why financial statements can lead us astray. They require us to expense all marketing expenditures the year they occur, when actually; customer relationships have a life for a corporation."[7] The actual intangible statistic that is crucial for investment decisions may be different from case to case. However, what is certain is that the value potential of current and future customers is of central importance. The ability of a company to acquire and retain attractive customers is ultimately crucial for that company's success in a competitive market.

According to McGovern et al. (2004), marketing and customer management issues are receiving less and less attention in boardrooms. In their survey of 30 large U.S. companies, more then one-third reported that their boards spend less than 10% of their time discussing marketing or customer-related issues. Today, few CEOs have marketing experience, and few boards have customer management, marketing, or strategy committees. Only a handful of boards visit or receive presentations from major customers, and if companies have customer councils, few boards ever get to hear what they have to say. In many boardrooms, few boards ever get to hear what they

[6]http://knowledge.wharton.upenn.edu/article.cfm?articleid=1073, November 17, 2004, p. 2.

[7]http://knowledge.wharton,upenn.edu/article.dfm?articleid=1073, Wharton School of the University of Pennsylvania, November 17, 2004, p. 2.

have to say. In many boardrooms, discussions about customers are purely anecdotal. Reibstein suggested that CFOs often worry endlessly about the cost of capital, but actually the retention rate of customers is far more important. He used a sensitivity analysis to illustrate his point, showing, for instance, that an improvement in customer retention rates from 60% in 70% has a more favorable impact on revenues than chopping the cost of capital from 16% to 10%.[8]

Regarding the issue of customer satisfaction, "We need to understand what it costs to improve levels of customer satisfaction and what it is worth to a company to have highly satisfied customers,"[9] said Reibstein, adding that it is possible to have paradoxical results in this area: In other words, consumer satisfaction can go up, yet profits and market share go down, "That can happen if the company is so focused on consumer satisfaction ratings that it gets rid of dissatisfied customers."[10] There are still many instances prove to be worth spending millions to increase customer satisfaction. For instance, *Starbucks Coffee* faced a dilemma caused by its success. The long waiting time for service was reducing customer satisfaction.[11] Yet to increase staff to reduce waiting times would cost $40 million.

4.1.3 Metrics: Non-DCF & Non-Option related

There are many ways to classify current existing marketing metrics in enterprise management. Some grouped metrics in clusters based on their interlocking nature such as operations, logistics, sales force, trade, finance etc. Our classification would mainly focus on its correlation with DCF and Op-

[8]http://knowledge.wharton,upenn.edu/article.dfm?articleid=1073, Wharton School of the University of Pennsylvania, November 17, 2004, p. 2.

[9]http://knowledge.wharton,upenn.edu/article.dfm?articleid=1073, Wharton School of the University of Pennsylvania, November 17, 2004, p. 2.

[10]http://knowledge.wharton,upenn.edu/article.dfm?articleid=1073, Wharton School of the University of Pennsylvania, November 17, 2004, p. 2.

[11]http://knowledge.wharton,upenn.edu/article.dfm?articleid=1073, Wharton School of the University of Pennsylvania, November 17, 2004, p. 3.

tion Valuation Method (OVM). However we would like to start with some common applied marketing metrics which are Non-DCF and Non-option related due to: a) It helps us to understand better the "logic" of marketing; b) We would like to be open minded regarding the possibilities, in the future, to study these metrics according to the perspective of DCF and OVM. These two reasons provided us as criteria to select certain metrics. Other important criterion of selecting those metrics is their correlations to customer value. Every metric is somehow related to the factors which will influence customer value of the firm since customer value is the one main focus of the extension of the 3-Model (Rao and Stevens, 2007) we have always been trying to pursue. Therefore we will not dig too deep into other holes of marketing metrics so as to not make our main target ambiguous.

- *Customer Profit (CP)*

CP is the profit the firm makes form serving a customer or customer group over a specified period of time and the profitability of customer can be defined as the difference between the revenues earned from and the costs associates with the customer relationship during a specified period. This metric requires assigning revenues and costs to individual customers. The main difference between CP and the other similiar metric Customer Lifetime Value (CLV) (see 4.1.4) is that CP measures the past and CLV looks forward. Based on the customer profitability we can identify which customers are profitable and which are not so as to improve firm profitability. Peppers and Rogers[12], of *Peppers & Rogers Group*, are among the leading experts in customer profitability. They claimed that not all customers are equal and their *One-to-One model* describes approaches for enhancing the value of every customer relationship. However most business experience the 80/20 rule which 80% of the money comes from 20% of the customers or the similar dominance of a few customers contributing the majority of the revenues and profits. Customer profitability can be expressed as follows:

[12]www.peppersandrogers.com

$$CP_t = R_t - C_t$$

Where R_t is the revenue from the customer during time t, and C_t is the cost incurred to acquire and support the customer during time t. In theory, this is a trouble-free calculation. Although painless in theory, large companies with a multitude of customers will find this a major challenge even with the most sophisticated databases.

- *Retention Rate*

Retention rate is one of the most traditional measures for tracking changes in the ability of the firm to retain customers. Retention rate can be defined as ratio of customers retained to the number total customers at starting period. The formula of retention rate can be showed as follows:

$$Retention\,rate_t = \frac{C_{at}}{C_{at-1}}$$

Where C_{at} is the number of active customers at the end of period t and C_{at-1} is the number of active customers at the end of time period $t-1$. According to Davis (2007), customer retention has been a long-cherished objective of businesses since losing a customer costs firms' money in terms of lost revenues, plus the costs incurred to attract the customer in the first place. Retention can also reveal the loyalty of customers and build an avenue to develop a deep relationship with customers; therefore most marketers see high customer retention rates as a desirable and worthy objective.

Reinartz and Kumar (2002) argued that customer loyalty and profitability must be managed concurrently to ensure maximum positive results. We have to be aware the balance between loyalty and profitability so as to make appropriate marketing decisions. The retention rate data can be obtained from retention surveys and such surveys are conducted on both current and

former customers. Customer account summaries and sales management department may also provide this detailed information regarding the retention situation.

- *Churn Rate*

Not all the customers are loyal. Besides knowing the percentage of customer retained, it is also very important to know how many customers a company loses versus how many are retained. The churn rate can be defined as the percentage of customers a business loses over a specific period of time:

$$Churn_t = \frac{C_t}{C_{at}}$$

Where C_t is the number of customers a business loses over time period t and C_{at} is the number of active customers at the start of time period t. Most marketers intend to develop strategies and programs that will minimize churn rate since the reason why customers left could send some signals to marketers so as to improve their product offerings and service qualities. Churn rate would also lead the curious marketers to further investigate why customers switched to a competitor, whether it is isolated or an indication of a larger, unsettling trend and how to actually improve the situation for remaining customers.

Churn rate can be obtained through two sources: Reactive, or post-customer departure, reports; and proactive, or pre-customer departure, reports. Churn rate is a more straightforward metric although it might also be frustrating since it is usually much harder to convince an already lost customer to return (Davis, 2007).

4.1.4 Metrics: DCF-related

Based on our classification of the marketing metrics, there are also some DCF-related marketing metrics. Even though the number of those DCF-

related metrics can not be compared with other common metrics, they are connected closely and numerically to the financial performance of the company.

4.1.4.1 *Customer Lifetime Value* (CLV)

In recent years, the marketing literature has developed and discussed the concept of customer lifetime value (CLV), which is the present value of all future profits generated form a customer (Berger and Nasr, 1998; Blattberg and Deighton, 1996; Blattberg, Getz and Thomas, 2001; Jain and Singh, 2002; Rust, Zeithaml and Lemon, 2000). Arguments for treating customers as assets that generate future profits, however, have had limited impact on the business and investment community for two main reasons. First is that the concept and models of customer lifetime value originated in the field of direct and database marketing and continue to focus in this domain. Many applications require an enormous amount of customer data as well as sophisticated models and concentrate on targeting customers with appropriate product or communication offers (CLV model can use direct database so that not an excessive amount of effort are demanded for the valuation). However this might appear to be of limited value to senior managers who are concerned with strategic decisions, or investors who do not have access to internal company data. Second is that few attempts have been made to link customer value to the value of the firm. This link is very essential if investors would like to view customers as assets.

Gupta and Lehmann (2003) have contributed to study those two limitations. They showed that it could be possible to use publicly available information to estimate the lifetime value of a customer for a publicly traded firm and built the link between customer and firm value which provides a useful guideline for strategic decisions such as mergers and acquisitions.

Farris et al. (2006) also defined CLV from a different way as the present value of the future cash flows attributed to the customer relationship. When

margins and retention rates are constant, the following formula can be used to calculate the lifetime value of a customer relationship:

$$CLV(m.u.) = \frac{Margin(m.u.) \cdot Retention\,Rate(\%)}{1 + Discount\,Rate(\%) - Retention\,Rate(\%)}$$

This CLV model has only three parameters: constant margin (contribution after deducting variable costs including retention spending) per period, constant retention probability per period and discount rate. Under the assumptions of the model, CLV is a multiple of the margin. The multiplicative factor represents the present value of the expected length (number of periods) of the customer relationship. When retention equals 0, the customer will never be retained, and the multiplicative factor is zero. When retention rate equals 1, the customer is always retained, and the firm receives the margin in perpetuity. The present value of the margin in perpetuity turns out to be $Margin/Discount\,Rate$. For retention values in between, the CLV formula can get the appropriate multiplier.

4.1.4.2 *Prospect Lifetime Value (PLV)*

According to Farris et al. (2006), PLV is the expected value of a prospect. It is the value expected form the prospect minus the cost of prospecting. The value expected from each prospect is the acquisition rate (the expected fraction of prospects who will make a purchase and become customers) times the sum of the initial margin the firm makes on the initial purchases and the CLV. The cost is the amount of acquisition spending per prospect:

$$PLV(m.u.) = Acquisition\,Rate(\%) \cdot [Initial\,Margin(m.u.) + CLV(m.u.)] -$$

$$- Acquisition\,Spending(m.u.)$$

If PLV is positive, the acquisition spending is a wise choice. If PLV is negative, the acquisition spending should not be made. Actually PLV can be very small even though CLV can be hundreds of dollars sometimes. PLV only applies to prospects, not customers, therefore a large number of small but positive-value prospects can add to a considerable amount of value for the firm.

4.1.4.3 *Customer Equity* Approach

Blatterberg and Deighton (1996) have coined the term Customer Equity (CE) for this value potential. Using their definition as a basis, CE can be interpreted as the sum of the discounted cash surpluses generated by present and future customers (within a certain planning period) for the duration of the time they remain loyal to a company, i.e. the sum of individual customer lifetime values (CLV) from the company's point of view. As these surpluses include manufacturing cost, CE can be regarded as the key driver of Shareholder Value in the sense of discounted Free Cash Flows from operational business activity. The more reliable the proposed methods are for calculating this figure, the more important it will become as a criterion on which to make investment decisions.

4.1.4.3.1 CE is still a young approach Surprisingly, although being of obvious importance for management in general and for marketing management in particular, literature taking a more comprehensive look at the design of a consequent value-based marketing concept has only recently been appearing (e.g. Blattberg and Thomas, 2001; Doyle, 2000; Rust et al., 2000; Srivastava et al., 1998 a, b).

First concepts putting CE at the center have been presented (Blattberg and Thomas, 1999, 2001; Rust et al., 2000). This paper contributes to the existing stream of research by describing an innovative, more stringent process framework as well as methods for calculating customer acquisition proba-

bility, retention duration, and Customer Equity itself. According to Doyle (2000), it is meant to serve as a further step towards redefining the marketing discipline as a 'management process that seeks to maximize returns to shareholders'.

What can be used to measure and increase the value potential of a customer from the company's viewpoint? What makes an existing or possible new customer attractive? In an environment of tough buyers' markets, a customer's attractiveness depends on various factors: his/her retention duration, the frequency with which repeat purchases are made, his/her price sensitivity over time, the pattern of costs he/she generates (e.g. frequency with which he/she calls the customer assistance center, pattern of complaints), his/her value as a lead user, as regards word of mouth, his/her option value, as well as his/her up- and cross-buying potential (e.g. Reichheld and Schefter, 2000; Cornelsen, 2001; Reichheld and Sasser, 1990). For companies competing for investors' money, this can only mean establishing these variables for their customers, segmenting them accordingly, processing customer segments depending on priority, and addressing them according to their needs. This implies credible and regular planning, determination and monitoring of *CLV* and *CE*. In addition, possible investors need to be convinced of the amount and sustainability of a calculated $CE - value$ by demonstrating what is undertaken within the management process to achieve or even increase it. To say it clearly: 'touching' Customer Equity in an effective and efficient way will not be possible without a strong *conceptual basis*.

