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« **Option chain and change management :
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Option chain and change management : a structural equation application.

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Abstract: :130 words

The aim of this work is to establish empirically with a structural equation model (SEM) the existence of links between the options perceived by the members of an industry, the expectation of future rents produced by the exercise of these options and firm or industry specific factors. The theoretical part of this work is based on the notion of option chain developed by Bowman and Hurry (1993). The empirical part is on the video-game industry. A questionnaire based dataset on 211 video-game creators allows us to represent the concepts of potential and real option from a strategic point of view. The study shows that the relations between perceived opportunities, capacities building and rent expectations are shared by the members of this industry and can be expressed as options.

Key words: Real options, Innovation and change management, structural equation analysis, video-game industry.

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Introduction

The success of a firm depends on her ability to earn increasing returns or obtain rents by creating and exploiting new projects, routines and technologies in a more efficient way than the other firms in the industry (Teece *et al*., 1997). Those projects are competitive opportunities that the firms must recognize, evaluate, and for which they must build operating capabilities to take advantage of them. The general management responsible for the firm's strategic direction fails frequently to manage the organization's technological innovation and change processes that create these opportunities (Adner and Levinthal, 2004a).

To help managers in their decision-making process in uncertain environments new techniques and theories are developed, one of them is the real option theory. This conceptual decision making framework is about to become a standard (McGrath *et al*., 2004). The formal approach, originating with financial models, dealing with future uncertainty and the opportunities a firm can seize, is appealing for managers.

Bowman and Hurry (1993) present a conceptual model, called option chain (the successive steps of creation, development and use of a real option) aimed to bring the real option logic from the financial field to the strategic management field. Their work was based on the intuition that people try to keep options open. The authors showed that the option chain could be seen as an analysis framework integrating many aspects of innovation management (resource allocation, sense making, organizational learning and strategic positioning) and that their model could be useful to explain many aspects of the development of a firm, from both a theoretical and an empirical point of view.

The real option logic gains a broad success in financial and managerial literature but the concept of option chain is comparatively very infrequently used in theoretical work and to our knowledge

no empirical work tries to represent it explicitly. This is regretful because the elimination of the causal logic behind the option chain pushes the managerial approach of real option into some wrong roads, considering situations as options when there are not (Garud *et al*., 1998; Adner and Levinthal, 2004a,b; Kogut and Kulatilaka, 2004). Also, the partial consideration of the option chain, focusing only on the real option element, makes the financial approach still predominant and avoids many non-financial topics of innovation management that are important from a strategic point of view such as organizational learning or firm strategy–structure relations.

In this work we use the option chain to answer a major issue, almost ignored in this literature, the question of the origin of the real options a firm possesses from a theoretical point of view and we propose a possible empirical approach.

We suggest the use of the entrepreneur/manager duality for explaining the creation of new options. This duality, often described by opposing two actors with different mind sets, responsibilities and abilities, can be found in many firms active in industry where constant innovation is a necessity.

The insights gained from considering real option and the entrepreneur/manager duality are bi-directional. On the one hand entrepreneurship, in a resource based framework, can explain the origin of real option and contribute to a better evaluation of its value. On the other hand real option can explain the direction a decision maker gives to the development of the new capabilities and resources, as an entrepreneurial activity, by suggesting another use of the resources. Combining entrepreneurship and real option explains the heterogeneity of the firm and its resources collection and capabilities building.

The empirical approach we propose is based on a structural equation model allowing us to create latent variables close to the notions used in the option chain and to test the relationships (the

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paths) existing between those variables along the chain. Our endeavour is to make a structure apparent between the different kinds of options. To that end, structural equation modelling (SEM) is an appropriate tool (Tabachnick and Fidell, 2007:30). The use of this tool in strategic management has strongly increased in recent years and, following Shook *et al.* (2004), is able to generate insights in the strategic management where the constructs are complex and multidimensional. This exploratory study is carried out on innovative firms from the video-game industry.

In the next section we present the theoretical background: the option chain. This is done by introducing the original model by Bowman and Hurry (1993) and the incremental developments and improvements that have been made since, including the addition of our entrepreneur/manager duality. The section ends with the proposal of a conceptual model of the genesis of option and new product development. Subsequent sections transform this conceptual model into a structural equation model, present the data, the empirical analysis and the results. The paper concludes by discussing the findings and their implications for future research.

