Behavioral Finance: Capital Budgeting and Other Investment Decisions*

Simon Gervais
Fuqua School of Business
Duke University
sgervais@duke.edu

November 24, 2009

Abstract

This chapter surveys the literature on the effects of behavioral biases on capital budgeting. A large body of the psychology literature finds that people tend to be overconfident and overly optimistic. Because of self-selection, firm managers tend to be even more affected by these biases than the general population. Indeed, the literature finds that biased managers overinvest their firm's free cash flows, initiate too many mergers, start more firms and more novel projects, and tend to stick with unprofitable investment policies longer. Corrective measures to reduce the effects of the managers' biases include learning, inflated discount rates, and contractual incentives, but their effectiveness in curbing overinvestment appears to be limited.

* This article will appear in *Behavioral Finance*, edited by H. Kent Baker and John R. Nofsinger, and published by Wiley/Blackwell.

INTRODUCTION

Capital budgeting is the process by which firms determine how to invest their capital. Included in this process are the decisions to invest in new projects, reassess the amount of capital already invested in existing projects, allocate and ration capital across divisions, and acquire other firms. In essence, the capital budgeting process defines the set and size of a firm's real assets, which in turn generate the cash flows that ultimately determine its profitability, value, and viability.

In principle, a firm's decision to invest in a new project should be made according to whether the project increases the wealth of the firm's shareholders. For example, the net present value (NPV) rule specifies an objective process by which firms can assess the value that new capital investments are expected to create. As Graham and Harvey (2001) document, this rule has steadily gained in popularity since Dean (1951) formally introduced it, but its widespread use has not eliminated the human element in capital budgeting. Because the estimation of a project's future cash flows and the rate at which they should be discounted is still a relatively subjective process, the behavioral traits of managers still affect this process.

Studies of the calibration of subjective probabilities find that individuals are overconfident in that they tend to overestimate the precision of their knowledge and information (Fischhoff, Slovic, and Lichtenstein, 1977; Alpert and Raiffa, 1982). In fact, research shows that professionals from many fields exhibit overconfidence in their judgments, including investment bankers (Staël von Holstein, 1972), engineers (Kidd, 1970), entrepreneurs (Cooper, Woo, and Dunkelberg, 1988), lawyers (Wagenaar and Keren, 1986), negotiators (Neale and Bazerman, 1990), and managers (Russo and Schoemaker, 1992).

Several factors may explain why managers may also be expected to be overconfident, especially in a capital budgeting context. First, capital budgeting decisions can be complex. They often require projecting cash flows for a wide range of uncertain outcomes. People are typically most overconfident about such difficult problems.

Second, capital budgeting decisions are not well suited for learning. As Kahneman and Lovallo (1993, p. 18) note, learning occurs "when closely similar problems are frequently encountered, especially if the outcomes of decisions are quickly known and provide unequivocal feedback." In most firms, managers infrequently encounter major investment policy decisions, experience long delays before learning the outcomes of projects, and usually receive noisy feedback. Furthermore, managers often have difficulty rejecting the notion that every situation is new in important ways, allowing them to ignore feedback from past decisions altogether. Learning from experience is highly unlikely under these circumstances (Einhorn and Hogarth, 1978; Brehmer, 1980).

Third, unsuccessful managers are less likely to retain their jobs and be promoted. Those who succeed may become overconfident because of a self-attribution bias. Most people overestimate the degree to which they are responsible for their own success (Miller and Ross, 1975; Langer and Roth, 1975; Nisbett and Ross, 1980). This self-attribution bias causes successful managers to become overconfident (Daniel, Hirshleifer, and Subrahmanyam, 1998; Gervais and Odean, 2001).

Fourth, managers may be more overconfident than the general population because of a selection bias. Those who are overconfident and optimistic about their prospects as managers are more likely to apply for these jobs. Moreover, as Goel and Takor (2008) show, firms may endogenously select and promote on the basis of overconfidence, as overconfident individuals are more likely to have generated extremely good outcomes in the past. Finally, as Gervais, Heaton, and Odean (2009) argue, overconfident managers may simply be easier to motivate than their rational counterparts and so hiring them is more appealing to firms.

The idea that overconfidence can lead to investment distortions, predominantly overinvestment, dates back to Smith (1776, p. 149) who writes:

> The over-weening conceit which the greater part of men have of their own abilities, is an ancient evil remarked by the philosophers and moralists of all ages. Their absurd presumption in their own good fortune has been less taken

> notice of. It is, however, if possible, still more universal... The chance is by every man more or less over-valued, and the chance of loss is by most men under-valued, and by scarce any man, who is in tolerable health and spirits, valued more than it is worth.

Although the field of psychology eventually came to influence the work of Knight (1921), Pigou (1926), and Keynes (1936), the world of corporate finance remained largely unaffected by psychology until much later. Simon (1955, 1959), Margolis (1958), and Cyert and March (1963) are some of the early proponents of the need to incorporate findings from psychology into corporate finance. Noting that decisions are ultimately taken by individuals inside the firm, these authors advocate adding a human component with motives and biases into the process by which firms make choices. In particular, Simon emphasizes the importance of including a systematic role for the factors that influence the way individuals gather, process, and interpret information, as well as the way they choose to organize. March and Simon (1958) further argue that the rational bounds of executives, especially those of the top executive or chief executive officer (CEO), are likely to shape a firm's decisions. According to Katona (1946), the fact that managers have their own preferences and traits directly affects how they make investment decisions on behalf of the firm and its shareholders.

The advent and impact of Modigliani and Miller's (1958) work, advocating the power of financial markets to endogenously prescribe a firm's real and financial decisions, combined with the popularity of the efficient market hypothesis (e.g., Fama, 1970), left little room for behavioral considerations in firms. Instead, the objective nature of capital budgeting prevailed as a firm's cost of capital became the product of a theorem on the irrelevance of financing. This approach came to dominate much of corporate finance until Roll (1986) proposed a hubris theory (reviewed in detail later) that seemed to reconcile much of the literature on mergers and acquisitions, reviving the behavioral approach in the process. As discussed in this chapter, the literature on the effects of behavioral biases on a firm's capital budgeting decisions has evolved considerably since then, especially in the last five to ten years.

Behavioral biases can affect the decisions of firms through their effects on investors (outside the firm) and managers (inside the firm). This review concentrates exclusively on the latter, or more specifically on the impact that managerial overconfidence has on a firm's investment decisions. The justification for this approach is intuitive. In capital markets, the presence of wealthy market participants who can afford to take large risks is likely to minimize the effects of biased decisions on security prices, resource allocations, and overall market efficiency. When biases affect the decisions of key employees within the firm, arbitraging them away is more difficult and costly for a third party. As such, the biases can have large and persistent effects. Baker, Ruback, and Wurgler (2007) provide an overview of the effects of investor irrationality on capital budgeting.

The remainder of the chapter has the following organization. The first section shows, using a simple theoretical model of capital budgeting, how managerial overconfidence and optimism lead to overinvestment. The second section presents a survey of the empirical literature that links the behavioral traits of managers to their firm's investment decisions. Some of the factors that can affect the extent to which managerial biases affect capital budgeting decisions are reviewed and discussed in the third section. Finally, the last section summarizes and offers some concluding remarks.

THEORY

A Model of Capital Budgeting with Overconfidence

This review begins with a simple model of capital budgeting that accommodates managerial overconfidence, which will guide the subsequent discussion. Suppose that the economy has only one period and that, at time zero, an all-equity firm must make a capital budgeting decision. To make decisions, the firm relies on a manager who acts benevolently in the best interest of the shareholders, i.e., the manager shares their value-maximization objective. The firm's manager must decide whether the firm should invest in a new project that

generates a cash flow of $\tilde{v}$ at the end of the period, where $\tilde{v}$ is a random variable that takes values in $(-\infty,\infty)$, and has a mean of $\bar{v}$. Assume that the cost of the project is $c>0$, and that this cost is incurred at time zero. If the proper one-period discount rate for the project is $r>0$, then the firm's profits from this project, in present value terms, are given by the random variable

$$\tilde{p}=i\left(\frac{\tilde{v}}{1+r}-c\right), \tag{1}$$

where $i\in\{0,1\}$ represents the decision to undertake ($i=1$) or drop ($i=0$) the project. That is, the firm's profits from the project are exactly zero when the manager chooses not to undertake the project, and they are $\frac{\tilde{v}}{1+r}-c$ when the manager chooses to make an initial investment of c for an eventual project payoff of $\tilde{v}$.

