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Real option analysis for assessing SMEs' entry modes: an illustrative case study

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To Irene, Anna and Mariano,

who offered me growth options and hope

ACKNOWLEDGMENTS

When I first went to my advisor's office I was looking for the possibility to deepen quantitative approaches in management studies: after two years of International Management courses I was convinced that more mathematical and statistical tools were still needed in my graduate education. After revising some literature about decision making processes I realized that the field of studies related to the application of quantitative methods and models on internationalization strategies was very large and diversified. More important, it represented a way to combine my management background with the solidity of numbers and data, which are fundamental in any kind of decision. This is the ratio that brought me to conduct this research. SMEs became later the focus of the analysis, as I have always been fascinated by the role they cover in the economy, in terms of employment contribution and innovativeness. Therefore, I owe a big thanks to my academic advisor.

Before starting I cannot miss to mention who was on my side during this path, started almost five years ago and finding with this paper its endpoint. First of all, my family which supported me anytime and allowed me to achieve important goals, never providing solutions but always showing means and demonstrating love. In this journey some relatives also gave a contribution, my gratitude goes to them for their commitment and for always being part of my life. My colleagues of both the undergraduate and master's degree for sharing with me an incredible adventure, trying to constantly capture insights from classes but never missing to have fun. We built a network I consider really valuable and that hopefully is going to remain strong even in the future. Finally, friends are too many to be mentioned individually: a particular thought goes to those who made me feel at home when I was not and another to those I could always rely on. Thanks also to those living abroad who made my exchange programs probably the best periods of my life.
Decisions are crucial in everybody's life and they are even more difficult when uncertainty and globalization consequences affect our lives. Here lies the challenge I deeply feel in my life and the type of firms I analyzed face in different terms and sizes: keep the tradition, grow in the international market, accept the way the world is changing.

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Mattia Zanella

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Introduction

Foreign market entry modes choices have been a widely discussed issue in the last decades because of its relevance in the international field. Globalization has increased the interest of both theorists and practitioners on internationalization processes, and managerial best practices and techniques are becoming more and more important over time. While large and well-established corporation can rely on talented management and wide resources, small firms face huge constraints which force them to be as effective as possible in the roads they take.

The main challenge for SMEs is not just how to enter the market once the possibility shows up: literature and real world data tell us that generally organizations tend to react by sending over the borders some export reducing as much as possible risks coming from these transactions. The real challenge is making an international investment, when time comes they struggle. How to do that? When is it worth? Which one among the available investments is better? Differently from big companies, SMEs build an internal export department only when the turnover generated by foreign clients is important, and approach direct investment only when the foreign market is likely to become as important as the domestic one. Therefore, the decision making process and the supportive managerial techniques are crucial: when applied correctly, they can provide useful information on future expected performance and provide suggestions about how to work with variables in order to increase revenues. Of course, every quantitative tool relies on some assumptions which always contain a marginal error. However, having some information is always better than not to have them at all.

In chapter one frameworks, models and data about the internationalization process of SMEs are provided; entry barriers, motivations, sources of uncertainty and drivers found in modern literature are also explained and discussed. Then, entry mode choices are presented and the upgrading path that growing companies tend to pursue is described.

Chapter two gives a brief outline of the decision making process followed by managers and explains it specifically in relation to strategic investment decision. After that, quantitative tools for decision making are presented: traditional ones, discounted and non-discounted methods as well. The chapter ends telling the pros and cons of these techniques: a particular focus is given to the need of flexibility that the assessment of strategic investments requires.

Chapter three starts describing decision trees, their structure, versions and limitations. Later, the real option theory is introduced: their logic, the differences between financial and real options, and

the MAD to their valuation. Then, the types of real options are listed before focusing on the growth option which deserved a wider explanation as it represents a key element of this research.

Chapter four links real option analysis to the market entry mode choice and present the case of a north-east Italian SME. Along the study four techniques are applied with a comparative perspective. It will be clear along the pages of this research that the uncertain environment inside which SMEs operate provide them valuable opportunities as well as obstacles, so that managers must take responsibility to change plans along the way even when this means to change partially the strategy. This is the reasoning understanding the investments addressed into foreign markets which are often huge, strategical and risky. When a SME enters a new foreign market it is hard to know how related activities will evolve in the future and if it will be possible, one day, to upgrade, by creating partnerships or locating a new plant in the host country. The aim of the research is to illustrate how different quantitative tools can catch, or not, the value of new opportunities available in post-entry stages of the internationalization process; moreover, it is argued that the growth option is the more appropriate tool in capturing the value of the upgrading path as it unlocks future worth opportunities.

Chapter 1

The internationalization process of SMEs

1.1 Roles and functions of SMEs in the market

Small and medium-sized enterprises (SMEs) represent today the major source of dynamism and innovation of our economy, they have been acquiring relevance and interest for the key role covered in the process of regional, national and global development (OECD 2009).

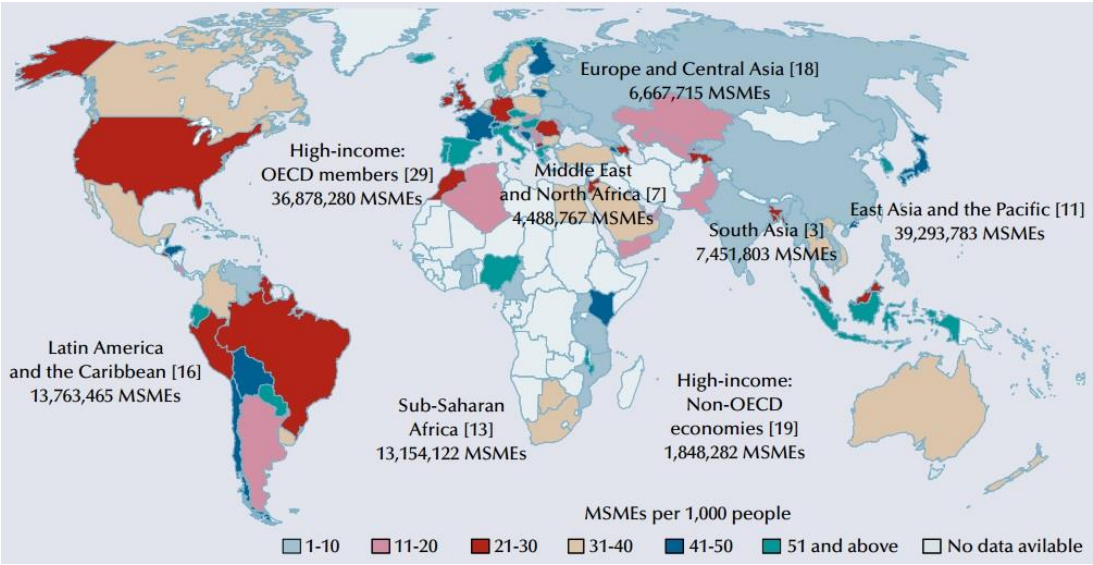
European Commission defines SMEs all those organizations with a staff headcount between 10 and 250, with a turnover between 2 and 50 million and a total balance sheet between 2 and 43 million. Specifically, firms under 50 employees and with a turnover and balance sheet under 10 million are considered small, above these thresholds they are considered medium (User Guide, EU 2015).

SMEs are categorized by size and they represent on one hand the evolution of a micro firm, and, on the other hand, the step before a large well-established company. According to the portal *GROWTH* of the European Commission SMEs constitute the 99 per cent of all businesses in Europe, while OECD, in the page dedicated to SMEs and Entrepreneurship, states that they represent the 95 per cent of the enterprises. These data suggest some considerations. First, SMEs generate the larger part of new jobs in the labor market, 80 per cent in Europe and between 60-70 per cent in the world (European Commission 2012). Further studies specify that in low-income countries the percentage of jobs generated by SMEs is 78 while it counts just for the 66 per cent in high-income countries (Ayyagari et al. 2011). A more accurate analysis would add that job creation is usually proportional to the size of the firm: enterprises changing class size (micro, small and medium) over time due to growth or downsizing can provoke both employment creation and destruction at economic-wide level and sector level (Annual Report on European SMEs 2014-2015). Second, they produce a huge part of national GDP, the average contribution is around 55 per cent (OECD 2009), varying from a 16 per cent in low-income countries to a 52-53 per cent in middle and high income countries (Edinburgh Group 2012). In US, for instance, that percentage goes up to 65. Third, their relevance pushes governments to build programs and strategies appositely designed for them: in countries like Germany, Iceland, Japan and New Zealand the 50 per cent of public industry programs are addressed to SMEs (Edinburgh Group 2012).

The Annual Report on European SMEs, for the year 2014-2015, argues (pg. 9) that this category of firms contributes in terms of value added (58 per cent) principally in the non-financial business sector. The report refers to all sectors of the economy (except financial services, public services, education, arts, culture, agriculture, forestry and fishing) where SMEs represent the 98 per cent of the total number of firms and create the 67 per cent of the total employment.

A study made in 2010 (Kushnir et al.) about micro small and medium enterprises (MSME) gave a broad overview on the worldwide presence of this category of firms (see figure 1). According to this research the average density of SMEs in high-income countries (well monitored by OECD) is very high, the density is still huge in the Latin American and Caribbean region, followed by Middle East and by Europe later on. Another interesting information from this collection of indicators (Kushnir et al. 2010) is that the growth rate of MSME, in the decade 2000-2009, has been three times higher in low-income economies in respect to high-income economies. According to the authors, this phenomenon finds explanation through the economic boom that emerging economies have experienced in that decade: this was due to the entry in EU for some countries of the East of the continent, to the implementation of economic agreements for other Latin American countries as well as to general paths of development previously undertaken. Considering these data, it seems that developing countries are characterized by some elements fostering SMEs development even more than developed ones.

Figure 1: Worldwide distribution of SMEs



Source: Kushnir et al. (2010)

Surely, the role of SMEs in employment generation and GDP contribution explains the reason why this category of firms has been under the lens of many theorists in the recent past. Areas of interest included taxation and regulations, roads for accessing financing. However, these peculiarities were already known and understood at the end of the last century and find today consolidation in the current macroeconomic scenario. Therefore, what makes SMEs crucial nowadays is something that does not belong to political economy analysis but is mainly associated with market dynamism and innovation, at both firm and industry level. This new frontier has been recognized also by the European Union which created the pioneer program Horizon 2020 with the intention to *"spread out innovation and pursue participation"* and to make the Europe of the future a builder of technologies and scientific knowledge by *"combining research and innovation"* (Commissione Europea 2014, pag. 5).

In many fields, SMEs have a key role in developing and exploiting new technologies which will play a major role in the generation of new sectors and revitalize the future innovations of the economy (Vaugelers 2008). The majority of the studies on innovation embedded in SMEs regards the entrepreneurial traits since generally both radical and incremental innovations find their origins in large firms, usually more R&D intensive. Large firms tend to have more access to talent and use to have more financial resources to employ on exploration activities. However, new paradigms have developed in the last decade designing completely new scenarios; small and medium firms have found new positions in the value chains and white spaces to compete.

First, the paradigm of open innovation (Chesbrough 2003, 2010) shows how large companies try to engage with small firms in their innovation process: proprietary systems and organizational structures often prevent big companies from disruptive innovation, SMEs instead demonstrate a great ability to explore new solutions and to combine their specialization with the means of the large firm (Lahi 2014). For example, as the technology becomes more complex, market leaders cannot handle with it alone, so that they scatter the knowledge among smaller firms, each one with key competences. Therefore, SMEs have learned more about how to collaborate through alliances and networking increasingly emphasizing the inbound research (Lee et al. 2010; Vaugelers 2008). The speed at which markets are changing in terms of technology developments, customer segment composition as well as supply chain architecture push even small firms in trying to be as updated as possible, encouraging exchanges with external organization, through a logic of cooperation rather than pure competition.

Second, the globalization of the market is changing firms' routines forcing some of them, active in most exposed industries, to internationalize their operation and to compete on different scales. The flattering of the world (Friedman 2005, Introduction) due to the large adoption of communication technologies and the diversification of internet channels allow SMEs to change face to their businesses despite of their small size. This has changed dramatically the way firms acquire inputs leading to the configuration of global value chains (Gereffi, Sturgeon 2005) more and more structured and with alternative governance types; nevertheless, internationalization forced small and medium-sized firms to approach new markets more frequently, sometimes exploiting entry strategies they had never managed before. There are no doubts that such changes influenced also the way firms used to take decisions since the new environment was no longer compatible with the traditional managerial techniques. The combination of these two paradigms shaped several industries which are nowadays moved by different rules. While cooperation was a skill already developed by many firms (for instance it represents a fundamental skill for all the actors operating in a district), globalization represented a huge challenge for a plenty of small and medium-enterprises.

Thus, SMEs became gradually an independent field of research separated by large firms, this new interest is explained by three justifications: for their strategic practices (methodological view); for the theories, entrepreneurship among others, applied to them (theoretical view); and for their characteristics, such as flexibility and dynamism, shown in the market (empirical view, Laghzauoi 2011). In this paragraph several challenges that SMEs are currently facing were presented, among them only the process of internationalization will be taken into account in this research and deeply discussed starting from the next sections.

1.2 International forces shaping firms' strategy

1.2.1 Models and frameworks for internationalization

Over the last decades, studies on the internationalization of SMEs have intensified trying to explain why and how small and medium-sized firms expand abroad. Three different approaches were developed: the economic approach, which regards the gradual organizational learning that push companies to explore new scenarios, the stage approach, which stresses the importance of economic factors such as supply and demand issues, and last but not least, the Uppsala model which considers involvement in industry networks (Laghzauoi 2011).

- The economic approach is well explained by Ruzzier and al. (2006) who identified three main elements of this interpretation. First, the theory of internationalization: firms naturally set abroad part of the vertical operations of their value chain (Casson 1995), moved usually by the intention to reach new customers and increase the demand. Second, the transaction cost theory developed by Williamson (1975) suggests that companies frequently face the choice to outsource their activities and often this ends up in a process of offshoring, sometimes it is convenient for the organization to get closer to existing suppliers or customers. Third, the eclectic paradigm (Dunning 1988) is addressed to firms of all sizes which move abroad following three pilasters (ILO). "I" stands for internalization and represents the ability of the firm to manage the activities vertically integrated; "L" stands for location and it refers to the advantages the firm can reach thanks to geographical factors; "O" instead stands for ownership which enrich in terms of learning and assets owned once the operations of the firm internationalize. This approach represents a good framework to understand firms' behavior but it might miss sometimes the value of social and industry relations.
- The stage approach argues that becoming international has to be considered a process made of different stages, each one intrinsically characterized by a different level of establishment (Coviello, McAuley 1999). Among stage approaches the most known is the Uppsala model, firstly developed by Johanson and Vahlne in 1977 and studied also in later contributions. In the Uppsala model authors focus on two elements, learning process and psychological distance: internationalization is seen as a gradual learning process where the more experience gained the more international the firm is likely to become. This model has represented a solid base for all the studies made in the last decades and provide good insights also for this research.

  The internationalization process is seen as a four stage path where decision-making has a crucial role, the experience acquired allows firms to choose the best option among those available. The four steps are:

  1. irregular and opportunist export
  2. export via an independent agent
  3. establishment of subsidiaries of sales
  4. production in the foreign country.

We will see that the four points are still considered the essentials possibilities for a company that wants to expand abroad. Following the scheme suggested by Johanson and Vahlne, once the company gains knowledge its decisions improve in quality and this has direct consequences on the activities performed and increases the market commitment; market commitment leads to new knowledge created and the virtuous circle follows as said.

Another stage approach is the I-model ("I" stands for innovation) which is based on the idea that the internationalization process follows the same steps of the product adoption life cycle (Genkema et al. 2000). The innovation-model was well summarized by Leonidou and Katsikeas (1996) through three stages. In the "pre-engagement" phase, firms which have already exported but are not doing it currently or those firms not exporting are grouped and they are seriously planning to start selling abroad. The next phase is called "initial" and involved firms exporting irregularly which show a great potential. Lastly, in the "advanced" phase firms export regularly and demonstrate quite a good experience, in this phase many of them start thinking to enlarge their presence abroad with higher investment.

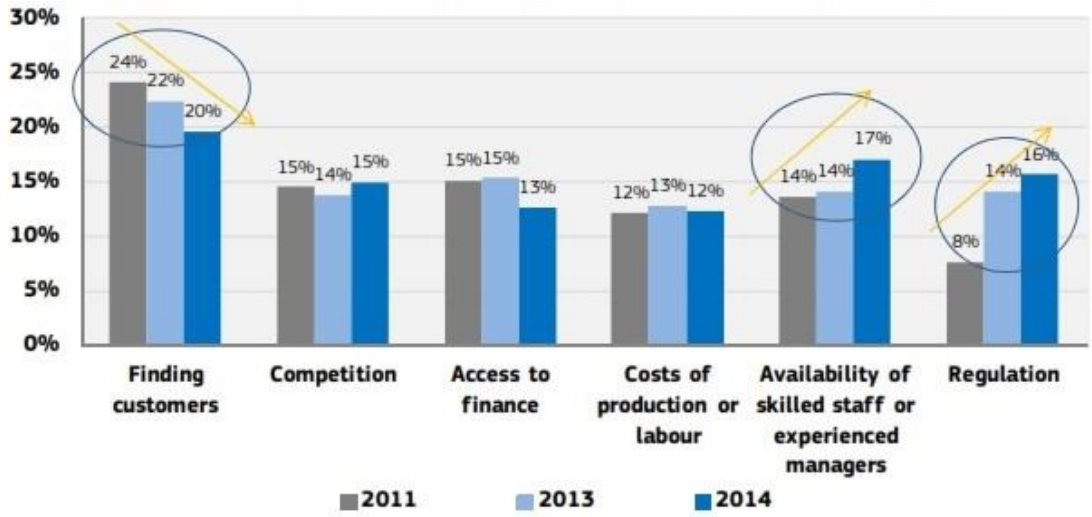
However, from 1977 onwards, all the models belonging to this category were strongly influenced by the Uppsala model and follow the principle of gradual implication of the firm in the market (Laghzauoi 2011).

- As anticipated before, the Uppsala model was revisited many times and in 1990 the same authors pointed out the importance of the position of the firm in its industry network. Internationalization is now described as the whole amount of operations performed abroad by the company within a net of close or far relationships, the model stresses the role of the network made of inter-organizational connections. Three stages are relevant (Johanson and Mattson 1988): prolongation, penetration and integration. Prolongation refers to all the investments the firms undertakes in order to expand its business abroad; penetration regards the development of the position inside the network in terms of bargaining power and resources controlled. The last phase sees the firm involved in an articulated net of relations where it has to be able to cooperate and capture value.

The network approach, in particular, seems to match well the characteristics of SMEs' internationalization process since both strength and weak ties allow small firms to satisfy some of their most imminent needs. For example, the network approach finds immediate application in the joint ventures (it will be defined precisely more ahead) through which the company can enter a foreign market with the help of one or more partners. These agreements, based on competences

and expertise, or on capital apportion, allow firms to give support on what they are excellent or on what they are willing to provide, and to receive support on what they are weak or not willing to provide. Companies involved in joint venture agreements usually demonstrate good negotiation skills and use their partners to meet new ones and to open new channels in the country; these behaviors fit quite well the theory of social network analysis and its structure of ties, nodes and clusters. The approaches presented try to answer somehow to firm's needs and characteristics. Figure 2 presents the most pressing problems of SMEs during the last few years: SMEs historically face difficulty in accessing resources of all kinds and struggle in exploiting their structural characteristics on a global scale. Among others, we focus the attention on the access to finance and the increasing difficulty in finding skilled human resources.

Figure 2: Most pressing problems for SMEs



Source: SAFE Survey (2014)

Many of these problems persist also in the international context where SMEs operate; several authors in the past argued that many of these issues are partially fixed by an effective international network. Availability of skilled staff (or experienced manager) and regulation are becoming more important, while finding customer is no longer the main motivation of getting international. This suggests that the external environment is gradually more and more relevant in firms' decision (Annual Report on European Union SMEs). Because of this fragmentation of models, further studies tried to summarize the factors influencing the internationalization process creating more general frameworks; these researches mainly focus on the traditional resource based view (Panrose 1959). This approach finds easy application in the field of SMEs because of their typical resource scarcity (Marchesnay 2002). Lam and White (1999), for example, argue that the internationalization process goes through three sensible decisions. First, the strategic choice, related to the way the firm wants

to compete with international opponent. Second, the structural choice which answer the question of how to organize the operations in the new extended context. Third, the human resource choice which is relevant for the level of internal integration and for the ability of the units to cooperate with foreign ones.

These frameworks and models, focusing on resources and competences needed for accessing international markets, are general in meaning and structure; their aim is to provide guidelines and schemes for interpreting the phenomenon of internationalization through the challenges that firms face once decided to expand abroad.

1.2.2 Motivations and drivers in SMEs' internationalization

In the past decades, several studies were made by institutions and academics in order to understand the motivations that lie under SMEs' choices of internationalizations: usually these researches are structured as wide surveys addressed to a significant sample of firms. Motivations are both internal and external and are national and sectoral specific (OECD 2009). A review of the key motivating factors includes growth motives, knowledge-based motives, network and social ties, and domestic or regional market reasons (OECD 2009). Zain and Imm Ng (2006) investigated how Malaysian small firms accessed external markets and found out that they are almost obliged in their choice by the network relationships they are tied with: later they can rely on the same relationships for any kind of support (resources) or structure (eventual entry mode partners).

Di Gregorio, Musteen and Thomas (2009) argue that often SMEs seek the reduction of costs through outsourcing and offshoring, especially for service activities: this first input to internationalization pushes them in new networks and increase their competitiveness in a larger market.

Lam and White (1999) recognize that many companies must internationalize when their customers or competitors have become global, some others do it because they feel that becoming global is a symbol of prestige and progress.

Secliuckiene (2013) interviewed several Lithuanian small-sized firms to understand their reasons: it came up that market saturation, the opportunity to operate in a growth-market (BRIC countries), profit margin and comfortable logistic were the most important points for these firms.

Tatoglu et al. (2003) focused on retail companies which had internationalized in East Europe and asked them their motivations among two categories, country and firm specific: they found that the five most relevant motivations were "increase sales", "future enlargement in the host country", "economic prosperity in the host country", "large market size" and "become international".

Furthermore, many other theoretical studies focus on "pull" and "push" motives: pull motives are due to contingent forces dependent on the economy of the home country, on lacks of the firm itself or on its external relations; push motives usually come from within the firm and work for its evolution.

In the following four types of motivations are explained, based on OECD (2009) analysis and research.

- *Growth motives* are considered one of the most decisive forces to internationalization since it shows always a positive correlation with profitability increase. An international presence often allows to reduce the dependence from a single market, to gain a stronger position, to enlarge your target market and then to increase the sales.
- *Knowledge-related motives* suggest that knowledge assets both pull and push SMEs into international markets. Knowledge pulls when firms lack knowledge needed for further development that is unavailable in the home country, the R&D foreign investments demonstrate this trend and the rise of new specialized area around the world. Knowledge pushes instead when managers with international experience and capacity take responsibility for bringing the offering (or an innovation) to other markets.
- *Network ties and supply chain links* trigger SMEs' internationalization as they are forced to behave as part of a broad group of actors where one's decision influence others. Taking advantage of collaborative links is a light motive in firms' actions and this implies also duties in the maintenance of intensity and vicinity of the relationship: once your partners or clients move abroad you cannot miss the challenge.
- *Domestic and regional market motives* are mentioned to stress the fact that many times the home country economic (or market) stagnation push firms to look for fortune abroad. Other times, instead, domestic motives refer to the firm's intention to take advantage of the country of origin effect, particularly strong for some countries and in some sectors.

Those presented are all good reasons for firms to decide to grow abroad and not to limit themselves in the home country, especially when the national economy or the sector addressed are in recession. In fact, motivations that lead to internationalization depend on the strategy previously adopted by the firm, on the sector in which it operates and also on the home country.

A different prospect has to be taken speaking about drivers: elements and forces that all firms have to take into account when they start to design their internationalization process. Drivers of internationalization are firm specific, as firms have different strategic goals (Flanders 2008). But

actually, all the firms that internationalize are motivated, at least partially, by the intention to grow by becoming more efficient or profitable, therefore their aim is to minimize costs on one side or increase sales and any other return on investment on the other side. Given this assumption, cost considerations and market conditions play a crucial role, but they are not the only determinants in a well-shaped international strategy. Drivers can be divided into two classes, internal and external. Internal drivers are identifiable within the firm and they influence the firm's performance; they are areas the firm should assessed to find out eventual weaknesses and strengths. For example, Cavusgil and Nevin (1981) described four determinants: the *differential firm advantage*, that groups all the product characteristics and technologies adopted that provide the firm a competitive advantage in the market; the *strengths of managerial aspirations* that represent the long-term goals and ambitions the top management wants to achieve; the *management expectations* that consists on the return expected from the investments; finally, the *level of organizational commitment* that allow to all the levels of the firm to provide financial and resource support to the international activities. External drivers focus on the external environment where the firm operate among many other actors, other type of forces tend to make the SMEs change direction and means. For example, Yip (2003) underlined four types of drivers. *Market drivers* are those related to the type of customers and distribution channels available to the firm; *cost drivers* depend on the opportunities to reach economies of scale and scope eventually able to increase firm's efficiency; *government drivers* are related to the presence of favorable or unfavorable policies, regulations or standard settings that could affect the decision alternatives available to the firm; *competitive drivers*, lastly, concerns the number of potential entrants and current competitors that will play on the same field.
However, internal and external drivers are associated to a counterpart, firms often face barriers that are presented in the next paragraph.

1.2.3 Entry barriers for SMEs

Although many barriers have been deleted over the last a few decades, thanks to the globalization process and to other macroeconomic factors, SMEs still face many obstacles in their process of growth out of the national borders (Flanders 2008). The literature about foreign markets entry strategy is mainly focused on those barriers SMEs face in high-growth economies since developing or already developed countries are usually the main destinations of their foreign investment. A market is defined high-growth when the product adoption rate by the customer is rising and an increasing number of potential customers is quickly being converted in actual customers.

Barriers represent a particularly relevant theme for SMEs because many of them lack the financial structure, political support and managerial capabilities needed for a successful entry. Very often research on international barriers regards cultural issues or home country effects (Berkema 1996); however, those considerations find consensus in marketing studies, what we mean with international barriers is the set of obstacles that firms face in terms of resources or competences widely considered. In a research report of Gent University (Flanders 2008, p. 21) the authors write: *"not only do SMEs have limited assets and financial resources, they also have little or no international experience in their management team, limited knowledge of international market, and limited international networks".*

A study made by Westhead et al. (2004) deserves to be mentioned. The study focuses on urban and rural UK SMEs and their internationalization process, and it finds that there are four different clusters of entry barriers. Those related to strategical issues, those related to operations and logistics, those caused by the lack of useful information, and lastly, those provoked by the process redesign.

Turker and Konakli (2016) research the importance of informational barriers and how they are perceived by firms: they found that there is a correlation between the lack of information and the others barriers the SME is facing. The five areas they depicted as more relevant are how to contact overseas customers, how to identify opportunities, language problems, customer habits and the lack of knowledge about the market.

Generally, barriers to the internationalization of SMEs can be classified in two different ways: internal versus external, or through the type of market the firm wants to enter.

Leonidou (2004) gave one of the best description of the first categorization. Internal barriers are divided in informational, functional and marketing ones. Informational obstacles are caused by the inefficiency of how we gain information and the ineffectiveness of how we use them: these obstacles emerge when we try to contact customers, when we analyze a market or we look for data. Functional obstacles are due to the lack of suitable resources and moderate the entry mode that the firm choses: evidences are financial limitations and inadequate personnel. Marketing obstacles, instead, concern all the decisions related to price setting, distribution channel and logistic and promotion activities: for some firms with a good financial situation and operational capabilities they can represent great obstacles. The same author then presents external barriers, this time clustered in four groups: procedural, governmental, task related and environmental. External barriers depend by definition on the geographical context (and economic environment as well) of the host country

(Flanders 2008). Procedural obstacles regard communication, procedures or payment transactions failure, due to the unfamiliarity of the firm with local practices. Governmental obstacles regard tariff and non-tariff barriers (as defined in industrial organization literature), restrictive regulations or protectionist measures. Task obstacles simply refers to the presence of competitors in the new country the firm will have to deal with. Finally, environmental obstacles are generally associated with the local social and economic rules of business often influenced by culture and routines.

The second categorization is based on the thesis that different countries present different barriers, here we discuss the study made by OECD in 2013 which states that BRICS (Brazil, Russia, India, China), OECD members and non-OECD members can show slight differences in both internal and external obstacles. The research confronted thousands of SMEs on the basis of the following type of obstacles: procedural barriers, governmental barriers, customer and foreign competitor barriers, business environment barriers and tariff and non-tariff barriers. BRIC countries, on one hand, have high "governmental barriers" as governments tend to advantage insider producers limiting import and promoting exports as their economy is growing. On the other hand, they have very low "business environmental-barriers" thanks to their internal market demand and number of opportunities (p. 54). Yet, non-OECD countries usually correspond to a high perception of "procedural barriers", "business-environmental barriers" as well as "customer and foreign competitor barriers"; while OECD countries see less obstacles in all the voices (see table pag. 57). Given that, the aim of this section is to provide an overview of foreign market entry barriers, in figure 3 the top ten barriers OECD considers more relevant today are presented.

Figure 3: Barriers ranked by SMEs using the top ten ranking method

Rank – Weighted factor	Description of barrier
1	Shortage of working capital to finance exports
2	Identifying foreign business opportunities
3	Limited information to locate/analyse markets
4	Inability to contact potential overseas customers
5	Obtaining reliable foreign representation
6	Lack of managerial time to deal with internationalisation
7	Inadequate quantity of and/or untrained personnel for internationalisation
8	Difficulty in matching competitors' prices
9	Lack of home government assistance/incentives
10	Excessive transportation costs

Source: OECD (2009)

The points analyzed allow to understand many factors influencing the choice to entry in a new market, obstacles come from out as well as within the organization and managers must foresee them to pursue efficiency and effectiveness in the internationalization process. Moreover, obstacles change in intensity according to the country: this suggest that an accurate analysis of the barriers has to be done in advance rather than focusing on one single destination. Additionally, public institutions of both home and host countries can represent a safe channel for those SMEs with lower productivity and scarce resource management (OECD 2009): policy makers have the power to provide support and incentives when entry barriers are more serious.

