13- Reining in Excessive Risk Taking by Executives: Experimental Evidence

Mathieu Lefebvre
University of Liège, CREPP; Boulevard du Rectorat, 7 Bâtiment 31, boîte 39, 4000 Liège, Belgium.
E-mail: mathieu.lefebvre@ulg.ac.be

and

Ferdinand M. Vieider[#]
GATE CNRS and Ludwig-Maximilians-Universität, Geschwister Scholl Platz 1, Munich, Germany.
Email: fvieider@gmail.com

14 September 2010

Abstract
Compensation of executives by means of equity has long been seen as a means to tie executives' income to company performance, and thus as a solution to the principal-agent dilemma created by the separation of ownership and management in publicly owned companies. The overwhelming part of such equity compensation is currently provided in the form of stock-options. Recent events have however revived suspicions that the latter may induce excessive risk taking by executives. We develop a basic model in which such risk-taking behavior is explained based on a richer array of risk attitudes than typically assumed in principal-agent theory. We then use this model to derive a series of hypotheses based on risk attitudes as predicted by prospect theory. In an experiment, we find that subjects acting as executives do indeed take risks that are excessive from the perspective of shareholders if compensated through options. Comparing compensation mechanisms based on stock-options to long-term stock-ownership plans, we find that the latter significantly reduce the uptake of excessive risks by aligning executives' interests with those of shareholders. Introducing an institutionalized accountability mechanism consisting in the requirement for executives to justify their choices in front of a shareholder reunion also reduces excessive risk taking, and appears to be even more effective than long-term stock-ownership plans. A combination of long-term stock-ownership plans and increased accountability thus seem a promising direction for reining in excessive risk taking by executives.

[#] Financial support from the Agence Nationale de la Recherche (ANR BLAN07-3_185547 "EMIR" project) is gratefully acknowledged. We are indepted to Sylvain Ferriol for programming the experiment, as well as to Marie Claire Villeval, Klaus Schmidt, and participants at the CREPP seminar and the ESA conference in Copenhagen for helpful comments.

***Keywords*:** executive compensation; stock-options; accountability; risk taking; prospect theory
***JEL Classification*:** D03, G28, G32, J33, L22

1. Introduction

Linking executives' wealth to company or stock-price performance has long been recognized as the solution to the agency conflict between the interests of owners and managers (Jensen & Meckling, 1976). The issue of how to best achieve such linkage has however resurfaced recently as the world debates how to improve the incentive mechanisms that have led to the recent crisis. Whilst there is clear agreement in the economic community that the debate is largely misdirected by focusing on the 'how much' rather than the 'how' of compensation (Jensen & Murphy, 1990), the mechanisms at the root of excessive risk taking as well as the best ways to obviate them appear more elusive.

The importance of stock-option payments has increased dramatically over the last two decades and holds a prominent place in the overall compensation of executives (Core *et al.* 2003; Hall & Liebman, 1998). Indeed, stock-option plans account for up to 40% of the median executive's compensation (Murphy, 1999). Our particular concern here is with the excessive risk taking that may be induced by distorted incentive mechanisms deriving from the overwhelming use of such stock-option plans (DeFusco *et al.*, 1991; Holden, 2005). Indeed, options seem to offer high rewards for short-term increases in stock prices whilst sheltering their holders from downside risks, thus rewarding volatility over stable stock-price developments (DeFusco *et al.*, 1990).

Traditionally, the compensation of executives through stock-options has been justified by the need of inducing some desirable risk appetite in otherwise risk-averse agents (e.g., Hall & Liebman, 1998). This argument however relies completely on the somewhat simplistic assumption of global risk aversion by executives (Wiseman & Gomez-Mejia, 1998). A wealth of evidence from the empirical literature points in the direction that risk attitudes will depend on decision frames and aspiration levels as well as the source of the uncertainty, and may thus vary over the outcome space (Abdellaoui *et al.*, 2010). We develop a simple model relaxing the assumption of global risk aversion. Assuming a richer array of risk attitudes based on prospect theory, we predict that some risk seeking may take place under stock compensation as well as under compensation through options. And this holds even when such risk taking is excessive from shareholders' point of view.

The availability of data on these issues is very limited, and often no clear-cut, causal conclusions can be drawn even where such data can be found. We thus investigate the effect of different compensation mechanisms experimentally. Experiments have the advantage of permitting controlled variations in one independent variable at the time, thus permitting the isolation of clear causal relationships. Even though such high internal validity comes at the cost of reduced

generalizability of findings to real-world phenomena, experiments are common in finance for issues that are difficult to disentangle in the real world (e.g. Biais *et al.*, 2005; Haigh & List, 2005; Thaler *et al.*, 1997), and can significantly supplement results obtained from the analysis of real-world data. Indeed, it has been shown that experiments may correctly predict real-world decisions in certain cases (Karlan, 2005). Furthermore, experimental investigation makes simplifications aimed at isolating fundamental causal relationship which closely resemble the simplifications made by theoretical models—and few people doubt the usefulness of theories because of the simplifications they entail.

We are thus interested in testing empirically whether compensation through stock options may lead to increased—and even excessive—risk appetite on the side of executives. In addition, we test the effectiveness of two measures that have been discussed both in the academic literature and in the recent policy debate as a means to reducing excessive risk taking by executives—the compensation through company shares rather than stock-options, and increased accountability of executives towards their shareholders. Paying executives in restricted company stock increases the linearity of the incentive instrument, thus aligning executives' payoffs directly with the interests of shareholders (Holden, 2005; Jensen & Murphy, 1990). Another possible solution may be to increase the direct power of shareholders by creating institutional structures that increase the pressure on executives to account for their actions.

Our results indicate that option-based compensation schemes can indeed induce risk taking by executives that is excessive from shareholders' point of view. Comparing compensation mechanisms based on stock-options to long-term stock-ownership plans, we find that the latter significantly reduce the uptake of suboptimal risks. Introducing an institutionalized accountability mechanism, consisting in the requirement for executives to justify their decisions in front of a shareholder reunion, also reduces excessive risk taking. Companies managed by executives rewarded through stock-ownership plans and held accountable are thus found to perform significantly better than companies managed by executives who are unaccountable and/or compensated through stock-options. A combination of long-term stock-ownership plans and increased accountability thus seems a promising direction for reining in excessive risk taking by executives.

In addition to these main results, we find that executives' behavior is described much better by our prospect-theory-based model than by classical accounts assuming universal risk aversion by executives. In general, a majority of our experimental subjects exhibit prospect theory type risk preferences. Aspiration levels and overweighting of small probabilities are found to make executives take risks even when compensated through company stock. When compensation takes

the form of stock options, executives tend to take excessive risks especially when they hold options that are at- or out-of-the-money—a finding that cannot be explained by classical expected utility models. We thus argue that expanding agency theory to allow for richer risk-attitudes as found in empirical investigations promises to greatly increase our understanding of the issues involved.

The present paper proceeds as follows. Section 2.1 discusses the issue of incentive-distortions resulting from compensating executives through stock-options. Sections 2.2 discusses potential solutions under the form of long-term stock-ownership plans. Section 2.3 introduces the concept of accountability, and discusses its working mechanisms. Section 3 introduces the experiment, with 3.1 presenting the experimental purpose and setup, and 3.2 the experimental design. Section 3.3 introduces a simple model aimed at explaining optimal investment strategies under alternative compensation regimes and assuming different risk attitudes; this model is then used to generate hypotheses for the empirical investigation. Section 3.4 reports the main results of stock ownership plans versus compensation through stock options, and section 3.5 reports the effects of introducing accountability; section 3.6 summarizes those effects statistically and introduces additional results; section 3.7 describes the risk attitudes of subjects and tests the relative predictions of our model, while section 3.8 presents results on selling behavior of stock options. Section 4 presents a discussion of our findings, and section 5 concludes the paper.

2. Stock-Option Plans: Distortion of Incentives and Potential Solutions

2.1 Stock option compensation: current practice and incentive effects

Stock-options play an important role in the compensation packages of executives, constituting up to 40% of the compensation of the median executive (Murphy, 1999). This is often justified by their incentive value, according to which options may be used to link the executives' income to company performance (Core *et al.,* 2003). However, there are increasing doubts that options may indeed be the best way to provide such a linkage of pay to performance. On the one hand, stock options have been shown to be more expensive for shareholders to emit than commonly thought, which casts doubt on their effectiveness as an incentive instrument (Hall & Murphy, 2003). Perhaps worse, serious doubts about the incentive value of options have been aired. One problem in the structure of incentives provided by stock options derives from the fact that while executives reap the benefits from increases in the stock value, they are at the same time sheltered from downside risks resulting from declines since they need not exercise their options in such a case.

Several characteristics of option compensation may induce risk seeking. One such mechanism is the downward repricing of exercise prices following a decline in stock value. While

such repricing has been justified with the need to maintain the incentive value of option plans intact, the anticipation of the possibility of option plans being repriced does *de facto* remove the downside risk for executives holding such options. The permissibility of hedging by the executive seems to be equally puzzling, given that it also allows the executive to profit from potential gains, while sheltering himself from potential risks (Bebchuk & Fried, 2003). Furthermore, executives have been found to be often compensated for "luck", i.e. for general industry or market trends that are unrelated to the executive's performance (Bertrand & Mullainathan, 2001).

Even if none of the above were true, an executive holding large amounts of options on company stock could still benefit from large stock volatility (DeFusco *et al.*, 1990; Murphy, 1999). Indeed, it is common practice that stock options are emitted *at-the-money,* i.e. at an exercise price equal to the market price of the stock at the date of emission. Once such options get vested, any shares bought by exercising them are immediately cashable. On the one hand, this creates an issue that, to maintain incentives, new options will need to be issued. More importantly, the executive will have an interest in spikes of share value more than in the creation of long-term company value. At this point however, the question of way stock options have proved so popular as a compensation mechanism remains to be addressed.

Traditionally, compensation through stock options has been explained as a solution to the agency problem inasmuch as it counteracts the natural risk aversion of executives (Agrawal & Mandelker, 1987, Feltham & Wu, 2001; Guay, 1999; Hall & Liebman, 1998; Smith & Stulz; 1985). Such an argument fundamentally relies on an assumption of uniform risk attitudes across the probability and outcome spaces. Modern descriptive theories on decision making under risk however indicate that risk attitudes may not be constant, but may depend on probability levels, reference points, or aspiration levels.

Once one abandons the classic assumptions of universal risk aversion on the side of executives, it is no longer clear whether compensation through options will indeed induce the desirable increases in risk taking postulated by classical theories, or whether it may instead induce risk seeking that is excessive from the point of view of shareholders. Some recent accounts of the issue indeed emphasize how stock options can encourage *excessive* risk taking (Bebchuk & Fried, 2003; DeFusco *et al.*, 1991; Hall & Murphy, 2003; Tufano, 1996). Finally, we argue that even in cases where both excessive risk taking and excessive risk aversion on the side of the executive are theoretically possible, the latter may entail the smaller danger for shareholders, given the catastrophic potential entailed by high-risk investment strategies revealed by the recent financial crisis.

An additional explanation can be derived from rent extraction models that have been

recently formulated in opposition to the classical contracting view. The latter assume that high compensation derives from cosy relationships between managers and boards, where the latter's interests are aligned with the ones of the executives themselves rather than with those of shareholders (Bebchuk & Fried, 2003; Bebchuk *et al.*, 2002; Bertrand & Mullainathan, 2001). While we are not so much concerned with the amount of compensation executives receive, rent extraction models also predict distortions in the provision of incentives. These distortions derive from the fact that compensation mechanisms need to be justifiable and their costs need to be played down in order to make them acceptable to shareholders. Options may be suitable for the obfuscation of the actual costs especially since option payments seem to be commonly perceived as less costly to shareholders than they actually are (Murphy, 2002).

2.2 Aligning incentives of executives and shareholders: long-term stock ownership plans

One way to align executives' interests with the interests of shareholders may be to force them to hold actual company stock (Holden, 2005; Jensen & Murphy, 1990). Studying a sample of companies that adopted *target ownership plans*—requirements that managers hold a given target value of the company in common stock—Core & Larcker (2002) showed that increased stock-ownership by executives significantly increased operating performance in the adopting companies in the two years following the adoption of the target ownership plan. They do however not discuss *why* performance increases, since the causal direction cannot clearly be isolated in their study.

Stock-based compensation provides a number of advantages over options once the concern about excessive risk aversion deriving from it is relegated to second rank. Stock options provide an incentive only as long as they are *at-the-money* or *in-the-money* (exercise price below current market price of shares). Indeed, *out-of-the-money* (exercise price above current market price) stock options may lose any kind of incentive value if the expectation of raising stock prices above their exercise price is low. Stocks owned on the other hand do always have incentive value, no matter what their current price may be. This also means that stocks do not need to be emitted as frequently as stock options, which tend to lose their incentive value much more quickly. Also, while executives are always sheltered against a stock depreciation when paid in options since the latter need not be exercised, stock that is actually owned by executives will move with company value, so that losses of stock value will also be felt.

Arguably, a dimension that may be just as important as the fact whether executives are compensated through stock options or actual company stock is the time-horizon of the compensation scheme. Indeed, it has been argued that option schemes may provide incentives that are better aligned with the interests of shareholders if the vesting period of options is postponed,

without any need for radical change of the compensation structure. On the opposite side of the spectrum, permitting executives to sell stock at any time may trigger excessive risk taking, inasmuch as they may benefit again from short-term stock-price fluctuations more than from the creation of long-term value. Bebchuk *et al.* (2009) discuss this issue at some length. Given however that stock options lose their incentive value if the stock-price declines while actual company stock does not, longer-term incentive structures would appear to be more effective when compensation takes the form of company stock rather than stock-options. In the present experiment, we thus compare stock-options with short vesting periods to long-term stock-ownership plans. This choices is driven by the main research aim of this paper: directly testing compensation schemes that have been proposed in the literature and in the policy debate against the most common regime in use at the moment.

