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Valuation models and Simon's bounded rationality

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This paper aims at reconciling the evidence that sophisticated valuation models are increasingly used by companies in their investment appraisal with the literature of bounded rationality, according to which objective optimization is impracticable in the real world because it would demand an immense level of sophistication of the analytical and computational processes of human beings. We show how normative valuation models should rather be viewed as forms of reality representation, frameworks according to which the real world is perceived, fragmented for a better understanding, and recomposed, providing an orderly method for undertaking a task as complex as the investment decision.

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INTRODUCTION

It may seem intriguing to believers in the idea of bounded rationality (BR) that firms often use complex valuation models in their consideration of investment opportunities, requiring the detailed forecast of a large number of variables throughout an extended time horizon – a task that seems disproportionate to the human limitations in gathering and processing information. It is the case of the discounted cash flow (DCF) model, the equivalent in corporate finance of the neoclassical profit maximization hypothesis. Seen as state of the art in financial valuation, the DCF model requires yearly estimates, *ad eternum*, of the cash flow generation of a project, implicating in the construction of meticulous forecasts on sales, prices, costs, etc. Moreover, one has to estimate the level of risk involved in the project to determine the appropriate risk premium, and conjecture the interest rate

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– or opportunity cost – that will prevail throughout the whole life of the project to calculate the proper discount rate to bring the cash flows to present value.

This paper aims at reconciling the evidence that sophisticated valuation models are increasingly used by companies in their investment appraisal with the literature of BR, according to which objective optimization is not possible in the real world because it would demand an excessively detailed knowledge by economic agents of the complex environment in which decisions are taken, and an immense level of sophistication of the analytical and computational processes of human beings. The assumption here is that the firm's investment decision is an adequate instance for empirically studying the effects of BR since it combines two compelling features: (1) decisions to be taken are extremely complex, embracing a prodigious number of alternative possibilities to be considered, the consequences of which are extremely difficult to assess and compare; and (2) decisions are typically decentralized, and the results obtained by each department have necessarily to be made explicit and conveyed to others by some form of communication, revealing aspects that remain concealed in individual decision-making.

Given that unrestrained optimization cannot be applied by firms in their practical investment decisions, the purpose of this work is to identify mechanisms that make these decisions possible and grant them some consistency. This paper is based on a broader work (Godoi, 2006), in which the case study methodology – based on in-depth interviews and on the observation and analysis of the processes effectively used by a pre-selected set of Brazilian firms –, is used to try to identify some of the main tools applied to investment decision-making. The current paper focuses on a specific segment of the decision problem: the task of estimating the future consequences of each possible course of action. Here we investigate how this process of analysis differs from textbook models of financial evaluation.

More particularly, we intend to show how normative valuation models should rather be viewed as forms of *reality representation*, frameworks according to which the real world is perceived by the firm, fragmented for a better understanding, and recomposed, providing an orderly method for undertaking a task as complex as the investment decision. In an environment where information appears so abundantly and in so many different forms, and attention has to be directed to a small portion of the vast universe of alternatives and variables to be considered, valuation models appear as important instruments (1) to lead the process of search for information in the right direction, (2) to structure the process of analysis, establishing procedures and priorities, and (3) to reduce the number of variables to be considered by the agent so that they are commensurate with human being's information processing limitations. Also, they allow for a division of labor according to which information can be manipulated by the individual most equipped to do so, representing an important source of power allocation and uncertainty absorption within the firm. Common procedures allow the same task to be replicated by different individuals within the organization, minimizing the interference of subjective elements. Finally, the use of valuation models retains an important jus-

tificatory role, communicating clearly to the rest of the organization the principles and system of values used for decision-making.

The main conclusion of this study is that even though the framework used to confer structure to the decision process (i.e., a formal valuation model like the DCF) is imported from the literature of objective rationality, its *form of implementation* has certainly a character of BR. As a form of reality representation, the valuation model is necessarily connected to the firm's history and experience, bringing to the decision process its own biases and simplifications as to how the problem must be perceived, factored, analyzed and recombined. Moreover, the model is fed by individuals with premises generated exogenously and often in an ad hoc manner, which reflect their subjective beliefs regarding the future. As a result, an interpretation of valuation models as means for bearing with BR propitiates a richer and more comprehensive discussion of the firm's investment processes and a better understanding of its decision-making tools than could possibly result from a static view of optimizing firms operating in situations of equilibrium.