1.3 International strategy and entry mode choice

1.3.1 International strategy formulation

Not all SMEs born with the intention to become global one day, many of them target the local market and develop capabilities specifically suitable for it. When firms first develop their strategy they might not include the possibility to expand abroad, simply it is not part of their ambitions. However, it could happen that "pull" forces, such as the network or further technology developments, drive the firm in foreign countries despite initial intentions. In this cases, a local designed business strategy is shaped and the firm aquires competences and assets to make it work. We will see in paragraph 1.3.3 how uncertain the international market is for new entrants: usually firms tend to grow and consolidate their position within national borders and generate as much wealth as possible in the well-known domestic environment; internationalization might become an option later, when the firm controls additional resources and considers the foreign expansion as a possible new source of profits.

On the contrary, a few entrepreneurs have global aspirations by day one and the internationalization in embedded in their strategy: these firms need a strong global mindset and specific competences because they cannot rely on a consolidate experience on the domestic market. Anyway, whenever the firms pursue international success, through a later inception or from the beginning, it needs to design a strategy that fits its ambitions but that takes into account the firm's internal capabilities as well as the external environmental constraints.

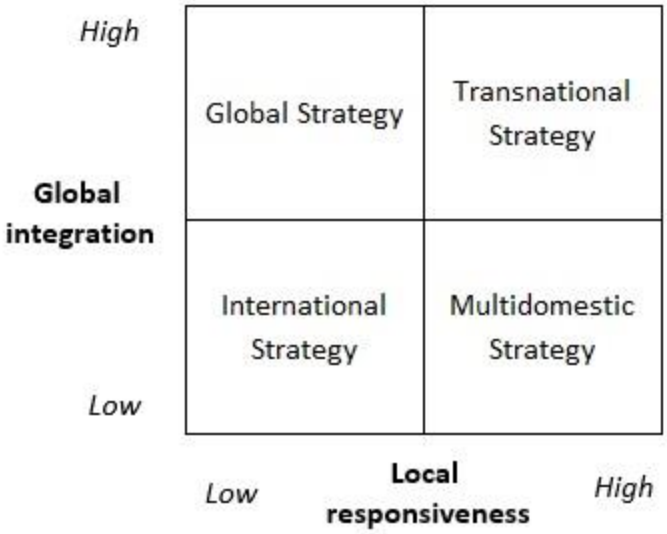
First, the SME needs a strategy. Let's define the mission of a company as what they think they have to do on a daily basis in order to fulfill the company's vision of the world and values that characterize them. The mission, and the consequent agenda setting, is the starting point of the strategy

formation. The next step is called "diagnosing" and consists in internal and external assessment (De Wit, Meyer 2010): the firm can design a strategy that fits its ambitions but without forgetting that both internal and external factors always influence, limit or foster the company's plan of actions. This road lead to the generation of a portfolio of alternatives, different means to a common end.

Second, the SME needs to find the best way. Once alternatives are identified the company needs to pick one or more than one and run with them: the firm is in the step of "action taking" that requires instantaneous "performance control". Here the plans are redacted and capital budgeting and operational budgeting activities take place in order to clarify the action programs, their requirements and expected results (Merchant 2007). For many SMEs an international opportunity can be a valuable strategic option and it needs to be evaluated through proper tools.

Imagine now that the SME decides to take the challenge of a foreign investment, the decisions that need to be taken are three: *where*, which is the better foreign marketplace for our business; *how*, what is the best configuration of our operations, how we should organize transactions from the entry time onwards; the *degree*, what is the level of commitment we are willing to accept in terms of time, personnel and money. While the geographical location choice is not the scope of this research, the *how* and the *degree* are its focus: they cannot be studied separately because of their interrelatedness as the how determine the degree and also the future option of eventually increase that degree. Strictly related with the degree of commitment previously explained, Doz, Santos and Williamson (2001) argue that international strategies could be judged according to the global integration between the warehouse and the foreign activities, and to the degree of local responsiveness of the business units positioned abroad. Their model is represented in figure 4.

Figure 4: Integration-responsiveness framework



Source: Doz, Santos and Williamson (2001)

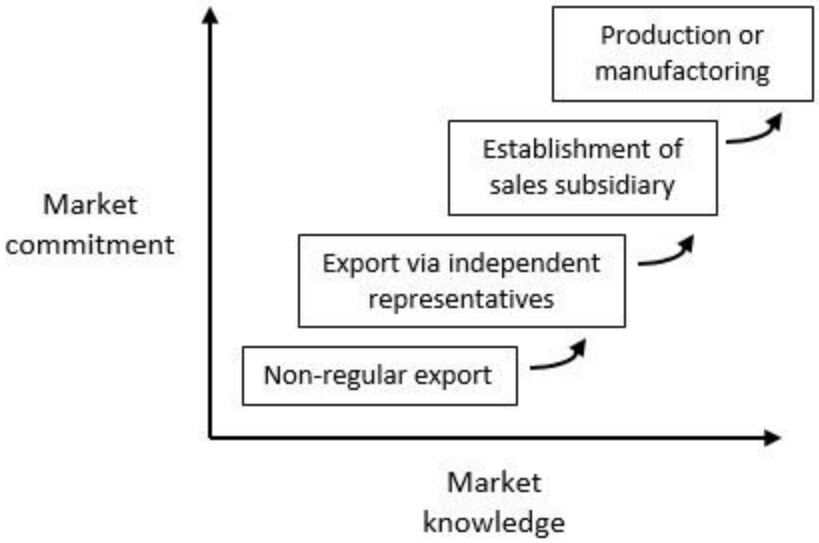
On one hand, firms are stimulated to integrate as coordination reduces costs and allows the achievement of economies of scales also through leveraging core competences. On the other hand, companies want to make their business units responsive enough in order to better fit customers' needs and to understand latent demand. Firms constantly struggle to find the right balance between the benefits (lower costs) of integration and those (high revenues) of responsiveness (Flanders 2008); the trade-off is even more challenging because integration allows control and enhances communication and sharing opportunities, responsiveness allows better to perceive the marketplace but requires units' independence. In the IR (integration-responsiveness) framework, firstly developed by Prahalad and Doz (1987), the global strategy happens when the headquarter has full control of all the operations spread out abroad: the goal is to supply the same product everywhere with the same characteristics and channels, a central entity coordinate and monitor the overall performance, worldwide managers ensure the respect of the standards. The international strategy is also called export or home-replication strategy: the firm sees the foreign market as separate and secondary compared to the domestic, it was entered to increase the sales and to add an end market for the domestic production line. In other words, the two strategies on the left side of the chart apply the idea of standardization. In the multi-domestic strategy, the firm gives autonomy to the subsidiaries by empowering the country (or area) managers who are free to make changes and take decisions allowing the offering to differ from the domestic one; the subsidiary is fully focused on the local customers and adapt their practices to the context, sometimes developing an own vision and responsive business strategy. The transnational strategy is the most difficult approach to implement as the firm tries to be as responsive as possible in order to fulfill customers' needs but keep a central control and coordination system among countries: knowledge sharing, global learning, economies of scale and cooperation are the advantages expected from this strategy. Each one of these strategies have pro and cons, sometimes the cost-benefit relationship is clear while some other times grey spaces emerge so that the strategy has to be assessed carefully. What has to be kept in mind is that the strategy application is gradual and often developed in phases, there is an entry phase and then an implementation phase. Strategies are always diversified and present unique peculiarities as every player tries to build a competitive advantage on them: some do it on costs, some on position, some on marketing elements, some others on the business model architecture.

1.3.2 Entry mode alternatives

The interest in entry mode choices was originated from the multinational enterprises (MNEs) literature (Deker 2004) and just a little had been developed about SMEs before the year 2000. As globalization increased scholars first focused on the Western MNEs and on their activities. Entry mode choices were, and still are, one of the most discussed topics in internationalization research: in fact, foreign market entry modes represent the third most researched field in international management, behind foreign direct investments and internationalization itself (Canabal and White 2008).

This paragraph goes through the entry modes known and widely analyzed in literature to provide an overview of them; what presented in the previous paragraphs can surely help in understanding them. The first contribution historically important is represented in Figure 5 which shows the four entry modes possibilities included in the Uppsala model.

Figure 5: Four steps of entry mode in a foreign market



Source: Adapted from Johanson and Vahlne (1977)

As seen in section 1.2.1, the Uppsala model is centered on the market knowledge and on the experience accumulated: the authors suggest that the market commitment increases gradually from an inconsistent export activity towards the creation of a subsidiary, all the firms entering in a foreign market follow this inverted waterfall. Later several studies shaped this idea (which remains still today a milestone in the internationalization process thinking) breaking the waterfall and suggesting that firms should pick an entry mode suitable for their characteristics and effective in achieving their target market.

The European Union (Final Report 2010) categorized the entry modes for SMEs in four types: export, sub-contraction, cooperation and FDI (foreign direct investment). Brouthers and Hennart (2007) reviewed several contributions to come up with a state of the art in the field, they found that sixteen entry modes had been mentioned but they all could be included in three macro-groups: contracts, joint ventures (JV), and foreign direct investments (FDI) also named wholly owned subsidiary (WOS). Pan and Tse (2000) made a simpler categorization by dividing entry modes into two groups: equity and non-equity. Equity modes are WOS (greenfield or brownfield) and JV as they require the firm to invest in new assets, firms deploying them need higher central control by the headquarter and an accurate financial management. Non-equity modes are contracts such as exporting, licensing, franchising, in which the firm regulates its business with local agents, distributors or other partners. Helpman et al. (2004) compared export activities with FDI and found that FDI represent a profitable option mostly for productive firms, export instead is available to firms of medium productivity while lower performers tend to serve only the domestic market; in other words, productivity determines the size of the foreign investment the firm can back.

In the following, granular definitions of the most common entry mode alternatives are briefly presented.

- Exporting: it is a function of international trades whereby goods produced in a country are brought to another country for being sold. When export is performed through national exporters, foreign importer, national or foreign trading companies as well as cooperatives, it is said *indirect export*. When, instead, it is performed by agents or local distributors, and managed by an own organization, personnel and functions, it is said *direct* or *organized export*.
- Licensing: it is the act to yield a right from the original owner, the author, to another actor, allowing him to obtain economic benefits from its utilization. The new owner (licensee) owes a fee to the author (licensor) in order to pay back the advantages he or her will gain from the right. Licensing consists in giving away an intellectual property, so that the contract usually contains specifications about the term, the territory and the renewal. In export activities, the licensee buys the possibility to distribute products under a trademark.
- Franchising: it is a collaboration formula between entrepreneurs for the production and distribution of goods and services, specifically suitable for new entrepreneurs who wants to take advantage of a well-known brand by taking responsibility of a very narrow asset. The

agreement links a consolidated trade offering and another society or person, which are willing to sell the offering and to follow the company's rules to build up their activity.

- Concession: it is a contractual right to carry on a certain kind of business or activity in an area. It consists in an agreement, usually released by public institutions whereby buildings or fields are given to privates with the aim to receive a fee and foster the development of that area or of a specific production. Firms looking for foreign direct investments may take advantage of them.
- Joint venture: it is an agreement between two companies which intend to share the ownership in order to share the burdens of the initial investments before and achieve then a join value given from their combined activity and cooperation. Joint ventures can be based on co-production or managerial support; in the second case, the local organization supports the foreign operator for what regards market knowledge and the relations with public institutions, sometimes it takes responsibility for the whole distribution.
- Wholly owned subsidiary (WOS): it is a company which stock is owned 100 per cent by another company, said parent company. The subsidiary become wholly owned through acquisition of the parent firm or spin off from the parent company as well. The ownership allows the parent company to have full control over the performance and the decisions of the subsidiary.

An additional differentiation needs to be specified about the last two points which constitute the so called foreign direct investments (FDI). Once the firm looks for a plant in the foreign country to set up the subsidiary, it has the option to make:

- Greenfield investment: it means that the firm prefers to build a new facility, in this way the firm decides the design of the architecture to make it to fit completely its sales or production systems as well as organizational structure; however, it costs more than the other option.
- Brownfield investment: it means that the firm prefers to purchase or lease an already constructed building, this allows the firm to save money and time in starting up the activities; the good aspect is that the building already follows the local regulations, but often it is difficult to modify (if rented) and it might not fit firm's technologies and organizational structure.

Sometimes the border line between an entry mode and another is very fuzzy: for example, some joint ventures are based on co-production and licensing agreements at the same time, some on franchising and concession. Other examples may be a brownfield subsidiary which operates thanks

to a public concession or a greenfield subsidiary built by the joint venture agreement between the local and the foreign organizations.

For what concerns exporting activities, a key role is performed by intermediaries. They link individuals and organizations, their activity is increasingly important when the geographical and cultural distance is more relevant (Peng and Ilinitich 1998). Generally, intermediaries tend to be market-focused rather than product-focused and are characterized by two elements: first, they are engaged especially by smaller firms which do not have the knowledge and the means to reach the destination market; second, they are particularly helpful to reach farer customers which shipment would be too costly for small firms. Being market-focused allow intermediaries to be cultural sensitive, which according to Skarmean and Robson (2008), enhance better performance and transaction-specific investments, increasing the quality of exporter-importer relationship.

As Brouthers and Hennart (2007) explained, FDIs can show up in four combinations: when the ownership is shared with a partner there is a partial acquisition or a greenfield joint venture, while when the ownership is total there is a full acquisition or a greenfield WOS.

All the considerations made and the phenomenon explained make very sense when applied to MNEs: large well-established companies were the major object of past investigations because of their relevance in the market and because they had been the first type of organizations experimenting new entry modes successfully. But how do SMEs deal with the entry in new markets? Which are the modes they prefer or can handle with? Many factors influence firms' choice and many firm and market-related aspects are carefully analyzed before take the decision. A key element regards the sources of uncertainty, SMEs are particularly sensible to internal limitations and external risk, very often this factor is one of the most crucial reasons of SMEs' entry mode choice.

1.3.3 Exogenous sources of uncertainty

The decision to enter a market is not a single discrete choice but the consequence of a sequence of conditional choices that gradually transform agents into actors with specific characteristics located in particular sectors at specific times (Geroski 1991). The usual behavior of an agent is to seek information to gather and later evaluate: as the flow of information becomes more and more specific and clear the agent start to invest in something more tangible. Enterprises do the same. Starting from an opportunity seeking stage they look for information in order to better understand the context and themselves; once they feel sufficiently informed and confident about the opportunity, they can invest in plants, equipment and human capital. Along the process the firm has

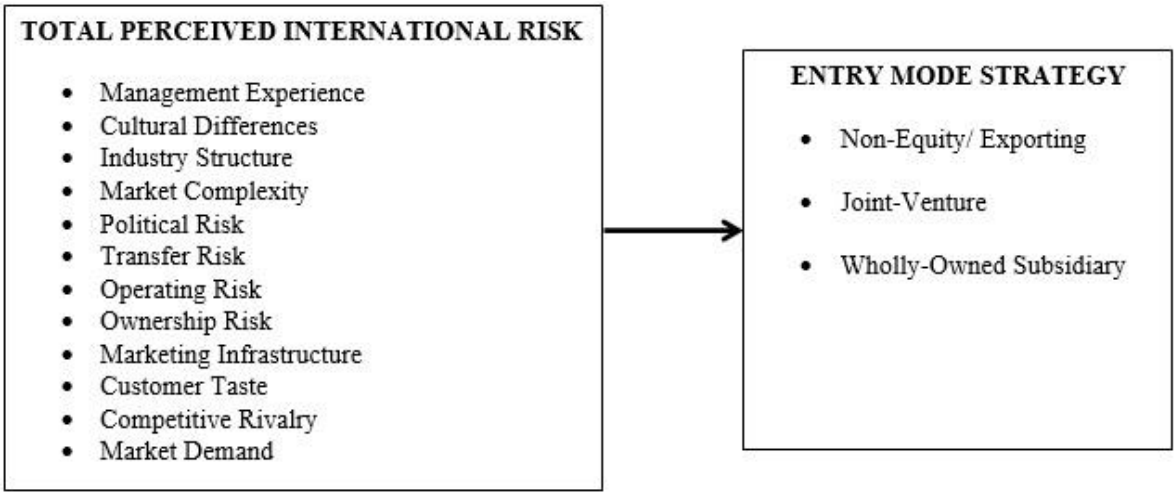
to take decisions about "whether to enter" earlier and then about the "how", the "when" and the "how much and how fast". However, in this process of subsequent decisions uncertainty pervades the external environment and the combination of future events that will affect the market. Uncertainty pervades also the ability of the firm to respond to changes in the market or to compete with incumbents and new entrants. Theories of entry base their existence in the hypothesis that entry corresponds to expected profits (Geroski 1991), but at what extent these profits are certain? To study entry modes it is necessary to identify which are the sources of uncertainty affecting them, which of them are easily manageable by the firm and which are not. Miller (1992) was probably one of the first authors emphasizing the need to specify the relationship between sources of uncertainty and a firm's expansion strategy. According to Cuypers and Martin (2010) managers have the possibility to manage the endogenous sources of uncertainty assessing the variables and acting to make improvements. Instead, exogenous sources of uncertainty are hard to control and even to understand, they force managers to follow a logic of "wait and see" without the possibility to make an impact. In their study on joint venture creation through the real option analysis they defined three sources of exogenously resolved uncertainty. One is the *economic uncertainty*, which is related to the macroeconomic situation of the host country and encompasses all the unknown about the economic activities and prices. Key variables are inflation, price, aggregate demand and competition: it is very difficult for a single firm to make a little impact on this type of uncertainty. Another one is the *local institutional uncertainty* due to legal, regulatory and social factors with the power to affect the business activity. Institutional instability provokes frequent changes in the regulation and often make the rules unclear, this is an uncertainty resolved exogenously as the firm does not have the strengths to influence governmental activities. Last but not least, the *exchange rate uncertainty*: entering in a foreign market means that the firm has to deal with a different currency from the one it is used to, changes in the exchange rate will influence the value of foreign investments. Being exposed to this risk means that the investment can increase or decrease in value according to the fluctuations of the exchange rate which is unpredictable. Regardless the countries where the firm operates, the exchange rate is impossible to manipulate. Endogenous uncertainties such as cultural-related, about the development of capabilities or scope-related can be managed by decision makers through human capital and management control systems.

A different interpretation of the problem was given by Lòpez-Duarte and Suàrez (2010) who assessed the link between external uncertainty and entry mode options through cultural distance, political risk and language diversity. Applying the Hofstede framework (power distance, uncertainty

avoidance, individualism and masculinity) they found that language diversity represents a great barrier especially when the expansion takes place through foreign direct investments: the authors suggest companies to look for partners when language diversity is not relevant and to avoid local partners when language diversity is huge, communication is an essential factor to achieve real cooperation and when it does not work it becomes a counterproductive factor.

Ahmed et al. (2002) researched the relation between risk perception and entry modes and defined 12 risks that the majority of the firms have to deal with in the international market. In their study the risk is spread out across many variables that can be grouped in three clusters. The first one concerns the marketplace: factors affecting this type of uncertainty are the competition, the demand, customer segments, taste and habits. The second cluster concerns the profile of the hosting country, political situation, infrastructure, public services and culture; this last element is often crucial for the success of marketing campaign, companies that do not understand cultural differences and issues often miss opportunities and make mistakes in their communication. The third cluster regards the company itself: its experience in the international context, the talent of management, the ownership and the governance, and how operations are organized (for example in the definition of internal transfer price across country, or logistics and material shipments).

Figure 6: International risks and entry modes



Source: Ahmed et al. (2002)

Figure 6 presents the main sources of international risk on the left square, and introduces consequent entry mode strategies in the box on the right.

Companies perceive risks differently according to their international experience and skills. When they perceive high risk they tend to choose more controllable and less equity options: this means that they prefer to manage operation from the home country, they may allow intermediaries to

acquire the ownership on final products, and they tend not to take responsibility for transportation. On the contrary, when companies perceive low risk they opt for more demanding entry modes in which initial investments are needed, and agreements with other parties and as well as with hosting institutions may be needed.

Certainly, different contributions in literature stressed different points but some take-away can be summed up: first, many sources of uncertainty affect entry modes and international strategies in general; second, external sources seem to be more challenging and the firm cannot influence them since they depend on the environment of the host country. Not many research, instead, went deeply through the effects that uncertainty has on post-entry firms' behaviors: surely once the new entrant has established its operations in the host country conditions keep changing and uncertainty does not disappear. Nevertheless, the firm could experience a growing trend or a fall in performance: therefore, it would be in the condition to optimize the entry mode adopted or kill the investment, trying to find a more appropriate arrangement still without having all the information needed. Calof and Beamish (1995) identified three main corrective stimuli that Canadian companies had addressed as major reasons for their subsequent post-entry adaptation: underestimation of exporting costs, misjudgment of local demand and incompatibility with the company's growth objectives. A contribution of Petersen, Pedersen and Benito (2002) gives some insights about what could happens to a company in the post-entry period. An impetus to switch due to changed circumstances is a frequent reason of post-entry adaptation. Changes might be the diminishing satisfaction with the foreign intermediary, the exporter's accumulation of market knowledge, the export market growth or the growth of the exporting companies. Such variations imply modifications in the entry mode strategy: "*An exporter's decision of whether to serve a foreign market through an intermediary or an employee salesforce cannot be taken once and for all. As the exporting company, the intermediary, or the foreign market change what is an appropriate operation method will also change. Thus, even exporters that initially "correctly" appointed a local intermediary may find that changing circumstances have made an employee salesforce preferable*" (p. 7). On the contrary, impediments to switch are also possible and force the firm to maintain a model not working successfully. This can be due to contractual restriction (severance payments to intermediary for example), to the loss of local sales revenue, the recruiting and training costs for the personnel employed and the foreign operation learning costs. If the investment is stopped these become all sunk costs that the firm prefer obviously to avoid. Thus, once the firm has entered the market numerous scenarios can emerge in the short, medium and long-term; it is convenient to the

firm to design its foreign investments in a flexible manner so that changes in the external environment of the host country would not provoke crisis.

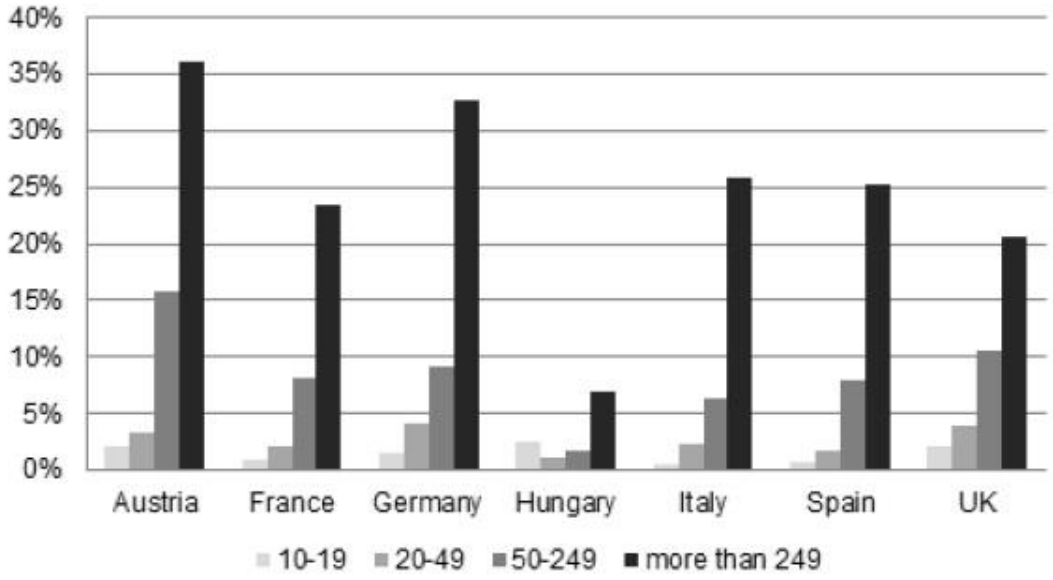
1.3.4 How SMEs cope with entry mode choices

The entry mode form represents a critical choice for every sort of firm accessing a new market, it is crucial for large firms and for smaller ones as well; choosing the right entry mode allows the firm to be successful in the development of its international strategy. Do SMEs rely on the same entry modes of larger entities? Flanders (2008) states that *"firms can choose from a range of options, including export (direct or via agents or distributors), licensing, franchising, joint ventures or wholly owned subsidiaries (through foreign direct investment). Some of these options are more suited for SMEs (e.g. exporting, licensing), while the financial needs and risks involved in others (e.g. FDI) may be too high for small firms*" (p. 29). The entry mode options remain the same also for micro, small and medium organizations, but actually slight differences emerge: first, SMEs may deploy the entry mode process differently; second, more likely, SMEs may find more efficient the adoption of some options and less favorable others. Thus, the entry mode choice depends on the available resources and commitment: more profitable SMEs, with a turnover closer to the upper definitional limit, might have the resources to enter a new market through FDI (even greenfield ones), while for many micro and smaller firm FDI are not an option at all. Often direct investments are not a feasible alternative for SMEs, because of their financial restrictions (De Chiara and Minguzzi 2002); SMEs may also meet hard difficulties when developing a joint venture because of their limited bargaining power and capital (Hutchinson et al. 2005).

Although there seems not to be a best entry mode for all small and medium sized firms, equity modes are more likely to take place in asset-specific investments while non-equity entry modes are viable for less asset-specific investments (Flanders 2008). These limitations in SMEs entry modes find consolidation in the data of the Center for Entrepreneurship, SMEs and Local Development (2013) of the OECD which declared that FDIs are made 5 per cent by micro firms, 10 per cent by small firms, 15 per cent by medium sized firms and 70 per cent by large firms. In fact, research agrees on the fact that the amount of equity based entry modes is proportional to the size of the firm; in other words, the number of SMEs investing abroad is strictly related to the size of the enterprise (EU 2010). Figure 7 shows the amount of firms, classified by size, with foreign affiliates (partners in joint venture or other strategic alliances) in a class of European countries. Figure 8,

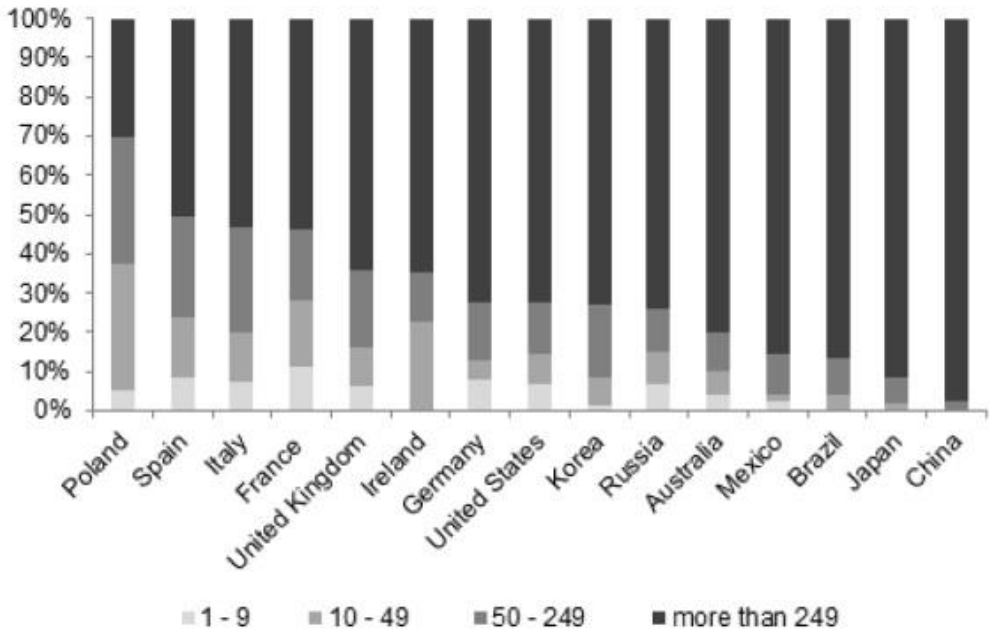
instead, shows the percentage of firms, classified again by size, which contribute to FDI for certain countries.

Figure 7: Share of firms with foreign affiliates, by firm size



Source: Navaretti et al. (2011)

Figure 8: Size composition of FDI makers



Source: OECD (2013)

In figure 7 all the countries considered follow a trend: the bigger the size of the firm, the higher the number of partners they have in foreign countries. Only Hungary counts great performances in its micro-firms. In figure 8 all countries make FDI mainly through big corporations, in Eastern countries such as China and Japan almost the overall amount of FDI is made by large companies; only Poland,

on the contrary, shows a great percentage of FDI performed by both small and medium-sized enterprises. Navaretti et al. (2011) also add that the bigger is the company, the higher the number of countries where it is likely to export or make investments. Nevertheless, FDI leads usually to higher performances over time: Lu and Beamish (2001) found that there is not a clear relationship between FDI and performances. On one side this is because FDI always imply an initial decrease in profitability before making profits and grow, on the other side it happens because combining export and FDI could not work, it is always better to bet only on high FDI.

Breuthers and Nakos (2002), already mentioned above, made some hypothesis on SMEs and their entry modes in foreign markets following the ILO model. From an ownership point of view, equity entry modes are preferred by SMEs of larger size, SMEs with a consolidate experience in the international market and SMEs with a differentiated offering. From a locational point of view, equity entry modes are adopted by SMEs perceiving high potential growth in a market and SMEs perceiving lower investment risk. From an internalization point of view, equity entry modes are preferred by SMEs perceiving high contractual risks in a target market. All these considerations can help in defining some points (in part summarized by the Final Report 2013 of EU): first, SMEs are much less involved in international activities than large corporations; second, the fixed costs of internationalization represent a relevant entry barrier and produce an almost monotone relationship between firm size and the degree of internationalization; third, the number of affiliates is higher in BRIC countries and in high-growth markets; four, international SMEs are more productive and innovative that their domestic counterparts, especially when they keep external relations with foreign affiliates. Therefore, SMEs perform better when developing an international strategy: they are likely to succeed when the foreign investment undertaken are pondered on their size and on the risk perceived, and when they rely on relationships with external affiliates. Given these point, all the alternatives explained in paragraph 1.3.2 are somehow available to SMEs; moreover, consider that no entry mode gives more probability of success a priori (Yip 2000). Actually, only the franchising model seems to be infeasible as the firm would need a strong brand to deploy it, generally only well-known giants have such an extended brand recognition and awareness; even the concession form finds difficult application as governments tend to advantage large corporation as they bring more investments and employment.