4.1.4.3.2 What is *CE* Marketing? Customer Equity Marketing is based on validated theories on consumer behavioral phenomena (e.g. cross-buying, further recommendation, duration of customer retention), concentrates on quantitative aspects, requires and initiates innovative database solutions and puts the important questions of marketing management into focus. It is influenced by one central maxim: steady creation of value through

strict orientation towards individual customer lifetime values.

Based on the article of Bayón et al. (2002), the core process of CE marketing can be outlined as Analysis, Planning, Implementation and Control. Regarding those four core stages, CLV is actually the basis of the CE marketing model. As what Bayón et al. (2002) mentioned, the basic prerequisite for an acquisition and customer retention management strategy geared to systematic value creation is knowledge of individual customer lifetime values for the customer base. They further explained a fundamental calculation model which is the individual CLV[13] for customer c, CLV_c is:

$$CLV_c = (C_c + W_o M_c) \cdot W_c$$

Where C_c is the sum of the cash surpluses, discounted to the present (reporting period) as a result of the direct transactions generated by customer c, viewed over her/his entire retention duration (lifetime). $W_o M_c$ are the cash surpluses of word of mouth activities by customer c, i.e. the sum of the cash surpluses of other customers generated by referral behavior of customer c discounted to the present. Initial model approaches to determine this value are available in the references (Cornelsen 2001; Bayón and Wangenheim, 2001). $W_c \geqslant 1$ is the aggregated weighting for the discounted cash surpluses generated by customer c as a result of his lead user, reference and option value potential.

4.1.5 Metrics: Option-related

Based on the current literature regarding marketing metrics, we have searched several $M\&M$ related journals and books for the recent five years[14]. How-

[13]The definition of CLV here is different from the two other definitions mentioned before with the same name.

[14]*European Management Journal*; *Journal of Marketing Management*; *California Management Review*; J*ournal of Derivatives*; *Journal of Finance,* etc.

ever we have encountered very few articles which are about applying option theory in connecting marketing metrics with the firm valuation model. [15]

Given much more flexibility by option theory, we intend to build this new bridge to connect the marketing metrics with the financial performance and strategic making of the firm (Chapter 5).

4.1.6 Other Conceptual Approaches

4.1.6.1 Dashboard Approach

Many marketing managers will tell you that marketing performance can't be measured – or at least that doing so is of little strategic value. The problem is that these managers don't know what to measure or how to interpret the results. They may collect all manner of plausible performance metrics – such as customer satisfaction scores and customer retention rates – but if these can't be correlated to marketing activities and revenue results, the data aren't very helpful.

4.1.6.1.1 Disadvantages with customer satisfaction scores, acquisitions rates and customer retention Popular metrics such as customer satisfaction, acquisition, and retention have turned out to be very poor indicators of customers' true perceptions or the success of marketing activities. Often, they're downright misleading. High overall customer satisfaction scores, for example, often mask narrow but important areas of major dissatisfaction, such as customers' unhappiness with long wait times or bad service. They can also mask any backsliding the company is experiencing relative to competitors; gently climbing satisfaction scores may be reassuring to management and the board, but if competitors' scores are increasing faster, that should be cause for alarm. Acquisition rates may be robust, but if old customers are abandoning ship as fast as new ones are coming on board, those

[15] See *Introduction*:15-17.

rates may be offering a deceptive picture of marketing's performance. And what, exactly, should the board make of stable customer retention rates? If customers are staying on because they are being held hostage by a contract, good retention figures may be obscuring the truth that customers will flee the instant they can.

4.1.6.1.2 Why such a conceptual framework as *Dashboard* is interesting? Even if today's boards wanted to exercise their governance over marketing activities, they wouldn't have the information they need to make sound judgments. Boards need a thorough understanding of how their companies are meeting customers' needs and how their marketing strategies support those efforts. According to McGovern (2004), no such company we know of provides its board with a scorecard that allows this.

Dashboard is structured to reveal the fundamental relationships between a company's main *business drivers*, its *growth strategy*, and its *marketing talent pool*. Dashboard allows the board to quickly and routinely assess how effectively marketing is supporting corporate strategy and to determine when marketing and strategy are misaligned. Armed with a clear understanding of marketing's role and performance, the board can optimize this critical function in the organization.

a) *Business drivers*: What are our company's key business drivers, and how well does our marketing strategy support them?

Any marketing dashboard must lead with a survey of the company's main business drivers. A driver is a business condition that, when manipulated or otherwise changed, will directly and predictably affect performance. Business drivers are, by definition, leading indicators of revenue growth. New business and share of wallet are business drivers. Increase or decrease either, and you will see a direct impact on revenues. Customer satisfaction, on the other hand, isn't always a business driver. Customer satisfaction could be

a business driver in the case of a high volume product with a high repeat-purchase rate, such as a soft drink. A real or perceived quality problem with such a product could instantaneously translate into a drop-off in revenues. Examples show that business drivers which are critical in on company may be unimportant in another. Therefore marketers must accept that there's no one-size-fits-all dashboard they can use and they must customize the tool for themselves. After establishing what the company's true business drivers are, management must cull the myriad possibilities down to the three or four key ones that will be the most fruitful to follow. At least one of these drivers, such as share of wallet, should indicate performance relative to competitors. At least one, such as loyalty, should clearly measure the customers' experience. And one, such as customers' average annual expenditures or lifetime value, should measure the growth of retained customers' business. Finally, any driver on the dashboard must be one the company can manipulate.

b) *Growth strategy*: What do our customers want, and how is our knowledge of their desires being translated into a pipeline of innovations?

The trends revealed by the main business drivers give the board important insights about customers and revenue growth. But these trends indicate only the rate of growth, not the company's strategy for sustaining it. To keep customers, you have to delight them, exceed their expectations, and anticipate, discover, and fulfill their latent needs. Once or twice a year, marketing should review for the board how the customer Base is segmented, how the size and profitability of each segment is changing, and how the company's products and services address the needs of each segment.

The second part of the dash board must describe the specific innovations in a pipeline of growth ideas that will allow the company to reach its short- and long-term revenue goals. And it must detail how revenues and profits associated with each innovation will add to those from core products to achieve growth objectives at least one to three years out. The total projected revenue stream should meet – and, in most cases, exceed – the organic-growth

expectation embedded in the firm's stock price. If it doesn't, all priorities pale in comparison to the need to identify new sources of growth.

c) *Marketing talent pool:* What marketing skills do we need and how do we acquire the skills we lack?

A company may have the best mass-marketing capability money can busy, but if it's a customer-service-driven firm with a pipeline of service innovations, what it really needs are customer-relationship-management skills. The board should expect a thorough appraisal of the company's marketing strategy and its inventory of marketing capabilities. If senior managers understand the company's key drivers and the company's overall strategy, it should be apparent to them what marketing skills will be required. Therefore, the third part of the marketing dashboard must identify the skills needed to achieve the revenues promised in the growth agenda and the steps required to develop or acquire any skills the company lacks.

In conclusion, companies need to close the gap between their boards and their marketing functions if they are to meet their expectations for growth. Marketers need to start thinking of themselves as general managers who can drive the business forward rather than as functional specialists who are isolated form the company's strategy. Organizations take their cues form the top. When the board turns its attention to the company's customers, the entire organization will become more market driven, more customer-centric, and more focused on generating organic growth.

4.1.6.2 RAVE: Integrated Value Management for Customer, Human, Supplier and Invested Capital

Strack and Villis (2002) introduced a new, integrated value management concept ($RAVE$) for managing human capital (*Workonomics*), customer capital (*Custonomics*), and supplier capital (*Supplynomics*), all in a value-oriented and quantitative way. This model is difficult to classify since it is related

with EVA, CVA and DCF methodology, however it is a conceptual approach and for this we include it here in this section.

After the birth of balance sheet accounting, invested capital has been the center of every firm and the reference point for the most important controlling metrics. However our focus today which is more than capital and manufacturing plants is access to customers and to employee know-how.[16] These new sources of value creation play no role in the widely used capital oriented business controlling metrics such as ROI or EVA (see 1.4) and CVA (Cash Value Added). The 'balanced scorecard' method (see 4.2.7.1) does not solve the dilemma either. It provides new metrics on the human resources and customer levels, but they are often isolated, quantitatively linked neither among themselves nor with the main financial metric of the company. $RAVE$ (Real Asset Value Enhancer) seems to be able to solve those problems. However, $RAVE$ is simply linked to the central EVA and CVA model in a quantitative way.

Many firms started to apply new value-oriented measures of performance after those classic static return measures *(ROC or ROE)*. Besides the discounted cash flow method, the residual income methods such as *Stern Stewart & Co.* 's EVA concept[17] and The *Boston Consulting Group*'s CVA concept are the most widely known and used. Profit is defined as $NOPAT$ (Net Operating Profit After Tax) and invested capital is calculated at book value in the simplest form of the EVA concept. Since ratios depend on the depreciation method and the age of the assets, both return on investment and EVA increase over time, all else being equal, even if operational performance does not change.[18] CVA hit this issue by replacing return on investment by $CFROI$ (cash flow return on investment) and valued invested capital at his-

[16]Siegert (2000) argues that with the transformation from the industrial age to the service economy, accounting and controlling should have been extended by the 'customer capital' dimension, and that with the transformation to the knowledge economy, the 'human capital' dimension needs to be added as well.

[17]Stewart (1991).

[18]Rappaport (1999:27).

torical prices. Therefore the value of a firm can be calculated by discounting future $CVAs$ or $EVAs$ and adding the invested capital at t_0. EVA and CVA are compatible with discounted cash flow (DCF) valuation method. The essential levers to raise value are to improve return on investment and profitable capital growth which are both strongly based on the classic capital view. Customers, employees and suppliers are not factored in the classic value management explicitly. However, the relevance of human, supplier and customer capital is determined by their availability and their contribution to company success. It is the quality of these factors, not the invested capital, which essentially determines the value-creation potential of today's companies. The traditional view tends to label those factors from the cost lens, cost of capital, personnel costs, materials costs and customer-related costs. Recently more and more researchers tend to analyze them as capital, investment capital, human capital, supplier capital and customer capital. Costs should be minimized but capital should be developed and managed.