This paper is divided as follows: in the first section, we make a selective survey of the literature. In the second section, we discuss Simon's ideas on reality representation, and how they can be useful in understanding decision-making processes. In the third section, we apply this theoretical framework to the investment problem, generalizing from the empirical evidence raised by the fieldwork. Here we draw interesting conclusions on firms' decision processes, and attempt to reconcile practical evidence with theory by means of a perspective based on the idea of BR: instead of anomalies or mistakes made by uninformed or naïve individuals, some non-conventional behaviors might actually be functional, even imperative to enhance the quality and accuracy of decisions in environments of fundamental uncertainty. The final section concludes, defending the importance of the use of routines in the investment decision process.

SURVEY OF THE LITERATURE

A decision-maker of any kind is typically confronted with a great number of alternative behaviors among which he must choose. His objective as a rational agent is to choose the strategy that leads to a preferred set of consequences, (1) listing *all* possible alternative strategies (search), (2) determining *all* consequences (analysis) and (3) comparing them (choice). While neoclassical theory assumes that the agent is capable of executing each of the steps below immediately, exactly and costlessly, Simon defends that perfect optimization is not possible in the real world because it would demand an excessively detailed knowledge of the complex environment in which decisions are made, and an immense level of sophistication of the analytical and computational systems of human beings. Furthermore, empirical evidence does not seem to corroborate the classical hypothesis of perfect optimization, which suggests that not even unconsciously (i.e., supra rationally) do agents behave as theory predicts. Simon proposes the idea of *bounded rational-*

ity (BR): agents have the intention of behaving in an objectively rational way but being incapable of doing so, they satisfy themselves with the rationality of the *procedures* used. Several lines of thought have emerged focusing on the specific forms that these limitations assume, as well as on possible solutions and modeling alternatives to such behavior (e.g., Rubinstein, 1998). Let us mention briefly and selectively some studies that concentrate on the difficulties of estimating consequences of actions (for a more extensive survey, consult Godoi, 2006, ch. 4).

Currently, the literature closer to the purpose of this paper is probably found in the field of corporate finance, in an endeavor to apply the evidence on detours from the strictly rational behavior to problems like the decision by firms to distribute dividends (i.e., the reverse of an investment decision) or mergers and acquisitions (an "investment" for the firm, even though not for the economy as a whole). A comprehensive survey of this literature and be found in Baker et al. (2005), who divide such studies in two main approaches. The *irrational (financial or portfolio) investor* perspective assumes that arbitrage is imperfect and, therefore, asset prices can be misaligned. Company managers, assumed rational because they behold more precise information on the business itself, recognize these distortions and respond to them by, e.g., catering and market timing (cf. Baker et al., 2005). Interesting conclusions from this literature include the idea that moments of excessive pessimism by capitalists might lead to the abandonment of potentially viable investment projects because they become expensive to finance, and the insight that excessive liquidity might force managers to undertake projects they would otherwise refuse (cf. Barberis and Thaler, 2003; Shefrin and Statman, 1984).

The second approach (i.e., that of the *irrational manager*) is more interesting to the purpose of this study, though less developed at this stage, both in terms of its theoretical assumptions and of empirical verification. It assumes that *managers* are subject to errors of perception and bias, but retains the assumption of *investor* rationality. Literature focuses typically on two particular biases, "optimism" and "overconfidence", the effects of which have been studied mostly through the analysis of mergers and acquisitions, of firm's capital structures and of the financing of new businesses. The main results, according to Baker et al. (2005, p. 2), suggest that: "(…) these biases, in leading managers to believe their firms are undervalued, encourage overinvestment from internal resources, and a preference for internal to external finance, especially internal equity". Baker et al. (2005) present a competent summary of the literature in economics and psychology relevant to the behavior of irrational managers. Empirical studies like Larwood and Whittaker (1977), March and Shapira (1987) and Ben-David (2004) present evidence of optimistic and overconfident behavior among managers.

An interesting research program – and similar in scope to the present paper – is the study of startups. Landier and Thesmar (2004) show, through the *ex post* analysis of results, that managers tend to overstate the chance of success; Merrow et al. (1981) suggest that building costs are frequently underestimated, and Statman and Tyebjee (1985) indicate that operational costs tend to be underestimated and revenues overestimated.

