

PAY, PREFERENCE, AND PRESSURE. EXPERIMENTAL TEST OF CEO PAY MODELS

REPORT

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Summary

Compensation packages, shareholder focus, and CEO preferences contribute to long-term financial and non-financial value creation. This laboratory experiment documents the effect of CEO compensation models on firm outcomes in the context of shareholder views and CEO characteristics. Investment in R&D and clean production is highest when these three value drivers all focus on the long term or on clean production.

This study reports on the results of an online laboratory experiment with over 3,000 participants to assess the effects of CEO compensation models focussing on long-term and/or sustainable outcomes in the context of shareholder and participant preferences for time, risk, and clean production. The analysis consists of two experiments in which participants make strategic decisions on firm resource allocation. We measure the treatment effect of compensation models by randomly varying the temporal orientation of compensation models (i.e. short-term versus long-term objectives) as well as the pay-out for clean production, and by paying experiment participants concordant with long-term and clean production performance.

In the first experiment, participants allocate resources towards either short-term production or R&D investments, in which the latter increases long-term production. In a second experiment, participants allocate resources towards either highly profitable dirty production with negative externalities or towards less profitable clean production without negative externalities. Using random assignment of compensation models to experiment participants, we find that compensation packages drive higher R&D investment as well as higher resource allocation towards clean production. Compensation models, then, play a crucial role in incentivising executives to create long-term financial and non-financial value. Shifting financial incentives towards long-term and/or clean production objectives leads to allocative decisions that increase R&D investments and clean production.

More specifically, reducing short-term incentives from 55 to 15 percent of short-term revenue, whilst in parallel raising long-term incentives from 15 to 55 percent of long-term revenue, results in a 14 percent increase in R&D-expenditures, on average. Similarly, reducing incentives from 120 percent to 70 percent for environmentally unfriendly production whilst in parallel raising incentives from 70 to 120 percent for environmentally friendly production, results in a 10 percent increase in investment in clean production, on average.

In order to assess the response of experiment participants to compensation mechanisms in relation to their (given) preferences for time, risk and pro-social outcomes, as well as to external pressures like shareholder focus, we survey respondent preferences and randomly vary (fictional) shareholder focus statements for long-term and/or clean production. When asked to decide on the allocation between current production and R&D, participants receive a 'shareholder statement' that either favours short-term profits or long-term profits. The other variant includes shareholder statements that either favour profit-maximisation or clean production. The analysis reveals that whilst compensation models continue to have a significant effect on allocative decisions, participant preferences for time, risk, and ESG and outside ('shareholder') preferences for long-term or clean production matter in their own right as well.

Additionally, the shareholder statement can influence the strategic decisions, even when there is no financial impact of that statement, namely when the compensation model is held constant. If participants receive a shareholder statement that urges them to focus on long-term profits, they invest 27 percent more in R&D on average, compared to the situation with a shareholder statement that urges them to focus on short-term profits. Regarding investment in clean production, participants with a shareholder statement that focuses on clean productions allocate 10 percent more resources to clean production, compared to participants that receive a pro-profit statement from their shareholders.

Finally, preferences can change the effect of a compensation model or shareholder statement on investment in R&D or clean production. Long-term oriented participants react stronger to long-term financial incentives than short-term oriented participants. This only holds when the shareholder statement is focused on the short term. However, shareholder statements do not have a different effect depending on the time preferences of the participants, it is positive in all cases. Additionally, risk-loving participants react stronger to a long-term shareholder focus, but the effect of the compensation model is the same for both groups. The effect of a compensation model or shareholder statement on investment in clean production is independent of the social preferences of the participants. Furthermore, preferences can also influence allocation decisions, irrespective of compensation models. For example, participants who believe businesses should focus more on ESG-related topics also invest more in clean production than other participants, regardless of the compensation model or shareholder statement. Additionally, risk-loving participants are more prone to investment in R&D than risk-averse participants.

The alignment of the compensation model, the participant's preferences, and the shareholder statement regarding long-term production or clean production, maximises investment in R&D or clean production. The joint effect of the compensation model, participant preferences, and external pressures exceeds the effect of the compensation model in isolation.

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1 Introduction

This report documents and interprets the effect of executive compensation models on executive behaviour and firm performance in an experimental setting. The analyses focus on how compensation models interact with shareholder pressure, personality, and preferences.

Reward Value, a non-profit organisation that aims to contribute to the redesign of executive compensation practices, has commissioned SEO Amsterdam Economics to study the effects of executive compensation models on executive behaviour and firm performance in an experimental setting.

1.1 Background and research question

Chief Executive Officers (CEOs) manage companies owned by shareholders. To ensure that CEOs manage the firm in such a way that the owner's objectives are achieved, a compensation model is used to align interests (Jensen & Meckling, 1976). The structure of CEO compensation has changed over the past few decades. In the last twenty years, a larger part of the total compensation package consists of equity incentives compared to the period before. The main idea is that rewarding the CEO with equity ensures he/she maximises the value of equity, which is also in the interest of the shareholders (Edmans et al., 2017). A widespread criticism of current CEO compensation is that it only focuses on the short-term financial goals and not on long-term financial value creation and non-financial value creation, such as Environmental, Social and Governance (ESG) objectives or Corporate Social Responsibility (CSR) criteria (Serafeim et al., 2019).

This research is concerned with the question of how a CEO compensation model contributes to creating long-term financial and non-financial value.

This question is answered using an experimental setup. The main reason for applying an experimental setup is that many studies use observational data in which causality is hard to establish due to the complexity surrounding compensation contracts and firm performance.¹ We recruit around 3,000 respondents to participate in an online lab experiment where they have to allocate resources to either current production or R&D for future production and to the production of a profitable product with a cost to society (negative externalities) or a less profitable product without a cost to society (ESG, without negative externalities). As each respondent participates in both studies, we obtain around 6,000 unique observations. The pay-out is determined by firm performance and the compensation model, which differs across groups in the experiment.

Literature has pointed out that compensation is not the only factor that determines executive behaviour and firm performance (often measured as financial value creation). Shareholder pressure, CEO personality traits, preferences, and intrinsic motivation all play a role in determining performance. Moreover, they are often interrelated as the responsiveness of CEOs to (equity) incentives is affected by their personality and intrinsic motivation. Our research strategy is to combine these factors in an experiment, which allows us to analyse which combination of

¹ Although several excellent studies do establish a causal effect between compensation and performance.

characteristics, shareholder focus, and compensation model leads to optimal behaviour in terms of maximising firm performance.

1.2 Pilot study

The research strategy and setup of the experiment have been tested in a pilot study. The pilot study shows that incentives work but that measured preferences also matter. Incentives do not work the same for everyone, and this heterogeneity correlates with preference measures. The pilot study shows that, in general, participants who score high on measured altruism, allocate more resources to the environmental-friendly product in the ESG treatment than participants who score low on measured altruism. However, when given an incentive for environmental-friendly production, the low-altruistic participants raise their allocation to this product and eventually match the allocation of the high-altruistic participants. For the high-altruistic participants, the higher bonus does not change the allocation significantly. This suggests that incentives work and interact with measured preference parameters. The results of the pilot study have been used to expand the experiment. For example, regarding the allocation choice of production now vs. investment in R&D, the pilot study does not show a significant effect of higher bonuses. A possible explanation is that the pilot study is underpowered, as the number of participants is limited. In the current experiment we expand the sample size substantially to try to deal with the issue of sufficient power.

1.3 Structure of this report

This study has strong foundations in academic research. The hypotheses are based on the academic literature on CEO compensation, its relation to CEO behaviour and firm performance, and previous experimental studies in this and related fields of research. Chapter 2 discusses the literature and presents the hypotheses. Chapter 3 elaborates on the set-up of the lab experiment. The main results are given in Chapter 4 and Chapter 5 concludes. The appendices describe the full methodology and additional results.

2 Forming hypotheses from academic literature

The experiment builds on the academic literature on CEO compensation, CEO personality, and firm performance. This chapter also describes the lessons learnt from previous experiments and derives hypotheses from the literature.

To design a meaningful and valid experiment, it needs to be based on the mechanisms pointed at in the academic literature. This chapter documents and discusses the most relevant studies regarding CEO compensation, CEO personality, preferences, and experimental research in this and related fields of research. The first section gives a brief overview of the relevance of executive compensation. The next section describes the importance of personality traits and preferences in explaining behaviour. Section 2.3 gives an overview of previous experimental research on compensation and firm performance. Finally, Section 2.4 derives the hypotheses that are tested in the experiment.

2.1 Why CEO compensation matters

Publicly listed companies generally have many and frequently changing shareholders. These owners delegate the daily management of the company to (a board of) executives. The chief executive officer (CEO) is the highest-ranking executive in a company and serves a unique role in the organisation as he/she determines the firm's strategy, the relationship with key stakeholders and the general reputation. Because of their prominent influence on the organisation, the CEOs personality characteristics are not solely visible in their personal preferences and behaviours but are also reflected in the strategies, structures and performances of their organisation (Resick et al., 2009).

A principal-agent problem arises between the shareholders and the executive(s), as shown by, amongst others, Jensen & Meckling (1976), Mirrlees (1999), and Holmstrom (2017). Shareholders must find the right executive(s) (which is difficult because of adverse selection), prevent opportunistic behaviour by the executive (who might suffer from moral hazard) and verify CEO performance (which is costly). In practice, it is hard to find a solution for the principal-agent problem. One solution is the monitoring of the executive by setting several goals. In addition to monitoring, (financial) incentives are created in such a way that they align in the best way possible with the interest of the shareholders (Ter Weel et al., 2019).

Executive compensation is the main instrument to align the executive's objectives with the owners' objectives (Edmans et al., 2017). Both the size of the compensation and the structure of the incentives is important (Jensen & Murphy, 1990). Companies set a wide range of targets to incentivise executives to focus on these objectives (De Angelis & Grinstein, 2015). The structure of these incentives matters too, because non-linearities in bonus schemes can lead to bunching at thresholds (Bennett et al., 2017), excessive risk-taking (Bettis et al., 2018), and lower R&D spending to meet short-term targets at the expense of long-term goals (Edmans et al., 2021). Additionally, targets should be set at the right level and relative to competing firms, otherwise there can be pay for luck, which does not require effort by the CEO (Daniel et al., 2020). A disadvantage of relative performance evaluation is that it may lead to systemic risk if all companies invest in the same asset classes (Albuquerque et al., 2019). Concluding, executive compensation has an impact on CEO behaviour and firm performance but designing the optimal contract to meet the shareholders' goals requires a careful exercise.

2.2 What else matters?

Personality traits have an influence on how CEOs respond to remuneration policies. As personality traits help explain consistency in behaviour and explain important life outcomes (Roberts et al., 2007; Borghans et al., 2008), it is important to consider these when assessing remuneration policies. Different remuneration schemes can have different effects, and the size of this effect is heterogenous across CEOs. The first paragraph describes which CEO personality traits affect firm outcomes and describes the underlying mechanisms. The first section describes the main findings and methods of relevant literature on CEO personality traits. A distinction is made between 'demographic characteristics' and 'personality traits'.

There are several types of background characteristics and personality traits affecting firm outcomes. Firstly, there are demographic characteristics that can easily be measured like age, education and gender. Secondly, there are traits. Examples are the Big Five characteristics: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. The characteristics of CEOs and the differences among them have been widely studied in both the academic and the business literature. In general, the literature states that personality traits of CEOs have a significant effect on activities within the organisation and its performance and thus prove that individual top executives do matter (Gow et al., 2016; Garcés-Galdeano & García-Olaverri, 2019). In this section, the demographic characteristics are discussed firstly. Secondly, personality and preferences are discussed.

2.2.1 Characteristics

Gender

The effect of gender on CEO pay and performance have been studied intensively in the literature but the empirical evidence is mixed. While some studies find that the compensation of female and male CEOs is not significantly different, others do document that female CEOs receive significantly lower compensation. On the one hand, Edmans et al. (2017) conclude that there is no statistically significant difference in the yearly salary of males and females after controlling for firm and individual characteristics. However, they do report that female CEOs only make up a small fraction (2.5%) of their sample and that female CEOs tend to run smaller firms. Also, Jordan et al. (2007), Ham et al. (2018) and Bugeja et al. (2012) do not report a statistically significant difference between female and male CEO pay. On the other hand, Elkinawy & Stater (2011) find that, after controlling for several characteristics, the salaries of female executives are around 5% lower than those for male executives.

