

# Reining in Excessive Risk Taking by Executives: Experimental Evidence<sup>#</sup>

*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*

Ludwig-Maximilians-Universität, Geschwister-Scholl-Platz 1, Munich, Germany  
Email: fvieider@gmail.com

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## **Abstract**

Performance-contingent compensation by means of stock options may induce risk taking in agents that is excessive from the point of view of the company or the shareholders. We test whether increasing shareholder control may be an effective checking mechanism to rein in such excessive risk taking. We thus tell one group of experimental CEOs that they may have to justify their decision making processes in front of their shareholders. This indeed reduces risk taking and increases the performance of the companies they manage. Implications are discussed.

**Keywords:** executive compensation; stock-options; incentives; accountability; risk taking

**JEL Classification:** D03, G28, G32, J33, L22

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\* Corresponding author. Tel: +3243663042. Fax: +3243669318

## 1. Motivation

The traditional financial agency literature has long tried to address the question of how to induce optimal levels of risk taking in executives. Traditionally, the focus has often been on how to increase the risk appetite of naturally risk averse agents (Agrawal and Mandelker, 1987; Feltham and Wu, 2001). Following the recent financial crisis, however, the focus has shifted to how to limit risk taking on the side of executives and financial managers when such risk taking is excessive from the point of view of shareholders or the company (Bebchuk et al. , 2010).

The microeconomic agency literature has generally emphasized an approach that is based on judging performance by the outcome achieved, which is institutionalized by tying pay to performance. A large body of evidence from the psychological literature, however, points out how holding people accountable purely for the outcomes they achieve—or rewarding them purely based on the outcomes they produce—may be suboptimal in cases where outcomes depend to a large extent on chance as well as skill (Baron and Hershey, 1988; Mauboussin, 2010; Tetlock and Vieider, 2011). There is also some evidence in the economic literature that executives are often rewarded for luck rather than skill (Bertrand and Mullainathan, 2001). A better system in such cases may be to hold executives accountable for their decision making process (Lerner and Tetlock, 1999)—something that has received hardly any attention in the microeconomic literature. Such systems have however been discussed in the management and organizational literature, where they are known under the name of “behavioral monitoring” (Ouchi and Maguire, 1975). Such monitoring can have positive effects inasmuch as “it relieves managers of achieving outcomes they can only partially influence, and instead focuses evaluation on means, which are assumed to be objectively and accurately assessed” (Wiseman and Gomez-Majia, 1998).

We conduct an experiment to test the effectiveness of process accountability as a means to rein in excessive risk taking by executives. Experimental executives' pay is thereby linked to performance through stock options to reflect currently widely diffused performance-contingent pay practices. Experimental executives are given a choice between two investment options to invest total company assets in every period—a high volatility investment and a low volatility investment. By design, the high volatility investment is always inferior in terms of expected value in order to test whether *excessive* risk taking will occur, and to what extent it may be reduced by introducing an additional process accountability requirement. Our results indicate that introducing an institutionalized accountability mechanism, consisting in the requirement for executives to potentially justify their decisions in front of a shareholder reunion, is indeed effective in reducing excessive risk taking, thus improving company performance.

The paper proceeds as follows. Section 2 discusses the nature of the principal-agent problem and the relevant accountability literature. Section 3 describes the experiment, with 3.1 providing an

overview of the experimental design and 3.2 presenting the results. Section 4 discusses the results and section 5 concludes this paper.

## **2. Increasing Accountability of Executives towards Shareholders**

One of the reasons why executives may take actions that are not fully in the interest of the shareholders is that the original principal-agent relationship has been substituted with a weaker surrogate relation. The so-called managerial power approach shows how there may be an issue in the fundamental structure of the principal-agent relationship postulated by traditional agency theory. 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 and Fried, 2003; Bebchuk et al. 2002). This suggests that increasing the institutional power of the original principal—the shareholder reunion—in the principal-agent relationship *vis-à-vis* the executive may improve the control exerted on the executive's actions. Empirically, the presence of large shareholders has been found to be associated with lower executive pay and better performance (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 and Mullainathan, 2001).