According to Strack and Villis (2002), $RAVE$ creates an integrated controlling system which provides a mirror image of the classic capital-based world, to manage a) human capital with the Workonomics Approach, b) customer capital with the Custonomics Approach, and c) supplier capital with the Supplynomics Approach, all in a value-oriented and quantitative way:

a) *Human Capital with Workonomics Approach*

Based on the model of Strack and Villis (2002), *Workonomics* can bring a level of transparency and structure to the human factor which is comparable to the one brought by capital-based systems to investment capital. They also analyzed three metrics which can be expressed by EVA or CVA and relevant to human resources: Value Added per Person (VAP), Average Cost per Person (ACP) and number of employees (P). The common anchor for the capital and the human resources views is EVA or CVA which can be explained further by figure 4.1:

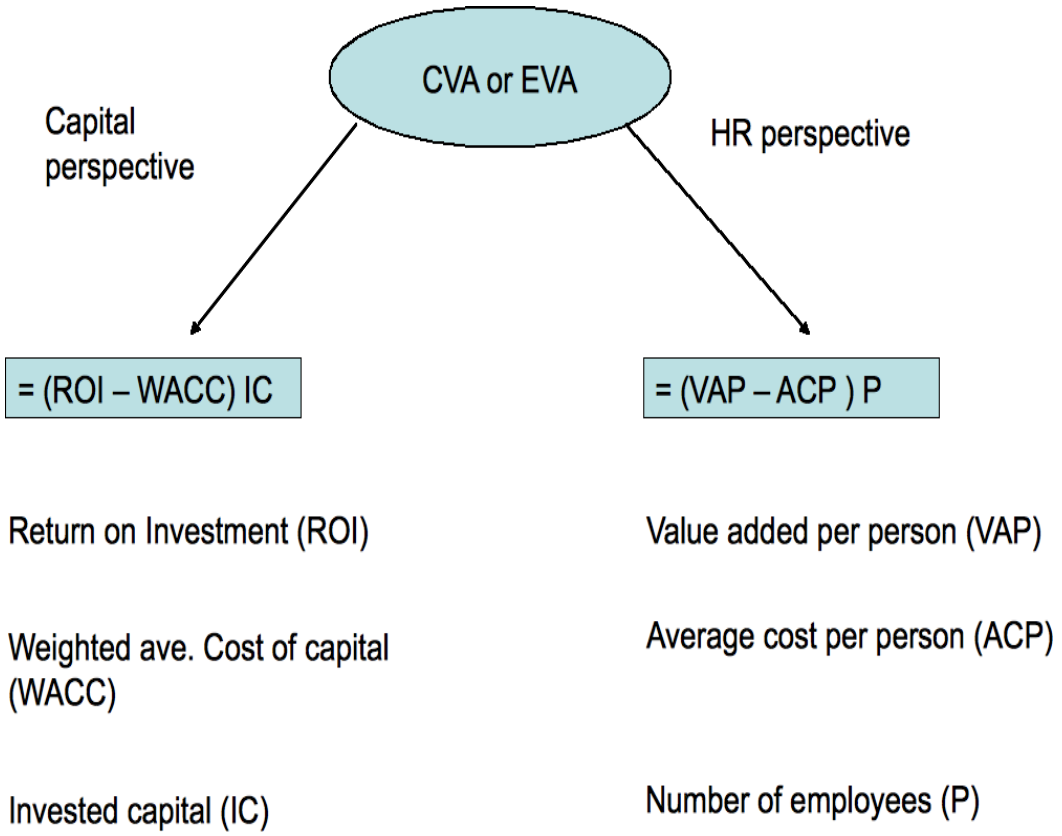


Figure 4.1: Capital and Human Resources Perspective

In this way, capital and employees, as essential company resources, are put on an equal footing and integrated in a single value management approach.

b) *Customer Capital with the Custonomics Approach*

In the *Custonomics* perspective, CVA or EVA can be expressed as the difference between Value Added per Customer (VAC) and the sales and marketing Average Costs per Customer (ACC), multiplied by the number of customers (C). As *Workonomics, Custonomics* approach is also anchored in the central model of EVA or CVA with similar analogies. *Custonomics* provides a quantitative controlling instrument for numerous customer-oriented firms (e.g., Internet firms, retailers, telecommunication firms, insurers, banks). The model of *Custonomics* can be further expressed as figure 4.2.

According to Strack and Villis (2002), *Custonomics* is more than a pure controlling took, since it brings up many strategic questions in the process of customer analysis and segmentation.

c) *Supplier Capital with the Supplynomics Approach*

In the *Supplynomics* perspective, CVA or EVA can be expressed as the difference of the Value Added per Supplier (VAS) and Average Cost of Supplier (ACS), multiplied by the number of suppliers (S). Suppliers can also be replaced by products or product groups (supplies). This leads to a value-oriented, product specific contribution margin calculation. *Supplynomics* view can be also further expressed by figure 4.3.

In conclusion, *Workonomics* measures and controls human capital; *Custonomics* measures and controls customer capital, and *Supplynomics* measures and controls supplier capital. $RAVE$ incorporates these assets as central factors for value creation and allows for a quantitative, value-oriented strategic and operational control of their value creation potential. The blueprint of $RAVE$ can be expressed as figure 4.4.

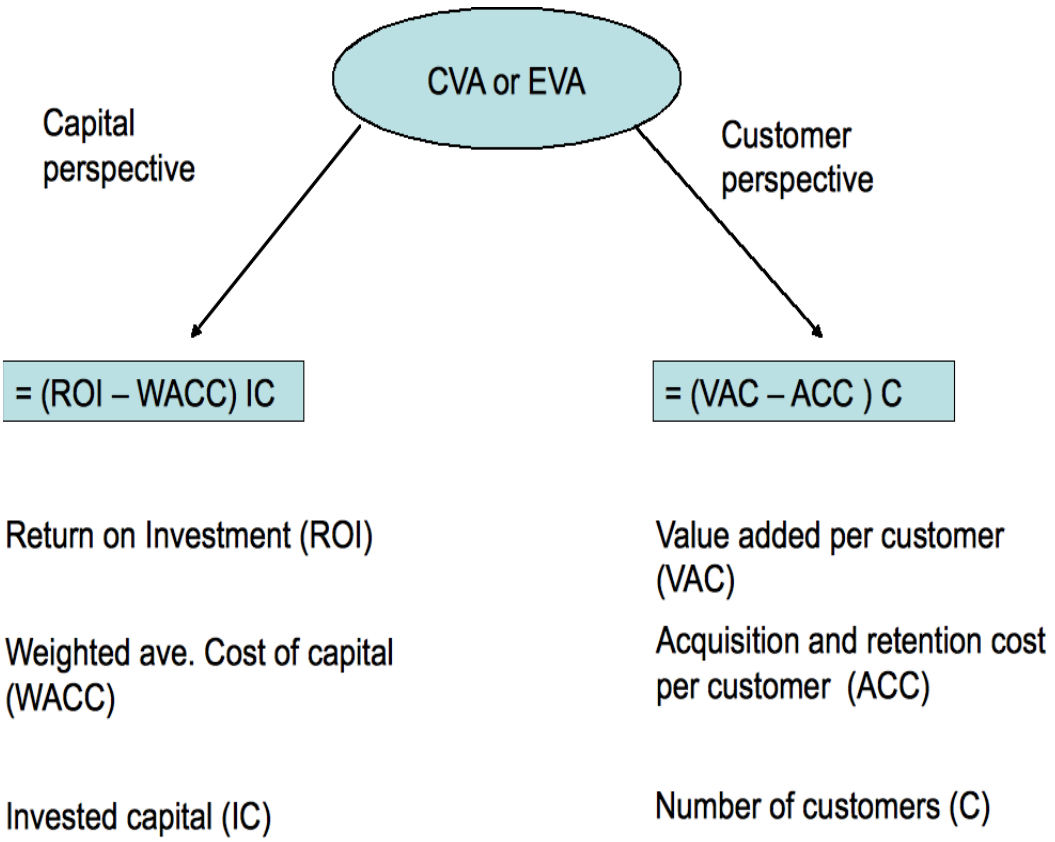


Figure 4.2: Capital and Customer Perspective

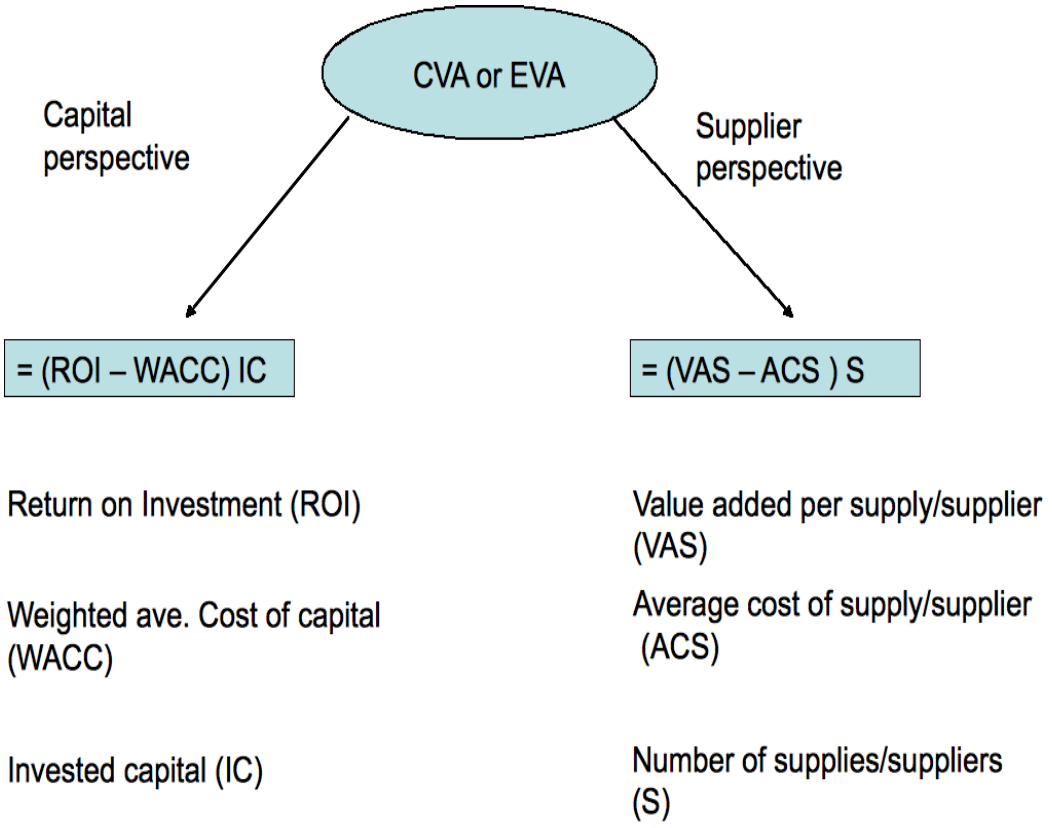


Figure 4.3: Capital and Supplier Perspective

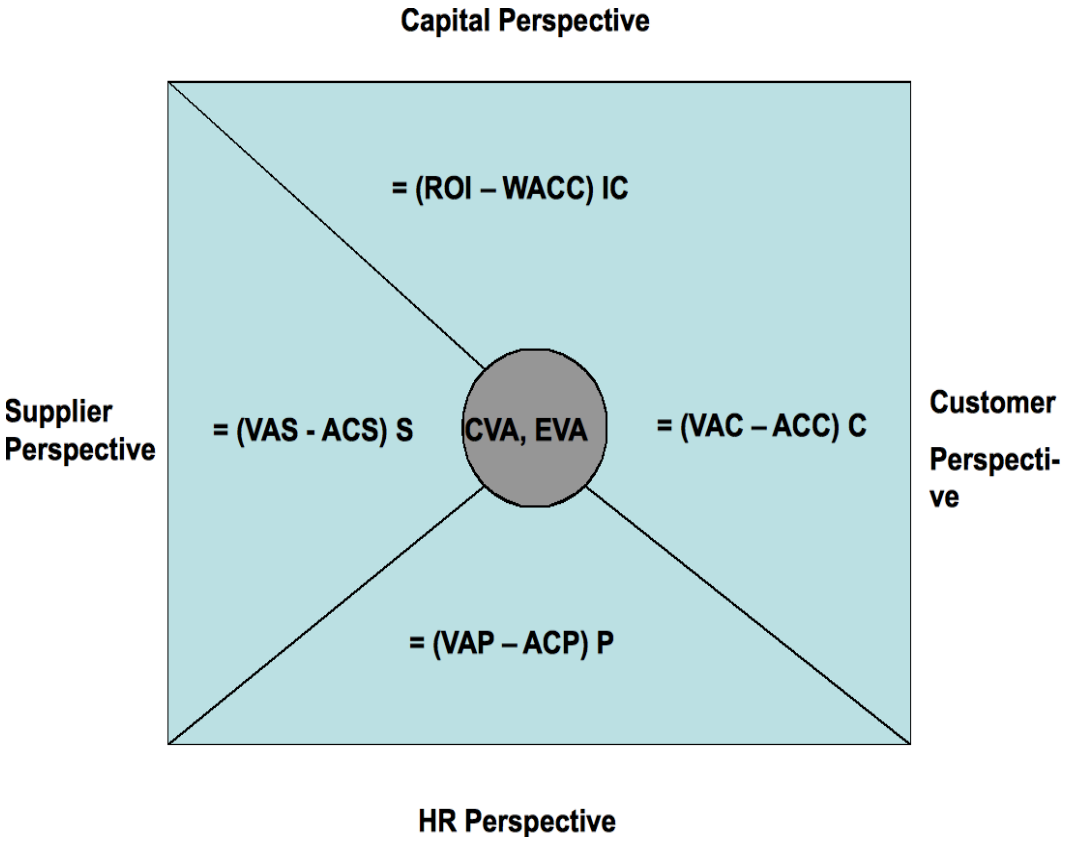


Figure 4.4: HR Perspective

4.2 The Firm and Employees: Human Capital Management

4.2.1 Origin of the concept of Human Capital (HC)

The original concept of human capital was brought up by Schultz (1961), an economist who proved that the yield on human capital investment through education and training in the United States was larger than that based on investment in physical capital. Schultz further elaborated his concept in 1981 as follows: 'Consider all human abilities to be either innate or acquired. Attributes... which are valuable and can be augmented by appropriate investment will be human capital... By investing in themselves, people can enlarge the choices available to them.'