Gender is often used as a control variable in models estimating firm performance. In most cases, no statistically significant effect of gender is found in studies analysing firm performance (Ham et al. (2018); Cole et al. (2015); Gilley et al. (2008)). Huang (2013) applies a different perspective to performance and concludes that a firms' Corporate Social Responsibility (CSR) performance, which is measured as the consistency of their CSR ranking, is associated with CEOs' characteristics. Huang's (2013) findings suggest that male CEOs influence a firm's CSR performance positively. Although CSR performance is not necessarily directly related to firm performance, it provides information regarding the new remuneration policy that is related to the ESG criteria.

Tenure

There is a trend towards a decline of tenure among executives. Antia et al. (2010) describe the decline of the average CEO tenure from eight to four years in the last 20 years. The estimated coefficients of Huang (2013) however suggest that CEO tenure has a positive effect on firm performance. This finding is consistent with the arguments in Antia et al. (2010) who observe that a shorter CEO horizon is associated with more agency costs, higher levels of information

risk and consequently lower firm valuation. It is also in accordance with the findings of Barker & Mueller (2002) who conclude that relative R&D spending increases with CEO tenure. On the other hand, Ham et al. (2018) show that tenure does not seem to influence firm investment and firm performance in a statistically significant way.

Age, education, and experience

A proxy for CEO quality is often related to age, level of education and experience. All three seem to affect firm outcomes or are included in models explaining performance as a control variable. Next to gender and tenure, Ham et al. (2018) and Huang (2013) include age as a control variable. Both studies do not report statistically significant coefficients on age, which could possibly be due to the correlation between tenure and age. Kaplan et al. (2012) study a wide range of CEOs on the relationship between CEO characteristics and performance. R&D spending is higher when CEOs are younger, when they have more work experience in marketing and/or engineering/R&D and have education related to advanced science (Barker & Mueller, 2002). Garcés-Galdeano & García-Olaverri (2019) find that young, well-educated CEOs with external experience are likely to improve innovative performance and the growth of the company. Cole et al. (2015) include covariates for age, experience, rank, and the level of education in their model to explain commercial bank loan risk assessment and their findings suggest that these characteristics influence behaviour but that they do not influence the effect of a compensation scheme.

2.2.2 Personality and preferences

CEO personality and preferences, measured by constructs such as the Big Five characteristics, overconfidence, narcissism, altruism, and risk aversion, are also likely to have an effect on firm outcomes. However, personality and preferences are hard to quantify and to incorporate in a model explaining CEO behaviour and firm performance. This section first discusses risk aversion, altruism, the Big Five, overconfidence, and narcissism.

Risk aversion

Risk aversion is the tendency to prefer results with little uncertainty and this can influence CEO decision making as investments require risk taking. People who are more risk-averse tend to prefer more conservative investments to higher-yielding but less certain ones. Risk preferences can be measured by using a question framework, such as the one developed in Bruner et al. (2008). They provide a widely used lottery approach, a seven-part classification system from very risk-loving to very risk-averse. Another example is Harrison & Rutström (2008), who measure risk aversion in a laboratory lottery setting. Falk et al. (2022) present the most straightforward method. They validated survey questions, allowing for the measurement of risk preferences using a question.

Altruism

Altruism shows a desire to help others without expecting a reward in return. The altruistic view of the CEO can influence the level of corporate social responsibility (Borghesi et al., 2014) and the preference for a certain type of compensation scheme (Dohmen & Falk, 2011). Furthermore, Haynes et al. (2015) conclude that managerial altruism in general leads to a focus on longer-term decisions and long-term firm performance. Their findings also suggest that too much altruism is likely to worsen firm performance, which implies that a balance between altruism and self-interest leads to optimal firm outcomes. These findings are in line with our pilot study, in which our estimated coefficients suggest that altruistic respondents preferred environmentally friendly production even without receiving a higher bonus for it. The higher bonuses mainly influenced low altruism respondents, as they responded by increasing environmentally friendly production. Falk et al. (2022) give survey questions to measure altruism.

The Big Five

Gow et al. (2016) show that the Big Five personality traits have a strong out-of-sample predictive performance (applying this method on different samples also predicts firm performance) and are rank-order stable for individuals over time. Furthermore, the Big Five personality traits are associated with choices for finance and investment and thereby for firm operating performance. The Big Five framework, operationalised by Goldberg (1993), has attained a central place in personality psychology. Personality psychology views these five personality traits as the “pattern of thoughts, feelings and behaviours that reflect the tendency to respond in certain ways in certain circumstances” (Roberts, 2009, p.140).

O’Reilly et al. (2014) link the personality of CEOs to organisational culture. They find that organisational culture affects a broad set of organisational outcomes, such as financial performance, reputation, analysts’ stock recommendations, and the attitudes of employees. They assess the personality of CEOs with the Big Five factor model. They obtain a score for each CEO by asking the employees of the firm to rate their CEO. This score was then included in the model to explain how CEO personality affects company culture, which in turn correlates to firm performance. Additionally, Gow et al. (2016) state that the Big Five characteristics are associated with financial choices, investment choices and firm operating performance, linking their research to O’Reilly et al. (2014). For example, openness is positively related to R&D investments, whereas conscientiousness is negatively related to growth. Rather than attempting to measure personality traits using questionnaires or interviews, they create a method using the linguistic features exhibited by CEOs during conference calls. This method is highly appropriate to obtain the characteristics for a large sample. For smaller samples, interviews and questionnaires of executives are feasible. Furthermore, Bono & Judge (2004) consider a meta-analysis of the Big Five personality traits. Despite generally weak result of other traits, they conclude that extraversion could be an important trait when predicting and understanding transformational and transactional leadership. Hence, it seems that extraversion indicates robust relations with leadership outcomes. A possible disadvantage in these types of studies is sorting of CEOs. CEOs are at a company because their leadership style or personality are likely a good match with the company’s culture and performance objectives.

Overconfidence

Overconfidence in CEO behaviour can be defined as the overestimation of the value a CEO believes he/she can create. It can influence the degree of risk perception and risk taking. Moderate overconfidence can increase expected output, due to the influence on which tasks people chose. However, greater overconfidence can lead to the undertaking of tasks that are too large (Weinberg, 2009). Malmendier and Tate (2005) propose the systematic tendency to hold options longer before exercise as a measure of overconfidence. Overconfident executives overestimate the future performance of their firms and hence are more eager to hold options since they expect to profit from higher stock prices. This has become the most common approach to estimate overconfidence; it was also further applied by Malmendier and Tate (2015), whose results show that for overconfident CEOs an increase of one standard deviation of cash flows increases investment 8 percent compared to rational CEOs. Other options to measure overconfidence include earnings forecasts, survey responses, or psychometric tests.

Narcissism

Narcissism, in the context of a personality trait, can affect firm investment and performance. It is positively linked to overinvestment and lower profitability (3 percent ROA) (Ham et al., 2018). Since there seems to be a strong positive correlation between signature size and narcissism, Ham et al. (2018) propose a method of measuring CEO signature size to examine the relationship between the CEO’s narcissism and firm investment. It is an informative method since it does not require study participants to answer direct questionnaires about their personality and because participants

are likely to be unaware that their ego would affect something as simple as their signature. Narcissism has been identified as a stable personality trait that can be measured with personality assessment tools.

Box 2.1 Lessons for experimental design

For our experiment, it is important to include demographic characteristics and personality traits in our model.

Characteristics

We can improve our experimental design by incorporating demographic characteristics by adding straightforward questions in the experiment. Although the empirical results in the literature suggest mixed results regarding the characteristics affecting firm outcomes, we include gender in our model, and we condition on the level of education. Age, tenure, and experience are not included because our participants are not actual CEOs and estimation is then an issue.

Personality traits

Risk aversion and altruism are less complex to measure and can be incorporated in our model. Risk preferences are measured on a scale of 0 to 10, where the relevant question is: *How do you see yourself: are you a person who is generally willing to take risks, or do you try to avoid taking risks?* (Falk et al., 2022).

Altruism is included in the pilot and can be included again. Altruism can be measured by asking questions in the survey regarding the distribution of obtained money from a lottery. Cole et al. (2015) ask the question what an individual would do when winning a lottery of € 100,000; whether the individual would keep it all for himself/herself or divide the money with family and friends. Falk et al. (2022) use a similar question, namely: *Imagine the following situation: You won 1,000 Euro in a lottery. Considering your current situation, how much would you donate to charity?, and How do you assess your willingness to share with others without expecting anything in return when it comes to charity?* (on a scale of 0-10).

To estimate CEO overconfidence, the most common empirical approach is to apply the tendency to hold options longer before exercise as a measure of overconfidence. The same holds for narcissism, which can be measured using signature size. To measure the Big Five characteristics, O'Reilly et al. (2014) asked employees of the firm to rate their CEO. The outcomes of these surveys were used to assign a CEO certain characteristics, which were included in the model. The paper of Gow et al. (2016) builds upon the article of O'Reilly (2014); they develop their measures using the linguistic features exhibited by CEOs during conference calls. Since these methods are complicated and time consuming for our research, we do not control for overconfidence and narcissism.

Source: SEO Amsterdam Economics (2022)

2.3 Experimental research on CEO compensation

Executive compensation models and their effects on executive behaviour and firm performance have been a topic of interest in the literature. The relationship between several types of payment structures and performance has been tested in laboratory experiments (Bruner et al., 2008; Ariely et al., 2009; Agranov & Tergiman, 2013; Harris et al., 2018). Bruner et al. (2008) use a survey setup to investigate the potential downsides of equity-based compensation, and they obtain estimated coefficients that suggest an increase in fraudulent behaviour. The experimental setup is similar for Agranov & Tergiman (2013), who investigate different payment schemes, and Harris et al. (2018), who examine how bonus caps and malus affect individuals' choices of risk and effort. Both employed a survey-based experiment and find that a relative piece rate contract maximises effort (Agranov & Tergiman, 2013) and bonus caps mitigate risk taking (Harris et al., 2018).

Field experiments show that performance-based compensation could lead to an increase in productivity, but there is no consensus in the literature on this (Camerer & Hogart, 1999; Lazear, 2000; Shearer, 2004; Bandiera et al., 2007; Gielen et al., 2010; Ottersen, 2016; Iqbal et al., 2019). The differing experimental setups, incentives and sample populations between the studies make it difficult to obtain a general consensus.

The three main lessons from previous experiments concern sample selection, shareholder views, and performance-based compensation. These lessons are explained in successive order.

2.3.1 Sample Selection

To obtain a sample with controlled variation (in our case compensation model or shareholder views), a laboratory experiment is used (Falk & Heckman, 2009). Due to the randomisation of the allocation to the treatments, it is then certain that there will be no confounding variables that influence both the outcome and the treatment making it possible to estimate a causal effect. A disadvantage is that the studied population will most likely be different from the population of interest; a great part of experiments in social sciences is performed with the participant group consisting of undergraduate students while the experiments want to obtain externally valid results. Students are often chosen due to their accessibility and low costs. Cleave (2013) found that selection bias was not a problem in measuring the social preferences of students who had to complete a classroom experiment and that the preferences did not differ from students who could volunteer to attend a laboratory experiment. Additionally, the prosocial behaviour of students can be seen as a lower bound for the general public (Falk et al., 2013). However, an ideal sample would be less homogeneous in many cases or at least closer to the target population. A solution is to select a sample group similar to the group of interest, for example, business students, when the researcher is interested in executives. It will not yield a perfectly represented sample, but the causal effect will at least be more externally valid.

Andersen and Lau (2018) offer an alternative: they use Amazon Mechanical Turkers. These are crowd workers who perform discrete on-demand tasks for a set rate. The “Turkers” have become a cheap option to quickly recruit many respondents (Berinsky et al., 2012; Paolacci et al., 2010). The benefit of using Turkers is that they provide a more diverse sample size compared to most undergraduate samples (Huff and Tingley, 2015). It can, however, be difficult to select a representative group of future CEOs as these are likely to not be crowded workers.