2.3 Increasing Accountability of Executives Towards Shareholders

Although the legal situation is quite heterogeneous across countries, shareholders do not generally have a direct influence on executive compensation. While in the US shareholders can vote down complete budgets set aside for compensation, they cannot specifically act on the compensation package of the chief executive officer alone. The managerial power approach shows how there may be an issue in the fundamental structure of the principal-agent relationship postulated by traditional agency theory (Jensen & Meckling, 1976). Indeed, the board seems to hold most of the powers theoretically attributed to the principal, while in practice its interests may often be closer to those of the agent (Bebchuk & Fried, 2003; Bebchuk *et al.*, 2002). This suggests that increasing the institutional power of the original principal in the principal-agent relationship—the shareholder reunion—*vis-à-vis* the executive and at the expense of the board may improve the relationship itself.

This brings us back to the origins of the principal-agent problem itself—the hidden information or limited time problem that has made delegation of power necessary in the first place. Clearly, day to day monitoring of the CEOs actions by a dispersed ownership structure is neither necessary nor advisable. Indeed, it may suffice for shareholders to have the power of requesting the CEO to justify and explain her decisions, and to vote about the approval or disapproval of such decisions, to change the CEOs course of action. Indeed, some evidence on the effectiveness of accountability requirements on the behavior of executives surfaces here and there in the finance literature. Johnson *et al.* (1997) find that negative press coverage of executive pay packages leads to lower subsequent compensation increases. Furthermore, it has been suggested that large shareholders will monitor the executive's actions more closely since they have a greater interest in

the company (Shleifer & Vishny, 1986). Empirically, the presence of large shareholders has been found to be associated with lower executive pay and better performance (Benz *et al.*, 2001; Cyert *et al.*, 2002). And the influence of such large shareholders seems to be particularly strong when they are present on the board, which increases their institutional standing (Bertrand & Mullainathan, 2001). Monitoring or *behavioral control* is thus often discussed in the organizational agency literature as a complement to the outcome control induced by linking pay to performance (Ouchi & Maguire, 1975; Wiseman & Gomez-Mejia, 1998).

We argue that an institutionalized requirement for the executive to justify her actions in front of shareholders directly could restore at least in part the original principal-agent relationship. Regardless of whether monitoring is close enough to really establish control, the mere threat of a shareholder resolution on the executive's performance (possibly with tangible consequences connected to it) may be enough to remind the executive of shareholders' interests. Accountability has indeed been shown to induce people to think more carefully about their choices, so as to preempt potential criticism by others (Lerner & Tetlock, 1999; Tetlock *et al.*, 1989; Vieider, 2009).

3. The Experiment

3.1 Purpose and setup

We propose to study experimentally whether compensating executives through stock-options may induce risk taking behavior that is excessive from the point of view of shareholders. We further want to test how such excessive risk taking can be reined in—and especially the effectiveness of long-term stock-ownership plans at achieving that aim. We thus contrast a compensation mechanism based purely on stock-options with one based purely on stock-ownership compensation. The issue whether at least some stock-options should be included in an executive's compensation package to induce desirable convexities in the compensation structure is not under investigation here. Indeed, by showing that options can induce *excessive* risk taking, we implicitly acknowledge the argument that they may be used to induce more risk taking on the side of risk averse executives if that should be deemed desirable.

We also introduce an explicit requirement for the executive to justify her actions in front of a shareholder reunion to test for potential effects of increased accountability. This is implemented through a mechanism giving a certain probability for a shareholder reunion to be called. Share-holders can then question the manager's choices, and are asked to hold a final vote of approval/disapproval of the executive's actions. That vote does not carry any practical consequences for the executive in our design. It seems important to underline at this point that the shareholders

are called to ask the executives about the reasons behind her decisions, so that no observation of the ex ante information at the disposal of the executive is required, limited knowledge about which is often invoked as one potential reason for the principal-agent relationship.

3.2 Experimental Design

Subjects. 156 subjects were recruited from a list of experimental subjects maintained at GATE, University of Lyon, France, using the ORSEE software (Greiner, 2004). Groups of six subjects needed to be formed, so that all sessions were run with either 12 or 18 subjects each. Subjects had an average age of 22 years, and 52% of subjects were female. 71% were studying economics or business management, 22% mathematics or engineering and the rest is not specified.

Main Task. In the main part of the experiment, groups of six subjects are formed. The composition of the groups is kept fixed for the 15 periods, and subjects do not know whom they are matched with. At the outset of the experiment, each group member is assigned the role of CEO of one company. In their function of CEO of a company, subjects are confronted with a sequence of investment decisions over 15 periods. In each period, the CEO decides between two investment opportunities into which to invest the total stock of company assets (screenshots in appendix A). The initial stock value of the company is €100 ($150) for everyone. The final value of the company will be determined by the outcome of the 15 investment decisions[1]. At the same time, each group member also acts as shareholder in the five other companies managed by the five other subjects in her group. The shareholder role is a passive role, in the sense that it does not require any action on the part for the subject (except at the very end in the accountability treatments, see below). However, it contributes towards final payoffs in the following way. Each subject is given one share with the initial value of €1 ($1.50) in each of the other five companies in her group. She is then paid the final value of that share (total company value divided by100) at the end of the 15 periods. The experiment was conducted using the REGATE software (Zeiliger, 2000).

Investment Decisions. In each period, the CEO has to choose between two investment opportunities in which to invest total company assets. The investment opportunities (*prospects*) are described in terms of percentage increases or decreases of the company's value. Investments are displayed graphically by means of pie-charts representing the probabilities of winning and losing in addition to a verbal description. The choice is always between a high volatility (*HV*) and a low volatility

[1] Please note that any change in share prices in our experimental model are generated purely by changes in the underlying value of the company assets as determined by investment outcomes—potential reactions by shareholders to option plans or to differences in risk taking by the CEO are not captured inasmuch as there is no market for shares.

(*LV*) prospect. The LV prospect always offers a higher expected value than the HV prospect, so that any risk taking observed is excessive from the point of view of the company or the shareholders by definition, inasmuch as it delivers a lower expected value. Indeed, differences in expected value were such that consistently investing in the LV option would yield an expected final company value that was almost 30 percentage points higher than the one obtainable by consistently investing into the HV option. In the initial instructions, subjects were given a graphical overview of the general characteristics of the two investments as well as an example representing a choice between two 'typical investments'. This graphical display, as well as the complete instructions and a table showing the parameters of all prospect pairs can be found in the appendix.

Stock-Option Compensation. The stock-option treatment is our baseline treatment. Each CEO obtains five stock-options in each period, which are emitted at-the-money, i.e. giving the right to buy company stock at the current stock value. For example, the five options granted before period one investment decisions are made give each the right to buy one share of the company at €1 ($1.50). The options get vested in the subsequent period and remain exercisable until the end of the game, so that they can be 'cashed' at any time. While in reality the options give right to buy company stock which can then be either sold or kept, this decision was unified in order to simplify the game. That is, exercising options in the experiment means buying stock and reselling it immediately, thus realizing the difference between current stock value and the exercise price of the option. This process seems to closely mimic real-world practices of "cashless exercise" (Heath *et al.,* 1999). Thus in every period after the first, the CEO is called upon to decide whether to cash her options after the results of the investment have become known (separately for options emitted in different periods). She will then obtain the new options and decide what kind of investment to take for the subsequent period.

Stock-Ownership Plan. In the stock-ownership condition subjects obtain an initial endowment of 10% of the company stock, corresponding to an initial value of €10 ($15). At the end of the 15 periods, they are paid the final value of their shares. They cannot sell their stock before the end of the 15 periods. Their payment structure thus coincides with the one of shareholders, who also obtain the value of their shares at the end of the 15 periods. The compensation parameters were designed in such a way that the total amount to be earned on average should be roughly equal to the compensation in the stock-option condition (see results sections for a discussion).

Accountability manipulation. In the baseline treatment subjects are *unaccountable.* While their actions will determine the final payoff of their shareholders, they cannot be traced back to them personally. In the *accountable* treatment on the other hand, subjects acting as CEOs may be called upon to justify their decisions in front of their shareholders. At the beginning of the experiment

subjects were asked to indicate their name so that they could be identified in case they would be extracted to justify their choices. They were assured that their names would not be kept together with their data and that this information would be destroyed after the experiment. Subjects are informed at the outset that in each group of six, one subject will be randomly extracted at the end of the game to justify her choices in front of the other five subjects in her group, who will act as shareholders. During the shareholder reunion, the shareholders were given a summary sheet displaying the decisions of the CEO and the evolution of the stock-value, and were allowed to interrogate the CEO about the reasons behind their decisions. At the end of that questioning phase, they were required to hold a vote approving or disapproving the management of the company. This vote held no monetary or other practical consequences, and subjects were dismissed as soon as this procedure was over.

Treatments. The overall experimental setup has thus the following structure:

Table 1: Experimental Design (number of subjects in parentheses)

	Stock Ownership	**Options**
Unaccountable	USO (48)	UOP (48)
Accountable	ASO (30)	AOP (30)

Risk attitude. Before the main part of the experiment described above, detailed risk attitudes were elicited. To achieve this, we used the method of Abdellaoui *et al.* (2008), altering it only sightly to speed up the process (see instructions in appendix D). We thus elicited six certainty equivalents for pure gain prospects, six for pure loss prospects, and one for a mixed prospect. This allows us to derive utility functions over relevant amounts, which together with the estimation of probability weighting functions for gains and losses allow for the precise estimation of loss aversion (Abdellaoui *et al.*, 2007; Schmidt & Zank, 2005). This was done before any treatment manipulations were introduced, so that the elicitation procedure was the same for all subjects. While one choice was selected for real pay in each domain (gains, losses, and mixed gambles), no information on payoffs was given until the very end of the experiment to avoid income effects. This part of the experiment lasted approximately 20 minutes.

3.3 A model of optimal investment strategies under different compensation regimes

In this section we develop a model aimed at generating hypotheses for our empirical investigation.

Though it easily generalizes to a wider class of compensation schemes, we will adopt the terminology of our experimental investigation to simplify exposition. Executives choose between investing into a low volatility (*LV*) investment project or a high volatility investment (*HV*) project. The expected value (*EV*) of the high volatility investment opportunity is always inferior to the one of the low volatility investment by design ($EV_{HV}<EV_{LV}$), since we want to test wether risk taking by executives may be *excessive* under compensation through options. As implicit in the designation, the standard deviation of the high volatility investment is always larger than the one of the low volatility investment: $\sigma_{HV} > \sigma_{LV}$.

In each period the CEO has to make a choice between two investments, so that both the EV and the variance of the investment in each period are a function of the CEO's choice. Such choices are repeated for T periods. CEOs are compensated either through stock-options or company shares. Under stock ownership, the manager is offered shares in the firm that are not tradable until the end of the contract, *T*. Under a stock-options contract, the manager receives, each period, a grant of stock-options that become vested in the subsequent period, so that they can be exercised in any period until the end of the contract at *T*. These stock-options are emitted at-the-money at the exercise price $e_t = y_t$., where y_t represents the value of shares on which the executive currently holds an option. For simplicity we will assume that whenever an option is exercised, the shares thus called will be resold immediately, so that realized gains for options emitted at time t and sold at time i will be $y_i - e_t$, $y > e$ and $i > t$.

We assume that CEOs maximize their own payoff, and first solve the problem for an expected value maximizer (defined as an individual who maximizes the mathematical expectation of the payoff). For CEOs compensated through company stock the problem is trivial: since the expected value of the LV investment is always higher, it is optimal to always choose the LV investment. When on the other hand a CEO is compensated through options, then her compensation varies linearly with the firm's stock price only to the extent that the share price exceeds the exercise price. This derives directly from the fact discussed earlier that options shield the manager from the down-side risk deriving from a decline in stock price. Hence the manager's payoff from an option emitted at time t is $max_i\{ y_i - e_t, 0\}$. Since the manager receives a grant of options in each period until T–1 , the CEO now chooses his investments so as to maximize the following expression:

$$\sum_{t=1}^{T-1}\left[\left(\max_i(0, y_i - e_t)\right)\right] \text{ with } t < i \leq T \qquad (1)$$

Feltham and Wu (2001) showed that the value of an option increases monotonically with its

variance. Under risk neutrality, it is thus easy to see that when compensated trough stock options, the CEO will always prefer the riskier investment. Smith and Stulz (1985) also showed that stock-options may induce risk-averse managers to choose investments with higher volatility. It is however far from clear that this result will carry over to our case, where the investment with a higher volatility is also inferior in terms of expected value. Indeed, Ross (2004) showed that this may not hold for a risk-averse executive. We thus now proceed to relaxing our assumption of risk neutrality in order to derive behavioral predictions for our experimental data.

We adopt a purely behavioral, and hence theory-neutral, definition of risk aversion. An agent is defined as risk averse whenever she weakly prefers the expected value of a prospect over the prospect itself. Similarly, she is defined as risk seeking whenever she weakly prefers the prospect over its mathematical expectation. Finally, she will be risk neutral if she is both risk averse and risk seeking (Wakker, 2010). This definition will allow us to adopt prospect theory as a descriptive theory of choice (Kahneman & Tversky, 1979)[2]. Prospect theory is descriptively superior to expected utility theory (Abdellaoui, 2000; Bleichrodt, Pinto, & Wakker, 2001), and it is increasingly used to explain issues in finance that were previously considered paradoxical (e.g., Bernartzi & Thaler, 1995; Fellner & Sutter, 2009). It has been found to hold not only for students but also for the general population (Booij & van de Kuilen, 2007) and influence the behavior of professional traders (Haigh & List, 2005). Furthermore, since prospect theory is more general then expected utility theory, the latter can be derived from it as a special case. Finally, since we have measured our subjects' risk attitudes, we can say that a majority of subjects do indeed display the behavioral patterns predicted by prospect theory (see below).