Elliott (1991) further developed the theory of human capital. He focused more on the quality instead only quantity of the labor supply. According to Elliott (1991), the decision to acquire or develop skills as an investment decision requires the outlay of resources now for returns in the future. He comments that:

> When investing in individuals, firms have fewer guarantees, than they do with machines, that they can secure the continuing use of their services. Individuals, unlike machines, can always decide to leave the firm, or they can decide to withdraw their labor, strike, go absent or work badly. Human capital theory proposes that individuals will invest in human capital if the private benefits exceed the costs they incur and that they will invest up to the point at which the marginal return equals the marginal cost.

4.2.2 Definition of HC

There are various definitions of human capital according to different authors. Bontis et al (1999) defined it as follows:

> Human capital represents the human factor in the organization; the combined intelligence, skills and expertise that gives the organization its distinctive character. The human elements of the organization are those that are capable of learning, changing, innovating and providing the creative thrust which if properly motivated can ensure the long-term survival of the organization.

Davenport (1999) brought up the point that actually people bring human capital to the organization although it is then developed by experience and training. Davenport (1999) states that:

> People possess innate abilities, behaviors and personal energy and these elements make up the human capital they bring to their work. And it is they, not their employers, who own this capital and decide when, how and where they will contribute it. In other words, they can make choices. Work is a two way exchange of value, not a one-way exploitation of an asset by its owner. Similar with the idea mentioned by Davenport, Ehrenberg and Smith (1994) also describe human capital theory as 'conceptualizes workers as embodying a set of skills which can be "rented out" to employers'.

Lepak and Snell (1999) state that 'The value of human capital in inherently dependent upon its potential to contribute to the competitive advantage or core competencies of the firm.'

Human capital theory can be related with the resource-based view of the firm as developed by Barney (1991). He described that sustainable competitive advantage is attained when the firm has a human resource pool that can not be imitated or substituted by its rivals. Ulrich (1998) combined human capital theory with competency movement. He believes the assessment of competency levels in performance management processes can reveal trends in the development of a competent workforce and therefore the value of that

workforce. Ulrich (1998) analyzed human capital consists of 'competence & commitment'. Becker (1993) contributed to the knowledge in regarding people as assets and stated that investment by organizations I people will generate worthwhile returns. Scarborough (2002) also comment in a similar way as follows:

This applies a concept of human capital that is similar to theories of physical capital. In human capital theory, reference is made to people and skills, whilst in theories of physical capital, reference is made to plant and equipment. A theory of human capital places emphasis on the way in which employee competencies create value for the organization in the same way that the ownership of physical capital (this might be something like an oil field or a factory building) contributes to the performance of the firm. Thus, applying human capital theory to view the worker as an asset has significant implications for management practice. It leads to the conclusion that firms need to redefine the costs associated with remuneration, training and development and career progression as investments that create value for the business. The theory therefore underpins the philosophy of human resources management (HRM) which, as developed in the 1980s, stated that employees should be treated as assets rather than costs. However, according to Baron and Armstrong (2007), Davenport (1999) had doubted the concept of regarding people as assets as the following reasons: a) workers should not be treated as passive assets to be bought, sold and replaced at the whim of their owners—increasingly, they actively control their own working lives; b) the notion that companies won human assets as they own machines is unacceptable in principle and inapplicable in practice; it shortchanges people by placing them in the same category as plant and equipment; c) no system of 'human asset accounting' has succeeded in producing a convincing method of attaching financial values to human resources; in any case, this demeans the more intangible added value that can be delivered to organizations by people.

Related to the third reason mentioned by Davenport (1999), even though we should not simply see workers as assets, however, a system of attaching added value through people into financial values of the firm is already on the way from my point of view. In order to make business or strategic decisions, we need to be aware of the potential value of the firm to reach the long term target. This part of potential value which is added through people can not only be interpreted literally but also numerically for further comparison within the industry or certain benchmark. Therefore it is definitely necessary to measure the value of human capital as part of the potential value that we can not easily obtain from the financial reports of the enterprise and such a measuring system as a coding bridge to transfer literal phenomenon to numerical results are inevitably useful for decision making.

4.2.3 The Human Capital Management (HCM)

Followed those aims and objectives, the concept of Human Capital Management (HCM) was born. According to Baron and Armstrong (2007 : 21), HCM is about 'obtaining, analyzing and reporting on data that informs the direction of value adding strategic, investment and operational people management decisions at corporate level and at the level of frontline management'. HCM is not only about measurement, but measurement with purposes. The *Accounting for People Task Force Report* (2003) mentioned that HCM involves the systematic analysis, measurement and evaluation of how people policies and practices create value. Baron and Armstrong (2007 : 21) defined the characteristic of HCM as follows:

> HCM is the use of metrics to guide an approach to managing people that regards them as assets and emphasizes that competitive advantage is achieved by strategic investments in those assets through employee engagement and retention, talent management and learning and development programs.

HCM is sometimes defined without the emphasis on measurement. Chatzkel (2004) comments that 'Human capital management is an integrated effort to manage and develop human capabilities to achieve significantly higher levels of performance.' Kearns (2005) describes HCM as 'The total development of human potential expressed as organizational value'. He supports the idea that HCM is all about creating value through people and the development in HCM is to translate the people development philosophy into value.

Merritt, HR director of $AT\ \&T$ described that the term HCM is entering our lexicon of change, but HCM can and should be more than HR with a new name. According to Merritt, the definition of HCM is a C-suite business discipline that develops enterprise human capital strategies and ensures the human capital portfolio is effectively managed. As C-suite members, the CFO (Chief Financial Officer) and CHCO (Chief Human Capital Officer) are accountable for overall enterprise performance.

HCM provides support in decision making by combining business and workforce intelligence to the development of enterprise human capital strategies. While we are considering or making decision if we should leverage the firm by issuing more debt which will influence the structure of the whole company, we are also facing the problem of how to leverage people and their ideas effectively to achieve such a business goal.

In general, Merritt concluded that HCM is about the enterprise, about human capital options expressed in dollars and data. This is a hot-seat position, not one for the faint of heart. Nor is it a position for a cold, numbers-only bottom liner. Each race is run and won, or lost, with real people with real lives. HCM is a cross-functional, cross-enterprise leadership discipline with oversight and decision-making responsibility and accountability. It requires business and financially savvy, technology-aware, data-embracing, senior leaders who bring strategic human capital expertise, business intelligence, and judgment to the C-suite table.

4.2.4 HCM and competitive advantage

Now more and more of a firm's market value is in "intangible" rather than book value. Today's performance results and tangibles such as cash and inventory on the balance sheet are easy to understand, measure, and manage—at least easier than concepts that drive stakeholder actions founded on beliefs about the future. Belief in the sustainability of profitable growth and competitive advantage drives much of the intangible market value. Perceptions about culture, operational values, ethics, and behaviors of the leaders and the workforce behaviors of the workforce influence customer, investor and employee decisions

Lepak and Snell (1999) comment that 'The value of human capital is inherently dependent upon its potential to contribute to the competitive advantage or core competence of the firm'.

Bassi and McMurrer (2007) mentioned that people are the only source of long-term competitive advantage. However for the record, there simply weren't robust methods for measuring the bottom-line contributions of investments in human capital management (HCM)—things like leadership development, job design, and knowledge sharing. Bassi and McMurrer also stated that most traditional HR metrics such as employee turnover rate, average time to fill open positions and total hours of training provided do not predict organizational performance. In their empirical research, Bassi and McMurrer (2007) analyzed a core set of HCM drivers that predict performance across different organizations and operations and they provides three cases (a large manufacturer, a public school system and a group of financial services firms) applying the survey related with their HCM drivers. According to Bassi and McMurrer (2007), these drivers can be categorized into five fields: leadership practices, employee engagement, knowledge accessibility, workforce optimization and organizational learning capacity. As what they concluded, globalization has left only one true path to profitability for firms operating in high-wage, developed nations: to base their competitive strategy

on exceptional human capital management.

According to Merritt, perhaps it is time to "buy" growth through a merger or acquisition (M&A). A major M&A deal is initially announced the stock of the acquired company usually goes up and the stock of the acquiring firm goes down. Shareholder skepticism is justified, as many mergers do not produce all the promised results. The wheeling and dealing of an M&A is heady, but the aftermath is often simply a headache. If the M&A proposition is based on anything more than merely buying the tangible book value assets and market footprint, then increased HCM due diligence[19] and preplanning for the post merger integration is critical before deal fever kicks in. Strategy and structure are only valuable as the results produced. The "make vs. buy" decision extends to more than products and services, but also workforces.

4.2.5 Measuring Human Capital

According to Baron and Armstrong (2007), the recognized importance of achieving human capital advantage (Boxall, 1996) has shed light on development of methods in measuring the value of that capital for the following reasons:

> Human capital constitutes a key element of the market worth of a company and its value should therefore be included in the accounts as an indication to investors or those contemplating a merger or acquisition of the total value of a business, including its intangible as well as its tangible assets. The process of identifying measures and collecting and analyzing information relating to them will focus the attention of the organization on what needs

[19]Due Diligence is a term used for a number of concepts involving either the performance of an investigation of a business or person, or the performance of an act with a certain standard of care. It can be a legal obligation, but the term will more commonly apply to voluntary investigations. A common example of due diligence in various industries is the process through which a potential acquirer evaluates a target company or its assets for acquisition (Hoskisson et al., 2004).

> to be done to find, keep, develop and make the best use of its human capital. Measurements of the value of human capital can provide the basis for resource-based HR strategies that are concerned with the development of the organization's core competencies. Measurements can be used to monitor progress in achieving strategic HR goals and generally to evaluate the effectiveness of HR practices. You cannot manage unless you measure. (Baron and Armstrong 2007: 11-12)

However, members of the accountancy profession have generally neglected the idea because they believe that numerical results or figures would be based on crude assumptions and as Schuller (2000) states, they would involve numerical precision which would be 'wholly out of line with these assumptions'. The *Accounting Standards Board*, which sets the rules for financial accounting in the UK has stated that 'We don't think you can solve problems by incorporating them in the accounts.' OECD (1998) also mentioned 'Measures of human capital have been strongly guided by what is possible to measure, rather than by what is desirable to measure.'

Sackmann et al. (1989) state that human resource accounting targets at 'quantify the economic value of people to the organization' in order to provide input for managerial and financial decisions. Bontis et al. (1999) concluded three types of human resource accounting models as: Cost models; HR value models and monetary models. They proposed that human resource accounting models attempt to calculate the value that human assets contributed to the firm by capitalizing pay expenditures. A discounted cash flow of total pay is included in the asset section of the balance sheet rather than classifying it as an expense. Bontis et al. (1999) also point out the problem with human resource accounting model, 'All of the models suffer from subjectivity and uncertainty and lack reliability in that the measures can not be audited with any assurance.' It is for this reason that the idea of human resource accounting is not generally welcomed by accountants or financial analysts.

It is also not accepted due to immorally treating people as financial assets which actually people are not simply 'possession' of the firm.

A number of researchers have advised caution in measuring human capital. Leadbeater (2000) concluded measuring can 'result in cumbersome inventories which allow managers to manipulate perceptions of intangible values to the detriment of investors. Scarborough (2002) emphasized the process of measuring and the uses for the information gathered were more important than the specific set of measures or metrics organizations. Hartley and Robey (2005) stated that reporting on human capital is not simply about measurement. Measures on their own such as those resulting from benchmarking are not enough; the relevance of the measures is important. Donkin (2005) also commented on the attitude towards measuring as follows:

> It is not the measuring itself that is the key to successful HCM, but the intentions behind the measuring and the resulting practices that emerge. The effectiveness of these practices is heavily dependent on how they are perceived and understood by frontline employees and the kind of workplace behaviors they encourage. Measuring is not a good in itself. Adopted without any rationale it will achieve little. Its prime uses are to evaluate cost and to test the effectiveness of a strategy, pointing the way to further improvement.