Another option is Prolific. This platform offers an extensive database and is made specifically for research purposes. Subjects can be screened in a range of dimensions, making it possible to acquire a sample group with specific characteristics, for example, higher education or management experience. The platform combines high recruitment standards at a reasonable cost (Palan & Schitter, 2018). In a range of experiments, participants from Prolific gave more reliable answers than Turkers and university students. This was measured by attention check questions and by how well results from established experiments could be replicated (Peer et al., 2017).

2.3.2 Shareholder views

CEOs of publicly traded companies know that the results of the company will influence shareholders' voting behaviour and in turn the executive's compensation. CEOs must thus keep in mind that they might only be able to keep their position by not taking too many risks. Shareholders seem to only respond negatively to high CEO rewards when firm performance is low due to loss aversion (Krause et al., 2014). However, for some investments in environmental and social causes, risks are more tolerated by shareholders' behaviour and in turn the executive's compensation.

CEOs can expect the support of shareholders in making sustainable investments before and after they are implemented, even though the return on investment might be low (Bauer et al., 2021). The pressure on companies and pension funds to take social and environmental views into consideration is rising. These institutions' function is to generate value for the stakeholders, which includes the shareholders. It is thus important to know if shareholders agree with the push to think more about other stakeholders. In two surveys conducted by Bauer et al. (2021), the

researchers asked participants, whose pension fund gave its members a real vote on the sustainable investment policy, their views on investment decisions. The first survey showed that 68 percent supported more sustainable investment, even though the expected value was negative compared to non-sustainable investments. The second experiment determined that support remained strong after the pension fund had implemented the new sustainable investment policy.

Social values of companies are becoming a subject where shareholders are starting to express their concerns increasingly in the form of shareholder proposals. Firms targeted by social shareholder proposals have higher scores on employee wellbeing and human rights performance (Eding & Scholtens, 2017). In some cases, picking a manager who spent resources on social causes, rather than strive for short-term maximisation for shareholders profit, can be more profitable in the long run due to the increase in employees' performance (Kajackaite & Sliwka, 2020). A famous example of this practice is the 105 percent pay raise Henry Ford gave to 90 percent of his employees working at his automobile plant in 1914. The sustained productivity increase that followed was between 40 and 70 percent (Daniel et al., 1987).

2.3.3 Performance-based compensation

Companies can choose from wide a variety of payment structures that usually consist of one or more parts. The parts of the payment structure can generally be divided into the following three categories: non-variable cash compensation (fixed salary), performance-based cash compensation, and performance-based equity or option compensation. The general problem with performance-based compensation is that the indicators used must be easy to measure and this thus far has prohibited the widespread use of social and environmental indicators. The next two subsections explain different forms of performance compensation and the third subsection focuses specifically on the compensation of CEOs. Note that the vast literature on tournament payment (e.g. Dohmen & Falk, 2011) is not included as the focus of this report is on other types of payment schemes.

Performance-based cash compensation

Economic experiments show that most types of performance-based payments structures have both up- and downsides compared to non-variable cash compensation, where the upside consists of increased effort and the downsides consist of fraud and excessive risk-taking. Ariely et al. (2009) concluded in several independent experiments that performance-based variable cash compensation can have a positive effect on effort but that raising incentives beyond a certain level may produce supra-optimal levels of arousal and hence decrease performance, which is in line with the Yerkes-Dodson law. In a field experiment with car windshield installers, the payment scheme was switched from an hourly rate to a performance-based rate, where the workers were paid a set amount for each windshield that they installed. The results saw that productivity almost immediately increased by 44 percent (Lazear, 2000). There have been other experiments showing the same results not only for blue-collar workers but also for managers (Shearer, 2004; Bandiera et al., 2007; Gielen et al., 2010; Iqbal, 2016). In another field experiment by Bun and Huberts (2018), it was shown that lowering performance-based cash compensation paired with an increase in fixed salary decreased productivity on average. Their study analysed a change in payment structure of a large marketing firm. The changes in payment structure caused, on average, a reduction of more than 7 percent in sales.

Performance-based cash compensation can also have a positive effect on the risk assessment of employees if used correctly. Volume incentives can distort the assessment of credit risk, for non-experienced as well as experienced personnel at financial institutions (Cole et al., 2015). Incentives that reward performance and penalise failure had a positive effect on risk assessment. However, there is no clear census in the literature on whether performance-based cash compensation increases productivity. Camerer and Hogart (1999) argue in a meta-study of seventy-four

different experiments that performance-based cash financial incentives have no effect on mean performance and rather decrease the variance in the performance of the participants.

Performance-based equity compensation

Performance-based equity compensation is a common feature but, next to incentivising effort, it can also lead to more fraud because the sensitivity of CEO wealth increases with performance (Bruner et al., 2008). Equity is often seen as a measure to link the behaviour of executives to the long-term value creation of the company. It is common for companies to base equity pay on the company's relative performance over a three-to-five-year period. The awarded equity is usually locked up for a minimum of five years. Payment schemes that reward employees for realised investment returns but do not penalise negative returns, encourage excessive risk-taking. Two commonly used measures to combat the potential forms of fraud and exercise risk-taking are: bonus caps and claw-back measures. Bonus caps create a ceiling for the variable compensation and claw-back measures make it possible to reclaim bonuses that were awarded in the past. A disadvantage to the bonus cap is that it can potentially cause a drop in effort after the maximum bonus is reached. This is less the case for the claw-back measures (Harris et al, 2018).

Performance-based compensation of CEOs

There have been theoretical models on improving the performance-based compensation of CEOs, some of which have been empirically assessed. An example is to base the variable compensation on not only stock price but also the price of debt, as proposed by Bolton et al. (2011). This should combat the excessive risk-taking, as the price of debt rises with an increase in risk and thus decreases compensation. They provided an empirical analysis that included debt into the compensation of executives and they concluded that their compensation model is believed by the market to reduce the risk for financial institutions. Edmans & Liu (2011) proposed a similar theoretical model that granted managers not only equity but also debt. Another option to improve the current pay structure is to set the performance measure relative to the performance of other companies (compensation is negatively correlated with output of other companies). This can incentivise the effort of executives (Agranov & Tergiman, 2013). Additionally, Ederer & Manso (2013) found in a randomised experiment where participants were tasked to make investment decisions of a lemonade stand for 20 periods that there is a positive causal effect in exploration (choice of location, price, etc.) by compensating participants for their efforts over the last 10 rounds of the experiment. Furthermore, some participants would be evaluated after the first 10 rounds and if their profits were below a certain margin the experiment would be terminated. In these trials offering a fixed payout if the margin was not met led to more exploration. The findings from these studies can be used to improve the compensation model in our experiment.

Box 2.2 Lessons for experimental design

For the experiment, the lessons from the sample section can be used to create a representative sample for our CEO population. The insight the literature provided about shareholder views is necessary for providing background information to our participants. The lessons learned from different compensation models can be used to optimise our own compensation model.

Sample selection

The most effective way to obtain a representative sample is to use the platform Prolific to conduct a lab experiment. Their platform allows for selecting participants in management functions.

Shareholder view

Participants in the experiment should know the consequences of their actions. Our experiment could provide participants with the information that their investments in environmental and social causes are appreciated by shareholders, even though it might lead to a lower return on their investment. This could be a point of analysis; how do participants allocate resources to production when they do receive this information and how do they allocate resources when they do not receive this

information. Participants could also be provided the information that shareholders do not like excessive risk-taking. Another option is that participants could lose their 'job' between rounds if losses are large; this would reflect a more realistic scenario.

Performance-based compensation

In our pilot study, certain performance-based compensation measures could nudge participants to socially desirable outcomes. In the next experiment, the goal is to improve the nudges to create a better supported compensation model.

Claw-back measures can be included in the experimental set-up, as was done by Harris et al. (2018). The experiment has participants make investments and they are paid a bonus proportional to the asset return only if the return exceeds a predefined threshold in the first period and is conditional on whether the project succeeds in the second period. The probability of making the targets is the same for both periods and stated with the list of investments.

Another option is to provide the participants with an option to invest not only in environmental investments but also in social investments. The return in the first period would be zero and the production would increase in later periods due to an increase in productivity of 'employees'. This works better if there are more than two periods.

The risk treatment could be improved in two ways: by including a riskier investment option and by making the compensation dependent on the risk participants take. In the pilot experiment, participants in the risk treatment had the option to choose a risky investment which had two outcomes with a positive return on investment. To make the investment decision more realistic, the next experiment could include a risky investment consisting of one positive outcome and one negative outcome. Another option is to make the compensation dependent on the risks a participant takes: we could test if participants decrease the amount of risk they take if the compensation would be lowered for excessive risk-taking.

Source: SEO Amsterdam Economics (2022)

2.4 Hypotheses on CEO compensation and CEO behaviour

Based on the literature we establish five hypotheses on CEO compensation and CEO behaviour. These hypotheses are still broad and apply to general CEO compensation and CEO behaviour. The literature, discussed in Section 2.2, shows that several personality traits are likely to affect CEO behaviour and compensation. In our experiment, altruism, time preference and risk aversion are included. Demographic characteristics are not included in the pilot study. Regarding the personality traits, we hypothesise that:

Hypothesis a: People with lower discount rates shift more of their production to R&D/long-term production than people with higher discount rates.

Hypothesis b: More altruistic people devote more resources to ESG-friendly production than less altruistic people.

Hypothesis c: People with a stronger risk preference are more likely to invest in risky production than people with a weaker risk preference.

In addition to personal traits, the literature (Section 2.3) shows that also the compensation model influences the production focus of CEO's. For example, Edmans et al. (2017) show that vesting equity is linked to a decrease in the growth rate of R&D and capital expenditures. In addition, it is associated with reductions in the positive analyst forecast revisions and positive earnings guidance. This implies that vesting equity causes CEOs to lower investment in long-term projects and to increase short-term earnings. This results in the following hypothesis.

Hypothesis d: Short-term incentives reduce investment in R&D/long-term value creation.

Furthermore, shareholder statements are included in the experiment. The shareholders are the owner of the company and have influence over the CEO. This also means that they can dismiss the CEO. The CEO is hence likely

to take shareholder interest in consideration. Following this reasoning, if shareholders are focused on the long-run, CEO's will be more focused on long-term production. The opposite holds for shareholders with a short-term focus. Therefore, we hypothesize that:

Hypothesis e: The statement of shareholders influences the focus on long-term and short-term goals; when shareholders favour the short-term, the CEO is likely to devote more resources to short-term production; when shareholders favour the long-term, the CEO is likely to devote more resources to long-term production.

3 Setup lab experiment

The experimental design allows us to test the effect of a compensation model and of a shareholder statement on executive behaviour. We include several preferences and intrinsic motivation as well. This chapter describes the design.

This chapter discusses the setup of the lab experiment. For the setup, the lessons drawn from of Chapter 1 and Chapter 2 are applied. Firstly, the objective of the experiment is discussed. Secondly, the experimental design is elaborated upon. This section describes the set up to analyse how compensation incentives affect executives' behaviour on two accounts: long-term value creation and the production of ESG-friendly goods.

3.1 Objective of experiment

The objective of this experiment is to analyse how compensation incentives affect executive behaviour on two accounts:

1. Investments in R&D for long-term value creation; and.
2. Production of environmentally friendly goods.

The experimental setting focuses on outcomes not on the decision-making process. The main hypothesis of the experiment is that a different compensation model leads to different outcomes. However, in real life, not all actions are financially motivated; intrinsic motivation or external pressure also play a role. We correct for this by measuring and subsequently controlling for preferences in our estimated models, such as time, risk, and social preferences of the subjects in the experiment. These preferences shape intrinsic motivation, affect choices and thus affect behaviour. Preferences affect the way people respond to incentives. For example, long-term oriented participants perhaps do not require a high bonus for long-term production as they are naturally inclined to focus on long-term performance. For participants with a short-term focus, however, a bonus may be required to steer them towards long-term performance. To further measure participants' focus, we include a question on their view on business: should businesses only pursue profits, or focus more on social/environmental issues, or a combination of these aspects. This also provides insight into the intrinsic motivation of participants. Are they intrinsically motivated to pursue profits, ESG goals or a combination of both?