Under prospect theory, risk attitudes are expressed through probability weighting functions, while the utility function captures attitudes towards money. One of the most important innovations of prospect theory is reference dependence—the idea that the evaluation of a given prospect or outcome depends on a reference point adopted by a subject. Reference dependence may give rise to different risk attitudes for gains versus losses as well as to loss aversion, a phenomenon by which people attribute more weight to losses than to monetarily equivalent gains which is thought to be the strongest component of risk aversion (Köbberling & Wakker, 2005). We will designate probability weighting for gains by w^+, and probability weighting for losses by w^-. $U(X)$ is taken to be utility over monetary gains X, and $U(-X) = -\lambda * U(X)$ is the utility over monetary losses, where λ is the loss aversion parameter. We will also designate gain percentages by α and loss percentages by β, so that for instance a gain in share value from a LV investment at time i can be written as $\alpha_{LV} * y_i$.

Let us again start with the simpler case of compensation through company stock. The

[2] Given that we use only two-outcome prospects, we need not worry about rank dependence for outcomes.

problem is identical for all periods by design, so that we can look at one period in isolation. Assuming that the current stock value acts as a reference point, a CEO will thus choose the LV investment whenever

$$w^{+}(p_{LV})*U(\alpha_{LV}*y_i) - \lambda*w^{-}(1-p_{LV})*U(\beta_{LV}*y_i) > w^{+}(p_{HV})*U(\alpha_{HV}*y_i) - \lambda*w^{-}(1-p_{HV})*U(\beta_{HV}*y_i), \quad (2)$$

where *p* represents the probability of a successful investment. This leads us the formulation of the following

Hypothesis 1: under stock compensation, loss aversion should generally drive subjects to choose the low volatility investment. Risk seeking may nevertheless be observed in some instance, and especially when **a)** subjects are gain-seeking, defined as the opposite of loss aversion, thus implying $\lambda<1$; **b)** subjects exhibit extreme probability weighting, such that the generally smaller probabilities of winning in the HV investment are overweighted; and **c)** the share price is short of some reference point or aspiration level.

We now move to the conceptually more interesting case of stock-option compensation. We start by looking at the problem in period zero or whenever all previously emitted stock-options have been sold, when a CEO holds only stock-options which are at-the-money. A CEO will now choose the HV investment over the LV investment if and only if

$$w^{+}(p_{HV})*U(\alpha_{HV}*y_i) > w^{+}(p_{LV})*U(\alpha_{LV}*y_i) \quad (3)$$

This derives from the fact that while any increase in stock value can be cashed in, decreases in share value do not result in monetary losses since options need not be exercised. Although there may still be a loss in future earning potential given a stronger decrease in share price from a HV investment, the attention will be mostly focused on the gain side of the prospects. Moreover, choices of the HV investment will be reinforced by commonly found overweighting of small probabilities (Abdellaoui *et al.*, 2009; Wu & Gonzales, 1996), given that the probability of a success is generally much lower in the HV investment than in the LV investment.

Let us now take the case in which in addition to the options just emitted, the CEO holds one additional option bundle which is either in-the-money or out-of-the-money. Since one of the option bundles (the one just emitted) will always be at-the-money, the relation in equation 3 will still be relevant for the decision. In addition however, there is now the consideration that any currently existing value of the other option bundle, y_i-e_t, may be lost (either completely or in part, depending on the value of β_{HV}). Loss aversion over accumulated value will thus work against the risk-seeking tendency produced by newly emitted options. If on the other hand the additional option bundle is out-of-the-money, this will create additional incentives for risk seeking in order to push the share price above the exercising value of the out-of-the-money options. The exercise price of that bundle

will thus act as an aspiration level (Carpenter, 2000; Diecidue & van de Ven, 2008), so that the HV investment will be especially attractive if $\alpha_{HV} > \pi > \alpha_{LV}$, where π represents the stock price increase necessary so that the options currently out of the money would be exactly at the money. This risk-seeking tendency is further reinforced by the fact that no losses can be felt for options that are at- or out-of-the-money, so that loss aversion will not play a role for the decision. This intuition leads us to the formulation of the following

Hypothesis 2: Under stock-option compensation, executives will display a propensity for taking risks that are suboptimal for shareholders since they are sheltered from losses and look mainly at the gain part; **a)** the extent of this risk taking will depend on the options held at the time of the decision so that the higher the value $\Sigma_t(y_i-e_t)$ of options held, the less likely subjects will be to choose the HV investment; more precisely **b)** subjects will be particularly risk seeking if all the options held at the moment of the decision are out-of-the-money; and **c)** subjects will be more averse to risks if all options currently held are in-the-money; also **d)** other things being equal subjects who tend to overweight small probabilities will take more risks; and finally, **e)** the more loss averse subjects are, the sooner they will exercise their options.

At this point, hypotheses 1 and 2 jointly give us our main hypothesis:

Hypothesis 3: CEOs compensated through stock options will be more likely to take risks that are excessive for shareholders than CEOs compensated through actual company stock.

Finally, we need to formalize our expectation that accountability will lead to a reduction in risk seeking. Recent empirical findings on decisions when the decision maker is responsible for others as well as himself indicate a cautious shift phenomenon, whereby people tend to exhibit increased risk aversion when deciding for others as well as themselves (Bolton & Ockenfels, 2009; Charness & Jackson, 2009). While in our experiment executives are always responsible for others' payoffs as well as their own, we may expect a cautious shift tendency when subjects anticipate the possibility of having to justify their decisions to those others who depend on them. While we thus expect accountability to have an effect on choices under stock ownership, more interesting effects should emerge when executives are compensated through stock options. Indeed we have seen above that executives compensated through stock options will generally display greater risk appetite (hypothesis 3), and that the risk taking resulting from this will generally not be in the interest of shareholders. We hypothesize thus that unaccountable executives will try and maximize their own payoffs, regardless of shareholder interest. When accountable however, executives will feel a conflict between maximizing their own payoff and maximizing shareholder payoff. This leads us to the formulation of the following

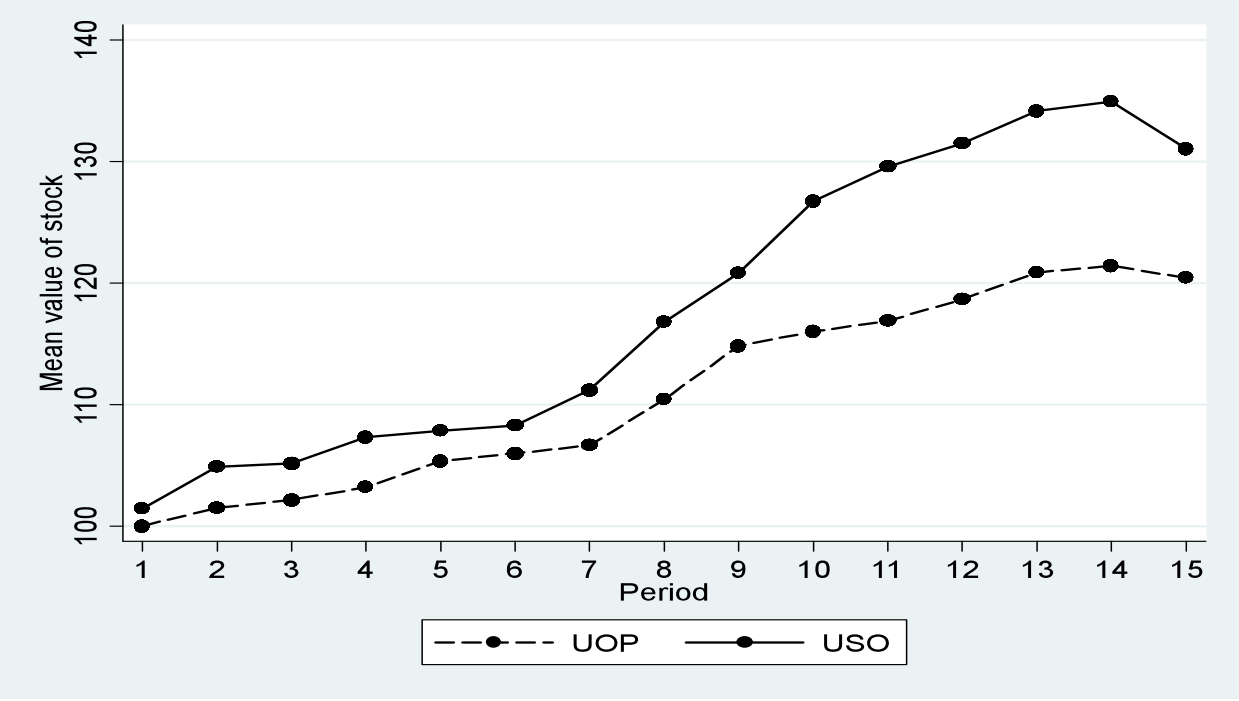
Hypothesis 4: Accountable CEOs will take less risks than unaccountable CEOs across

compensation systems; **a)** this effect is likely to be stronger under stock-option compensation, where the maximization of an executive's income does not require the same choices as maximizing shareholder value; which means that **b)** executives compensated through options will sacrifice some of their profits when accountable so as to increase shareholder value.

3.4 Results: reducing risk taking through long-term stock-ownership plans

As hypothesized, executives take risks that are excessive from the point of view of shareholders when compensated through stock-options. Figure 1 shows the development of mean stock values by compensation type for unaccountable subjects. It can clearly be seen that the mean stock value of companies managed by CEOs compensated through stock outperforms companies managed by CEOs compensated through stock-options. Indeed, the mean final value of companies managed by CEOs compensated by means of stock-ownership plans is over 10 percentage points higher than the mean final value of companies managed by CEOs compensated with stock-options.

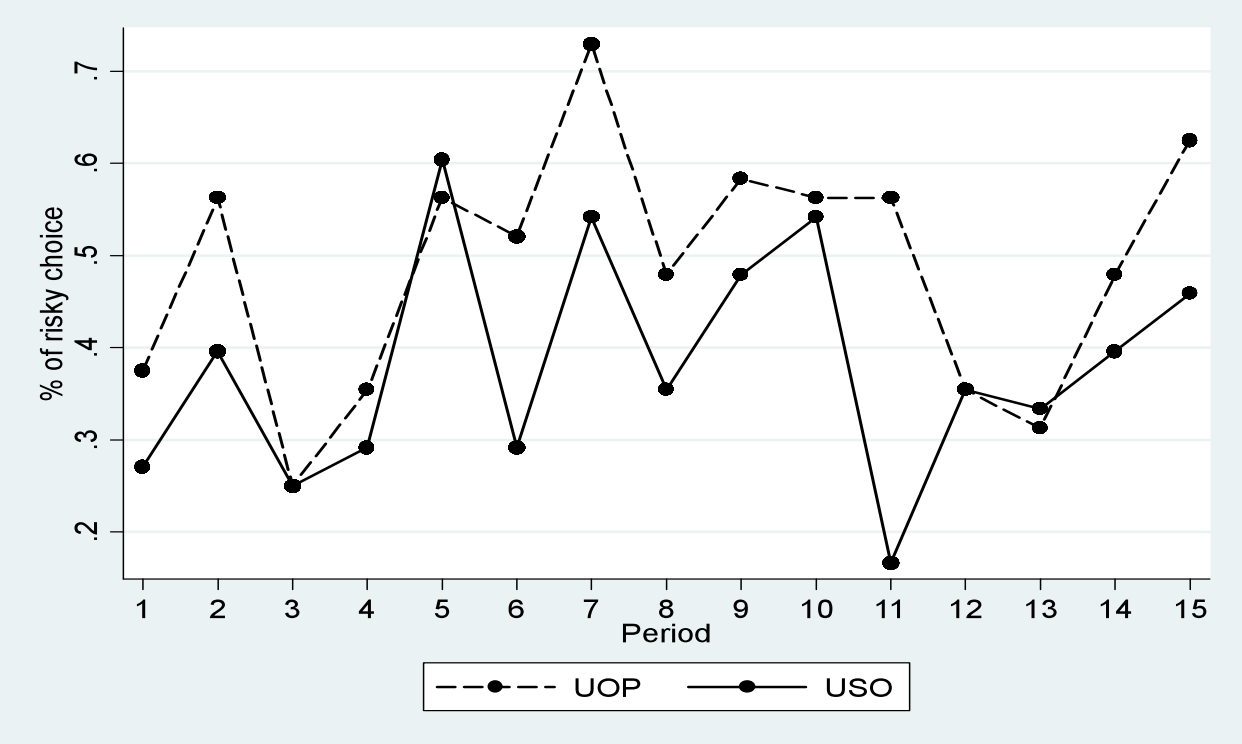
Figure 1: Average stock evolution in option treatment (UOP) versus stock ownership (AOP) treatment over the 15 periods.



Looking directly at investment decisions, subjects can be seen to take significantly less risk on average when they hold stock in the company they manage compared to when they are compensated through options. As can be seen in figure 2, subjects holding stock in the company they manage take less risk than subjects compensated through options for almost all choices. Even

from these first graphical results, we can thus already conclude that hypotheses 3 is supported by the data.

