CAPITAL BUDGETING VALUATION

Financial Analysis for Today's Investment Projects

H. Kent Baker, Philip English, Editors

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CHAPTER 22

Decision Making Using Behavioral Finance for Capital Budgeting

YURI BIONDI
Tenured Research Fellow, French National Center of Scientific Research, Ecole Polytechnique of Paris

GIUSEPPE MARZO
Tenured Research Fellow, University of Ferrara, and Professor of Business Economics and Management, University of Ferrara

INTRODUCTION

Accepted methods of capital budgeting are based on the neoclassical assumptions of individual rationality (Ross, 2004) and profit maximization by the business firm. Individuals are then assumed to make their decisions according to the discounted utility model (DUM), formalized by von Neumann and Morgestern (1947) or Savage (1954). They then revise their subjective expectations according to Bayesian rules that ensure the progressive convergence of revised expectations to the "true" probability of events and values. Because risk cannot be priced under this approach (i.e., its price turns out to be zero), the neoclassical framework of analysis further assumes that individuals are risk averse. In a similar vein, the business firm is assumed to be a "slot machine" that discounts future net cash inflows against present net cash outflows where capital budgeting decisions are concerned.

When the clash between theory and reality (and practice) is measured against this peculiar conceptual framework, the most widespread response repeats the "as if" developed by Friedman (1953) and his methodological unrealism. Accordingly, all that matters are the implications of one theory, not the overarching representation of reality upon which such theory is based. This paradoxically leads to a world in which reality is expected to comply with a theory that is unrealistic by definition, which is then understood as the best of the possible worlds: the world that normatively should be attained and the framework with which actors should comply to achieve that world.

Methodological unrealism combined with DUM is not the only approach provided by social scientists interested in financial decision making. According to Fransman (1994), theoretical pluralism has eventually been the driver for human

knowledge development. Simon (1978) has championed the critique of methodological unrealism and the development of an alternative conceptualization. In his Nobel lecture, Simon stresses numerous logical fallacies in Friedman's (1953) reasoning. By taking the example of falling bodies, Simon (p. 495, fn. 1) concludes: "We can use [the simple law, ignoring air resistance] to predict the path of a body falling in a vacuum, but not the path of one falling through the Earth's atmosphere." Accordingly, unrealistic theorizing does not seem the most appropriate method for driving the construction of parachutes and airplanes. Is it then appropriate as the foundation for developing financial decision making when confronted with ignorance, hazard, and economic organizational dynamics, realistic features of practice that are not incorporated under the DUM?

Simon's (1978) Nobel lecture disagrees with accepted doctrine and refers to the longstanding tradition in the institutional area of economic thought criticizing the neoclassical assumptions of "individual rationality" and the firm as a "slot machine." Veblen (1898, pp. 73–74) describes and stigmatizes the neoclassical representation of the human mind as follows: "the hedonistic conception of man is that of a lightning calculator of pleasures and pains, who oscillates like a homogeneous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact. [. . .] Spiritually, the hedonistic man is not a prime mover." In the same line of reasoning, Commons (1934, p. 244) called our historical epoch "the Age of Stupidity." Indeed, Commons argues that people are not the rational creatures that the Enlightenment had suggested in the eighteenth century. Rather, Commons (p. 682) held that "man is a being of stupidity, passion, and ignorance," not to mention guile, theft, and treason.

Concerning the special environment of the business firm, Shubik (1993) contends that actual accounting systems are neglected by neoclassical theorizing. According to the latter, Shubik (p. 74) states:

> Firms are not institutions. Production is described by production correspondences available to all who have the resources. It is as though the only items necessary to bake a cake were the ingredients and a recipe (free to and immediately understood by all). The firm as an entity with an internal organization and a management with goals of its own is not included in this abstraction.

On the contrary, Shubik (1993, p. 77) notes that accounting systems factually are quantifying devices employed in ongoing economic organizations, "directed towards helping governments and firms to cope with ongoing problems of day to day and year to year decision-making. First and foremost, accounting of all varieties has had to grapple with the dynamics of both the firm and government." These accounting systems integrate the institutional structure of production (Biondi, Canziani, and Kirat, 2007).

Drawing upon this institutional economic perspective, this chapter aims at disentangling the contribution of the behavioral and institutional approaches to financial decision making. Both individual decision making and the institutional rules framing the capital budgeting processes take place in specific organizational contexts. Behavioral approaches address individual processes of knowledge discovery, treatment, and revision. Institutional approaches deal with cultural, social, and regulatory structures that frame and shape those individual processes.

The rest of the chapter reviews the contribution of each approach along three complementary organizational dimensions and related patterns of research. First, the cognitive dimension introduces a more comprehensive and realistic understanding of the working of the human mind in the context of financial decision making. Second, the organizational dimension explores this decision making in the specific socioeconomic contexts where that decision-making process takes place. Third, the institutional dimension subsumes alternative criteria of decision making that can be taken as a reference according to these behavioral and organizational perspectives.

COGNITIVE DIMENSION

The hypothesis of rationality imposes a peculiar framework on analysis and is based upon various cognitive assumptions. In particular, it requires the complete and timely availability of all the relevant information required to "do the right thing" and the revision of previous decisions and expectations according to Bayesian rules.

By contrast, behavioral research tries to overcome this framework that is fraught with unrealistic tenets and misleading representations of the human mind. It investigates the actual modes of decision making and essentially distinguishes two orders or levels of knowledge that are mobilized to perform the financial decision. From one side, individuals hold, process, and update a specific set of individual worldviews, which are peculiar representations based on their perception of the contextual situation where the decision has been made. From the other side, they apply heuristics and rules of thumb in order to choose among alternative lines of action that are envisioned according to those worldviews.