Before choosing i, the manager receives a private signal about $\tilde{v}$, which he can use to make a more informed investment decision for the firm. Assume that this signal is given by $\tilde{s}=\tilde{\varepsilon}\tilde{v}+(1-\tilde{\varepsilon})\tilde{\eta}$, where

$$\tilde{\varepsilon}=\begin{cases}1, & \text{prob. } a\\ 0, & \text{prob. } 1-a,\end{cases} \tag{2}$$

$a\in[0,\frac{1}{2}]$, and $\tilde{\eta}$ has the same distribution as $\tilde{v}$ but is independent from it. Thus the manager's signal has the same unconditional distribution as $\tilde{v}$, but the likelihood that it is actually equal to $\tilde{v}$ is measured by a, which can be interpreted as the manager's skill. Otherwise (i.e., with probability $1-a$), the manager's information is pure noise. This implies that

$$\mathrm{E}(\tilde{v}\mid\tilde{s})=a\tilde{s}+(1-a)\bar{v}=\bar{v}+a(\tilde{s}-\bar{v}). \tag{3}$$

That is, a signal $\tilde{s}$ above (below) $\bar{v}$ leads to higher (lower) posteriors about $\tilde{v}$.

Larrick, Burson, and Soll (2007) find that when individuals face a relatively difficult task, the degree of overconfidence they exhibit is highly correlated with their thinking that they are better than average. That is, for such tasks, overconfidence can be viewed as an over-valuation

of one's skill. This is in fact how Gervais and Odean (2001), Gervais and Goldstein (2007), and Gervais et al. (2009) model overconfidence. This correspondence between overconfidence and perceived skills is also consistent with March and Shapira's (1987) finding that managers tend to believe outcomes to be largely controllable and projects under their supervision to be less risky than is actually the case. Larwood and Whittaker (1977), who find that managers tend to overestimate their ability to lead a project to success, document a similar illusion of control.

Therefore, the manager's overconfidence is modeled as his tendency to overestimate his own skill. More specifically, the manager is assumed to think that his skill is $a+b$, where $b \in [0, \frac{1}{2}]$. When $b=0$, the manager is rational and properly weighs the information contained in $\tilde{s}$; when b is close to $\frac{1}{2}$ on the other hand, the manager grossly overestimates the precision of his information and puts much extra weight on it. In particular, for him,

$$\mathrm{E}_b(\tilde{v} \mid \tilde{s}) = (a+b)\tilde{s} + (1-a-b)\bar{v} = \bar{v} + (a+b)(\tilde{s} - \bar{v}), \tag{4}$$

where the "b" subscript denotes the manager's expectation under his biased information set. Thus, compared to a rational manager, the overconfident manager overvalues (undervalues) the project's future cash flows when $\tilde{s} > \bar{v}$ ($\tilde{s} < \bar{v}$).

In his effort to maximize firm value, the manager will choose to undertake the new project if and only if its conditional NPV, $\frac{1}{1+r}\mathrm{E}_b(\tilde{v} \mid \tilde{s}) - c$, exceeds zero. Using (4), this is equivalent to $\tilde{s} > s_b^*$ where, assuming an interior solution,

$$s_b^* \equiv \bar{v} - \frac{\bar{v} - c(1+r)}{a+b} = \bar{v} - \frac{1+r}{a+b}\left(\frac{\bar{v}}{1+r} - c\right) \tag{5}$$

represents the information threshold above which projects are undertaken. Since a small value of s_b^* leads to more projects being undertaken (i.e., $\Pr\{\tilde{s} > s_b^*\}$ is decreasing in s_b^*), equation (5) shows that the effect of overconfidence on investment can go either way, depending on the sign of $\frac{\bar{v}}{1+r} - c$, the NPV of the project without any information about $\tilde{v}$. When the project's cash

flow has a small expected value ex ante (i.e., $\bar{v}$ is small) or the project is expensive to undertake (i.e., c is large), overconfidence leads to overinvestment as the information threshold s_b^* used by the manager is lower than the threshold

$$s_0^* = \bar{v} - \frac{\bar{v} - c(1+r)}{a} \tag{6}$$

that the firm's shareholders would prefer the manager to adopt.

Clearly, overconfidence can also lead to underinvestment when $\bar{v}$ is large or c is small. This is because the manager then overturns more projects based on overweighed negative information than he undertakes based on overweighed positive information. As Gervais et al. (2009) point out, this possibility is less likely to apply when firms compete for projects, as the projects that require time-consuming and costly information gathering will be the ones that are not obviously profitable ex ante. For example, every firm has a permanent option to bid on a multitude of other firms, but a positive signal about the synergistic gains with one such firm is usually what triggers an acquisition. That is, in most reasonable situations, $\frac{\bar{v}}{1+r} - c < 0$ and only a sufficiently positive signal leads to an investment. The model therefore predicts that overconfidence will most often lead to overinvestment.

Overconfidence vs. Optimism

The meaning of overconfidence is different from that of optimism, the belief that favorable future events are more likely than they really are. Researchers generally find that individuals are unrealistically optimistic about future events. They expect good things to happen to them more often than to their peers (Weinstein, 1980; Kunda, 1987). For example, Ito (1990) reports that foreign exchange companies are more optimistic about how exchange rate moves will affect their firm than how they will affect others. Despite the fact that overconfidence and optimism are technically distinct, the two biases are often taken to mean the same thing in the finance literature. In the context of capital budgeting, this turns out to be legitimate, as only

information that leads to new investments affects firm value. The fact that overconfident managers overweight negative information does not affect the outcome that the investment is not made. Thus, the effect of overconfidence is one-sided, just like that of optimism.

To illustrate the similarity of the two biases in a capital budgeting context, managerial optimism is modeled by a perceived first-order stochastic shift in $\tilde{v}$. As a result of this bias, the manager estimates the unconditional mean of $\tilde{v}$ to be $\bar{v}+\beta$, with $\beta \geq 0$, as opposed to just $\bar{v}$. He also systematically overestimates the mean of $\tilde{v}$ conditional on $\tilde{s}$ as, for him,

$$\mathrm{E}_{\beta}(\tilde{v} \mid \tilde{s}) = a\tilde{s} + (1-a)(\bar{v}+\beta), \tag{7}$$

which is increasing in β. As a result, the optimistic manager undertakes the project if and only if $\tilde{s} > s_{\beta}^{**}$ where

$$s_{\beta}^{**} \equiv \bar{v} + \beta - \frac{\bar{v}+\beta-c(1+r)}{a}, \tag{8}$$

which, using the fact that $a<1$, is seen to be decreasing in β. Therefore, just like overconfidence, optimism leads the manager to undertake more projects. Because this is the case, both biases will be discussed interchangeably throughout this chapter, as they typically are in the literature.

Worth noting is that Cassar and Gibson (2007) find that managers are not optimistic in their revenue forecasts; they do not systematically overestimate the cash flows that their firm are expected to generate. However, they do find that the same managers exhibit overconfidence, as their revenue forecasts tend to be too extreme and excessively volatile. Similarly, Ben-David, Graham, and Harvey's (2008) survey of CFOs allows them to measure both their overconfidence and optimism. They find that overconfidence is a key driver of investment, whereas optimism has a more marginal effect on investment.

EMPIRICAL EVIDENCE

Measuring Overconfidence

The first challenge faced by empiricists when testing for the presence and impact of managerial biases on corporate decisions is to develop a plausible measure of their biases. Although managerial overconfidence is likely to lead firms to overinvest, simply uncovering incidences of overinvestment to prove or disprove any behavioral theory of corporate decision making is generally insufficient. The reason is simple; many alternative theories revolving around asymmetric information or agency arguments can lead to the same predictions (Stein, 2003). As such, in order to make a convincing case about behavioral influences on capital budgeting, researchers must associate some measure of overconfidence with firms' eventual investment decisions and the outcome of these decisions.