The experiment will be hosted online and distributed among Prolific² members who will receive a payment based on their outcomes during the experiment. We have been unable to target actual CEOs, but we target university-educated people with management experience who arguably could be future CEOs (Brink et al., 2020). This chapter also discusses the sample size and the representativeness of the sample. As Prolific's currency is British pounds, all values are denoted in GBP's.

² <https://www.prolific.co/>

3.2 Experimental design

3.2.1 Overview

Participants play a game in which they are the CEO of a fictitious company. The CEO is endowed with 50 resources to allocate.

In experiment 1 (long-term), the CEO can allocate 50 resources to production now or investment in R&D. Production now yields a higher short-term revenue but investment in R&D yields a higher long-term revenue. We also consider a case with uncertainty in the success of the investment in R&D. The chance of a successful investment increases in the resources allocated to R&D.

In experiment 2 (ESG), the CEO can allocate 50 resources to Product 1, which yields a higher revenue but also a cost to other participants (e.g. emissions), or to Product 2, which yields a lower revenue but without a cost to other participants. Product 1 thus comes with a negative externality. The social cost of the negative externality is not reflected in the private cost of the firm (cf. Pigou, 1920).

Participants earn their salary in points. These points depend on revenues earned. They are eventually translated into currency. 30 points are equal to £ 0.01.

All participants participate in both experiment 1 and experiment 2; the order is randomised. At the end, the computer chooses randomly for which experiment they receive the pay-out. This pay-out is determined by their choices during the experiment.

Figure 3.1 Steps in the experiment

1. Introduction
 2. Background questions on preferences and view on business
 3. Explanation of experiment and allocation choice
 4. Try-out of allocation choice
 5. Explanation of payments and compensation model
 6. Shareholder statement
 7. Actual allocation choice
 8. Outcomes of allocation choice and confirmation
- Repeat steps 3-8 for second experiment
9. Question view on business
 10. Explanation that 1 of the 2 experiments is paid out
 11. End of experiment

3.2.2 Different steps in the experiment

Participants take the following steps in the experiment (see Figure 3.1). They first receive a brief introduction about the experiment, the next step is to answer several questions on preferences and their view on business. An explanation of the experiment and the allocation choice follows, including examples. In the next step, participants can practice with the allocation in a try out, which does not affect the payment. Afterwards, the payment structure and bonus parameters are explained. The next screen gives the shareholder statement and then follows the actual experiment. As participants take part in two experiments, they repeat some steps. After both experiments are done, participants receive the question with their view on business again, to see if it has changed throughout the experiment. Finally, we explain that participants receive the reward of one of the two experiments, after which the end of the experiment is reached.

Appendix A shows the various allocation choices participants can make. They immediately see the impact of their allocation choices on production, revenues, and the payment (in points). During the try-out phase, they can try as many times as they want to maximise the revenue/payment or to minimise the cost to other participants. Participants must remember these choices to make the optimal choice. The level of effort provided by the participants can differ. The experiment is transparent in the sense that participants see the outcome of their actions. However, they do not know which experiment will be paid out, and the conversion from points to GBP may require more effort. The sections below explain the most salient features of the experiment.

3.2.3 Treatment

Within these experiments, the setting is the same for all participants, except for:

- a. The compensation models; and
- b. The shareholder statements.

These are the only factors that differentiate the control group from the treatment group.

The general setup for the long-term experiment is that participants receive a fixed wage, a bonus for production in period 1, and a bonus for production in period 2. The general setup for the ESG experiment is that participants receive a bonus for the production of Product 1 and a bonus for the production of Product 2, but they incur a cost if other participants have allocated resources to Product 1. Likewise, other participants also incur a cost for the resources allocated to Product 1 by the participant.

The treatments are randomly assigned to the participants. Randomisation ensures a causal effect can be established, as the compensation model is uncorrelated with other (unobservable) characteristics. As the shareholder statement can differ, we control for that when analysing the effects of the compensation model and vice versa. Table 3.1 gives an overview of all 14 combinations of experiments and treatments.

Table 3.1 shows that for the long-term experiment there are two compensation models: one contains a fixed wage, a high short-term bonus, and a low long-term bonus, the other one has a fixed wage, a low short-term bonus, and a high long-term bonus. In the ESG experiment, there are three compensation models: the bonus for the product without a cost to society is either equal to, higher than, or lower than the bonus for the product with a cost to society. Each compensation model has two different types of shareholder statements. In the long-term experiment, there is a pro short-term shareholder statement and a pro long-term shareholder statement. In the ESG experiment, there is a pro-profit or a pro-social shareholder statement.

Table 3.1 Overview experiments and treatments

Nr.	Experiment	Compensation model	Shareholder statement
1.1.1	Long-term, no risk	Fixed wage, high short-term bonus, low long-term bonus	Pro short-term
1.1.2	Long-term, no risk	Fixed wage, high short-term bonus, low long-term bonus	Pro long-term
1.2.1	Long-term, no risk	Fixed wage, low short-term bonus, high long-term bonus	Pro short-term
1.2.2	Long-term, no risk	Fixed wage, low short-term bonus, high long-term bonus	Pro long-term
1.3.1	Long-term, risk	Fixed wage, high short-term bonus, low long-term bonus	Pro short-term
1.3.2	Long-term, risk	Fixed wage, high short-term bonus, low long-term bonus	Pro long-term
1.4.1	Long-term, risk	Fixed wage, low short-term bonus, high long-term bonus	Pro short-term
1.4.2	Long-term, risk	Fixed wage, low short-term bonus, high long-term bonus	Pro long-term
2.1.1	ESG	Equal bonus for product with or without cost to society	Pro-profit
2.1.2	ESG	Equal bonus for product with or without cost to society	Pro-social
2.2.1	ESG	Higher bonus for product without cost to society	Pro-profit
2.2.2	ESG	Higher bonus for product without cost to society	Pro-social
2.3.1	ESG	Higher bonus for product with cost to society	Pro-profit
2.3.2	ESG	Higher bonus for product with cost to society	Pro-social

Source: SEO Amsterdam Economics (2022)

3.3 Long-term value creation

There are two experiments for long-term value creation. In one version, investments in R&D have a certain outcome. In the other version, investments in R&D have a risky outcome where the probability of a successful investment increases as more resources are allocated to R&D. The treatments described below are the same for both versions.

3.3.1 Compensation model

The status quo (1.1 and 1.3)³ is that short-term performance is rewarded more highly than long-term performance. This is also reflected in the bonus parameters. The short-term bonus is higher than the long-term bonus. The fixed wage is 6,000 points, the short-term bonus is 0.55 points per revenue in period 1, and the long-term bonus is 0.15 points per revenue in period 2.

³ 1.1 represents 1.1.1 and 1.1.2, 1.3 represents 1.3.1 and 1.3.2. Because the shareholder statements do not affect the compensation model, they are left out of this description.

The treatment group (1.2 and 1.4)⁴ has a higher bonus for long-term performance than for short-term performance. The fixed wage is again 6,000 points, the short-term bonus is 0.15 points per revenue in period 1, and the long-term bonus is 0.55 points per revenue in period 2.

Hypothesis 1: Participants with a higher bonus for long-term production allocate more resources to R&D than participants with a higher bonus for short-term production.

3.3.2 Shareholder statement

Participants also receive a shareholder statement before allocating their resources. This shareholder statement does not change the compensation model but conveys the focus of the shareholders. If the participant allocates resources in line with the shareholder statement, there is no benefit for the participant. If the participant allocates resources not in line with the shareholder statement, there is also no cost for the participant.⁵

The participant receives either a *pro short-term* statement or a *pro long-term* statement.

1. Pro short-term: Shareholders expect that the company maximises short-term revenue.
2. Pro long-term: Shareholders expect that the company maximises total revenue over period 1 and period 2.

Although the shareholder statement does not influence the incentives, we expect that it will influence outcomes, as it directs the attention towards either the short-term or long-term. This may then enforce the incentive or counteract the incentive, for example, if a high short-term bonus is combined with a pro long-term shareholder statement.

Hypothesis 2: Participants with a pro long-term shareholder statement allocate more resources to R&D than participants with a pro short-term statement, keeping the compensation model constant.

If both hypothesis 1 and hypothesis 2 are validated by the data, indicating that both the compensation model and shareholder statement can influence investments in R&D, it is interesting to assess which of the effects is prevalent. Is a shareholder statement enough to nudge participants towards the value-maximising allocation, or can a compensation model add strength to the nudge? Likewise, are the incentives of a compensation model weakened by an opposing shareholder statement?

3.4 ESG

3.4.1 Compensation model

The status quo (2.1) is that both products with and without a cost to society are rewarded equally. This is also reflected in the bonus parameters. Participants do not receive a fixed wage but receive a bonus per revenue per Product. For the control group, the bonus is equal for both products. Thus, the bonus for Product 1 is 1 point per £ revenue and the bonus for Product 2 is 1 point per £ revenue.

⁴ 1.2 represents 1.2.1 and 1.2.2, 1.4 represents 1.4.1 and 1.4.2. Because the shareholder statements do not affect the compensation model, they are left out of this description.

⁵ In reality there may be a cost, as the shareholders evaluate the CEO's performance. We abstract from that in this experiment.

The treatment group (2.2) has a higher bonus for Product 2, which does not have a cost to society. There is also no fixed wage; the bonus for Product 1 is 0.7 points per £ revenue and the bonus for Product 2 is 1.2 points per £ revenue. We expect that the treatment group allocates more resources to Product 2 than the control group.

Hypothesis 3: Participants with a higher bonus for the product without a cost to society allocate more resources to the production of this product than participants who receive an equal bonus for the product with and without cost to society.

The other treatment group (2.3) has a higher bonus for Product 1, which does have a cost to society. There is also no fixed wage; the bonus for Product 1 is 1.2 points per £ revenue and the bonus for Product 2 is 0.7 points per £ revenue. We expect that the treatment group allocates more resources to Product 1 than the control group.

Hypothesis 4: Participants with a higher bonus for the product with a cost to society allocate more resources to the production of this product than participants who receive an equal bonus for both products.

3.4.2 Shareholder statement

The participant receives either a *pro-profit* statement or a *pro-social* statement.

1. Pro-profit: Shareholders expect that the company maximises revenues.
2. Pro-social: Shareholders expect that production of goods without a cost to society results in a lower revenue. However, they expect the company to allocate at least some resources to the production of goods without a cost to society.

Although the shareholder statement does not influence the incentives, we expect that it will influence outcomes, as it directs the attention towards either the profit-maximising behaviour or social-welfare-maximising behaviour. This may then enforce the incentive or counteract the incentive, for example, if a higher bonus for production without a cost to society is combined with a pro-profit shareholder statement.

Hypothesis 5: Participants with a pro-social shareholder statement allocate more resources to the product without a cost to society than participants with a pro-profit statement, keeping the compensation model constant.

If both hypothesis 3 or 4 and hypothesis 5 are validated by the data, indicating that both the compensation model and shareholder statement can influence production of the “clean” product, it is interesting to assess which of the effects is prevalent. Is a shareholder statement enough to nudge participants towards the social-welfare-maximising allocation, or can a compensation model add strength to the nudge? Likewise, are the incentives of a compensation model weakened by an opposing shareholder statement? We seek to answer these questions in the experiment.

3.5 Preferences and characteristics

We measure several preference parameters. This allows us to examine the effect of incentives for different groups of respondents. The measurement of these parameters is described in Appendix A. The pilot version of this experiment suggested that low-altruistic respondents are more influenced by incentives for the production of environmentally friendly goods than high-altruistic respondents, who in the baseline scenario already produced the socially optimal amount of environmentally friendly goods. We take the following preferences into account:

- Time preference;

- Risk preference; and
- Social preference.

For time preference, participants who have a below median preference for the long term (lower than 7), are classified as short-term oriented, and participants who have a median and higher preference for the long term (7 and above), are classified as long-term oriented.

For risk preference, participants who have a median (6) and higher preference for risk are classified to the risk-loving oriented group. Participants who have a below median preference for risk are classified as risk-averse oriented participants.

For social preference or altruism, participants who donated less than £50 (the median) out of £1000 to charity are assigned to the low altruism group. Participants that donated more than or equal to £50 out of £1000 to charity are assigned to the high altruism group.