Theoretical Background

An option gives the right but not the obligation to take a specific decision (invest, defer, alter) on an underlying asset, for a predetermined price at, or before, a certain time. For example, a firm can possess a production plant, and choose, depending on customer demand or competition, to construct a bigger capacity plant to obtain economies of scale (a growth option) or, on the contrary, to momentarily shut down the plant (option to defer production). The firm has the right, but not the obligation, to change her production capacity. This option, depending on the

information at hand at the moment of exercise, allows the firm to seize new revenues flows or to reduce costs.

Figure 1 represents the successive developments of the real option chain in the strategic management literature. The following discussion and presentation of the option chain and the introduction of the entrepreneur / manager duality rely on that figure.

--- Insert Figure 1 about here ---

Standard option exploitation

The area labelled ① represents the initial step of the real option theory as it can be found in today's major textbooks on that topic (Trigeorgis, 1996; Amram and Kulatilaka, 1999) and is highly influenced by the financial literature. This short option chain is the following: the option is supposed to exist, to be available to the decision maker. The decision maker (always referred to as the manager in this literature) evaluates the option contingently to the future possible states, and decides to exercise it or not.

To exercise means that the project enters a phase of building and exploitation. Once the firm is in an exploitation phase new options can arise such as expanding the size of the plant, diversifying the production, or in the worst case, stopping the production and shutting down the factory.

Identification of opportunities, the emergence of the potential option

The previous representation, as noticed by academics in the strategic management field, makes the important assumption that the option exists and that the decision maker is informed of its existence. This is, obviously, not always the case. Bowman and Hurry (1993) struck by that implicit hypothesis, introduced the notion of shadow option (or potential option in the following),

the option that a firm could exploit, or at least consider in her portfolio of choices but of which she is not aware. In other words the authors intuition is that the firm possesses resources and knowledge giving her options that the decision makers ignore.

Opportunities (and not yet options) come into existence when individuals have different beliefs in the possibilities offered by the available or potential resources to transform some inputs into some outputs that can be sold and raise a profit (Kirzner, 1979). An opportunity is a favourable, momentary circumstance or situation that has been recognized after one has sought it or that has spontaneously appeared. Once the potential option is taken into account (area ② Figure 1) the rest of the option chain can be considered in the same way as described above. When the shadow option is recognized, it moves from the potential option label to the real option label. The option has then to be evaluated, compared to the other options, by taking into account the probable interaction between the different options the firm possesses in her portfolio of choice.

The addition made by Bowman and Hurry (1993) does not completely answer the question of the origin of the real option, it merely shifts the debate. Instead of explaining the origin of the real option, the genesis of the potential option must be elucidated.

Introduction of the entrepreneur / manager duality

A historical approach of entrepreneurs in the microeconomic theory (Barreto, 1989) shows that when authors need to introduce novelties or special variations into a theory of the firm they often refer to the figure of the entrepreneur. In this work we consider entrepreneurship as a resource of the firm making it possible to discover opportunities (Cohendet *et al.,* 2000). Kirzner introduced the concept of "entrepreneurial alertness" as the special ability of the entrepreneur to see where products (or services) do not exist and can be profitably exploited. Alertness exists when one

individual (or a group in the case of diffused entrepreneurship) has an insight into the value of a given resource while others do not.

Once the opportunity is identified ③ one can notice that the entrepreneur certainly does not have the specific knowledge and expertise in all domains necessary to fulfil his goal. This leaves him in charge of finding and combining the adequate resources for building new productive competences. This building process is not instantaneous, it is mainly path dependent and involves tacit knowledge acquired through learning by doing and experimentation (Kogut and Zander, 1992). This implies that firms who create knowledge are also option-creating firms. By creating new knowledge these firms expand their cognitive frames and therefore their real options. To explain that phenomenon McGrath and Boisot (2005) use a biological metaphor. The combination of different elements (like genes in biology) allows the firm to obtain a variety of different structures depending on the complexity of the possible combinations. The higher the degree of freedom of the combinations, the broader the variety of potential outcomes. This degree of freedom in the combinations corresponds to the liberty the entrepreneurs take in their representations. This specific entrepreneurial mindset is a source of potential options. The value of the entrepreneurial resource derives here from his ability to combine different expert knowledge in such a way as to create and exploit opportunities. The conceptual liberty of the entrepreneur is a source of options, however this liberty has to match the flexibility of the firm. The complex recombination of elements envisaged by the entrepreneur must be put into practice by the firm, to this end the complexity of the firm must at least match the complexity envisaged by the entrepreneur to satisfy Ashby's law (Ashby, 1956).