Purely outcome-based monitoring systems and rewards may be especially tricky when performance-contingent pay assumes non-linear forms such as compensation through stock options. Indeed, under such compensation schemes risks affect executives and shareholders differently. While executives are rewarded for increases in stock prices and sheltered from losses (Feltham and Wu, 2001), shareholders are exposed to the whole spectrum of stock-price movements. This has been justified traditionally with the idea that linear compensation of executives—which would thus equalize their incentive structure with the one of shareholders themselves—may induce excessive risk aversion. This argument however relies on the assumptions of executives being risk averse expected utility maximizers—an assumption that has been shown to be far from innocent and that is generally not supported (Fiegenbaum, 1990; Wiseman and Gomez-Majia, 1998; Lefebvre and Vieider, 2011).

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 (Charness and 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. Indeed, given the asymmetry in payoff mechanisms between executives and shareholders, it may be optimal for executives to take high levels of risk

even when such risk-taking involves choosing investment opportunities with relatively low expected value. For shareholders, on the other hand, such risk taking will always be suboptimal in our experiment, so that a conflict between private motives and responsibility for shareholders is likely to emerge.

This in turn makes our accountability manipulation somewhat special. Indeed, most accountability manipulations in social psychology regard individual decisions. In the present setting however there may be an additional element of moral hazard, with executives deciding in their own interest when their actions are not observable. The experiment is thus related to a strand of literature mainly in economics, in which decisions that affect the decision maker as well as others are made visible to the group—e.g. donations in a dictator game (Hoffman et al., 1996) or contributions in a public goods game (De Cremer et al., 2001; Rege and Telle, 2004). However, the latter studies generally manipulate a kind of implicit accountability, without the need or the opportunity for the decision maker to explain the reasons behind her choices—a manipulation that has generally been found to be particularly strong and to lead to better decision making processes (Lerner and Tetlock, 1999).

Given the discussion above, we hypothesize 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 also means that executives will sacrifice some of their profits when accountable so as to increase shareholder value and to make their decisions more easy to justify.

### **3. The Experiment**

#### **3.1 Experimental Design**

*Subjects.* 78 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 58% of subjects were female. 78% were studying economics or business management, and 25% mathematics or engineering.

*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<sup>1</sup>. 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 from 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 by 100) 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 (*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.* 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 a 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

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<sup>1</sup> 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.

means buying stock and reselling it immediately, thus realizing the difference between current stock value and the exercise price of the option. This process closely mimics 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.

*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. The randomized extraction was implemented inasmuch as it simulates a probability with which the executive's actions become known, and hence mimics the hidden action problem at the base of the principal-agent relationship. 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 the decision making process. 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.

*Risk Attitudes.* We used the method of Abdellaoui et al. (2008) to elicit detailed risk attitudes. We 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 (M. Abdellaoui et al., 2007; Schmidt and 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. 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 as risk neutral.

### 3.2 Results: reducing risk taking through increased accountability

Figure 1: Average choices of risky investment by accountable and unaccountable subjects