The Representativeness and Availability Biases

Numerous cognitive biases, documented by Tversky and Kahneman (1982, 1983) and Tversky, Slovic, and Kahneman (1990), among others, affect an individual's decision making. For example, probabilities that individuals assign to an event are influenced by the "representativeness" of that event. Individuals evaluate the probability of an event depending on similarities of that event with well-known classes, disregarding evidence about the underlying probabilities. Consequently, they usually find patterns in random data based on the similarity of those random walks with some nonrandom pattern. People are also affected by the so-called "law of small numbers," which is the tendency to believe that even small-sized samples should reflect the properties of the parent population. For example, if five heads are generated out of five tosses of a fair coin, then people think that tails are due, in order to balance the 50/50 base-rate probability of a fair coin toss.

The "availability bias" acts through recalling similar events from the decision-makers' memory. The easier is the recollection of an event, the higher will be the probability assigned to its occurrence. Researchers also find that people make estimates starting from an initial value (anchoring) and then adjusting it in order to find out the final answer over a series of trials and errors (known as anchor-and-adjust) (Kahneman, Slovic, and Tversky, 1982). Such a bias can affect estimations in cash flows representations.

The Prospect Theory of Kahneman and Tversky

Cognitive biases depart from assumptions of individual rationality and need to be understood from a distinctive framework of analysis. Kahneman and Tversky (1979) develop "prospect theory" in order to take into account the individual decision making as it is factually performed. Through the analysis of individual responses to several prospective games, they find that individuals are affected by the "framing effect." Different ways of presenting the same problem lead to different decisions. Before them, Slovic (1972) demonstrates the existence of such an effect by studying the decisions of medical therapies chosen by individuals in different contextual frames. Benartzi and Thaler (1999) further show the relevance of this framing effect in which subjects systematically judge a share of common stock as riskier when its returns are presented on a weekly basis than when presented on a yearly basis. Weekly volatility is usually greater than yearly volatility, but subjects cannot distinguish between the weekly and the yearly contexts.

According to the new framework of analysis, individual choice is made on the basis of both a "value function," which tabulates the value assigned to a prospect comprising a series of expected payoffs, and a "weighting function" associated with the weight assigned to probabilities associated with those payoffs. In particular, every prospect's value is a function of a reference point, usually the status quo or an aspiration level, with respect to which the prospect's payoffs are coded as gains or losses. The value function is S-shaped, generally concave for gains and convex for losses, and is steeper for losses than for gains. Depending on how the decision is presented, an individual frames the value function in terms of gains or losses with respect to his or her own reference point. The decision maker displays a gain-seeking behavior or a loss-avoiding behavior if the alternative decision is put on the loss side or, respectively, on the gain side. Contrary to practiced DUM, not only do individuals fail to show a unique and positive relationship in the risk-return relationship (subsumed by compound discounting), but they also tend to change the direction of this relationship depending on the way they frame decisions.

Cognitive Biases in Intertemporal Choices

Biases in intertemporal choices are similar to those shown by prospect theory and are well documented. Thaler (1981) and Lazaro, Barberan, and Rubio (2002) provide evidence of persistent deviations and anomalies relative to DUM such as the "common difference effect," the "absolute magnitude effect," and "delay-speedup asymmetry."

Concerning the common difference effect, the "stationary property" of DUM assumes that, given a preference relation between the alternatives (x; t) and (y; t^*) with $y > x$ and $t^* > t$, such a relation still holds when the dates of occurrence of the alternatives are increased by a common time interval, that is, between (x; $t + n$) and (y; $t^* + n$). This assumption does not hold in practice as shown in Thaler (1981). Olsen (1993) and Cropper, Aydede, and Portney (1992, 1994) find similar results. This implies that the discount rate appears to decrease as a function of the time delay, implying a hyperbolic or simple discounting formula.

Concerning the absolute magnitude effect, large monetary amounts are less discounted than small ones, proportionally speaking (Thaler, 1981; Benzion, Rapoport,

and Yagil, 1989; Chapman and Elstein, 1995). In particular, delay–speedup asymmetry, which constitutes a classic framing effect, implies an asymmetric preference between speeding up a loss and delaying a gain (Loewenstein, 1988). A greater amount is then required to compensate for delaying an incoming reward from t to $t + n$ than for anticipating (speeding up) a loss by the same interval from $t + n$ to t. Loewenstein finds that the former appears to be about two to four times greater than the latter. The two combined imply a discount rate that varies with the size and sign of expected payoffs.

On this basis, Loewenstein and Prelec (1992) systematize intertemporal biases affecting individual choices into a behavioral model of intertemporal choice. Their model is reference-point based and relies, as does prospect theory, on both a discount function and a value function. It includes asymmetry in intertemporal switches, framing effects, effects of prior expectations on choice, higher than market-based discount rates estimated from purchases of consumer durables, and nonmonotonic optimal benefit plans. In particular, the model predicts the tendency to cut investment when profit is lower than anticipated.

The Problems with Dynamic Revision of the Knowledge Basis

Further criticisms of the classic model concern the process of revising decisions or expectations taken on the basis of DUM. Dohmen, Falk, Huffman, Marklein, and Sunde (2009) provide empirical evidence that individuals neither apply Bayesian rules when they revise their knowledge basis nor do their decisions approximate the results provided by those rules. Other studies such as Epstein, Noor, and Sandroni (2010) try to formalize this kind of non-Bayesian updating. In particular, Walliser and Zwirn (2001) suggest distinguishing two orders of probabilities that drive distinctive kinds of revision: one concerns single events (revising) and another concerns wholes of events (updating probabilities of probabilities). In the case of extraction of colored balls from one box, the first-order probability concerns the extraction of one red (black) ball, while the second-order probability concerns the very presence of red (black) balls in the box. Drawing upon the implications of the "law of small numbers," this framework of analysis may be applied to the occurrence of rare events. Rare events seldom occur over time and tend to disappear from individuals' memory. This might lead them to wrongly "update" their worldviews by excluding the very possibility of such events, thus neglecting all the consequences of their rare but still possible occurrence.