A broader application of the concept of BR could significantly extend the range of phenomena studied to problems beyond optimism and overconfidence: "Boundedly-rational managers cope with complexity by using rules of thumb that ensure an acceptable level of performance and, hopefully, avoid severe bias" (Baker et al., 2005, p. 46). Rules of thumb, distinct to the normative criteria of net present value (NPV), are relatively common in the area of financial management, as shows the empirical evidence (cf., Gitman and Forrester, 1977; Graham and Harvey, 2001; Welch, 2004). Nevertheless, it is undeniable that complex quantitative valuation models like the DCF are frequently used and continue to be the apparatus recommended in almost every normative study on the matter. Acknowledging that, this paper intends to explore the topic in a different direction: instead of concentrating on the anomalies, i.e., situations when the recommended methodology is not used at all, we choose to focus on the circumstances when firms actually *attempt* to employ it, and explore how the decision-maker reconciles the complexity and great demands for information and processing capabilities of the model with his intrinsic limitations.

REALITY REPRESENTATION

According to a BR approach, the investment decision process begins with the construction of a reality representation, which includes not only the definition of a *theory* or model on how the world works, but also the measuring and estimation of *premises*, factual or value-based, that will feed this model. The theories and premises effectively applied by organizations are in part acquired from the environment, and in part imagined or created internally at the organization, and are perpetuated in the form of procedures and routines.

The concept of reality representation was extracted from Simon's writings on complexity. The *theories* are the artifact that the entrepreneur uses to make his investment decisions; his interpretation of the real world, with its own simplifications and abstractions. Such theories tend to mirror certain characteristics of human beings' information processing systems, such as their tendency to represent reality in the form of a *hierarchy*, or a set of parts or subsystems, which behave quite independently from each other (what Simon calls *near decomposability*). Systems of this kind are more easily understood by the human mind since some aggregative proprieties of the parts and a few rules of interaction are enough for a reasonable description of reality. Therefore, hierarchies tend to be the representations "chosen" by our minds as forms of directing and structuring our efforts to understand complex phenomena. Looking at a complex problem according to a hierarchical mental structure allows us to organize our search for a solution and economize time and effort by taking it in steps. When certain "clues" are found that signalize progress, the part that generates it is separated from the rest and taken as a "given", on top of which the analytical process can build on.

Many scholars have elaborated Simon's ideas of near decomposability. Edigi

and Marengo (2004) raised the issue of *division of knowledge* as analogous to the Smithian *division of labor*. Similarly, Earl and Potts (2004, p. 317) defend that "(…) institutions are devices for handling BR by partioning the world into separable units". They combine Simon's ideas on BR with the concepts of paradigm by Kuhn (2003 [1962]) analyzed by Kelly (1963), proposing that people deal with the complexity of the world modeling it as if it were decomposable, building their world views in a hierarchical manner and limiting the number of dimensions in terms of which they see the world.

Extending this same concept, we could say that firms have finite lists of possible investments, which depend on their expertise and interest in a particular market. Corporate strategies would be developed in the form of a system with core constructions, which receive a more significant role in the compartmentalization of the world, and horizontally divided into subsystems. In a world where there is turbulence, entrepreneurs need near-decomposable ways of thinking. Aspects of the organizational culture need to be preserved throughout a vast spectrum of events, and the routines and rules that the firm imposes on its contributors is a way of doing that. The choice of valuation models to be used in the analysis of investment opportunities is just one of many examples of such mechanisms.

This relatively rigid hierarchical structure, however, is capable of dealing with only half the problem, i.e., the portion that is redundant, repetitive and, thus, possible to crystallize in the form of a routine. However, investment opportunities bring also an element of novelty and *fundamental* uncertainty that cannot be automated. Following Shackle's insight (1949) that uncertainty is a fundamental precondition to entrepreneurship, the firm must be capable of dealing with a future that cannot be projected because it is yet to be created. Imagination, or creativity, is, therefore, an important counterpart or palliative to deal with uncertainty, filling in gaps of information that the agent is incapable of obtaining or estimating objectively. Since a complete analysis of all alternatives is impossible due to limitations of time and processing capabilities, the process of mapping and appraising alternatives has a necessarily heuristic and selective nature, leaving ample space for imagination. People differ naturally in their capacity for imagination and in the particular connections they make. Therefore, citing Shackle, "(…) the boundedness of uncertainty is essential to the possibility of decision" (apud Loasby, 2004, p. 268).

THE DCF MODEL AS A REALITY REPRESENTATION

To illustrate the decision process described above – i.e., a relatively rigid hierarchical structure, or theory, complemented with leaps of creativity and imagined premises – we will depict the process of investment analysis most similar to normative prescription: the use of detailed quantitative models for cash flow estimation like the DCF. Why do firms constrained by BR attempt to apply such a sophisticated model? In part, they follow recommendations and normative studies

that seek the optimal way to proceed in such situation but ignore practical difficulties in implementation. Nonetheless, such models, in their "simplified versions" developed by firms to deal with real world limitations, seem particularly useful in other ways.