The scope of this research pose an additional question related to the fact that entry mode choices affect the cash flows of the foreign investment. In fact, as Canabal and White pointed out (2008) "*a few studies have been made which discuss how a firm's entry mode choice will influence post entry*

decisions and performance" (p. 12). Once the entry mode is applied in practice it is very difficult to change it radically. In fact, on one side empirical research indicates that once entry mode choices are taken and operations established, they are very difficult to modify so that these decisions have long term consequences (Flanders 2008). On the other side we have seen how uncertain the environment is, things can change and the favorable conditions we relied on could be no longer true. Therefore, it is reasonable to make successive changes on the model adopted to enter the market when all the benefits the firm will gain (discounted) overcome the switching costs required. In 2002 Pedersen, Petersen and Benito asserted that *"changes should happen inasmuch as the benefit of substituting the existing operation method more than offset the anticipated switching costs"* (p. 3). Thus, if things go well and the firm intend to grow it might need to upgrade its model moving to a more demanding (in terms of costs) and structured system. On the contrary, if things go badly the firm might need to narrow the market extent of its model or even bail it out.

In figure 8 a table is proposed in order to clarify the options generally available to SMEs, we decided to focus on the upgrading possibility that firms should include in their analysis when deciding the entry mode. In fact, entry mode is just a necessary step in the internationalization process, it cannot alone ensure success; post entry strategies, commitment of resources and contingences foresee can dramatically rise the odds.

Figure 9: Comparison between entry modes options

	Initial cost	Payback period	Level of Control	Upgrading path
Export via distributor	low	short	low	Export via agent
Export via agent	low	short	low	Joint venture
Joint venture	high	middle/long	high	FDI brownfield
FDI	high	long	high	FDI greenfield

Source: own elaboration

The grid in Figure 8 provides a comparison between entry modes and suggests which are the alternatives the firm could aspire taking into account its financial resources (costs), the time needed for the breakeven of the investment, the degree of control over the foreign activities and the natural upgrading path. Two additional considerations are needed. First, joint ventures and wholly owned subsidiaries are riskier options: companies are highly committed because of the huge initial investment and present a relevant exposure if the external environment turns out negatively. Second, the upgrading path does not have to necessary follow the gradualism of the column, a firm

may move from an export system directly to a wholly owned subsidiary because the market trend indicates high sales potential.

It is not the aim of this paper to determine theoretically to which entry mode the firm should aspire given its size and future ambitions: in real world several internal and external analysis are required and tailored around each single case. Quantitative techniques can give information about the convenience of alternative entry modes. In the next two chapters decision-making tools will be presented to show how to choose the entry mode and somehow capture the option of upgrading it.

Chapter 2

Quantitative tools for decision making

2.1 Strategic investment decisions

2.1.1 Outline of the decision making process

A decision is a specific action that one can take in the present or in the future but not in the past. A decision is a conclusion reached or action taken regarding a present or future event based on past, present, or forecasted information (Eapen 2009). This definition has some implications: first, decisions in the past are like sunk costs, they may have an impact on the current decisions only through the information they have generated; second, decisions may or may not result into actions, in any case they are strongly dependent on the information used; third, information can be imprecise, historical or forecasted, based on theory and empiricism, influenced by data and opinions as well.

Decision making is considered one of the most important skills in business, especially when things get tough: when crucial decisions have the power to start a process of change and unfreeze the status quo, sometimes they turn strategies redefining the objectives to pursue. Decision making is a fundamental skill in companies also because it requires problem solving, design thinking capabilities; managers of all levels are asked frequently to take critical decisions, executives even more.

Decision making can be quantitative or qualitative, sometimes it is both. Think about a firm which is trying to redesign its customer relationship management system: on one side customer satisfaction, willingness to pay, quality perceived and employee morale have to be taken into account; on the other side, number of visits and appointments, sales and average value produced per employee, marginal contribution of products sold as well as timing have to be assessed.

The study of decision making has developed through theoretical approaches, in the following points four models are briefly introduced according to the scheme of Butler et al. (1993, p. 8-14).

- *The rational* model: decision-makers search for all possible options to compare and evaluate them and choose the optimal one. The first step is called *recognition*, in which the environment is surveyed scanned for information; then the *diagnosis* takes place, here the

problem is defined in terms of the actor's objectives. Then there is the *research* of possible options and the *design* of solutions; then solutions are *evaluated* and the optimal one is chosen; the solution picked need to find *authorization* within the organization so that it can have easy *implementation*.

- *The bounded-rational* model: it points out the limitations of the rational approach since managers take decision under pressure, with disagreement and with incomplete information. The first step is the problematic search; once problems are found the actor map out all the decision tree to comprehend better in a situation of *cognitive limit*. Under *time pressure* (especially investment decisions), actors look for *incrementalism* to complete solution at least partially to follow a progressive completion. Sometimes *intuition* is combined with computation in order to solve trade-offs and to gain more *satisfaction* from the final effects.
- *The political model*: it is based on the idea that organizations are made of interests that compete for resources. Therefore, individuals leverage their *bargaining* to find best deals, sometimes *guiles* are part of the process, while some other times actors tend to build *coalitions* for the achievement of shared goals. *Biasing* is the fundamental ability to make the rules of the game and influence others significantly.
- *The Garbage Can Model*: according to this model, problems do not follow a strict structure but consist in an "organized anarchy" with three main characteristics. First, ambiguity characterizes both problems and alternatives causing a situation of *problematic preferences*; second, the *technology* is ambiguous as the relation between cause and effect is not clear; third, decisions are taken through a *fluid participation*, because of limited time and resources there is a high turnover of actors.

According to Clemen (1996) a critical step once a complicated problem is posed is to identify the critical elements of the situation. The first element is "values and objectives": values are what matters for the actor, while objectives are things the actor wants to achieve; some objectives are related to each other's, all are consistent with values. While long-term objectives in companies usually concern growth, profitability and making money and decisions have the scope to pursue them, values often help in the decision making to reduce alternatives or privilege some of them to others.

A second element is the "decision to make". Once objectives and values are understood the actor has to take the decision, there are always at least two alternatives otherwise there would not be a

decision to make. Now, alternatives have to be evaluated and the better one is picked; another possibility may be to wait and look for more information. However, this option is not necessarily costless.

Many times there is not a single decision to make, but several sequential decisions. It is important to recognize when one decision leads to another, in this case the actor would prefer to understand previously the whole sequence in order to assess alternatives appropriately.

The third element is "uncertain events": problems often are complicated for the uncertainty about what the future holds. The possible events that can happen in the resolution of uncertainty are called outcomes: the decision maker has to estimate the expected value of those outcomes which have to have an impact at least on one of the objectives. Of course, a situation can involve more than one uncertain event: the larger the number of uncertain but relevant events, the more complicated the problem.

The fourth element is "consequences", after the last decision is make and the last uncertain event is solved the actor has to deal with the effects. It might be a loss or a profit as in the case of a firm or a matter of increased or decreased value of an investor's portfolio; a good way to account monetary consequences is to consider the net value of inflows and outflows. Certainly, decisions are supposed to impact on the objectives of the actor but, because of uncertainty, we know that effects might be positive or negative.

Timing and planning horizon are two other issues related to decision making. Moreover, decisions ordinarily involve trade-offs among objectives, this aspect should be well understood before proceeding with valuations.

Decision making is usually considered as a process: a series of actions, changes or functions that bring about an end or result, it evolves over time and almost always involves iteration (Forman et al. 2001). Decision making can be considered a process as it is made of elements organized into a structure, it employs several steps and it presents possible courses of actions. Each course of action need to be assessed through a tool that presents the possible outcomes that could result, the likelihood of these outcomes and their eventual consequences. But decision making does not end once the tool has been applied and the decision taken: managers constantly look for quantitative feedbacks such as deviations and market response in order to implement the strategy with corrective actions.

If we consider the case of the decision making process for a SME looking for entering a foreign market, we can exemplify the decision process as follows. The firm has decided to grow and is

convinced to have the means to do it, they set the goals they want to achieve in the first three years in the new market and they decided a budget (these are the objectives). We can decompose the problem and analyze its structure:

- analyzed the context and find the sources of uncertainty that may affect firm's performance;
- forecast future cash flows having, different entry modes foresee different cash flows;
- decide which is the best quantitative techniques to assess the alternatives, it can be used more than one;
- applied the tool and take a decision.

Additional analysis might be needed if some conditions have changed in the meantime, otherwise the option chosen can be implemented. Surely, the process of consecutive partial decisions that leads to a major decision requires people, time, resources and suitable managerial quantitative tools.

2.1.2 Investment valuation theory

Independently from the economic status, firms are asked to invest to increment their operative activities and to optimize opportunities (Ross et al. 2010). The decisional process that guides investment choices is called *capital budgeting*, which is a set of activities performed by finance managers dealing with real-life investment problems. These activities are important because the investment decisions taken today determine how much additional capital the organization will add to its current stock of capital; the capital that the firm will use in the future to produce goods and services. Note that we can define *strategic* only those investments that are crucial in company's life as they have the power to modify the long-term structure and competitive assets of the firm (Micalizzi 1997). Often, such strategic investments are the launch of a new innovative product, the penetration into new markets or the entry in new geographical markets. In other words, we can call strategic all those investments which have substantial effects on the long term financial and operational performance of companies (Atik 2012).

This typology of investments usually brings submerged value which is very difficult to capture through traditional capital budgeting techniques. First of all, strategic analysis deals with all the decisions needed to achieve long-term objectives, while capital budgeting techniques are the tools used to measure the impact of such decisions.

Profit-oriented firms are generally oriented to sales maximization, profit maximization, financial stability, survival in the long term as well as technological leadership. Some firms may not be interested in industrial leadership as they are able to successfully supply larger firms, some may prefer cost reduction and a lean structure to increase efficiency so that sales do not have to grow, all want to create profit to remunerate stakeholders. However, the objectives the firm wants to pursue cannot be all maximized at the same time as trade-offs tend always to emerge (for example, leadership and innovation may require temporary periods of low sales and less market share). Thus, we can assume that companies, when making strategic investments, have the possibility to maximize some variables, under certain constraints, and to bear lower performance on others.

Consider a firm that wants to enter a new foreign market. Certainly, it can be considered a strategic investment decision as it will have effects on the future life of the company, modifying both the overall strategy of the firm and its assets. Then, "entry the market" will be one of the most pressing objective for a while: the firm might be able to minimize entry costs and to create convenient partnership abroad, but it is likely that initial sales would be low and some functions of the company may suffer because of lack of attention or resources addressed to the investment. In this concrete case, the strategic analysis would define the alternatives available to the firm in terms of markets, products, brands, alliances and resources needed; capital budgeting techniques, instead, would tell if the investments embedded in those alternatives are convenient. Therefore, even entry modes need capital budgeting techniques to assess the feasibility of the investment.

According to Trigeorgis (1995), capital budgeting approaches follow four phases:

1. identification and classification of investment opportunities;
2. information search and gathering;
3. valuation and selection of the most convenient alternatives;
4. development of a sensitivity analysis in order to comprehend the impact of different scenarios on the operation.

Because of its large application, capital budgeting cannot be considered an activity performed within a specific function; it consists in a group of valuation logics which support the whole decision process within an organization. Strategic investment decisions are usually taken by top manager or executives because of their relevance in company's future life. Capital budgeting has the scope to provide them with useful information and data elaborated through suitable tools.

Techniques in corporate finance generally use cash flows, while financial accounting generally stresses income or earnings (Ross et al. 2010). Therefore, when valuing a single project, discounted cash flows received have to be used, when valuing the firm as a whole entity, discounted dividends (cash flows received by the shareholder) have to be used. Capital budgeting techniques employ cash flows because they represent real money. Using simple cash flows is not even enough as calculation requires incremental cash flows: the additional operating cash flows that the firm receives from taking the new project. In other words, incremental cash flows are the changes in an organization's cash flows that occur when the firm accept a project.

In fact, there is a difference, sometimes great, between firm's cash flows with the ongoing project and the cash flows of the firm without the project. For example, when a firm undertakes the option to create a joint venture abroad its cash flows change, more or less dramatically according to the size of the agreement. The new project implies initial investments for contracting, time consumption, personnel, logistic arrangements and joint venture organizational structure; then, while the outflows will hopefully reduce year by year, inflows are supposed to grow quite continuously and create more and more value. In this logic, cash flow definition is a very important step and managers should take into accounts the following points.

- *Sunk costs* are not incremental outflows; they represent costs occurred in the past that cannot be changed by accepting or rejecting the project.
- *Opportunity costs* should be taken into account: for running the project the firm must invest some of its assets which could be applied to alternative opportunities with potential profits.
- E*rosions* or *synergies* can occur: the new project could erode the firm's commitment and attention usually addressed to other divisions or projects, this may lead to a decrease in sales. On the contrary, the new project could generate new synergies and internal alliances which lead to higher performance in the existing activities.
- *Allocated costs* should be viewed as outflows of a project only if they are incremental costs of it. Accountants use to allocate some general costs across different projects; however, to properly assess a single project it is preferable to consider only the incremental flows strictly related to it.

The definition of such cash flows is crucial to develop an appropriate analysis. Operating cash flows are identified usually through three approaches: the top-down approach, the bottom-up approach and the tax-shield approach. We do not detail them because we prefer to focus on techniques, what is important to know is that all of them include in their calculation revenues, cash costs, depreciation

and taxes. As Micalizzi (1997) specifies, the net cash flows have to be *monetary*, to represent a cash movement, *differential*, to represent the implementation of the project, *net of taxes* and *gross of financial charges* as only the flows coming from operations management have to be considered.
The Net Present Value technique is certainly the most effective tool for evaluating projects, as it computes the difference between the sum of the actual values of cash flows and its initial cost, discounting the cash flows from the first year onwards. But it is not the only one. In the next two sections traditional quantitative tools are presented with the aim to give an overview of them: all of them are expected to use cash flows as input and to come up with a valuable solution for managers.

2.2 Quantitative tools

2.2.1 Traditional managerial techniques

As investments represent a fundamental input of corporate evolution and growth and often they require the firm to take risks, managers need to use some techniques to compute the profitability and the convenience of a project, whatever it is. Even theorists along decades tried to designed tools to help executives in clarifying the components of a decision making process. This topic is so relevant in the financial field because of the uncertainty that surrounds phenomena: not politicians nor economists can always predict future trends and environmental changes, so that it happens that investments which were supposed to create value end in losses.
In this paragraph three managerial techniques are presented and a brief example is given for each one. The methods are explained following Oakshott (2009), while the examples are taken from Tolotti (2015). The three methods chosen take into account the attitude to risk of the actor which is not always considered in other techniques. In fact, some decision-makers are *risk-seekers* because they are prepared to take the risk of making a loss if there is also a chance of making large gains. Other decision-makers are *risk-averse* as they always tend to choose the safer option which allows them to reduce or avoid losses.

Payoff tables

A payoff table is simply a table that gives the outcomes of a decision under different conditions or *states of nature*. These states of nature depend on one factor which have the power to influence future cash flows: it can be the market demand, the domestic competition, the global economy as

well as the foreign market rate of acceptance of the product, among others. The criteria most commonly used in the assessment are:

- Maximax rule
- Maximin rule
- Minimax regret rule
- Hurwicz criterion
- Expected monetary value
- Expected opportunity loss

The *maximax* rule chooses the best of all the possible outcomes and it is a rule usually followed by risk-seeker actors; the *maximin* rule, instead, chooses the best of the worse and it is usually adopted by risk-averse actors. Then, the *minimax regret rule* minimizes the maximum opportunity loss, which is the loss that occurs when the actor does not take the best option. To compute the opportunity loss, we subtract each payoff for a particular state of nature from the best that could be achieved given the state. The *Hurwicz criterion* aims to find a compromise between the cautious maximin rule and the optimistic maximax rule. However, weights are assigned to the best and worse payoffs for each decision option and the one with the highest payoff will be chosen. The formula of weighted payoff is:

$$\alpha \times worse\ payoff + (1 - \alpha) \times best\ payoff$$

The value of alpha depends on the decision maker's attitude to risk: the smaller the value, the bigger the risk she is willing to take (when α = 0 the decision coincides with the maximax rule, when α = 1 the maximin rule). The *expected monetary value* (EMV) is what we expect to receive as payback from the investment, given a certain probability that the event or condition occurs. It is calculated multiplying each payoff for the probability that the payoff takes place.

Expected opportunity loss (EOL) is very similar to the EMV method except for the fact that probabilities are applied to the opportunity loss and the option that minimizes it is the one chosen. Let's look to an example. Figure 10 shows three possible scenarios of expected profits.

Figure 10: Payoff table, data on profits

Decision	State of the market		
	High	*Medium*	*Low*
Manufacture	80	40	-20
Royalties	50	30	10
Sell	20	20	20
Probabilities	p = 0.2	p = 0.5	p = 0.3

The maximax rule emphasizes, optimistically, the best case scenario. It identifies the maximum gain for each of the alternatives, which are 80, 50 and 20, and picks the alternative with the higher number, 80. The maximax rule would choose the manufacture option.

The maximin rule, instead, emphasizes, pessimistically, the worst case scenario. It looks at the lower profit for each of the alternatives, which are -20, 10 and 20, and picks the better one, 20. The rule here would choose the sales option.

For the maximax regret rule we have to find the higher value for each column (scenario) which are 80, 40 and 20. Then, the regret table must be built to determine how much I would regret having chosen one alternative X, knowing that a scenario Y has realized. In the table below, values have been computed subtracting the 80, 40 and 20 for each original profit value.

Figure 11: minimax regret rule

	High	*Medium*	*Low*
Manufacture	0	0	40
Royalties	30	10	10
Sell	60	20	0

Therefore, the maximum value for each alternative is taken, 40, 30 and 60, and the alternative corresponding to the lower one is chosen. Here the rule would take the royalties option. To apply the Hurwicz criterion suppose α to be equal to 0.6. Following the rule described above we can obtain weighted profit values which result to be 20, 26 and 20. The rule chooses the alternative corresponding to the higher weighted value (26) that is royalties. The EMV is easily obtained by multiplying each value of the row times the probability that it occurs. The results are 30, 28 and 20 so that the best alternative is manufacture. Finally, the EOL computation needs a new table (figure 12) in which the potential losses are listed.

Figure 12: Opportunity losses table

Decision	State of the market		
	High	*Medium*	*Low*
Manufacture	0	0	30
Royalties	20	10	0
Sell	5	5	6

Thus, the probabilities are now applied to the table above following the same procedure of the EMV. The calculation results are 9, 9 and and 5.3. The alternative that minimize the EOL is the sell option.

Utility theory

One method of considering the actor's attitude to risk is to evaluate their *utility function*. This is possible by converting monetary values into a scale between 0 and 1 in such a way that the change in the utility reflects truly changes in the actor's preference for different amount of money. Utility is defined as the desirability of preference that individuals or societies have for a given outcome; in other words, it is a measure of the attractiveness of a potential outcome.

The approach deployed to find the utility function is called *probability-equivalence*.

The first step consists in computing the EMV of each alternative available to the decision maker: it is obtained by multiplying the outcome (*S*) for the probability it occurs (*Pr*).

$$EMV = Pr_1 \times S_1 + Pr_2 \times S_2 + \cdots + Pr_1 \times S_n$$

The largest among all the possible payoffs (*Nmax*) is given the utility of 1, the smallest (*Nmin*) the utility of 0. To better define the attitude to risk of the decision-maker some questions have to be asked: the aim is to capture the threshold probability at which the actor is indifferent between a risky and a riskless option. Therefore, the utility of an investment is equal to the sum of possible utilities each multiplied for the probability it occurs. The utility function follows an equation where probabilities are the thresholds found and the utilities are 1 and 0:

$$U(N) = Pr \times U(Nmax) + (1 - Pr) \times U(Nmin)$$

The utility function can also be represented in a graph with utility in y-axis and the outcomes in the x-axis. The last step is to substitute the monetary values in the starting table with the utility values computed (all between 0 and 1) and finally make the decision that maximizes the expected utility.

In the following example the starting data are the same of figure 10. By converting monetary values in a scale between 0 and 1 we obtain the scores represented in figure 13.

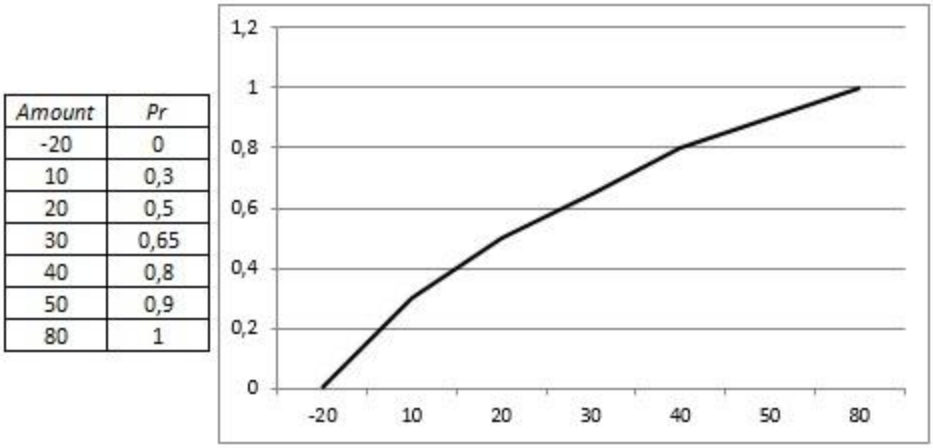
Figure 13: Data, from 0 to 1 scale

	High	*Medium*	*Low*
Manufacture	1	0,8	0
Royalties	0,9	0,65	0,3
Sell	0,5	0,5	0,5
Probabilities	0,2	0,5	0,3

Computing the EMV of the values above we obtain respectively 0.6, 0.595 and 0.5: the rule suggests the alternative of manufacture. Assuming the risk aversion of the decision-maker by asking her willingness to pay a certain amount of money in a lottery, according to the likeliness of the winning

80 against losing 20 (respectively 1 and 0), and following the probability-equivalence approach the utility function can be determined. Figure 14 shows the utility function.

Figure 14: Utility function



Amount	Pr
-20	0
10	0,3
20	0,5
30	0,65
40	0,8
50	0,9
80	1

Multi Criteria Decision-Making (MCDM)

The techniques met so far involve single objectives, expected value or utility for example. However, often it could be useful for decision-makers to rely on multiple criteria in order to exhaustively ponder the decision. Sometimes, for example, actors want to minimize some factors (risk, cost) and maximize others (profit, utility) at the same time. Think about a company which is about to decide where to set a plant: it has to consider several influencing factors such as electricity supply, parking space, the size of the building, the renting or purchasing cost, the distance from the most important suppliers among others. How could all the relevant factors be considered in a single tool? A quantitative technique that follows this ration is SMART (Simple Multi Attribute Rating Technique), firstly developed by Edwards (1971). First, the decision-maker has to decide a set of criteria that she considers important to the problem she is facing, they can be just a few or many. When criteria are several, it may be useful to build a vertical tree where criteria follow a top-down scale of importance, hierarchically. Second, the decision-maker has to define a scoring system to explicit the characteristics of the options per each criterion. Each option is given a score from 1 to 100 in the criteria, then all the scores belonging to the same criteria are summed and the percentage is computed in such a way that the sum of the column is 100. Third, the decision-maker uses the swing weights to ponder criteria: the aim is to give a percentage of importance to each of them (the sum must be 100%). Now it is clear which criteria are felt more important by the actor. Therefore, if criteria were equally weighted the decision-maker would have just to sum the scores for each

option. But, as criteria are weighted as well we compute the value of the option with the following formula:

$$Aggregate\ benefits = W_1 \times score_1 + W_2 \times score_2 + \cdots + W_n \times score_n$$

In the equation, W represents the weight of one of the nth criterion while "score" is the assessment of the option (from 1 to 100) for that criterion. Computing the aggregate benefits for each option allow a comparison of the options. To see the relationship between benefit and costs an *efficient frontier* is usually derived in a graph. Aggregate benefits are on the y-axis while costs on the x-axis. As the wish of the decision-maker is to minimize costs and maximize benefits the efficient frontier represents the boundary over which the points represent good efficiency. The frontier can be very useful to reduce the number of possibilities; however, further analysis is still needed to assess the remaining options.

We consider an example to describe the method more clearly. Data in figure 15 present five alternatives and consider three criteria: the table shows the costs, the delivery time and the values for each criteria.

Figure 15: MCDM table data

	Data		Criteria		
	Monthly cost	Delivery time	Availability	Environment	Del time
Barge	28000	6	0	90	0
Sea Tanker	20000	5,25	70	100	14
Road	45000	0,5	100	0	100
Rail	40000	2	90	80	73
Road & Rail	44000	4	80	60	36
		Values	100	20	80
		Weights	*0.5*	*0.1*	*0.4*

Once the decision maker assigns values to the criteria to express their importance in her opinion, weights can be found by summing the values and divide each value for the total. For the example in figure 15 we have:

$$Sum\ of\ values = 100 + 20 + 80 = 200$$

$$W(availability) = \frac{100}{200} = 0.5$$

Similarly, we can obtain the weights for the other two criteria, "environment" and "del time". We can compute the weighted average corresponding to all the alternatives by multiplying the values

of each criterion for the weights and summing them; in that way we obtain the aggregate benefits for each alternative. For example, to compute the benefits for the Rail the formula is:

$$B(Rail) = 90 \times 0.5 + 80 \times 0.1 + 73 \times 0.4 = 82.2$$

Once obtained the weights of criteria and calculated the benefits of each alternative, we have to consider costs: the lower cost count as 100 and the higher one as 0, the others are a consequence of this. We obtained the value by assuming that the difference between the lower cost, 20000, and the higher, 45000, must be divided in 100 parts. So that we computed:

$$Spread = 45000 - 20000 = 25000$$

$$Unit\ value = \frac{25000}{100} = 250$$

Now, for example, if we want to know the cost of the "Barge" option:

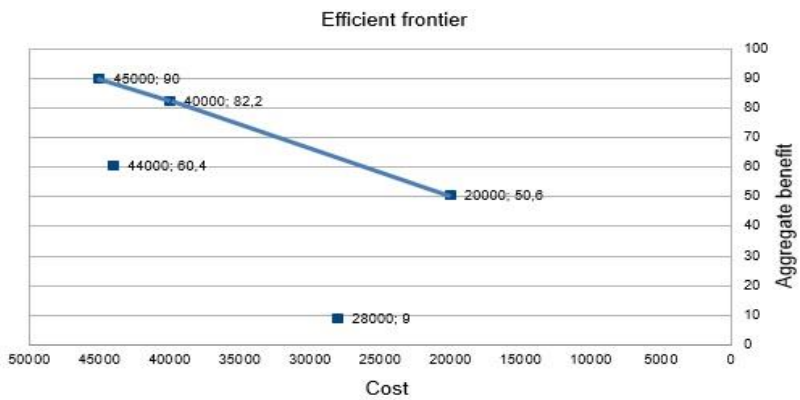
$$Spread = 45000 - 28000 = 17000$$

$$C(Barge) = \frac{17000}{250} = 68$$

Then, the decision-maker has to ponder the relationship between benefit and cost: values are multiplied for predetermined weights in order to achieve a total result.

Figure 16: Cost-benefit relation and efficient frontier

	Benefits	*Costs*	*TOTAL*
Barge	9	68	38,5
Sea Tanker	50,6	100	75,3
Road	90	0	45
Rail	82,2	20	51,1
Road & Rail	60,4	4	32,2
Weights	*0,5*	*0,5*	max: 75,3



This final passages are shown in figure 16. Results are then plotted in a chart where an efficient frontier can be underlined. The blue line represents the efficient frontier under which solutions are not convenient. Therefore, the final ranking sees Sea Tanker as the best option, followed by Rail and Road.

2.2.2 Non-discounted methods

Before going ahead in this paragraph, it is necessary to remind the rule according to which one euro received in the future has less value than a euro received today. This is because the money available today can be reinvested in order to gain a higher return. The today value of one euro that will be received in the future represents its *present value*. Investments can be assessed using discounted methods, where the future values of investments is discounted, or through un-discounted methods where cash flows are taken as they show up. In what follows we discuss the non-discounted methods.

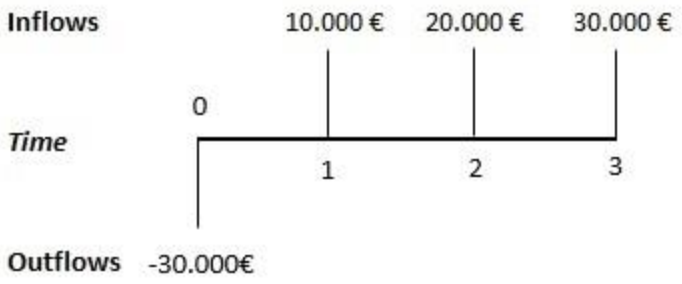
Payback Period

One of the most diffused alternatives to the NPV method is the *Payback Period*. Every investment comports an initial outflow and later, usually from the first year onwards, subsequent inflows. Cash flows always show up in different moments. Say that we decide to take an investment which cash flows, one per year, are (Figure 17):

$$(-30.000€, 10.000€, 20.000€, 30.000€)$$

We suppose that after an initial expenditure positive flows start from year 1 and follow until year 3. The payback period method determines how long it takes to obtain what we had pay at the beginning of the investment. In this specific case, the payback period is two years as the sum of 10000€ plus 20000€ gives 30000€.

Figure 17: Payback Period cash flows



Companies that follow this rule in their investment decision adopt it like a thumb rule: they choose a payback period they feel confident with (cut-off date) so that all the investments with equal or shorter payback period are accepted while longer ones are refused.

This technique is often used by large corporation when making relatively small decisions: middle or lower level managers are allowed to use it because it is simple and because it is related to investments of little amount. The method is suitable, for example, for small firms which have very fast-growth perspective and not so much access to capital: with a short payback such firms ensure to have the money needed for reinvestment opportunities within a pre-specified time period.

However, this method presents some limitations. First, it does not consider the timing of the cash flows within the payback period. If we compare two investments with the same payback we should undertake the one with higher inflows paid earlier (as the money could be reinvested to obtain a larger payoff). The method does not say anything about it because it does not discount flows. Second, it does not consider the cash flows after the payback period: if we are comparing two investments with same flows within the payback but different flows after the payback period, we should pick the one with higher inflows in the long term. The method, again, does not say anything about this dilemma. Third, the choice about the duration of the payback period is arbitrary; the method does not specify how to define it even though the financial situation of the company should be considered. Thus, despite simplicity and rapidity, this method does not seem applicable to a strategic investment decision such as entry mode choices.

Accounting Rate of Return

Another approach to investment decisions is the *Accounting Rate of Return*. The ARR method is calculated through the sum of the profits gained by the project less taxes and depreciation, divided for the accounting average value of the investment along its lifetime.