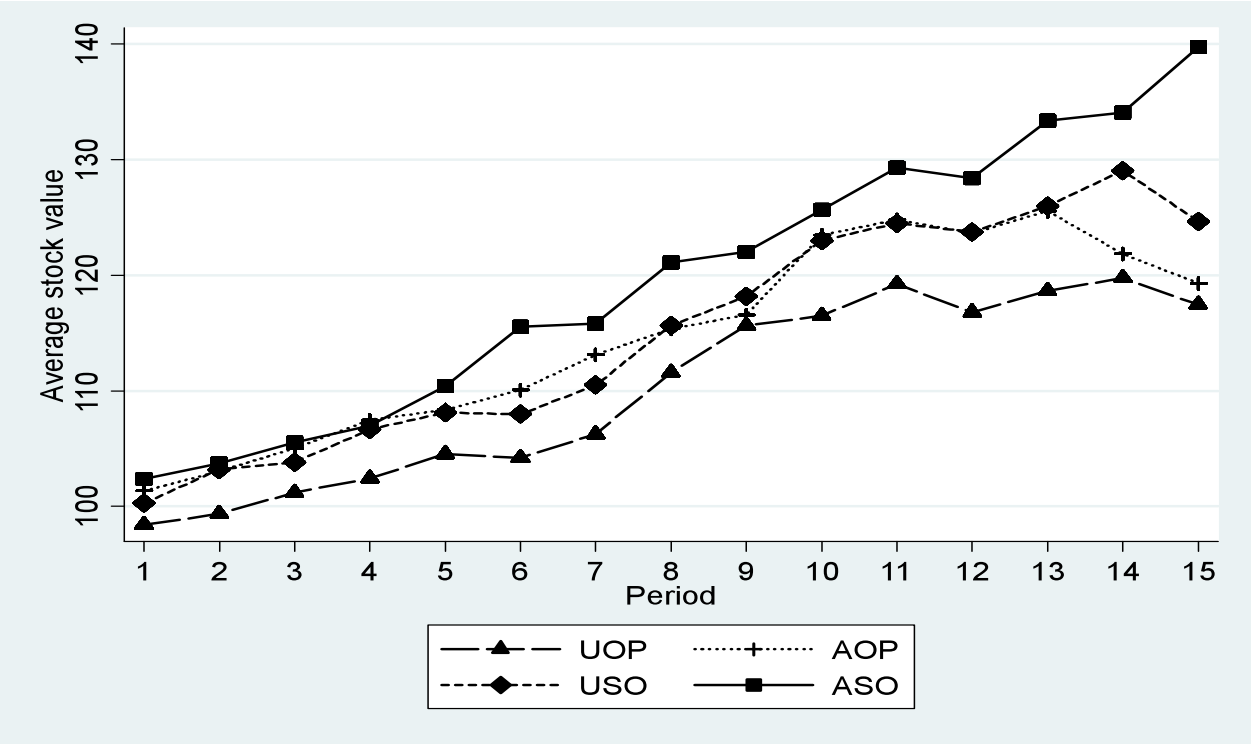
Figure 2. Average choice of HV investment in the option treatment (UOP) and the stock ownership treatment (USO)



3.5 Results: reducing risk taking through increased accountability

We now proceed to looking at the accountability manipulation. As can be seen from figure 3, accountability improves company performance under both the option compensation and the stock-ownership compensation mechanism. The best performing companies are those managed by CEOs who are held accountable and incentivized though stock-ownership plans. The worst performing companies are the ones managed by unaccountable CEOs incentivized through stock-options. This confirms our conjecture that the use of stock-option plans encourages risk taking that is excessive from the point of view of shareholders, who are paid their final share value. It also shows that accountability improves performance under both regimes, an effect that must derive from the lower risk-taking it induces.

Figure 3: Comparison of mean company performance across the four treatments



This intuition is supported by the data. Figure 4 shows average choices for the risky investment under the option condition when subjects are unaccountable and when they are accountable. It shows clearly how on average accountable subjects choose less risk throughout, thus clearly confirming our hypothesis 4. While the same general pattern of reduced risk taking by accountable subjects is also observed for subjects who are compensated through stock-ownership plans, the difference is less pronounced. While the effect is much less clear than for option compensation, accountability still reduces risk taking in the stock ownership condition. This will become more apparent from the statistical results presented in the next section, where additional elements of the decision making process such as differences in expected value of the two investment prospects can be controlled for.

Figure 4: Average choices of risky investment in the option condition by accountable (AOP) and unaccountable (UOP) subjects

3.5 Regression analysis of overall results: drivers of choice

The last two sections have descriptively shown the effectiveness of stock-ownership plans and of accountability in reducing sub-optimal risk taking behavior by executives. We now take a closer look at what is driving choice behavior in general, across all treatments. Table 2 shows the results from a random effects Probit model regressing the choice of the HV investment on dummy variables indicating the treatments and a number of other variables. All specifications include period dummies as well as demographic variables such as age, gender and whether the participant is studying economics or business administration.

In specification (1), we simply look at the effect of our main treatment variables—whether executives are compensated through options or stock, and whether they are held accountable or not. In addition, we include the difference in expected value between the two proposed investments. This variable allows us to check if subjects take expected payoffs into account when making their decision. In specification (2), we add several measures of two other potentially important drivers of choice—past choices and the general company performance. In order to investigate the possibility of path dependency or simply the effect of past events, we add the stock-value in the previous period as well as the growth rate of the stock value resulting from the last investment. We also add information on whether the participant chose a risky investment in the preceding period, if the investment in the previous period was successful, and a crossed variable indicating success of a risky investment.

The compensation through stock instead of options significantly reduces risk taking by executives—an effect that is very stable across all specifications. This confirms our main hypothesis 3. Accountability is also effective at reducing the uptake of excessive risks, thus supporting out hypothesis 4. And indeed accountability effects are stronger in the option treatment than in the stock treatment (χ^2=8.82, p=0.012, Chow test), supporting our hypothesis H4a.

Table 2: Drivers of choice (Random-effects Probit model)

Dep. Variable: choice of the risky investment	**(1)**	**(2)**
Stock-ownership	–0.243** (0.116)	–0.255** (0.131)
Accountability	-0.301** (0.121)	-0.335** (0.136)
Difference in expected value	-0.351*** (0.106)	-0.343*** (0.108)
Previous period stock value		-0.049 (0.146)
Growth rate		-0.011*** (0.003)
Choice of risky in previous period		-0.194** (0.093)
Success in the previous period		0.078 (0.083)
Success in the previous period if choice of risky		-0.390*** (0.135)
Gender (male=1)	0.024 (0.116)	0.010 (0.130)
Econ/business studies	-0.271** (0.134)	-0.312** (0.150)
Constant	0.183 (0.381)	0.767* (0.438)
Period effects	YES	YES
Nb observations	2340 (156 subjects)	2184 (156 subjects)
LL	-1375	-1278

Note: *** significant at the 1% level; ** at the 5% level and * at the 10% level. Standard errors in parentheses.

To test hypothesis 4b, we need to take a look at the payoffs earned by executives. As displayed in Table 3, on average subjects earn a payoff of €12 in the stock ownership condition and €10 in the option condition[3] (Z = 1.191, p=0.233; Mann-Whitney test). When looking at the stock ownership condition alone, we find that unaccountable subjects earn an average of €9 ($13) as compared to an average of €15 ($22) earned by accountable subjects (Z = -2.188, p=0.028, Mann-

[3] These amounts are the actual payoffs as a CEO. They do not contain the payoffs from being a shareholder in the other companies.

Whitney test). This goes to show that unaccountable executives take risks that are excessive not only from the perspective of their shareholders, but that the level of risk is suboptimal even for themselves. In the stock option condition on the other hand, accountable subjects earn only €5 ($7) on average, which compare to an average of €14 ($21) earned by unaccountable subjects in the same payment condition (Z= 1.863, p=0.063, Mann-Whitney test). As will be further shown below in the section on option selling behavior, this difference is indeed caused by differences in risk taking and not so much in the selling behavior of options. This finding thus indicates a conflict between the maximization of own profits and maximization of shareholder value in the option condition. Making executives accountable in the option compensation condition pushes them towards acting more in the interest of shareholders by taking fewer risks, even if they thus have to sacrifice some of their own profits (actually €9 on average, or 2/3 of their potential payoff!). Our hypothesis 4b is thus supported as well.

Table 3: Average payoffs

	Stock ownership	Stock option	Total
Unaccountable	9.2 (5.0)	14.3 (20.1)	11.9 (14.9)
Accountable	14.8 (16.2)	5.1 (13.2)	9.9 (15.5)
Total	12.0 (12.3)	9.8 (17.6)	

Note: standard deviation in parentheses; values refer to earnings as CEOs but they do not contain earnings from stock ownership in the other five companies in the group.

Getting back to our main regression results, the fact that differences in expected value (actually: expected stock-value changes) are highly significant throughout goes to show that subjects carefully examine the parameters of the investment choices when making a decision. It also seems worth mentioning that the effect of the difference in expected value appears much more important in the stock-ownership condition than in the option condition. Indeed, it is highly significant in the former ($p<0.01$), while only marginally so in the latter ($p<0.1$), and the coefficient is almost twice as large for stock-owners ($\chi^2=6.48$, p=0.039, Chow test). This makes indeed sense if one considers that the aim of maximizing own revenue is best achieved through expected value maximization if one is compensated through actual stock, while income in the option condition depends on stock-value change rather than expected value. It also provides an additional indication that when risk taking occurs in the stock-ownership condition it does so mostly for prospect pairs that are close in terms of expected value, and that it is thus relatively less harmful to shareholders than the more erratic risk-seeking embarked upon by executives compensated through options.

As to the general population variables, there is no main effect of gender or age. Interestingly however, field of study has a significant effect. Indeed, economics or business management

students take less risk than the other subjects. In order to understand this finding better, we need to look at the effect for different compensation schemes in isolation. Indeed, we find that economics and business students take significantly less risks than other subjects in the stock-ownership conditions ($p<0.01$). When compensated through stock options on the other hand, they take slightly more risks than other subjects (ns). This means that in a way they are better at maximizing their own payoff, which is linked to stock value in the stock-ownership conditions, but not in the stock-option conditions.

Apart from the main effects just discussed, several interesting insights can be gained from the data. Indeed, in a dynamic setting carrying over the effects from past events, investment choices are likely to be dependent on the path taken by the stock-value of the company managed. This shows in the data in several ways. First of all, subjects are much less likely to make a risky investment if they have invested into the risky asset in the previous period, and the investment has been successful. This goes to show how they try to capitalize upon a gain that has been obtained, and to gradually increase it with less risky investments. As shown by the slight negative effect on risk taking of the growth rate in company stock, especially a large increase in company value makes it less likely that the risky investment will be chosen again, while a large decrease will make risk taking more likely. Interestingly, the interaction effect between risky choice and success in the last period is completely driven by the stock-option condition—once a large gain has been realized there, subjects try to further increase their return on options held by investing in the low volatility prospect (more on this below). In the stock-ownership condition on the other hand what is significant is the simple choice of a risky investment in the previous period—once the riskier prospect has been chosen, subjects generally revert to the low volatility investment regardless of whether the risky investment chosen in the last period has been successful or not.

One issue we have not yet discussed is the one of risk attitudes. Indeed, from the results shown above it is already apparent that in the stock ownership treatment risk seeking—while much lower than in the stock option treatment—is present and all but negligible. Given the fact that the HV investment is always inferior to the LV investment by design, traditional theories assuming global risk aversion would be hard pressed to explain these results. The next section will thus provide a closer look at individual risk attitudes, and test the hypotheses set out in our model which have not yet been addressed.

3.6 Risk attitudes and reference point effects

Following Abdellaoui *et al.* (2008), we classified a subject as risk averse (seeking) within each domain, if she was risk averse (seeking) for at least 4 out of 6 prospects in said domain. If a subject

had exactly three risk averse and three risk seeking answers in one domain, then she was classified in the mixed category. As can be seen from table 4, most of our 156 experimental subjects cannot be classified as universally risk averse or risk seeking. The majority pattern is indeed one of risk aversion for gains (59%) and risk seeking for losses (55%), and the combination of the two is also the modal pattern at the individual level. The average loss aversion coefficient was 1.86, with 27% of subjects classified as gain seekers.

Table 4 : Classification of subjects in terms of risk attitude

		LOSSES			
		Risk averse	Risk seeking	Mixed	Total
GAINS	Risk averse	27	45	20	92
	Risk seeking	6	27	8	41
	Mixed	4	14	5	23
	Total	37	86	33	156

We have already seen above that our main hypotheses—hypothesis 3 and 4—are fully supported by the data. We next take a closer look at hypotheses 1 and 2. As far as hypothesis 1 is concerned, we have already seen that in general subjects take a relatively low level of risk when compesnated through stock. It remains however to be explained why they would take any risks at all. In order to test the sub-hypotheses of 1, we look at some possible reference points, loss aversion, and at overweighting of small probabilities and the underweighting of large probabilities. Table 5 shows the results of a random effects probit regression. The regressions are similar to the ones presented in Table 2 except for several covariates that are likely to be highly correlated with the new explaining variables, and which have thus been dropped.

We first look at reference points. Since there is no unequivocal theoretical prediction about the reference points in the stock ownership condition, we tried out several plausible values. A natural reference point is the status-quo, or initial value of the shares. Additional reference points may be the best performance observed in the past; or some aspiration level that could e.g. be given by the final expected value. The latter reference point was not found to be significant and was dropped from the regression. Both the initial value of the shares and the highest stock value reached in the past however have a marginally significant effect. As predicted, when the stock price falls below those reference points, risk seeking increases, thus confirming hypothesis H1c.

In addition to reference point effects, we examined the influence of individual parameters that may be expected to influence choice behavior according to our decision model. In particular, we introduced a measure of the overweighting of small probabilities, given by the ratio of the certainty equivalent to the expected value of a prospect at a probability of 10%; a measure of

underweighting of large probabilities, given by one minus the ratio of the certainty equivalent to the expected value of a prospect at a probability of 70%; and a dummy indicating gain seekers—subjects with lambda<1. As predicted by our model, the overweighting of small probabilities is a very important predictor of choices of the HV investment—indeed its coefficient is equivalent to the one of the difference in expected value, and it is significant throughout. This confirms our hypothesis H1b. Underweighting large probabilities is also marginally significant, with likelihood of choosing the HV investment increasing in creasing with the extent to which probabilities are underweighted, as predicted by our model. There is on the other hand no effect of gain seeking, so that our hypothesis H1a is not supported.