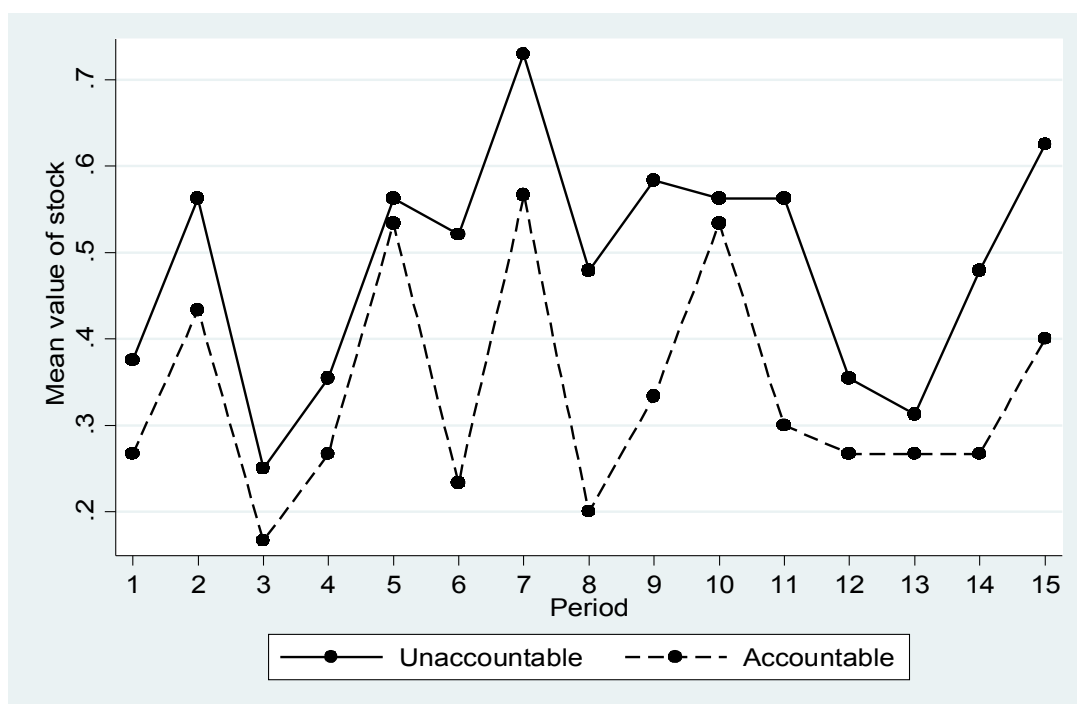


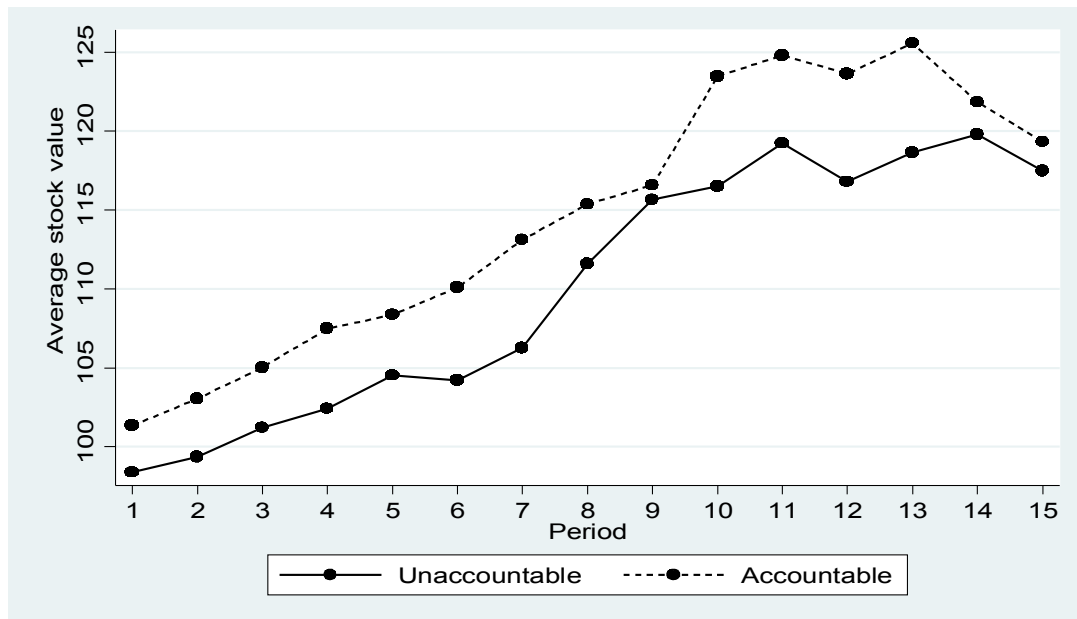
Figure 1 shows the percentage of risky choices by unaccountable and accountable subjects. It can be seen clearly that accountable subjects take less risks than unaccountable subjects in all periods. Since any risk-taking is sub-optimal by design, these choices should also be reflected in the performance of companies managed by accountable and unaccountable CEOs. Figure 2 shows company performance over the 15 periods of the experiment. And indeed, companies managed by accountable subjects can clearly be seen to outperform companies managed by unaccountable subjects. This effect is undermined somewhat by some endpoint effects showing up in the last two periods, which cannot entirely be explained by the choices shown in figure 1. Especially the large decline in period 14 seems thereby due mostly to bad luck by accountable subjects.