For a long time, such measures of overconfidence were hard to find in finance, especially for agents making important decisions within corporations. In fact, in his review of the literature on capital budgeting, Stein (2003) mentions managerial overconfidence as a "potentially very promising" avenue for studying the investment decisions of firms. As he argues, ample evidence from psychology shows that individuals tend to be biased in their estimates of probabilities and that these biases affect their economic decisions. For the most part, however, the lack of direct overconfidence measures prevented empiricists from making a convincing case about the effects of this bias on capital budgeting decisions. This has changed in recent years as researchers have found clever ways to measure the overconfidence of key employees in corporations. So far, overconfidence estimates have come from various sources of data: the personal decisions of executives about their stock options and acquisition of company stocks, the tone used to portray a company's chief executive officer (CEO) in magazine and newspaper articles, surveys administered to executives, and the earnings forecasts of management.

Malmendier and Tate (2005a, 2008) pioneered the idea of using stock and stock option data to proxy for executive overconfidence. The essence of their strategy is to classify CEOs

according to their tendency to voluntarily remain under-diversified when they have the option not to do so. More specifically, the authors classify CEOs as overconfident when they hold on to their vested stock options past their optimal exercise time, and when they increase their exposure to their firm's specific risk by regularly acquiring additional company stock.

The second measure can also be attributed to Malmendier and Tate (2005b, 2008), who turn to articles about CEOs in the popular press (e.g., *The Economist*, *Business Week*, and *The New York Times*) to infer whether a CEO is overconfident. Specifically, they compare the number of articles that portray a CEO as being "confident" or "optimistic" to the number of articles that portray him as "cautious," "conservative," "not confident" or "not optimistic." The authors classify a CEO as being overconfident in a given year when the former exceeds the latter for that year's articles about him.

The third approach to measure the biases of executives is to construct and administer surveys that allow an inference on the respondents' behavioral traits. Such is the approach followed by Ben-David et al. (2008) and Sautner and Weber (2009). For example, Ben-David et al. poll senior finance executives (most of them CFOs) with a series of questions about the distribution of their forecast of returns on the S&P500 index. The authors interpret tight distributions as a sign of overconfidence and high expected returns as a sign of optimism.

Finally, Lin, Hu, and Chen (2005) estimate the overconfidence of managers using data about their forecasts of company earnings. More specifically, they infer that a CEO is overconfident when he tends to overstate his firm's earnings forecasts, after controlling for the CEO's economic incentives to issue such inflated numbers. Interestingly, Ben-David et al. (2008) confirm the validity of such an approach by documenting a positive correlation between their measure of CFO overconfidence based on S&P500 return forecasts and the tightness of the same CFO's estimates of his own firm's cash flows.

The Sensitivity of Investment to Cash Flow

According to classical economic theory, a firm's investment should be driven exclusively by the profitability of its opportunities. More specifically, the value of a firm's Tobin's (1969) Q should be sufficient to explain the level of its investment. However, as documented by Fazzari, Hubbard and Petersen (1988) and numerous authors following them (for a review of this literature, see Hubbard, 1998), this prediction does not seem to hold empirically. Firms that have more cash and rely less on debt financing tend to invest more than other firms, keeping investment opportunities fixed. The literature contains several explanations for this result, including the effects of adverse selection and moral hazard on the cost of external financing and Jensen's (1986) empire-building theory (for a review, see Stein, 2003). Another explanation is from Heaton's (2002) model of overconfident CEOs. Overconfident CEOs are reluctant to finance new investments by issuing risky securities that they perceive to be undervalued. Yet, the presence of cash or the ability to issue (almost) riskless debt creates the financial slack these CEOs require to pursue their aggressive investment strategies.

Malmendier and Tate (2005a) perform a series of regressions of investment on various variables known to explain the investment decisions of firms including Tobin's Q and cash flows. To test the prediction that CEO overconfidence increases the impact of cash flows on investment, they include an interaction term between cash flows and their measure of CEO overconfidence in their regressions. Their results confirm existing findings on investment-cash flow sensitivity; the coefficient on cash flow is positive and significant. Their results also show that, as predicted by Heaton (2002), the investment reaction of overconfident CEOs to cash flows is stronger. In all their regressions, the coefficient on the interaction term is positive and significant.

To refine their test of Heaton's (2002) model, Malmendier and Tate (2005a) test the prediction that financially constrained firms should be more affected by CEO overconfidence than other firms. After sorting their sample of firms according to Kaplan and Zingales' (1997)

measure of a firm's financial constraint, they confirm that the impact of CEO overconfidence on the relationship between investment and cash flow is limited to firms that have difficulty in accessing capital markets to finance their investments.

Several other authors have confirmed Malmendier and Tate's (2005a) results, leading Campbell, Johnson, Rutherford, and Stanley (2009) to use firm investment data to proxy for executive overconfidence. For example, using a similar regression strategy with alternative measures of CEO overconfidence (as discussed above), Malmendier and Tate (2005b) and Lin et al. (2005) confirm that the investment-cash flow sensitivity gets stronger with CEO overconfidence. A related line of inquiry that is particularly promising can be found in the work of Glaser, Schäfers, and Weber (2008). They extend Malmendier and Tate's (2005a) study to a larger set of decision makers within the firm, including the CFO and members of the executive and supervisory boards. Besides confirming Malmendier and Tate's (2005a) results about the effect of CEO overconfidence on investment, Glaser et al. find that CFO overconfidence has little or no effect on investment, but that board overconfidence is partly responsible for the effect of overconfidence on investment.

Although Ben-David et al.'s (2008) results are not about the investment-cash flow sensitivity per se, they indicate that firms whose CFOs overestimate their ability to predict S&P500 returns have capital expenditures that are 8 percent higher than the average firm. Interestingly, their results also show that only overconfidence regarding long-term return distributions (i.e., ten-year returns), as opposed to overconfidence about short-term return distributions (i.e., one-year returns), helps explain the level of capital expenditures, which are themselves long-term investments for the most part.

Mergers, Acquisitions, and Takeovers

In their review of the literature on corporate control, Jensen and Ruback (1983) conclude, from the empirical evidence existing at that point (e.g., Dodd, 1980; Asquith, 1983;

Eger, 1983), that mergers do not create any value for the bidding firms. Subsequent work by Bradley, Desai, and Kim (1988) and Berkovitch and Narayanan (1993) shows that acquisitions have a negative impact on the value of acquiring firms. More recently, Andrade, Mitchell, and Stafford (2001) document that from 1973 to 1998 acquiring firms experienced average abnormal returns of -0.7 percent during the three-day window surrounding the announcement of a merger. Similarly, Moeller, Schlingemann, and Stulz (2005) report that, in over 12,000 acquisitions from 1980 to 2001, acquiring firms have lost a combined value of $220 billion at the time they announce their plan to acquire firms for an aggregate amount of $3.4 trillion.

In an effort to explain the price patterns of bidding and target firms around takeovers, Roll (1986) proposes managerial overconfidence as an important driver of corporate acquisitions. His “hubris hypothesis” for takeovers (for a formal model see Xia and Pan, 2006) has two main ingredients. First, in the presence of a market price for a firm’s equity, the outcome of the bidding process is asymmetric—a bidding firm will make an offer if its valuation is higher than the market price, otherwise, no offer is ever observed. That is, only the positive valuation errors of the bidder ever become public. This, of course, is not enough to conclude that acquiring firms will eventually overpay on average. A rational bidder would take this winner’s curse into account and make sure that the expected gains, conditional on the acquisition taking place, are nonnegative. This is where the second ingredient comes into play. Although markets can be expected to eliminate the idiosyncratic mistakes of irrational individuals when they are aggregated across all market participants, the same cannot be said about the market for takeovers. In this market, the mistake of one exuberant CEO does not get instantly corrected by a host of competing arbitrageurs. Instead, this mistake directly leads to the takeover and market prices subsequently adjust to aggregate and reflect the views of all. Thus, as Roll (p. 199) writes, “takeovers reflect individual decisions.”