ORGANIZATIONAL DIMENSION

This research explores the decision-making process in the specific economic environment where it takes place, whether a business or nonbusiness firm. According to Anthony (2007, p. 208),

> to be consistent with the profit maximization premise, a firm should invest in new assets whenever the return from the investment is equal to or greater than the marginal cost of capital, provided that there is no other available investment opportunity which will permit an even greater return. In theory, therefore, the businessman is supposed always to know his marginal cost of capital, and he is

> supposed to know about and evaluate all other investment opportunities every time a project is presented for consideration. [. . .] Evidently, businessmen take a much less complicated approach; they set up criteria such as maximum payback or minimum acceptable return, which if things work out as anticipated will ensure a satisfactory profit. This leads to quite different working rules from those prescribed by the economists; indeed, the difference in the literature between articles by economists and articles by practical businessmen on this subject is so great that it is difficult to believe they are writing about the same problem.

From the behavioral perspective, the main topics in this area are the representation of expected cash flows for the investment project, the incorporation of optimism and overconfidence biases, and the possibility for an escalation of commitment to a failing course of action related to the sunk cost effect.

The Representation of Expected Cash Flows

Many authors (Hogarth and Makridakis, 1981; Pinches, 1982; Scott and Petty, 1984; Mukherjee, 1987; Kaplan and Ruback, 1995; Strand, 1999) claim that accepted theory is mainly focused on the methodologies and techniques of valuation, while too little attention has been given to both estimating and forecasting expected cash flows. Cash flow forecasting practices potentially contain major cognitive biases, especially those known as optimism and overconfidence. The relevance of these two biases is, however, at issue. While some authors propose a systematic increase in the risk-adjusted discount rate for cash flows (Miller, 1987) in order to offset the biases, others disagree and criticize the methodology of the analysis itself (Brown, 1974; Miller, 1978).

A survey by Kaplan and Ruback (1995) shows that experts' forecasts deviate no more than 10 percent from the realized value of transactions. However, Hribar and Yang (2006) provide evidence that overconfident chief executive officers (CEOs) are more likely to undermine their own forecasts of earnings and to issue point forecasts (that is, forecasts that are based on a single value instead of a range). Also, the forecasts of overconfident CEOs have a narrower range. The findings of these studies suggest that experts may create forecasts that are as biased as behavioral finance scholars maintain.

While optimism can be understood as the increase of the mean of expected values, overconfidence produces a reduction of the expected variance of these values. Optimism translates into the overvaluation of expected inflows as well as the undervaluation of expected outflows (Hogarth and Makridakis, 1981). Kahneman and Lovallo (1993) show that optimism in estimates usually comes from the fact that decision makers isolate the actual problem from its contextual situation. Decision makers neglect future opportunities, past experiences, and available statistics. This brings them to behave optimistically, in spite of analyzing past and prospective data. Weinstein (1980) finds that the degree of desirability, perceived probability, personal experience, perceived controllability, and stereotype salience may influence the degree of optimistic bias. Puri and Robinson (2007) show that optimism is related to numerous work and life choices. For example, more optimistic people work harder, expect to retire later, are more likely to remarry, invest more in individual stocks, and save more. The authors also find that while

moderate optimists have reasonable financial behavior, those who are overly optimistic generally behave in an imprudent way.

Overconfidence and representativeness biases can influence the capital budgeting processes. According to Kahneman et al. (1982, p. 8), predictions of future prices (or profits) depend on insensitivity to predictability and are subject to the representativeness bias: "If the description of the company is very favorable, a very high profit will appear most representative of that description; if the description is mediocre, a mediocre performance will appear most representative." According to Kahneman and Riepe (1998), the human mind appears to work as a pattern-seeking device. This leads decision makers to give a rational meaning to events that can actually be random. For example, even though the following two sequences derived from tossing a coin—HHHTTT and HTHTTH (where H stands for heads and T for tails)—have the same probabilities, the second sequence is perceived to be more random than the first one.

The Optimism Bias

Controlling for optimism in cash flows representations is performed either in audit analysis, when forecasted cash flows are compared to actual, or by asking users of cash flow estimations if they feel cash flows are optimistically forecasted. Pohlman, Santiago, and Markel (1988) conduct a survey of the Fortune 500 companies and find a significant difference between forecasted and actual cash flows, even though the differences might result from factors other than optimism such as agency costs and accidental events. They also find that defining the figures that an unbiased estimator would predict is difficult. Marshall and Meckling (1962) confirm the presence of optimism bias after making a Bayesian correction of prior estimates to account for unexpected events at the time of forecasting.

Statman and Tyebjee (1985) design an experiment based on a previous study by Cyert, March, and Starbuck (1961) to verify that users of estimates are aware that they may be optimistically biased. The authors find that many users believe that estimates are systematically biased towards optimism and the seniority of users is positively correlated with such a belief. In particular, users with more than three years of experience tend to overly correct their estimations. In their survey of Fortune 500 companies, Pruitt and Gitman (1987) find that analysts' capital forecasts are optimistically biased and managers adjust estimates downward to offset such upward bias. Statman and Tyebjee confirm that more experienced people tend to adjust estimates to compensate for optimism. Ascher (1993) reviews several project appraisals undertaken by the World Bank and finds that forecasted return rates are optimistically biased and are therefore higher than actual realized rates of return.