Table 1 shows the results of a random effects Probit model regressing the choice of the riskier HV investment on a dummy variable indicating the treatment and a number of other variables. All specifications include period dummies as well as demographic variables such as age, gender<sup>2</sup> and whether the participant is studying economics or business administration. The effect of

<sup>2</sup> In some accountability studies gender effects have been found, whereby men react more strongly to accountability manipulations than women, especially in front of a male audience (Brandts & Garofalo, 2011). We do not find any main or interaction effect of the gender variables, and do thus not report the coefficients in our regression analysis to keep the exposition tractable.

accountability is clearly to significantly reduce risk taking. Risk aversion is thought to play an important role in the decision making of CEOs. Indeed, risk aversion by CEOs has been used as an argument for using stock-option compensation over stock-ownership plans to link CEO pay to company performance (for a detailed analysis of risk attitudes induced by different compensation mechanisms, see Lefebvre and Vieider, 2011). Adding a general index of risk aversion for gains, we indeed find a negative and strongly significant effect as we would expect.

**Figure 2:** Comparison of mean company performance managed by accountable and unaccountable subjects



While the difference in expected value between the two investment options does not reach significance, a success in the last period from a HV investment makes it less likely that another HV investment will be chosen again. A similar effect is also captured by the variation in stock price from the last period. Indeed, a positive variation in stock price reduces risk taking, indicating a strategy whereby subjects reduce risk taking following a successful investment in order to capitalize on any realized gains. Interestingly, this strategy seems to be used more by accountable subjects, which after an increase in the stock price reduce the likelihood of investing into a HV investment more strongly. Another interesting effect is found for accumulated gains: without accountability, we find the typical income effect, with risk taking increasing in accumulated gains. With accountability however we do not find such an effect. This indicates a contentment strategy, where difficult-to-justify risks are taken by accountable subjects only when they deem this strictly necessary, but subjects resort to lower risk strategies once a certain level of income has been achieved.



**Table 1:** Drivers of choice of the HV investment

<b>Dep. Var: choice of HV investment</b>	<b>I</b>	<b>II</b>	<b>III</b>
Accountability	-0.562*** (0.197)	-0.539*** (0.190)	-0.377* (0.200)
Difference in EV	-0.249 (0.152)	-0.250 (0.152)	-0.272* (0.152)
Choice of HV in last period	-0.098 (0.131)	-0.099 (0.131)	-0.110 (0.133)
Success in the last period	0.132 (0.123)	0.127 (0.123)	0.121 (0.124)
Choice of HV * success in the last period	-0.576*** (0.196)	-0.578*** (0.196)	-0.560*** (0.197)
Risk aversion		-0.410** (0.179)	-0.412** (0.179)
Accumulated gains	0.027** (0.012)	0.026** (0.012)	0.032** (0.013)
Stock price variation at t - 1	-0.014*** (0.004)	-0.014*** (0.004)	-0.009** (0.004)
Accumulated gains*accountability			-0.052** (0.025)
Stock variation*accountability			-0.029*** (0.009)
Constant	-0.647 (0.704)	-0.395 (0.689)	-0.394 (0.687)
Observations	1092	1092	1092
LL	-629	-627	-620