The power of Roll’s (1986) hubris hypothesis comes from its ability to jointly explain several empirical facts about takeovers. Overconfidence leads to overvaluation and in turn to

bidding mistakes. As Roll argues, this process is largely consistent with the announcement of a takeover being associated on average with a reduction in value for the bidding firm, an increase in value for the target, and little or no change in combined value for the target and bidder firms. Since Roll's conjecture, the market for corporate acquisitions has become an important, if not the main, arena for testing the effects of managerial overconfidence on firms' investment decisions.

An early attempt to link CEO overconfidence with merger activity is the work of Rovenpor (1993), who relies on independent readers to rate the confidence level of CEOs based on their recent speeches. She finds the confidence of CEOs to be positively related to the number of acquisitions they attempt, number of acquisitions they complete, and dollar value of the acquisition transactions. Observing that acquisitions lead to lower long-term profitability (e.g., Ravenscraft and Scherer, 1987) and stock returns (e.g., Agrawal, Jaffe, and Mandelker, 1992), Hayward and Hambrick (1997) proceed to investigate Roll's hubris hypothesis by correlating the acquisition premium with three proxies of CEO overconfidence: the recent performance of the acquiring firm, the recent media praise of the CEO, and the compensation of the CEO relative to that of the next highest paid executive. After controlling for various known determinants of the acquisition premium, they find that all three overconfidence proxies are positively correlated with the acquisition premium. They also show that the relationship between the two variables is stronger when the CEO is likely to have more decision-making power, that is, when he is also chairman of the board, and when the proportion of inside directors is large. All these results are consistent with the hubris hypothesis.

Malmendier and Tate (2008) also investigate this hubris hypothesis using stock option exercise decisions to estimate the overconfidence of CEOs. They find that firms whose CEO is overconfident are 65 percent more likely to make an acquisition, after controlling for various determinants of mergers, including the size, cash flow, and Tobin's (1969) Q of the acquiring firm. In line with Heaton's (2002) prediction that overconfident managers favor using internal

resources to finance new investment, the authors show that their results get stronger when they concentrate on firms that are cash rich. Finally, because overconfident managers think that they are acting in the shareholders' best interest, the acquisitions of firms led by overconfident CEOs are expected to be even more damaging to firm value than the average acquisition. This is also confirmed by Malmendier and Tate (2008) who find that the price reaction of the acquirer, as measured by the three-day abnormal return around the announcement of the merger, is three times as negative as the average abnormal return (-0.90 percent vs. -0.29 percent). They also estimate that, over their sample period (1980 to 1994), CEO overconfidence accounts for roughly $2.15 billion of the $4.39 billion loss experienced by shareholders.

Liu and Taffler (2008) extend Malmendier and Tate's (2008) results by adding the overconfidence of the target firm's CEO, also estimated via their stock option exercise decisions, in the set of explanatory variables. They find that the overconfidence of the target firm's CEO negatively affects the acquiring firm's performance in the three-day window around the announcement of the deal. Their interpretation of the result is consistent with Gervais and Goldstein's (2007) theoretical prediction that firms with an overconfident CEO require a larger acquisition premium, as these CEOs are reluctant to part with the projects they overvalue. Another extension of Malmendier and Tate's (2008) results is the work of Croci, Petmezas, and Vagenas-Nanos (2009). Using a similar methodology on stock option and merger data from the United Kingdom between 1990 and 2005, they confirm that overconfident CEOs lead their firms into more value-destroying acquisitions than their rational counterparts. The authors also report that business cycles do not affect their results which are similar in booms and in recessions.

Using press portrayal of the CEO to measure his overconfidence, Brown and Sarma (2007) also document that overconfident CEOs are more prone to engage in merger transactions. In addition, they document that CEO dominance, as measured by the ratio of the CEO's total remuneration over their firm's total assets, reinforces the relationship between CEO

overconfidence and acquisition frequency. Thus, the combination of the CEO's bias with a relatively free reign over the firm's decisions most likely engenders merger activity.

Finally, Ben-David et al. (2008) find that firms with overconfident CFOs tend to engage in more acquisitions than firms with more rational CFOs. As with capital expenditures, only the CFO's overconfidence about long-term return distributions has any explanatory power. Their evidence concerning announcement returns is also consistent with the rest of the literature. More specifically, they find that bidder returns during the three days that include the announcement date are 1.3 percent lower for firms with overconfident CFOs than for the median firm. Thus, overconfidence of both the CEO and the CFO appears to affect the frequency and value of mergers.

Entrepreneurs, New Markets, and Novel Projects

Another capital budgeting situation that is particularly prone to the effects of managerial overconfidence involves entrepreneurs in small, often private, firms. Because fewer people are involved in the capital budgeting process of these small firms, the biases of its key decision makers are less likely to be confronted by others or by a lengthy decision process. Exacerbating this problem is the fact that these small firms are often involved in projects and markets for which little or no data are available, rendering any kind of statistical model powerless in curbing hasty investment decisions. Finally, although the extreme risks involved in many entrepreneurial decisions can be paralyzing for most individuals, they are more easily handled and even welcome by overconfident individuals. In other words, entrepreneurs will naturally tend to be overconfident as rational individuals stay away from risky entrepreneurial activities (De Meza and Southey, 1996; Van den Steen, 2004). In fact, Busenitz and Barney (1997) document that overconfidence is a key trait that differentiates entrepreneurs from managers in large organizations. Therefore, the fact that several researchers have investigated the role of overconfidence in the investment decisions of entrepreneurial firms is not surprising.

Cooper et al. (1988) find that entrepreneurs assess their own chances for success to be higher than those of their peers. For example, they report that 35 percent of the entrepreneurs in their sample attach a 100 percent probability to the event that their new venture will succeed even though over half the ventures end up failing. Similarly, the majority of high technology industry entrepreneurs surveyed by Corman, Perles, and Vancini (1988) perceive no risk in their prospect for success. In a multinational survey of entrepreneurs, Koellinger, Minniti, and Schade (2007) find that countries in which entrepreneurs exhibit a high degree of overconfidence show more start-up activity but a higher failure rate.

Firms also tend to make large mistakes when they decide to enter a new market. Davis (1985) reports that firms systematically overrun their budget for new projects, that 80 percent of new firms overestimate their eventual market share, and that these tendencies are worse in high technology industries. In an experimental study, Camerer and Lovallo (1999) document a "reference group neglect" effect, in which agents fail to properly take their competition into account when they assess their prospects for success in a new market. That is, the tendency of individuals to overestimate their skills relative to those of their peers (e.g., Svenson, 1981) can be particularly detrimental when these individuals must compete with their peers.

At the product level, Simon and Houghton (2003) interview 55 managers of small firms in the computer industry that are on the verge of launching a new product. Using content analysis to estimate each manager's overconfidence about the eventual success of the product, they find that managers with greater overconfidence introduce more pioneering (i.e., riskier) products and tend to fail more often. Similarly, other studies document that managerial overconfidence leads to plant expansion (Nutt, 1993) and to innovation (Staw, 1991).

Costs, Planning and the Escalation of Commitment

Managerial overconfidence and optimism do not lead to overinvestment only through inflated cash flows. Another channel of overinvestment that originates in these biases is the tendency for managers to underestimate the costs of projects as well as their time to completion (Kidd, 1970; Hall, 1982; Lovallo and Kahneman, 2003). As Buehler, Griffin, and Ross (1994, 2002) document and discuss, individuals display a systematic downward bias when they predict the completion time of a task. For managers, this planning fallacy reduces realized project and firm value for two reasons. First, project costs are higher because some of these costs are directly proportional to completion time (e.g., labor). Second, the delayed completion means that the positive cash flows coming from the project's operations are also delayed, and so their discounted value is less than initially anticipated by the manager.

A related phenomenon that greatly affects the cost and thus the profitability of projects is the escalation of commitment to which managers often subject their firms. Just as most individuals have a tendency towards escalation in their private endeavors (Staw, 1976; Teger, 1980; Arkes and Blumer, 1985), managers of firms tend to let their commitment escalate in negotiations (Bazerman and Neale, 1992), to throw good money after bad (Garland, 1990; Ross and Staw, 1993), and to make suboptimal decisions in real option scenarios (Denison, 2009). This failure to ignore sunk costs is illustrated in a particularly vivid example by Ross and Staw who document the Long Island Lighting Company's decision to build and operate the Shoreham Nuclear power plant for a projected cost of $75 million, a project abandoned 23 years later after $5 billion had been sunk into it. The authors attribute this behavior to the decision-makers' initial overconfidence and to a self-serving bias by which they attribute negative outcomes to outside forces, justifying the non-revision of their cash flow forecasts going forward.