Some models try to capture such optimistic bias. For example, Heaton (2002) develops a model with overoptimistic managers and efficient capital markets. According to the model, if managers believe that the firm is undervalued in capital markets, they may either underinvest if financial outsourcing is required, or overinvest in negative net present value (NPV) projects, even if they are still assumed to act in shareholders' interest. Thus, a mix of under- and overinvestment can exist independent of any agency cost or opportunistic behavior. Tyebjee (1987) shows that managers more engaged in new product development projects are usually more optimistic and that, during the planning process, they hold some "illusion of

control," that is, the tendency to believe that controlling or having an influence on outcomes is possible, even if this is not true (Langer, 1982).

Glaser, Schäfers, and Weber (2008) further analyze the phenomenon by focusing on all senior managers instead of a single manager's behavior. The authors find that when managers are optimistic, they increase their exposure to company-specific risk when transacting company stocks and invest more. Their evidence also shows that managerial optimism increases their investment–cash flow sensitivity. Similarly, Lin, Hu, and Chen (2005) find that in firms confronted with higher financing constraints, optimistic management implies higher investment–cash flow sensitivity.

The Overconfidence Bias

The overconfidence bias is related to the representativeness heuristic. Representativeness occurs when the decision makers feel that the decision problem in which they are engaged is similar to other issues with which they have already dealt. Overconfidence can be rooted in individuals' personality (Schaefer, Williams, Goodie, and Campbell, 2004) or generated by contingent situations. Langer (1982) analyzes the role of the "illusion of control," which involves a false faith in personal capabilities. Langer distinguishes among skill-based situations, when a causal relationship exists between skilled behavior and performed result, and lucky situations, where good luck plays the major role. Because subjects can frame lucky situations as skill-based situations, they wrongly believe that they have the situation under control.

Decision makers are sometimes overconfident because they no longer exactly remember what they thought at the moment of valuation. Using hindsight, decision makers seek to justify what they did and thus rationalize any previous decision (this is the so-called hindsight bias). Radzevick and Moore (2008) contend that people are more confident when their own side is strong and this feeling is independent of the strength of the competition. They link this effect to the fact that people have better information about their own side than the other side. By contrast, Moore and Cain (2007) show that overconfidence is not as universal as it is often supposed to be. Their paper presents evidence that people usually feel below average on difficult skill-based tasks.

Empirical researchers have investigated overconfidence bias in corporate executive decision makers. Ben-David, Graham, and Harvey (2007) find evidence that executives are overconfident. Companies with overconfident CEOs use lower discount rates for investment valuation, finance projects using more debt, and use proportionally more long-term debt. CEOs are also less likely to pay dividends. Malmendier and Tate (2005a, 2005b) find similar results. Camerer and Lovallo (1999) show evidence of the effect of overconfidence on start-up investments. Cooper, Woo, and Dunkelberg (1988) survey 2994 entrepreneurs and find them to be optimistic and overconfident. Entrepreneurs see very favorable prospects, with 81 percent of the interviewees viewing the odds of success as 7 out of 10 or better and 33 percent perceiving such odds as 10 out of 10. The authors also document that entrepreneurs believe that they can control their own destiny, the "control illusion" effect. Cooper et al. further find that past experience does not mitigate this perception.

Continuing this line of inquiry, Ucbasaran, Westhead, Wright, and Flores (2010) find that entrepreneurs do not appear to adjust their optimism for past business failures. Koellinger, Minniti, and Schade (2007) find that subjective and often biased perceptions have a crucial impact on new business creation across all the countries in their sample. They report that the national environment with its social and cultural underpinnings plays a significant role. Further, their evidence shows a negative correlation between overconfidence and the survival chances of nascent entrepreneurs.

The Sunk Cost Effect

The way decisions makers represent sunk cash flows can also lead to flaws in their analysis. Sunk costs are expenses made in the past that cannot be recovered. Such costs should not affect the valuation of a project under the DUM model. This treatment is commonly covered in standard finance texts. In particular, sunk costs should not affect the decision whether undertaking, continuing, or stopping the project. Because sunk costs do not influence a project's future cash flows, the analyst should ignore them in performing the valuation of the investment. However, sunk costs affect differential cash flows from continuing or stopping the project. If the firm stops a project, sunk costs should be accounted for as losses, and the manager in charge of that project would be accountable for them.

Contrary to DUM theory, many studies provide evidence that decision makers often consider sunk costs in making their decisions (Arkes and Blumer, 1985; Kogut, 1990; Roodhooft and Warlop, 1999). Fantino (2004) argues that poor decision making is often the result of the misapplication of rules and principles that have led to effective decisions in the past. This especially applies to the base-rate fallacy, which refers to the tendency to ignore background information in favor of case-specific cues in assessing the probability of an event, and the sunk cost effect. Roodhooft and Warlop show that sunk costs are relevant in the make-or-buy decision even after controlling for other opportunistic and relational variables.

Keasey and Moon (2000) perform experiments that confirm the sunk cost effect. Specifically, their evidence shows that subjects are more likely to continue a bad project if they have already made a prior investment. Fellner (2009) studies the decision to terminate a project. He finds that the sunk cost effect affects executives and project managers differently and that the scale of the project is unrelated to the perception of failure. Parayre (1995), adopting a constructive critical perspective, develops a theoretical model that shows the conditions under which the sunk cost effect can be a successful precommitment strategy. In sum, under conditions of limited knowledge, Arrow (1974, p. 6) notes that "the past is relevant because it contains information which changes the image of the future; the probabilities which govern future actions are modified by observations on the past. It follows that present decisions with implications for the future are functions of past values of variables as well as present values."