However, there must be a way to evaluate the added value through people in the organization and this way involves the assessment of the value or contribution to help managers for decision making financially and from the point of HR practices. The aims are as what Mayo (1999) mentioned, to assess 'the value of future earnings opportunities'.

4.2.6 Classification of measures in Human Capital

According to Kearns (2005), there are basically three types of measures: 1) Activity measures: simply record the level of activity such as the number of training days per employee. There is no record related with the quality of the activity. 2) Performance measures: assess performance improvements in such terms as contribution, productivity and profitability. 3) Added value measures: assess the extent to which the measured value of the contribution of people exceeds the cost of generating it. ROI (return on investment) or return on capital employed measures can be broadly included.

Up to the record, added value measures are the most revealing followed by performance measures. Activity measures are easier to obtain but they do not give any further indication of the outcomes of the activity.

4.2.7 Analytical models for measuring HC

A number of the most commonly used analytical approaches for measuring human capital are reviewed with an assessment of their benefits and limitations.

4.2.7.1 Balanced scorecard

The "balanced scorecard" is a strategic management approach developed by Kaplan and Norton (1996). Kaplan and Norton described this approach as:

> The balanced scorecard retains traditional financial measures. But financial measures tell the story of past events, an adequate story for industrial age companies for which investments in long-term capabilities and customer relationships were not critical for success. These financial measures are inadequate, however, for guiding and evaluating the journey that information age companies must make to create future value through investment in

customers, suppliers, employees, processes, technology, and innovation.

The balanced scorecard identifies four perspectives from which to view an organization: financial perspective; customer perspective; internal business process perspective; learning and growth perspective. The model presents each perspective within a system representing multiple objectives as a basis for setting targets.

- Benefits and Limitations

The main benefit of the balanced scorecard is that it combines people issues with financial and other business considerations. It also provides a means to evaluate strategic planning and a vehicle for communication between graphic illustrations of performance for both internal and external audiences. Balanced scorecard allows goal alignment through the whole organization.

In case, the balanced scorecard becomes too functionally oriented, then too many measures and too many numbers will come into the picture and therefore, the effectiveness of the tool will be lost. Another main limitation of balanced scorecard is that it does not help the management in improving the important drivers that affect the success of a company. Balanced scorecard needs to be continuously reviewed by the companies. It should be updated regularly because the main drivers keep on changing. A static Balanced Scorecard will result in measuring the wrong things and therefore could cause to go down the wrong path.

4.2.7.2 The human capital monitor

Mayo (2001) has sought to identify the human value of the enterprise or 'human asset worth'. He comments that people should be viewed as assets rather than costs. The model focuses on three main areas: How an organization should recognize the intrinsic diversity in the worth of its people and value it; How to create a framework of people-related metrics as part of an

organization's overall performance; How to quantify both the financial and non-financial value to stakeholders.

The human capital monitor can be used to derive an overall quasi-financial measure of human asset worth which is calculated as employment cost multiplied by an individual asset multiplier (the weighted average assessment of capability, potential, contribution and stakeholder value) divided by 1000.

According to CIPD[20], this is a tailored approach where an absolute figure is not important. The process of measurement leads you to consider whether human capital is sufficient, increasing or decreasing and highlights issues to address. Mayo (2001) emphasizes that we have to be cautious by not using too many measures, instead, to focus on a few relevant enterprise-wide measures that are critical in creating shareholder value or achieving current and future organizational goals.

- Benefits and limitations

The major advantage of the human capital monitor is that it translated capability, contribution of individuals into a numerical value or 'a price tag' as mentioned by Baron and Armstrong (2007). Based on this advantage, the assessments of transferring this part of value into a price tag are still largely subjective, which limits the validity of the final value obtained. Also, this approach also neglects the accompanying actions or strategies to develop this worth.

4.2.7.3 The organizational performance model—Mercer HR Consulting

In the early 1990s, *Mercer HR Consulting* assembled a research group of labor/organizational economists and work psychologists to develop methods to measure the business impact of human capital practices in organizations.

[20] *Chartered Institute of Personnel and Development (CIPD)*, London.

The group started to conduct a review and assessment of documented empirical research on the workforce drivers of organizational productivity. The review included hundreds of studies in economic, psychology, communications and general management, covering more than 1,000 organizations. The work led to a model that explicitly linked HCM to organizational performance and, ultimately, shareholder value. (*Human Capital Reporting An Internal Perspective Mercer* 2005 : 17)

According to the model, a firm's human capital strategy consists of six interconnected factors:

1. *People* – who is in the organization; their skills and competencies on hiring; what skills and competences they develop through training and experience; their level of qualification; and the extent to which they apply firm-specific or generalized human capital;

2. *Work Process* – how work gets done; the degree of teamwork and interdependence among organizational units; and the role of technology;

3. *Managerial structure* – the degree of employee discretion, management direction and control; spans of control, performance management and work procedures;

4. *Information and knowledge* – how information is shared and exchanged among employees and with suppliers and customers through formal or informal means;

5. *Decision making* – how important decisions are made and who makes them; the degree of decentralization, participation and timeliness of decisions;

6. *Rewards* – how monetary and non-monetary incentives are used; how much pay is at risk; individual versus group rewards; current versus longer-term 'career rewards'.

Each of those factors plays a different role within the context of each organization, creating a unique corporate 'DNA'. There is no explicit human capital strategy since for many organizations these elements have been developed piecemeal. Human capital might not be optimized due to potential misalignment of various components of the model. This indicates that there are real opportunities for substantial improvement in returns. Identifying those opportunities requires disciplined measurement of human capital assets and management practices which affect their performance. (*Human Capital Reporting An Internal Perspective Mercer* 2005 : 18)

- Benefits and limitations

The organizational performance model analyzed all the factors which combine the impact by the contribution of people to business performance. Each organization can build their unique 'DNA' based on these factors and can emphasize their unique characteristics. Mercer's statistical tools, including Internal Labor Market Analysis (ILM) and Business Market Modeling, allow detailed review and identification of the unique drivers for a given organization (Nalbantian et al. 2004). Like most of the available models, results will be entirely dependent on the context in which the organizational performance model is applied by assuming certain level of information available. Many organizations would not yet be in a position to apply this model effectively. (Baron and Armstrong 2007: 73)

4.2.7.4 The Human Capital Index

The Human Capital Index is marketed by *Watson Wyatt Worldwide* who has constructed a survey of companies linking their key management practices to their market value. It is initially based on US research and then extended to Europe, the survey linked shareholder value creation with evidence of critical HR practices. The findings, presented in human capital index: human capital as a lead indicator of shareholder value (*Watson Wyatt Worldwide*

2002), concluded four major categories of HR practice could be linked to a 30 percent increase in shareholder value.The four critical practices are:

1. Clear rewards and accountability that differentiate between high and poor performers.

2. A collegial and flexible workplace environment encouraging teamwork and cooperation.

3. A commitment to hiring and retaining the best people and development of recruitment practices to support the firm's strategic aims.

4. A level of integrity in communication strategy where goals are clearly stated and business processes have a high level of transparency.

- Benefits and limitations

The model directly links the four categories concluded by the survey with a numerical percentage increase in shareholder value. This also means that better people management practices will result in a better business performance measured by market value and shareholder value. However, the methodology focuses more on a 'best practice' concept of value adding HR policies than 'best fit' approach applied in the models presented thereafter. The survey is based on great amount of correlations and aggregated data which does not provide the firm-specific context to assess a given organization's human capital. It is also criticized that it is not able to demonstrate that the practices lead to high performance or vice versa.

4.2.7.5 The engagement model

The application of the engagement model that has been most widely publicized relates to research at *Sears Roebuck* (Rucci et al., 1998) which focuses on the employee—customer—profit chain.

The essential theory of the engagement model is that if you can keep your employees satisfied, they will help ensure that your customers remain satisfied so that the customers in turn will ensure and improve your corporate profits. Therefore we can see this model indicates that high level of employee satisfaction will lead to a better customer service and with higher satisfaction of the customers, it will improve the corporate performance. It is so called 'engagement model' since this model interlinks pursuit of employee satisfaction and engagement with the concept of HR strategy and business alignment. Sear's demonstration of this chain has been replicated in the UK by a number of organizations, including the *Nationwide Building Society.*

Measuring and improving employee satisfaction for some companies, especially in the retailing and service sectors, has become an important basis of organizational improvement. Other organizations, such as *Standard Chartered Bank, Tesco* and *B&Q* (Matthewman 2003), have shown demonstrable links between employee morale and business metrics, particularly at the business unit performance level (including shrinkage, absenteeism, employee theft and customer profitability).

- Benefits and limitations

The engagement model is easy to understand, and it can be applied in any circumstances and slows organizations to assess their policies and practices in a more structured way. However, some factors associated with successful engagement are hard to influence in the short term so that measurement of human capital contribution is hindered by the time lag required for action to take place. (Baron and Armstrong 2007: 76).

4.2.7.6 People and performance model

The *Bath Research Team* (Purcell et al., 2002) developed the people and performance model, based on the assumption that, if a link exists between HR practices and measures of performance outcomes (as we know it does),

there must be certain propositions as to why it exists. Professor Purcell and his team of researchers at *Bath University School of Management* further explored and helped CIPD to unlock the 'black box' between people and performance to discover what kind of activities really make a difference, and how these can be stimulated and directed towards business performance. "There is also clear evidence of a link between positive attitudes within the company towards HR policies and practices, particularly from senior managers, and levels of satisfaction, motivation, commitment and, ultimately, operational performance." (Purcell et al., 2002).

This model is also referred to as the AMO model because it asserts that, for people to perform better, beyond the minimal requirements demanded of the job, they must have: 1) the ability to do so because they possess the necessary knowledge and skills, including how to work with other people; 2) be motivated to do the work and do it well; 3) be given the opportunity to deploy their skills both in the job and more broadly, contributing to work group and organizational success.

Overall, the research found that managing performance through people is about encouraging them to exhibit discretionary behavior, and that this is more likely to happen when people find their jobs stimulating and challenging, and when they feel motivated and committed to their employer. The role of HR is therefore in developing policies and practices that make work and the work environment more satisfying and motivating, or contribute to the AMO building blocks. (Baron, CIPD Report)

- Benefits and limitations

The people and performance model helped to unlock the 'black box' between people and performance to discover what sort of activities can make differences and how these can be stimulated and directed towards business performance. Even though there were loads of researches related with people and business performance, however there is still lack of real guidance for practitioners as to what practices would be likely to bring returns and

why. From the other lens, the people and performance model focused more on the relationship between employees and the organization but did not include 'client' as a factor which is also quite vital for the performance of the organizations.

4.2.7.7 The Newbury Index Rating (NIR)

"Organizations that fail to get best value out of their human capital will never realize the full value of their business", says Kearns (2005), co-founder of *The Newbury Index Ratin*g, which is based on viewing the organization from a number of perspectives with the aim of producing a measure that indicates how well the organization is managing to capitalize on the value of its people. NIR serves organizations based on three main purposes: 1) a solid foundation for exploring significant improvements in organizational value. 2) a diagnostic for specific actions that will improve your NIR. 3) a means for comparing how well you gain a competitive edge through effective people management.

NIR is the result of fourteen years of research and development. Paul Kearns set out with the clear aim of creating a common framework and universal set of indicators for revealing how well organizations manage their people based on the following questions:

1. Who is your dedicated HR strategist and does that person have a full seat at board level?

2. Can you demonstrate a value-added performance improvement from all of your employees over the past 12 months?

3. Does all your training expenditure produce an acceptable return on investment?

4. What methodology do you use to answer question 3?

5. Does your organization have a clearly defined and effective learning system in operation?

6. What is your projected added value (in monetary terms) from HCM practices over the next three years?

7. What methods do your employees use to improve the value you receive from your supply chain?

8. If you use a balanced scorecard, or similar management model, do you have a discrete measurement for 'people' measures? If so, provide examples.