Tableau 51: Risk attitudes in the stock-ownership condition (random-effect probit model)

Dep. Variable: choice of the risky investment	**(1)**	**(2)**
Accountability	-0.123 (0.159)	-0.084 (0.143)
Difference in expected value	-0.431*** (0.151)	-0.446*** (0.151)
Stock value	0.177 (0.192)	0.159 (0.188)
Stock below the initial value	0.211* (0.122)	0.197* (0.122)
Stock below the past best performance	0.284* (0.168)	0.285* (0.167)
Gain seeking		-0.083 (0.150)
Overweighting of small probabilities (CE/EV|p=0.1)		0.348*** (0.118)
Underweighting of large probabilities (1–CE/EV|p=0.7)		0.181* (0.199)
Nb observations	1092 (78 subjects)	1092 (78 subjects)
LL	-629.553	-624.438

Note: All specifications include period effects and control for gender, age and field of study.*** significant at the 1% level; ** at the 5% level and * at the 10% level. Standard errors in parentheses.

We next take a closer look at hypothesis 2. The basic level or risk taking when all options are at-the-money is relatively high at 36%, which is similar to the level of risk taking observed when executives hold a mixed bundles containing both options that are in- and out-of-the-money (34%).

The regression reproduced in table 6 also clearly shows that risk taking decreases in the total value of options held, thus confirming our hypothesis H2a. To test our hypotheses H2b and H2c, we need to disentangle the options held by the CEO. Regression (3) thus introduces three dummies indicating that all options held (except the bundle just emitted, which is always at-the-money by definition) are in-, at-, or out-of-the-money, with the effect being measured against the forth possible case in which the CEO holds a mix of options with some in- and some out-of-the-money. It can clearly be seen that holding only options that are in-the-money significantly reduces risk taking, which is now at 26%. When on the other hand all options held are out-of-the-money, risk taking increases dramatically to 70%. This confirms hypotheses H2c and H2b respectively. Finally, overweighting of small probabilities increases risk taking all else being equal—a confirmation of hypothesis H2d. In order to test hypothesis H2e we will need to look at the selling decisions of options, which is done in the next section.

Table 6: Risk attitudes in the stock-options condition (random-effect probit model)

Dep. Variable: choice of the risky investment	**(1)**	**(2)**	**(3)**
Accountability	-0.486*** (0.164)	-0.447*** (0.156)	-0.433*** (0.157)
Difference in expected value	-0.286* (0.149)	-0.287* (0.149)	-0.281* (0.151)

Stock value	0.218 (0.208)	0.203 (0.207)	0.226 (0.222)
Total value of options held	-0.246*** (0.057)	-0.247*** (0.056)	-0.052 (0.059)
All options in-the-money			-0.323** (0.136)
All options out-the-money			0.804*** (0.124)
All options at-the-money			-0.321 (0.202)
Overweighting of small probabilities (CE/EV|p=0.1)		0.299*** (0.128)	0.241** (0.129)
Underweighting of large probabilities (1–CE/EV|p=0.7)		0.193 (0.226)	
Nb observations	1092 (78 subjects)	1092 (78 subjects)	1092 (78 subjects)
LL	-635.148	-631.406	-594.670

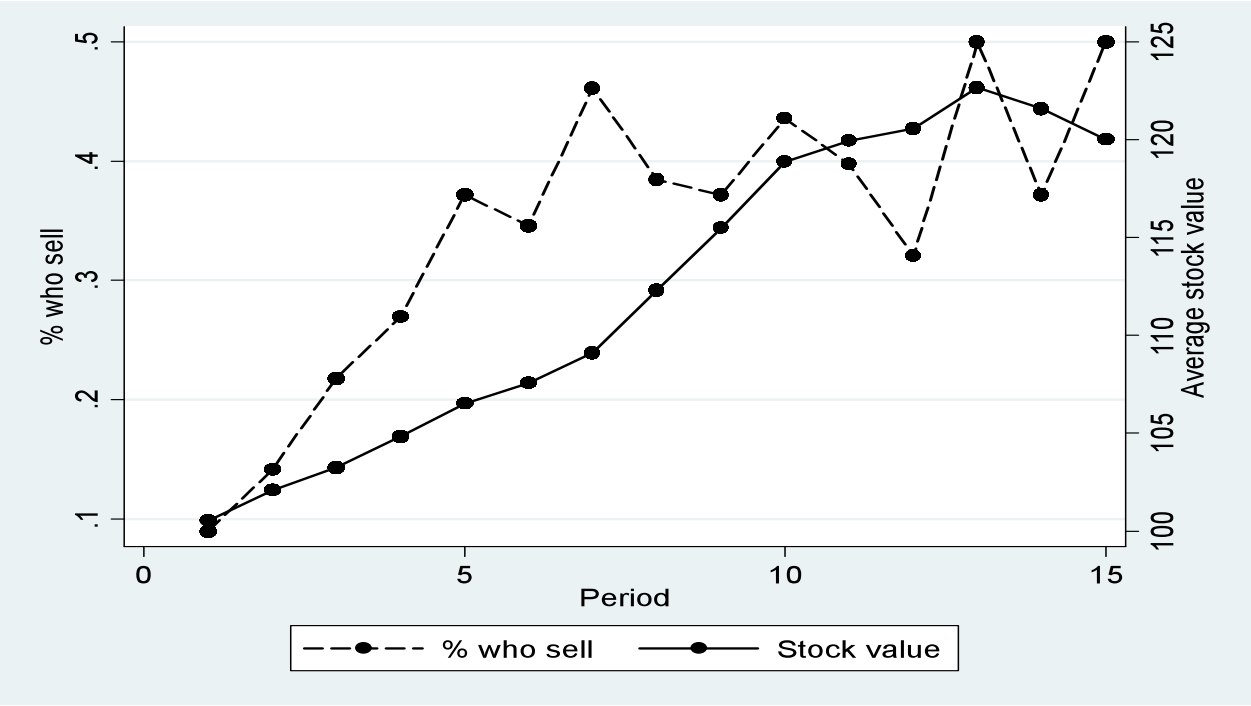
Note: All specifications inculde period effects and control for gender, age and field of study.*** significant at the 1% level; ** at the 5% level and * at the 10% level. Standard errors in parentheses.

3.7 Selling decisions for Stock Options

We next take a look at executives' option selling behavior. While some studies on behavioral patterns in option selling behavior do exist (Core & Guay, 2001; Heath *et al.*, 1999; Huddard & Lang, 1996), no experimental studies on the issue have been conducted to the best of our knowledge. Retracing previously found patterns in our data may thus serve the double purpose of confirming the generality of behavioral patterns found, and of validating the behavior of our subjects if such patterns are indeed reproduced.

On average, subjects wait three periods before exercising their options and the average number of options sold at once is 15.3. Out of the 1170 option bundles emitted, 305 are never exercised. The average gain on the sale of a bundle of 5 options is 0.57 cents (0.90¢) which correspond to a gain of 11.4 cents (16¢) per option. If we look at treatment differences, accountability does not affect the waiting time for selling the options nor the number of options sold. The average gain is however 0.69 cents ($1) for unaccountable subjects, and only 0.36 cents (55¢) for accountable subjects. This is explained by the lower levels of risk taking under accountability discussed above . Figure 5 plots selling decisions of at least some stock-options against the average stock value.

Figure 5. Option selling decisions and stock-price evolution



From the descriptive analysis presented so far it appears clear that options are often exercised long before their termination date. From a normative point of view, people should not exercise options before they expire because the market value of a "live" option exceeds the proceeds from exercise (Heath *et al.*, 1999). However, studies have shown that this premature exercise may be rational. The main reason for selling stock options are liquidity considerations, which do obviously not apply in our experimental setting. In addition however, stock-options do also provide subjects with a sure amount of cash in the current period and an uncertain amount of cash in the future. In this sense, subjects may sell their options too early if they are loss averse, thus exhibiting a sort of myopic loss aversion (Benartzi & Thaler, 1995; Fellner & Sutter, 2009; Thaler *et al.*, 1997).

Huddart & Lang (1996) showed that recent movements in the stock value are also important in explaining exercising decisions. This provides an indication that exercise decisions are sensitive to risk aversion. Heath *et al.* (1999) examined whether psychological factors influence exercise decision. They showed that exercise decisions depend on whether the current price is above or below a psychological reference point. Individuals were found to be more likely to exercise their options when the stock value exceeds a reference point fixed at the maximum value of the stock-price over the last year. They also present evidence that decisions to exercise options depend on recent stock-price movements. In particular, they are found to depend positively on past short-term

returns, while longer term returns seem to play no significant role. Core & Guay (2001) confirmed the psychological findings documented by Heath *et al.* (1999) in a broad sample.

Table 7 presents a Probit analysis regressing option selling decisions on a number of potential explanatory variables. We take as dependent variable the selling decision (1 if sold, 0 if kept) for each bundle of five options. Option bundles are thus followed from their emission period through the selling period, and may be included in the regression between one and 15 times, depending on when they are emitted and when they are sold. This results in a total of 5159 observations.

First of all, we find a highly significant effect of loss aversion. Loss averse individuals are much more likely to sell their stock in any given period, thus foregoing potential future gains due to their fear of losing already available gains. This confirms our hypothesis H2e. Accountability produces a marginally significant negative effect, indicating that accountable subjects are less likely to sell their options in any given period compared to unaccountable subjects. However, a closer look suggests that the effect captured by accountability may be due to different selling strategies pursued by accountable subjects relative to unaccountable subjects. Indeed, if one includes an additional variable measuring total risk-taking throughout the 15 investment periods, accountability is no longer significant (although the risk-taking measure is not significant either). This indicates a different investment strategy pursued by accountable subjects relative to unaccountable subjects, which in turn changes selling behavior, rather than a direct effect of accountability.

Reassuringly, the potential gain that can be realized by selling a package of options influences decision. This goes to show that the overall majority of subjects understood the payoff mechanism quite well. In order to test for economic rationality in the decision to exercise, we also include the expected value of any option packages held. This variable is calculated by taking future choices of subjects for given, and taking the expected value of the stock-price evolution conditional on those choices. We find a significant negative effect of this measure of potential future gains on selling decisions. This indicates that the higher the value of any options held is likely to get in the future, the more likely subjects are to hold on to them instead of selling them immediately. This fact is again conductive to the conclusion that subjects clearly understood the remuneration mechanism. Quite naturally, holding a larger amount of options makes selling them more likely. Furthermore, the number of options already sold also makes it more likely that options will be sold in any given period. The latter finding could be due to several factors, including a general positive trend in stock-price, a different investment strategy, or the perpetuation of an initial selling strategy (e.g. 'sell as soon as a positive gain can be realized').

Table 7: **Decisions to exercise options**

Dep. Var: exercising option	**(1)**	**(2)**	**(3)**
Accountability			-0.108*
			(0.059)
Loss aversion		0.055***	0.051***
		(0.018)	(0.018)
Potential gain from selling	0.170***	0.148***	0.147***
	(0.033)	(0.034)	(0.034)
Expected future value increase	-0.223***	-0.156***	-0.156***
	(0.034)	(0.034)	(0.034)
Nb options held	0.062***	0.062***	0.062***
	(0.004)	(0.004)	(0.004)
Nb options sold	0113***	0.114***	0.116***
	(0.005)	(0.005)	(0.005)
Cumulated gains	-0.034***	-0.044***	-0.048***
	(0.011)	(0.011)	(0.011)
Reference point (highest share price reached)	0.346***	0.368***	0.368***
	(0.069)	(0.069)	(0.070)
Stock value (t-1)	-0.671***	-0.442*	-0.389*
	(0.220)	(0.232)	(0.233)
Nb observations	5159	5159	5159
LL	-1409	-1404	-1403

Note: The dependent variable is the decision to exercise options or not. *** significant at the 1% level; ** at the 5% level and * at the 10% level. Standard errors in parentheses. All specifications include period effects and control for gender, age and field of study.

We also find an income effect for selling (exercising) decisions. Indeed, a higher accumulated income makes it less likely that options are sold in any given period, indicating a higher acceptance of the risk deriving from keeping the options longer-term. We also find a highly significant effect of a reference point as suggested by previous studies. Representing such a reference point by a dummy variable indicating whether the current stock-price is higher or lower than in any preceding period, we find that a stock-price above the reference point makes an exercising decision much more likely.

5. Discussion

We hypothesized that compensating executives through stock-options may induce risk taking that is excessive from shareholders' point of view. Investigating the issue experimentally, we do indeed find excessive risk taking by executives compensated through stock-options. This results in companies managed by executives compensated through stock-options faring significantly worse than companies managed by executives who are compensated with actual company stock and forced to hold such stock long-term. A further way to reduce risk taking is making executives more accountable in front of their shareholders, by introducing the possibility for shareholders to ask executives to justify their decisions. Such an accountability requirement is indeed effective for both types of incentive mechanisms, such that the best performance is obtained by companies managed by executives who are compensated through stock and held accountable. The worst performance on the other hand obtains when executives are unaccountable and compensated through stock-options.

What is more is that the different incentive structure under stock-ownership plans does not only reduce excessive risk seeking per se. As indicated by the increased effect of the expected value difference between the two investment options under stock-ownership, stock-ownership also canalizes what risk seeking remains to high volatility investments that are relatively closer to the low volatility prospect in terms of expected value. This indeed explains why company performance is improved so clearly under stock-ownership incentives, even though a certain amount of risk taking survives in the stock-ownership condition.

The last point deserves some further attention. Indeed, it directly contradicts classical arguments in favor of stock-options that represent them as a remedy to potentially excessive risk aversion on the side of CEOs. We clearly show that compensation through stock options can induce risk-seeking that is *excessive* from the point of view of shareholders, a decisional pattern that cannot be explained recurring to traditional accounts based on global risk aversion. Replacing such an account with a richer array of risk attitudes based on descriptive findings about behavior under risk and uncertainty allows us to derive a rich set of predictions that are generally born out by the data. Indeed, it is shown that even executives compensated by means of a linear stock ownership contract do take risks—and that this holds true even when the riskier investments are strictly dominated. In addition, the richer set of risk attitudes assumed allows us to predict levels of risk seeking based on the asset position of an executive. From this evidence we thus conclude that it is high time to abandon the simplifying assumption of global risk aversion in principal-agent theory in favor of a more insightful, if more complex, approach.

Finally, while the traditional literature has focused primarily on the foregone gains from risk-averse

behavior, the recent financial crisis points in the direction that excessive risk-seeking behavior may imply much larger costs. In this sense, we belief that accepting some risk aversion may be preferable over inducing potentially excessive risk seeking.