Dealing with Opportunity Costs

Cash flow representation should also deal with opportunity costs. *Opportunity cost* is the value or return a decision maker gives up by choosing one alternative rather

than another. In the DUM approach, opportunity cost is an important element for choosing alternative investment opportunities that is captured through the use of solely incremental cash flows in valuation. Psychological studies, however, find that the consideration of opportunity costs in valuation is often absent or disvalued (Chenhall and Morris, 1991; Casey, 1994).

Kahneman, Knetsch, and Thaler (1986, 1990, 1991) study the behavior of subjects asked to set a price for buying or selling a predefined widget. As expected, selling prices are usually greater than buying prices. In setting the prices, incurred costs associated with actual cash outflows are valued more than opportunity costs. This problem of incorporating opportunity costs relates to the so-called "endowment effect," which states that an asset is valued more if it is already held by the valuing subject. Thaler (1980) argues that even though opportunity and out-of-pocket costs should receive the same treatment according to DUM theory, subjects actually provide very different valuations for them.

The Escalation of Commitment to a Failing Course of Action

The escalation of commitment to a failing course of action is a well-known phenomenon that refers to continued investment in a project when expected future results are negative and suggest abandoning it. Researchers such as Staw (1974, 1976) have studied this phenomenon since the 1970s. It is now recognized as a major pitfall in the control of an investment project. This phenomenon is related to the sunk cost effect. According to self-justification theory (Festinger, 1957; Staw and Fox, 1977; Brockner, 1992), individual responsibility, especially when formalized in organizational terms, can push the person in charge to continue a project despite negative expected results. Individual commitment is usually rewarded and is judged as a characteristic of a reliable human being. The choice of pursuing a failing course of action can then result from the inability of decision makers to free themselves from the social norms in which they are embedded (Staw, 1981).

Another explanation for escalation is rooted in prospect theory (Kahneman and Tversky, 1979). Individuals are loss-averse in the loss side, especially when they deal with alternatives characterized by high expected losses and low probable positive results (the loss aversion bias). This is, of course, a potential source of the commitment escalation effect since the attempt to avoid the high expected losses leads individuals to choose the continuation of the project. In this way, their loss and failure will be delayed and they can go on hoping to eventually generate positive outcomes in the future. Finally, specialization can provide another explanation for the commitment escalation effect (Williamson 1985, 1991; Zardkoohi, 2004). Because the value of specialized and project-specific resources is greater when they are employed by the undertaken project than elsewhere, the abandonment of a failing project contrasts with the preservation of the project-specific value of those resources.

INSTITUTIONAL DIMENSION

Under DUM, criteria such as NPV and internal rate of return (IRR) are considered as the only appropriate criteria when making capital budgeting decisions. The biases discussed in the prior sections suggest that alternative criteria incorporating

cognitive and organizational dimensions may be desirable. In fact, traditional practitioner criteria such as payback period or a preference for financial slacks have been treated as heresy or stupidity and dismissed on the grounds of failing to meet DUM criteria.

However, ease of understanding and implementation are important features for adopting a capital budgeting methodology. In a survey conducted on the capital budgeting methods adopted by Fortune 500 companies, Burns and Walker (1997) show that ease of use is of paramount importance in choosing between capital budgeting methods. Easiness can then be considered as a meta-criterion for evaluating capital budgeting projects. Other factors that influence the choice of decision criteria include familiarity with valuation methods; the comprehensibility of different methods; and the ease of data gathering and calculation. As a result, "crude" but simpler methodologies can survive competition from sophisticated but overcomplicated techniques.

Alternative Rationales

This section explore three topics offering rationales for departing from accepted models of investment valuation: (1) the adoption of hurdle rates for investment project valuation and selection; (2) the adoption of selection criteria that are second-best criteria or absolutely suboptimal criteria in the light of the DUM approach, such as payback period; and (3) a generalization of discounting based on different rates for discounting and replacing cash flows from investment projects.

Hurdle Rates and Capital Budgeting

Some studies find that firms use discount rates higher than a theoretically "correct" rate such as one based on the capital asset pricing model (CAPM) (Summers, 1987; Kaplan and Atkinson, 1988; Drury, 1990). They argue that such errors can compromise the firms' competitiveness due to an underinvestment phenomenon resulting from using artificially higher rates. A discount rate that is too high can also be detrimental for firm continuity.

Identifying an appropriate discount rate may involve several potential problems. For example, even if decision makers agree on using the CAPM to determine the cost of a firm's equity, the calculation of such a rate can result in different figures depending on the econometric tools and measures applied during the calculation process. According to several studies, the range of discount rates may be very large and vary between 4.5 and 6 percent (Copeland, Koller, and Murrin, 1991), 6 to 8 percent (Brealey, Myers, and Allen, 2006), 2 to more than 8 percent (Jagannathan and Meier, 2002), and –10 to 20 percent (Shefrin, 2007).

Welch (2000) documents how economists do not share a common perspective on discounting. The use of differing hurdle rates can then depend on (and be justified on the basis of) the application of different models by firms and researchers. The comparative validity of the differing models is still at issue from a theoretical perspective. A useful example to illustrate this idea is the so-called "beta-dead" strand of research. Fama and French (1992, 1993) criticize the ability of the beta approach to efficiently reflect the relevant systematic risk of a security. They do this by showing its ineffectiveness in predicting assets' returns.

The authors then argue for better explanatory factors related to fundamental analysis and accounting information such as the market-to-book ratio. Stein (1996) still supports using the CAPM for rational capital budgeting, but different perspectives on the effectiveness of beta can translate into different approaches to calculating the discount rate.