An aspect of optimism in project planning that has yet to make its way into behavioral corporate finance is the possibility that the bias leads to a self-fulfilling prophecy (e.g., Sherman, 1980). By setting optimistic goals and completion deadlines for their projects, managers

intrinsically commit themselves and their teams to extract more value from these projects than they would otherwise (e.g., Heath, Larrick, and Wu, 1999). In other words, their dedication to making the project meet expectations gets them closer to these expectations even if they do not meet them.

FACTORS AFFECTING THE IMPACT OF MANAGERIAL BIASES

Learning and the Attribution Bias

In theory, managers should eventually learn from the outcomes of their investment decisions and appropriately adjust their beliefs about their ability to process information. If this were the case, managers' expectations should become better calibrated over time and, as a result, they should make fewer investment mistakes. For example, Koellinger et al. (2007) document that nascent entrepreneurs tend to be more overconfident in their skills than are established entrepreneurs. However, this does not seem to always be the case. First, the feedback that managers get about their investment decisions is often imprecise and can take a long time to arrive. Second, because managers infrequently make important investment decisions, they rarely receive quality feedback. Third, the psychology literature documents that the process of learning about one's own ability is often plagued by an attribution bias in which people overestimate (underestimate) the degree to which they are responsible for past successes (failures). As Hastorf, Schneider, and Polifka (1970, p. 73) write, "we are prone to attribute success to our own dispositions and failure to external forces" (see also Miller and Ross, 1975; Langer and Roth, 1975; Zuckerman, 1979).

The model of capital budgeting set forth in this chapter can easily accommodate the possibility that managers learn about their ability over time as they observe the outcomes of earlier investment decisions. The multi-period version of the model, in which the manager makes a sequence of one-period investment decisions, is similar to Gervais and Odean's (2001) model about the self-attribution bias of investors. As they show, the slow, infrequent, and

imprecise feedback that managers receive about their investment decisions leads them to become overconfident and to stay that way for extended periods of time. This is in fact the outcome originally anticipated by Knight (1921, p. 231): “A dependable estimate of ability can only come from a considerable number of trials... And in business management no two instances, perhaps, are ever very closely alike, in any objective, describable sense.” As such, convergence to correctly calibrated beliefs is unlikely to occur in the corporate arena and long-lasting overconfidence is likely to follow early success.

The predictions associated with this learning behavior essentially map the overconfidence dynamics into policies that the manager is likely to follow over time given a sequence of outcomes. For capital budgeting, the overconfidence prompted by the success of past investment decisions should lead the manager to make similar decisions in the future. Again, the corporate acquisition market has so far provided the best opportunity to test this theory. In fact, Roll (1986, p. 206) writes: “One would expect a higher level of hubris and thus more aggressive pursuit of a target in firms that had experienced recent good times.” This is precisely the main empirical finding in papers by Doukas and Petmezas (2007) and Billett and Qian (2008). Specifically, both sets of authors document that CEOs who make a successful acquisition are more likely to follow it with acquisitions that negatively affect their firm’s stock price. That is, early acquisition success boosts the CEO’s confidence to the point that he starts conforming to Roll’s (1986) hubris hypothesis in subsequent acquisitions. This is also consistent with the work of Moeller et al. (2005) who find that large loss deals (i.e., deals that lose in excess of $1 billion) tend to happen to firms that have been successful with their previous acquisitions.

The possibility that the success of past decisions leads executives to subsequently make similar but perhaps irrational decisions is not limited to corporate acquisitions. For example, Tyler and Steensma (1998) document that top executives tend to be overly attracted by strategic alliances when they perceive such alliances to have benefitted their firm in the past.

Similarly, in their study of French entrepreneurs, Landier and Thesmar (2009) document that serial entrepreneurs tend to be more consistently optimistic and attribute the result to a self-attribution bias. Finally, in their study of the effects of overconfidence on corporate policies, Ben-David et al. (2008) document that CFOs are more confident about their estimates of future market returns when past returns are high. That is, CFOs seem to gain confidence as the overall economy, not just their firm, is doing well.

Hurdle Rates

As discussed in this chapter, the literature on the effects of overconfidence and optimism on capital budgeting points to the tendency of managers to overestimate project cash flows. This leads to overinvestment, especially if firms do not adopt any control mechanisms aimed at trimming estimated cash flows. A natural instrument to counterbalance the inflated cash flows resulting from the behavioral biases of decision makers is the discount rate that they use to calculate NPVs. More specifically, the prescription of an inflated discount rate to calculate a project's NPV should serve to reduce the effect of the manager's bias on his cash flow estimates.

Given the prevalence of managerial overconfidence, seeing that firms use hurdle rates that often substantially exceed their cost of capital objectively calculated using standard techniques is not surprising. For example, in their surveys of capital budgeting techniques, Schall, Sundem, and Geijsbeek (1978), Gitman and Mercurio (1982), Poterba and Summers (1995), and Meier and Tarhan (2007) all report that the hurdle rates used by companies appear abnormally high. As Dobbs (2009) argues, a related practice that effectively curbs excessive optimism in cash flow forecasting is the provision of incentives that make managers focus on the short-term profitability of projects. As Stein (1989, 1996) shows, financing concerns force managers to adopt a more myopic investment strategy through the adoption of higher discount rates that reduce the weight of long-term cash flows in investment

decisions. This short-term focus is also consistent with Graham and Harvey's (2001) survey evidence that the payback period rule, which ignores cash flows beyond the payback period, is the third-most frequently used capital budgeting method and that small firms use it as much as the NPV rule.

Contractual Incentives

The model of capital budgeting introduced earlier treats the firm and its manager as the same. That is, the underlying assumption is that the manager benevolently performs his duties to maximize the total value of the firm. Following the seminal work of Ross (1973), Jensen and Meckling (1976), and Holmström (1979), the last three decades have seen a proliferation of papers incorporating a systematic treatment of agency theory into the decision process of firms, as originally suggested by Berle and Means (1932). In this literature, contracts are designed in such a way that they provide the agent (i.e., the manager) with the incentives to act in the best interest of the principal (i.e., the firm or its shareholders). Traditionally, the misalignment of incentives is due to moral hazard and asymmetric information problems. In recent years, this theory of contracts and incentives has been extended to account for the behavioral traits of managers and the impact they have on agency problems.

The work of Goel and Thakor (2008) and Gervais et al. (2009) captures the point of this literature. In these papers, a firm's risk-neutral shareholders hire a risk-averse manager to make investment decisions on their behalf. Two main sets of results are established. First, the manager's overconfidence serves to reduce the moral hazard that his risk aversion creates (Jensen and Meckling, 1976; Treynor and Black, 1976). That is, the manager's risk aversion makes his investment decisions overly cautious, but his overconfidence provides a naturally offsetting force by making the manager think that his information and skill allow him to control risk better than he really can. In this context, both papers establish the result that some overconfidence is beneficial, but too much of it leads to overinvestment which is detrimental.

The second main result follows from this observation and from optimal risk-sharing arrangements. When contractual incentives must come with a transfer of risk from the risk-neutral firm to the risk-averse manager, they are cheaper and more efficient if the manager can commit to an investment strategy that is as close to first-best as possible. This is precisely what overconfidence achieves; the biased manager naturally follows an investment policy that is more in line with the shareholders' objective, and so compensation arrangements can be more efficient.

In related papers, Adrian and Westerfield (2009) and Giat, Hackman, and Subramanian (2009) analyze dynamic principal-agent models in which the beliefs of the principal about project payoffs differ from those of the agent. The former paper establishes that, when the agent is more optimistic than the principal, equilibrium contracts lead to increased effort incentives, investment, and output. The latter paper adds the possibility that the principal and agent learn about the project's eventual payoff over time. The authors characterize the situations in which investment is expected to increases (when the agent is moderately optimistic compared to the principal) or decrease (when the agent is highly optimistic compared to the principal) over time. Finally, using a calibration of their model on data from pharmaceutical R&D projects, Giat et al. establish that managerial optimism is an important determinant of these firms' investment decisions and value.