Suppose to have undertaken a five-year investment: you would be able to record revenues, subtract costs to them, get the gross flows, subtract depreciation and taxes to obtain a net profit. In *step one* we compute the average net profit, we provide an example using inputs of figure 17:

$$Average\ Net\ Profit = \frac{100.000 + 150.000 + 50.000 + 0 - 50.000}{5} = 50.000€$$

The decision maker has to find the net amount of the inflows from year 1 onwards. The initial expenditure is divided into the following years using a depreciation technique. The inflow for each year is also reduced of the amount of the taxes. Once the net values are obtained per each year

they can be sum and divided for the number of years involved in order to find the average net profit. In *step two*, we compute the average value of the investment summing the value of the investment of each year (initial expenditure less total depreciation) and divided for the number of years.

$$Average\ investment = \frac{500.000 + 400.000 + 300.000 + 200.000 + 100.000 + 0}{6} = 250.000€$$

Step three consists in dividing the average net profit with the average value of the investment, the formula results in the ARR. Firms may decide previously which is the minimum ARR they are willing to accept and use it as a rule for accepting or denying investments.

$$ARR = \frac{50.000}{250.000} = 20\%$$

Figure 18 provides a practical example of ARR computation for a five-year investment; the initial expenditure is 500000€ and the depreciation rule is the same amount per year.

Figure 18: Example of ARR computation

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenues	€ 433.333,00	€ 450.000,00	€ 266.667,00	€ 200.000,00	€ 133.333,00
Costs	€ 200.000,00	€ 150.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00
Gross Flows	€ 233.333,00	€ 300.000,00	€ 166.667,00	€ 100.000,00	€ 33.333,00
Depreciartion	€ 100.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00	€ 100.000,00
Gross Profit	€ 133.333,00	€ 200.000,00	€ 66.667,00	€ -	-€ 66.667,00
Taxes (t=0.25)	€ 33.333,00	€ 50.000,00	€ 16.667,00	€ -	-€ 16.667,00
Net Profit	€ 100.000,00	€ 150.000,00	€ 50.000,00	€ -	-€ 50.000,00

However, the ARR method presents two important weaknesses. First, it relies on the net profit and on the accounting value of the investment, both can be extracted from firm's budgets but sometimes they are arbitrary and non-monetary. For example, some costs are depreciated following an accounting techniques while others are attributed to the current year. In real life these choices are discretional. Second, the method does not consider the timing of the flows. In the example of figure 18, the result would not have changed if the net profits were inverted in different years, this because, again, discounted methods do not take timing into account.

2.2.3 Discounted methods

Net Present Value

The Net Present Value (NPV) method is widely suggested in the literature as the best approach for the valuation of any kind of project. The method takes into account the time value of money. The

same amount of money has different value if considered at different stages. The money available earlier can be invested (with a return rate) in order to obtain a higher payoff. This leads to take into account the future value (FV) or compounded value of that amount of money. The opposite consideration leads to the concept of present value (PV): how much money one must invest today in order to have a predetermined inflow tomorrow. PV is obtained dividing the FV by the discounting factor (one plus rate of return). Thus, by definition, the NPV is given by the sum of the present values of all the future cash flows less the initial cost.

$$NPV = -Cost + PV = -I_O + \sum_{t=0}^{N} \frac{NCF}{(1+r)}$$

Where:
N = number of periods
NCF = net cash flow
I = initial investment
r = discounting rate which corresponds to the opportunity cost of the financial resources invested.

The NPV is the present value of future cash flows (summation) minus the present value of the cost of the investment. The basic rule can be generalized as follows: accept a project if the NPV is greater than zero, reject it if NPV is less than zero. Let's look to a practical application in figure 19.

Figure 19: Example of Net Present Value computation

Year	Cash flow
0	-€ 10.000,00
1	€ 2.000,00
2	€ 2.000,00
3	€ 4.000,00
4	€ 4.000,00
5	€ 5.000,00

Discount rate = 10%

NPV = € 2.312,99

$$NPV = -10000 + \frac{€\,2000}{(1+0,1)} + \frac{€\,2000}{(1+0,1)^2} + \frac{€\,4000}{(1+0,1)^3} + \frac{€\,4000}{(1+0,1)^4} + \frac{€\,5000}{(1+0,1)^5}$$

The initial investment is 10000 euros which is followed by increasing inflows in the subsequent years. Applying the NPV, two concepts are relevant: cash flows and discounting rate. While we defined cash flows at the end of the paragraph 2.1.2, a clear definition of the discount rate has not been given yet. The discount rate is the rate of return used in a discounted cash flow analysis to determine the present value of future cash flows. In fact, in a discounted cash flow analysis, the sum

of all future cash flows (C) over some holding period (N), is discounted back to the present using a rate of return (r).

The concept of compound growth means that if we invest today 100.000€ and we earn 10% per year, then the investment will grow to about 161.000€. On the contrary, when we go back from a future value to a present value we use the rate of return as a discount rate.

In discounted cash flows analysis, the choice of discount rate can dramatically change the valuation. See the example in figure 20.

Figure 20: Sensitivity of NPV to the discount rate

YEAR	$	*Discount rate*	*NPV*
	-€ 1.000.000,00	8%	€ 79.854,20
1	€ 100.000,00	9%	€ 38.896,51
2	€ 100.000,00	10%	€ 0,00
3	€ 100.000,00	11%	-€ 36.958,97
4	€ 100.000,00	12%	-€ 72.095,52
5	€ 1.100.000,00	13%	-€ 105.516,94

Figure 20 shows how different discount rates lead to different NPV; since the thumb rule wants the decision maker to accept investments with a NPV above zero, the choice of which discount rate to use is crucial. Certainly, riskier activities require a higher discount rate: an investor would be willing to invest in a risky asset only if the return rate is reasonably high. Consequently, the higher the discount rate, the lower the NPV.

Now, individual and corporate may follow different strategies in the choice of the discount rate. Often, actors consider the opportunity cost of capital: it is the rate of return the actor would expect to earn in the marketplace on an investment of comparable size and risk. For a corporate, selecting the discount is a bit more difficult. Often the "weighted average cost of capital" is used, as it represents a "hurdle rate": the company, to be profitable, has to earn a rate of return greater than the cost of capital.

In finance, the risk-free rate is the theoretical rate of return of an investment with zero risk. It represents the return interest an investor would expect from a riskless investment over a period of time. This concept is based on the assumption that it is always possible to find in the market a stock which return is known ex ante. The risk-free rate will be used more ahead in the research.

NPV is a sensible approach which is based on three characteristics:

- NPV uses cash flows: while earnings are an artificial construct, flows represent actual cash which is suitable for capital budgeting techniques;

- NPV uses all the cash flows: other approaches (payback period for example) ignore cash flows beyond a specific date, in such a way it might be difficult to compare investments with similar flows in the period;
- NPV discounts the cash flows properly: this method takes into account the time value of money in a reasonable way.

Because of the applicability and the reliability of NPV method, the method is applied very frequently in practice.

Internal Rate of Return

The internal rate of return (IRR) is the most important alternative to the NPV method. It provides a single number to summarize all the values of a project: this number does not depend on variables of the external market but only on internal cash flows. The computation of IRR is quite simple as it is made with the formula of NPV. Let's assume that the NPV of an investment is negative. As cash flows cannot be modified, the only possibility is to change the discount rate. Adopting a trial-and-error procedure we can lower the discount rate until the NPV would be zero. By definition, the IRR is the rate of return at which the NPV is equal to zero. This brings us to the conclusion that if the discount rate is lower than the threshold indicated by the IRR the investment should be accepted, otherwise it has to be refused. Suppose to have several future cash flows. The IRR method allows the decision-maker to set the minimum NPV she is willing to accept for the investment. In the formula, the IRR can be posed as unknown variable and the equation is solved. In this way we can have information about which is the IRR needed to achieve a specific NPV. An easy example of a four-year investment, which require an initial expenditure of 500 euros, is provided in figure 21.

Figure 21: Example of IRR computation

Year	Cash flow
0	-€ 500,00
1	€ 100,00
2	€ 200,00
3	€ 300,00
4	€ 400,00

IRR = 27,27%

$$0 = -500 + \frac{€\,100}{(1+IRR)} + \frac{€\,200}{(1+IRR)^2} + \frac{€\,300}{(1+IRR)^3} + \frac{€\,400}{(1+IRR)^4}$$

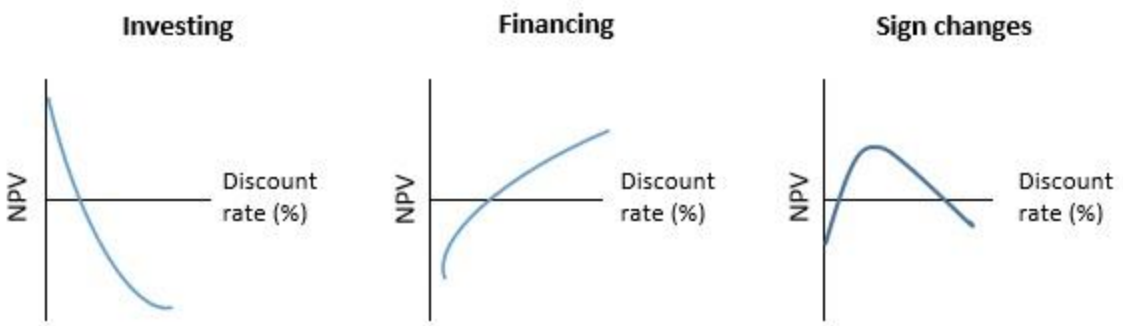
Thus, the IRR is the rate that causes the NPV of the project to be zero. The equation is resolved taking the IRR as unknown. The example in figure 21 tells the manager: accept the project if the IRR is greater than the discount rate, reject it if the IRR is less than the discount rate. It is clear, in fact, that the NPV is positive for discount rates below the IRR and negative for discount rates above the IRR; in cases like this, NPV and IRR rules coincide.

However, often the computation of IRR brings some problems. The first point of discussion regards the *investing or financing* situations. Common investments require a previous expenditure to gain future inflows (investing). Others, unusual but existing, first register an inflow and in the following period comport an outflow (financing). In the second scenario, the NPV is positively related to the discount rate: this implies that the financing should be accepted if discount rate is above the IRR and rejected if lower than IRR. Exactly the opposite of the investment situation. Thus as general rule we can say that investing project are the norm, accept projects with a discount under the IRR. In financing projects, the reasoning is the contrary.

A second point to be discussed concerns projects with *changes of sign*, as the project could have an initial outflow, then positive cash flows before other negative ones. How do IRR analysis behave in this situation? Project financed by lease agreements may follow this pattern of cash flows. In general, this changes in sign produce multiple IRRs: theoretically, cash flows with n changes in sign have n IRRs. When manager face two IRRs for a project they should accept those projects with a discount rate is out of the range.

The three situations of investing, financing and multiple IRRs are shown in figure 22.

Figure 22: IRR trends



The analysis of the IRR approach considers further limitation related to the nature of the projects. Projects can be mutually exclusive, it means that the company can choose to run project A or B, or none of them; to pick one exclude the other. Otherwise, projects can be independent: it means that the acceptance or rejection of one does not affect the acceptance or rejection of the other. These

relationships between projects lead to advanced versions (Ross et al. 2010) of the IRR such as the modified IRR (MIRR) and the incremental IRR which go beyond the intention of this paper to only present the traditional tool.

2.3 Limitations of traditional methods: a need of flexibility

In this chapter we went through a set of techniques which usually constitute the manager's toolbox for investment decisions. Graham and Harvey (2001) investigated the use of capital budgeting techniques in Canadian and US companies and they found that the percentages of managers who applied always or almost always a given technique was around 75 per cent for the IRR and the NPV. For the payback method it was 55 per cent while for the ACC or a discounted version of the payback only the 30 per cent. Moreover, in a scale from 0 to 4, companies used to apply very frequently (3.41/3.42) the IRR or NPV, 2.25 the payback method and only 1.50 or less the ACC and other tools. These insights from the field suggest what is the level of accurateness of the tools and tell the supremacy of NPV and IRR among others. However, the use of the techniques varies with the industry: firms able to reproduce and forecast cash flows can easily apply the NPV; on the contrary, firms operating in markets where prices fluctuate a lot and the demand is very uncertain are more likely to apply payback logics or other indexes.

2.3.1 NPV and uncertainty

Even though the NPV, when adopting the risk-free version, is easily applicable to several contexts, it encounters some limitation due to the fact that it does not take into account risk factors. Earlier in this chapter we defined risk-seekers and risk-averse decision makers and we said that they behave differently. With regards to this point, the applicability of the NPV is not influenced by the actor's attitude, but by the risk of the investment. For example, when flows are quite certain because of an undersigned contract with stable partner, NPV is likely to capture the actual present value of the investment. However, it is not difficult to imagine flows very uncertain in both monetary value and temporal manifestation. This is because reality is always different from the previsions a firm can carefully determine, we already introduced the issue in paragraph 1.3.3 for the exogenous side.
Micalizzi (1997) propose some risky areas in a project development.

- The *economic risk* is mainly due to exogenous factors like pricing, while *technical risk* concerns endogenous factors.

- The *operative risk* is related to the activities daily performed by the company in the implementation of the project. The *financial risk*, instead, regards three factors: leverage risk, due to the debt level of the company's financial structure; *rate risk*, which could produce unforeseen costs for the company; *exchange rate risk*, which is intrinsic to the fluctuations of the currency exchange rates.
- The *systematic risk* is due to the impact that great events that could take place would have on the general economy; the *specific risk*, instead, regards peculiar uncertainties related to the firm's activities and the likeliness that some of them do not succeed.
- The *sectoral risk* includes the risk due to existing and new entrant competitors and the technological risk of new innovations.
- The *market risk* is related partially to the general risk of the demand within the industry, and then it is related to the risks that emerge in the relations with suppliers and customers.
- The *country risk* depends on the relationship that firms establish with public authorities, their duties and the regulations.

This last risk area is especially critical for companies operating in foreign markets. Once managers recognize the exogenous and endogenous uncertainty that could potentially influence the project's performance they should also calibrate the decision-making technique adopted.

For example, NPV can be adapted to an uncertain context modifying the discount rate in the formula. This is what firms generally do following a debt-to-equity ratio. In the computation of the NPV illustrated in the previous paragraph, to include the specific risk related to the business, the formula can be modified substituting r with a risk factor. Literature suggests that it should corresponds to the opportunity cost of capital of a determine project, which consists on the expected return rate of an alternative investment with the same level of risk (Dallocchio 1996). Therefore, the WACC (Weighted Average Cost of Capital) approach begins with the insight that projects of levered firms are simultaneously financed with both equity and debt (Ross et al. 2010). It represents the rate the company expects to pay on average to all its security holders in order to finance its assets (Borsa Italiana: "Il costo medio ponderato", 2011). From an investor perspective, it is the minimum rate that a third party requires as return for investing in the company.

The WACC is an average between the cost of equity (Rs) and the cost of debt which is $Rb(1\text{-}t)$, where t is the tax rate. The weight for the equity, $S/(S+B)$ and the weight for debt $B/(S+B)$, are target ratios. Target ratios are generally expressed in terms of market values.

$$WACC = \frac{S}{S+B}R_S + \frac{B}{S+B}R_B(1-t)$$

The equity as well as the level of debt can be extracted from the budget of the firm. More difficult is the evaluation of the other factors. The cost of equity can be computed through the Capital Asset Pricing Model (CAPM) which assume a proportional relationship between the return of an asset and the risk premium of the market: the higher the risk, the greater the expected return. The formula to find Rs is:

$$R_S = r_f + \beta \times (r_m - r_f)$$

Where:

R(f) = risk-free rate
R(m) = expected market return
β = sensibility coefficient

The risk-free rate corresponds to the return of a riskless activity. β represents the value of the systematic risk, obtained by dividing the covariance between firm's returns and market returns (nominator) with the variance of market returns (denominator). β>1 represents high risk, β<1 represents less risk; if β is between 0 and 1 the risk is under the average of the sector and "moves" in the same direction. R(m) represents the average expected return of a diversified market portfolio. The cost of debt corresponds to the return on debt (ROD) which can be found by dividing financial chargers with the gross financial debt (both coming from the firm's budget):

$$ROD = \frac{Annual\ interest\ payment}{Market\ value\ of\ debt}$$

Filling all the inputs required into the formula the WACC is easy to find. This approach is reasonable to apply when the debt-to-value ratio remains constant over the life of the project which is true for most real-life investments.

Another way to develop a risk analysis is called *sensitivity analysis,* whereby the decision-maker aims to underline the possible consequences due to the uncertainty related to the most important variables characterizing the project.

The method consists in determining some hypothesis in order to assign to each variable a likely value. With these new values, the relative NPV is computed. The final objective is to examine the variability of the result as one of the variables changes assuming others to be constant. The sensitivity is given by the following formula:

$$\text{NPV variation/variable variation}$$

This procedure is applicable only when risk factors are identified and their variations can be hypothesized and it does not take into account the probability of events to occur. Moreover, the analysis is limited as long as it computes the sensitivity with one factor variation at a time, while uncertainty is always due by a combination of factors.

Uncertainty emerges when it is not possible to determine a priori the probability distribution of the expected outcomes of the project. Indeed, when uncertainty is high the investment cannot be described by only one cash flow but by a series of flows. Therefore, the risk measure of an investment is given by the dispersion (volatility) of these possible flows around the expected one. The version of NPV presented in this paragraph overcome the main problem related with the uncertainty but it does not solve other problems explained in the next section.

2.3.2 Additional limits of traditional techniques

Complicated projects present subsequent and interdependent choices, characteristics that the NPV method struggle to capture. A complicated project is usually fragmented into phases, it is uncertain in both inflows and outflows and is often influenced by external variables. Such an investment requires a careful definition of the critical nodes and the analysis of the interrelatedness between components. Think about the investment made to open up sales in a foreign country. We could design it as a gate and go stage process in which the company can proceed only if it receives positive feedback (performance). Certainly, there would be an information seeking phase, an entry phase and hopefully a growth phase. Then, cash flows can be predicted but the level of uncertainty is high: the firm could define earlier the initial costs, but unforeseen costs can emerge, inflows can follow the assumptions made but they can change over time as well. Therefore, the techniques adopted should be flexible enough to capture this complexity.

When do capital budgeting techniques fail? Micalizzi (1997) gives three answers. First, when the technique applied is not correct for the investment considered; second, when the method is right but the application is developed in a wrong way; third, when existing methodologies do not fit completely the reality.

When the environment is relatively uncertain and the firm's goal is to maximize the firm's value, NPV is still considered the main tool of capital budgeting. Are NPV and the other techniques analyzed suitable for all kind of investments? Surely, they succeed in normal investments, but their limit in pondering uncertain factors which characterize real project suggests that they are not successful when evaluating *strategic investments*. These investments (see paragraph 2.1.2) are

characterized by a high level of uncertainty and by flexible progressive decisions. Traditional tools, especially NPV, seem not to match the peculiarities of strategic investments for three reasons (Micalizzi 1997):

1. NPV assumes that cash flows are determined before undertaking the investment and, once obtained, management is expected to merely execute the operations related to the investment. NPV is a great tool when the management does exactly what the predetermined plan says.
2. The WACC, assumes that the level of riskiness of the project will remain the same along its whole life and for that reason it can be determined when it begins.
3. Projects must be independent, they do not have to affect the future performances of others and their consequences must be resolved within the NPV computation.

Quite often, we know, the decisions related to a project require further data and must be assessed later in time, the level of uncertainty may change over time, and the decisions taken may have effect on others projects and other projects can affect the one considered. Thus, what management should do if the discount rate is not identifiable correctly and if the firm struggles in defining relatively certain cash flows? The strategic investment would be very hard to assess. Furthermore, as the investment is strategic, it probably needs an amount of resources that changes the status quo inside the company producing effects on other projects and activities. Again, think about a project organized in phases, where a decision will be taken at the end of each phase according to the performances. Phases are not linked each other in a way that allow decisions to be taken in advance and performances are not easily definable.

As foreign market entry modes are processes fragmented in phases, often uncertain in cash flows and influenced by circumstances factors, traditional tools result to be outdated and not appropriate to evaluate them. Specifically, entry mode decisions have a strong interaction with future opportunities. Indeed, the entry mode determines the structure and the operations a firm will adopt to enter the new market; as explained in the end of paragraph 1.3.3, these elements are not easy to change in future and will influence the ability of the firm to join new opportunities or not. Strategic investments, entry modes among others, require more flexible techniques capable of capturing the right values of the options proposed under conditions of complexity, uncertainty and multi-step analysis. Two techniques are presented in the next chapter with the aim to bridge the gap.

Chapter 3

In search of flexibility

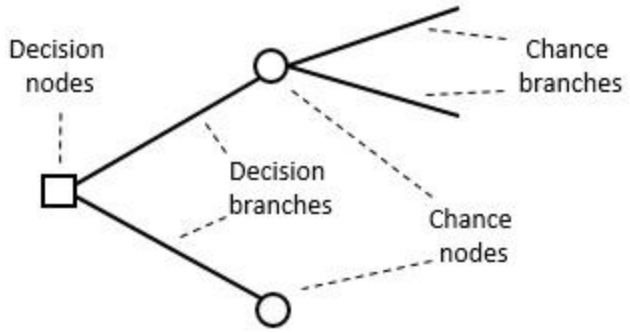
3.1 Decision tree analysis

3.1.1. Theory on decision trees

Complicated problems can find resolution through a model where decisional junctions are represented by a flow diagram called tree of decisions (DT). In fact, as seen in paragraph 2.3.2, the interrelatedness and the complicatedness of a problem require a precise definition of crucial moments in the timeline when important decisions have to be made, specific dates are not important but the sequence does. A decision tree describes graphically the decisions, the events that may occur and the outcomes associated with the combinations of decisions and events. Probabilities are assigned to each event, and values are determined for each outcome. The first element that deserve to be mentioned of this method is the possibility to draw the alternatives including more details (Clemen 1996). Decision trees are a good way to ignore sunk costs as they do not find graphical inclusion. Moreover, they allow also to include uncertainties in the analysis knowing that often they depend on other events or other players (Gilboa 2011). External uncertainties are not controllable by the single decision maker. When other players are operating in the same industry, we try to figure out what they might do or which is the likelihood that they undertake some actions, and sometimes we do something with the aim to influence their decision process. In other words, players in the same context often have control upon some of the events which characterize our decision tree. Moussa et al. (2006) underline the ability of DTs to process choices under uncertainty and that they are suitable especially for decisions under risk because of their ability to represent the probability of the consequences of decisions. Gilboa (2011) stresses also the fact that decision trees are very useful in representing consequentialism: arriving at a certain decision, I can forget about all the other parts of the tree, including the path that led me where I am. The current choice, at a particular point of the tree, should depend only on the options available. Consequentialism allow people to avoid behaviors to be influenced by regret feeling and sunk costs, whatever choice you could have done belong to a subtree, different from the one you are facing.

The skeleton of a single stage decision tree is shown in figure 23. The tree flows from left to right, and so the initial square node on the left side represents the starting point of the analysis.

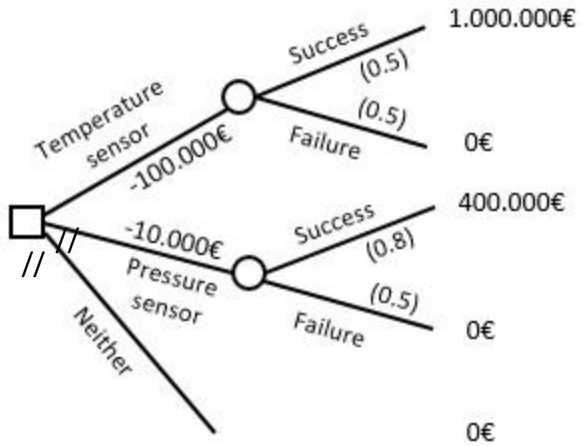
Figure 23: Decision tree



Source: Oakshott (2009)

Square nodes represent the points where the decisions are made, while the round nodes are the points at which chance takes over (Oakshott 2009). The first node on the left is called *decision node* or *root node*. *Decision branches* represent the alternatives available to the decision-maker: each one has an own intrinsic value and each one requires an initial investment to be undertaken. The alternatives' value is computed in the *chance nodes*, while *chance branches* tell the probability of an event to occur. We recall that the sum of the probabilities associated with chance branches must be equal to 1. On the right side of the tree, at the end of the flow, *outcomes* are written for each scenario; these are also called *endpoints* of the tree. Figure 24 helps in clarifying the decision tree structure. Once a decision or a chance branch is recognized to be of lesser value that branch is expelled from the tree by "pruning" (//). In the tree depicted, the decision regards which of the alternative products should a firm implement.

Figure 24: Decision tree example: product implementation



Source: Oakshott (2009)

Say that the firm can opt for one of the two alternative products or for not to implement a new product at all. The temperature sensor is more expensive to implement but it has a great potential in the market; instead, the pressure sensor is more affordable. Once the product is chosen it can be successful or it can be a failure, chance branches indicate the probability for each event. At the endpoint, revenues are listed. To compute the overall value of each alternative the concept of *Expected Monetary Value* (EMV) is needed. The computation moves from the right to the left following the opposite path of how the tree is built and read, for that reason the process is called *rollback method*.

First, we need to compute the net profit (NP) at the endpoint of each chance branch. If the company opt for the temperature sensor and they succeed:

$$NP = 1.000.000 - 100.000 = 900.000€$$

While, if the new product fails in the marketplace:

$$NP = 0 - 100.000 = -100.000€$$

If the company decides to opt for the pressure sensor, and the new product succeeds:

$$NP = 400.000 - 10.000 = 390.000€$$

While, if the pressure sensor fails:

$$NP = 0 - 10.000 = -10.000$$

Once obtained all net profits, EMVs can be computed:

$$EMV(temperature) = 0.5 \times 900.000 + 0.5 \times (-100.000) = 400.000€$$

$$EMV(pressure) = 0.8 \times 390.000 + 0.2 \times (-10.000) = 310.000€$$

The EMVs integrate in the analysis the probabilities of success and failure events. Even though the distance between the net profits is dramatically reduced, the temperature sensor remains the best alternative for the company.

The example above illustrates how decision trees can handle complex situations in which different scenarios have different likelihood to occur. Probabilities have certainly a strong impact on the numbers employed in the EMV computation but they are not the only influential factor. If the outcomes are the same for different alternatives, and only the probabilities differ, then probabilities

alone are sufficient to say which of the alternatives is the best. In the next section advanced decision trees are presented to find a better match with real-world situations.

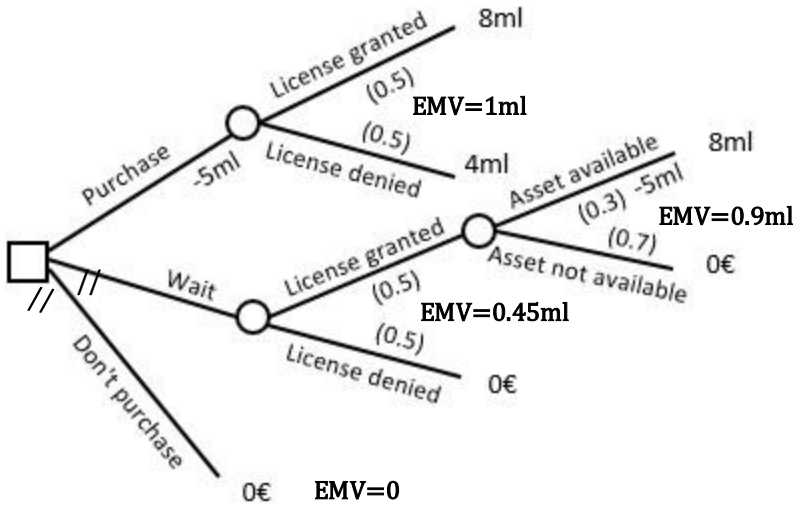
3.1.2 Advanced decision trees

Real-life decisions are often *multi-stage* and imply the phenomena of *dependent uncertainties*. Multi-stage means that the whole flow is drawn through an initial tree, and then through subtrees with their root nodes, which are essentially other decision nodes of the tree. Uncertainties, instead, are said dependent because one is subsequent the other: this means that the decision maker cannot consider them separately, the first one somehow affects the subsequent one by reducing it. The rollback method has to be applied as in the traditional tree but this time more steps of calculation take place. Two examples with relative solution processes are discussed in the following sections. Examples are taken from the teaching materials of the Techniques for Managerial Decision course (Tolotti 2015) of Ca' Foscary University.

Dependent uncertainties

Imagine a firm which is looking for making a huge investment. The decision is whether to purchase now the required assets or not, taking into account that in the next future a license has to be issued to allow the company to operate. Another option is to wait in order to see before if the license will be available and then to purchase the assets: in this case we need to take into account that the asset might be no longer available. Here the firm faces two stages of uncertainty, the license allowance and the availability of the asset. See figure 25 to understand the flow. Once the asset is purchased, if the license will not be granted the firm will be able to sell it at a lower price.

Figure 25: Example with dependent uncertainties



Once the tree diagram is plotted it is easier to realize the two elements of uncertainties. To make it clear an additional specification is needed. The second uncertainty is somehow dependent from the first one, this shapes also the nature of the probability. Mathematically, this is called conditional probability and it is computed through the *Bayes' theorem*. The formula aims to find the relevant probability that should be applied when one probability is anticipated by another one.

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B)}$$

(1)

Remember that, when events are independent:

(2)
$$P(A \cap B) = P(A) \times P(B)$$

More ahead, the formula of total probability will be useful as well:

(3)
$$P(A \cup B) = P(A) + P(B)$$

This is the reason why in the EMV computation we still use probabilities 0.3 and 0.7, the license allowance and the availability of the asset are not related each other. However, this concept helps us to note that the second uncertainty is described by conditional probabilities:

$$P(asset\ availability|license\ granted) = 0.3$$
$$P(asset\ not\ available|license\ granted) = 0.7$$

Three endpoints result with 0 profits as no investment was made and no revenues are obtained. In three others endpoints a revenue is achieved: if the company purchased and the license was granted revenues would be 8 million; the same revenues would show up if after waiting the license was granted and the asset still available; if the asset was bought and the license not granted the revenues would be 4 million. Anyways, purchasing consists in a 5 million expenditures.

We can compute the net profit. In case the company purchase and the license is granted:

$$NP = 8.000.000 - 5.000.000 = 3.000.000€$$

In case the company purchase but the license is denied:

$$NP = 4.000.000 - 5.000.0000 = -1.000.000€$$

Then, in case the company decides to wait, the license is granted and the asset still available:

$$NP = 8.000.000 - 5.000.000 = 3.000.000€$$

To evaluate the tree, we need to compute the EMV for these three endpoints. It appears clear that the third net profit calculated above is subject to two uncertainties experienced in subsequent moments. So that the first EMV to compute applying the rollback method is:

$$EMV(wait_2) = 0.7 \times 0 + 0.3 \times 3.000.000 = 900.000€$$

Now, we can compute the final expected monetary values for each branch:

$$EMV(purchase) = 0.5 \times 3.000.000 + 0.5 \times (-1.000.000) = 1.000.000€$$
$$EMV(wait) = 0.5 \times 0 + 0.5 \times (900.000) = 450.000€$$
$$EMV(not\ purchase) = 0€$$

The rollback method allows us to find the final expected value in monetary terms per each decision branch: not purchasing brings no value at all, purchasing is 1 million worth while the expected monetary payoff is case of waiting is only 450.000€. Therefore, purchase immediately is the best choice.