The use of hurdle rates (or discount rates higher than theoretically correct ones) might also be treated as a pragmatic response to overoptimism and overconfidence biases in cash flows estimation. Some authors such as Hogarth and Makridakis (1981), Statman and Tyebjee (1985), and Pohlman et al. (1988) find a systematic overvaluation of the expected cash flows accruing to investment projects. In this case, adopting higher discount rates is a crude way to compensate for such upward estimates. This type of adjustment may create two alternative kinds of problems. First, decision makers may then be confident of having corrected both optimism and overconfidence, while these biases could still persist. Second, if the overestimation of cash flows by managers is a heuristic tool for incorporating the value of embedded real options that are not explicitly valued, then the higher discount rate can offset the greater value assigned to the project's expected but unincorporated cash flows (Busby and Pitts, 1998).

External or internal financial rationing is a further justification for using hurdle rates. In the case of external rationing, hurdle rates operate as a substitute for the profitability index. For example, Mukherjee (1991) highlights that a hurdle rate is more understandable than other criteria of project selection such as the profitability index. Concerning internal financial rationing, hurdle rates might operate as a mechanism of organizational control in order to balance information asymmetries (Antle and Eppen, 1985; Arya, Fellingham, and Glover, 1998). When information is asymmetrically available within a firm, the divisions proposing an investment project are usually better informed on the likely profitability of the project than their headquarters. Because divisions may then aim to retain resource slacks, headquarters may react by adopting an internal system of financial rationing. In such a context, hurdle rates are detached from project risks and serve as a tool for allocating financing among the firm's divisions by taking into account opportunistic slack behavior.

Departing further from DUM assumptions, hurdle rates may also be a tool for dealing with dynamic sustainability or continuity of the firm (Marzo, 2007). Finance theory and the CAPM are essentially static in the sense that they assume market pricing takes into account all possible future contingencies. Static approaches assume implicitly that markets are complete, as did the original Arrow and Debreu (1954) model. However, complete markets for any future contingency only exist in theory. A firm applying the CAPM (or any other market-based calculation of project risk) could obtain, at best, only the maximization of static efficiency that neglects other alternative options different from those actually available.

To make a decision that is consistent over time (dynamic perspective), firms should consider that current prices could not (and actually do not) integrate any possible future use of every present and future resource. Such deficiency is firmly related to the fact that innovation takes place in firms, not in markets, and its value depends on inner specificities and structures (or systems) that supersede the market price system. To take into account future opportunities originated by such a firm-specific environment, management can use hurdle rates to constrain

current proposals and therefore save current cash funds for future projects still under development. This behavior can be even more pronounced if the firm expects to suffer from financial constraints such as a lack of cash availability in the future. In sum, hurdle rates can act appropriately as internal tools for valuing and selecting investment projects, especially under intertemporal financially constrained conditions.

Valuing Investment Projects by Payback Period

The DUM approach claims that compounded or discounted cash flow (DCF) techniques (not only NPV and IRR but also those based on real options analysis) are the optimal criteria for valuing and selecting investment. In particular, in the simplest situation of a project that does not embed real options, the NPV method is assumed to define the value of the project. Surveys show that although DCF techniques are increasingly employed during the last few decades, corporate management still uses other DUM suboptimal methods or "rules of thumb" (Sangster, 1993; Graham and Harvey, 2001).

In particular, behavioral finance scholars such as Shefrin (2007) argue that using the payback period criterion reflects the decision makers' cognitive errors, linked to their inability to learn how to correctly value investment projects. In fact, the role of this method should not be undermined. Even if using the payback period derives from a low level of managerial sophistication, it may also be useful in some circumstances.

First, suppose that a firm is comparing two alternative investment projects, A and B, with the same NPV. If the two projects are evaluated by using the "right" risk-adjusted rate of return, the firm should be indifferent to choosing A or B. However, the cash flow profiles of the two projects may differ over time. For example, project A's lower cash flows are expected to occur at more near future periods, while B's higher cash flows are expected to take place at more distant future periods. The manager may then effectively apply the payback period as a way of dealing with future financial constraints or uncertainties, on the basis that estimates for the distant future are in principle less reliable and more subject to disappointment and hazard. Therefore, project A dominates B because its value is less exposed to the remote future.

Second, the above discussed hurdle rate approximation of the optimal exercise of a "wait-and-see" option can be translated in terms of the payback period (Boyle and Guthrie, 1997; McDonald, 1999). Accordingly, given the stochastic process of the project's cash flows, when the maximum value of the option is approaching, the payback period of the investment declines relative to the past, making the payback period an acceptable heuristic for valuing the investment alternative.

Finally, the payback period is a way to cope with cash or budget constraints because it ranks projects in terms of their speed in refunding the investor. That is, payback shows the length of time needed for cash inflows to cover the initial outflows incurred by the investment project.

A Generalization of Discounting under Multiple Discount Rates

Investment valuation criteria ultimately relate to the fundamental relationship between investment decision making and time. The DUM approach was developed

to fit competitive market pricing and conditions that are assumed to clear the financial market or put the economic system into general equilibrium. However, such an approach may be at odds with viable rules under conditions of ignorance, hazard, and organizational dynamics.

All financial decisions implicitly deal with the future. Discounting is a practical method to account for the timing of the investment projects that have to be assessed, resulting in two measurement outcomes: a conventional measure for net economic value, and a comparative ranking of different opportunities at disposal.

The discounting approach incorporates the time element of the project in its cash inflows and outflows to rank the different opportunities. The value of this element contributes to frame the current decision into an understanding of the future states of the ongoing activity. Thus, discounting is expected to enhance the decision makers' understanding of time horizons.