At this point, there is little to no empirical evidence about the interaction of contractual incentives, managerial overconfidence, and investment decisions. For example, although Ben-David et al. (2008) find that overconfident CFOs receive a larger fraction of their compensation through stock options, they do not investigate how these variables jointly affect firms' investment policies. Similarly, Brown and Sarma (2007) document that CEO overconfidence and CEO compensation separately affect the frequency of a firm's corporate acquisitions, but they do not investigate how these two explanatory variables interact. As Gervais et al. (2009) argue, in equilibrium, contractual arrangements between firms and top executives should adjust to reflect

the effects of behavioral traits. The fact that researchers have uncovered a positive correlation between the overconfidence of managers and the aggressiveness of their investment policies seems to indicate that contracts are either suboptimal or too sticky, or alternatively that managerial overconfidence is valuable elsewhere in the firm's organization.

SUMMARY AND CONCLUSIONS

People tend to be overconfident in that they overestimate the precision of their information and their ability to control risk. Firm managers are especially prone to such a bias, as their overconfidence endogenously leads them to decision-making roles and proves to be difficult to learn away in an environment with infrequent and imprecise feedback. In capital budgeting situations, overconfident managers tend to overinvest. As the existing empirical literature shows, overconfidence leads managers to invest free cash flows more rapidly, to initiate more mergers, to start more new firms and invest in more novel projects, and to stick with an unprofitable investment policy for too long. Learning, inflated hurdle rates, and contractual incentives can reduce the investment distortions that result from managerial overconfidence, but do not appear sufficient to eliminate them.

The literature on the impact of managerial biases on capital budgeting is still relatively young. Most of the progress on directly linking proper measures of executive overconfidence to their firm's investment policy has been made in the last five to ten years. In this author's view, the fact that managerial traits seem to systematically and persistently correlate with the investment policies of firms is still somewhat of a puzzle in need of more research. In addition to a deeper exploration of the interaction between contractual incentives, overconfidence, and investment policy, a productive direction is to study the entire set of tradeoffs that overconfidence brings to an organization. That is, the overaggressive investment policy that comes with managerial overconfidence could be the cost for larger benefits elsewhere in the firm. For example, recent work on the leadership role of overconfident agents by Gervais and

Goldstein (2007) and Bolton, Brunnermeier, and Veldkamp (2008) seems to indicate that overconfidence is valuable for the internal workings of firms. In the same vein, models by Bernardo and Welch (2001), Englmaier (2006), Chu (2007), and Gervais et al. (2009) show that overconfidence can increase efficiency, the likelihood of survival, and economic growth. In this light, the overall *NPV* of overconfidence in firms is possibly positive, despite the capital budgeting mistakes that it prompts.

REFERENCES

Adrian, Tobias, and Mark M. Westerfield. 2009. "Disagreement and Learning in a Dynamic Contracting Model." *Review of Financial Studies* 22:10, 3873-3906.

Agrawal, Anup, Jeffrey F. Jaffe, and Gershon N. Mandelker. 1992. "The Post-Merger Performance of Acquiring Firms: A Re-Examination of an Anomaly." *Journal of Finance* 47:4, 1605-1621.

Alpert, Marc, and Howard Raiffa. 1982. "A Progress Report on the Training of Probability Assessors." In Daniel Kahneman, Paul Slovic, and Amos Tversky (eds.), *Judgment Under Uncertainty: Heuristics and Biases*, 294-305. Cambridge: Cambridge University Press.

Andrade, Gregor, Mark Mitchell, and Erik Stafford. 2001. "New Evidence and Perspectives on Mergers." *Journal of Economic Perspectives* 15:2, 103-120.

Arkes, Hal R., and Catherine Blumer. 1985. "The Psychology of Sunk Cost." *Organizational Behavior and Human Decision Processes* 35:1, 124-140.

Asquith, Paul. 1983. "Merger Bids, Uncertainty, and Stockholder Returns." *Journal of Financial Economics* 11:1-4, 51-83.

Baker, Malcolm, Richard S. Ruback, and Jeffrey Wurgler. 2007. "Behavioral Corporate Finance." In B. Espen Eckbo (ed.), *Handbook of Corporate Finance: Empirical Corporate Finance*, 145-188. Amsterdam: North-Holland.

Bazerman, Max, and Margaret Neale. 1992. “Nonrational Escalation of Commitment in Negotiation.” *European Management Journal* 10:2, 163-168.

Ben-David, Itzhak, John R. Graham, and Campbell R. Harvey. 2008. “Managerial Overconfidence and Corporate Policies.” Working Paper, Duke University.

Berkovitch, Elazar, and M. P. Narayanan. 1993. “Motives for Takeovers: An Empirical Investigation.” *Journal of Financial and Quantitative Analysis* 28:3, 347-362.

Berle, Adolph, and Gardiner Means. 1932. *The Modern Corporation and Private Property*. New York: Macmillan.

Bernardo, Antonio E., and Ivo Welch. 2001. “On the Evolution of Overconfidence and Entrepreneurs.” *Journal of Economics and Management Strategy* 10:3, 301-330.

Billett, Matthew T., and Yiming Qian. 2008. “Are Overconfident CEOs Born or Made? Evidence of Self-Attribution Bias from Frequent Acquirers.” *Management Science* 54:6, 1037-1051.

Bolton, Patrick, Markus K. Brunnermeier, and Laura Veldkamp. 2008. “Leadership, Coordination and Mission-Driven Management.” Working Paper, Columbia University.

Bradley, Michael, Anand Desai, and E. Han Kim. 1988. “Synergistic Gains from Corporate Acquisitions and Their Division between the Stockholders of Target and Acquiring Firms.” *Journal of Financial Economics* 21:1, 3-40.

Brehmer, Berndt. 1980. “In One Word: Not from Experience.” *Acta Psychologica* 45:1-3, 223-241.

Brown, Rayna, and Neal Sarma. 2007. “CEO Overconfidence, CEO Dominance and Corporate Acquisitions.” *Journal of Economics and Business* 59:5, 358-379.

Buehler, Roger, Dale Griffin, and Michael Ross. 1994. “Exploring the ‘Planning Fallacy’: Why People Underestimate Their Task Completion Times.” *Journal of Personality and Social Psychology* 67:3, 366-381.

Buehler, Roger, Dale Griffin, and Michael Ross. 2002. “Inside the Planning Fallacy: The Causes and Consequences of Optimistic Time Predictions.” In Daniel Kahneman, Paul Slovic, and

Amos Tversky (eds.), *Judgment Under Uncertainty: Heuristics and Biases*, 250-270. Cambridge: Cambridge University Press.

Busenitz, Lowell W., and Jay B. Barney. 1997. "Differences between Entrepreneurs and Managers in Large Organizations: Biases and Heuristics in Strategic Decision-Making." *Journal of Business Venturing* 12:1, 9-30.

Camerer, Colin, and Dan Lovallo. 1999. "Overconfidence and Excess Entry: An Experimental Approach." *American Economic Review* 89:1, 306-318.

Campbell, T. Colin, Shane A. Johnson, Jessica Rutherford, and Brooke W. Stanley. 2009. "CEO Confidence and Forced Turnover." Working Paper, Texas A&M University

Cassar, Gavin, and Brian Gibson. 2007. "Forecast Rationality in Small Firms." *Journal of Small Business Management* 45:3, 283-302.

Chu, Angus C. 2007. "Confidence-Enhanced Economic Growth." *B. E. Journal of Macroeconomics* 7:1, 1-18.

Cooper, Arnold C., Carolyn Y. Woo, and William C. Dunkelberg. 1988. "Entrepreneurs' Perceived Chances for Success." *Journal of Business Venturing* 3:2, 97-108.

Corman, Joel, Benjamin Perles, and Paula Vancini. 1988. "Motivational Factors Influencing High-Technology Entrepreneurship." *Journal of Small Business Management* 26:1, 36-42.