Additionally, we consider the respondents view on business as that may influence their behaviour in the experiment. This measures if respondents focus on profit maximalisation, ESG, social issues etc. We include the following list of topics:

1. Brand image
2. Climate change
3. Emissions reduction
4. Fair labour
5. Long-term profits
6. Providing living wages
7. Sales growth
8. Satisfying shareholder demands
9. Short-term profits
10. Social inequality
11. Supporting local communities
12. Technological innovation

This list consists of 6 topics that we classify as 'ESG focus', namely climate change, emissions reduction, fair labour, providing living wages, social inequality, and supporting local communities. By ranking the top 3 topics, we can calculate a score of ESG focus. Participants receive 3 points if the number 1 answer is an ESG topic, they receive 2 points if the number 2 answer is an ESG topic, and they receive 1 point if the number 3 answer is an ESG topic. They could thus earn a total of 6 points on this scale. Participants with 0-2 points are defined as having a low ESG focus and participants with 3-6 points as having a high ESG focus.

3.6 Methods

3.6.1 Estimation

The hypotheses can be answered by comparing the means of different groups, for example, do *participants with a higher bonus for long-term production (mean 1) allocate more resources to R&D than participants with a higher bonus for short-term production (mean 2)*? We calculate the difference of means (mean 1 - mean 2) and test whether this

difference is statistically significantly different from zero. If it is positive and statistically significant (using independent t-tests), it suggests that the higher bonus for long-term production did increase the number of resources allocated to R&D. Since the compensation models (treatment) are randomly assigned to participants, they should not correlate with any background characteristics. In this case, there is no need to control for other variables, as the difference in means can be seen as the causal effect.

Recall that in treatment 1.1.1 participants have a higher short-term bonus and a pro short-term shareholder statement and that in treatment 1.2.1 participants have a higher long-term bonus and also a pro short-term shareholder statement. As treatment is randomly assigned, and people cannot choose for another compensation model (meaning everyone is a 'complier'), we can calculate the Average Treatment Effect (ATE) for the participants with a pro short-term shareholder statement as:

$$ATE = \text{mean input } R\&D_{1.2.1} - \text{mean input } R\&D_{1.1.1}$$

and similarly for other treatments and shareholder statements. If the ATE on the compensation model is not significantly different over the various shareholder statements, the groups can be combined, i.e. comparing 1.1 with 1.2 but controlling for the shareholder statement.

Additionally, we can also test the effect of the shareholder statement. Recall that in treatment 1.1.1 participants have a high short-term bonus and a pro short-term shareholder statement. In treatment 1.1.2 participants have a high short-term bonus and a pro long-term shareholder statement. To test whether the shareholder statement affects the inputs in R&D, we can again calculate an ATE. The entire setting, including the compensation model, is the same, but only the shareholder statement differs, which was assigned randomly. The ATE for the shareholder statement is the difference between mean inputs in R&D under 1.1.2 and under 1.1.1:

$$ATE = \text{mean input } R\&D_{1.1.2} - \text{mean input } R\&D_{1.1.1}$$

The significance of the ATE's will be calculated using t-tests. The t-tests assume that the outcome variable, input in R&D, is normally distributed. Since the outcome variable are ordinal, it does not have a normal distribution, so this assumption is in fact violated. A non-parametric test, which does not have an assumption about a prior distribution, such as the Mann-Whitney-Wilcoxon (MWW), is also an option. These tests are, however, not as informative as the t-test. De Winter and Dodou (2010) showed in a simulation study that the t-test and MWW test have similar power for most testing situation; only in the case of severe skewness was there less power in the t-test. Additionally, the Type I error rate was close to 5% for both methods.

Furthermore, we perform additional exploratory subgroup analyses based on the background characteristics and preferences:⁶

- Time preference
- Risk aversion
- Altruism
- ESG views
- Gender

⁶ The view on business question can also enter the regression, but a classification of the answers should be made first.

The main focus is on the preferences and ESG views. Gender is included in the appendix as a robustness check and, since we condition the sample on higher education, we do not include it in the models.

The analysis with subgroups will increase the precision of the estimation. Since the outcome variable (resources allocated to R&D) is interval⁷, there are multiple approaches for estimation. The simplest one is ordinary least squares (OLS) regression; this is the same as a t-test if only one binary variable is included. To obtain an interpretable result of the influence of the personal characteristics, regressions will be estimated where the shareholder statement or the compensation model is held constant. In case where we are interested in the effect of risk aversion, the following regression equation will be used, once for the short-term shareholder group and once for the long-term shareholder group:

$$y_i = \beta_0 + \beta_1\chi_{1i} + \beta_2\chi_{2i} + \beta_3\chi_{1i}\chi_{2i} + \varepsilon_i$$

With:

y_i = amount invested in R&D

χ_1 = risk aversion (0/1)⁸

χ_2 = compensation model (0/1)⁹

There are then four groups: two for the risk variable and two for the compensation model. The difference in the means in each variable will be the coefficient. So the coefficient for risk aversion indicates if there is a significant difference in the amount invested in R&D for risk adverse and risk loving participants. The interaction term between risk aversion and compensation model will indicate if the effect of the compensation model is different for participants with differences in risk aversion. Additionally, the following regression will be estimated, once for the short-term bonus group and once for the long-term bonus group.

$$y_i = \beta_0 + \beta_1\chi_{1i} + \beta_2\chi_{3i} + \beta_3\chi_{1i}\chi_{3i} + \varepsilon_i$$

With:

y_i = amount invested in R&D

χ_1 = risk aversion (0/1)¹⁰

χ_3 = shareholder statement (0/1)¹¹

Similar regressions are performed for time preference in this variant of the experiment. In the ESG variant, there are three separate regressions where the compensation model is held constant, as there are three compensation models tested. This procedure will be used for the estimation of all personal characteristics of interest. These regressions include altruism and the ESG view on business.

3.6.2 Sample size

We have a total sample size of 3,004 participants. As every participant completes two versions of the experiment, one in the long-term setting and one in the ESG setting, we have a total of 6,008 observations. 3,004 for the long-term experiment and 3,004 for the ESG experiment. Recall that long term has eight variations in compensation model and shareholder statement and ESG has six variations in compensation model and shareholder statement.

⁷ Six options with equal distances in between, namely 0, 10, 20, 30, 40, or 50.

⁸ Equal or above the median = 1, Below the median = 0

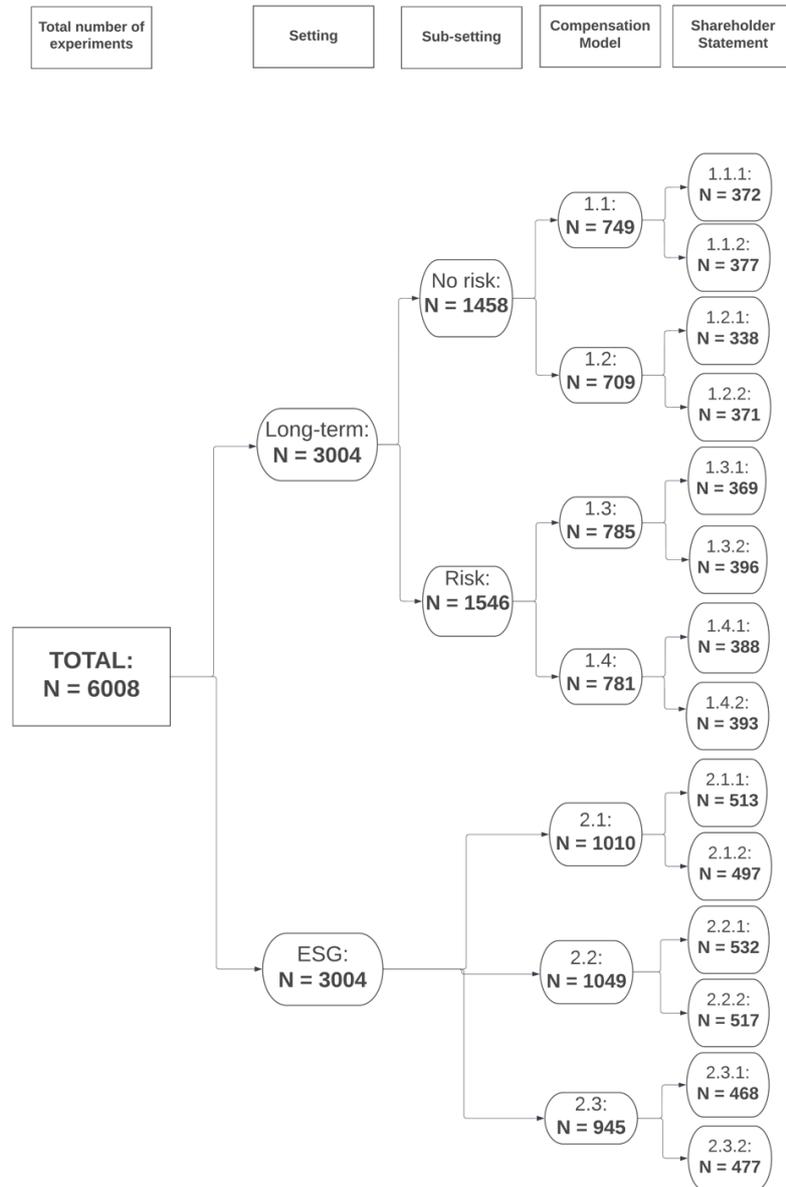
⁹ Long-term bonus = 1, Short-term bonus = 0

¹⁰ Equal or above the median = 1, Below the median = 0

¹¹ Long-term statement = 1, Short-term statement = 0

Furthermore, we split the participant group in two when controlling for background characteristics, for example, a high risk preference and a low risk preference group. This brings the total number of groups at 28. As participants are assigned treatment randomly, the sample size is approximately equally large per variation.

Figure 3.2 Visual representation sample size per experiment



Source: SEO Amsterdam Economics (2022)

An analysis always consists of two groups or two variations. Figure 3.2 visually represents this. When comparing the compensation models in the long-term treatment without risk, disregarding differences in shareholder statements, we compare 1.1 and 1.2. Both 1.1 and 1.2 have respectively 749 and 709 participants, indicating the total sample size for that analysis is 1,458. Similarly, keeping the compensation model constant (e.g. 2.1), but differing between the shareholder statements (2.1.1 and 2.1.2), results in a total sample size of 1,010 participants. Further analysing this result using preferences, such as altruism and shareholder statement, results in 4 groups of both approximately

250 participants. We thus have a sufficient sample size for each analysis, ensuring robust results that are not driven by a few individual participants (also see Box 3.1).

Box 3.1 Using pilot experiment to guide sample size selection

The pilot experiment was an exploratory study and will be used as a baseline to calculate the sample sizes. Similar to this study, the exploratory study has three types of compensation models: long run, long run with risk, and ESG. The long-run and long-run-with-risk treatments used the same control group. The sample size can be calculated on the basis of the primary hypothesis, which is that a different compensation model leads to a difference in investment in R&D.

The following section will summarise the results for the pilot experiment and will derive effect sizes for every compensation model. This is a metric to standardise the difference between means. All effect sizes below 0.2 are considered; around 0.5 is considered a medium effect and a large effect is around 0.8. Cohen's effect size is widely used (Fritz et al., 2012).

- In the experiment with the **long-run** compensation model, the control (N = 113) and treatment (N = 84), the difference was 0.90 (control group mean=28.76, SD=7.34; treatment mean=27.86, SD=8.22). Cohen's effect size is 0.12.
- In the experiment with the **long-run-with-risk** compensation model, the control (N = 113) and treatment (N = 108), the difference was 2.84 (control group mean=28.76, SD=7.34; treatment mean=25.93, SD=8.32). Cohen's effect size is 0.36.
- In the experiment with the **ESG** compensation model, the control (N = 95) and treatment (N = 100), the difference was 2.37 (control group mean=29.47, SD=9.9; treatment mean=27.1, SD=10.47). Cohen's effect size is 0.23.