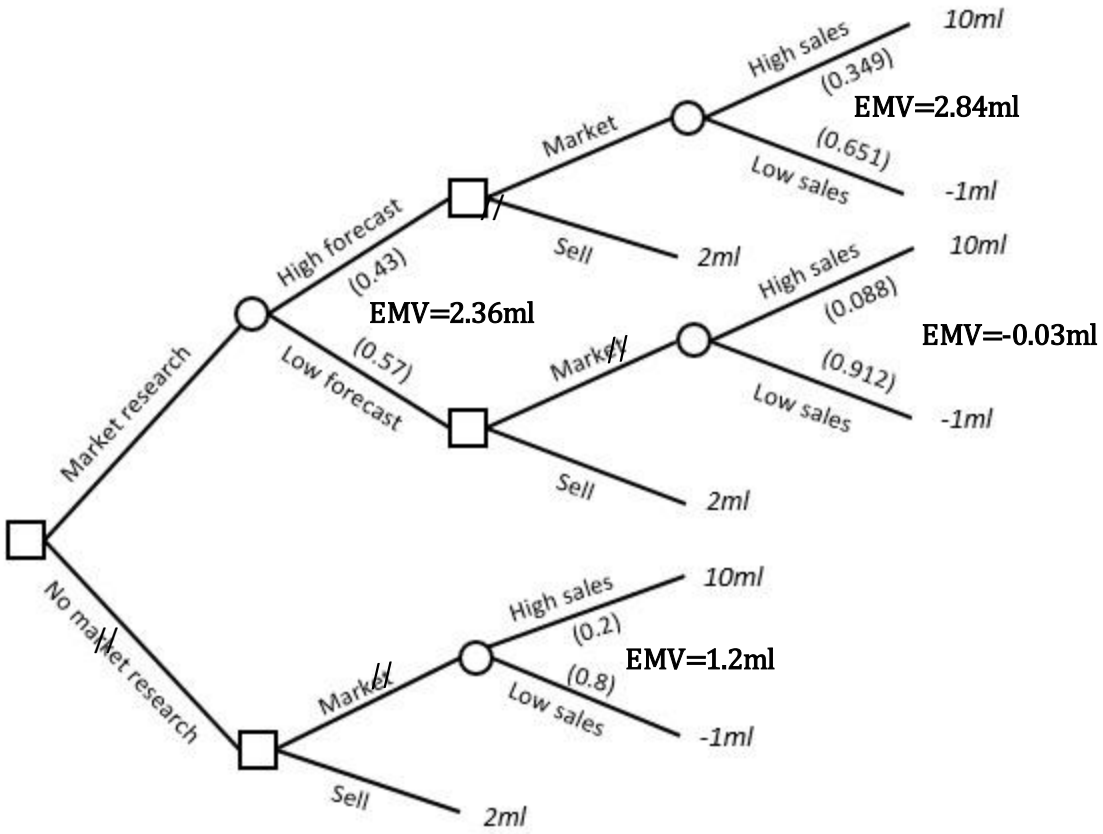
Sequential decisions

Real business problems often include sequential steps: a set of consecutive decisions one actor has to make. In this case, the tree presents more decision nodes and branches, one for each additional decision. This wider tree diagram is probably well applicable to the topic of this research as the foreign market entry is made of consecutive decisions sensitive to the SME's performances.

The following example starts from a root node in which the management wonders whether to market a product or not. As the competition is very strong in the sector, the company is thinking about selling the rights for 2 million. However, if the decision is to market the product, there could be high sales, with probability 0.2, or low sales, with probability 0.8. To each option a profit or a loss is associated. The additional alternative (which enlarge the diagram) is to commission a market research survey. Knowing the market research analysts, the company foresee that the result will be 75 per cent correct when sales are supposed high, and 65 per cent when sales are supposed low. Even if research would advise against marketing the product, the company still can sell the rights. This multi-staged problem is exposed in figures 26 and 27. Note that some probabilities are missing: the probability of market research giving a high and low forecast and the probability of high and low demand given the different outcomes of the market research. These probabilities can be computed through the theorem of Bayes.

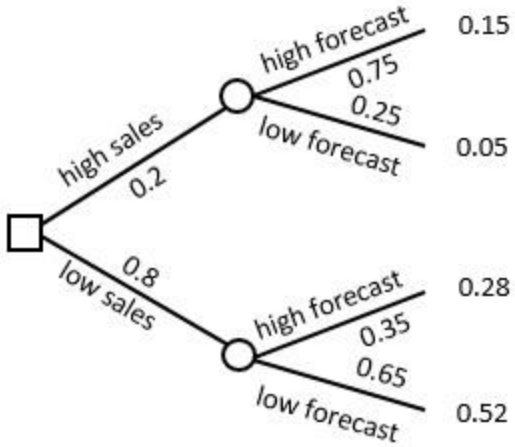
In figure 26 the final decision tree is plotted.

Figure 26: Sequential decision tree



Before drawing it, we had to do a step back. In figure 27, the last information provided by the track are represented. The probability tree is addressed to find the intersection probability between the events high or low sales and the results of the market research.

Figure 27: Partial probability tree



For example, applying formula (2), 0.15 is the result of 0.75 times 0.2, and so on. Now we can use formula (3) to compute the following probabilities:

$$P(high\ forecast) = 0.15 + 0.28 = 0.43$$
$$P(low\ forecast) = 1 - 0.43$$

Then, formula (1) is applied to compute the conditional probabilities needed in the diagram:

$$P(high\ sales|high\ forecast) = \frac{0.15}{0.43} = 0.349$$
$$P(low\ sales|high\ forecast) = 1 - 0.349 = 0.651$$
$$P(high\ sales|low\ forecast) = \frac{0.05}{0.57} = 0.088$$
$$P(low\ sales|low\ forecast) = 1 - 0.088 = 0.912$$

Now, the whole decision tree can be built and the probabilities found can be used and applied to develop the rollback method.

The tree in figure 26 is a sequential decision tree as there are more decision nodes in which the EMV has to be computed. Thanks to the previous calculations all the probabilities are listed and the rollback process can be developed, the net profits are written at the endpoints. For simplicity it was not included in the analysis the cost of making the market research as the aim here is to show how sequentiality works in decision trees. Let's calculate now the EMV in order to find the best path to follow. First of all, we compute the EMV for the three chance nodes on the right of the diagram.

$$EMV = 0.349 \times 10.000.000 + 0.651 \times (-1.000.000) = 2.840.000€$$
$$EMV = 0.088 \times 10.000.000 + 0.912 \times (-1.000.000) = 30.000€$$
$$EMV = 0.2 \times 10.000.000 + 0.8 \times (-1.000.000) = 1.200.000€ \times$$

Thus, the option with higher value must be selected: so that 2.84 million is preferable to 2 million, 2 million is preferable to a loss of 30 thousand euros and 2 million, again, are preferable to 1.2 million. The last EMV must be computed in the first and upper chance node:

$$EMV = 0.43 \times 2.840.000 + 0.57 \times 2.000.000 = 2.360.000€$$

Since 2.36 million is a higher amount the 2 million obtained in the lower branch the preferred pattern emerges. Therefore, if the cost of the market research is sustainable, the company should commission it. This step allows the introduction of another concept said *expected value of missed information*. In the example, the expected value of missed information is the difference between the outcomes in the "market research" and "not market research" branches, 2.36 and 2. In other words, 0.36 expresses the difference between the levels of uncertainty existing in the two

alternatives; the difference is due to the fact that one branch (market research in this case) leads to solutions reliant on a larger amount of information.

3.1.3 Decision tree limitations and the entry mode perspective

Despite the path of subsequent decisions to take, the sequential decision tree appears similar to the basic decision trees and follows the same rules. Its major quality is to allow managers to take decisions considering alternative scenarios that could occur in consecutive periods of time. However, decision trees face also some limitations.

- First of all, decision trees do not take into account the decision-maker's attitude to risk (Oakshott 2009), we have seen before that actors are naturally divided in risk-averse and risk-seekers. The most convenient pattern along the flow is chosen through the expected monetary value pondered by probabilities, no reference is made towards the actor's willingness to risk. In fact, in the example proposed on sequential trees, managers could have considered the investment of one million narrow compared to the 10 million gain.
- Second, the EMVs computed along the tree are not flexible enough to back eventual modifications in the inputs, even the smallest change in the probability or in the revenues of one option can make the other alternative better. Indeed, outcomes and payoffs can later emerge different from how we expect.
- Third, trees built to represent complicated problems are often complex, they require time to be plotted and they can be made of subtrees, as we have seen. Therefore, the decision process can take more time than in other methods. Complexity leads to another issue: since probabilities and revenues are somehow forecasted, the more nodes are in the tree and the more EMVs you have to compute, the less accurate the analysis is likely to be.
- Finally, a relevant constraint is represented by probabilities. How do we compute them? Often, probabilities are decided by managers who give a personal opinion, based on their experience and knowledge of the market, about how likely is an event to occur. This perhaps represents the main weakness of the method.

Given these weaknesses which may affect the results, some authors criticized the application of decision trees on multi-level problems. For example, Moussa et al. (2006, p. 1254) state: *"Most scholars tend to agree that the EV approach is suitable for repetitive decisions because it represents the average outcomes for the long run. However, the EV approach does not work for all repetitive problems; it is suitable only for situations where decisions are not only repetitive but also*

deterministic". Brennan and Trigeorgis (2000, p. 3) say that decision tree analysis *"offers little guidance as to how future decision probabilities or contingencies affect project risk and therefore project discount rates".*

Despite these limitations, decision trees have the merit to force managers to think about as many possible consequences of a decision as they can, and about how likely they are. In this way decision-makers have a clearer vision of both positive and negative scenarios they could face and the decision is taken more conscientiously. At this point, the question is whether these pro and cons make the decision tree method applicable to the object of the research, the foreign market entry modes. The analysis made in chapter one underlines three main needs: flexibility, in order to include on the decision eventual ongoing modifications; phases definition, in order to reflect in practice the real entry process; to ponder uncertainty, in order to deal with the most important unknowns faced by firms. Multi-stage (sequential) trees seem to fit quite well these needs as their characteristics fit the structure of new market entry modes. We can think about a SME which can enter a new foreign market only through a special license provided by local institutions, managers know that the company is in list for that allowance as others foreign competitors do, so they assume a probabilistic perspective. Additional personnel can be hired immediately in order to provide them the training needed in advance and be able to operate in the foreign country as soon as the license is released. At the same time, the company may prefer to wait and see if the license is detained. The company, thanks to its international experience, knows that once entered it would take two years to reach the breakeven. However, if sales are good enough, management would tend to establish an own subsidiary after one year in order to grow more rapidly. If sales are low the firm would keep the export mode and reach the breakeven without any change, even if this would probably mean a little loss. This problem can be easily represented graphically through a decision tree.

Even if this is a simplified example, the tree approach responds to the need of a multi-phase representation of the problem. Literature did not frequently apply this method applied to the topic of entry modes. However, we will see in the next paragraphs that decision trees were largely applied in this field when designed as skeletons of real options.

3.2 Real option analysis

3.2.1 Option theory

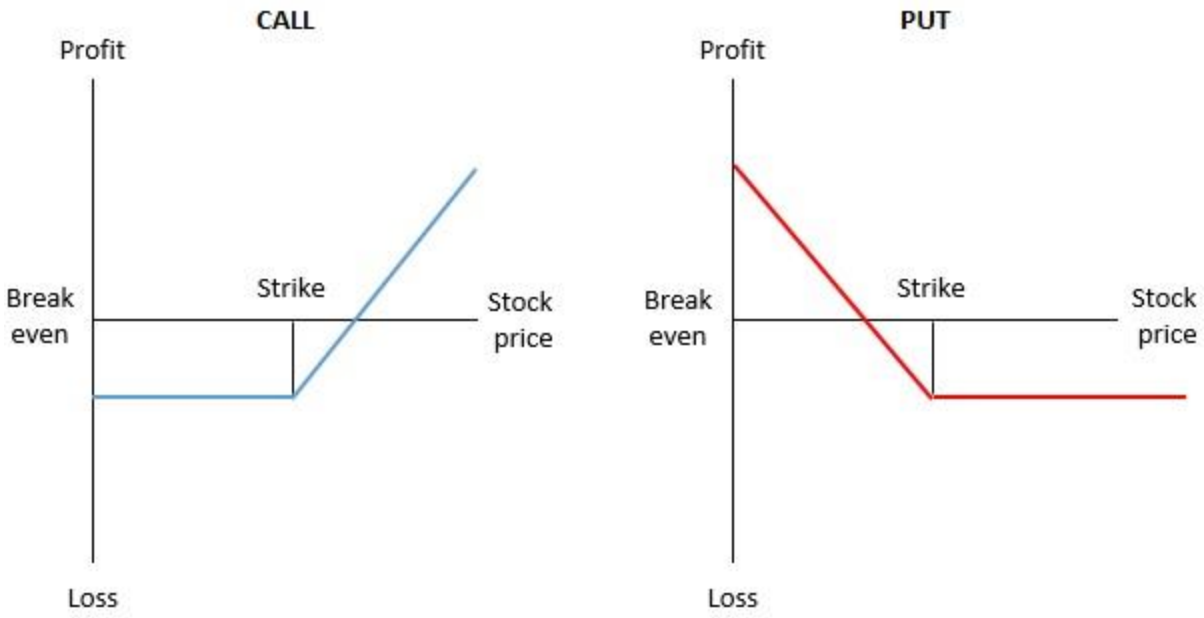
The real option (RO) approach is somehow the extension of financial option theory on real (non-financial) assets. While financial options are handed by a contract, real options are embedded in

strategic investment decisions. In 1977, professor Steward C. Myers of MIT Sloan School of Management introduced the concept of "real options" and years later he wrote (1984, p.16): *"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".*

In finance, an *option* is a contract whereby the owner has the right, but not the obligation, to acquire (call option) or sell (put option) an underlying asset which the option has been created on. The option can be exercised at the fixed *strike price*, at any date before maturity (American) or at the maturity (European).

The *call option* exercised guarantees to the owner the right to receive the underlying asset at the given pre-specified price. Therefore, as shown in figure 28 (left), the call option makes sense to be exercised only when the stock market price exceeds the strike price. In the horizontal axes there is the price of the underlying asset at maturity, in the vertical axes profits are shown. In terms of payoff, the initial price (premium) causes a loss because the option has a cost. The investor bet on the increasing price of the stock so that its payoff will rise; on the contrary, if prices go down the investor will lose the premium paid.

Figure 28: Call and Put Options



Source: www.borsaitaliana.it, "Cosa sono le opzioni" (2011)

The *put option* guarantees to the owner the right to sell the underlying asset at a fixed price at maturity. Therefore, the option makes sense to be exercised only if the underlying asset market

price is lower than the strike price (see figure 28, right). The profit corresponds to the difference between the strike price and the market price. This option is convenient when the market price is lower than the strike.

Denote with S the current price of the underlying asset and X the strike price, the value of the call and put option at maturity is determined as follow:

$$V_{call} = MAX(S_T - X, 0)$$
$$V_{put} = MAX(X - S_T, 0)$$

In particular, an option is said to be "at-the-money" when the strike price is equal to the price of the underlying asset. It is said to be "in-the-money" when the investor has a profit, the strike price is lower in call options (higher in put option) then the price of the underlying asset. It is said to be "out-of-the-money" when it is not convenient to exercise the option. These concepts will find clearer definition in the next sections where the problem of strike price definition is examined.

3.2.2 Methods for valuing financial options

Options are part of a larger class of financial instruments known as derivative products, or simply, derivatives. Many options are created in a standardized form and traded through clearing houses on regulated options exchanges, while other over-the-counter options are written as bilateral, customized contracts between a single buyer and seller, one or both of which may be a dealer or market-maker.

There are the factors influencing the value of an option:

- The *stock price* (S_T) and the *strike price* (K), as we presented in the previous section. For call options, the higher the stock price, the higher the value of the option. For put options, the higher the stock price, the lover the value of the option.
- *Time to maturity* (T) tends to increase the value of an option as a higher it is, the more chances the holder has to exercise it. This is true for American options, which can be conveniently exercised before maturity.
- Stock prices' *volatility* (σ): volatility is a measure of the risk of the stock and it represents the uncertainty related to its future price movements. If the volatility, is high it means that prices could assume a broad range of future values. In case of a call option for example, the holder welcome positively a high upward volatility because it represents a n increase in the option's value.

- The *risk-free rate* (r) is the interest rate influencing the value of cash flows. While increases in the interest rate usually comport a decrease in the stock prices, here the higher the risk-free rate the higher the value of the option.
- The *dividends* (D) expected from the stock: since the value of the stock decreases whenever dividends are distributed, they have a negative effect on a call option's price.

The two most important methods for financial option valuation are the Black and Scholes (1973) formula and the binomial lattice model introduced by Cox, Ross and Rubistein in 1979.

The Black and Scholes formula

The Black-Scholes formula gives a theoretical estimate of the price of European options. Black and Scholes use a "replicating portfolio", a portfolio composed of the underlying asset and the risk-free asset that had the same cash flows as the option being valued, to come up with their final formulation.

The model is based on three assumptions on the asset.

- The rate of return on the riskless asset is constant and thus called the risk-free interest rate.
- The instantaneous log return of stock price is geometric Brownian motion, and we will assume its drift and volatility is constant.
- The stock does not pay dividends.

Other assumptions on the market are:

- there is no arbitrage opportunity;
- it is possible to borrow and lend any amount of cash at the riskless rate;
- It is possible to buy and sell any amount of the stock;
- The above transactions do not incur any fees or costs (i.e. taxes).

Given these assumptions, authors demonstrated that the value of a call option C) and a put option (P) are respectively:

$$C(S,t) = N(d_1)S - N(d_2)Ke^{-r(T-t)}$$

$$P(S,t) = Ke^{-r(T-t)} - S + C(S,t) = Ke^{-r(T-t)}N(-d_2) - N(-d_1)S$$

With:

$$d_1 = \frac{ln\left(\frac{S_t}{X}\right) + (r + \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}}$$

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

Where:

$N(d)$ = cumulative distribution function of a standard normal distribution
$T\text{-}t$ = time to maturity
S = spot price
K = strike price
r = risk-free rate
σ = volatility of returns of the underlying asset

Binomial lattice model

The approach presented here is called CRR method from the name of its authors, Cox, Ross and Rubistein (1979). The model adopts binomial trees (also called "lattice trees" in finance) to represent graphically a multi-stage pattern. The model assumes that the underlying asset could rise to an upper value (increment) or fall to a lower value (decrement) during each interval composing the time horizon. The method proceeds along three steps. First, the decision tree is built; second, the option value is calculated for each final node; third, a sequential calculation of the option value at each previous node has to be made.

In order to determine the *up* and *down* states, the binomial model uses two estimators:

$$u = e^{\sigma \times \sqrt{\Delta t}}$$

$$d = \frac{1}{u}$$

Where:

σ = standard deviation of percentage variations of flows.

Δt = time period steps.

Authors make the assumption that the interest rate is constant, so that letting r being one plus the riskless interest rate over one period they also require $u>r>d$. In fact, under the risk neutrality assumption, today's fair price of a derivative is equal to the expected value of its future payoff discounted by the risk free rate.

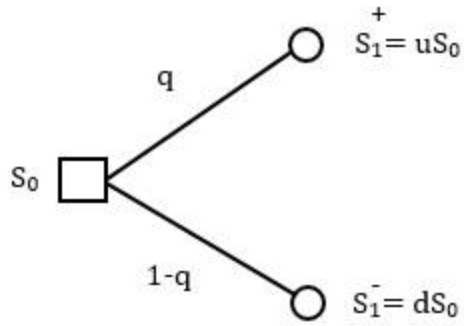
Therefore, the model assumes that from each value, say S, two other values can derive in the next period, S^+ and S^-, following the natural evolution of the binomial tree. They represent an approximation of the future expected values of the cash flows. They can be found through the following formulas:

$$S^+ = u \times S$$

$$S^- = d \times S$$

In other words, S represents the value of the risky activity which may increase to S^+ with probability q, or decrease to S^- with probability 1-q. Figure 29 shows the aspect of a lattice tree employed in the CRR method and developed along one period of time.

Figure 29: Binomial tree in the CRR method



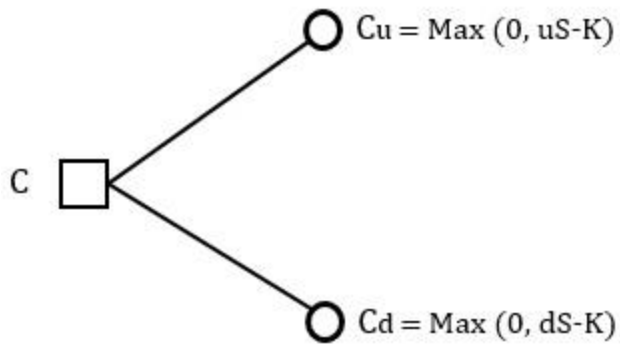
Source: Cox, Ross and Rubistein (1979)

Now, at each final node the intrinsic value of the option (exercise value) has to be found, it corresponds to the higher between zero and the node value less the initial investment:

$$C_u: Max[0, uS_0 - K]$$
$$C_d: Max[0, dS_0 - K]$$

Where K is the strike price and S is the spot price of the underlying asset at a certain period. We can transfer this step in the tree as shown in figure 30.

Figure 30: Binomial tree, value of the option in period one



Source: Cox, Ross and Rubistein (1979)

Once this step is complete the rollback process can be followed and, starting with the penultimate node, we work back to the first node of the tree, whose value is the value of the option.

Remaining in a one period life of the option, we suppose now to build a portfolio containing Δ shares stock and an amount B of riskless bonds. Since we can select Δ and B in a way we wish, suppose we

choose them in a way to equate the end-of-period values of the portfolio and the call for each possible outcome. In such a way we build a So that we have:

$$\Delta uS + rB = C_{\mathrm{u}}$$

$$\Delta dS + rB = C_d$$

Solving the equations as a system we find:

$$\Delta = \frac{C_u - C_d}{(u-d)S}$$

$$B = \frac{uC_d - dC_u}{(u-d)(1+r)}$$

Additionally, if there are no riskless arbitrage opportunities:

$$C = \Delta S + B = \frac{C_u - C_d}{u-d} + \frac{uC_d - dC_u}{(u-d)(1+r)} = \left[\left(\frac{r-d}{u-d}\right)C_u + \left(\frac{u-r}{u-d}\right)C_d\right] : (1+r)$$

This is true only if that value is greater than S-K, otherwise C=S-K. Simplifying the second part of the equation above we define p and 1-p as follow:

$$p = \frac{(1+r)-d}{u-d}$$

$$1-p = \frac{u-(1+r)}{u-d}$$

Observe that p will always have a value between 0 and 1. In fact, p is the value that q would have in equilibrium if investors were risk neutral.

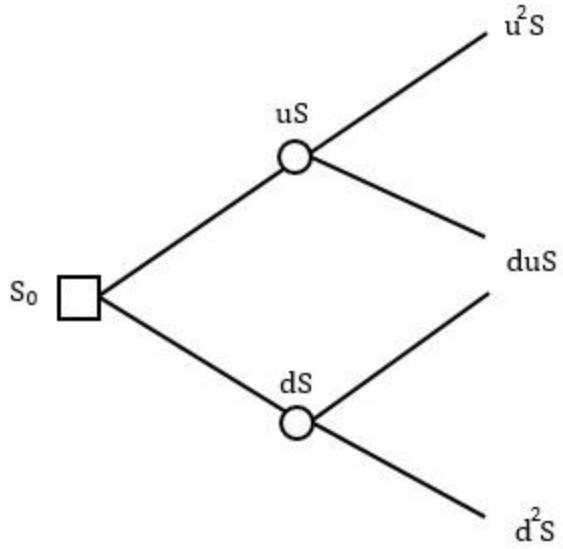
Therefore, expected values are calculated multiplying the option values of the later two nodes (up and down) times the respective probabilities (p and 1-p). The expected value is then discounted at the risk free rate (r).

We are now able to synthetize the formula for C as:

$$C = \frac{pC_u + (1-p)C_d}{(1+r)}$$

Trying to add additional stages in the model, let's say two, the tree would result in three possible outcomes, as figure 31 shows.

Figure 31: Option tree in a two-stage period



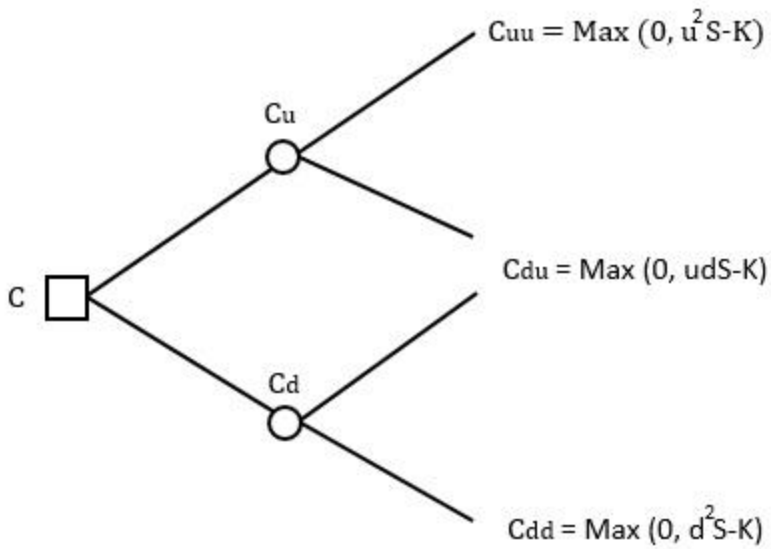
Source: Cox, Ross and Rubistein (1979)

Similarly, we can compute now the value of the option at each end node of the tree, from the upper one to the bottom we have:

$$C_{uu} = max[0, u^2S - K]$$
$$C_{du} = max[0, duS - K]$$
$$C_{dd} = max[0, d^2S - K]$$

For example, C_{uu} stands for the value of an option two periods from the current time if the stock price goes up for both periods; the other two values follow the same logic. Remember also that Cud and Cdu are the same value. Following the same procedure of one period life options we obtain the tree in figure 32:

Figure 32: Value of the option in two periods



Source: Cox, Ross and Rubistein (1979)

Following the procedure of Δ and B we can obtain a replicating portfolio represented in the two equations that follow:

$$\Delta u^2 S + rB = C_{uu}$$
$$\Delta udS + rB = C_{ud}$$

Again, the two equations are solved as a system in order to obtain Δ and B, which value can be found through these formulas:

$$\Delta = \frac{C_{uu} - C_{ud}}{(u^2 - ud)S}$$

$$B = \frac{C_{ud} - (udS \times \Delta)}{(1 + r)}$$

Another replicating portfolio is built and equations are assumed to be equal to Cud and Cdd. Similarly, we obtain Δ and B: now, it is possible to compute Cd and Cu through the same formula applied to find C in one period time.

The formulas are:

$$C_u = [pC_{uu} + (1 - p)C_{ud}] : (1 + r)$$
$$C_d = [pC_{du} + (1 - p)C_{dd}] : (1 + r)$$

Once obtained Cu and Cd, can now easily move to the left of the diagram in order to find the value C of the call option. Suppose periods are many, it is possible to find a general formula for finding the value of a call. Sai n the number of periods remaining and j the number of the node where the value is computed we have:

$$C = \left[\sum_{j=0}^{n} \frac{n!}{j!\,(n-j)!} p^j (1-p)^{n-j} \max(0, u^j d^{n-j} S - K) \right] : r^n$$

Let's say a to be the minimum number of upward moves which the stock must make over the next n period to be in-the-money; a will be the smallest non-negative number such that:

$$u^a d^{n-a} S > K$$

So that for all j equal or major to a, we know:

$$\max\left(0, u^j d^{n-j} S - K\right) = u^j d^{n-j} S - K$$

And then:

$$C = \left[\sum_{j=a}^{n} \frac{n!}{j!\,(n-j)!} p^j (1-p)^{n-j} \left(u^j d^{n-j} S - K\right)\right] : r^n$$

If a>n, the call would finish out-of-the-money, even if it moves upward every period; therefore, the current value must be zero.

Thus, the formula can be broken in two terms:

$$C = \left[\sum_{j=a}^{n} \frac{n!}{j!\,(n-j)!} p^j (1-p)^{n-j} \frac{u^j d^{n-j}}{r^n}\right] - Kr^{-n} \left[\sum_{j=a}^{n} \frac{n!}{j!\,(n-j)!} p^j (1-p)^{n-j}\right]$$

As it can be notices that:

$$p^j (1-p)^{n-j} \frac{u^j d^{n-j}}{r^n} = \left(\frac{u}{r} p\right)^j \left[\frac{d}{r}(1-p)\right]^{n-j}$$

Yet, we pose:

$$p' = \frac{u}{r} p$$

$$1 - p' = \frac{d}{r}(1-p)$$

The two expressions can be interpreted as complementary binomial distribution functions and lead to a final equation for finding C:

$$C = S \oplus (a, n, p') - kr^{-n} \oplus (a, n, p)$$

This is the binomial option pricing formula, where the risk-neutral probability is:

$$p = \frac{r-d}{u-d}$$

Therefore, the calculations made for the one period valuation formula are valid for any number of periods. The value of the call should be the expectation, in a risk-neutral world, of the discounted value of the payoff it will receive.

3.2.3 From financial options to real options

The basic definition of financial options provides the ration understating real option analysis and allow us to go back to the topic of strategic investment decisions. Indeed, the name "real option analysis" derives from its similarities with the financial field (option) and from its application to real-world controllable cash flows (real).

Brennan and Trigeorgis (2000) introduce their book about project flexibility presenting three approaches they believe to emerge looking to project analysis methods.