The decision to exercise the option and to turn to a production phase corresponds to a managerial decision making process. A reason why the manager does not enter the option chain earlier

comes from the nature of the output of the shadow option. The output of the knowledge building process (what is done during the shadow option) is difficult to evaluate, the knowledge is disperse and the manager is not aware of all pieces before the entrepreneur ends his action. Following March (1991), we could say that in the option chain, the entrepreneur is in charge of the explorative learning of the firm and the manager of the exploitative learning. The managerial decision depends on the balance between entering the market with the actual resources and knowledge or waiting for absorbing more capacities.

Empirical model development and hypotheses

Building on the notions and the conceptual model presented previously we draw a path model capturing the relations and the logic behind the option chain. This model incorporates the following effects: (i) industry and (ii) firm specific effects on potential option generation, those constitute the necessary condition for novelty, (iii) industry and (iv) firm specific effects on the development and exercise of the potential option into a real option, and (v) the expected influence of those options on the future rent of the firm.

The relations between industry and firm specific features on potential option creation

The effects of market and technological uncertainty on firm decision have received abundant attention over the years. In particular the relation between uncertainty and development of options and new competences has been developed. The relation between uncertainty and the elements of the firm is particularly discussed when the firm has to act in such an environment. The choices available to her are to stick to the existing few competences or to develop her portfolio of competences widely, which has implications from an organizational point of view and on the risk profile of the firm.

Following the option literature, the greater the technological uncertainty, the more flexible the firm needs to be (Kogut, 1991, Folta, 1998). On the contrary when the uncertainty is relatively low, resources can be widely engaged in a few precise projects (McGrath, 2000).

Hypothesis 1a: The higher the innovativeness of the industry, the greater the creation of potential options.

Hypothesis 1b: The higher the innovativeness of firm employees, the greater the creation of potential options.

The relations between potential options and real options

The passage from a potential to a real option involves a managerial decision of allocation of resources to the development of a project. This requires to value the flexibility of the firm, and implies acquiring, retaining, deploying or abandoning some knowledge inventories and views developed by a part of the firm.

Levinthal and March (1993) described the knowledge inventory of a firm as "a small number of specialized competencies maintained by the individuals and groups that make up the organization" (p.103). Managing knowledge inventories is problematic because "where situations or proper responses are numerous and shifting, it is harder to specify and realize optimal inventories of knowledge. By the time knowledge is needed, it is too late to gain it; before knowledge is needed, it is hard to specify precisely what knowledge might be required or useful. It is necessary to create inventories of competencies that might be used later without knowing precisely what future demands will be" (p. 103). This management problem is the source of myopias and decision biases. McGrath (1999) surveyed many of those myopias and decision biases that can be confronted by a manager or entrepreneur hindering the development of

potentials into real capabilities or, in that case, real options. Miller (2002) proposes a model for assessing the difficulties of the managers to overcome these biases when allocating resources in a knowledge based framework. Also Miller and Shapira (2003), in an experimental economic framework, show that the evaluation of opportunities, when they are presented in the form of options, is in practice difficult and does not always follow the direction and/or magnitude predicted by theory.

All those authors show that describing the link between the potential and the real option is difficult. However in a study of more than 300 projects, McGrath and Dubini (1999) show that the perception of option potential is a powerful driver of resource commitment and has implications for the organizational design. Accordingly we can say that the development of potential options fosters the existence of real options.

Hypothesis 2: The perceived potential of an option will increase the likelihood of it being developed as a real option.

The relations between industry and firm specific features on the exercise of a real option

Amit and Schoemaker (1993) introduced the notion of strategic industry factors: the set of resources and capabilities that have become primarily determinant for the survival and development of the firms in a defined industry. These generic strategic assets are completed in each firm by firm specific strategic assets, referring to the resources and capabilities developed by a single firm for obtaining and protecting rents. In the light of these definitions, the strategic position of a firm evolves each time she –or a competitor– develops new resources or capabilities leading to a firm specific strategic asset. In the case of a major development in an industry those

strategic industry factors can change considerably, creating the need for all the firms to develop new resources.

Following the previous discussion two hypotheses on the real option exercise can be formulated, in relation to the determinant of the industry strategic assets, and to the firm specific competences and resources.

Hypothesis 3a: The perceived threat of competitors is positively related with the exercise of real options.

Hypothesis 3b: The uniqueness of the competences developed is positively related with the exercise of real options.