The data just discussed seem to indicate that accountable subjects do not only generally take less risks than unaccountable subjects, but that they also follow a different investment strategy overall, whereby they try to capitalize on any gains in share price realized by switching to low risk strategies. However, any account of such behavior must by necessity be incomplete if one fails to consider the decisions by CEOs on when to cash their options, i.e., the decisions on how to maximize their own income. Indeed, if there is a capitalization strategy, we would expect accountable CEOs to hold on to their options longer—not least because it may take longer to accumulate a good revenue margin, while the risk of losing parts of one's potential income will be lower. At the same time, we would also expect loss averse agents to sell their options too early.

Such an account is at least partially confirmed by the selling behavior shown in figure 3. Accountable subjects seem to hold their options somewhat longer on average (see also regression below). What seems to be even more evident, however, is that accountable subjects manage to sell *more* of their options on average (statistically significant at  $p=0.001$ , two-sided Mann-Whitney test). While they sell more options, however, those options are generally sold at a lower profit margin (0.51 cents per bundle of options which compares to 0.74 cents for unaccountable subjects). Overall, this leads to lower earnings: accountable subjects earned only €11 (\$16) on average, which compare to an average of €19 (\$28) earned by unaccountable subjects (significantly different at  $p<0.05$ , two-sided Mann-Whitney test). This confirms our hypothesis that executives will sacrifice

some of their own payoffs to please shareholders when they are accountable. This finding thus indicates a conflict between the maximization of own profits and maximization of shareholder value.

**Figure 3:** % of options sold per period

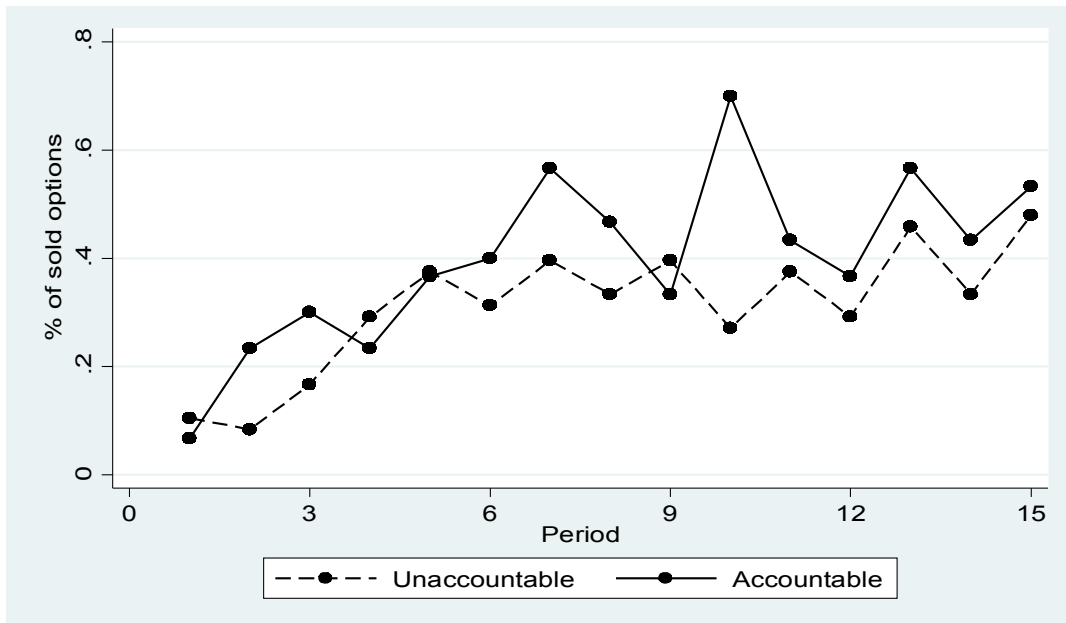


Table 2 reports a random effects Probit model regressing the selling decision on a number of explanatory variables. We take as dependent variable the selling decision (1 if sold, 0 if kept) for each bundle of five options. Option bundles are thus followed from their emission period through the selling 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. A negative effect thus indicates a decision not to sell in a given period—or in other words, to hold on to one's options longer.