The nature of the compensation scheme is not the only difference between our option and stock-ownership treatments. Indeed, one characteristic of the stock-ownership plan that seems rather fundamental is the long-term nature of the stock compensation, which is contrasted to a short-term structure of option compensation. In reality, stock-ownership often provides short-term incentives as well, and may in such a case reinforce the perverse effects of stock-options already held by executives (Bebchuk *et al.* , 2009). It is thus conceivable that increasing vesting periods of options may be effective at reducing risk taking as well. Indeed, there is some evidence in our data that by decreasing risk taking, accountability also changes option selling strategies by making executives hold on to them longer-term—an indication that the inverse relationship of lower risk taking when options have to be held longer-term may also hold. Notwithstanding this evidence, long-term stock ownership plans seem the best way to encourage lower risk taking. Indeed, while options lose their incentive value after significant declines in stock prices because they are too far out-of-the-money, stocks preserve their full incentive value at any stock price. Executives also bear actual losses, especially if some of the regular compensation is provided through stock as seems to be the case in the US because of tax issues.

There remains however the question of the best temporal structure of incentives and selling restrictions on stocks. Bebchuk *et al.* (2009) show that the fact that stock could only be sold after five years at Lehman Brothers did not obviate the advantage of short-time stock-price fluctuations over long-term value creation after the first five years in office, since in every year thereafter new stocks become sellable and are indeed offloaded by executives. One potential solution may be to force executives to hold their stock until they retire from the company as in our experiment. This solution has however been criticized for creating potential incentives for early retirement—a fact that was not an issue in the experiment, since the duration of the game was fixed at 15 periods. An alternative may be to permit the sale of only a small fraction of stock every year. Obviously, differences in the exact implementation may all have specific advantages and disadvantages. An investigation of this issue is certainly important, but lies beyond the scope of the present paper.

Our experiment has also shown that introducing the possibility of holding executives accountable in front of a shareholder reunion may be a potentially powerful disciplining mechanism. Such monitoring mechanisms have been largely neglected in the empirical literature, and are thus still poorly understood. Fehr & Schmidt (2007) offer experimental subjects the

possibility to invest in costly verification to be added to a bonus reward system. Although experimental agents do exert higher effort when such a verification mechanism is added, a pure bonus mechanisms still provides higher payoffs to principals given the cost of verification. Bartling, Fehr, & Schmidt (2009) also experimentally contrasted a monitoring contract with one based on trust—although the monitoring was based on close supervision of employee effort provision. The case may however be quite different in cases where the agency problem is generated not so much by the unobservability of the agent's effort level, but rather by the issue of encouraging some type of 'optimal behavior' which is difficult to closely prescribe ex ante.

Indeed, when the effort-outcome linkage is affected by considerable amounts of uncertainty, closer inspection of the decision making *process* may well be superior (or at least complementary) to the linking of payoffs to *outcomes* implied by pure incentive contracts (Tetlock & Vieider, 2010). Our experimental CEOs were on average willing to sacrifice a payoff of €9—or two thirds of their pay—in order not to acquire a reputation of selfishness amongst their peers. When millions of euros are at stake, a CEO may be more reluctant to sacrifice such an amount for saving her face. It thus seems important that real implications be connected to a shareholder vote. In our experiment, we wanted however to show that a simple justification need in front of a shareholder reunion may be enough to shame a CEO into acting in the shareholder's interest. Indeed, in the present context the interests of the shareholders must appear to be rather clear—although they may well be in contrast with the private preferences of the executive. Taking actions that are clearly more conductive to the achievement of her own objectives than the fulfillment of shareholders' interests may become a lot more costly for an executive if her reputation or even job may thus be threatened.

We have implemented a random mechanism by which one and only one executive in each group of six is extracted to justify her choices. One of the reasons behind this design choice was to avoid issue of symmetry or tacit collusion in cases where all executives anticipated the need to justify their choices to each other. Since all group members knew that only one of them would be called to justify her choices in front of the others, justifications based on tacit collusion (I maximized my own payoff in the understanding that everyone else would do the same) were excluded. The dramatic effect of accountability on payoffs in the option treatment goes to show that this implementation mechanism was indeed successful.

In reality, shareholder reunions are likely to be called based on outcomes rather than at random. This may result in an outcome bias, inasmuch as excessive risk taking is likely not to be sanctioned as long as performance is good. This suspicion is also confirmed by our impression from the justification and voting sessions following the experiment, in which experimental executives where questioned about the motives by their choices only when risk-taking had been unsuccessful . This leaves any accountability system vulnerable to the vagaries of the economic cycle, with

behavior by executives less likely to be detected in the upward part of the cycle. This shows again the necessity of the combination of an accountability system with more appropriate incentives, so that even in the absence of an immediate threat of justification—and its potential consequences—an executive has an interest to perform in the best interests of shareholders.

A potential criticism to our experimental design is that due to the symmetry in the setup it may have been optimal in the option treatment for every CEO to maximize her own payoffs to the detriment of her shareholders, inasmuch as everybody could earn higher payoffs by doing so (a sort of efficiency argument at the group level). While this is true to a certain extent, inasmuch as the loss in payoff as CEO was less than compensated by the increase in the payoffs from the shareholder function for unaccountable CEOs compensated through stock options, assuming that our experimental subjects reasoned this way appears quite a stretch. Indeed, it would have been hard to them to predict how much earning they would need to give up by a change of strategies ex ante. Furthermore, the experimental task was clearly presented as one in which each experimental subject mainly acted as the CEO of a company who may have to justify their choices to others, while the shareholder role was clearly secondary. Given this emphasis, we deem it unlikely that our subjects saw the game as a symmetric one. Finally, we have discussed how experimental CEOs did not see fit to offer such an explanation when held accountable—a strong indication against this line of reasoning.

At this point, we also need to address potential subject pool effects. We have already seen in the results section how economic and business students seem to take more rational decisions than others. This may well derive from their better understanding of the issues at hand. It is however often alleged that using students as experimental subjects may reduce the external validity of any results obtained. The fact that the overwhelming proportion of our subjects are economic and business students—and that future CEOs can be expected to be drawn from that pool to a large extent—seems to reduce such concerns. Furthermore, alleged subject pool effects need not always go in the expected direction. For instance, Haigh & List (2005) found that myopic loss aversion is actually *accentuated* by using professional traders instead of students in an experiment—the opposite of what the authors had expected. One could thus argue that having more experience with the kind of decisions subjects are called upon to take in our experiment may if anything accentuate their tendency to increase their own profits, even if this works to the detriment of shareholders.

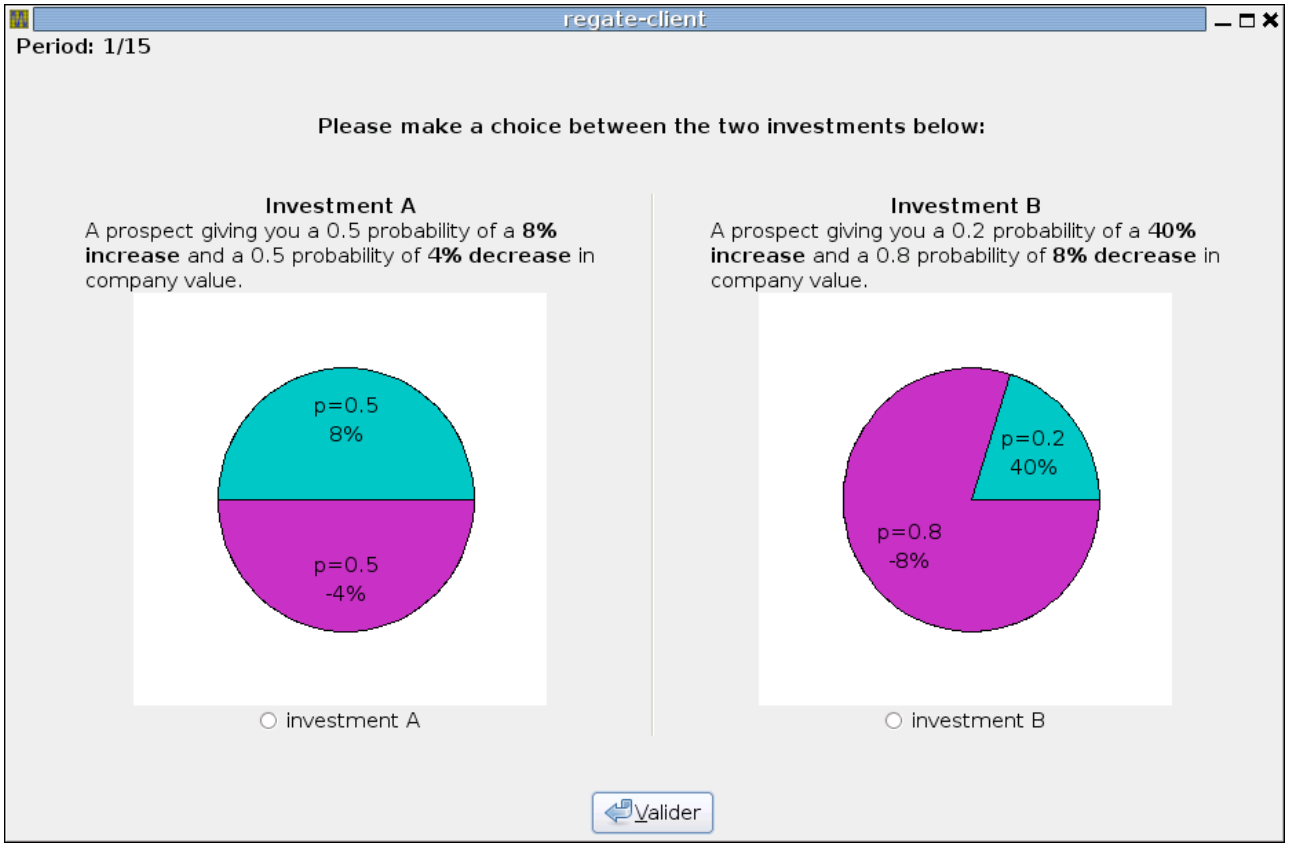
6. Conclusion

The recent crisis has drawn attention to the incentive effects of current equity compensation practices. To test for such effects, we conducted a laboratory experiment to clearly identify causal relationships. We found that executives do indeed take risks that are excessive from shareholders'

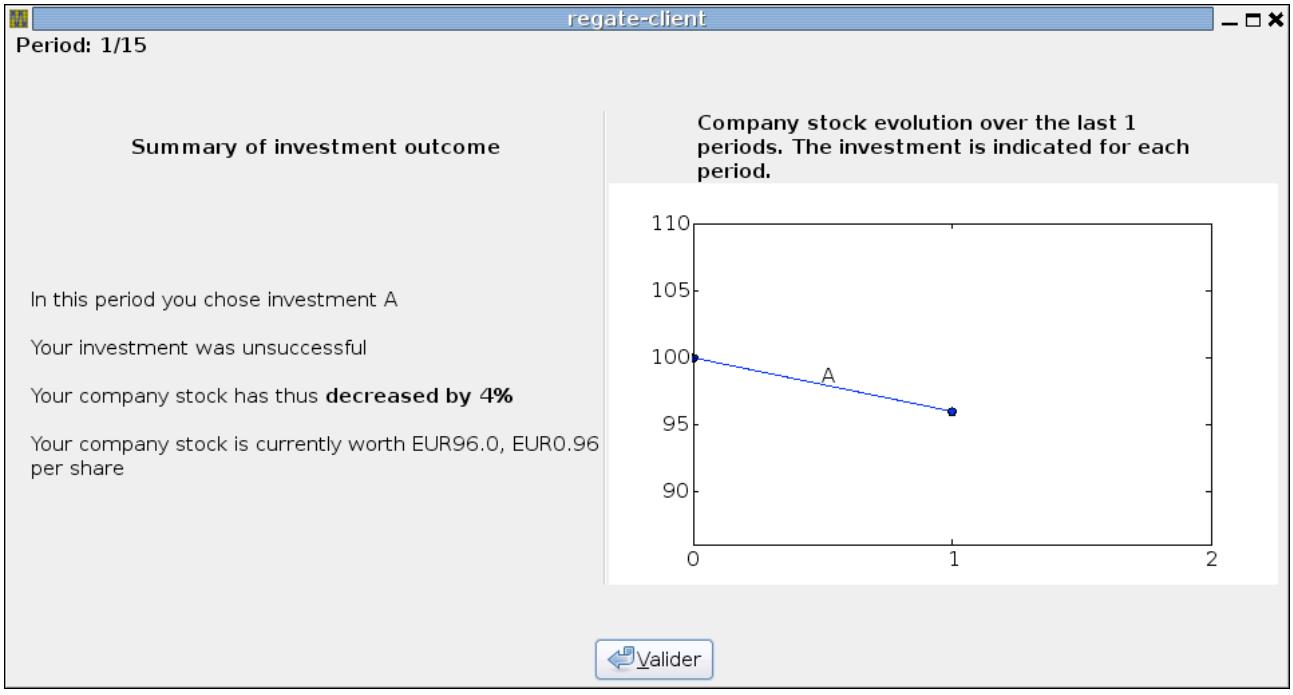
point of view when compensated through stock-options with short vesting periods. Compensating executives through long-term stock-ownership plans instead of stock-options is shown to reduce such excessive risk taking, though it does not completely eliminated it. This is explained through a model that abandons the classical agency theory assumption of global risk aversion in favor of a richer, behaviorally founded, model of risk attitudes. Furthermore, making executives accountable for their actions in front of their shareholders is also effective at reducing excessive risk taking. This leads to the conclusion that the most effective instrument for reducing risk appetite in executives may be a combination of long-term stock-ownership compensation and an institutional or regulatory framework increasing the accountability requirements on the side of executives. Reducing risk appetite even at the potential cost of suboptimal caution under a linear stock-ownership compensation scheme does indeed appear to be less costly than the potentially devastating consequences of excessive risk taking.