The relations between potential options, real options and firm performances

The links between future rent and project development are explored theoretically and empirically in some studies, even if it is not always in a clear option formulation. Makadok (2001) presents a rent generation model where the firm can choose between building her own resources or picking up existing resources on the market. While the creation of resources corresponds entirely to our option chain and leads to rents, the picking up of resources corresponds more to a catching up strategy leading to a small advantage that is only possible when there are other firms in the industry who have built and stored those resources. Hence one could wonder if the fact the competitors have those resources is not a brake upon a superior profitability of the firm and whether those two resource acquiring techniques are not substitutes or complements, enhancing or detracting each other value. In an empirical work McGrath *et al*. (1996) identify drivers of future rents from innovation. Among these drivers are the understanding by the teams of the client satisfaction objectives, quality objectives, cost objectives, proficiency and the expectation

of distinctive efficiency and value from the firm corresponding to the increase in value that customers will obtain from the firm rather than by products from competitors.

From these observations we formulate the following hypotheses linking real option, potential option and firm performance.

Hypothesis 4a: Expected Firm performance depends positively on the development of real options.

Hypothesis 4b: Expected Firm performance depends negatively on the perceived threat of competitors.

Hypothesis 4c: Expected Firm performance depends positively on the development of firm specific competences.

Methodology

Sample survey

The study consists of a survey conducted on 211 employees of different video-game companies based in Europe, Asia, U.S.A. and Canada. The survey is completed by employees from firms of different sizes. All the respondents were active in that industry by the time of the survey and participated in the development of new products. The product can be either the final product (the video-game) sold to the consumer, or a computer program needed for the development of a new game. This program can be developed for in-house utilization by another project group of the same firm or sold to another company.

The data are second hand, they were collected by a game developer survey conducted through internet (see Tschang, 2005, for details on the dataset building method) and was not conceived for testing the option chain but for evaluating the work conditions of the employees in that

industry and their communication with the management. The data do not allow us to know the level of responsibility of the respondents (manager or another member of a project team) nor the activities of the respondents (programmer, artistic, design or integration activity…).

But the survey is composed of many questions concerning the development of the firm, her evolution compared to competitors, and the sharing of opinions between management and employees that allow us to created latent variables corresponding to our needs.

Cadin *et al*. (2006) conducted a study on the HRM practices in the video-game business investigating industry and firm specificities. They consider the differences in the function of human resources, the employment model and the growth model of the firms and conclude that the video-game firms needs (as organizations) and practices are the same in the U.S. and in the E.U. The HRM practice and the organizational scheme are contingent to the industry not to the country. Hence the variance introduced by the variety of the respondents belonging to firms of different sizes should be moderate and we can use our country heterogeneous data set in the following study.

On the other hand, it is probable that the size of the firm influences the employee rewards and career management possibilities and thereby affects the risk-taking behaviour and willingness to create more innovative products (a less conventional product can be seen as a riskier product). However all firms in this specific industry share the necessity to innovate, therefore this size effect should be of modest relevance.

Apart from these points there are other reasons why we choose the video-game industry for this exploratory study of the option chain. To ease our work, it is more likely to find a good

representation of the option chain in an industry where the pace of new product launching is high and where the firm has to constantly reposition herself in a quickly evolving environment. In that case the set of internal competences and resources is dependent on and concurrent to those of the competitors. This is the case in this business as reported by Cadin *et al*. (2006:296) : "Everything in the game industry is based on confidentiality and anticipation (…) it is essential to stay in the race (…) it is more difficult to keep up to date with new technologies, competitors projects and trends".

The dynamics of the industry is to a great extent imposed by the evolution of the underlying technology. The development of new computers and consoles every five to six years offers the video-game engineers new calculation power allowing them to conceive enhanced products but also confronts them with higher expectations from the customers (Burgerlman *et al*., 2005; Schilling, 2003). This environment eases the adoption of a product development process in the form of an option chain.

Item development

The items in the questionnaire submitted to the employees are answered by giving a score on a 1 to 5 Likert type scale, where a higher score is associated with a higher approval of the item. Two choices are open to us for linking the different questions to the latent variables. We can use a factor analysis and use the aggregated factor obtained to calculate the correlation matrix for the SEM analysis on the latent variables, or we can use a larger correlation matrix where all the items appear. As our main concern is to establish the simple link between potential and real options we use the first approach. This has another advantage, the distribution for each latent variable is closer to a normal distribution when we work on the aggregate latent variables and thus gives better overall results for the model estimation. The reliability of the construct obtained by

grouping the items of the questionnaire is assessed with Cronbach's alpha. The alpha for each construct is above or close to the 0.7 recommended level (Hair *et al.*, 2005), details are given in Table 1.

--- Insert Table 1 about here ---

RESULTS

Descriptive statistics and correlation matrix

Descriptive statistics and the correlation matrix for each of the latent variables are provided in Table 2. Figure 2 illustrates the relations between the construct involved in the option chain previously discussed.