First, such models have an important justificatory role, granting a certain scientific character to the process and facilitating the communication of procedures and results. Especially in corporations with sophisticated governance structures, the high demand for "accountability" at several instances of the investment decision and execution requires that managers describe their decision processes to outside stakeholders in the most objective way possible. In a situation like this, the use of a standardized textbook model like the DCF, with its specific jargon, simplifies dramatically the communication process, transferring some of the model's reputation of objectivity and correctness to the firm's individual decision process.

But more importantly, such models offer a theoretical framework to think about the problem, a system which structures the process and can be shared by the organization, *unifying reality representations*. It represents a consistent form of factoring intricate problems, allowing the decision-maker to deal with it piecemeal by solving simpler sub-problems and then recombining these partial solutions. The compound problem can thus be fragmented for a better understanding, providing an orderly method for undertaking a task as complex as the investment decision, and offering a template according to which all investment alternatives are evaluated and compared. Ultimately, it helps the agent deal with the excessive demands for attention and processing capabilities. In an environment where information appears so abundantly and in so many different forms, and attention has to be directed to a small portion of the vast universe of variables to be considered, valuation models structure the analysis, establishing procedures and priorities, and reduce the number of variables to be considered by the agent so that they are commensurate with his processing limitations. Even knowing that many of the inputs that feed the model lack accuracy, the model objectively establishes the type of information needed to proceed ideally, thus directing the search efforts in the right direction.

In addition, the job of forecasting inputs can be divided among the several departments within the organization, allocating the task according to available resources, and common procedures can be set so that the same task can be replicated approximately by different individuals within the organization. Such a tool synchronizes expectations of several firm associates, allowing the decision to take place even in a scenario of great uncertainty and avoiding the trap of inaction. Consistent with the propositions of BR, what one needs sometimes is not so much an absolutely correct conceptualization of reality, but one that can be understood by all participants and that facilitates action instead of paralyzing it. A successful model condenses information, absorbing more data than it produces, and therefore promotes the decision.

It is clear, however, that even though the framework used to structure the decision process is imported from the literature of objective rationality, its *form of*

implementation has a character of BR. The model chosen, acting as reality representation, brings to the decision process its own biases and simplifications as to how the problem must be perceived, factored, analyzed and recombined. Moreover, the model is fed by individuals and departments of the organization with premises that are generated exogenously to the model and often in an ad hoc manner and that reflect their beliefs and expectations regarding the future. In the form of economic, sales or cost forecasts, etc., these figures (which are in themselves estimates conditioned to the opinions and perceptions of those who create them) are used as data or "facts", raw material to develop other estimates (e.g., profit forecasts). Evidence is replaced by conclusions.

This device *absorbs uncertainty* at several points of the decision chain, and is also an important source of *power allocation* (cf., March and Simon, 1993 [1958]. The recipient is constrained in his ability to judge how accurate the premise is; his interpretation is based on his reliance on the source and not on the examination of evidence. The person who uses his own direct perception of the reality summarizes information obtained from the environment, filtering it according to his own criteria and values, and transmits it to the organization, at which point it becomes an important source of action premises and, therefore, a source of power. The communication patterns will determine how often and intensely the consequences of certain particular actions, e.g., are brought to the attention of top management and, therefore, considered.

From our fieldwork, we can extract some remarkable examples of the use of relatively complex valuation models as reality representations (Godoi, 2006, ch. 6). Let us mention briefly a few to illustrate our point. A fund manager who supervises the allocation of resources of an equity fund demands that his employees develop detailed quantitative models for each of the companies they follow, aware that these models are excessively sensitive to certain very volatile and uncertain premises, like the rate of discount or the rate of growth in perpetuity. However, these models are essential, in his point of view, because they allow him to test different scenarios and conduct sensitivity analysis to an ample spectrum of companies, comparing them. Also, in a situation where different people (in the present case, different analysts) are responsible for monitoring parts of the universe of choice, models are important to unify assumptions and minimize the subjectivity of forecasts.