Appendix A: Decision Screens, Main Experiment

i) Investment screen



ii) feedback screen



iii) option selling decision (option compensation only)

Appendix B: Instructions main experiment (option payment, unaccountable)

In this part of the experiment you will be asked to take repeated decisions over 15 rounds. You have **two roles** in this part, one as CEO of a company, and one as stockholder in 5 other companies managed by five other people in your group. Groups are randomly formed at the beginning of part 2 and stay the same for all 15 rounds. Just as you are a shareholder in the 5 companies managed by the other 5 people in your group, the other 5 people in your group are shareholders in your company and part of their payoff thus depends on your company's performance.

Please notice that your decisions are **completely anonymous**, and that neither the experimenter nor any of the shareholders in your company (the other 5 people in your group) can trace any decisions or outcomes back to you. As a matter of fact, neither you nor the other people taking part in the experiment will know who of the others in the experiment was in their group of 6.

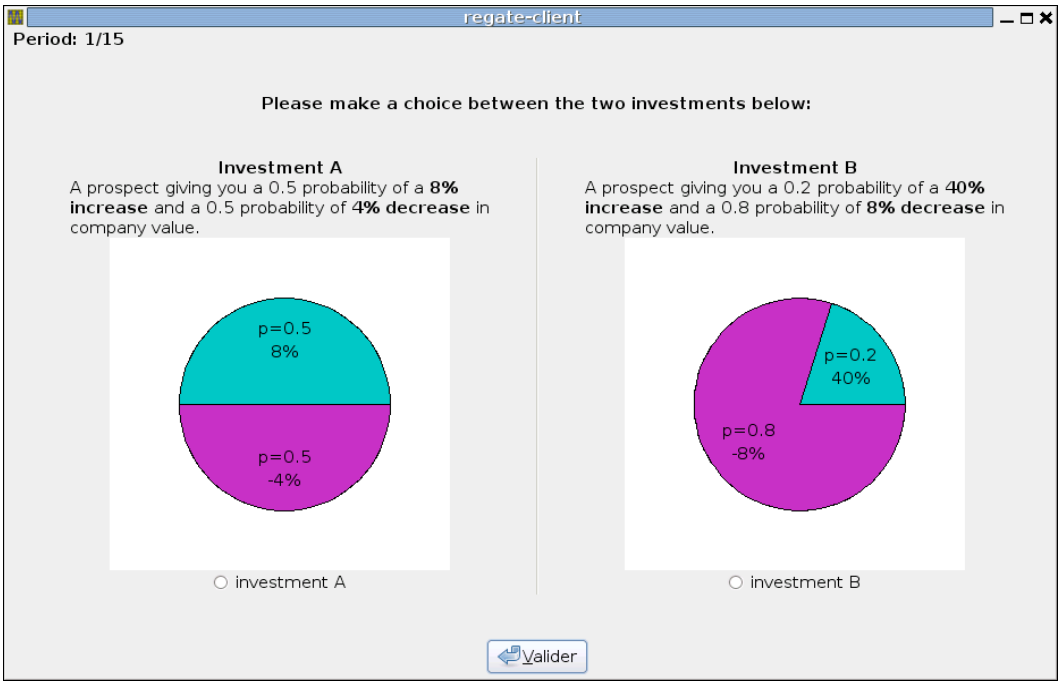
In your function as CEO, you are managing a company. Your company has an initial value of 100 euros, corresponding to 100 shares of the value of 1 euro each. Your main decision will be to choose in each period **which of two investment projects you want to invest the assets of your company in**: investment A or investment B. You will have to make a choice between these two options, and you have to invest the total value of your company in every period. Each investment will be described for each period, and is characterized by its outcomes and its probabilities. Outcomes are given in percentage changes of company value, which can be either positive, negative or zero.

Example:

A typical choice is shown in the screen below. In the example shown, you are called upon to decide between two investments for your company assets:

- *investment A*, which gives you a 50% chance that the company assets will *increase* by 8% and a 50% chance that they will *decrease* by 4%
- *investment B*, which gives you a 20% chance that the company assets will *increase* by 40%, and an 80% chance that the value of your company assets will *decrease* by 8%

Imagine that you are facing the first investment decision (period 1), and that the company you manage is thus worth 100 euros. Imagine now you choose investment A and your investment is successful. Your company is now worth 108 euros, which corresponds to a value of 1.08 euros per share. This will be your starting value for period 2. There are 15 periods of investment in total.



Payoffs:

Contrary to part 1, **all your decisions will now count** towards your final payoff. Your payoffs are determined as follows. Before each investment period, you will obtain **5 stock options** that give you the right to buy company stock in any future period for the exercise price indicated on the option. Options will be emitted at company value and will become vested (that is, cashable) in the subsequent period. You can then decide separately for options obtained in different periods whether you want to: 1) cash the options, thus obtaining the difference between the current stock price and the emission value of the option (times 5 since you have five options); or 2) keep the options and preserve the right to exercise them in a later period.

Example (continued):

Following the example given above, this means that before your first investment decision you have obtained 5 stock options with an exercise price of 1 euro each (the company value divided by 100). Imagine again that you chose option A and that your investment was successful, so that your share value increased to 1.08 euros per share. You will now be asked whether you want to sell your options (*actually*: buy company stock and resell the stock, but the decision is only one and incorporates the two steps) or whether you want to keep the options.

If you decide to sell your options, in the example above you now gain 0.08 euros (8cents) on each of them for a total of 40 cents (the current stock value minus the exercise price for the five shares you can buy). If you decide to keep them, you obtain no money but preserve the right to sell them at a later point. Whatever your decision, at this point 5 new options will be emitted at an emission value of 1.08 euros each and you will start round 2. Once again, you will choose an investment, become feedback on whether the investment was successful or not, and you will again be asked whether you want to exercise your stock options. In case you have not yet sold your period 1 options, you will now be asked separately whether you want to sell your period 1 options and whether you want to sell your period 2 options.

Your Role as Shareholder:

In addition to your role as CEO, you are also a **shareholder in the 5 companies** managed by the other 5 people in your group (just as those other 5 people are shareholders in your company). This is a passive role, inasmuch as it does not require you to take any decisions. However, the shares you hold in the other companies will contribute towards your final payoffs as follows. In each of the 5 companies, you initially hold one share worth 1 euro. At the end of the 15 rounds, you will be paid out the total value of the shares you own in the different companies. For instance, if the final value of company 4 is 103 euros and the final value of company 6 is 187 euros, you will obtain 1.03 euros from your share in company 4, and 1.87 euros from the share you own in company 6 (plus whatever your shares in the other 3 companies are worth).

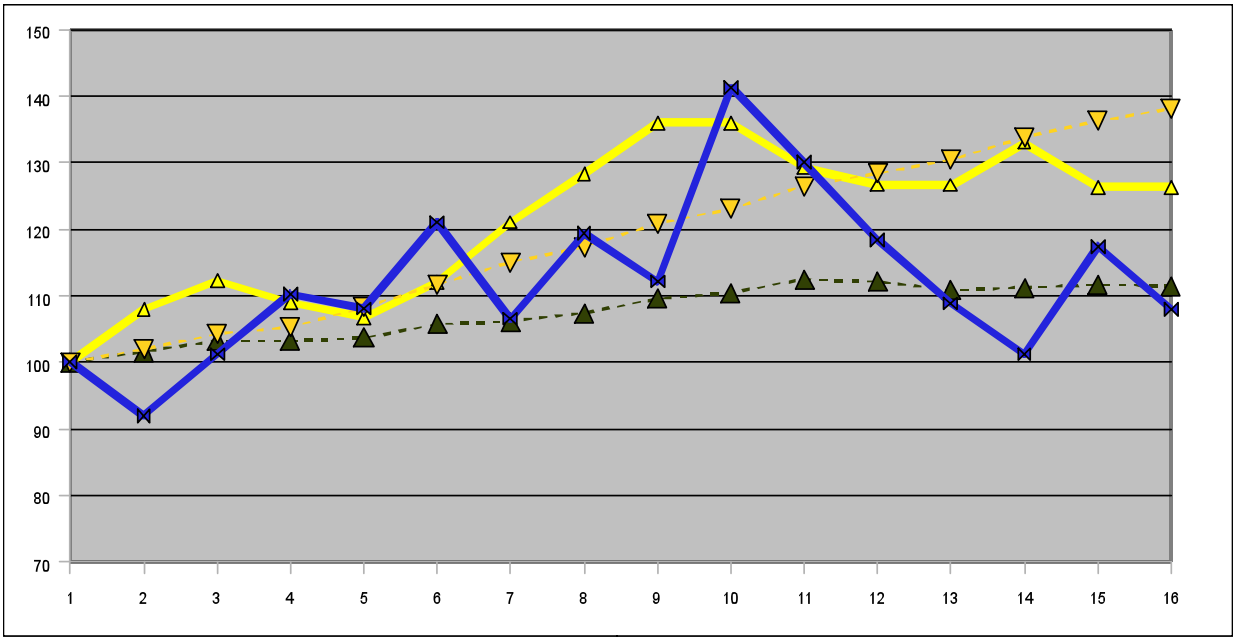
Typical Properties of Investments:

Finally we include a graphical display of the **typical properties of investments A and B**, derived from a simulation of investments with very similar characteristics. Please notice that the changes displayed in the graphs below are not the ones that will obtain in the experiment, but that they represent only random realizations from the same type of investment that have obtained in the past. However, the general trends that are indicated reflect the two types of investment that you will face. This means that the graphical display should not be seen as a substitute for careful considerations of probabilities and outcomes, but only as **an indication of the general average characteristics of the different investment types**.

Graph 1 below displays the evolution of typical investments A and B in 15 periods in the past (thick solid lines, with the light line representing investment A and the dark line representing investment

B). Graph 1 also shows the long-term average returns of the two investment types (thin dashed lines, with the light line representing investment A and the dark line representing investment B). Those average returns are what results from observing investment types A and B over thousands of trials and averaging the outcomes.

Graph 2 shows the same data in a different way. While graph 1 shows the evolution of company stock as you will also see it during the experiment, graph 2 shows absolute percentage changes on the previous period (not taking base values into account). The data are the same as in graph 1, but they are displayed in a different way to show changes period per period.



Graph 1: Solid lines indicate the evolution of investments A and B over 15 periods in the past; the dashed lines indicate long-time trends of the two investment types; light grey lines indicate investment type A, dark grey lines investment type B.

Appendix C: Investment Pairs

	HV prospect		**LV prospect**	
	Prob. (loss, gain)	% change	Prob.(loss, gain)	% change
Pair 1	(0.8, 0.2)	(-8, 40)	(0.5, 0.5)	(-4, 8)
Pair 2	(0.6, 0.4)	(-4, 10)	(0.3, 0.7)	(-2, 4)
Pair 3	(0.6, 0.4)	(-6 ,9)	(0.6, 0.4)	(-1, 7)
Pair 4	(0.9, 0.1)	(-2, 22)	(0.2, 0.8)	(-2, 4)
Pair 5	(0.5, 0.5)	(-8, 12)	(0.3, 0.7)	(-4, 5)
Pair 6	(0.6, 0.4)	(-12 ,19)	(0.5, 0.5)	(-2, 8)
Pair 7	(0.4, 0.6)	(-15 ,12)	(0.5, 0.5)	(-2, 6)
Pair 8	(0.8, 0.2)	(-6, 34)	(0.2, 0.8)	(-6, 6)
Pair 9	(0.7, 0.3)	(-10 ,26)	(0.7, 0.3)	(-0, 6)
Pair 10	(0.5, 0.5)	(-8, 13)	(0.4, 0.6)	(-5, 8)
Pair 11	(0.7, 0.3)	(-9, 20)	(0.5, 0.5)	(-2, 5)
Pair 12	(0.9, 0.1)	(-8, 60)	(0.6, 0.4)	(-0, 4)
Pair 13	(0.8, 0.2)	(-7, 30)	(0.3, 0.7)	(-3, 5)
Pair 14	(0.6, 0.4)	(-10, 16)	(0.6, 0.4)	(-5, 12)
Pair 15	(0.9, 0.1)	(-8, 70)	(0.8, 0.2)	(0, 7)

Appendix D: Instructions Risk Elicitation

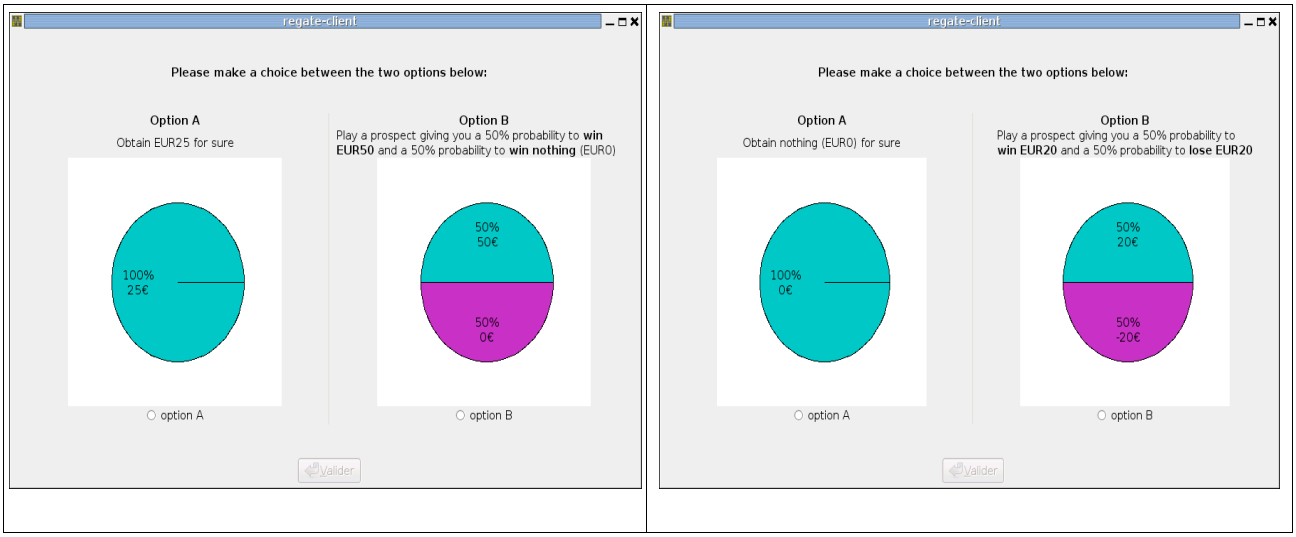
Part 1 of the experiment consists in choices between lotteries. All the choices you make are **completely confidential** and cannot be traced back to you personally. Please consider each decision problem carefully before you indicate your decision, as your final payoff will depend on your choices in addition to chance.