The first one is composed by static models: investments are seen as a stream of cash flows whose characteristics are given. In the second group we find controllable cash-flow methods, in which projects can be managed actively to resolve exogenous uncertainties about some variable. The third approach presents dynamic methods (p.2) as: *"game-theoretic models, in which it is assumed that projects can be managed actively to take into account not only the resolution of exogenous uncertainties but also the reactions of outside parties, in particular of competitors in the product market".*

Decision tree analysis belong to the second stage of methods, which presents a problem in the definition of the discount rate under the presence of risk. This problem was solved by the Black and Scholes model (1973): they showed that it is possible to create an equivalent portfolio, constituted in part by units of the underlying asset and in part by risk-less bonds, which represents, step by step, the value of the contract. Then, possible returns follow a normal distribution, differently from the binomial solution we have analyzed. The analysis, initially addressed to financial assets, was later applied to project valuation in order to fill the lack of the second-stage methods.

The main advantage recognized to real options is the ability to assess investments with flexibility; where does it come from? First of all, option analysis takes into account the effects on project risk caused by the controllability of the cash flows, for that reason it overcomes more traditional methods which ignore future decision contingencies. Secondly, real option analysis takes into account the possibility that cash flows of an investment can change not only as a consequence of internal actions or the availability of new information, but also as consequence of agents outside the firm such as suppliers, competitors and institutions.

As said, real options represent the application of financial option theory to non-financial assets. Many theorists have been studying the phenomenon because of its revolutionary approach in the evaluation of investment alternatives and resource allocation. Many other studies tried to compare "financial options" and "real options" in order to stress some of their common characteristics, to make their definition clearer, and to understand better how to evaluate them. There are some basic similarities. Both financial and real options are exercised under uncertain conditions: payoffs and dividends are not certain because future is always unpredictable. They are irreversible: once the option is exercised the actor cannot regret and avoid consequences; this means that some investments are particularly sensible to external factors so that highly irreversible projects tend to

be deferred or divided in phases. Both present a choice between two or more alternatives. Finally, they allow the suspension of the decision and the possibility to delay; sometimes this is positive and the actor gather new information, some other times this allows competitors to erode firm's share. There are also some differences which can be summarized in the following points.

- In the financial context, the shorter the maturity the lower is the uncertainty; on the contrary, real options have to be exercised or abandoned even if uncertainty is dominant.
- In the financial field, scenarios move from in-the-money to out-of-the-money and the investor can decide to exercise when it is most convenient; differently, real options' value swings and push the actor to modify variables to mitigate fluctuations. External factors such as prices, demand or customer preference shape the size of the opportunities available to the firms, so that managers work on prices, product characteristics as well as promotion activities to make option as valuable as possible.
- Financial options have a fixed maturity, real options do not. Rarely in the real world the option to make strategic investment expires.
- Financial options are exchanged in markets and information are available to everybody, everywhere and every time; this is not true for real options which value is harder to monitor.
- The payoff earned in financial options is easily identifiable as the difference between the strike price and the stock; real options' payoff is hard to assess as there is no certainty about market and organizational variables affecting the value of the option.
- Last but not least, the volatility of financial options is relatively easy to control using standard deviation; this is not possible for real options as new strategic projects do not have corresponding projects in the market.

Copeland and Tufano (2004) stressed what they considered the two main aspects differentiating financial and real options. The first is related to the information necessary to value financial options and make decisions about exercising them: holders of options on a company's share can base their exercise decisions on the current price of company's stock. Instead, in real option analysis, underling assets are difficult to evaluate. The second difference relates to the clarity of options' terms. While the right to exercise financial option is well-defined, it is often unclear what the holder of a real option has the right to buy or how long that right will last. Many options are subsequent (such as R&D or new product development) because management can invest money in the critical points of the development path. How could we determine the time span after which the right expires? The

answer could be that the right expires when a specific advantage of the option is no longer guaranteed. However, most of the times it is not easy to define real option's term.

Real option analysis enhances the assessment of project investments with more flexibility as it foresees the possibility that empowered managers modify choices according to both internal and external changing factors. Therefore, taking insights from the financial field, real options started to be used to evaluate physical real assets, especially in those firms with a significant amount of managerial flexibility and huge impact of uncertainty (Mun 2006). Several authors in the last decades supported the thesis that real options are more appropriate tools for investment appraisal. Besides flexibility, the approach lies on the idea that real investment activities are sources of opportunities that managers can undertake under certain conditions. Micalizzi (1997) reminds that real option theory lies on two assumptions: strategic investments generate real options and management have the required adaptability to take advantage of them. Opportunities can bring wealth to firms as long as managers see their existence, understand them and take them when convenient; therefore, managers regain an active role in strategic investment decision process and are recognized to have the power of make changes along the way. Moreover, options are valuable when there is uncertainty: managers know that they are expected to undertake and proactively manage investments by changing subsequent plans in response to market conditions.

Amram and Kulatilaka (1999) emphasized the real option approach arguing that it should be considered as a *way of thinking* because it is the only method which can provide value creation in an uncertain world.

According to them, the approach presents three components specifically worth for managers:

1. *Options are contingent decisions*: payoff are nonlinear because the decisions depend on how events turn out, poor events or good ones lead to different opportunities and therefore decisions.
2. *Option valuations are aligned with financial market valuations*: the approach uses financial market inputs to value complex payoffs across all types of real assets.
3. *Option thinking can be used to design investments proactively*: nonlinear payoffs can also be a design tool. The first step is to identify and value the option, the second step is to redesign the investment to better use the option.

Thinking in terms of options change the decision maker perspective and allow decisions to be coherent with a constantly changing marketplace.

However, the relevance of real options is often limited to market and organizational conditions. For example, a RO approach is particularly relevant in markets where demand and supply trends are constantly changing, determining contingency, flexibility and volatility. In a very stable and predictable market NPV is likely to be more reliable. Again, RO approach makes sense for those firms able to seed, size and exploit opportunities in terms of managerial abilities and organizational structure: firms organized in rigid structures, with old-style management and slow information flows tend to miss new opportunities and privilege the exploitation of existing assets. RO approach works properly also when the financial structure is solid and allows managers to fund new projects.

The today environment surrounding us requires firms to be flexible and adaptable, and to enhance the pursuing of strategic investments when profitable. Real options represent an additional component of firms' toolkit particularly performing under uncertain conditions. Managerial flexibility, choice revision and adaptation as well as investment interdependences and interactions are all factors neglected by traditional quantitative methods. In search of flexibility, computational methods and different types of real options are discussed in the next sections.

3.2.4 Valuing real options

Once the main characteristics and peculiarities of real options are identified, it is time to focus on the quantitative procedures that can be applied to evaluate them. The scope of this action is to quantify the value of a strategical opportunity a firm has found. Micalizzi (1997) argues that the assessment of an investment through the real option analysis should follow three steps. First, compute the value of the options. Second, analyze the overall value of the options in order to identify synergies among opportunities, usually it is done through the algebraic sum of options' value. Third, perform a sensitivity analysis, which helps in assessing the impact that specific relevant variables have on the value obtained. More precisely, sensitivity analysis is the technique used to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumptions. It is a way to predict the outcome of a decision if a situation turns out to be different compared to predictions.

Although theory on real options has been developing for a long, only few managers adopted it and many others give up after a while (Bain & Company survey 2001). A reason may be the complexity of the resolution, but the main critique addressed to the method is that it tends to overestimate the value of uncertain projects, encouraging companies to over invest in them. Van Putten and

MacMillan (2004) argued that managers tend to perceive real options and discounted cash flows methods as mutually exclusive. Instead, the two techniques should be integrated. NPV works only when we are fairly sure about the forecasted cash flows; sometimes, even if cash flows are accurately forecasted, they have to be discounted at a high rate to reflect the long odds of achieving the predicted returns.

But what about if cash flows are higher than what expected? The NPV has lost some value. Here lies the reason why the authors argue that the two methods are complementary. Suppose to valuing a project with high uncertainty. On one hand, NPV should be computed with a high discounting rate. On the other hand, high uncertainty leads to higher opportunities so that the value of the option increase. This means that the two methods can be integrated in an extended formula:

$$Extended\,NPV = NPV + OP$$

The total value of an investment is the sum of the basic NPV and the value of the applicable real options (also said "option premium"). The NPV must be calculated deterministically on the future net cash flows, without considering any kind of future opportunities. All the possible changes and scenarios should be included in the value on the real options. The value of an opportunity can be positive or negative; sometimes changes to the original investments lead to losses and managers have to activate corrective actions.

When we talked about the NPV in chapter two we described the thumb rule according which projects with positive NPV must be accepted and those with negative NPV refused. When NPV is very high, there are no doubts, management can run with it; when NPV is very low there are no doubts as well. However, the majority of projects lie in the middle: the option value can be a determinant factor in providing evidence to accept or refuse the investment.

Thus, how the value of a single option is determined? The methods suggested in the literature are derived for financial options, but some of them are also suitable for real options. In other words, as Moretto and D'Alpaos (2004) pointed out: *"the real option approach provides the decision-maker with a tool to address the issues of irreversibility, uncertainty and timing, drawing the valuation procedures from the body of knowledge developed for financial options during the past decades"*. According to these references, real options' valuation depends on five variables which are fundamental in the evaluation of their financial counterparts.

- The *value of the underlying asset*: in ROs the asset is the project or investment undertaken, if its value increases, the value of the option tend to increase as well. The current value of this asset is the present value of expected cash flows from initiating the project now.
- The *exercise price*: it is how much the decision maker has to pay when the option is exercised (it corresponds to the strike price). In other words, a project's option is exercised when the firm owning the rights to the project decides to invest in it. The cost of making this investment is the exercise price of the option. The underlying assumption is that this cost remains constant.
- The *expiration date*: in ROs the maturity corresponds to the endpoint of investment's life. The project option expires when the rights to the project lapse. While this input can be estimated easily when firms have the explicit right to a project (through a license or a patent, for instance), it becomes far more difficult to obtain when firms only have a competitive advantage to take a project.
- The *standard deviation* (σ) of the returns of the activity: uncertainty is given by the volatility of assets' values, the higher the volatility the higher is the uncertainty and the probability that unexpected payoffs can realize.
- The *risk-free interest rate* (r): along option's life a risk-free rate has to be available; the higher the rate, the higher the value of the option.

These components contribute to define the value of the option. Specifically, the value of a call option (call) is directly proportional to the value of the underlying activity, to the volatility, to the risk free rate and to the duration of the option; while, it is inversely proportional to the exercise price.

Standard deviation is used as a measure for risk: the more possible outcomes of an investment are spread out around the expected value (μ), the riskier the investment is. The dispersion of the possible values from an of a project measured by standard deviation is called *volatility*. When future cash flows are characterized by relevant levels of uncertainty as they are likely to differ from expected ones, standard deviation has to be taken into account in order to ponder the value of the option. There is no doubt, indeed, that the present value of the expected cash flows that measures the value of the asset will change over time, partly because the potential market size for the product may be unknown, and partly because technological shifts can change the cost structure and profitability of the product. The variance in the present value of cash flows from the project can be estimated in three ways. First, the variance of a similar project that the same firm (or another one)

has introduced in the past can be used as reference. Second, the firm can predict possible future scenarios and assign to them a probability to occur, and then estimate the variance across present values; similarly, probability distributions can be estimated for each of the inputs and then a simulation used to compute the variance. Third, the variance in the market value of publicly traded firms involved in the same business (as the project being considered) can be used as an estimate of the variance.

Option theory computes the market value of an opportunity considering the value of a *replicating portfolio* which offers the same expected return of the opportunity. This implies that the opportunity and the replicating portfolio present the same risk; furthermore, to avoid opportunities of arbitrage, the portfolio and the opportunity must have the same present value, so that the option's value is derived from the portfolio's value. In finance, the replicating portfolio is composed by a part of underlying assets and a part of debt; therefore, even in real option analysis, a replicating portfolio must be created and the type and size of the underlying activity must be identified.

In paragraph 3.2.2 the Black and Scholes formula and the CRR method were considered as resolution procedures for financial options, while in this section we underlined the fact that real options' valuation take reference from financial counterparts for the variables that contribute to determine their value. Thus, how can real options be assessed?

When theorists firstly aimed to apply the Black and Scholes formula to real options, they found some obstacles. First of all, in real options the underlying asset is the present value of future cash flows, which are not tradeable. Often the holder of the real option is even the only company having that option. Then, they assume that the stock follows a continuous time Geometric Brownian Motion where the value of the underlying follows a log-normal distribution. This is not true in real options because the value of the project could dramatically change over time and the investment could be abandoned; moreover, projects' values are affected by many variables so that its distribution varies as well.

Then, a problem related to volatility arises. Volatility of the firm's stock value is not a good measure of project uncertainty. If the company has undertaken a similar project in the past, historical volatility on its returns can be used; the company could also take as reference similar existing projects in the industry. However, most of the times the firm is valuing a completely new project which is hard to compare with other previously or currently undertaken. In fact, the volatility of an investment is influenced by many factors related to the firm, such as prices of inputs, time to market

and external environment among others. Therefore, while volatility is assumed to be constant in financial option, in real options it is supposed to change as these factors change as well.

Moreover, while Black and Scholes assume costs to be constant and not uncertain, but in real world projects' costs are affected by uncertainty. Van Putten and MacMillan (2004), emphasize the need to include uncertainty on costs on real option computation. They propose to multiply the project volatility for the ratio of revenue volatility on cost volatility: in this way if we are more certain about revenues (volatility is lower) the ratio would be less than one and the total volatility is reduced, on the contrary, if we are more certain about costs, the ratio would be more than one and the total volatility increases. Furthermore, the Black and Scholes formula is based on the existence of a traded replicating portfolio: however, it is quite hard to find stock which returns are close to those of the real world project.

For all these reasons the Black and Scholes formula is not considered an appropriate tool for real option valuation.

On the contrary, lattice (or binomial) trees, and the use of risk-neutral probability, fit better real option characteristics. Binomial trees give managers the possibility to identify possible scenarios and to decide whether to invest or not. Copeland and Tufano (2004) argue that binomial models built around decision trees are ideally suited to real-option valuation. They argument this thesis underlying that binomial trees use algebra and *"can also be more easily customized to reflect changing volatility, early decision points, and multiple decisions. Their relative transparency and flexibility mean that you can tinker with a binomial model you've created until it closely reflects the project you wish to value"* (p.94).

These reasons pushed other theorists to consider the use of binomial trees, and the CRR method in particular, as the most reliable technique for real option valuation. For example, Brandão, Dyer and Hahn (2005) tried to solve real-option problems through decision tree analysis. Their approach lies in the consideration that market risks depend on market states and can be hedged by creating a replicating portfolio of traded security; private risks, instead, are project specific and thus cannot be hedged by trading securities. The market component is then valued using market information (risk-neutral probabilities), while the private component is valued using subjective beliefs and preferences (subjective probabilities). The integrated rollback method proceeds as follow: the first step is the computation of NPV in each endpoint; then, for the chance nodes with private uncertainties subjective probabilities and exponential utilities are used, while for chance nodes with market uncertainties risk-neutral probabilities must be used.

We do not go deeper in this valuation process although innovative in the approach suggested; in the next section a more widely adopted method will be introduced.

3.2.5 The MAD approach

The method

The Market Asset Disclaimer approach was presented by Copeland and Antikrov in their *Real Options* (2001), where a detailed description of the model is provided. Proponents of this method argue that the option pricing approach gives the correct value because it captures the value of flexibility correctly by using an arbitrage-free replicating portfolio approach. The starting point of their work is the so called *market asset disclaimer*: *"We are willing to make the assumption that the present value of the cash flows of the project without flexibility (i.e., the traditional NPV) is the best unbiased estimate of the market value of the project were it a traded asset"* (Copeland and Antikarov, p. 94). A second important assumption is that asset prices follow geometric Brownian motion (GBM): this provides the rationale for using binomial lattice. They also argue that no matter how strange or irregular the stochastic pattern of future cash flows may be, the value of the project will follow a normal random walk through time with constant volatility.

Step number one consists in computing future cash flows expected from the investment, and discounting them at an appropriate rate in order to find their present value (we do not need the NPV as the initial investment will be used as *strike price* K). Then the method requires to find the volatility of the project by applying the Monte Carlo simulation: authors suggest to include in the analysis the main sources of uncertainty and configure them in a single measure of volatility.

In the next step d and u are computed using the volatility (σ) found and the expiration time (t):

$$u = e^{\sigma \times \sqrt{\Delta t}}$$

$$d = \frac{1}{u}$$

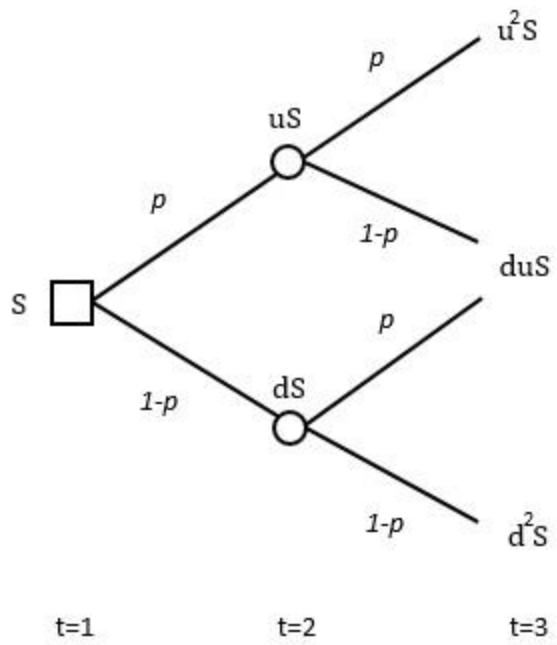
We can additionally compute the risk-neutral probability at which the up and down events occur:

$$p = \frac{(1+r) - d}{u - d}$$

$$1 - p = \frac{u - (1+r)}{u - d}$$

Assuming a two-time period, the correspondent binomial tree would be drawn like in figure 33:

Figure 33: Binomial tree for the MAD approach in a two-time period



In figure 33, S is the present value of the expected cash flows of the investment; we obtain the values of the other chance nodes by multiplying S with *u* and *d*. Then, following the CRR procedure, the value of the option at all the endpoints (Cuu, Cud and Cdd) must be found through the following maximizations:

$$Cuu: max(Su^2 - K, 0)$$

$$Cud: max(Sud - K, 0)$$

$$Cdd: max(Sd^2 - K, 0)$$

Now, it is possible to find the value of the option in period t=1 and t=0 only applying the rollback method and solving the replicating portfolios built as follow:

$$\begin{cases} Su^2\Delta + rB = Cuu \\ Sud\Delta + rB = Cud \end{cases}$$

$$\begin{cases} Sud\Delta + rB = Cud \\ Sd^2\Delta + rB = Cdd \end{cases}$$

Where data are taken from the tree and r is the discounting rate (one plus the risk-free rate). It is possible to compute the value of Δ and B by solving the equation systems; for example, from the first system we obtain:

$$\Delta = \frac{Cuu - Cud}{(u^2 - ud)S}$$

$$B = \frac{Cud - (Sud \times \Delta)}{r}$$

We are now able to compute the value of the option in the up node for t=1, using the two inputs just found:

$$Cu = Su \times \Delta + B$$

The same procedure leads to find the Δ and the B from the second system and to compute the Cd for the down node. The value of the option in t=1 is given by:

$$Max(Cu, Su - K)$$
$$Max(Cd, Sd - K)$$

Then, another replicating portfolio is built:

$$\begin{cases} Su\Delta + rB = Cu \\ Sd\Delta + rB = Cd \end{cases}$$

Analogously to the previous passages, the system is solved for Δ and B and they are used to compute the value of the option in t=0:

$$C = \Delta S + B$$

After C is obtained, the last step is:

$$Max(C, S - K)$$

Which result represents the value of the option in t=0.

Differently from the Black and Scholes, where inputs have simply to be put in the formula, this approach seems more complicated and time consuming. Certainly, this method counts some weaknesses such as the fact that future cash flows (which determine the present value of the investment) and the standard deviation (volatility) are estimated by managers; only the risk-free

rate comes from the market. Proponents of the MAD approach argue that the same, weaker assumptions that are used to justify the application of net present value to rigid corporate investments can be used to justify the application of real options to flexible corporate investments (Borison 2003): therefore, the use of inputs data from expected cash flows and other subjective assessment is appropriate.

A practical example

The inputs needed to apply the MAD approach are indicated in the following points, the example is taken from Borison (2003): it is the case of a new discovered oilfield, the company can buy it now or can purchase an option to buy it later for 20 million.

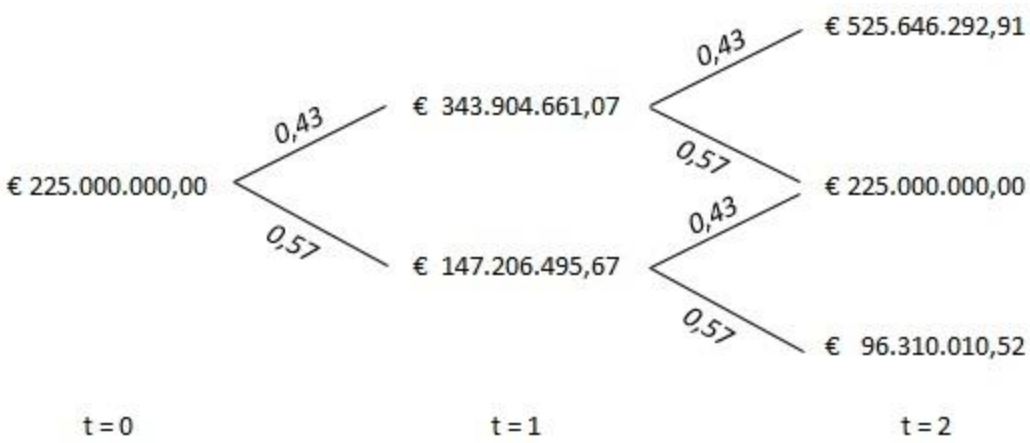
- Current value of expected cash flows: 225 million euros.
- Time to maturity: 2 years.
- Risk free interest rate: 3%.
- Volatility estimate: 30%.
- Exercise price: 175 million euros.

The exercise starts computing u and d:

$$u = e^{0,3\times\sqrt{2}} = 1,5285$$

$$d = \frac{1}{u} = \frac{1}{1,5285} = 0,772$$

We progressively multiply S (the present value) times u, d, ud, u^2 and d^2, in order to obtain the up and down values that have to be filled in the tree; the risk neutral probability is indicated in the branches:



The present value of the expected cash flows goes up with probability 0,4298 and down with probability 0,5702. Option's value in t=2 is found as follows:

$$Cuu: \max(525.646.292,41 - 175.000.000,00; 0) = 350.646.292,91€$$

$$Cud: \max(225.000.000{,}00 - 175.000.000{,}00; 0) = 50.000.000{,}00€$$

$$Cdd: \max(96.310.010{,}52 - 175.000.000{,}00; 0) = 0€$$

Now, the replicating portfolio can be built in order to find Δ and B:

$$\begin{cases} 525646292{,}9\ \Delta + 1{,}03B = 350646292{,}9 \\ 225000000\ \Delta + 1{,}03B = 50000000 \end{cases}$$

$$\begin{cases} 225000000\ \Delta + 1{,}03B = 50000000 \\ 96310010{,}52\ \Delta + 1{,}03B = 0 \end{cases}$$

Solving the first system we find Δ=1 and B=-169.902.912,6. The second system, instead, leads to Δ=0,3885 and B=-36.329.501,99. We use these data to complete the formula for Cu and Cd:

$$Cu = 343.904.661{,}07 \times 1 + 1{,}03 \times (-169.902.912{,}6) = 174.001.748{,}4€$$

$$Cd = 147.206.495{,}67 \times 0{,}3885 + 1{,}03 \times (-36.329.501{,}99) = 20.864.727{,}44€$$

So that we can find the values of the option in t=1:

$$Max(174.001.748{,}4; 343.904.661{,}07 - 175.000.000{,}00) = 174.001.748{,}4€$$

$$Max(20.846.727{,}44; 147.206.495{,}67 - 175.000.000{,}00) = 20.846.727{,}44€$$

Another replicating portfolio must be created:

$$\begin{cases} 343904661{,}1\ \Delta + 1{,}03B = 174001748{,}4 \\ 147206495{,}7\ \Delta + 1{,}03B = 20864727{,}44 \end{cases}$$

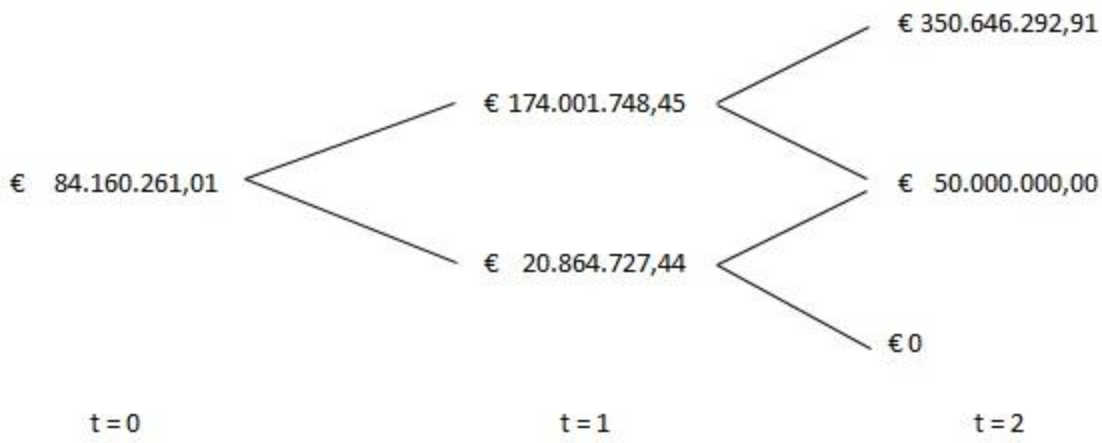
The system is solved for Δ=0,7785 and B=-91.010.817,27. Finally, we can compute the value of the option simply applying the formula:

$$C = S\Delta + B = 225.000.000 \times 0{,}7785 - 91.010.817{,}27 = 86.160.261{,}01€$$

$$Max(86.160.261{,}01; 225.000.000{,}00 - 175.000.000{,}00) = 86.160.261{,}01€$$

It can be noticed that the value of the option is positive, this means that the investment is worth to undertake. If the oilfield is purchased in t=0 the profit, expected cash flow less strike price, is 50 million; if the option is exercised in t=2, profits, option value less option price, are about 60 million. Therefore, it is convenient to wait and exercise the option later.

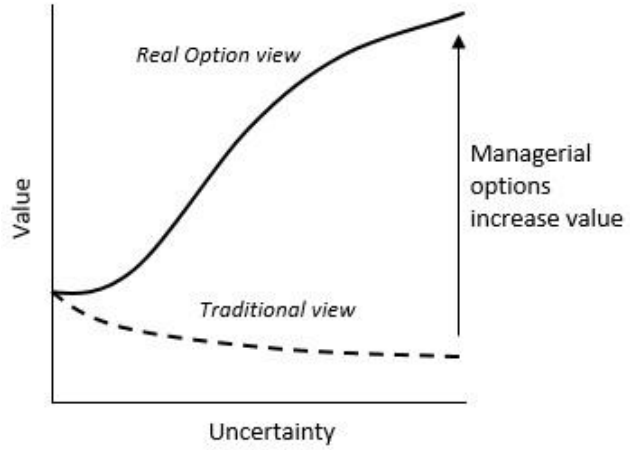
The following tree shows the tree with the values of the option at each time period.



3.2.6 Types of real options

Real option analysis concentrates much more on the value of future opportunities rather than on the value of the net flows coming from operations. This is the reason why an extended NPV has been presented in the previous paragraph as the best road for a correct computation of investments with incorporated real options. As anticipated in chapter two, once the way of thinking explicitly includes uncertainty, the whole decision making framework changes; manager should manage uncertainty by ranking investments in order to take the advantages it creates (Amram and Kulatilaka 1999).

Figure 34: Comparison of traditional and real option views



Source: Amram and Kulatilaka (1999)

In the traditional view a higher level of uncertainty leads to a lower asset value. The real option approach instead lies on the conviction that uncertainty leads to a higher asset value whenever *"managers identify and use their options to flexibly respond to unfolding events"* (Amram and Kulatilaka 1999; p. 15). Figure 34 represents well this idea: value (of the firm) and uncertainty are

combined in a simple graph, the lines plotted show how real option view differs from the traditional one.

Uncertainty creates opportunities which, if undertaken, increase the value of the firm over time; in fact, a flexible investment strategy modifies the exposure of the firm by applying changes to the original plan.

Real option theory helps in understanding the ongoing flow of an investment suggesting always which actions are worth to take.

Since real option theory focuses on opportunities, they have been categorized and given a name to help practitioners to recognize them when they appear. Indeed, the starting point of working with a real option approach is to identify them. Following Trigeorgis (1996) an overview of different types of real options is provided. The *growth option* is skipped in this list because it will be the object of a broader description in the next section.

Deferment option

Timing is a crucial factor for investment decisions. The firm always considers which is the optimal time to invest: whether to "operate" or "not to operate", more specifically whether to "start producing" or to "wait". Generally, deferment regards the "when" to start the project. If the choice is to operate, an initial investment (I_0) is made: the expenditure corresponds to the switching cost the firm would handle with if decided to change the operating mode. This option generates immediately positive cash flows. On the contrary, no cash flows are generated by the option "wait". However, waiting to invest could be often the better option, even if "start to operate" represents attractive benefits with positive present value; the firm may wait for more favorable conditions and invest later when the switching cost would be lower and cash flows higher. This dynamic assumes that the project depends on some uncertain variable exogenous to the project. Examples of typical variables are: the increase of the market price of the good, cost reduction, new licenses or patents which could ensure market leadership, the discover of new resources, and so on. Sometimes, supposing that the company will have same right to launch the project also in the future, the deferment option has value and should be considered in the overall valuation of the project.

Expansion option

It regards the possibility to enlarge the scale of the project from a structurally and dimensionally point of view. Sometimes products or services demonstrate unforeseen performances and become adapt to satisfy other niches or markets, market trends also show an increasing rate of adoption in

the marketplace. This is a typical scenario which pushes management to expand the scale of production. In other words, the firm has already made the initial investment enabling it to operate on a base-scale project, but later considers to make an additional outlay to expand the operations. The switching cost in this case is the cost to expand: management may deliberately favor new expensive technologies or new personnel to respond quickly to the increasing market demand.

Contract option

The firm considers contracting operations from the current scale of production when it is worth to save a part of its variable operating costs. Assuming that fixed costs are sunk costs, the firm may find convenient to save the variable costs as the total amount of inflows for that investment do not cover and overcome them. In a situation like this, operating variable costs represent the switching cost which motivate the company to contract the project. This option is undertaken by management when the conditions and the variables under which the project is being developed are very uncertain and there is a concrete risk to experience a regression in terms of performances. Contraction does not mean bailing out, it consists in a reduction of the scale in order to being able to manage the project if things get tough and to put at risk a narrower asset.