Structured models offer an additional advantage: they allow for the maintenance of discipline, which in many cases is essential for the correctness of the decision. Decisions made based on distinct premises can hardly be compared, a posteriori, among themselves, compromising the appraisal of the business. Moreover, differently from textbook exercises in which the decision is clearly located in time, or is periodic (e.g., annual), in the real world the possibility of certain decisions remains open for long periods of time, or even for the whole life of the business. The decision to leave or persevere in a specific industry, e.g., is a shadow that always hunts the entrepreneur. Investment options that remain permanently available bring an additional problem to the decision-maker: many of the relevant variables

present high volatility, or are cyclical. Since human capacity to grasp the future is inevitably contaminated by the present mood on how things are, and the difficult task of forecasting is often solved by extrapolating the current situation into the future, a contemplation of the project during a moment of pessimism might lead to equivocated decisions, like closing a business in the low end of a cycle that is about to be reversed. Ironically, we have here a situation where excess information might reduce the quality of a decision. One entrepreneur says:

If you are always thinking about the decisions you've made, staring at the computer's screen the whole day monitoring how things are, you won't work. The more you check something, the more anxious you become, and you end up making the wrong decision, based on the emotion of the moment (verbal communication [VC])[1].

Establishing a certain periodicity, not excessively long or overly short, to evaluate decisions seems to be one of the most important practices to avoid contaminating judgment with short-term considerations and psychological elements that, inevitable, affect human beings. In general, this periodicity is conditioned to the availability of concrete information that can be directly compared with an expectation previously had. E.g., when a homebuilder finishes the construction of a building, it compares the effective cost with the former estimate, feeding the premises for future projects and realigning its models. When it publishes its quarterly results, a corporation makes a more complete evaluation of its performance, adjusting expectations.

Paradoxically, to be rational in a dynamic and long term context, one has to give up the permanent consideration and reconsideration of every aspect of the decision that neoclassical rationality implicitly defends. Firms are able to act consistently and appropriately because they are capable of isolating themselves from the daily volatility, without loosing the faculty of periodically evaluating its results. Only some kind of "enlightened discipline" allows for the conciliation of two so contradictory objectives. Here, again, a quantitative model like the DCF has the important role of offering a template for monitoring and measuring results, increasing discipline and standardizing procedures.

Safeguards and fail-safe devices

The model chosen to represent reality has to be fed with estimates of certain key variables, a process that involves the difficult task of forecasting future events. Usually the agent has a relatively vague and incomplete theoretical understanding of the phenomena, based on expectations he has developed in previous situations.

[1] A full description of the companies visited and individuals interviewed, as well as the detailed protocol used for the case studies, can be found in Godoi (2006, Appendix). Individual names are not associated to specific comments in order to preserve confidentiality. Interviews were conducted in Portuguese; eventual distortions and mistakes resulting from translation to English are the responsibility of the author.

To this he adds information obtained from opinion makers, the press and individuals with whom he interacts. Gaps are filled with extrapolations of the past and with leaps of imagination.

Interestingly, entrepreneurs recognize that the forecasting processes they use in such uncertain situations are inevitably inexact: "*they know that they don't know*". Therefore, they seem to adopt a series of heuristics to address this problem, safeguards to protect firms from very wrong decisions. E.g., they recognize explicitly the fragility of forecasts by using relatively high intertemporal rates of discount (cf. Loewenstein and Prelec [1992]). Simon sees our relative lack of concern towards the distant future as a recognition of our inability to forecast and calculate the consequences of our actions beyond short distances into the future, and an acceptance that these consequences are vague and diffuse (cf. Simon, 1996 [1981], p. 157).

Similar treatment is given to information whose source is doubtful. In subjects distant to his personal expertise, the observer cannot rely on data obtained from his own experience, and has to trust knowledge obtained from third parties. By attributing discount rates positively related to his degree of ignorance on the subject, the agent seems to be adjusting the second-hand information he obtains to a "risk of imprecision". This mechanism could provide one reasonable explanation for the reluctance by the entrepreneurs interviewed to diversify into different industries.

In addition, if an exact forecast is impossible in a scenario of uncertainty, rational agents tend to prefer, ceteris paribus, courses of action that allow them to reevaluate their position in the future. Thus, there is a liquidity premium to be applied to alternatives that leave the group of possible choices open in a subsequent moment of time, e.g., minimizing sunk costs and irreversible actions. Simon saw the broad use of models of adaptation with feedback (as opposed to purely predictive models) and the use of homeostatic systems as evidence of this liquidity preference.

SUBJECTIVITY, INERTIA AND INNOVATION

The role of imagination and creativity in complementing the more objective valuation model in areas where it remains indeterminate is not the only channel of "contamination" of the analysis by subjective elements. Since each agent can only consider a small spectrum of the universe of possibilities and information involved in a complex decision, and this spectrum is locally determined (i.e., it consists of opportunities and data that are close to his reality), his present and past experience are crucial to define how the decision will be made and which alternative will be chosen. Our fieldwork raised important considerations with respect to the subjective character of the process and of the result of a decision, and we will summarize here a few of them.