The regressions show that loss aversion plays a strong role for selling decisions, with loss averse CEOs selling their options earlier on. 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'). As already for investment choices, we find an income effect also 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. This effect is even reinforced under accountability, which goes to show that subjects do indeed try to capitalize on any gains obtained, but do so mostly when they have already accumulated some income.

**Table 2: Option-exercising decisions**

	I	II	III
Accountability	0.005 (0.074)	0.056 (0.075)	0.354*** (0.099)
Loss aversion		0.135*** (0.027)	0.128*** (0.027)
Accumulated gains	-0.125*** (0.012)	-0.139*** (0.012)	-0.118*** (0.012)
Stock variation from the last period	0.061*** (0.004)	0.059*** (0.004)	0.059*** (0.005)
Nb options sold	0.126*** (0.006)	0.127*** (0.006)	0.129*** (0.006)
Peak price	0.304*** (0.082)	0.344*** (0.083)	0.424*** (0.111)
Accumulated gains*accountability			-0.107*** (0.020)
Stock variation*accountability			-0.003 (0.009)
Peak price * accountability			-0.136 (0.160)
Constant	-3.014*** (0.349)	-3.232*** (0.355)	-3.279*** (0.355)
Observations	5159	5159	5159
LL	-1757	-1745	-1757

We also find a highly significant effect of a reference point as suggested by previous studies (Baucells, Weber, & Welfens, 2011; see also Lefebvre & Vieider, 2011, for an analysis of such effects in the present setting). 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. Finally, we find a simple main effect of accountability in regression III, which mainly shows the effect that accountable subjects sell more options in general, as already discussed above.

## 6. Discussion

Our experiment clearly shows how making executives accountable in front of their shareholders is an effective mechanism to rein in excessive risk taking on the side of executives. While some excessive risk taking does still take place under accountability, it is significantly reduced, something that also shows in company performance. Obviously, the specific accountability mechanism we have implemented may be seen as lacking realism in several ways. We will start our discussion by addressing such potential criticism.

While shareholders could vote on whether they approved a CEOs action, no actual consequences were connected to a vote of no confidence in our experimental design. Nevertheless, our experimental CEOs were on average willing to forego 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 want 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 shareholders' interest.

Costs of monitoring the actual behavior of CEOs can in practice be quite high. Also, reality is obviously more complex than our simple binary investment choice, so that it may not always be clear how risky an investment was relative to others. Nevertheless, we believe that a general idea of the riskiness of an investment can be obtained by shareholders at least ex post. Obviously, whether obtaining such information and taking action may be considered worthwhile will generally depend on company performance, such that outcome monitoring, being automatic, will still present a primary means of controlling executives. In this sense, our random mechanism to determine which CEOs will be called to account for their actions is not very realistic, since shareholders can be expected to call such a meeting more often when a company underperforms. Still, this may be expected to weaken the effectiveness of our accountability mechanism, such that the results obtained are all the more impressive.

A different criticism to our experimental design is that due to the symmetry in the setup it may have been optimal 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 of accountable CEOs relative to unaccountable CEOs was less than compensated by the increase in the payoffs from the shareholder function, assuming that our experimental subjects reasoned this way appears quite a stretch. Indeed, it would have been hard for 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.

It also seems important to note that we do not want to make a general statement on the desirability or not to compensate executives through options. Lefebvre & Vieider (2011) provide detailed results on the risk attitudes induced by different incentive mechanisms. There is no doubt that options can produce positive results when any risk taking by executives may be desirable for shareholders. We wanted to test an extreme case in which risk taking is always undesirable. Since in risky environments outcomes will depend to a large extent on luck or chance as well as effort or skill, it seems desirable to supplement existing forms of outcome monitoring through pay for performance with process monitoring systems that can be used when purely outcome-based systems

fail. Our results show that merely the possibility of being called to justify one's actions is indeed an effective tool to align executive investment behavior with the interest of shareholders.