Switch option

The option to switch (or convert) is typically available when projects are in the initial or in the final phase. The switch option means to change the inputs employed, or how they are combined, for obtaining the expected result; moreover, it means to use inputs already available to the firm changing their allocation to obtain a different output. The first case is said process adaptability; the second one is called product adaptability. The opportunity to switch is usually leveraged in R&D departments when projects such as new product generation are developed: sometimes, when the project is not advancing, hijacking can be the most reasonable path and efforts can be addressed to slightly different goals. This option may seem not applicable to strategic investments which tend to be capital intensive and large scale. However, process adaptability allows to convert remained assets and consequences of an earlier undertaken project, which has been prematurely shut down or contract, to a new one.

Abandon option

When firms, currently operating, face negative prospects, they may consider valuable to abandon the project in exchange to a salvage value. Although the cash flows generated are positive and an eventual abandon would cut revenues, it is worth to shut down a project when it is supposed to find

in the short term obstacles it will not overcome. In other words, abandoning a project today has value as long as a specified salvage value is gained and a short-term decline is avoided. If the current salvage value (which here represents the switching cost) is higher then what the firm expects to receive from the market in the next future, it would be better to abandon the investment. Intuition would suggest that valuable options for firms are only those which allow the organization to grow, such as the expansion or the growth options. Actually, this is not always true since growth comes only from profitable investments and not from all kind of them. Often, contraction or abandon options are extremely valuable because they allow the firm to avoid future losses abandoning unprofitable projects; even if irreversible, abandon actions may allow the firm to save some assets and exercise them in a switch option. Growth sometimes requires stability periods and little declines to maintain a general increasing trend in the long-term.

Suspension option

The suspension (or temporary-stop) option consists in the opportunity to make the project on standby for a while until conditions allow it to be profitable again. For example, a production facility may not be working optimally for a given period because its revenues do not even cover the variable costs. Management could make the decision to suspend production. Common fields of application of this option are all the sectors which performance are influenced by external factors' price (e.g. oil, wheat, construction costs). Temporary suspension ("mothballing") many times does not involve costs to close the well, but often there are reactivation costs to consider.

Intraproject and interproject option

Interproject options arise when the development of one project creates value that attach to other projects. Sequencing options, for example, are interproject options: the sequence of subsequent option has a value; what counts is that they must be somehow related one another.

Traditional capital budgeting analysis will miss this option because projects are evaluated on stand-alone basis. As anticipated in previous paragraphs undertaking strategic investments often generate different resource allocation, shift of focus and attention, changes in organizational cooperation and coordination techniques. However, well performing firms have the capacity to create synergies and sharing opportunities which allow cost reduction and time, effort and resources savings. This is particularly true for interproject options but it works also in intraproject options which are opportunities within the single project where the exercise of the preceding option is prerequisite for continuing the project itself.

The options to defer, abandon and suspension (not presented here) belong to the larger family of options related to time which tell how important timing elements are fundamental in investment decisions: environmental conditions change so frequently that management must monitor all the variable involved to take the right decisions at the right moment. The options presented above represent opportunities often available to managers, who can assess them and pick those more valuable. Assessment can be done through a normal decision tree applying the standard NPV formula; alternatively, the CRR method performs the same task through a more advanced analysis.

3.2.7 The growth option

The *growth option (GO)* is the tool under lens in our comparative analysis. The hypothesis of this thesis is that the growth option can represent and depict the upgrading path of entry modes processes. The growth option may seem similar to the expand option and actually they count some commonalities such as the investment they require to be exercised and the boost towards future incoming revenues. However, a slight but crucial difference lies in their definition. While the expand option refers to an enlargement of the scale of the operations based on an increasing market demand, the growth option regards to preparing the rights conditions and structures in order to be ready when future opportunities will rise up. The expansion option regards the current scale, the growth option is related to setting the future growth of the project.

From an investment point of view corporate growth options are strategically much more important than expand ones, they are usually associated with new initiatives having long term benefits. Trigeorgis (1996) defines corporate growth options as *"early investments which can be seen as prerequisites or links in a chain of interrelated projects. The value of these early projects derives not so much from their expected directly measurable cash flows as from the future growth opportunities they may unlock"* (p. 14). Such early investments may be R&D pilot projects, natural resources search activities, strategic acquisitions, building information-technology network, first-generation product and new plant creation. The author adds that: *"although in isolation the proposed facility may appear unattractive, it may represent only the first in a series of similar facilities if the process is successfully developed"* (p.13).

In table 1 we review the literature on growth option, in order to better understand it, its applications and possible configurations. In the table 1 we summarized authors, year of publication, field of application and results of a collection of contributions on the topic. In the list there are only articles

specifically related to the "growth option" and published after 2000s, more general paper on real options or on mathematical advanced techniques were not considered for this review.

Table 1: Review of the literature about "growth options"

Year	Authors	Field	Results
2001	Jou	Corporate borrowing, liability effects	Firm's debt capacity is inversely related to its GO value. When firms incur higher costs for later expansion their GO value decrease.
2002	Kim, Sanders	Strategic actions in IT investment	When interaction effects are high and competitor reactions low, scaling or scoping up (GO) is usually the best option to undertake. Moreover, if a GO was taken in the last period it is likely to be selected also in the current period.
2002	Davis	Impact of volatility	Increasing volatility can destroy GO value, especially for firms holding "quality" GO. Furthermore, firms holding numerous GOs have more possibilities to experience a future growth.
2005	Décamps, Villeneuve	Dividend policy	Delate dividend distribution when a valuable GO is available, even if initial cash flows will be negative. Liquidity constraints have an ambiguous effect on the decision to exercise; in fact, without liquidity constraints the opportunity would be worthless.
2006	Anderson, Garcia-Feijòo	State dependent cash flows risk	Book-to-market ratio and size change as firm exercise investment opportunities and their existing asset depreciate. Consequently, exposure to systematic risk and expected stock return evolve in predictable manners.
2006	Barclay, Smith	Debt capacity	As additional GOs are added to the firm's portfolio its total value increase and the optimal total debt level declines. The relation between growth options and book leverage ratios tend to be negative.
2006	Tong, Reuer	Firm and industry-specific influence factors	Heterogeneity of firms' proprietary options and their difference in managing them determine their future performance. Therefore, the total GO value is higher when heterogeneity is relevant.

2007	Reuer, Tong	Corporate investment	GOs are enhanced under specific conditions. One source of GO is the internal accumulation of resources (e.g. R&D) which gives rise to internal GOs, another one is resource acquisition (e.g. joint venture) which creates external GOs.
2007	Camon, Simon, Zhao	Idiosyncratic risk	GOs explain the trend in idiosyncratic volatility beyond alternative explanations. Divestments increase the focus of the firm: on one hand the diversification is reduces, on the other hand the risk of the investment increases.
2011	Purnanandam, Rajan	Capital structure	Firms decrease their leverage when converting the GOs into tangible assets. The conversion imply a capital expenditure, employee growth and relative decline in research and development expenses.
2012	Ahroni, Ho, Zeng	Profitability of enhanced momentum strategies in Australia	The value of a GOs of a firm is correlated with its past success. Therefore, successful firms experience a constant increase of the value of the GOs. Winner are those firms that risk the more and expect high returns. Momentum profitability is high for those with low book-to-market firms, those which experience high volatility in growing revenues, and those with a low cost structure.
2012	Fujiwara	Biotech startup under uncertainty	Retaining decisions are usually motivated through sunk costs. The value of GOs is very important especially for startup in deficit inside which R&D has a decision retaining function as a learning option in itself.
2012	Sbuelz, Caliari	State dependent cash flow risk	How state dependent cash flow risk impact on the optimal investment policy and on the value of the GO of scaling up incurring in an irreversible investment depend on the level of the volatility and of the sensitivity of the cash-flows.

2013	Arnold, Wagner, Westermann	Macroeconomic conditions and credit risk	Companies with high GOs tend to be riskier and particularly sensitive to macroeconomic risk. Under this condition, firms with great expansion options have an high propensity to default.
2013	Peters, Thiel, Tucci	Patent choice	Publishing invention can yield significant benefits in terms of speed, cost and available options in the innovation and commercialization process. Patenting can helping protect and strengthen the market position and increase the value of the GO in the long term.
2014	Triegeorgis, Lambertides	Stock return	GO variables, namely growth in capital investment and yet-unexercised growth option, are significantly and negatively related to stock returns. There is a direct negative relation between creation of future GOs and average stock return.

Source: own elaboration

Summarizing the main finding from cited papers we can distinguish between two points of view. From an internal point of view, high capabilities, low level of debt and capital availability enhance growth option undertaking. Moreover, heterogeneity in the types of real options available and a successful pattern of undertaken growth options push the company to invest again in that kind of opportunities (path dependency).

From an external point of view, high uncertainty, low competition and risky macroeconomic conditions enhance growth options undertaking, except when risk become systematic.

Other relevant contributions on growth options were published by Perotti and Kulatilaka in the end of the last century. In 1998 they defined growth options as strategic options because they lead to long-term investments. Moreover, they argued that when the strategic advantage is strong, increased uncertainty encourages investment in growth option. This is because higher uncertainty always means more opportunities. However, an increase in systematic risk discourages the acquisition of growth options. Later on, in 2000, the same authors demonstrated that postponing the exercise of a growth option sometimes can have dramatic consequences in a market with strong competitors. On one hand, delaying allows to gain capabilities useful in the growth process, on the other hand, it could reduce the financial flexibility and firms might lose momentum.

Chapter 4

An illustrative case study

4.1 Applying real options to entry mode choices

4.1.1 The real option process

In the previous chapters we went through the internationalization process of small and medium enterprises, the traditional quantitative tools for decision making and most advanced and flexible techniques for managing uncertainty. In paragraph 3.2 an overview of the real option theory has been provided. Many theorists propose an additional interpretation of real options: the sum of future opportunities (options) available to the firm determine the value of the firm. In fact, given a starting value of today, firm's asset of tomorrow will be more or less valuable depending on the ability of the firm in pursuing profitable opportunities. The presence of real options modifies the exposure to external uncertainty determining a range of possible future outcomes achievable through firm's performances. This view is enriched by Luehrman (1998) who published an article titled "Strategy as a portfolio of real options" in which he says that *"executing a strategy almost always involves making a sequence of major decisions. Some actions are taken immediately, while others are deliberately deferred, so managers can optimize as circumstances evolve. The strategy sets the framework within which future decisions will be made, but at the same time it leaves room for learning from ongoing developments and for discretion to act based on what is learned"* (p. 90). This means that corporate strategies are made of subsequent alternative options, some of them are worth to be exercised, some others are not; the better the strategy will be chosen (and so options exercised), the higher the future value of the firm.

Of course, this interpretation makes more sense when the options considered are those strategically relevant, those which can make an impact on future performances of the firm. For example, a defer option on an annual common partnership may not have an impact on the future value of the company; on the contrary, the early-stage investment (growth option) made for the launch of a new product may strongly influence the future inflows of the company. Therefore, once the type of options available to the firm are identified, these must be assessed through an analysis which

follows a multi-stage perspective. Once again, the real option approach demonstrates that decision-making techniques should be flexible enough to accept changes along the way.

The options analysis process must respond to the "real options way of thinking" explained above and in the previous chapter. Moreover, differently from financial options real options are difficult to identify and to depict in all their characteristics. Therefore, it is very important along the process to make sure that all the right inputs are included correctly.

Figure 35 shown the "Solution Process" proposed by Amram and Kulatilaka (1999) in which four steps are introduced as drivers of the real option analysis.

Figure 35: The Solution Process

Step 1. Frame the application
Step 2. Implement the Option Valuation Model
Step 3. Review the results
Step 4. Redesign

Source: Amram and Kulatilaka (1999)

Frame of applications regards the decision that has to be taken and the related option, the types of uncertainty (external and internal) mostly affecting the decision, the decision rule which will tell if the option is worth to be exercised and a review to make it easy to understand. The second step requires to explicit the option valuation model we decided to implement, in the case study presented more ahead the technique is the RCC method. To make the analysis valuable, all the inputs must be correct and meaningful. Then, results need to be reviewed in order to understand which are the most critical inputs and the threshold beyond which the decision would change. The last step compares the results obtained with the initial frame in order to find out if results are coherent and help to make the decision, otherwise something has to be changed.

Even if timing options are not investigated in this research we might need to take them into account along the way. For example, it might happen that the firm is under no pressure and so willing to wait to see how the market and the industry evolve. Therefore, when facing the option, a simple but effective thumb rule will be considered (Scarso 1996). If the value of the growth option is high, the exit cost is low and there is no opportunity to switch the investment, the growth option should be exercised. If the value of the growth option is low, the exit cost is high and there are possible alternative investments the firm could pursue, for the firm it would be better to wait. This simple framework will be used to apply real option analysis to the case study.

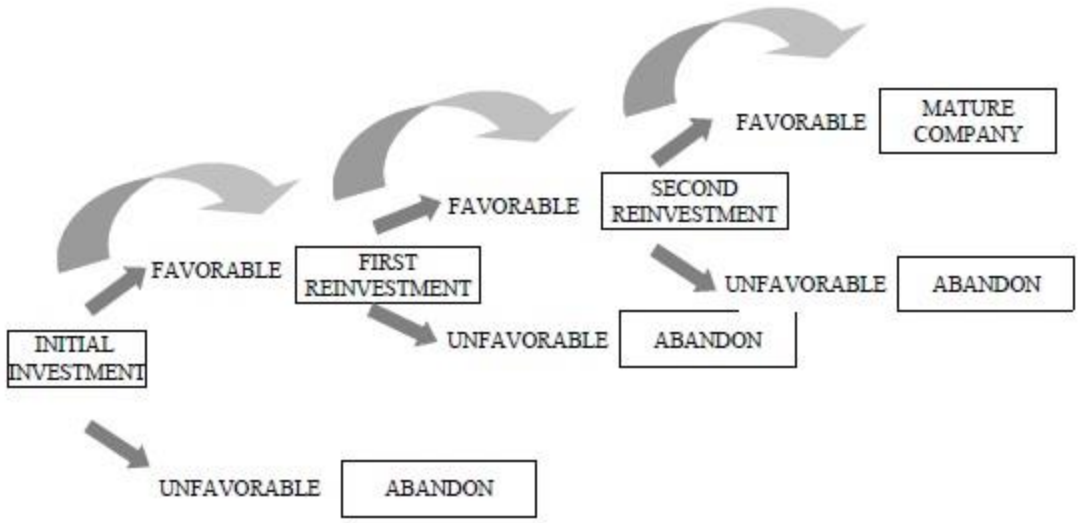
4.1.2 Real options on entry modes

Applying real options on foreign market entry modes choices is not something new. Several authors applied real options on the internationalization process: the majority of the contributions are on large well-established companies, much less on small and medium enterprises. These contributions explore the possibility to assess the convenience of strategical actions through one or more types of options; in fact, that such decisions can be viewed as opportunities the firm may undertake or not. The first author linking real options and entry modes (not in foreign markets) was probably Kogut (1991) who investigated joint ventures through the application of the option expansion. Many others contributed to the body of knowledge of entry modes recognizing that the real option theory could be helpful in understanding decision challenges in internationalization processes. For example, Buckley and Tse (1996) built a synthetic real option approach on *foreign direct investments*. FDI strategies were also analyzed through a real option perspective by Song, Makhija and Lee in 2008 and 2014, their aim was to compare the growth option to the switching option in order to understand when one investment was more likely to be undertaken. *Joint ventures* are another typical object of analysis developed through real options. Chi (2000) found that the presence of real options in the negotiation process affects the structure of the agreement. Tong, Reuer and Peng (2014) argued that international joint venture represents a valuable growth option which value is captured by firms when ownership, product-market focus and geographic locations are well designed. *Greenfield and brownfield investments* as well as cross-country acquisition are other hot topics in foreign market entry modes. Gilroy and Lucas (2005) stated that using a real option approach allows to include the flexibility and the irreversibility of the investment in the entry mode decision; this, for example, should lead to consider a greenfield investment the right choice to shift from an export strategy to an early stage of FDI. Greenberg at al. (2001) sustained the idea that brownfield investments represent a more valuable growth option when environmental and health issues are taken into account. Miller and Folta (2002) focused on optimal timing to execute the investment and found that it depends on current dividends, preemption possibilities, and whether the option is simple or compound, proprietary or shared. In 2006, an analysis developed by Alessandri et al. focused on the geographical location and found that the growth option value is primarily affected by firm effects and secondly by country-industry effects. Among others, Brouthers et al. (2008) represent a key publication in the application of real option on foreign market entry mode. They argue that adding real options to the traditional transaction cost models significantly

improves their explanatory power. Moreover, firms that combine real options to transaction cost models register higher level of subsidiary satisfaction.

Growth option as well as others options, count a solid background of meaningful applications. This research, similarly to previous ones, aims to use the real option approach to explain better the behavior of specific firms in specific situations. In paragraph 3.2.4 we defined growth options as early investments enhancing future growth opportunities. Scarso (1996) wrote that "*Growth (or incremental) options give the opportunity to benefit from subsequent investments, as in the case of modular projects. In general, they are new capabilities which can be exploited by later investments. In several cases it is impossible to define them accurately until some time has passed, after the firm has assimilated the know-how provided for the initial investment*". Therefore, growth options have to be seen as a subsequent set of opportunities that if undertaken can provide value and make the firm to grow. This idea is well represented by figure 36 where a three-step pattern is represented: in each decision point the firm compares the options to invest for growth with the option to abandon.

Figure 36: Investment sequence to maintain a pattern of growth



Source: Dapena (2003)

Figure 36 emphasizes the need to see the growth option as a pattern of successful consecutive investments. However, when should the company adopt a real option approach to decide if this pattern is worth? The growth option should be assessed in the stage "initial investment" because that investment locks the future opportunities that will eventually bring the firm to the stage "mature company".

The hypotheses of this research are:

- first, even if the upgrading path along the entry mode alternatives may not seem attractive, it opens up to a series of future opportunities which, if developed correctly, may lead to a great success in the foreign market;
- second, the growth option is the best technique to assess whether the upgrading is worth.

The first point is quite intuitive and simply fits the growth option definition. The initial investment (figure 32) may be a license needed for exporting a good in order to enter for the first time in a market; it may also be a brownfield investment which might represent a first step for building a future established subsidiary. The second point finds justification at the end of Chapter 2 when we stressed the argument that traditional discounted methods lack flexibility when evaluating strategical investment decisions. Technology advances and the effects of globalization create enormous growth opportunities, and so misevaluation risks are higher (Dapena 2003).

The process explained and the hypotheses made will be analyzed through a case study in the next section of this chapter.

4.2 The case: Glaxi Pane S.r.l.

4.2.1 The firm

Glaxi Pane S.r.l. is a modern bread producer located in the suburbs of Padua, north-east of Italy. The firm was born in the '50s with the aim to deliver bread to other local retailers. When, in 1985, the second generation of Galante's family entered in the management, the firm became an industrial producer. Now-a-days, Glaxi Pane relies on a great market share in Italy and counts some clients also abroad. Their business is based on a wide variety of products made with high quality ingredients; the production process creates frozen bread which is then shipped to large retailers or sellers. There are two main lines of products, Glaxi Bar and Glaxi Restourant: they differ in terms of bread types, taste, shape and ingredients in order to fit as much as possible all the needs expressed by the market. The production process is divided in two lines as well, one is completely automatized, the other is still under human control: the main phases are dough making, leavening, cooking, boxing and freezing. From a commercial point of view, the workflow starts with the arrival of the order from the client and follows with verifications, preparation and external shipment (performed by third parties). New market trends force the company to continuously experiment innovative recipes and redesign the offering; food sector regulations push the them to guarantee higher safety

standards in both production and shipment phases. These are the elements through which Glaxi Pane tries to combine the authenticity of the traditional bakery with the efficiency of the modern production systems.

Before proceeding, it is necessary to make sure that the case study works. Glaxi Pane is coherent with the purpose of this research for three reasons:

- It belongs to the small and medium enterprise category. The identity card of the company tells that the total turnover in 2015 was 8.035.104,00 euros, a 10% more than what resulted in 2014; employees are 35, divided among administration, production and sales department. Given this information, we can say that the firm can be considered *small*.
- Its business fits the internationalization process as presented in chapter one. Modern technologies and communication systems changed somehow the way firms internationalize their processes: new platforms of global sourcing and on-line purchase are now available and firms may do not need joint ventures and subsidiaries to reach their customers more effectively. This is true especially for B2C and service sectors. Glaxi Pane, instead, follows a B2B logic and commercialize alimentary goods focusing on great products and great logistics. For that reason, its international expansion has followed and will follow an incremental path.
- It is already involved in international sales activities. Glaxi Pane started to sell abroad its bread in 2003 in Germany through a local retailer which they still today rely on. The second foreign market in terms of sales is Spain, where the company export since 2006. Other clients, with regular purchases, are in Netherlands, Croatia, France, Belgium and Greece. The last market entered by Glaxi Pane is Egypt where, in 2014, the relationship with a big retailer allowed the company to enter through a privileged channel. Sales stopped in 2014 because of regulatory limitations but the company is currently preparing the requirements to continue the operations.

These points are crucial because they ensure the case to be representative of the population we have analyzed; several other firms, in fact, operate with similar scale and system.

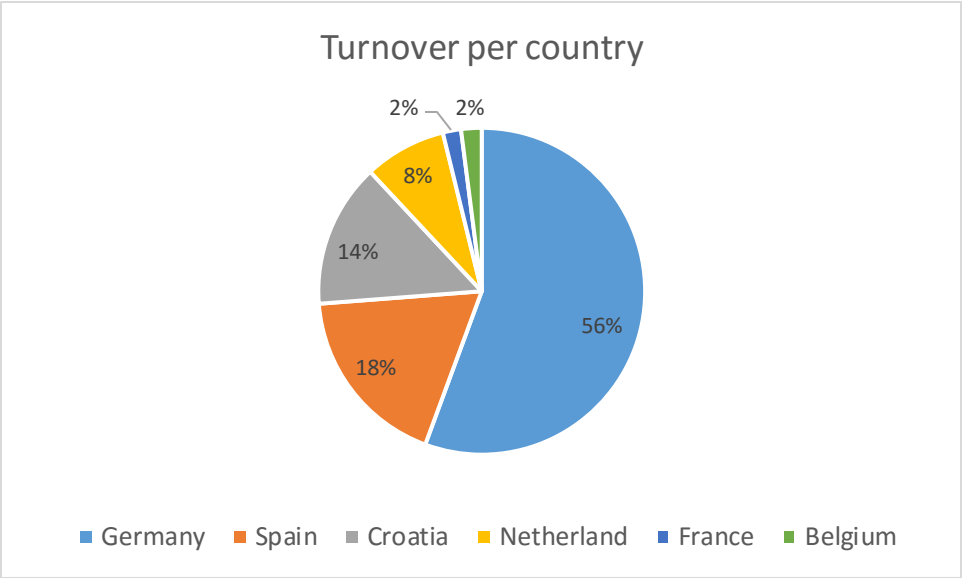
The introduction of a case study at this point of the paper has the function of illustrating a practical example: on one hand it relies on the theory presented, on the other hand it is expected to respond positively or negatively to the hypotheses made. The aim is not to build solid theory (real options have already been used successfully on entry modes and their superiority to traditional methods has been demonstrated as well), but to understand the dynamics present within single setting (Eisenhardt 1989). In fact, despite preconceptions, case studies offer evidences which may confirm

existing theory or showing real world dynamics. However, this approach counts also limitations. First, the case study presents just a single scenario and cannot be generalized; second, the case could follow exceptional events which may not represent best practices or rules applicable to other contexts. This weaknesses of the method become less important when the number of the case studies investigated increase. In single case studies, like this, the challenge is to present rich data by simply presenting a relatively complete rendering of the phenomenon (Eisenhardt 2007). Data gathered are both qualitative and quantitative. Qualitative data were obtained by interviewing the General Manager of the firm who provided a clear review of market trends, sources of uncertainties as well as firm's international strategies. Then, the Export Manager, in charge for foreign activities, has described more precisely timing, operations and logistic issues. Quantitative data were taken from budgets.

4.2.2 Justification and internationalization process

Since 2003 onwards, Glaxi Pane tried to make its presence abroad gradually more robust and competitive. Data from year 2015 say that the turnover produced abroad is 809.572,12 euros, which represents the 10% of the whole turnover. The main country was Germany which generated the 52,62%, Spain generated 18,16%, Croatia did 14,27%, Netherland contributed for the 8%, while France and Belgium are around 2%.

Figure 37: Glaxi Pane foreign turnover



We analyze now from a theoretical perspective Glaxi Pane's behavior in order to define better its current challenge and possible future perspectives. First of all, the firms adopt a sort of multi-

domestic strategy (Doz, Santos and Williamson 2001): the level of integration is low but the responsiveness is high. In other words, there are no real investments on the foreign territories (subsidiaries), transportations are performed by third parties and charged to the client, some relations are carried on a regular basis but some others are not. However, Glaxi Pane tends to design specific offerings for specific countries, in a few cases offerings are also customer-related. This does not mean that the company dramatically changes lines of production and varieties of bread; it means that combination of varieties, names, catalogues and prices change responsively.

The approach reflects the nature of the direct export system, the practice of selling abroad through local distributors but employing own personnel and structure (see chapter 1). This allowed the company to find an equilibrium between the effort put, in terms of money invested, the entrepreneurial risk occurred and the profit made. Another crucial discriminant between direct and indirect exporting is the ownership: except the case of one client, Glaxi Pane maintains its brand on all its product. Thanks to the strategy of managing transactions through own agents and sale managers, the local retailer become a mere intermediary linking the firm to its final customer. Of course, the retailer still has a critical role in the extended value chain and performs a fundamental task.

This approach brings to the firm many advantages (in terms of entry barriers) that the Export Manager of Glaxi Pane has emphasized: almost absent capital investments, only little changes in the organizational structure, reduction of operative costs, absence of interaction with local final client and possibility to leverage economies of scale. In other words, when the knowledge and the networking on the market is little, direct export is a very efficient system. Moreover, uncertainties about future are strongly reduced: the most relevant are the cost of the inputs to produce the bread and the maximum price at which bread can be sold.

Operating in western European countries, such as Germany, Spain, France and Netherlands, implies transaction with the same currency, similar customer taste, a good quality of infrastructure and transportation alternatives, and very little cultural distance. Some differences can emerge in countries such as Croatia and Egypt where the currency is different and the final clients may need different types of bread. However, retailer once again amortizes the differences asking for a responsive offering.

Although their goal has always been to succeed in the Italian market and supply only some clients abroad, foreign markets increased their relevance along time and represent today a great opportunity to enlarge margins by increasing the volumes of sold products. This became more

evident in the last a few years when sales in the domestic market has slightly declined until when it was clear that Italy alone will not be sufficient to guarantee the growth of the firm. While Italian market has been stable among time until having a little decrease, foreign market experienced a dramatic increase in sales (see the example of Germany in the next section): specifically, the growth is due to higher sales per client, while the number of client per country remained almost the same. The long term objective of the firm is growth and increasing of stakeholder remuneration. A new warehouse is almost ready in Padua to host a new automatized process to enlarge the production capacity; moreover, seven months ago the company hired two export managers with years of experience in the field. The strategy is clear:

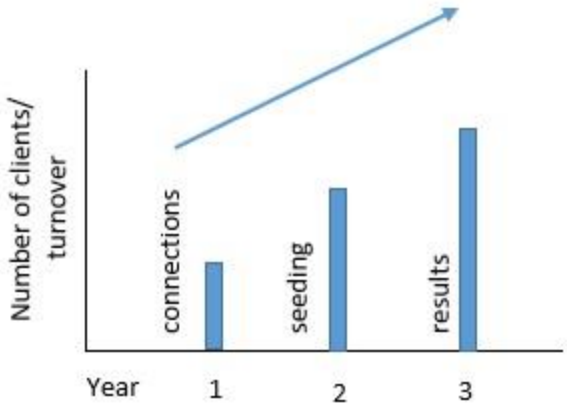
1. increasing the number of local retailers distributing its products in each host country with relevant historical flows (Germany, Spain and Croatia);
2. increasing the total amount of turnover generated by foreign clients in order to balance the stability of the demand in the Italian market.

How to do that? One possibility is to search for new retailers or big shops from the Italian headquarter: find potential clients, contact them, flight abroad to meet them bringing a set of samples and hopefully get the first order. Export managers call it a "gate and go" process since after each step Glaxi Pane has to wait for positive feedbacks before proceeding, it takes time. Another possibility, capital intensive and riskier, is to open a subsidiary in the host country: rent a facility, hire personnel and design the organization. This option looks harder to execute and very demanding for the investment (in terms of money, time, effort) required. However, the just hired manager ensure that it would allow to achieve goals in half time. This second option represents a *shift* from the direct export entry mode towards a foreign direct investment entry mode, describing what was earlier defines as *upgrading path*.

The alternative to build a joint venture with local partners is not even considered for three reasons. Glaxi Pane has no experience on international negotiations and should hire consultants for receiving support. Then, local retailers are big distributors buying a large variety of products from several foreign suppliers, it would be easy for them to replace the firm; Glaxi Pane would not have bargaining power. Finally, the time spent in creating the joint venture could be spent in looking for new customers which would probably lead to the same result in terms of profit. Therefore, creating a joint venture seems to be time consuming and less valuable.

Whatever option the company would undertake, management tends to follow a few rules along its process towards internationalization. They are represented in figure 38.

Figure 38: Glaxi Pane three-step internationalization process



Source: own elaboration

They are convinced, for example, that developing a market would take from one to three years: the first year is for establishing the connections and start seeding, the second year for seeding and consolidate relationship with partners, the third year is when first results start to emerge and the company can rearrange the strategy according to what they learnt. This three step process underlines three elements: the importance of the relationships with retailers (they represent the initial entry channel), the learning pattern which allow the firm to take sequential decision (without learning the subsidiary option would not be available), and the timing that often determines when the investment is worth to take.