The variables are not skewed except for those concerning the firm competences and innovativeness that are slightly skewed to the right (5 points). This can mean that people are optimistic in their own work, and see the development of new products necessary. It can also partly be the expression of over confidence (McGrath, 1999).

It should also be noted that the standard deviation of the industry innovativeness variable is about the same as the industry threats variable, the same can be said between firm innovativeness and firm threat variables. The standard deviation is higher in the variables in accordance with the competitor's reaction (industry related variables) than for the firm variables corresponding to a shared opinion in the firms. The relations in Table 2 are compatible with the path relation of our structural model and the underlying hypothesis we formulated.

--- Insert Table 2 and Figure 2 about here ---

Both industry innovativeness and firm innovativeness are positively correlated with potential options indicating that an innovative environment fosters the creation of options. Rent expectation is positively correlated with the firm competences and the different types of options but negatively with the industry variables. In the option chain, the highest correlation is between potential option and real option indicating a strong relation between these constructs. The highest correlation among all the parameters is between industry threats and firm competences. This somewhat troubling positive relation suggests that the competitors know each other very well and that the competition results in a positive emulation, we discuss this in a community perspective in the conclusion.

Structural analysis

We employ Amos 4.0 to develop a structural model that tests the relations proposed and some alternative path models employing the same constructs with different paths or leaving out some of the constructs and paths.

The main model we tested obtained a χ^2 value of 11.59 with 13 degrees of freedom and p-value of 0.562. This means that the null hypothesis (the model fits the data) cannot be rejected. The results are listed in Table 2, alternative measures of fit are given in Table 3. All paths are significant, the fit indicators are on average acceptable.

--- Insert Table 3 and 4 about here ---

As expected the analysis shows that potential options are highly associated with real options and that both industry and firm innovativeness affect the potential options. So far the hypotheses H1a, H1b and H2 cannot be rejected, although the influence of the industry innovativeness is small

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compared to the firm effects. The option chain continues through hypothesis H4a where real option affects the rent expectation. The representation of the option chain is therefore achieved. We can notice that industry threats affect negatively the rent expectation and the real option creation, suggesting that when the competition is tough firms focus on some projects reducing their real options.

The statistical analysis we perform implies that the data fit the model, but this does not mean that no other models exist that have a similar or perhaps better fit. Then, understandably, we consider alternative models.

Alternatives models

The alternative models we test correspond to the dismissal or addition of different paths. The main alternative models tested are listed in Table 5. The dismissal of one path leads generally to a shrinking of the p-value and to the rejection of the model (e.g. model 2). The model general fit is only slightly modified when the hypotheses H3a and H3b affecting the real option variable are dropped. Permutation between H3a,b and H4a,b paths shows that the model needs a link between industry threats and firms competences with either the real option or rent expectation variable but there is no clear preference which one should be taken. Also a correlation path between industry innovativeness and firm innovativeness leads to a minimal improvement of the model. This is somehow surprising when we consider this industry as innovation oriented.

--- Insert Table 5 about here ---

The addition of a path between rent expectation and potential option does not lead to an improvement of the model (model 4). Therefore the recursive part of the option chain, mentioned in the work of Bowman and Hurry (1993), is not empirically represented with these data.

The model with the best fit, built with paths in accordance with our framework, is obtained by adding a path between firm innovativeness and firm competences and concentrating the relations on the real option variable. This result echoes the dynamic capabilities approach of the firm, where the capacity of a firm to innovate is considered as a competence.

From this analysis, we see that our initial model gives fair results compared to alternative models, only a few are acceptable in the same range as our model and hardly any fits better the data than our representation. We now turn to the discussion of these results.

Discussion

In this work we developed the conceptual option chain scheme proposed by Bowman and Hurry (1993). We show an empirical approach of that concept by developing a structural equation model. The results we found support those of other authors linking the fields of innovation management and investment decision (Van de Ven, 1986; Brown and Eisenhardt, 1995; McGrath and Dubini, 1999; Tushman and Andersen, 2004; Cho and Pucik, 2006) and suggest some new paths for future research.

We found that the members of an organization recognize that the differences between their own competences and those of the competitors are the source of rents or profits obtained by catching the consumer's demand. The employees of the firms account simultaneously for the demand pull and technology push implication of product development. The differential in resources and competences existing between a firm and the industry is the origin of the rent expectation which is in line with the arguments of the resource based view of the firm. The historically dependent

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accumulation of resources and the idiosyncratic routines developed are at the source of the higher performance of firms and influence their capacity to change dynamically (for a broad survey of these questions Foss, 1997; and a more management oriented perspective in Pfeffer and Salancik, 2003).