There are different views about discounting. The DUM approach adopts a market basis and stresses only a positive compound discounting rate. Samuelson (1976, pp. 473–474) defines this rate both as the "*market* standard of performance" and the *competitive* opportunity rate for inside investment projects. Welfare economics questions the level of the discount rate in the case of welfare choices involving the "claims of posterity." Some industrial economists such as Hayes and Garvin (1982, p. 70) further criticize the logic underlying compound discounting and argue that

> An over-reliance on analytic techniques like discounting future cash flows leads managers to defer critical investments in the capital stock on which their companies depend. Such techniques and the assumptions on which they rest, claim these authors, inevitably bias managers against investment and thus short-change the future of American industry.

Following the same line of reasoning, Porter (1998, p. 466), speaking about corporate investment and industrial time horizons, criticizes the American capital investment system and stresses the need to "evaluate investments in two stages—first, determining the asset positions needed for competitiveness and second, evaluating exactly how to achieve those positions." According to Porter (p. 439), every investment has to cope with special conditions related to corporate goals and organizational principles, senior management intervention, and capital allocation and investment monitoring systems. From this perspective, investment valuation criteria are important in affecting the corporate investment decision-making process. Within the firm, running the business is then the priority. Corporate management is called to make investment valuation suitable for the special context and needs of the firm. From the same perspective, Shackle (1967, p. 99) suggests considering money as "not useful in itself," but as "a store of strategic power."

Within the firm, the view of the financial process of investing provided by the DUM approach appears to be incomplete. This approach is especially concerned with a market basis and general competitive conditions under complete and perfect markets. It neglects, therefore, the special economics of relational economic contexts that cope with the specifics of the business firm. Samuelson (1976, p. 473) once called the critique of discounting the "bogey of compound interest." Scared by the bogey, decision makers would be unable to cope with the future of the ongoing

activity since the preference for today is computed only by a negative compound weight on future states. The bogey leads to neglecting the financial process of investing that is concerned with real time and context. Investment opportunities could then be misevaluated and the whole investment information treating process may be biased when decision makers operate under the compound discounting scheme.

Recent advances in relational contracting and behavioral finance support and expand that earlier critique:

- According to Baker, Gibbons, and Murphy (2001, 2002) and Biondi, Canziani and Kirat (2007), markets and firms should be understood as two different economic environments. Managerial tasks in the firm require judgment and knowledge of the specifics of complex situations. The firm as a relational economic context must provide its special way to coordinate these tasks because they cannot be controlled by outside market arrangements. In short, firms must have management and related decision-making rules because their governance cannot replicate the market. In particular, this managerial coordination allows firms to improve on market outcomes. Inside investment projects can have better returns of reference than the outside returns from market alternative replacements.
- Recent developments in behavioral finance fostered by Kahneman and Tversky (1979) stress the need for a double choice in the investment decision-making process: a weighting function that establishes the weights for each expected result and a value function that ranks the expected results themselves (Kahneman and Riepe, 1998; Frankfurter and McGoun, 1999; Marzo, 2002).
- The influential works of Loewenstein and Thaler (1989), Loewenstein and Prelec (1992), and Laibson (1997) argue for simple or hyperbolic discounting coupled with a behavioral approach to economic individual preferences.

Notwithstanding, decision makers are accustomed to considering rules based on compound discounting (either present value or IRR) as the benchmark for their investment decisions. A new interpretation of discounting seems to be required to bridge the gap between the recent theoretical insights and widespread practices. The new interpretation may generalize valuation rules to the relational economic context that frames all those investment projects to be assessed.

What is, therefore, the actual meaning of discounting? Decision makers look at discounting to estimate the value of timing and to establish some conventional criterion to compare internal (that is, firm-specific) investment opportunities. Under this scheme, a single measurement is called to summarize each investment project in order to portray a vast collection of operations, conditions, risks, and results in a simple and effective way. From this perspective, discounting is expected to provide the shortcut method to obtain such a measure. The discounting measurement process is consistent with the statistical notion of the mean of the cash flows sequence, whose weight must be established according to the decision-makers' perspectives and to the ongoing continuity (and future conditions) of the whole business activity.

Every business activity constitutes a special relational economic context. Its decision makers receive information through numerous channels that treat and reduce that information by various ways and under special conditions. Discounting is one of the information-treating devices that allows decision makers to rank and choose investment opportunities. Because this process is laden with ignorance, hazard, and dynamics, the information provided is typically blurred or filtered information, meaning that some aspects of the information may be obscured or lost.

In this context, the DCF-based approach attempts to deliver information in a form that permits only one rational conclusion. However, the information generating process actually affects the decision. In fact, empirical researchers deny that common measures such as NPV and IRR play a clear-cut role in choosing between alternative investment projects (Sangster, 1993). Investment issues are so critical that they require judgment and knowledge of the specifics involving complex and dynamic activities. The information-filtering process only provides some pieces of information that are relevant and reliable to make decisions. Decision makers have still recourse to various measures including payback and accounting rate of return that are harshly criticized by advocates of the DUM approach. Investment valuation criteria based on DCF analysis are widespread and influential. Yet, decision makers also use criteria based on alternative approaches, including some that are theoretically incompatible with DUM, to gather relevant information about each investment opportunity. All these investment valuation criteria are then more complement than substitute, and together provide a better picture of the project scope and implications.