Subjectivity appears most obviously in the process of reality representation.

A human being is not capable of considering in all its complexity a problem with innumerable variables as is the investment decision, being many of these variables uncertain or indeterminate. His mind, therefore, designs a simplified representation, which will serve as the artificial environment in which the problem is considered. The determination of this model involves an active process of selection of the aspects of reality that will be considered, ignoring others that are supposedly less important or more difficult to estimate. This representation will be noticeably subject to past experiences, ideologies and beliefs of the person who builds it. E.g., an executive with vast experience in finance would tend to emphasize particular variables, like the degree of leverage and cash flow generation of a project, while another executive whose background is mostly in marketing and sales would worry to a larger degree with issues like the size of the market and the velocity of sales. Therefore, how one decides depends to some extent on personal history, qualification and previous experience.

Also, the type of information the agent is exposed to attracts his attention to specific regions of the universe of analysis and raises considerations of one or another kind. In the interviews conducted, e.g., it became clear the important role played by economic consultants, bank analysts and the press in general in the establishing of premises. Thus, models are often fed with consensus forecasts, or "the average opinion" – a behavior that might be useful in anchoring expectations. Take the financial market: the price of a particular asset depends on the general perception on its fundamentals and the funds' flow this perception generates – a second order effect – and not on the fundamentals themselves. Therefore, a successful investor needs to anticipate variations of this perception, and, consequently, of the average opinion. Similarly, firms try to follow the "business flow", or the general mood in the markets. Additionally, the average opinion is usually an important focal point to which decisions converge. The resolution to make the "conventional decision", i.e., to stay close to consensus, offers frequently lower risks to the decision-maker: "Being wrong with the crowd in justifiable; you don't loose you job, your client. Being wrong on your own is very hard" (VC).

Finally, the selection of the objective of the business is an important determinant of how reality will be perceived. Among the companies visited one can identify several business models: family businesses, corporations with transparent governance structures, etc. In each case, reality is perceived and acted upon according to a lens, conditioned to values and "truths" pre-established by the organizational culture and rarely questioned during the daily operation of the business. Models and quantitative simulations, supposedly objective instruments of analysis, seem often to serve more as ways of reinforcing the views the organization had previously formed intuitively, or as instrument of rhetoric to justify certain decision.

Such a statement only makes sense if one recognizes that it is impossible, in the real world, to have a purely neutral or objective model of analysis. Some of the assumptions used to build and feed the model are always based on speculation about uncertain variables and inevitably contaminated by preconceived ideas of the agents, previous experiences, characteristics of their personalities, etc. There-

fore, if rationality is limited by the incapacity of human beings to consider completely and objectively all aspects of a complex reality, and this deficiency is compensated by the use of imagination and simplifications to complete the missing parts of the puzzle, the flip side of the coin of BR is the subjectivity of decisions.

Inertia in the investment process

The presence of fundamental uncertainty – or the intrinsic impossibility to estimate certain variables needed for analysis –, and the consequent subjectivity of the investment decision process might explain a few anomalies, or detours from the traditional rational results. Let us exemplify with one of them: the inertia of investment, i.e., the tendency by firms to continue investing even when profit-maximizing conditions are not met.

Inertia is nourished by many cognitive and cultural mechanisms; one of them is firms' inclination to put to use all funds it can seize. We found in our fieldwork that an important incentive that triggers the process of search for new investment opportunities is the internal availability of funds. Instead of an entrepreneur who has found an attractive investment opportunity searching for funding among capitalists to undertake it, firms with excess cash "create" investment options or sometimes undertake projects that individually would not be carried out if they had to be funded externally.

The usual explanations for this behavior rely on a combination of optimism and overconfidence by manages and principal-agent conflict (cf. in the first section). There are other more subtle candidates, however. Since there is no unique and objective measure of risk, decisions are made based on the perception of risk by the agent, and not the risk per se. This perception, in turn, is contaminated by the individual's previous experience, his background and education, characteristics of his personality etc. Therefore, entrepreneurs as a group, sharing specific experiences, might have risk perceptions that differ from the average impression of society, as a whole that is embedded in market prices. E.g., Brazilian entrepreneurs, due to past experiences (confiscations of savings, changes in rules and currency, inflation, etc), seem to implicitly apply a heavier discount rate to sovereign bonds to compensate for perceived credit and regulatory risks than the market. Concurrently, their familiarity with the dynamics of their own business, as well as the sensation of "control" over the future decisions of the firm, create a perception that their business is less risky than the market would allow, which could lead to the undertaking of investments with recurring rates of return below those that an economist would consider the opportunity cost.