To conclude, we discus two elements of this work, the future development of the option chain and the implication of the video-game industry data we used.

The option chain with other critical issues in strategy

Brown and Eisenhardt (1995:374) note that the creative processes where the competences of the firm are "matched" with the market needs in such a way as to create new products should be explored. In particular the firm governance mechanism between top management and project management for evaluating, creating and exploiting synergies between competences in the firm are to be investigated in the light of the real option theory. Recent developments in organization theory and theory of the firm see this in the rebirth of the old duality between entrepreneurs and managers. The economic distinction between an entrepreneur as an innovator as opposed to a manager responsible for the administrative tasks is no more sufficient. Both of them have to answer problems of sense making, diffused entrepreneurship, networked organization and entrepreneurial and managerial life cycles among others. These domains influence the way a firm develops her strategy and impacts directly on the option chain that appears here too linear. We can advocate that it could be difficult to empirically test a more complex option creation and utilization model, but this remains a possible future path of research.

An important issue, not mentioned in that work, is that of the type of rent created. Options on new technologies can produce Schumpeterian rents, options on trademarks or licenses allow the firm to seize monopoly rents. Accordingly, the specificity of an option developed by the firm

allows her to seize a specific type of rent and therefore some option chains are more valuable for the firm than others. In that sense, the option chain approach could be another way of defining dynamic capabilities. A firm with good dynamic capabilities is a firm who is able to move faster or more slower on some options chains and can link them together for achieving unique resources. We line up here with the approach of Mathews (2003) who characterizes the firm strategic moves by expanding their real options via external resources acquisition. In this work he lists the advantages and disadvantages (even feasibility) of internal and external development of real options. As we do in our work he insists on the option chain structure and the simultaneous consideration of the industry and firm innovativeness and threats. But both works do not tackle the dynamic capabilities and rent generating mechanism with the option chain, leaving it open for further research.

The limits due to the video-game industry data used

The video-game industry and the underlying problematic of new product development in an evolving industry fit perfectly the purpose of the option chain. However the data used in this study were collected during a particular period of the video-game industry corresponding to a certain level of uncertainty that could have an impact on the results. Data came from the period before the launch of new platforms, when firms had to reinvent the electronic entertainment. Schilling (2003) studied such a period of technological and business uncertainties during a plate-form change. She concluded that the firms are obsessed by the technology gap and their capacity of using the full potentiality of the calculation capacity of the platform. Therefore the importance given to uncertainty and innovativeness in the empirical findings can be somehow overestimated.

The other problem specific to this industry is that the firms are organized –deliberately or not– in communities. Therefore the opinions and practices are largely shared industry-wide. Dougherty (2001) analyzed the innovation procedure of several firms and showed that there are significant differences between the firms successful in their innovation process and the others. The central reason comes, for this author, from the project orientation of the different teams, and the integration of the outputs from the different teams. The successful innovators are those who dispatch the problems in different workgroups corresponding to the competences of the individuals and to their competitive advantage. The individuals see themselves as belonging to communities of practice with a specific task or problem to solve. The individuals of those firms understand that the value created by establishing and developing a long term relation with the customer on the basis of their innovative products is important. In addition to the community perspective, the organizational structures of the firms in the video-game industry are almost similar, consequently the opinions and expectations of small working groups are largely the same. Only major strategic moves, corresponding to major investments for the firms can make significant differences in the types of products developed. This is not captured at employee level, but rather at the decision level which is not taken into account in that study.

Related to this is the control of the specific organization of work flows in the video-game industry (and other innovation oriented industries) that relies critically on some individuals who act as sense makers. Simon (2006) shows on case studies of a large video-game company that the existence of shared meaning of the project and the interrelation of the different projects within the firm and its co-evolution with the practice of the industry is a key factor of success. This integration capacity is not clearly mentioned in our dataset and deserves attention in future work.

Finally, the further development of the real option construct in the strategic management should try to replicate this approach in other industries. As suggested by authors in strategic management (Barnett, 2003) and finance (Zingales, 2000) the next step should be the identification of the main elements of the theory of the firm that could be utilized to represent adequately the option chain concept in a framework better suited for strategic management analysis than the traditional Black-Scholes financial approach.