Croci, Ettore, Dimitris Petmezas, and Evangelos Vagenas-Nanos. 2009. "Managerial Overconfidence in High and Low Valuation Markets and Gains to Acquisitions." Working Paper, University of Surrey.

Cyert, Richard M., and James G. March. 1963. *A Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.

Daniel, Kent D., David Hirshleifer, and Avanidhar Subrahmanyam. 1998. "Investor Psychology and Security Market Under- and Overreactions." *Journal of Finance* 53:6, 1839-1885.

Davis, David. 1985. "New Projects: Beware of False Economies." *Harvard Business Review* 63:2, 95-101.

Dean, Joel. 1951. *Capital Budgeting*. New York: Columbia University Press.

De Meza, David, and Clive Southey. 1996. “The Borrower’s Curse: Optimism, Finance and Entrepreneurship.” *Economic Journal* 106:435, 375-386.

Denison, Christine A. 2009. “Options and Escalation of Commitment: A Behavioral Analysis of Capital Investment Decisions.” *Accounting Review* 84:1, 133-155.

Dobbs, Ian M. 2009. “How Bad Can Short Termism Be? A Study of the Consequences of High Hurdle Discount Rates and Low Payback Thresholds.” *Management Accounting Research* 20:2, 117-128.

Dodd, Peter. 1980. “Merger Proposals, Management Discretion and Stockholder Wealth.” *Journal of Financial Economics* 8:2, 105-137.

Doukas, John A., and Dimitris Petmezas. 2007. “Acquisitions, Overconfident Managers and Self-Attribution Bias.” *European Financial Management* 13:3, 531-577.

Eger, Carol Ellen. 1983. “An Empirical Test of the Redistribution Effect in Pure Exchange Mergers.” *Journal of Financial and Quantitative Analysis* 18:4, 547-572.

Einhorn, Hillel J., and Robin M. Hogarth. 1978. “Confidence in Judgment: Persistence of the Illusion of Validity.” *Psychological Review* 85:5, 395-416.

Englmaier, Florian. 2006. “A Strategic Rationale for Having Overconfident Managers.” Working Paper, Harvard University.

Fama, Eugene F. 1970. “Efficient Capital Markets: A Review of Theory and Empirical Work.” *Journal of Finance* 25:2, 383-417.

Fazzari, Steven, M., R. Glenn Hubbard, and Bruce C. Petersen. 1988. “Financing Constraints and Corporate Investment.” *Brookings Papers on Economic Activity* 1, 141-195.

Fischhoff, Baruch, Paul Slovic, and Sarah Lichtenstein. 1977. “Knowing with Certainty: The Appropriateness of Extreme Confidence.” *Journal of Experimental Psychology* 3:4, 552-564.

Garland, Howard. 1990. “Throwing Good Money After Bad: The Effect of Sunk Costs on the Decision to Escalate Commitment to an Ongoing Project.” *Journal of Applied Psychology* 75:6, 728-731.

Gervais, Simon, and Itay Goldstein. 2007. “The Positive Effects of Biased Self-Perceptions in Firms.” *Review of Finance* 11:3, 453-496.

Gervais, Simon, J. B. Heaton, and Terrance Odean. 2009. “Overconfidence, Compensation Contracts and Capital Budgeting.” Working Paper, Duke University.

Gervais, Simon, and Terrance Odean. 2001. “Learning to Be Overconfident.” *Review of Financial Studies* 14:1, 1-27.

Giat, Yahel, Steve Hackman, and Ajay Subramanian. 2009. “Investment under Uncertainty, Heterogeneous Beliefs and Agency Conflicts.” Working Paper, Jerusalem College of Technology.

Gitman, Lawrence J., and Vincent A. Mercurio. 1982. “Cost of Capital Techniques Used by Major U.S. Firms: Survey and Analysis of Fortune’s 1000.” *Financial Management* 11:4, 21-29.

Glaser, Markus, Philipp Schäfers, and Martin Weber. 2008. “Managerial Optimism and Corporate Investment: Is the CEO Alone Responsible for the Relation?” Working Paper, Universität Mannheim.

Goel, Anand M., and Anjan Thakor. 2008. “Overconfidence, CEO Selection and Corporate Governance.” *Journal of Finance* 63:6, 2737-2784.

Graham, John R., and Campbell R. Harvey. 2001. “The Theory and Practice of Corporate Finance: Evidence from the Field.” *Journal of Financial Economics* 60:2-3, 187-243.

Hall, Peter. 1982. *Great Planning Disasters*. Berkeley, CA: University of California Press.

Hastorf, Albert H., David J. Schneider, and Judith Polefka. 1970. *Person Perception*. Reading, MA: Addison-Wesley.

Hayward, Mathew L. A., and Donald C. Hambrick. 1997. “Explaining the Premiums Paid for Large Acquisitions: Evidence of CEO Hubris.” *Administrative Science Quarterly* 42:1, 103-127.

Heath, Chip, Richard P. Larrick, and George Wu. 1999. “Goals as Reference Points.” *Cognitive Psychology* 38:1, 79-109.

Heaton, J. B. 2002. “Managerial Optimism and Corporate Finance Managerial Optimism and Corporate Finance.” *Financial Management* 31:2, 33-45.

Holmström, Bengt. 1979. “Moral Hazard and Observability.” *Bell Journal of Economics* 10:1, 74-91.

Hubbard, R. Glenn. 1998. “Capital-Market Imperfections and Investment.” *Journal of Economic Literature* 36:1, 193-225.

Ito, T. 1990. “Foreign Exchange Rate Expectations: Micro Survey Data.” *American Economic Review* 80:3, 434-449.

Jensen, Michael C. 1986. “Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers.” *American Economic Review* 76:2, 323-329.

Jensen, Michael C., and William H. Meckling. 1976. “Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure.” *Journal of Financial Economics* 3:4, 305-360.

Jensen, Michael C., and Richard S. Ruback. 1983. “The Market for Corporate Control: The Scientific Evidence.” *Journal of Financial Economics* 11:1-4, 5-50.

Kahneman, Daniel, and Dan Lovallo. 1993. “Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking.” *Management Science* 39:1, 17-31.

Kaplan, Steven N., and Luigi Zingales. 1997. “Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints.” *Quarterly Journal of Economics* 112:1, 169-215.

Katona, George. 1946. “Psychological Analysis of Business Decisions and Expectations.” *American Economic Review* 36:1, 44-62.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

Kidd, John B. 1970. “The Utilization of Subjective Probabilities in Production Planning.” *Acta Psychologica* 34, 338-347.

Knight, Frank H. 1921. *Risk, Uncertainty and Profits*. Boston, MA: Houghton Mifflin Company.

Koellinger, Philipp, Maria Minniti, and Christian Schade. 2007. ‘‘I Think I Can, I Think I Can: Overconfidence and Entrepreneurial Behavior.” *Journal of Economic Psychology* 28:4, 502-527.

Kunda, Ziva. 1987. “Motivated Inference: Self-Serving Generation and Evaluation of Causal Theories.” *Journal of Personality and Social Psychology* 53:4, 636-647.

Landier, Augustin, and David Thesmar. 2009. “Financial Contracting with Optimistic Entrepreneurs.” *Review of Financial Studies* 22:1, 117-150.

Langer, Ellen, and Jane Roth. 1975. “Heads I Win, Tails It’s Chance: The Illusion of Control as a Function of the Sequence of Outcomes in a Purely Chance Task.” *Journal of Personality and Social Psychology* 32:6, 951-955.

Larrick, Richard P., Katherine A. Burson, and Jack B. Soll. 2007. “Social Comparison and Confidence: When Thinking You’re Better Than Average Predicts Overconfidence (and When It Does Not).” *Organizational Behavior and Human Decision Processes* 102:1, 76-94.

Larwood, Laurie, and William Whittaker. 1977. “Managerial Myopia: Self-Serving Biases in Organizational Planning.” *Journal of Applied Psychology* 62:2, 194-198.

Lin, Yueh-Hsiang, Shing-Yang Hu, and Ming-Shen Chen. 2005. “Managerial Optimism and Corporate Investment: Some Empirical Evidence from Taiwan.” *Pacific-Basin Finance Journal* 13:5, 523-546.