9. Do you clearly distinguish between activity, performance and added value measures?

10. What system do you have in place to capture added-value ideas from employees?

- Benefits and limitations

The list of questions upon which rating is based is searching and comprehensive. Only organizations with very sophisticated measurement processes will be able to answer many of the questions. (Baron and Armstrong 2007: 77)

Chapter 5

Extension of Rao and Stevens (2007) Model

5.1 The Approach of Rao and Stevens (2007) Extending the 3-Model

We summarize very briefly regarding the extension model proposed by Rao and Stevens (2007). Then we will indicate why we did not follow this line of investigation.

Rao and Stevens (2007) first assumed four states of nature at $t = 1$, where the return on the priced risk factors have joint binomial probability distribution with joint probability matrix $P_{2\times 2}$. They denoted "o" and "p" for the optimistic and pessimistic states so as to obtain the formulations of the cash flow beta of asset, the returns beta of asset and the risk-neutral valuation (RNV) expression for asset. Later on Rao and Stevens (2007: 45-46) expanded their binominal probability distribution into a "joint s-nominal" so that they have the $s \times s$ states ($s > 2$) joint probability matrix $P_{s\times s}$. Under the assumption of such $s \times s$ states, the state cash flows and state returns on the priced risk factor can all be expressed in vectors so as to yield the

certainty-equivalent valuation expression (the $s \times s$ states) RNV.

The idea behind is to find the probability π_i and π_ϕ which are the state "o" risk-neutral probability for the asset i and state cash flows vector ϕ since such probability can be used to value asset i or state cash flows vector ϕ.

Since we can deal Rao and Stevens (2007) model with options (Chapter 2), we think the extension model could also be accomplished by the logic of options (in our case, the ROs) and this is also more coherent with the work we have done .

5.2 An Extension of CAPM

Another concern we have when extending the model of Rao and Stevens (2007) is whether this affects the use of CAPM; the answer has to be affirmative. In the literature of DCF approach, the role of *uncertainty information* is generally ignored and due to this, the study on real options is developed under the hypothesis of *complete information*. CAPM is formulated and applied from this hypothesis. Our own study of the extension of 3-Model will handle CAPM. However, implicitly we will go further on introducing the cost $Q(t)$ so as to carry out the modification of the portfolio. In order to go further than the study of traditional CAMP, we are inspired but not following the important pioneer Merton (1987).

Merton proposed an extension of CAPM, which is known as CAPMI and it allows him to obtain a discount rate for risk adjusted cash flows taking into account the incomplete information as we just mentioned. The mathematical formulation of CAPMI is as follows:

$$r_A = r + \beta_{A\cdot}(a_M - r) + \lambda_A - \beta_A \cdot \lambda_M \tag{5.1}$$

(if $\lambda_A = \lambda_M = 0$, we are in the case of CAPM), where

$r_A =$ expected return of asset A;

$\beta_A =$ beta of asset A;

$r =$ risk-free interest rate;

$a_M =$ expected return of market portfolio;

$\lambda_A =$ associated cost in obtaining the information referring to asset A;

$\lambda_M =$ average weighted cost associated in obtaining the information referring to assets in the market;

With the introduction of $Q(t)$ (see section 5.4), we are grouping the effects of the costs λ_A and λ_M [1]. Therefore, our level of analysis is relatively wider, and it seems not difficult for us (at least from a technical point of view) to generalize the model handling the $Q_A(t)$ and $Q_M(t)$; it means that we accept $Q(t) = f(Q_A(t), Q_M(t))$. This could be a continuation of our study.

5.3 One Fundamental Option: The Option of Modification

A firm has employees' and clients' portfolio. Therefore the firm possesses the property of the portfolio of realized products by the employees and protfolio of clients although the affirmation of such portfolio can be too excessive. In both cases, it turns out to be obvious that such property rights are not of the same nature; for example, those cases which acquire a building or a plot; in these cases, the rights of property are not given once and for all.

We talk about property of products or clients because it is allowed to operate on them; it means that a firm has options to intend to improve returns by driving up the motivations of employees, the fidelity of clients, the capture of talents, the information campaigns to clients and/or investors,

[1] For the objective to reflect the associated factors with employees and clients, we think it would be difficult to have a specific β.

etc. The introduction of Human Capital and Marketing metrics (see Chapter 4) will give information to the managerial board and such information (with corresponding cost) can help to evaluate the firm's options.

This way, we can affirm that the firm possesses the option of modification on stated portfolios. If a) we were in conditions to evaluate such options; b) also, we could find out the optimal moment to exercise; c) we were capable of transmitting to investors the value of those options added to the firm, then the opinion of investors regarding the firm's value can have potential improvements with respect to the current market value.

Based on these ideas, we will develop a model which handles both portfolios *jointly* (since the condition of only one portfolio would be a simple particular case) in the following section. Therefore the portfolio is synonymous with the one it combines. As we mentioned in Chapter 3 when we review the option literature, there exists models which allow to evaluate in the condition of unobservable underlying assets. At the beginning, we thought this was the type of models which was convenient for us to carry out the extension of Rao and Stevens (2007) model. However, later we realized that the information the firm possesses on clients and employees referred to the quality and efficiency, could be applied equivalently to the observance of the underlying assets. Although in this case it is a question of an observance of internal nature, instead of the external nature of the market (nevertheless, the firm in a competitive market has the external reference proceeding from the competitors).

Another obstacle for us is the evaluation of the option of modification, as we have presented earlier, in constrast to what happens to the ordinary models, based on our case it is not necessary to accept the hypothesis of liquidity of underlying assets. In conclusion, we must elaborate a model which accepts the observance but not liquidity of the underlying assets.

5.4 Proposed Model

Suppose that the current joint portfolio of products made by employees and orders of clients is generating a net cash flow of $CF_1(t)$ by unit of time, and after the modification (which means after the performances regarding the joint portfolio) will generate an expected net cash flow of $CF_2(t)$ by unit of time. We accept that the cost of carrying out the modification is symbolized by $Q(t)$ and it is measured in accordance with costs which increases the motivation of employees, fidelity of clients, etc. (as it has been indicated before).

We have to allow an evolution of $CF_1(t)$, $CF_2(t)$ and $Q(t)$ and agree with the most typical modelling of options. Also we suppose that this evolution is described by a geometric Brownian motion[2]; for $j = 1, 2$, we can see:

$$\begin{cases} d(CF_j) = & a_j \cdot CF_j \cdot dt + \sigma_j \cdot CF_j \cdot dZ_j \\ dQ = & a_0 \cdot Q \cdot dt + \sigma_0 \cdot Q \cdot dZ_0 \end{cases} \tag{5.2}$$

Where:

$a_0 =$ expected growth rate of cost Q;

$a_j =$ expected growth rate of cash flow CF_j, $j = 1, 2$;

$\sigma_0 =$ standard deviation of a_0;

$\sigma_j =$ standard deviation of a_j, $j = 1, 2$;

dZ_0 and $dZ_j =$ increases associated with the corresponding Wiener process, $j = 1, 2$.

[2]We allow the hypothesis of Brownian motion also because we confront the difficulty to find another different hypothesis plausible, and the obtained results can be applied as initial references which guides our study to be more precise with reality.

The market value of the firm will be $V_j(t)$, with:

$j = 1$, it remains the current political environment

$j = 2$, modify the joint portfolio

Therefore we can get:

$$V_2(t) = V_1(t) + \Delta V_1(t) = V_1(t) + \alpha(t) \tag{5.3}$$

According to the DCF methodology, we can have:

$$V_j = E_t \left[\int_t^{\infty} CF_j(u) \cdot e^{-r_j \cdot (u-t)} \cdot du \right] \tag{5.4}$$

Where:

$E_t =$ expected conditional information referred to CF_j from time t;

$r_j =$ compounded rate which reflects the risk associated with CF_j;

The solution of this expected formular measured by (4) is the same as follows (applying the "Geometric Progression Sum") :

$$V_j = \frac{CF_j(t)}{r_j - a_j} \tag{5.5}$$

Since the firm has the right to convert its portfolio at the moment considered to be profitable, the market value of the firm after the conversion would be minimum equal to $V_1(t)$. Consequently, it is logical for the firm to choose the moment $t = t_{opt}$ so that $V_2(t_{opt})$ is maximized.

Therefore we can formulate, with precision, the expected value of the firm in $t \leqslant t_{opt}$:

$$V = V(t) = V(CF_1(t),\, CF_2(t),\, Q(t)) =$$

$$= \underset{\{t_{opt}\}}{Max}\, E_t \left[\int_t^{t_{opt}} CF_1\,(u) \cdot e^{r_1 \cdot (u-t)} \cdot du + \left(\frac{CF_2(t_{opt})}{r_2 - a_2} - Q(t_{opt}) \right) \cdot e^{-r_3 \cdot (t_{opt} - t)} \right]$$

Where the first term inside the bracket is $V_1(t)$,the value of the firm till the date of modification; the second term represents the value of the firm at date t_{opt}, deducting the modification costs, adjusted to a discount rate of r_3. In consequence, we can write as:

$$V = V(t) = \underset{\{t_{opt}\}}{Max} \left\{ V_1(t) + E_t \left[\left(\frac{CF_2(t_{opt})}{r_2 - a_2} - Q(t_{opt}) \right) \cdot e^{-r_3 \cdot (t_{opt} - t)} \right] \right\} \tag{5.6}$$

Therefore we have to verify that $V(t) = V_1(t) + Value\, of\, the\, option\, of\, modification$. If we symbolize $C^*(t)$ as the value of the option and if it is exercised at t_{opt}, we can have:

$$V(t) = V_1(t) + C^*(t) \tag{5.7}$$

Comparing (5.6) and (5.7), we can deduce the value of $C^*(t)$ as:

$$C^*(t) = \underset{\{t_{opt}\}}{Max}\, E_t \left[\left(\frac{CF_2(t_{opt})}{r_2 - a_2} - \frac{CF_1(t_{opt})}{r_1 - a_1} - Q(t_{opt}) \right) \cdot e^{-r_4 \cdot (t_{opt} - t)} \right] \tag{5.8}$$

(see the meaning of r_4 later)

If we have:

$$B(t_{opt}) = \frac{CF_2(t_{opt})}{r_2 - a_2} - \frac{CF_1(t_{opt})}{r_1 - a_1} - Q(t_{opt})$$

Therefore we can have:

$$B(t_{opt}) = V_2(t_{opt}) - V_1(t_{opt}) - Q(t_{opt}) \tag{5.9}$$

This means that $B\left(t_{opt}\right)$ is the profit measured at t_{opt}, obtained by exercising the option at date t_{opt}. Consequently, $C^*(t)$ maximizes the profit $B\left(t_{opt}\right)$ discounting it from $t \geqslant t_{opt}$ by the appropriate discount rate r_4 :

$$C^*(t) = C^*(V_1,\, V_2,\, Q) \tag{5.10}$$

A mathematical problem of optimization is raised: how to maximize (5.8)? Which is to say, how to value the option of modification? From a mathematical abstract optics, the answer can be obtained quickly: applying the variation techniques in Dynamic Programming[3].

However, from the practice point of view, this answer can not be perfectly justified since it needs a correct specification of r_4 to implement. Consequently, the real problem does not consist of the mathematical application in (5.8), which means the problem we need to solve is not with mathematical nature but of financial nature: the determination of r_4.

This is the typical difficulty in Finance: how to determine the appropriate discount rate towards the situation we are studying? In order to overcome this difficulty, we are led to the option theory. Although the option theory is applicable due to our intention of the study, it is also necessary to bear in mind the logic it follows. First we might think of valuing $C^*(t)$ by formulating

[3]The three typical variation techniques are the Calculus of Variations, the Dynamic Programming of Bellman and the Optimal Control Theory of Pontryagin.

the typical financial options. Methodologically, such valuation rests on the argument of arbitrage without risk (which is based on the law of one price) and this demands the transaction liquidity on the underlying assets.

In our case, the underlying asset of the option is considered without liquidity. In consequence, we have to leave the idea of applying financial standard options but consider another type of options, Real Options (ROs). Actually it is typical in the ROs literature to accept that the uncertainty of variables applied reflects the uncertainty of the underlying assets which can be replicated by a special traded assets, the *spanning assets*[4], which loosens up the assumptions that arbitrage pricing requires[5]. We start from this idea and also accept that investors form the price of assets in accordance with CAPM, although they are ready to incorporate this model with information costs regarding the option of modification.