Moreover, some firms are managed by "inspired leaders" who have an almost religious sense of mission, a commitment with the business that the entrepreneur sees reflected in the portrayal society makes of him. Similar to the Keynesian animal spirit, leaders seem to follow a particular ethics, embedded in value attributes and considerations of ego, status and self-image that affect their decisions, and consider themselves as having a responsibility towards employees, clients, etc to

perpetuate the business. Additionally, entrepreneurs' risk preferences seem to be asymmetric, resulting in a risk-seeking behavior. They often associate the success of the firm to their opportunity to be prominent socially and financially.

I saw in this business my opportunity to stand out. More than calculating the payback and doing profitability studies, what I thought was: this is my chance to be someone. I did not have much to loose, but could earn a great deal (VC).

On the other hand, the role of "rentier" is seen in a very negative way: "I would feel an exploiter to live of interest not producing anything" (VC). This set of cultural and psychological factors grants certain inertia to the investment and justifies that some amount of funds are invested even when purely quantitative considerations of return are not met. There is, nonetheless, a limit beyond which these subjective considerations cannot be sustained: "When I start loosing money, I will stop" (VC) is a typical rule mentioned by entrepreneurs. However, within the grey area between losses or zero profits and the opportunity rate, other considerations apart from pure earnings influence the decision.

Measurement of profitability in itself seems to be an imprecise task. Contrary to the cases in our textbooks of finance, in which one calculates easily the return of a simple example given, the reality of firms is much more complex. Accounting subtleties (e.g., how one accounts for the effects of inflation) affect significantly the results obtained. Even for the in-house evaluation of past results, a series of assumptions have to be made, and those are necessarily embedded in subjective perceptions. Numbers are often used more as a form of a posteriori "rational" justification of a previously existent opinion on the desirability of the business, than as a neutral instrument of decision-making. Moreover, managers often use proxies for profitability not always very judiciously chosen. External signs of company growth (sales volume, number of employees, etc.) were more frequently mentioned by entrepreneurs as indicators of the success of a decision than more concrete considerations of profitability. This might be explained by the simplicity and availability of such evident indicators as opposed to return calculations, more complex and subject to subjective assumptions.

If such examples of subjectivity can be found in the evaluations of past results, a much larger room for maneuver exists in the case of forecasts of future events. As we saw in the first section, entrepreneurs tend to be excessively optimistic about their capacities and competences. Hence, even if the past has not been brilliant, there is always the expectation that things will improve in the future, whether because the cause of the previous failure has been identified and corrected, or because one expects a change in the external environment. This leads to a positive bias towards investment.

In their extreme form, the considerations above apply also to the decision to disinvest. Here, the barriers – financial, social and psychological – to exit are generally very high. The cost of leaving an industry can be significant in certain situations and embraces the recognition of a patrimonial loss. Psychologically, while this loss is not effectively realized with the sale or closure of the firm, it remains at a different cognitive level, representing a potential but not inevitable effect. Simi-

larly to findings in behavioral finance that portfolio investors are reluctant to sell shares that are presenting losses, entrepreneurs seem to postpone the decision to close firms and interrupt unsuccessful investments. The investment flow has, therefore, certain inertia, and the rate of profit of the economy must be significantly below the interest rate for investments in maintenance to be interrupted.

Analysis of innovation

The role of imagination and subjectivity appears even more strongly in the case of innovative investment opportunities, since the company does not have information internally on the potential profitability of a new project, as it does when investing in expanding its existing activities. A firm that decides to develop an original product does not know exactly how much it will cost to develop and latter sell it. Resources are often advanced for a long period of time in R&D of a new product whose results are themselves uncertain: a considerable portion of new medicines researched simply fail. Decision-making in a situation of extreme uncertainty is more complex than admitted in the simplified DCF models. The interesting question here is what tools are actually used by individuals and organizations in such situations to provide some kind of judiciousness and structure to the decisions that have to be made. It seems that, even though the more traditional tools are used to help the entrepreneur consider the more objective aspects of the decision, they are crucially complemented by more unstructured and subjective techniques.