The information can be used to perform a power analysis. It is important to understand that the parameters for the new experiment are different from the last experiment and that the effect size is expected to be larger for every treatment. We will use the following parameters to estimate the required sample size using the program G*power:

- Alpha = 0.025 (one-tailed)
- Power = 0.80
- d (effect size) = 0.35

The alpha and power levels are commonly used in experimental settings (Suresh & Chandrashekar, 2012). The required sample size is 130 per group or 260 in total with an allocation ratio of 1, meaning both groups have an equal sample size. This shows that a sample size of 1,500 or 2,000 for comparing compensation models gives sufficient power. The same holds for comparing shareholder statements or preferences: each group has at least 130 observations.

The actual effect sizes were a bit higher than 0.35 in the baseline results. In a post-hoc analysis we can establish that the achieved power is 0.99. The power in the personal preferences groups was lower (<0.5) due to a low effect size.

Source: SEO Amsterdam Economics (2022)

3.6.3 Sample selection

Section 2.3.1 elaborated on the best method to select a sample. We obtain our participants from the platform Prolific. The selection criteria for this experiment will be:

- Aged 18 or older
- Fluent in English
- Completed undergraduate degree or higher
- Experience in a management position

This leads to a potential group of 11,113 respondents that have been active in the past 90 days. As we needed 3,000 participants, this would require a response rate of 27 percent over the entire sample. Prolific states that a typical response rate of 40-50 percent can be expected.¹² With result: within one day we obtained the required number of participants.

¹² <https://researcher-help.prolific.co/hc/en-gb/articles/4407449546002-Audience>

4 Results

Setting the right compensation model steers investment in R&D and clean production. Shifting shareholder focus plays an important role in shaping outcomes and combined with the right compensation model leads to the optimal outcome. Preferences and intrinsic motivation change the specifics but not the headline conclusion.

This chapter describes the results of the experiment. It is divided into two sections: the baseline results and the influence of preferences. Each section describes the effect of the compensation model and shareholder statement in the three variants of the experiment: long term (no risk), long-term risk, and ESG. The influence of patience and impatience is described for both long-term variants. Risk aversion is included in the analysis of the long-term variant including risk. Finally, altruism and intrinsic ESG focus play a role in the ESG variant of the experiment.

The sample of 3,004 participants that was obtained through Prolific has a mean age of 39, with a minimum of 19 and a maximum of 84. All participants have at least an undergraduate degree, management experience and were fluent in English. Approximately 54 percent of the sample consists of females and the other 46 percent of males. 16 percent of the participants were students. The highest attained degree of most participants (55 percent) is an undergraduate degree, 39 percent completed a graduate degree and 5 percent a PhD. All statistical tests performed in the results section are using an alpha of 5 percent. As all 3,004 participants took part in two experiments (one long term and one ESG), we have a combined number of 6,008 observations.

To clarify some definitions used in this chapter:

- Short-term bonus refers to the variant with the higher short-term bonus and the lower long-term bonus.
- Long-term bonus refers to the variant with the lower short-term bonus and the higher long-term bonus.
- Higher bonus for the dirty product refers to the variant with the higher bonus for production with a cost to society (dirty production) and a lower bonus for production without a cost to society (clean production).
- Equal bonus refers to the variant with the bonus for production with a cost to society (dirty production) being equal to the bonus for production without a cost to society (clean production).
- Higher bonus for clean product refers to the variant with the lower bonus for production with a cost to society (dirty production) and a higher bonus for production without a cost to society (clean production).
- Short-term shareholder statement refers to the shareholder statement that communicates a focus on short-term revenues
- Long-term shareholder statement refers to the shareholder statement that communicates a focus on long-term revenues
- Pro-profit shareholder statement refers to the shareholder statement that communicates a focus on revenues over a lower cost to society
- Pro-social shareholder statement refers to the shareholder statement that communicates a focus on a lower cost to society over revenues.
- Pressure refers to the shareholder statement

4.1 Baseline results

4.1.1 Long run, no risk

A higher bonus for long-term production leads to a higher allocation of resources to R&D (Table 4.1). This effect is statistically significant and holds for both participants with a short-term (ST) shareholder statement and with a long-term (LT) shareholder statement. The effect of the long-term focused compensation model is highest when there is a short-term shareholder statement, namely 3.6 more units allocated to R&D. For participants with a long-term shareholder statement, the effect is 2.1 more units allocated to R&D.

Table 4.1 Shifting pay and pressure towards the long term increases investment in R&D

	ST bonus		LT bonus
ST shareholder statement	16.3	+	19.9
	↓ +		+ ↓
LT shareholder statement	21.2	+	23.3

Source: SEO Amsterdam Economics (2022), based on 1458 observations

When shareholders have a long-term focus in their statement, participants allocate more resources to R&D, holding the compensation model constant. The monetary incentives of the participants did not change, but changing their focus has a significant effect on their behaviour. This effect is highest when participants have a short-term-focused compensation model, namely 4.9 more units allocated to R&D, compared to 3.4 units when there is a long-term-focused compensation model. Again, both effects are statistically significant.

Investment in R&D is maximised when both the compensation model and the shareholder statement are aligned and focused on the long term. This combination led to 23.3 resources invested in R&D. This is 7 resources more than participants with both a short-term focused compensation model and shareholder statement. This signifies a 43 percent increase in investment in R&D.

The effect of the shareholder statement is larger than the effect of the compensation model. The average effect of the long-term shareholder statement on investment in R&D is 4.2 units, whereas the average effect of the long-term compensation model is 2.9 units. This difference is statistically significant. However, this does not rule out the effectiveness of the compensation model. As mentioned above, the alignment of a higher bonus for long-term production and a long-term orientation of shareholders results in the highest investment in R&D.

Box 4.1 Both the compensation model and shareholder statement are effective in moving participants towards the revenue-maximising investment in R&D

The revenue-maximising level of R&D investment in the long-run experiment was 20 units. A lower or higher allocation than 20 units did not maximise firm revenues. The probability of being at the revenue-maximising level is predicted by means of

logistic regression. Odds ratios above 1 indicate that the group has a significantly higher chance of being at the revenue-maximising level of R&D investment than the baseline group. Odds ratios below one signify a lower chance. Odds ratios where the confidence intervals are around one indicate that there is no significant difference between the two groups. The results are shown in the table below.

Odds ratios and 95% confidence intervals

	Odds ratio	2.50%	97.50%
Long-term Bonus	1.10	1.02	1.18
Long-term Shareholder Statement	1.10	1.02	1.18
Long-term Bonus* Long-term Shareholder Statement	0.93	0.84	1.03

Compared to participants with a high short-term and a short-term shareholder statement:

- A higher *long-term bonus* and a short-term shareholder statement increases the odds of investing 20 units in R&D by 1.10.
- A high short-term bonus and a *long-term shareholder statement* increases the odds of investing 20 units in R&D by 1.10
- The difference of the effect the long-term bonus and shareholder statement is not significant. Both have a similar effect on reaching the revenue-maximising investment in R&D. The alignment of the long-term bonus and long-term shareholder statement thus do not add to the probability of being at the revenue-maximising level.

Source: SEO Amsterdam Economics (2022), based on 1458 observations.

4.1.2 Long-run, risk

The results for the long-run risk treatment are similar to the experiment without risk. A higher bonus for long-term production leads to a higher allocation of resources to R&D (Table 4.2). This effect is statistically significant and holds for both participants with a short-term statement and with a long-term statement. The effect of the long-term focused compensation model is highest when there is a short-term shareholder statement, namely 2.5 more units allocated to R&D. For participants with a long-term shareholder statement, the effect is 2.1 more units allocated to R&D. The effect size for the group with a short-term shareholder statement is about 1 unit smaller than in the no risk treatment (see Table 4.1); for the long-term shareholder statement group this effect is similar to the no-risk treatment.

Table 4.2 With uncertainty, shifting pay and pressure towards the long term still increases investment in R&D

	ST bonus		LT bonus
ST shareholder statement	17.1	+	19.6
	↓ +		+ ↓
LT shareholder statement	22.7	+	24.8

Source: SEO Amsterdam Economics (2022), based on 1546 number observations

When the shareholders focus on the long-term in their statement, participants allocate more resources to R&D, holding the compensation model constant. The monetary incentives of the participants did not change, but changing their focus has a significant effect on their behaviour. This effect is highest when participants have a short-term focused compensation model, namely 5.6 more units allocated to R&D, compared to 5.2 units when there is a long-term focused compensation model. Again, both effects are statistically significant.

Investment in R&D is maximised when both the compensation model and the shareholder statement are aligned and focused on the long-term. This combination led to 24.8 resources invested in R&D. This is almost 8 resources more than participants with both a short-term focused compensation model and shareholder statement. This signifies a 45 percent increase in investment in R&D.

The effect of the shareholder statement is significantly larger than the effect of the compensation model. The average effect of the long-term shareholder statement investment in R&D is 5.4, whereas the average effect of the long-term compensation model was 2.3. This difference is statistically significant. However, this does not rule out the effectiveness of the compensation model, as the alignment results in the highest investment in R&D.

Box 4.2 Compensation model and shareholder statement do not raise odds of being at revenue-maximising allocation in the experiment with a risky outcome of R&D investment

The revenue-maximising level of R&D investment in the long-run experiment with risk is also 20 units. A lower or higher allocation than 20 units did not maximise firm revenues. The probability of being at the revenue-maximising level is predicted by means of logistic regression. The results are shown in the table below:

Odds ratios and 95% confidence intervals

	Odds ratio	2.50%	97.50%
Long-term Bonus	0.95	0.88	1.02
Long-term Shareholder Statement	0.95	0.88	1.02
Long-term Bonus* Long-term Shareholder Statement	1.06	0.96	1.17

None of the different compensation models or shareholder statements have a significant effect on being at the revenue-maximising allocation of 20 units in R&D. This means that these treatments generally raise inputs in R&D to above 20 units, which is sub-optimal in terms of revenue-maximisation.

Source: SEO Amsterdam Economics (2022), based on 1546 observations.

4.1.3 ESG

A higher bonus for clean production leads to the highest production of the clean product (the product without a cost to society). There is a significant increase in the investments in clean production when there is a shift from an equal bonus to a higher bonus for the clean product, both for participants with a pro-profit shareholder statement and a pro-social shareholder statement (Table 4.3). The effect of the compensation model between an equal bonus and a higher bonus for the clean product is 2.7 units in the pro-profit shareholder statement group and 2.4 in the pro-social shareholder statement group. An equal bonus for clean and dirty productions leads to significantly more clean production compared to a compensation model with a focus on dirty production but this increase is solely significant when it is accompanied by a pro-social shareholder statement. The effect between a higher bonus for the dirty product and an equal bonus in the pro-social shareholder statement group is 1.4 units, and this effect in the pro-profit shareholder statement group is 1.1 units (not significant).

Table 4.3 Higher bonuses for clean production and a shareholder focus on clean production are effective

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	23.7	=	24.8	+	27.5
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	26.0	+	27.4	+	29.8

Source: SEO Amsterdam Economics (2022), based on 3004 observations

Box 4.3 A higher bonus for clean production only leads to social-welfare-maximising behaviour when accompanied by a pro-profit shareholder statement

The social-welfare-maximising allocation is 30 units for the production of product 2 (the clean product). However, the revenue-maximising level of investment in product 2 experiment was 20 units. As production of the dirty product (product 1) implies a cost to society, the revenue-maximising allocation is not the social-welfare-maximising allocation. The probability of being at the revenue-maximising level is predicted by means of logistic regression. The results are shown in the table below.

Odds ratios and 95% confidence intervals

	Odds ratio	2.50%	97.50%
Equal Bonus	1.03	0.98	1.10
Higher bonus for clean product	1.17	1.10	1.24
Pro-social Shareholder Statement	1.10	1.04	1.17
Equal Bonus * Pro-social Shareholder Statement	0.99	0.92	1.08
Higher bonus for clean product * Pro-social Shareholder Statement	0.93	0.86	1.01

Compared to participants with a higher bonus for the dirty product and a pro-profit shareholder statement:

- An equal bonus and a pro-profit shareholder statement does not have a significant effect the odds of allocating 30 units to clean production.
- A higher bonus for the clean product and a pro-profit shareholder statement increases the odds of allocating 30 units to clean production by 1.17.
- A higher bonus for the dirty product and a pro-social shareholder statement increases the odds of allocating 30 units to clean production by 1.10.
- There are no significant differences in the effect of equal bonus and the effect pro-social shareholder statement.
- There are no significant differences in the effect of higher bonus for the clean product and the effect pro-social shareholder statement.