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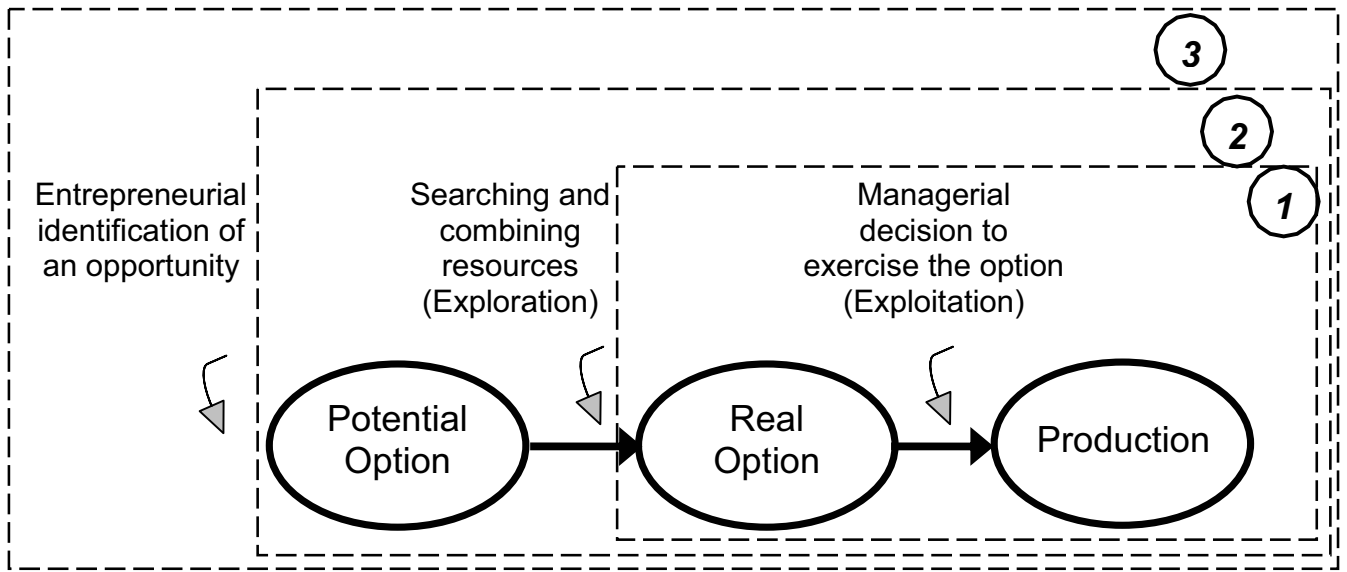
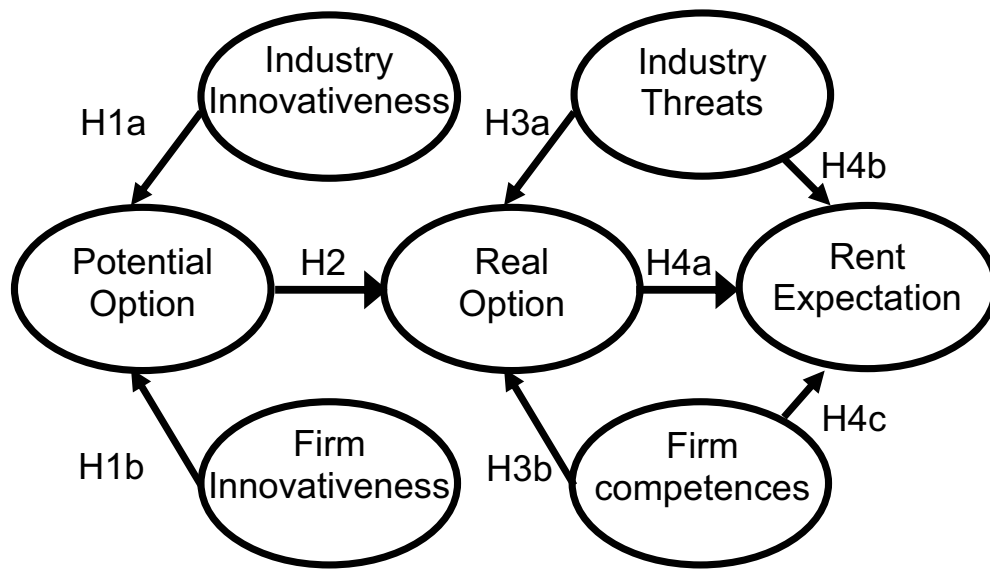**Figure 1** The option chain in the strategic literature

Figure 2 The structural model to be tested

Table 1 Latent variable definition**:** The following questions have been used for creating the latent variables (1-not at all, 3- to some extend, 5- to a very large extend)