## **7. Conclusion**

We designed an experiment in which executives compensated through stock options take investment decisions on behalf of shareholders. The excessive risk taking observed for unaccountable subjects is reduced substantially when executives face the possibility that they may need to justify their decision in front of a shareholder reunion. Indeed, they sacrifice substantial amounts of money to conform to the interests of shareholders. A mechanism that increases the power of actual shareholders to call executives to account for their behavior thus seems a promising addition to existing pay-for-performance schemes, which may fail in cases where the outcomes depend to a large extent on chance as well as skill.

## Appendix A: Decision Screens, Main Experiment

### i) Investment screen

regate-client

Period: 1/15

Please make a choice between the two investments below:

**Investment A**  
A prospect giving you a 0.5 probability of a **8% increase** and a 0.5 probability of **4% decrease** in company value.

Outcome	Probability
8% increase	0.5
4% decrease	0.5

investment A

**Investment B**  
A prospect giving you a 0.2 probability of a **40% increase** and a 0.8 probability of **8% decrease** in company value.

Outcome	Probability
40% increase	0.2
8% decrease	0.8

investment B

Validar

### ii) feedback screen

regate-client

Period: 1/15

**Summary of investment outcome**

In this period you chose investment A  
Your investment was unsuccessful  
Your company stock has thus **decreased by 4%**  
Your company stock is currently worth EUR96.0, EUR0.96 per share

**Company stock evolution over the last 1 periods. The investment is indicated for each period.**

Period	Stock Value
0	100
1	96

Validar

iii) option selling decision (option compensation only)

regate-client

Period: 1/15

The current stock price is EUR0.96 per share. Please take a decision  
You hold the following vested options:

5 Period 1 options, exercise price: EUR1.0 each       sell       keep

 Valider

## **Appendix B: Instructions main experiment (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:**

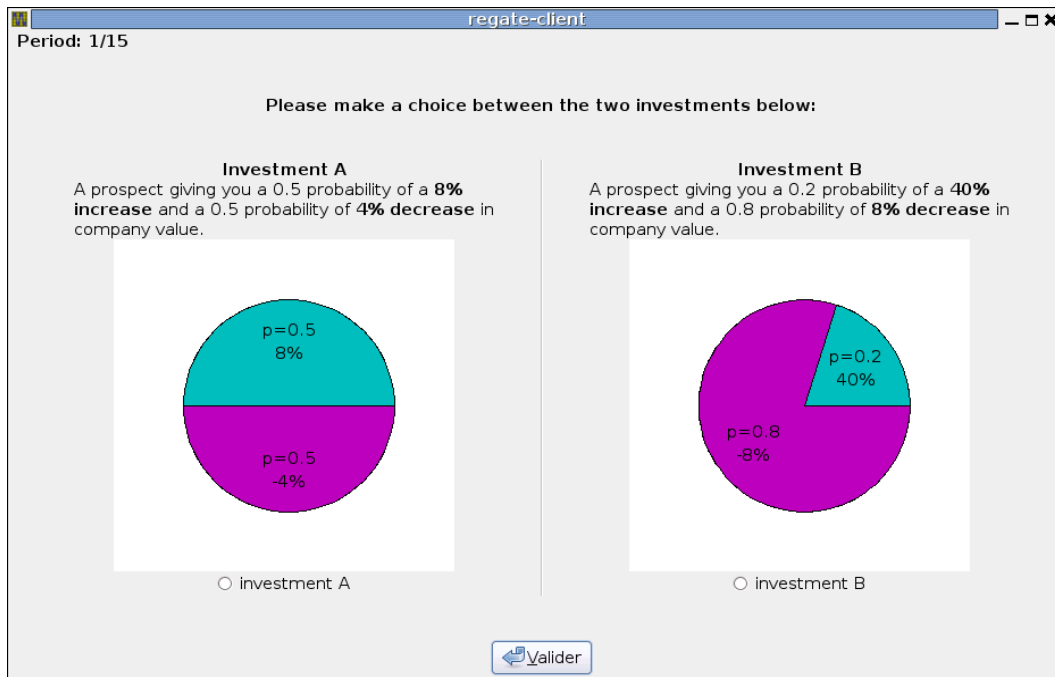
A typical choice is shown in the screen below. In the example shown, you are called upon to decide between two investments for your company assets:

*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).