This appears to be the spirit of discounting as an information-treating device in actual investment decision making. One particular flaw of the DCF scheme deserves to be overcome. As Baldwin (1959, pp. 98–99) claims:

> It is to one critical assumption underlying the usual procedure [of present value and IRR] that I take strong exception. The future receipts and payments are reduced to their present value by discounting them at the same rate as that which the proposed investment is estimated to provide. In other words, management assumes that, for the period between the base point and the time when the funds are spent or collected, the funds are, or could be, invested at the rate of return being calculated for the proposal. This is simply not true. Indeed, it is only by coincidence that the two would be at all alike.

According to recent theoretical developments, every business activity generates a special financial process, which produces inside returns that are expected to improve on the outside returns from alternative replacements. As an information-treating device involved in this process of investing, discounting can no longer neglect time and context. It has to account for these different returns of reference instead of one unique rate in order to take into account the replacement structure of future inflows. In particular, a generalization of discounting may apply to the conventionally established cash flow pattern in which the actual replacement mix is comprised of replacements at compound interest, at simple interest (bonds and so on), or has a more complex return structure. Following this line of reasoning (Biondi, 2010), the generalization provides a family of financial measures based on

at least two discount rates of reference, one for inside investment (y) and another for outside replacement (i), represented as:

$$\sum_{t=0}^{n} f(1+i;1+y;t;a_t)\cdot a_t \text{ or, in a continuous time: } \int_0^n f(y;i;t;a_t)a_t dt \qquad (22.1)$$

where $a_0 \ldots a_n$ = the cash flow sequence for the investment project; y = the discount rate for outflows (negative cash flows); and i = the discount rate for inflows (positive cash flows). This formulation may be further generalized to multiple rates over time instead of one constant rate for the entire period, and to expected measures for each flow: $E_t(a_t)$. This generalization differs from the usual approach based on compound discounting alone:

$$\sum_{t=0}^{n} (1+i)^{-t}\cdot a_t \quad \text{or} \quad \int_0^n e^{-i\cdot t}\cdot a_t dt. \qquad (22.2)$$

The difference between NPV and IRR based on compound discounting ultimately rests on the different assumptions about the replacement (reinvestment) rates and term structure. In the case of NPV, the replacement is assumed to be made at the discount rate, while in the case of IRR, it would be made at the same rate as IRR. Thus, the generalized approach vindicates the return-based measures like IRR and logically unifies discounted values and discounted rates of return. Usual measures with one unique discount rate for investment and replacement, as well as other measures based on compound (exponential) or simple (hyperbolic) discounting, become special cases of the generalized function *f(y;i;t;a)*. This function declares the underlying discounting logic and describes the relationship between inside investments and time horizons applied by decision makers to compare inside investment opportunities. A change in the replacement rate clearly modifies the project's return, but it does not modify its comparative ranking. Further studies on the relevant properties of *f(y;i;t;a)* may be developed. For example, Rubinstein (2000) suggests a function where the discount factor f_t is decreasing in t and increasing in a_t (the larger the sum of money at stake, the higher (closer to 1) is the discount factor). She suggests a procedural rationality approach framed with nonexpected utility theory (see also Kahneman and Riepe, 1998; Frankfurter and McGoun, 1999).

The DUM approach assumes that the project's investment rate and the replacement rate are the same, and this would be true under a perfect capital market. Yet, if capital markets are imperfect and firms are conditioned by capital rationing, this approach will lead to under (over) valuing the discounted value of low (high) return projects. This is because the cash inflows from the projects are reinvested at the same rate as the cash outflows, while the actual rates of reference differ. For instance, by assuming that the rate of reference for discounting is the investment rate, the usual IRR over (under) values investment projects with high (low) rate of return. This implies that cash flows from projects with high (low) return will be reinvested at a higher (lower) rate, hence leading to over (under) valuation

of the project. The usual approach fails to consider more realistic reinvestment opportunities available to the firm and may mislead the capital budgeting process, especially when ranking alternative investment projects.

SUMMARY AND CONCLUSIONS

The accepted approach to capital budgeting leaves decision makers without appropriate guidance because it ignores the cognitive, organizational, and institutional dimensions of their decision. This chapter has summarized alternative perspectives addressing these specific dimensions. Together, they suggest generalizing the current approach based on DCF analysis to provide decision makers with alternative ways to assess investment opportunities under more realistic approaches driven by behavioral and institutional finance.

DISCUSSION QUESTIONS

1. What are the basic tenets of prospect theory? Why is this theory so important for behavioral finance?
2. Which cognitive and organizational biases affect the representation of cash flows to be employed in capital budgeting?
3. What is the role of hurdle rates in behavioral capital budgeting?
4. Is the hypothesis of one unique discount rate for financing and investing appropriate for capital budgeting? How can this hypothesis be generalized?

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ABOUT THE AUTHORS

Yuri Biondi is a tenured research fellow of the French National Center of Scientific Research (CNRS) at the Ecole Polytechnique of Paris and affiliated professor at the CNAM of Paris. He is editor-in-chief of *Accounting, Economics and Law—A Convivium* (published by The Berkeley Electronic Press) and editor of *The Firm as an Entity: Implications for Economics, Accounting and Law* (Routledge, 2007). His research interests include economic theory and economics, accounting, and finance of business and nonbusiness organizations. He graduated from Bocconi University

of Milan, University of Lyon, University of Brescia, and Sorbonne University of Paris.

Giuseppe Marzo is a tenured research fellow of Business Economics and Management at the University of Ferrara and a Professor of Business Economics and Management at the University of Ferrara. He is a member of the Advisory Board of *Accounting, Economics and Law—A Convivium* and the co-editor of *Visualising Intangibles: Measuring and Reporting in the Knowledge Economy* (Ashgate, 2007). His interests are in the fields of real options theory, business finance, behavioral finance, intangible assets valuation, and the methodology of finance. He received his Ph.D. from the University Ca' Foscari of Venice.