Formular (5.5) indicates us that the value of $V_1(t)$ and $V_2(t)$ are expressed by the same algebraic structure. Moreover, since the cash flows associated with $V_1(t)$ and $V_2(t)$ come from the same firm, we believe that as a point to start our analysis, we can accept that two groups of cash flows follow the same stochastic process. If this stochastic process verifies the Ito's lemma generalized for the three state variables Q, V_1, V_2, we can modelize the instantaneously change of $C^*(t)$ as:

$$dC^* = [\left(a_0 \cdot Q \cdot \frac{\partial C^*}{\partial Q} + a_1 \cdot V_1 \cdot \frac{\partial C^*}{\partial V_1} + a_2 \cdot V_2 \cdot \frac{\partial C^*}{\partial V_2}\right) +$$

$$+ \left(\frac{1}{2}\sigma_0^2 \cdot Q^2 \cdot \frac{\partial^2 C^*}{\partial Q^2} + \frac{1}{2} \cdot \sigma_1^2 \cdot V_1^2 \cdot \frac{\partial^2 C^*}{\partial V_1^2} + \frac{1}{2}\sigma_2^2 \cdot V_2^2 \cdot \frac{\partial^2 C^*}{\partial V_2^2}\right) +$$

[4]See Chapter 4.

[5]See, for example, McDonald and Siegel (1985); Pindyck (1991).

$$+(\sigma_0\sigma_1\rho_{0,1}\cdot Q\cdot V_1\cdot\frac{\partial^2 C^*}{\partial Q\cdot\partial V_1}+\sigma_0\sigma_2\rho_{0,2}\cdot Q\cdot V_2\cdot\frac{\partial^2 C^*}{\partial Q\cdot\partial V_2}+\sigma_1\sigma_2\rho_{1,2}\cdot V_1\cdot V_2\cdot\frac{\partial^2 C^*}{\partial V_1\cdot\partial V_2})]\cdot dt+$$

$$+\sigma_0\cdot Q\cdot\frac{\partial C^*}{\partial Q}\cdot dZ_0+\sigma_1\cdot V_1\cdot\frac{\partial C^*}{\partial V_1}\cdot dZ_1+\sigma_2\cdot V_2\cdot\frac{\partial C^*}{\partial V_2}\cdot dZ_2 \qquad (5.11)$$

Since the return obtained through option only comes from the capital gain, if we symbolize this return by $C^*(t)$ for unit of time measured by a_{c^*} , we can have:

$$a_{c^*}=E\left[\frac{dC^*}{C^*\cdot dt}\right] \qquad (5.12)$$

where dC^* will be given by (5.11) .

In accordance with CAPM we are handling, the return a_{c^*} has to satisfy the following equation (McDonald and Siegel, 1985):

$$d_0\cdot Q\cdot\frac{\partial C^*}{\partial Q}+d_1\cdot V_1\cdot\frac{\partial C^*}{\partial V_1}+d_2\cdot V_2\cdot\frac{\partial C^*}{\partial V_2}+$$

$$+\frac{1}{2}\sigma_0^2\cdot Q^2\cdot\frac{\partial^2 C^*}{\partial Q^2}+\frac{1}{2}\sigma_1^2\cdot V_1^2\cdot\frac{\partial^2 C^*}{\partial V_1^2}+\frac{1}{2}\sigma_2^2\cdot V_2^2\cdot\frac{\partial^2 C^*}{\partial V_2^2}+$$

$$+\sigma_0\sigma_1\rho_{0,1}\cdot Q\cdot V_1\cdot\frac{\partial^2 C^*}{\partial Q\cdot\partial V_1}+\sigma_0\sigma_2\rho_{0,2}\cdot Q\cdot V_2\cdot\frac{\partial^2 C^*}{\partial Q\cdot\partial V_2}+$$

$$+\sigma_1\sigma_2\rho_{1,2}\cdot V_1\cdot V_2\cdot\frac{\partial^2 C^*}{\partial V_1\cdot\partial V_2}-r\cdot C^*=0 \qquad (5.13)$$

Where:

$$d_k=a_k-\frac{\sigma_K}{\sigma_M}\cdot\rho_{k,M}\cdot(a_M-r),\ k=0,\,1,\,2 \qquad (5.14)$$

$r =$ risk-free interest rate;

$a_M =$ expected return on the market portfolio;

$\sigma_M =$ standard deviation of the return on the market portfolio;

$\rho_{k,M} =$ correlation coefficients between the return on the market portfolio and $\begin{cases} k = 0, & \frac{dQ}{Q} \\ k = 1, & \frac{\partial V_1}{V_1} \\ k = 2, & \frac{\partial V_2}{V_2} \end{cases}$

In order to simplify, we suppose those functions which express our three state variables reflect that the cost of the modification (options) realized in the portfolio is null[6] like McDonald and Siegel (1985) mentioned.

Although this hypothesis is lack of managerial realism, it turns out to be useful since it allows us to be familar with the problem we are investigating and also it provides one advantage recognized by boundary conditions. Particularly, C^* is always close to 0 under at least one of the following conditions: Q is very big; V_1 is very big; V_2 is very small or equals to 0. Therefore, we can have:

$$\frac{V_1}{V_2} \to \infty \; or \; \frac{Q}{V_2} \to \infty$$

With what we have achieved so far, we have $C^*(V_1, V_2, Q) = 0$, which constitutes a boundary condition. The other two boundary conditions are:

$$C^*(V_1, V_2, Q = 0) = C^*(V_1, V_2)$$

[6]In this condition, it is known in mathematics that the state variables are absorbing at zero.

$$C^*(V_1 = 0,\, V_2,\, Q) = C^*(V_2,\, Q)$$

Formular (5.11) with those three boundary conditions prepared for the problem so that we can apply the techniques provided by the theory of *Partial Differential Equations (PDE)*, which is highly developed for one or two variables[7]. In order to unify the mathematical process, instead of handling the last two conditions it would be useful to introduce two new variables:

$$X_{02} = \frac{Q}{V_2},\ X_{12} = \frac{V_1}{V_2} \tag{5.15}$$

Therefore the expression of $C^*(V_1,\, V_2,\, Q)$ can be written as the following formulars[8]:

$$C^*(V_1,\, V_2,\, Q) = V_2 \cdot C^*(\frac{V_1}{V_2},\, \frac{V_2}{V_2},\, \frac{Q}{V_2}) \Rightarrow$$
$$C^*(V_1,\, V_2,\, Q) = V_2 \cdot C^*(X_{02},\, X_{12}) \tag{5.16}$$

The PDE of (5.13) will be transformed as following indicated (C^* depends on (5.15)):

$$(d_2 - r) \cdot C^* + (d_1 - d_2) \cdot X_{12} \cdot \frac{\partial C^*}{\partial X_{12}} + (d_0 - d_1) \cdot X_{02} \cdot \frac{\partial C^*}{\partial X_{02}} +$$

$$+(\frac{1}{2}\sigma_1^2 + \frac{1}{2}\sigma_2^2 - \rho_{1,2} \cdot \sigma_1 \cdot \sigma_2) \cdot X_{12}^2 \cdot \frac{\partial^2 C^*}{\partial X_{12}^2} + (\frac{1}{2}\sigma_0^2 + \frac{1}{2}\sigma_2^2 - \rho_{0,2} \cdot \sigma_0 \cdot \sigma_2) \cdot X_{02}^2 \cdot \frac{\partial^2 C^*}{\partial X_{02}^2} +$$

$$+(\sigma_2^2 + \rho_{0,1} \cdot \sigma_0 \cdot \sigma_1 - \rho_{0,2} \cdot \sigma_0 \cdot \sigma_2 - \rho_{1,2} \cdot \sigma_1 \cdot \sigma_2) \cdot X_{02} \cdot X_{12} \cdot \frac{\partial^2 C^*}{\partial X_{02} \cdot \partial X_{12}} = 0 \tag{5.17}$$

[7] See, for example, Kythe, Puri and Schäferkotter (2003); Ockendon, Howison, Lacey and Movchan (2006).

[8] In formular (5.16) , $C^*(X_{02},\, X_{12})$ should be written, in fact, as $C^{**}(X_{02},\, X_{12})$ since the functional relationship with respect to those variables (5.15) changes. However, in the field of PDE, it is habitual to understand this change and not introduce a new symbol.

With respect to the boundary conditions associated with (5.17), we can have:

$$\begin{cases} C^*(X_{02},\, X_{12})\, when\, X_{02} \to \infty,\, X_{12} \to \infty, & \to 0 \\ C^*(X_{02},\, 0) = & C^*(X_{02}) \\ C^*(0,\, X_{12}) = & C^*(X_{12}) \end{cases} \tag{5.18}$$

The last two boundary conditions allow us to achieve a closed form solution to this type of problems, which we can find in the work of McDonald and Siegel (1986). One last comment of the model is: what happens when only one of the variables (5.15) is null? We have to further look at those two cases as follows:

a) $X_{02} = 0 \;\Rightarrow \frac{Q}{V_2} = 0 \;\Rightarrow Q = 0$ (not really realistic in the sense of economics). Therefore (5.17) can be written as:

$$(d_2 - r)\cdot C^* + (d_1 - d_2)\cdot X_{12}\cdot \frac{\partial C^*}{\partial X_{12}} + \left(\frac{1}{2}\sigma_1^2 + \frac{1}{2}\sigma_2^2 - \rho_{1,2}\cdot\sigma_1\cdot\sigma_2\right)\cdot X_{12}^2\cdot\frac{\partial^2 C^*}{\partial X_{12}^2} = 0$$

The partial derivatives are converted into ordinary derivatives, which will be an ODE of the second order: the type of equation is applying the classical variables x, y.

$$A_0\cdot x^2\cdot y'' + A_1\cdot x\cdot y' + A_2\cdot y = 0$$

This is a Cauchy-Euler Differential Equation, which can be solved by the theory of ODE.

b) $X_{12} = 0 \Rightarrow \frac{V_1}{V_2} = 0 \Rightarrow V_1 = 0$ (It corresponds to the case that the firm interferes in the financial market, hypothetically, incorporating the option of modification from the first moment). Therefore (5.17) can be converted into:

$$(d_2-r)\cdot C^*+(d_0-d_2)\cdot X_{02}\cdot\frac{\partial C^*}{\partial X_{02}}+\left(\frac{1}{2}\sigma_0^2+\frac{1}{2}\sigma_2^2-\rho_{0,2}\cdot\sigma_0\cdot\sigma_2\right)\cdot X_{02}^2\cdot\frac{\partial^2 C^*}{\partial X_{02}^2}=0$$

We would make the same comments for this expression as what we have done in case a).

5.5 The Optimal Moment to Exercise

Under the hypothesis of rationality, the firm delays the exercise of the option of modification when market value of the firm is bigger than the market value in case of an immediate exercise. This means that the option will be exercised at the moment that both values match. If, when we reach this moment (t_{opt}), we can symbolize *all* the variables by adding "$*$", so that we have (see (5.9)):

$$\begin{cases} C^*(V_1^*,\, V_2^*,\, Q^*) = & V_2^*-V_1^*-Q^* \\ \left(\frac{\partial C^*}{\partial Q}\right)^* = \frac{\partial\left(V_2^*-V_1^*-Q^*\right)}{\partial Q}\,|_{Q=Q^*}= & -1 \\ \left(\frac{\partial C^*}{\partial V_1}\right)^* = \frac{\partial\left(V_2^*-V_1^*-Q^*\right)}{\partial V_1}\,|_{V_1=V_1^*}= & -1 \\ \left(\frac{\partial C^*}{\partial V_2}\right)^* = \frac{\partial\left(V_2^*-V_1^*-Q^*\right)}{\partial V_2}\,|_{V_2=V_2^*}= & 1 \end{cases} \tag{5.19}$$

If as indicated in (5.15), we work with the variables X_{02} and X_{12}, then (5.19) will take the following form (which contains no boundary conditions):

$$\begin{cases} C^*(X_{02}^*,\, X_{12}^*) = & 1-X_{02}^*-X_{12}^* \\ \left(\frac{\partial C^*}{\partial X_{02}}\right)^* = & -1 \\ \left(\frac{\partial C^*}{\partial X_{12}}\right)^* = & -1 \end{cases} \tag{5.20}$$

Since the question is raised, the formulated free boundary problem (5.17) and (5.20) is lack of a closed form solution (or at least the theory of PDE hasn't found out the solution). Therefore the problem must be solved by numerical methods, more specifically, the *finite elements method* allows us to find the numerical solution[9].