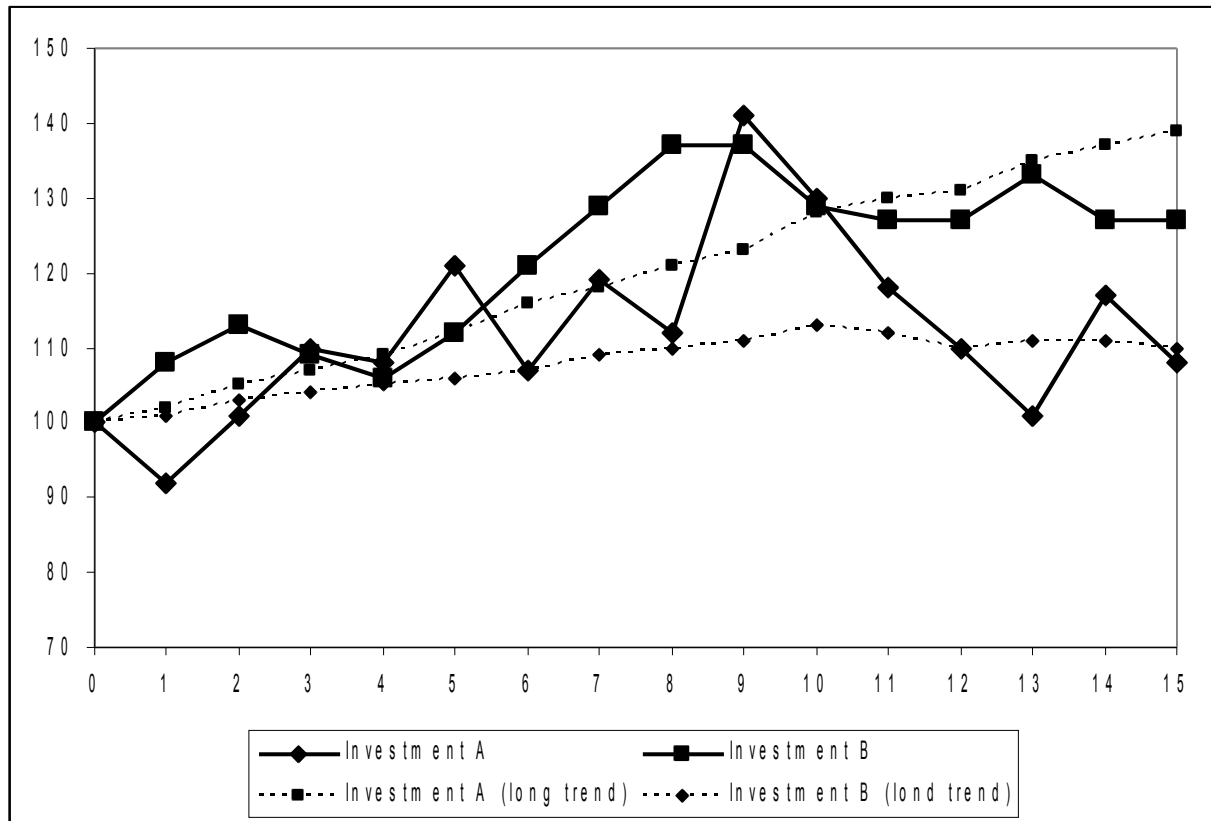
### **Typical Properties of Investments:**

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 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.



### Appendix C: Investment Pairs

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

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