Liu, Yue, and Richard Taffler. 2008. “Damned Out of Their Own Mouths: CEO Overconfidence in M&A Decision Making and its Impact on Firm Performance.” Working Paper, University of Edinburgh.

Lovallo, Dan, and Daniel Kahneman. 2003. “Delusions of Success: How Optimism Undermines Executives’ Decisions.” *Harvard Business Review* 81:7, 56-63.

Malmendier, Ulrike, and Geoffrey Tate. 2005a. “CEO Overconfidence and Corporate Investment.” *Journal of Finance* 60:6, 2661-2700.

Malmendier, Ulrike, and Geoffrey Tate. 2005b. “Does Overconfidence Affect Corporate Investment? CEO Overconfidence Measures Revisited.” *European Financial Management* 11:5, 649-659.

Malmendier, Ulrike, and Geoffrey Tate. 2008. “Who Makes Acquisitions? CEO Overconfidence and the Market’s Reaction.” *Journal of Financial Economics* 89:1, 20-43.

March, James G., and Zur Shapira. 1987. “Managerial Perspectives on Risk and Risk Taking.” *Management Science* 33:11, 1404-1418.

March, James G., and Herbert A. Simon. 1958. *Organizations*. Cambridge, MA: John Wiley & Sons, Inc.

Margolis, Julius. 1958. “The Analysis of the Firm: Rationalism, Conventionalism, and Behaviorism.” *Journal of Business* 31:3, 187-199.

Meier, Iwan, and Vefa Tarhan. 2007. “Corporate Investment Decision Practices and the Hurdle Rate Premium Puzzle.” Working Paper, HEC Montréal.

Miller, Dale, and Michael Ross. 1975. “Self-Serving Biases in Attribution of Causality: Fact or Fiction?” *Psychological Bulletin* 82:2, 213-225.

Modigliani, Franco, and Merton H. Miller. 1958. “The Cost of Capital, Corporation Finance, and the Theory of Investment.” *American Economic Review* 48:3, 261-297.

Moeller, Sara B., Frederik P. Schlingemann, and René M. Stulz. 2005. “Wealth Destruction on a Massive Scale? A Study of Acquiring-Firm Returns in the Recent Merger Wave.” *Journal of Finance* 60:2, 757-782.

Neale, Margaret A., and Max H. Bazerman. 1990. *Cognition and Rationality in Negotiation*. New York: The Free Press.

Nisbett, Richard E., and Lee Ross. 1980. *Human Inference: Strategies and Shortcomings of Social Judgment*. Englewood Cliffs, NJ: Prentice Hall.

Nutt, Paul C. 1993. “Flexible Decision Styles and the Choices of Top Executives.” *Journal of Management Studies* 30:5, 695-721.

Pigou, Arthur C. 1926. *Industrial Fluctuations*. London: Macmillan.

Poterba, James M., and Lawrence H. Summers. 1995. “A CEO Survey of U.S. Companies’ Time Horizons and Hurdle Rates.” *Sloan Management Review* 37:1, 43-53.

Ravenscraft, David J., and F. M. Scherer. 1987. “Life after Takeover.” *Journal of Industrial Economics* 36:2, 147-156.

Roll, Richard. 1986. “The Hubris Hypothesis of Corporate Takeovers.” *Journal of Business* 59:2, 197-216.

Ross, Stephen A. 1973. “The Economic Theory of Agency: The Principal’s Problem.” *American Economic Review* 63:2, 134-139.

Ross, Jerry, and Barry M. Staw. 1993. “Organizational Escalation and Exit: Lessons from the Shoreham Nuclear Power Plant.” *Academy of Management Journal* 36:4, 701-732.

Rovenpor, Janet L. 1993. “The Relationship between Four Personal Characteristics of Chief Executive Officers (CEOS) and Company Merger and Acquisition Activity (MAA).” *Journal of Business and Psychology* 8:1, 27-55.

Russo, J. Edward, and Paul J. H. Schoemaker. 1992. “Managing Overconfidence.” *Sloan Management Review* 33:2, 7-17.

Sautner, Zacharias, and Martin Weber. 2009. “How do Managers Behave in Stock Option Plans? Clinical Evidence from Exercise and Survey Data.” *Journal of Financial Research* 32:2, 123-155.

Schall, Lawrence D., Gary L. Sundem, and William R. Geijsbeek. 1978. “Survey and Analysis of Capital Budgeting Methods.” *Journal of Finance* 33:1, 281-287.

Sherman, Steven J. 1980. “On the Self-Erasing Nature of Errors of Prediction.” *Journal of Personality and Social Psychology* 39:2, 211-221.

Simon, Herbert A. 1955. “A Behavioral Model of Rational Choice.” *Quarterly Journal of Economics* 69:1, 99-118

Simon, Herbert A. 1959. “Theories of Decision-Making in Economics and Behavioral Science.” *American Economic Review* 49:3, 253-283.

Simon, Mark, and Susan M. Houghton. 2003. “The Relationship between Overconfidence and the Introduction of Risky Products: Evidence from a Field Study.” *Academy of Management Journal* 46:2, 139-149.

Smith, Adam. 1776. *The Wealth of Nations*. London: Methuen & Co., Ltd. (Cited from Bantam Classic edition, 2003.)

Staël von Holstein, Carl-Axel S. 1972. “Probabilistic Forecasting: An Experiment Related to the Stock Market.” *Organizational Behavior and Human Performance* 8:1, 139-158.

Staw, Barry M. 1976. “Knee-Deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Course of Action.” *Organizational Behavior and Human Performance* 16:1, 27-44.

Staw, Barry M. 1991. “Dressing Up Like an Organization: When Psychological Theories Can Explain Organizational Action.” *Journal of Management* 17:4, 805-819.

Stein, Jeremy C. 1989. “Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior.” *Quarterly Journal of Economics* 104:4, 655-669.

Stein, Jeremy C. 1996. “Rational Capital Budgeting in an Irrational World.” *Journal of Business* 69:4, 429-455.

Stein, Jeremy C. 2003. “Agency, Information and Corporate Investment.” In George M. Constantinides, Milton Harris, and René M. Stulz (eds.), *Handbook of the Economics of Finance*, 111-163. Amsterdam: North-Holland.

Svenson, Ola. 1981. “Are We All Less Risky and More Skillful Than Our Fellow Drivers?” *Acta Psychologica* 47:2, 143-148.

Teger, Allan I. 1980. *Too Much Invested to Quit*. New York: Pergamon Press.

Tobin, James. 1969. “A General Equilibrium Approach to Monetary Theory.” *Journal of Money, Credit and Banking* 1:1, 15-29.

Treynor, Jack L., and Fischer Black. 1976. “Corporate Investment Decisions.” In Stewart C. Myers (ed.), *Modern Developments in Financial Management*, 310-327. New York: Praeger.

Tyler, Beverly B., and H. Kevin Steensma. 1998. “The Effects of Executives’ Experiences and Perceptions on Their Assessment of Potential Technological Alliances.” *Strategic Management Journal* 19:10, 939-965.

Van den Steen, Eric. 2004. “Rational Overoptimism (and Other Biases).” *American Economic Review* 94:4, 1141-1151.

Wagenaar, Willem A., and Gideon B. Keren, 1986. “Does the Expert Know? The Reliability of Predictions and Confidence Ratings of Experts.” In Erik Hollnagel, Giuseppe Mancini, and David D. Woods (eds.), *Intelligent Decision Support in Process Environments*, 87-107. Berlin: Springer.

Weinstein, Neil D. 1980. “Unrealistic Optimism about Future Life Events.” *Journal of Personality and Social Psychology* 39:5, 806-820.

Xia, Xinping, and Hongbo Pan. 2006. “The Dynamics of Corporate Takeovers Based on Managerial Overconfidence.” *Journal of American Academy of Business* 10:1, 378-386.

Zuckerman, Miron. 1979. “Attribution of Success and Failure Revisited, or: The Motivational Bias Is Alive and Well in Attribution Theory.” *Journal of Personality* 47:2, 245-287.