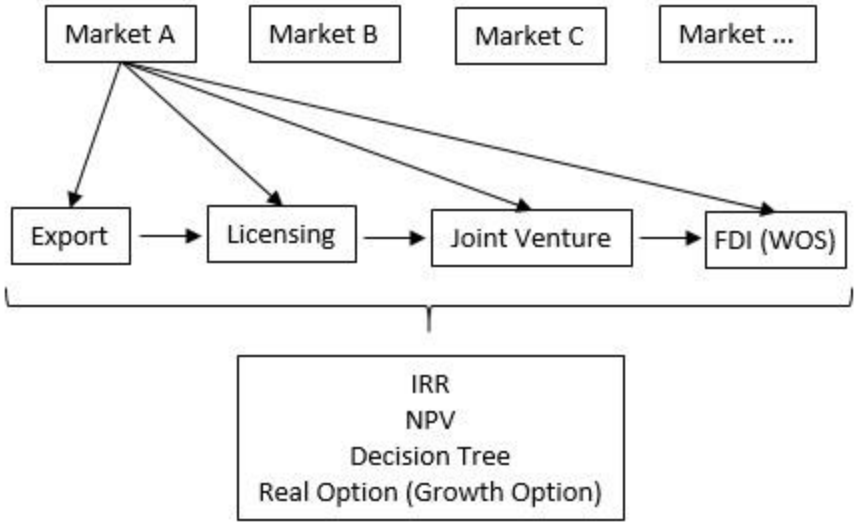
4.2.3 Appraisal process and cash flows

The investment related to the post-entry future growth of Glaxi Pane will be evaluated by applying the tools presented in the previous chapters. The scope is to develop a comparative analysis in order to verify whether the pros and cons discussed are true also for entry mode investments, and therefore which tool is more suitable for the analysis.

Figure 39 shows the process followed and aims to clarify the ratio understating the research. The four main entry modes are placed side by side to the markets as available alternatives. Generally, a SME that undertakes the internationalization process follows a pattern from the left to the right experiencing one or more of the stages indicated (following the order indicated by arrows).

According to this logic and in agreement with Glaxi Pane, German market was picked for the analysis since its performances have been over time the most successful and it shows today a great potential growth.

Figure 39: Market – entry mode combinations and techniques



Source: Adapted from Atik (2012)

Table A presents costs, revenues and net cash flows (inflows less outflows) from year 2003, when the company first entered the market, to year 2016 (prediction for the year were added to the first quarter). Outflows are the sum of operative fixed costs and variable costs, while inflows are all the revenues. Flows were calculated following the rules presented in paragraph 2.1.2 on strategic investment decisions and cash flows definition.

TABLE A: Historical costs and revenues for the German market from Glaxi Pane

Year	Outflows	Inflows	Net Cash Flows
2003	€ 500,00	€ 2.163,96	€ 1.663,96
2004	€ 3.118,53	€ 1.897,88	-€ 1.220,65
2005	€ 16.962,09	€ 3.036,16	-€ 13.925,93
2006	€ 2.688,29	€ 22.503,49	€ 19.815,20
2007	€ 14.250,75	€ 72.437,76	€ 58.187,01
2008	€ 3.456,47	€ 88.168,46	€ 84.711,99
2009	€ 7.808,78	€ 208.018,18	€ 200.209,40
2010	€ 6.301,35	€ 304.785,15	€ 298.483,80
2011	€ 7.738,60	€ 360.190,92	€ 352.452,32
2012	€ 5.355,72	€ 399.624,69	€ 394.268,97
2013	€ 24.265,12	€ 339.560,93	€ 315.295,81
2014	€ 21.731,71	€ 435.390,94	€ 413.659,23
2015	€ 30.288,08	€ 426.042,29	€ 395.754,21
2016	€ 42.533,63	€ 447.344,40	€ 404.810,77

In the previous section two alternatives were presented: keep looking for customer from the headquarter or investing some resources for a subsidiary. Table A helps in providing information

about the expected costs and revenues rate of growth for the first case (Scenario 1). Data for the second case (Scenario 2) were found through a qualitative research based on the history of the company, performance and experience, and on the characteristics of the host country, such as average salary, cost of renting a facility and so on. It is important to underline, despite the amount of capital invested, that Scenario 2 represents strategic investment decisions as they have long-term consequences and change dramatically the configuration of the firm.

The analysis was developed on a ten years' period: on one hand this was considered by managers the minimum timespan required to see future effects of present decisions, on the other hand predictions on longer periods would be too uncertain and unreliable.

Scenario 1: Direct Export

- The company expects revenues to grow at a 5% rate per year thanks to new customers which will be purchasing quite constantly.
- Costs are composed in part by salaries, a share of them was applied in relation to the turnover produced in the German market, and in part by selling costs, waste removal, trip costs, catalogs and promotion activities. Two fairs will be attended, in 2017 and 2020.
- The level of the selling costs will grow of around 25.000€ per every 100.000€ turnover increase; a part of these outflows corresponds to the new personnel that must be hired to handle with the higher workload.

TABLE B: Costs and revenues in the case of direct exporting

Year	Outflows	Inflows	Net Cash Flows
2017	€ 55.000,00	€ 469.711,62	€ 414.711,62
2018	€ 45.000,00	€ 493.197,21	€ 448.197,21
2019	€ 45.000,00	€ 517.857,07	€ 472.857,07
2020	€ 55.000,00	€ 543.749,92	€ 488.749,92
2021	€ 75.000,00	€ 570.937,42	€ 495.937,42
2022	€ 75.000,00	€ 599.484,29	€ 524.484,29
2023	€ 100.000,00	€ 629.458,50	€ 529.458,50
2024	€ 100.000,00	€ 660.931,43	€ 560.931,43
2025	€ 100.000,00	€ 693.978,00	€ 593.978,00
2026	€ 125.000,00	€ 728.676,90	€ 603.676,90

Scenario 2: Brownfield FDI

- The investment is undertaken by year 2017 and consists in a facility with a few offices and a little freezing cell where sample or very little quantities of the product can be stored. The

subsidiary would be located in one of the three richest federal states of the country which are also close to the main retailers the company is currently operating with: number 7 (Hesse), number 10 (North Rhine-Westphalia) and number 11 (Rhineland-Palatinate).

- From an organizational point of view there will be two stages. Stage one will take two years: rent the subsidiary, do a preparatory work, hire three German agents who will be coordinated from the Country manager (who will be the today's export manager for Germany). Stage two: if the subsidiary has performed well, the company will hire two more local agents.
- The investment would consist in a brownfield FDI: it means that the company will not build a new warehouse, it will pay a rent for the whole building and it will pay for its fixed and variable costs. This was estimated to cost around 120.000€ for the first three years and 100.000€ for the following years as the company is expected to find or negotiate more favorable conditions.
- The column of costs (see table C) is also increased by salaries, a percentage of them was calculated in relation to the turnover developed in Germany, and by selling costs. In the first and in the fourth year of the new investment the firm will have to face recruitment and selection costs for the local agents needed. Once every a few years a fair has to be done, and a couple of them will be attended in the first years of the investment (2017 and 2020) to support the work of agents on the field.
- Finally, the company expects the turnover to grow at a 5% growth in the first two years, plus 10% per period in the following years with an increase of 15% only in the years right after the fairs, 2018 and 2021.

TABLE C: Costs and revenues in case of FDI

Year	Outflows	Inflows	Net Cash Flows
2017	€ 232.500,00	€ 469.711,62	€ 237.211,62
2018	€ 220.500,00	€ 540.168,37	€ 319.668,37
2019	€ 220.500,00	€ 594.185,21	€ 373.685,21
2020	€ 252.500,00	€ 653.603,73	€ 401.103,73
2021	€ 242.000,00	€ 751.644,28	€ 509.644,28
2022	€ 242.000,00	€ 826.808,71	€ 584.808,71
2023	€ 242.000,00	€ 909.489,58	€ 667.489,58
2024	€ 242.000,00	€ 1.000.438,54	€ 758.438,54
2025	€ 242.000,00	€ 1.100.482,40	€ 858.482,40
2026	€ 242.000,00	€ 1.210.530,64	€ 968.530,64

Cash flows in the tables above assume that things will follow the pattern designed from year 2017 to year 2026 (the company adopted a ten-year perspective); however, things might change in the market and in the company as well, new opportunities might be available in the future and the company could expand or convert its investment.

As the company has been operating in the market for a while its net cash flows, in the second scenario, are positive by day one of the investment, so that break even analysis do not make sense; however, even if the firm could keep exporting and making revenues, the overall profit would grow at a lower rate.

Now, is it worth to upgrade towards an FDI or it would be better to continue to export? Next sections assess the investment by applying NPV, IRR, decision trees and real options.

4.2.4 NPV and IRR

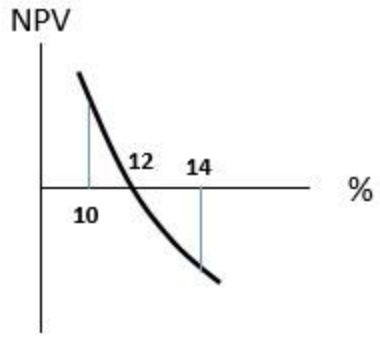
First of all, the assessment of the investment itself (from year 2017 and with a ten years' lifetime) is carried out. Table C, despite the investment in the new plant, presents positive net cash flows because the firm can still rely on previous clients and contracts. Incremental cash flows represent the difference between cash flows showing up in the WOS case (FDI) and those that would take place if nothing changed (export): we need them to isolate subsidiary's performance year by year. In such a way we can evaluate more accurately the results of the investment, Net Present Value (NPV) and the Internal Rate of Return (IRR) are computed. The table below shows exactly what is the difference between the firm's performance in the FDI entry mode and firm's performance in the exporting entry mode. By subtracting net cash flows of scenario 2 with net cash flows of scenario 1 we obtain the incremental cash flows of the upgrading investment.

TABLE D: Incremental cash flows for the investments

Year	FDI	Export	Net Cash Flows
2017	€ 237.211,62	€ 414.711,62	-€ 177.500,00
2018	€ 319.668,37	€ 448.197,21	-€ 128.528,84
2019	€ 373.685,21	€ 472.857,07	-€ 99.171,86
2020	€ 401.103,73	€ 488.749,92	-€ 87.646,19
2021	€ 509.644,28	€ 495.937,42	€ 13.706,87
2022	€ 584.808,71	€ 524.484,29	€ 60.324,43
2023	€ 667.489,58	€ 529.458,50	€ 138.031,08
2024	€ 758.438,54	€ 560.931,43	€ 197.507,12
2025	€ 858.482,40	€ 593.978,00	€ 264.504,40
2026	€ 968.530,64	€ 603.676,90	€ 364.853,74

Cash flows are negative until year 2020, then they turn positive until 2016. The computation of IRR is easy and it was found by applying the IRR function to the incremental cash flows column in a normal excel sheet, it resulted to be 12%. In fact, for a discounting rate of 12% the NPV is equal to 0; for higher rates (>12%) the NPV is negative, as risk is considered higher, while for lower rates (<12%) the NPV is positive. The graph shows the trend.

Figure 40: IRR for the incremental investment



The chart in figure 40 reflects the one exposed in chapter 2 (paragraph 2.2.3) representing a situation of investing.

The NPV analysis, instead, is more structured because a rate of return has to be chosen. The Weighted Average Cost of Capital (WACC) is a possibility. For the risk-free rate, a ten years' Italian government BTP was taken as reference. While the β and the $\mathrm{R(m)}$ were both taken from datasets on European averages per industry (Glaxi Pane belongs to "Food processing"). Data come from datasets of Bureau van Dijk (Aswath Damodaran website, 2016). The other data come from firm's budget. For 2017, first year of the investment, inputs are:

$\mathrm{E} = 841.462{,}00$ €
$\mathrm{D} = 506.944{,}00$€
$\mathrm{T} = 31{,}40\%$
$\mathrm{R(f)} = 1{,}450\%$
$\mathrm{R(m)} = 10\%$
$\beta = 0{,}83$
$\text{Financial charges} = 34.371{,}00$€

Thus, the cost of equity and the cost of debt are:

$$K_e = 0{,}0145 + 0{,}83 \times (0{,}1 - 0{,}0145) = 8{,}55\%$$

$$K_d = \frac{34.371}{506.944} = 6{,}78\%$$

S that the weighted average cost of capital is:

$$WACC = 0{,}0855 \times \frac{841.462}{1.348.406} + 0{,}0678 \times (1 - 0{,}314) \times \frac{506.944}{1.348.406} = 7{,}082\%$$

Therefore, we can compute the NPV to the incremental cash flows from year 2017 to 2026 by applying the NPV formula to the last column of table D, the present value we obtained is 161.863,41€.

Suppose now that, since the investment is in a foreign country, security holders apply higher financial chargers. Say the discount rate is 10% and let's repeat the same calculation; this time the NPV is 62.058,39€. It can be noticed that the higher the discount rate the lower the net present value, the trend is coherent with what shown in figure 34.

Incremental cash flows are essential to understand the convenience of the investment. If we compute the NPV for table B and C, we obtain positive results on both. If we consider the WACC as the discounting rate: the NPV of scenario 1 is 3.76 million, NPV of scenario 2 is 3.92 million. However, since management perceives scenario 2 riskier than scenario 1, we can reasonably apply a higher rate (say 10%) on FDI cash flows, NPV results to be 3.42 million.

Moreover, we found that the IRR of both the scenarios is "undefined": as the net cash flows are all positive, no rate of return leads to a NPV equal to zero.

It is evident that the NPV for the two scenarios depend strongly on the rate of return chosen: for example, sensitivity analysis showed that the NPV of the two scenarios is the same when the rate of return is 12,2758%. For that reason, the analysis on incremental cash flows is necessary because it allows to understand how worth the investment is.

4.2.5 Decision tree

We consider now a decision tree for Glaxi Pane's post-entry process in Germany and focus on its current challenge.

The company can wait and keep exporting, otherwise it can operate through a rented subsidiary. In both scenarios sales can be high or low: in case of FDI managers are fairly sure that the market share will rise, in case of direct export the firm is likely to succeed anyways. If a subsidiary is rented and things go well, the firm might think to expand in a couple of years; if things go bad, the firm might decide to go back to the direct export (in figure 35 "abandon"). Alternatively, if the firm waits and experiences an increase of sales in the next two years, a FDI would be the most reasonable choice. In all the other scenarios the firm waits (maintaining the status quo): of course, abandoning the

market is not an option the firm is willing to consider given that direct export does not require any investment or increasing risk.

In case Glaxi Pane waits, probabilities are:

$$P(high\ sales) = 0{,}8$$

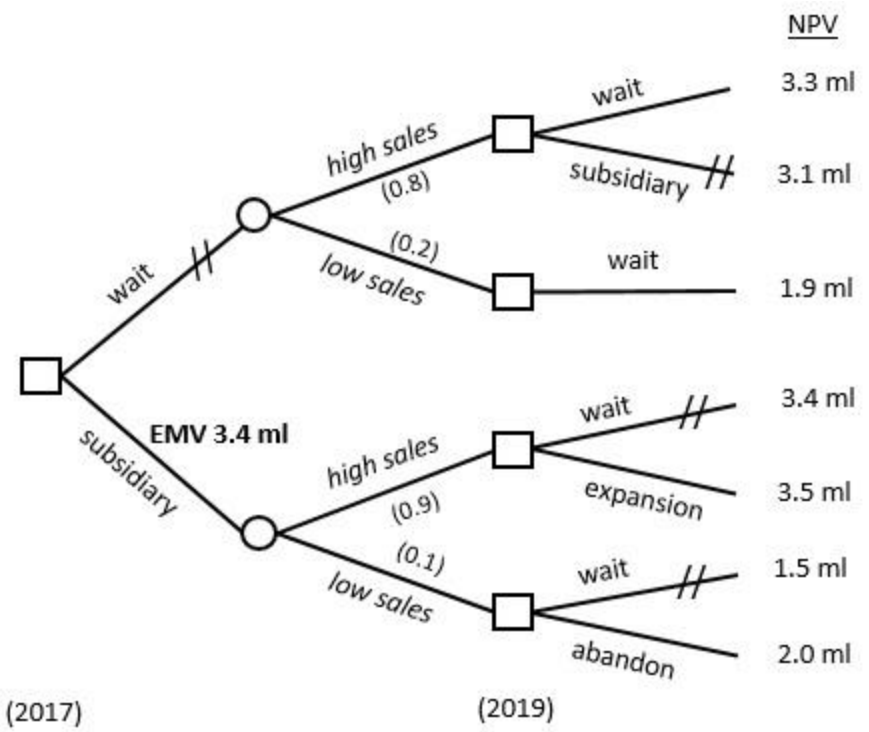
$$P(low\ sales) = 1 - 0{,}8 = 0{,}2$$

While, if a subsidiary is rented, probabilities are:

$$P(high\ sales) = 0{,}9$$
$$P(low\ sales) = 1 - 0{,}9 = 0{,}1$$

NPVs are indicated in each endpoint of the tree; values were computed (10% rate of return) considering that there are no changes from 2019 to 2026 in the entry mode adopted. In two cases values were directly taken from table B and C, while in the other cases we had to make some assumptions. In the expansion branch the subsidiary building is purchased for 500.000€, so that from 2019 there are no more renting costs; low sales branches comport always a 10% decrease in revenues from the previous year. The problem described so far is drawn in the decision tree of figure 41.

Figure 41: Multi-stage decision tree for the foreign market entry of Glaxi Pane



The first step of the rollback method consists in comparing the options on the right side of the tree, the decision branch with lower NPV is pruned. Then, the EMVs per each of the two chance nodes:

values are multiplied for the probabilities of the events “high sales” and “low sales”. In more detail we have:

$$EMV_{subsidiary} = 0{,}8 \times 3.364.380{,}14 + 0{,}2 \times 1.942.052{,}41 = 3.417.685{,}24€$$

$$EMV_{wait} = 0{,}9 \times 3.567.329{,}64 + 0{,}1 \times 2.070.885{,}62 = 3.079.914{,}59€$$

The decision branch with lower value is pruned, the one with higher Expected Monetary Value represents the best choice. Therefore, it is more valuable to rent the subsidiary by now and change the entry mode in the German Market.

Probabilities of high and low sales chosen demonstrate a certain degree of confidence in both decision branches: managers felt quite sure in assigning higher probability to the event “high sales” because of the signed ongoing contracts, the general growth of the demand and their experience in the German market. We saw in chapter 3 that probabilities assigned to events have a strong impact on the final EMV of the root node. Suppose that probabilities for the upper branch are given and reliable (Glaxi Pane relies on market research and own data from the field), while probabilities on the “subsidiary” branch are based on managers’ perception and intuition, and so we can assume they are less reliable. A sensitivity analysis can be performed to answer this question: what is the threshold probability at which EMV in case of subsidiary renting is equal to EMV in case of wait, and so this is no longer the best choice? It can be found that this probability is 0,6743 for “high sales” and consequently 0,3257 for low sales. Since this value is quite far from the one identified by managers, renting a subsidiary remains the best alternative even when probability slightly changes.

4.2.6 Real option

Glaxi Pane can change its operating mode by renting a subsidiary in Germany and hiring a few employees, this would open a new scenario in the German market where other future opportunities are likely to be exploited. In other words, the opportunity that Glaxi Pane may undertake is what in chapter 3 was presented as a “growth option”. The main uncertainties influencing this strategical decision are the capacity of the firm to attract new clients, the regularity of retailers’ orders and the average renting price in Germany for the next decade. However, rather than being viewed as a problem, this uncertainty should be viewed as the reason why the project growth option has value. If the expected cash flows on the project were known with certainty and were not expected to change, there would be no need to adopt an option valuing framework, since there would be no value to the option.

Let's assume a 10 years' perspective and try to assess the post-entry opportunity to grow through a real option approach. The *extended NPV* represents the right tool (see section 3.2.3). In order to apply the MAD approach, we need the following inputs:

- Current value of expected cash flows: 239.558,39€.
- Time to maturity: 2 years.
- Risk free interest rate: 1,45%.
- Volatility estimate: 35%.
- Exercise price: 177.500,00€.

We can start building the tree by computing the up and down values, u and d are needed:

$$u = e^{\sigma\sqrt{\Delta t}} = e^{0,3\sqrt{2}} = 1,6405$$

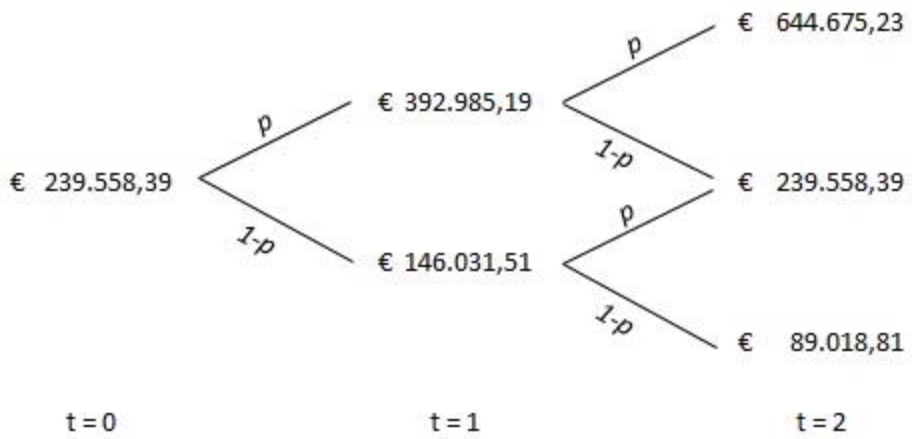
$$d = \frac{1}{u} = \frac{1}{1,6405} = 0,6096$$

Now, the risk-neutral probability can be computed:

$$p = \frac{(1+r) - d}{u - d} = \frac{0,4049}{1,0309} = 0,3928$$

$$1 - p = 1 - 0,3642 = 0,6072$$

The binomial tree can be drawn: using u and d we compute *Su*, *Sd*, Suu, *Sud* and *Sdd*, and we add them in the tree.



Option's value in t=2 can be found as follows:

$$Cuu: \max(644.675,23 - 177.500,00; 0) = 467.175,23€$$

$$Cud: \max(239.558,39 - 177.500,00; 0) = 62.058,39€$$

$$Cdd: \max(89.018,81 - 177.500,00; 0) = 0€$$

We can build now the replicating portfolios:

$$\begin{cases} 644675{,}2333\ \Delta + 1{,}03\ B = 467175{,}2333 \\ 239558{,}3889\ \Delta + 1{,}03\ B = 62058{,}38889 \end{cases}$$

$$\begin{cases} 239558{,}3889\ \Delta + 1{,}03\ B = 62058{,}38889 \\ 89018{,}80935\ \Delta + 1{,}03\ B = 0 \end{cases}$$

The first system leads to Δ=1 and B=-174.963,036; the second one has solutions in Δ=0,4122 and B=-89.391,64. These data are used to find Cu and Cd in the following way:

$$Cu = 392.985{,}19 \times 1 - 174.963{,}036 = 218.022{,}15€$$
$$Cd = 146.031{,}51 \times 0{,}4122 - 89.391{,}64 = 24.027{,}40$$

Now the value of the option in t=1 can be found:

$$Max(218.022{,}15; 392.985{,}19 - 177.500{,}00) = 218.022{,}15€$$
$$Max(24.027{,}40; 146.031{,}51 - 177.500{,}00) = 24.027{,}40€$$

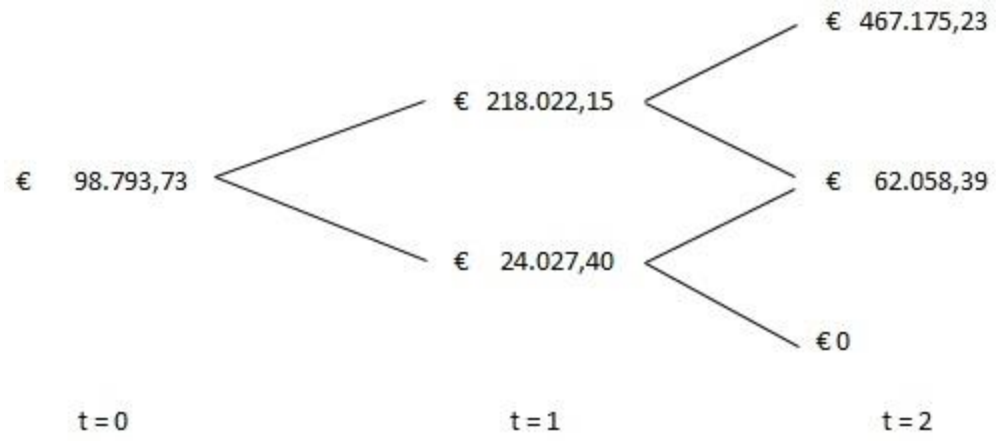
Another replicating portfolio is created:

$$\begin{cases} 392985{,}1909\ \Delta + 1{,}03B = 218022{,}1549 \\ 146031{,}5122\ \Delta + 1{,}03B = 24027{,}40113 \end{cases}$$

The system is solved for Δ=0,7855 and B=-89.391,64. The value of the option in t=0 is found through the following formulas:

$$C = 239.558{,}39 \times 0{,}7855 - 89.391{,}64 = 98.793{,}73€$$
$$Max(98.793{,}73; 239.558{,}39 - 177.500{,}00) = 98.793{,}73€$$

The tree represented below indicates the value of the option at each time:



The value of the option is positive; this suggests that the investment is worth to undertake.

In the analysis, the volatility was assumed to be 35%, which indicates quite high uncertainty. This value was picked because managers of Glaxi Pane perceive the option very risky: the company have always operated in the domestic market and investing abroad is seen as a revolution.

As suggested in chapter 3, the volatility can be found by applying a Monte Carlo simulation where more sources of uncertainty are included. Specifically, a few drivers strongly affecting the value of the expected cash flows can be considered and simulations built according to their variations. For example, Copeland and Tufano (2004), analyzing the new plant creation of a chemical company, used as main variable the spread between the market price of the product and the cost of a key input. Similarly, Brandão et al. (2005) used as key driver the variable operating costs. We preferred not to focus on single inputs of Glaxi Pane's production process or bread market price because their values could differ significantly in the German Market and historical volatility may not be reliable. Instead, the value of the option has been computed with three levels of uncertainty in order to perform a sensitivity analysis. Figure 42 shows the value of the option associated to three different sigma.

Figure 42: Volatility and option value

Volatility (σ)	OV
20%	€ 79.052,58
30%	€ 92.269,79
40%	€ 105.207,90

The case practically demonstrates that the higher the volatility, the higher the value of the option. Indeed, in the real option reasoning uncertainty is seen as a source of opportunities, many of which are valuable.

4.2.7 Discussion on results

In previous sections four tools were applied to the case study with the aim to assess how valuable the international investment (scenario 2) is.

The IRR could be applied only to the incremental cash flows of table D which manifest initial losses until a turning point from which positive net flows start; the IRR obtained suggest that as long as the discount rate would be equal to the WACC, or at least under 12%, the investment is worth to take.

Since the NPV is largely positive for the net cash flows of both table B and C, incremental flows are the only way to assess the performance of the investment itself: they allow to see how much value

the brownfield subsidiary would really add compared to keeping the direct export entry mode. It is clear that this consideration assumes the flows in tables B and C not to vary over time.

Moreover, it can be noticed that a slight variation of the discounting rate leads to a dramatic change in the NPV. This suggests that the firm should carefully analyze the investment before undertaking it as a little change in the internal or external conditions can make the investment less profitable.

Decision trees were drawn to represent alternative choices and relative consequences. More attention has been payed to the possibility to delay the entry in the market or eventually abandon or expand the investment made. In fact, the most positive aspect of building the decision tree is that it allowed us to evaluate different alternatives at the same time. This is not possible in NPV and in real option techniques neither. On the contrary, the results of this method rely too much on probabilities arbitrarily decided by managers of the company and not extracted from market solid information.

The endpoint "wait", with NPV of 1.9 million, deserves to be analyzed better. Abandoning the market does not make sense as the direct exporting does not require additional costs even if sales decrease and profits go down. If this happened, while the general demand is at least stable, the firm should wonder whether the entry mode adopted is right. It is possible that other competitors created subsidiaries to get closer to national retailers reducing the bargaining power of Glaxi Pane and destroying its position in the German market.

Finally, the real option analysis was applied. It can be noticed that the value of the growth option today is higher than the NPV we have computed earlier on the same cash flows. This confirms what some practitioners argued on real option: overestimation is a risk and we should be careful especially in making strategic investment decisions. However, in Glaxi Pane case, since the NPV of the investment (table C) is widely positive and the firm can rely on valuable contracts and experience, the positive value of the option provides a consistent proof that the brownfield FDI should be undertaken.

The establishment of a commercial platform in a foreign market represents a dramatic change in Glaxi Pane's organization and identity, for that reason managers should apply more than a single quantitative tool for such an assessment: indeed, limitations of a technique can be successfully overcome through the application of another.

Conclusion

Some firms may be willing to take an investment because doing so allows them to make in the future some other investments; it can be argued that such an investment provides the firm with an option to grow, and the firm should therefore be willing to pay a price for such an option. Consequently, a firm may be willing to lose money on the first investment because it perceives the option to grow as having a large enough value to compensate for the initial loss. This is the case of Glaxi Pane as well: the firm may invest now or wait a couple of years before losing the advantage to be the first Italian bread distributor with a subsidiary in the German west territory. Is the management willing to face a temporary decrease of the total profit from that market in order to achieve a higher value in the medium and long-term? Indeed, the investment opens the door to other hidden opportunities, such as expansion (anticipated in decision tree analysis) or conversion. For example, the subsidiary could be bought and become a WOS in order to cut fixed costs and apply the modifications needed, or it might become a commercial platform for other countries such as Netherlands and Belgium becoming a new logistic hub.

This means that a growth option often leads to a great value in the long term, higher than the one captured by quantitative tools.

Since all the techniques applied gave positive response to the opportunity analyzed, which one should be considered more reliable? They all showed their limitations. The IRR gives only little information on the investment by focusing on the rates of return; the firm may consider it only to understand what is the minimum rate of return they should accept. The NPV demonstrates once again solidity: we can change the rate (higher if the risk perceived is relevant) in order to see if the investment is worth. However, as discussed along these pages, both methods are rigid and do not accept changes in the inputs across time. Therefore, if we want to empower managers in their activity allowing also for changes along the way, we need to assess investments with more flexibility. In other words, when the context is uncertain, traditional techniques perform poorly.

Decision trees offer a road map which allow to see the endpoint of each pattern started from the root and influenced by events. This is the kind of map managers appreciate because it clarifies the consequences of each decision. However, the way probabilities were identified and the assumptions made in order to find the NPV of each endpoint rise some doubts on the reliability of final results.

Valuing options on investments reflects a management approach based on learning and behavioral adaptation. The technique adopted takes into account the possibility that the market goes up or

down and considers the value of expected cash flows with a certain volatility. It also foresees the possibility that the investment is undertaken in a determined time span. This method is not unfailing but this case study arises its favorable point: the flexibility in the valuation allows to capture the value coming from uncertainty. This seems to be even more important in growth options where future opportunities are locked in the exploitation of a first investment.

Back to the case study presented, results found suggest that internationalization is a road to take and that a brownfield subsidiary is valuable. Possibly, managers can use more than one technique to assess the alternatives they have, being aware of their limitations and of the assumptions they rely on.

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