5.6 The Extended Rao and Stevens (2007) Model

In the section 1.5, we suggest that the market value of a firm, modelled according to the framework of M&M, could be increased by the amount α (see formula (1.10) and (1.11)) due to the utilization of policies of loyalty and capture applied to a set of employees and/or customers, which increase the satisfaction of these stakeholders. Section 5.4, see formula (5.7), can lead us to the following equation which we have $t = t_{opt}$:

$$V^*(t_{opt}) = V_1(t_{opt}) + C^*(t_{opt})$$

Where $V_1(t_{opt}) = V(t_{opt})$ is firm's value in the case of not applying those policies mentioned above; this means that $V_1(t_{opt})$ is the firm's market value at t_{opt} only taking into account those stakeholders studied in the Rao and Stevens (2007) 3-Model.

The problem of *objective function* (see formula (5.19)) and *boundary conditions* (see formula (5.20)) provides us $C^*(t_{opt})$ which is the value of the option of modification when exercised at the optimal moment. In consequence, we could accept that:

$$C^*(t_{opt}) = \alpha(t_{opt}) \tag{5.21}$$

[9]See Duffy (2006); Topper (2005).

Therefore, the amount α which was introduced in the section 1.5 would be:

$$\alpha = \alpha(t_{opt}) \tag{5.22}$$

According to what was stated in the subsection 1.2.1, we could write:

$$V_1(t) = \sum_{t=1}^{t_{opt}} \frac{FCF_t}{(1+WACC)^t} \tag{5.23}$$

$$WACC = K_E \cdot \frac{E}{D+E} + K_D \cdot (1-\tau) \cdot \frac{D}{D+E} \tag{5.24}$$

All this allows us to write:

$$V^*(t_{opt}) = \sum_{t=1}^{t_{opt}} \frac{FCF_t}{(1+WACC)^t} + C^*(t_{opt}) \tag{5.25}$$

The expression (5.25) raised us two problems: 1) To obtain a measurement of cash flows which are not the traditional FCF_t (we symbolize as FCF_t^*) and those not taking into account of flows associated with the option of modification as well as the stochasticity. 2) To find the expression for WACC which correspondes to such cash flows which we can represent as $WACC^*$. Therefore we could have:

$$V^*(t_{opt}) = \sum_{t=1}^{t_{opt}} \frac{FCF_t^*}{(1+WACC^*)^t} \tag{5.26}$$

Since (5.26) would capture its own stochasticity of the option of modification, the solution to those two problems aforementioned turns out to be very difficult. In any case, we have not been capable of advancing in finding the soluion which is another challenge for this work.

A final observation shed light on the section 2.2, the hypothesis **H3** is introduced and based on the Rao and Stevens (2007) 3-model. We can further see what Rao and Stevens (2007: 60-61) stated:

> The need to extend the model analytically to a multi-period setting and to admit dynamic features of the tax code is clear. However, this is a formidable task.

We think that part of this "formidable task" has been solved by the introduction of our option of modification, which manages a whole period equally distributed between $t = 0$ and t_{opt} . However, there still remains many unresolved issues as indicated by Rao and Stevens (2007: 61):

> The researcher attempting this generalization must model the firm's borrowing interest rate in a multi-period world wherein the coupon rate will be determined endogenously by dynamic features of the tax code.

We think that some of the difficulties raised by Rao and Stevens (2007), for example the model of firm's borrowing interest rate, can be solved using the ROs and basing on the results provided by the theory of exotic options.

Conclusion

I. Retrospectives

- Chapter 1
  - The literature review related to valuation models especially the DCF model, allows us to conclude that the conceptual frame of Modigliani and Miller, to determine the market value of a firm as it is understood today, is too restricted because only three types of stakeholders (shareholders, debtholders and goverment) are considered (the role of the last one was not deeply analyzed till now).
  - Consequently, we need to dig more deeply in the study of the role of government as well as the possible influence of other stakeholders on the market value of the firm.
  - The search of a study regarding the role of the government in the literature has led us to the work of Rao and Stevens (2007) which provides a complete view of the aforementioned issue based on our judgement.
  - To consider the influence of other stakeholders on the market value of a firm has led us to propose a rough scheme of a more general valuation model (Chapter 5).

- Chapter 2
  - The carried out study in Rao and Stevens (2007) requires a better level of explanatory detail. Therefore it would be better to explain through graphs which could represent clearly the effect of those three types of stakeholders aforementioned.
  - Through the visualization of those graphs which could show us better in details, we can conclude that the application of financial options methodology allows us to interpret completely the results of the model.
  - The corresponding valuation, in some cases, is based on the intrinsic value of a call and in other cases, is based on the formulation of the value of a warrant (both of European type).
- Chapter 3
  - The application of financial options theory does not only have the character of simple (although satisfactory), formal use of a few mathematical expressions, but also such theory is conceptually adapted to the field of Corporate Finance which is inside the frame where the model of Rao and Stevens (2007) was developed.
  - Financial options theory does not result to be sufficient in order to tackle the extension of the model which can be seen as a reference that does not include other stakeholders different from shareholders, debtholders and the government: such other stakeholders are employees and clients which stay excessively away from the hypotheses which the aforementioned theory is based.
  - The literature review on the Real Options (ROs) theory suggests us certain types of ROs might be used to evaluate the value creation which would take place in case of loyalty and capture policies for both employees and clients.

- Chapter 4
  - In order to evaluate the value creation produced by having applied the loyalty and capture policies for both employees and clients, the literature has been revised regarding the metrics used in the managerial practice and we can summarize that the majority of the mentioned metrics have a partial character, and they are exclusively empirical but not directly oriented from capturing value creation. Even metrics based on DCF are very scarce and poorly convincing.
  - The application of ROs theory, in the managerial practice relative to two new groups of stakeholders, is practically non-existent.
  - In the academic literature, there are some attempts to reflect on the convenience of adopting the ROs theory but very few works result in the proposition of a model: the very few models which have been proposed give us the impression that they are more concerned with using the formulations rather than justifing its application. We can affirm that there is still lack of an authentic conceptual framework underpinning the application of the aforementioned theory from the viewpoint of all types of stakeholders (there is a related study newly published in 2009 in the field of marketing as noted in the *Introductio*n). From another way to explain, the application of ROs theory imposes a new angle to look at things. For such a reason, we quoted the saying of Proust, who indicated us to see things from new lens rather than the way we are used to.

- Chapter 5
  - We conclude that the generalization of Rao and Stevens' (2007) own model has a simple character without specifying what would

be the new "state variables" and without reconsidering whether such a generalization breaks the mold of CAPM.

- The evaluation of value creation through loyalty and capture policies of employees and clients shows that we could go beyond the CAPM framework. We do not tackle the creation of a new framework but being inspired by the study of Merton's CAPMI and the work of Bellalah, we think that, in spite of being supported by CAPM, it would be interesting to introduce information costs so as to evaluate the cost of the loyalty and capture policies as mentioned before.
- We propose one valuation model, "the option of modification", meaning that those rights associated with the option are owned by the firm to proceed on the "portfolio" of employees and "portfolio" of clients. We have to bear in mind that the word "portfolio" is used in an excessive way since the ownship does not concede equal rights such as real estate property, for example. In the model, the aforementioned information costs are introduced.
- The valuation of the option through the proposed model is used to estimate increased value of the firm accepting hypothetically that a major degree of loyalty and capture corresponde to the increased value.
- To convert this increased value into an increase of the firm's market value, it is necessary to develop a sufficient communication policy so that investors could judge first and decide afterwards if they have recognized such an increase.
- The proposed model also allows the application for only one of the two new groups of stakeholders. In particular, referring to employees, although we do not develop the issue, we would have a criterion to adjust remunerations of different types according to

the value created and risk incorporated.

– The model adopts a more general scheme, which is introduced in Chapter 1, to complete its formulation applying the option of modification valuation.

II. Future Research

Desde aquí veo un camino que no sé a dónde lleva; es por tal motivo que deseo recorrerlo. (Rosalía de Castro)

- In the model of Rao and Stevens (2007), the authors admit that there was no retention of profits on the part of the firm so as to simplify the model. An extension study would be to incorporate the possibility of rentention of profits. Then, it should be further investigated whether such an incorporation affects the valuation model we proposed.

- In section 2.2, it is indicated (**H11**) that in this study we do not consider neither inflation or deflation during the lifetime of the project. These factors can be introduced into the future research.

- In section 2.2, **H2** indicated that there is no bankruptcy cost. A further study should be carried out (like 3-model and the extended 3-model) abandoning such hypothesis.

- To study the situation in which the qualitative changes which lead to policy decisions on employees and customers originate two different stochastic processes, with certain degree of correlation between them (probably strong and positive). Thus, it would surpass the hypothesis of a single stochastic process, which we used to model the proposed option of modification.

- Section 4.1.3 indicated the Non-DCF and Non-Option marketing metrics. Future research could deepen conceptually in the Retention Rate, Churn Rate, Dashboards Approach, Customer Equity Approach and RAVE with the objective intending to express them in terms of DCF and then engaging the ROs logic.

- A simplifying condition which has been applied in this model is that, mathematically speaking, zero absorption state variables, or in economic terms, decisions at zero cost. This condition is not very realistic (although relevant researchers have used elsewhere) because any decision by nature could be considered as a significant cost. Therefore, the model should be improved by abandoning the condition including a non-zero cost absorption. This poses a barrier option (with non-zero cost absorption).

- In the model of option of modification, the function of information costs, $Q(t)$. Therefore, a most detailed study of the function from the cost components point of view, would result in a model of option of modification more interesting than the one we have raised.

- Based on Merton's CAPMI, the work of Bellalah (2009: 550 - 583) includes a chapter entitled "Extended Discounted Cash Flows Techniques and Real Options Analysis within Information", containing information costs and the subsequent reformulation of the WACC. This study raises the possibility of conducting an investigation to compare the model proposed by Bellalah with the one we presented (the option of modification).

- Chapter *5* proposed to search the measures of FCF_t^* and $WACC^*$ which incorporate cash flows and the stochasticity associated with the options of modification. We would like to study in the future the problem raised but we need more solid steps for this direction.

- Chapter *5* also suggested the possibility of one ROs based on the exotic option theory. Specifically we refer to this expansion of 3-model with our extension to incorporate one stochastic process which represents the dynamics of the firm's borrowing interest rate in the long run.
- In the same line of study, it is interesting to try to reformulate the EVA methodology so as to include information costs.
- The reformulated EVA perhaps could be associated with both the model of Bellalah and the one we proposed.

We propose here an outline of the empirical research:

1. Select a set of big Chinese firms which are listed in the international markets.
2. Select a time period common for all the firms chosen according to certain criteria.
3. Establish the corresponding time series of market value for each firm (e.g. weekly data which corresponds a certain day of the week for all the firms).
4. For every weekly selected day and firm, apply the formula of 3-model (with options) for the corresponding estimated value.
5. For each firm, form the time series of the difference between the value obtained in 3 and 4.
6. Study the last time series. If the value difference are systematically small, we could conclude that:
   (a) The 3-model is a good estimator for market value.

(b) There is no recognition by the market for possible policies of loyalty and capture of other stakeholders than those included in the 3-model.

Instead, if value difference of the time series has relatively large quantities, a qualitative study will have to be tackled. This study should naturally follow certain model of investigation. Due to certain recent work (Wong Lip Soon, 2002), the study could follow the inductive model proposed by Creswell (1994) as follows:

(a) Researcher gathers information.

(b) Researcher asks questions.

(c) Researcher forms categories.

(d) Researcher looks for patterns (theories).

(e) Researcher develops a theory or compares patterns with other theories.

After obtaining the result from this inductive process, we will reach a quantitative stage. This way our model of option of modification can be contrasted. Such contrast can lead new way for the research.

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