Source: SEO Amsterdam Economics (2022), based on 3004 observations.

Participants that were shown a pro-social shareholder statement invest significantly more in the production of the clean product than participants with a pro-profit shareholder statement. The effect can again not be attributed to a monetary reward, as the shareholder statement was not enforced in any way. In all three compensation model

groups there is a significant increase. The effect of the pro-social shareholder statement was 2.3 in the higher bonus for the dirty product group, 2.6 in the equal bonus group, and 2.3 in the higher bonus for the clean product group.

The production of the clean product was the highest when participants had a higher bonus for the clean product paired with a pro-social shareholder statement. This led to an allocation of 29.8 units towards clean production. This is 6.1 units more than people with a higher bonus for the dirty product and a pro-social shareholder statement or in other words a 26 percent increase.

The effect of the compensation model is not significantly different from the effect of the shareholder statement. This means that both mechanisms have an equally large (and positive) effect on the allocation of resources to clean production.

4.2 Influence of preferences

As described in section 3.5, we divide participants into two groups for each measured preference. The split between two groups allows for an insightful comparison between different preferences. However, it may be that there are also differences between participants within a group, as the questions used to measure these preferences used scales. These differences are then not captured by our analysis.¹³

4.2.1 Effect of time preference on results for long-run, no risk

Bonuses and shareholder statements are effective in raising investment in R&D for both short-term and long-term oriented participants¹⁴ (see respectively Table 4.4 and Table 4.5). However, long-term oriented participants react stronger to higher long-term bonuses than short-term oriented participants. In a situation with a higher short-term bonus, long-term oriented participants devote fewer resources to R&D than short-term oriented participants, disregarding the shareholder statement. However, in a situation with a higher long-term bonus, long-term oriented participants devote more resources to R&D than short-term oriented participants. This shows that long-term orientation and a long-term bonus go hand-in-hand to increase investments in R&D.

Furthermore, the effect of a high bonus for long-term production is the highest when there is a short-term shareholder statement; short-oriented participants allocate 2.5 units more to R&D compared to 1.4 in the case of a long-term shareholder statement. For long-term oriented participants, the effects of a long-term bonus are respectively 5.1 and 3.2 units.

¹³ Appendix B describes additional results, including the effect of gender on investment in R&D and clean production. Males tend to invest less in R&D than females in our setting, but there is no difference for investment in clean production. The results further confirm the main baseline results.

¹⁴ Participants that answered below the median, lower than 7, are defined as short-term oriented, and participants that answered on the median and higher, seven and higher, are defined as long-term oriented.

Table 4.4 Short-term oriented participants invest more in R&D when shareholders prefer long-term production, and the compensation model has a higher reward for long-term production

	ST bonus		LT bonus
ST shareholder statement	17.2	+	19.7
	↓ +		+ ↓
LT shareholder statement	21.4	+	22.8

Source: SEO Amsterdam Economics (2022), based on 862 observations

Table 4.5 Long-term oriented participants invest more in R&D when shareholders prefer long-term production, and the compensation model has a higher reward for long-term production

	ST bonus		LT bonus
ST shareholder statement	15.1	+	20.2
	↓ +		+ ↓
LT shareholder statement	20.9	+	24.1

Source: SEO Amsterdam Economics (2022), based on 596 observations

The results in Table 4.4 and Table 4.5 show differences in the effects of the compensation model and shareholder statement. Table 4.6 and Table 4.7 test these differences formally. Table 4.6 shows the differences holding the shareholder statement constant, while Table 4.7 shows the differences holding the compensation model constant.

In the group where the short-term shareholder statement group is kept fixed, a long-term bonus has a larger effect on long-term oriented participants than on short-term oriented participants. In general, long-term oriented participants with a short-term bonus invest 2.1 units less in R&D than the short-term oriented participants with a short-term bonus (Table 4.6). For the short-term oriented participants, a long-term bonus raises investment in R&D by 2.5 units. For the long-term oriented participants, the effect of a long-term bonus is 2.6 units larger, so the total effect is 5.1. Concluding, long-term oriented participants react stronger to a long-term bonus when there is a short-term shareholder statement.

In the long-term shareholder statement group, long-term oriented participants do not significantly differ from short-term oriented participants regarding the effect of the long-term bonus treatment (Table 4.6). The effect of the long-

term compensation model is still positive but not significantly different from short-term oriented participants than for long-term oriented participants.

Table 4.6 The effect of the long-term compensation model for short-term oriented participants is 2.6 larger than for long-term oriented participants in the short-term shareholder statement group

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Long-term orientation ¹⁵	-2.112** (1.053)	-0.479 (0.959)
Long-term bonus	2.530*** (0.979)	1.390 (0.875)
Long-term orientation * Long-term bonus	2.630* (1.534)	1.748 (1.368)
Constant	17.176*** (0.682)	21.422*** (0.623)
Observations	710	748
Adjusted R2	0.033	0.011
Residual Std. Error	10.025 (df = 706)	9.194 (df = 744)
F-statistic	9.113*** (df = 3; 706)	3.883*** (df = 3; 744)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Next, the compensation model is held constant (Table 4.7). In the group with a short-term bonus, there is no statistically different effect of the shareholder statement for long-term or short-term oriented people. Long-term oriented participants do, however, invest less in R&D than short-term oriented participants (-2.1)

In the group with a long-term bonus, there is no statistical difference between participants who are long-term oriented or short-term oriented in the amount they invest in R&D. Furthermore, there is no statistically different effect of the shareholder statement for long-term or short-term oriented people.

Table 4.7 No difference in the amount invested in R&D by long-term shareholder group for long-term and short-term participants holding the bonus constant

Dependent variable: Amount invested in R&D	(1) Short-term bonus	(2) Long-term bonus
Long-term orientation ¹⁶	-2.112** (1.025)	0.518 (1.051)

¹⁵ The main effect of long-term orientation, when the participants are not split into the shareholder groups, is -1.28 and not significant.

¹⁶ The main effect of long-term orientation, when the participants are not split into the compensation model groups, is -0.96 and not significant.

Dependent variable: Amount invested in R&D	(1) Short-term bonus	(2) Long-term bonus
Long-term shareholder statement	4.246*** (0.937)	3.107*** (0.915)
Long-term orientation * Long-term shareholder statement	1.633 (1.444)	0.751 (1.453)
Constant	17.176*** (0.664)	19.706*** (0.662)
Observations	749	709
Adjusted R2	0.062	0.030
Residual Std. Error	9.755 (df = 745)	9.450 (df = 705)
F-statistic	17.429*** (df = 3; 745)	8.265*** (df = 3; 705)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

4.2.2 Effect of time preference on results for long-run, risk

Bonuses and the shareholder focus are effective for both short-term and long-term oriented participants in a situation with uncertainty. Long-term oriented participants seem to react stronger to higher long-term bonuses than short-term oriented participants. However, this effect is moderate compared to the situation without risk. In case of a short-term shareholder statement, short-oriented participants allocate 1.9 units more to R&D with a compensation model that is focused on the long-term compared to 2.0 in case of a long-term shareholder statement. For long-term oriented participants, these effects are respectively 3.3 and 2.2.

Table 4.8 Short-term oriented participants invest more in R&D when there is a long-term bonus and shareholders give a statement in favour of the long-term, even in case of risk.

	ST bonus		LT bonus
ST shareholder statement	17.0	+	18.9
	↓ +		+ ↓
LT shareholder statement	22.6	+	24.6

Source: SEO Amsterdam Economics (2022), based on 883 observations

Table 4.9 Long-term oriented participants invest more in R&D when there is a long-term bonus and shareholders give a statement in favour of the long-term, even in case of risk.

	ST bonus		LT bonus
ST shareholder statement	17.3	+	20.6
	↓ +		+ ↓
LT shareholder statement	22.8	+	25.0

Source: SEO Amsterdam Economics (2022), based on 663 observations

The results in Table 4.8 and Table 4.9 show differences in the effects of the compensation model and shareholder statement. Table 4.10 and Table 4.11 test these differences formally. Table 4.10 shows the differences holding the shareholder statement constant, while Table 4.11 shows the differences holding the compensation model constant.

In the short-term shareholder group, long-term oriented participants do not statistically differ in the amount invested in R&D from short-term oriented participants (Table 4.10). The effect of the long-term bonus is not different for short-term and long-term oriented people. The results also hold for the long-term shareholder statement group.

Table 4.10 The effect of the long-term bonus is not different for short-term and long-term oriented people holding the shareholder statement constant.

Dependent variable:	Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Long-term orientation ¹⁷	0.312 (1.043)	0.238 (1.023)	
Long-term bonus	1.967** (0.950)	2.011** (0.951)	
Long-term orientation * Long-term bonus	1.307 (1.458)	0.203 (1.445)	
Constant	16.967*** (0.682)	22.576*** (0.664)	
Observations	757	789	
Adjusted R2	0.015	0.007	

¹⁷ The main effect of long-term orientation, when the participants are not split into the shareholder groups, is 0.24 and not significant.

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Residual Std. Error	9.912 (df = 753)	10.054 (df = 785)
F-statistic	4.923*** (df = 3; 753)	2.968** (df = 3; 785)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Next, the compensation model is held constant (Table 4.11). In the short-term bonus group, long-term oriented participants do not statistically differ in the amount invested in R&D from short-term oriented participants. The effect of the long-term shareholder statement is again not different for short-term and long-term oriented people. The table shows that the effect of the long-term shareholder statement is sizeable, but the size does not differ for short-term or long-term oriented participants. The results also hold participants who received a compensation model with a bonus with a focus on the long term.

Table 4.11 Long-term oriented participants do not statistically differ in the amount invested in R&D from short-term oriented participants holding the compensation model constant.

Dependent variable: Amount invested in R&D	(1) Short-term bonus	(2) Long-term bonus
Long-term orientation ¹⁸	0.312 (1.000)	1.619 (1.073)
Long-term shareholder statement	5.610*** (0.907)	5.654*** (0.992)
Long-term orientation * Long-term shareholder statement	-0.074 (1.391)	-1.177 (1.508)
Constant	16.967*** (0.654)	18.933*** (0.696)
Observations	765	781
Adjusted R2	0.076	0.057
Residual Std. Error	9.505 (df = 761)	10.433 (df = 777)
F-statistic	21.971*** (df = 3; 761)	16.798*** (df = 3; 777)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

¹⁸ The main effect of long-term orientation, when the participants are not split into the compensation model groups, is 0.96 and not significant.

4.2.3 Effect of risk preference on results for long-run, risk

There is no clear difference in the number of resources devoted to R&D by risk-averse participants and risk-loving participants¹⁹. A compensation model with a higher reward for long-term production does increase the resources invested in R&D significantly for both groups. For risk-averse participants the number of resources invested in R&D increase by 1.9 and 2.7, respectively for the short-term shareholder statement and the long-term shareholder statement. For risk-loving participants the increase is 3.5 and 0.9 units, again respectively for the short-term shareholder statement and the long-term shareholder statement. The 0.9 increase for risk-averse participants with a long-term shareholder statement is not significant.

For both the risk-averse and the risk-loving groups, a long-term focused shareholder statement has a large positive effect. For risk-averse oriented participants, the average units devoted to R&D is 4.2 higher with a short-term focused compensation model and 5.0 with a long-term focused compensation model when shifting from a short-term to a long-term shareholder statement. For risk-loving participants the increase in units devoted to R&D from a short-term shareholder statement to a long-term shareholder statement is 8.0 and 5.4, again respectively for the short-term compensation model and the long-term compensation model.

Table 4.12 Risk-averse oriented participants invest more in R&D when there is a long-term bonus and shareholders give a statement in favour of the long-term

	ST bonus		LT bonus
ST shareholder statement	17.3	+	19.2
	↓ +		+ ↓
LT shareholder statement	21.5	+	24.2

Source: SEO Amsterdam Economics (2022), based on 931 observations

¹⁹ Participants who answered above the median (6) and higher were assigned to the risk-loving oriented group. Participants who answered below the median were defined as risk-averse oriented participants.