Latent variable	Items:
Industry Innovativeness	- Other companies in the industry launch more innovative products than your company - Other companies in the industry produce a larger variety of products (RPG, FPS…) than your company - Other companies in the industry produce for a larger variety of platforms (computer, console) than your company Cronbach Alpha: 0.78
Firm Innovativeness	- Most of the products development in your company are new, based on new ideas and/or new practices - Your company commits many employee to the development of new technologies/processes - Your company commits many physical, financial, organizational and logistical resources to the development of new technologies/processes - Your company innovates more than the majority of the firms in this industry - Your company places strong emphasis on R&D, technological leadership, and innovation - Your company tries to create small, autonomous units to encourage innovation and flexibility Cronbach Alpha:0.84
Potential Option	- The business practices, corporate culture and management style of your company gives you a lot of free decision possibilities - Your company is flexible according to her equipment and resources - Your company is flexible according to her human resource management practices and routines - Your company develops an exhaustive set of alternatives before making important management decisions - The project you are involved in will help the company to learn new manufacturing, production or operations skills - The project you are involved in will help the company to learn about new market segments and market opportunities - The project you are involved in will help the company to learn what product features and attributes our customers really care about Cronbach Alpha: 0.81

Real Option	- To use this technology/process your company had to invest significantly in specialized equipment and facilities - To use this technology/process your company had to invest significantly in skilled human resources - The technology/process your company develops or uses now is based on previous investment in equipment - The technology/process your company develops or uses now is based on previous investment in human resources - When your company sees business opportunities, she can seize them quicker than her competitors Cronbach Alpha: 0.74
Industry Threats	- It is difficult for competitors to imitate the product/technologies/process your company uses (scale inversed for the latent variable construction) - How do you rate your company ability to evaluate the market development of next generation game/console (scale inversed for the latent variable construction) - Your company believes that unstable, rapidly changing environments provide more opportunities than threats (scale inversed for the latent variable construction) Cronbach Alpha: 0.69
Firm Competences	- The technological risks (that the systems would not work as planned) of the projects your are involved in are usually mastered - The organizational risks (that the systems would not integrated with others, or are not reusable) of the projects your are involved are usually mastered - The financial resources are adequately dispatched between different projects - The human resources are adequately dispatched between different projects - People in your company accept change readily Cronbach Alpha: 0.74
Rent – Profit Expectation	- With this project your company will achieve higher profit than competitors - As a result of this project, customers will be willing to pay a premium price for our offers - This project is likely to significantly improve the quality of our offers compared to past quality levels Cronbach Alpha: 0.81

Table 2 Latent variables descriptive statistics and correlation matrix

Latent variable	Mean	Std. Dev.	Ind. Innov.	Firm Innov.	P. Option	R. Option	Ind. Threat	Firm. Comp.
Ind. Innov.	2,59	0,92						
Firm. Innov.	3,08	0,59	0,08					
P. Option	3,78	0,49	0,24	0,08				
R. Option	3,17	0,38	0,04	0,28	0,38			
Ind. Threats	3,53	0,89	0,17	-0,14	0,32	0,12		
Firm. Comp.	3,3	0,57	0,09	0,11	0,27	0,29	0,41	
Rent Expect.	3,37	0,64	-0,11	0,29	0,44	0,28	-0,23	0,38

Table 3 Structural Model results, N= 211, χ^2 =11.59, Probability level = 0.562

Path	Maximum Likelihood Estimation	Standard Error
Industry innov. to potential option (H1a)	0.066	0.14
Firm innov. to potential option (H1b)	0.357	0.25
Potential option to real option (H2)	0.344	0.18
Industry threats to real option (H3a)	-0.087	0.12
Firm competences to real option (H3b)	0.430	0.29
Real option to rent expectation (H4a)	0.285	0.22
Industry threat to rent Expectation (H4b)	-0.241	0.13
Firm competences to rent expectation (H4c)	0.511	0.33

Table 4 Goodness of fit for the measurement model

	Initial Model	Best Revised Model	Desired Levels
χ^2	11.59	7.069	Smaller
Df	13	10	-
χ^2 / Df	0.89	0.7069	<3.0
p-value	0.562	0.719	> 0.05
GFI	0.878	0.918	> 0.9
AGFI	0.738	0.769	> 0.8
Standardized RMR	0.049	0.035	< 0.05

Table 5 Test of alternative models

Model	Path differences with initial model	x^2	P-value
1	Initial model + Industry Innovativeness ➜ Firm Innovativeness	10.40	0.58
2	Initial model without H4b and H4c	13.91	0.45
3	Initial model without H3a and H3b	12.33	0.58
4	Initial model + Rent Expectation ➜ Option Potential	11.55	0.48
5	Initial model + Firm Innovativeness ➜ Firm Competence	7.06	0.71
	Industry innovativeness ➜ Real Option		
	Firm Innovativeness ➜ Real Option		
	Without H4b and H4c		

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