A vital mechanism that was identified by the fieldwork is the use of management strategies, defined here in a generic and abstract manner. E.g., an entrepreneur said that he classifies the products of his industry according to their degree of technology. His assumption is that the higher the technology required to manufacturing an item, the fewer the competitors who will be able to develop it and, therefore, the higher its expected profitability. Even without having clear estimates of the attractiveness of developing a specific item, whenever an opportunity arises to invest in the development of a well positioned item in his "technological rule", he undertakes it.

The existence of such strategies, i.e., qualitative beliefs regarding the future of the business, appeared in a great number of interviews and seem to be heuristics often used as (1) ways to limit the universe of options that will be analyzed in more detail; (2) criteria for choice in situations where there is not enough information for a more meticulous decision-making process; and (3) ways to communicate within and outside the firm the niche where it has chosen to act. The first two items also have the advantage of reducing the decision-maker's anxiety. To decide in an uncertain environment can be a stressful situation, to the point of precluding any action. Defining, sharing and following a certain line of conduct is a way to organize the decision process, isolate the elements that will be effectively considered and justify choices made based on pre-established patterns. The routine makes the decision process easier, or practicable.

Another essential factor in such decisions is the ex post monitoring of results. The entrepreneur who makes his decision based on open and relatively vague criteria is perfectly aware of that, and anticipates the occurrence of a certain degree of error. Therefore, he attributes great importance to the detailed and periodic monitoring of results, which allows him to make complementary decisions to correct possible failures. E.g., the same entrepreneur who asserted that he decided to invest in the development of a new project based mostly on intuition, meticulously monitors sales, checks prices, costs, etc., and has a high degree of a posteriori knowledge of the facts of the firm. Surprisingly, thus, an efficient recipe for intricate decision-making seems to be to combine a relatively simple decision model with detailed instruments for the monitoring of ex post performance. There seems to be not *one* correct course of action, but various possible paths that lead to success. Often, more important than the original decision is how this strategy is implemented; to avoid very significant errors that could question the continuity of the business, while one corrects smaller faults through an efficient feedback system. What economic theory sees as a unique decision – the decision to invest or not in a specific project – is usually the broader result of a set of smaller decisions throughout time, a chain of choices, being difficult to attribute responsibilities for the success or failure of a line of action to any of these intermediary steps. Moreover, investment decisions are not abstract and timeless entities, but concrete opportunities that appear or disappear according to the moment and previous decisions.

CONCLUSION: DCF MODEL AS A ROUTINE

This paper discussed some fundamental difficulties faced by entrepreneurs in making investment decisions. Such problems are the result of limitations on the rational behavior of human beings, as defined by Simon: the impossibility of considering a great number of variables, simultaneously, the difficulty in forecasting future state of uncertain variables etc. In order for such impediments not to lead to inactivity, agents need to be contented with satisfactory – as opposed to optimal – decisions. However, this process of conforming with the "good" given that the "optimum" is unattainable is in itself very complex: one needs to determine his degree of tolerance (or satisfaction level, using Simon's term), or how good is "good enough". Since there is no objective criterion for establishing this threshold, it becomes an additional choice that has to be made by the agent, a second problem to be solved.

Additionally, applying the concept of satisficing implicitly presumes that it is possible to estimate the utility (in the case of investment, the return), of a decision in order to determine whether it is "good enough" or not. This assumption is, in many cases, far from truth. Entrepreneurs are obliged to decide whether to invest or not in the development of a certain product without having a reliable estimate of the return of such decision. It is not just the case of being pleased with more or

with less, but of deciding in one direction or the other despite the huge burden of doubt – a matter of fundamental uncertainty.

This study defends that the main tool that allows us to defeat apathy in situations like this, which combine BR with fundamental uncertainty, is the use of routines. These routines vary from simple heuristics applied in an almost automatic fashion to repeated decisions and "checkpoints" that protect the decision-maker from very wrong decisions that could jeopardize the survival of the business to, in its most sophisticated form, corporate strategies and complex qualitative views about the future direction of the company.

Valuation models themselves, which, in textbook situations are seen as the exclusive, complete and objective form according to which the decision is made, are perceived by firms as one of these routines, structuring the deliberation process, facilitating communication and selecting the variables and the criterion for choice that will be used, among the many possible and legitimate. While the textbook DCF model seems to contain the truth, the whole truth, and nothing but the truth about the decision to undertake or not a project, entrepreneurs see it as an additional tool that supports the decision, incomplete because incapable of capturing all nuances of a project, and incorrect because contaminated with subjective premises about the uncertain future, but useful to organize the process of analysis.

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