In the choice pairs involved in part 1, you will be called upon to make repeated choices between a sure amount of money and a lottery with two outcomes. As to the outcomes of the lottery, there are three basic types of lotteries: 1) lotteries giving you a certain probability to win an amount of money, and a complementary probability of winning nothing (*pure gain lottery*); 2) lotteries giving you a certain probability to lose an amount of money, and a complementary probability of losing nothing (*pure loss lottery*); and 3) lotteries giving you a probability of winning a certain amount of money and a complementary probability of losing a certain amount of money (*mixed lottery*). All the information necessary for you to take a decision will be displayed on the computer screen.

Given this setup of the lotteries, and given that the parameters of a decision change for each decision problem that is presented to you, it is crucial that you **pay close attention to both outcomes and probabilities**. Also, pay attention to the sign of the outcome as it may be positive or negative! While you can incur losses in this part of the experiment, the payoffs are calibrated in such a way that it is extremely unlikely for you to lose money over the course of the whole experiment.

For pure gain or pure loss lotteries, you will be asked to choose repeatedly between any given lottery and different certain amounts. According to your choices, the certain amount will be adjusted upwards or downwards for the subsequent decision. You will then be asked again to choose between the new certain amount and the lottery. After five choices, you will pass on to the next lottery.

For mixed lotteries, a procedure analogous to the one described above is used. The only difference is that for these lotteries what changes in subsequent iterations is not the sure amount of money (which now stays always at 0), but rather the amount to be lost in the lottery. Below you find an example of a choice for a pure gain lottery and for a mixed lottery.



We next describe how your payoffs for this part of the experiment will be determined. Only some of the choices you make will be randomly drawn and played for real money. While the exact procedure is described in detail below, the most important thing for you to know is that **you will perform best if you make each decision as if it were the only one to be played for real**. In other words, there does not exist any way in which you can outsmart the system by choosing according to some predetermined strategy.

Three choices will be extracted for real play from the lotteries presented to you in part 1—one choice involving a pure gain lottery, one choice involving a mixed lottery, and one choice involving a pure loss lottery. All choices within the given domain have the same probability of being extracted.

Whatever choices are extracted will then be played out at the end of the experiment. If in the choice that is extracted you have chosen the sure amount, that amount will be added to (or subtracted from for loss lotteries) your total payoff. If you have chosen the lottery, a random draw will determine whether you have won or lost, and the corresponding amount will be added or subtracted from your total payoffs.

The payoff will only be determined once the whole experiment is finished. When you are done with the questions in part 1, please wait for the other people in the experiment to finish as well. As soon

as everybody has completed the first part, we will proceed to distributing the instructions for part 2.

References

Abdellaoui, Mohammed (2000). Parameter-Free Elicitation of Utility and Probability Weighting Functions. *Management Science 46(1)*, 1497-1512.

Abdellaoui, Mohammed, Aurélien Baillon, Laetitia Placido, & Peter P. Wakker (2010). The Rich Domain of Uncertainty: Source Functions and Their Experimental Implementation. *American Economic Review, forthcoming*.

Abdellaoui, Mohammed, Han Bleichrodt, & Olivier L'Haridon (2008). A Tractable Method to Measure Utility and Loss Aversion under Prospect Theory. *Journal of Risk and Uncertainty 36*, 245-266.

Abdellaoui, Mohammed, Han Bleichrodt, & Corina Paraschiv (2007). Loss Aversion under Prospect Theory: A Parameter-Free Measurement. *Management Science 53(10)*, 1659-1674.

Agrawal, Anup, & Gershon N. Mandelker (1987). Managerial Incentives and Corporate Investment and Financiang Decisions. *Journal of Finance 42(4)*, 823-837.

Barberis, Nicholas, Ming Huang, & Tano Santos (2001). Prospect Theory and Asset Prices. *Quarterly Journal of Economics (116(1)*, 1-53.

Bartling, B., Ernst Fehr, & Klaus Schmidt (2009). Screening, Competition, and Job Design: Economic Origins of Good Jobs. Working Paper

Bebchuk, Lucian A., Alma Cohen, & Holger Spamann (2009). The Wages of Failure: Executive Compensation at Bear Stearns and Lehman 2000–2008. Discussion Paper No. 657, Harvard Law School.

Bebchuk, Lucian Arye, & Jesse M. Fried (2003). Executive Compensation as an Agency Problem. *Journal of Economic Perspectives 17(3)*, 71-92.

Bebchuk, Lucian Arye, Jesse M. Fried, & David I. Walker (2002). Managerial Power and Rent Extraction in the Design of Executive Compensation. *University of Chicago Law Review 69(3)***,** 751-846.

Benartzi, Shlomo, and Richard H. Thaler (1995). Myopic Loss Aversion and the Equity Premium Puzzle. *Quarterly Journal of Economics 110(1)*, 75-92.

Benz, Matthias, Marcel Kucher, & Alois Stutzer (2001). Stock Options: The Managers' Blessing: Institutional Restrictions and Executive Compensation. Working Paper No. 61, University of Zurich Institute for Empirical Research in Economics.

Bertrand, Marianne, & Sendhil Mullainathan (2001). Are CEOs Rewarded for Luck? The Ones without Principals Are. *Quarterly Journal of Economics 116(3)*, 901-932.

Biais, Bruno, Denis Hilton, Karine Mazurier, & Sébastien Pouget (2005). Judgmental

Overconfidence, Self-Monitoring, and Trading Performance in an Experimental Financial Market. *Review of Economic Studies 72*, 287-312.

Bleichrodt, Han, José Luis Pinto, & Peter P. Wakker (2001). Making Descriptive Use of Prospect Theory to Improve the Prescriptive Use of Expected Utility. *Management Science 47(11)*, 1498-1514.

Bolton Gary E., & Axel Ockenfels (2009). Risk Taking and Social Comparison. A comment. *American Economic Review*, forthcoming.

Camerer, Colin F. (2000). Prospect Theory in the Wild: Evidence from the Field. In *Choices, Values, and Frames*. Daniel Kahneman and Amos Tversky eds., Cambridge University Press.

Carpenter, Jennifer N. (2000). Does option compensation increase managerial risk appetite? *Journal of Finance* 55, 2311–2331.

Charness, Gary, & Matthew O. Jackson (2009). The Role of Responsibility in Strategic Risk Taking. *Journal of Economic Behavior and Organization 69*, 241–247.

Core, John E., & Wayne R. Guay (2001). Stock Option Plans for non-Executive employees. *Journal of Financial Economics 61*, 253-287.

Core, John E., Wayne R. Guay, & David F. Larcker (2003). Executive Equity Compensation and Incentives: A Survey. *Economic Policy Review*, 27-50

Core, John E., & David F. Larcker (2002). Performance Consequences of Mandatory Increases in Executive Stock Ownership. *Journal of Financial Economics 64*, 317-340.

Cyert, Richard, Sok-Hyon Kang, & Praveen Kumar (2002). Corporate Governance, Takeovers, and Top-Management Compensation: Theory and Evidence. *Management Science 48(4)*, 453-469.

DeFusco, Richard A., Robert R. Johnson, & Tomas S. Zorn (1990). The Effect of Executive Stock Option Plans on Stockholders and Bondholders. *Journal of Finance 45(2)*, 617-627.

DeFusco, Richard A., Tomas S. Zorn, & Robert R. Johnson (1991). The Association Between Executive Stock Option Plan Changes and Managerial Decision Making. *Financial Management 20(1)*, 36-43.

Diecidue, Enrico, & Jeroen van de Ven (2008). Aspiration Level, Probability of Success and Failure, and Expected Utility. *International Economic Review 49(2)*, 683–700.

Fellner, Gerlinde, & Matthias Sutter (2009). Causes, Consequences, and Cures of Myopic Loss Aversion – An Experimental Investigation. *The Economic Journal 119(537)*, 900-916.

Feltham, Gerald A., & Martin G.H. Wu (2001). Incentive Efficiency of Stock versus Options. *Review of Accounting Studies 6*, 7-28.

Guay, Wayne R. (1999). The Sensitivity of CEO Wealth to Equity Risk: An Analysis of the

Magnitude and Determinants. *Journal of Financial Economics 53*, 43–71.

Haigh, Michael S., & John A. List (2005). Do Professional Traders Exhibit Myopic Loss Aversion? Experimental Analysis. *Journal of Finance 60(1)*.

Hall, Brian J., & Jeffrey B. Liebman (1998). Are CEOs really paid like beaurocrats? *Quarterly Journal of Economics 113(3)*, 653–691.

Hall, Brian J., & Kevin J. Murphy (2003). The Trouble with Stock Options. *Journal of Economic Perspectives 17(3)*, 49-70.

Heath, Chip, Steven Huddart, & Mark Lang (1999). Psychological Factors and Stock Option exercise. *Quarterly Journal of Economics 114(2)*, 601–627.

Holden, Richard T. (2005). The Original Management Incentive Schemes. *Journal of Economic Perspectives 19(4)*, 135-144.

Huddart Steven, & Mark Lang (1996). Employees Stock Option Exercises: An Empirical Analysis. *Journal of Accounting and Economics 21*, 5-43.

Jensen, Michael C., & 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., & Kevin J. Murphy (1990). CEO Incentives: It's Not How Much You Pay, But How. *Harvard Business Review 3*, 138-153.

Johnson, Marilyn F., Susan L. Porter, & Margaret B. Shackell-Dowell (1997). Stakeholder Pressure and the Structure of Executive Compensation. Mimeo. Available at SSRN: http://ssrn.com/abstract=41780 or doi:10.2139/ssrn.41780

Kahneman, Daniel, & Amos Tversky (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica 47(2)*, 263-291.

Karlan, Dean S. (2005). Using Experimental Economics to Measure Social Capital and Predict Financial Decisions. *American Economic Review 95(5)*, 1688-1699.

Köbberling, Veronika, & Peter P. Wakker (2005). An Index of Loss Aversion. *Journal of Economic Theory 122*, 119-131.

Lerner, Jennifer S., & Philip E. Tetlock (1999). Accounting for the Effects of Accountability. *Psychological Bulletin 125*, 255-275.

Murphy, Kevin J. (1999). Executive Compensation. In Handbook of Labor Economics, vol. 3, O. Ashenfelter & D. Card eds.

Murphy, Kevin J. (2002). Explaining Executive Compensation: Managerial Power versus the Perceived Cost of Stock Options. *The University of Chicago Law Review 69(3)*, 847-869.

Ouchi, William G., & Mary Ann Maguire (1975). Organizational Control: Two Functions. *Administrative Science Quarterly 20(4)*, 559–569.

Ross, Stephen A. (2004). Compensation, Incentives, and the Duality of Risk Aversion and Riskiness. *Journal of Finance* 64, 207–225.

Sappington, David E. M. (1991). Incentives in Principal-Agent Relationships. *Journal of Economic Perspectives 5(2)*, 45-66.

Schleifer, Andrei, & Rober W. Vishny (1986). Large Shareholders and Corporate Control. *Journal of Political Economy 94(3)*, 461-488.

Schmidt, Ulrich, & Horst Zank (2005). What is Loss Aversion? *Journal of Risk and Uncertainty 30(2)*, 157-167.

Smith C.W., & René M. Stulz (1985). The Determinants of Firms' Hedging Policies. *The Journal of Financial and Quantitative Analysis 20(4)*, 391-405.

Tetlock, Philip E., Linda Skitka, & Richard Boettger (1989). Social and Cognitive Strategies for Coping with Accountability: Conformity, Complexity, and Bolstering. *Journal of Personality and Social Psychology 57(4)*, 632-640.

Tetlock Philip E, & Ferdinand M. Vieider (2010). Ideology, Agency and Accountability: Explaining Shifting Managerial Preferences for Alternative Accountability Regimes. University of California at Berkeley working paper.

Thaler, Richard H., & Eric J. Johnson (1990). Gambling with House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice. *Management Science 36*, 643–660.

Thaler, Richard H., Amos Tversky, Daniel Kahneman, &Alan Schwartz (1997). The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test. *Quarterly Journal of Economics 112(2)*, 647-661.

Tufano, Peter (1996). Who Manages Risk? An Empirical Examination of Risk Management Practices in the Gold Mining Industry. *Journal of Finance 51(4)*, 1097-1137.

Tversky, Amos, & Peter P. Wakker (1995). Risk Attitudes and Decision Weights. *Econometrica 63(6)*, 1255-1280.

Vieider, Ferdinand M. (2009). Separating Real Incentives and Accountability. Working Paper, Erasmus University Rotterdam.

Wakker, Peter P. (2010). Prospect Theory for Risk and Uncertainty. Cambridge University Press, Cambridge.

Wiseman, Robert M., & Luis R. Gomez-Mejia (1998). A Behavioral Agency Model of Managerial Risk Taking. *Academy of Management Review 23(1)*, 133–153.

Wu, George, & Richard Gonzalez (1996). Curvature of the Probability Weighting Function. *Management Science 42(12)*, 1676-1690.

Zeiliger, R. (2000). A Presentation of Regate, Internet Based Software for Experimental Economics, http://www.gate.cnrs.fr/~zeiliger/regate/RegateIntro.ppt, GATE. Lyon: GATE.