Table 4.13 Risk-loving participants invest more in R&D when there is a long-term bonus and shareholders give a statement in favour of the long-term

	ST bonus		LT bonus
ST shareholder statement	16.7	+	20.2
	↓ +		+ ↓
LT shareholder statement	24.7	+	25.6

Source: SEO Amsterdam Economics (2022), based on 615 observations

The differences between Table 4.12 and Table 4.13 are tested in Table 4.14 and Table 4.15. Table 4.14 shows the differences while holding the shareholder statement constant and Table 4.15 shows the differences while holding the compensation model constant.

In the short-term shareholder group, risk-loving participants do not statistically differ in the amount invested in R&D from risk adverse participants (Table 4.14). The effect of the long-term bonus is not different for risk-loving and risk-averse people.

In the long-term shareholder group, risk-loving participants invest 3.2 more than risk-averse participants. This effect is significant. The effect of the long-term bonus is, again, not statistically different for risk-loving and risk-averse people.

Table 4.14 Risk-loving participants invest 3.2 more than risk-averse participants in the long-term shareholder group.

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Risk-loving ²⁰	-0.622 (1.064)	3.208*** (1.038)
Long-term bonus	1.878** (0.927)	2.710*** (0.919)
Risk-loving * Long-term bonus	1.597 (1.477)	-1.842 (1.454)
Constant	17.336*** (0.656)	21.486*** (0.633)
Observations	757	789

²⁰ The main effect of Risk-loving, when the participants are not split into the shareholder groups, is 1.30 and not significant.

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Adjusted R2	0.014	0.021
Residual Std. Error	9.921 (df = 753)	9.983 (df = 785)
F-statistic	4.461*** (df = 3; 753)	6.711*** (df = 3; 785)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Next, the compensation model is held constant (Table 4.15). Risk-loving participants do not statistically differ in the amount invested in R&D from short-term oriented participants in the short-term bonus group. The effect of the long-term shareholder statement is 3.8 larger for risk-loving participants than risk-averse people.

In the long-term bonus group, risk-loving participants do not statistically differ in the amount invested in R&D from risk-averse participants. The effect of the long-term bonus is again not statistically different for risk-loving and risk-averse people.

Table 4.15 The effect of the long-term shareholder statement is 3.8 units larger for risk-loving participants than risk-averse people in the short-term bonus group.

Dependent variable: Amount invested in R&D	(1) Short-term bonus	(2) Long-term bonus
Risk-loving ²¹	-0.622 (1.012)	0.975 (1.077)
Long-term shareholder statement	4.150*** (0.864)	4.982*** (0.980)
Risk-loving * Long-term shareholder statement	3.830*** (1.410)	0.391 (1.513)
Constant	17.336*** (0.624)	19.214*** (0.689)
Observations	765	781
Adjusted R2	0.089	0.057
Residual Std. Error	9.437 (df = 761)	10.433 (df = 777)
F-statistic	25.918*** (df = 3; 761)	16.805*** (df = 3; 777)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

²¹ The main effect of Risk-loving, when the participants are not split into the compensation model groups, is 0.29 and not significant.

4.2.4 Effect of altruism on results ESG

There is a limited difference in the number of resources devoted to clean production between low-altruistic and high-altruistic participants.²² Although, the number of units invested in the clean product is slightly higher for participants with high altruism. However, this difference is not significant therefore one should not read too much into this difference. In both cases, the change from an equal to a clean compensation model significantly increases the number of resources devoted to clean production. The effect is present despite the type of shareholder statement present. When bonuses are shifted in favour of dirty production to an equal bonus for clean and dirty production, both low and high altruistic participants invest more in clean production. However, the effect is not significant for low altruistic participants.

Table 4.16 Mean input in product 2 (clean product) for participants with low altruism

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	23.7	= →	24.1	+ →	27.1
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	25.8	= →	26.9	+ →	29.2

Source: SEO Amsterdam Economics (2022), based on 1865 observations

Furthermore, the shareholder statement also affects the resource allocation. A pro-social shareholder statement, compared to a pro-profit shareholder statement, increases investment in clean production for all types of compensation models.

²² Participants that donated less than £50 (the median) out of £1000 to charity are assigned to the low altruism group. Participants that donated more than or equal to £50 out of £1000 to charity are assigned to the high altruism group.

Table 4.17 Mean input in product 2 (clean product) for participants with high altruism

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	23.6	+	25.8	+	28.1
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	26.5	+	28.3	+	30.8

Source: SEO Amsterdam Economics (2022), based on 1139 observations

The differences between Table 4.16 and Table 4.17 are tested in Table 4.18 and Table 4.19. Table 4.18 shows the differences while holding the shareholder statement constant and Table 4.19 shows the differences while holding the compensation model constant.

In the pro-social shareholder group, high-altruism participants do not statistically differ in the amount invested in R&D from low-altruism participants (Table 4.18). The effect of the equal bonus and higher bonus for the clean product is not different for high-altruism and low-altruism people. The same results hold for the participants in the pro-profit shareholder group.

Table 4.18 High-altruism participants do not statistically differ in the amount invested in R&D from low-altruism participants holding the shareholder statement constant.

Dependent variable: Amount invested in clean product	(1) Pro-profit statement	(2) Pro-social statement
High altruism ²³	-0.170 (1.123)	0.685 (1.008)
Equal bonus	0.375 (0.941)	1.071 (0.867)
Higher bonus for clean product	3.367*** (0.932)	3.385*** (0.851)
High altruism * Equal bonus	1.891 (1.549)	0.740 (1.396)
High altruism * Higher bonus for clean product	1.137 (1.537)	0.933 (1.388)

²³ The main effect of altruism, when participants are not split into shareholder statement groups, is 0.25 and non-significant.

Dependent variable: Amount invested in clean product	(1) Pro-profit statement	(2) Pro-social statement
Constant	23.737*** (0.679)	25.789*** (0.607)
Observations	1,513	1,491
Adjusted R2	0.017	0.022
Residual Std. Error	11.694 (df = 1507)	10.586 (df = 1485)
F-statistic	6.350*** (df = 5; 1507)	7.572*** (df = 5; 1485)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

In Table 4.19, the compensation model is held constant. In all three compensation model groups, high-altruism participants do not statistically differ in the amount they invest in clean production from low-altruism participants. Additionally, there is no statistical difference in the effect of the pro-social shareholder statement for high or low altruism participants.

Table 4.19 High-altruism participants do not statistically differ in the amount they invest in R&D from low-altruism participants holding the compensation model constant

Dependent variable: Amount invested in clean product	(1) Higher bonus for dirty product	(2) Equal bonus	(3) Higher bonus for clean product
High altruism ²⁴	-0.170 (1.093)	1.721 (1.052)	0.967 (0.949)
Pro-social shareholder statement	2.052** (0.929)	2.748*** (0.931)	2.070** (0.830)
High altruism * Pro-social shareholder statement	0.855 (1.540)	-0.297 (1.487)	0.651 (1.345)
Constant	23.737*** (0.661)	24.112*** (0.643)	27.104*** (0.578)
Observations	945	1,010	1,049
Adjusted R2	0.008	0.015	0.013
Residual Std. Error	11.388 (df = 941)	11.526 (df = 1006)	10.573 (df = 1045)
F-statistic	3.530** (df = 3; 941)	6.083*** (df = 3; 1006)	5.602*** (df = 3; 1045)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

²⁴ The main effect of altruism, when participants are not split into compensation model groups, is 0.88 and non-significant.

4.2.5 Effect of ESG focus on results ESG

Participants²⁵ who believe businesses should focus more on ESG related topics, invest more in clean production than participants that give more weight to non-ESG related goals. For both groups, a compensation model more in favour of clean production increases the investment in cleaner production. However, when there is a shift between a compensation model that focuses on dirty production (higher bonus for the dirty product) to a model where dirty and clean production are equally rewarded (equal bonus), the increase is in some cases not statistically significant. The exception is for participants with a pro-profit shareholder statement and a low ESG view and for the participants with a pro-social shareholder statement and a high ESG view; for these people, the increase is significant. Again, it becomes clear that participants with a pro-social shareholder statement on average invest more in clean production than participants who receive a pro-profit shareholder statement.

Table 4.20 Mean input in product 2 for participants with low ESG view

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	22.1	+	24.1	+	26.3
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	25.0	=	26.3	+	28.7

Source: SEO Amsterdam Economics (2022), based on 1848 observations

²⁵ In the experiment we asked participants to rank three objectives that businesses should focus on. There were 12 options in a randomised order where participants could choose from. Six were about ESG and the other six about profit or development. A maximum of six points should be obtained; participants received three points if an ESG option was chosen first, two points if they had an ESG option on the second place and one point for an ESG option on the third place. Participants with 0-2 points are defined with a low ESG view and participants with 3-6 points with a high ESG view. For the same analysis where the two groups are divided into groups 0-3 and 4-6 is included in the appendix as a robustness check, the same conclusions hold.

Table 4.21 Mean input in product 2 for participants with high ESG view

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	24.7	= →	25.2	+ →	28.2
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	26.7	+ →	28.2	+ →	30.5

Source: SEO Amsterdam Economics (2022), based on 1156 observations

The differences between Table 4.20 and Table 4.21 are tested in Table 4.22 and Table 4.23. Table 4.22 shows the differences while holding the shareholder statement constant and Table 4.23 shows the differences while holding the compensation model constant.

In the pro-profit statement group, participants with high ESG views invested 2.5 units more in clean production than participants with low ESG views (Table 4.22). The effect of a compensation model with an equal bonus and higher bonus for the clean product is not different for people with high ESG views and low ESG views. Receiving a higher bonus for the clean product increased investment in clean production by 4.1 units compared to the situation with the higher bonus for the dirty product.

In the pro-social statement group, participants with high ESG views invested 1.7 units more in clean production than participants with low ESG views. This result is statistically significant. Again, the effect of the equal bonus and higher bonus for the clean product the same for people with a high or low ESG view.

Table 4.22 Participants with high ESG views invested 2.5 units more in clean production than participants with low ESG views in the pro-profit group.

Dependent variable: Amount invested in clean product	(1) Pro-profit statement	(2) Pro-social statement
High ESG view ²⁶	2.507** (1.107)	1.725* (0.989)
Equal bonus	1.959* (1.173)	1.332 (1.072)
Higher bonus for clean product	4.163*** (1.191)	3.706*** (1.069)

²⁶ The main effect of High ESG view, when the participants are not split into the shareholder groups, is 2.09**.

Dependent variable: Amount invested in clean product	(1) Pro-profit statement	(2) Pro-social statement
High ESG view * Equal bonus	-1.372 (1.521)	0.132 (1.383)
High ESG view * Higher bonus for clean product	-0.637 (1.520)	0.075 (1.374)
Constant	22.143*** (0.865)	25.000*** (0.767)
Observations	1,513	1,491
Adjusted R2	0.021	0.025
Residual Std. Error	11.670 (df = 1507)	10.570 (df = 1485)
F-statistic	7.587*** (df = 5; 1507)	8.548*** (df = 5; 1485)

Source: SEO Amsterdam Economics (2022). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Consecutively, the compensation model is held constant (Table 4.23). In the higher bonus for the dirty product group and the higher bonus for the clean product group, participants with high ESG views invested in the clean product than participants with low ESG views, 2.5 and 1.87 units more, respectively. In the equal bonus group, participants with a high ESG view do not statistically differ in the amount they invest in clean production from participants with a low ESG view. Additionally, in all bonus groups there is no statistical difference in the effect of the pro-social shareholder statement for participants with high or low ESG views.

Table 4.23 Participants with a high ESG view do not statistically differ in the amount they invest in clean product from participants with a low ESG view holding the compensation model constant.

Dependent variable: Amount invested in clean product	(1) Higher bonus for dirty product	(2) Equal bonus	(3) Higher bonus for clean product
High ESG view ²⁷	2.507** (1.075)	1.135 (1.030)	1.871** (0.942)
Pro-social shareholder statement	2.857** (1.176)	2.230** (1.131)	2.401** (1.050)
High ESG view * Pro-social shareholder statement	-0.783 (1.511)	0.721 (1.475)	-0.071 (1.339)
Constant	22.143*** (0.841)	24.101*** (0.783)	26.305*** (0.741)
Observations	945	1,010	1,049

²⁷ The main effect of High ESG view, when the participants are not split into the bonus groups, is 1.86**.

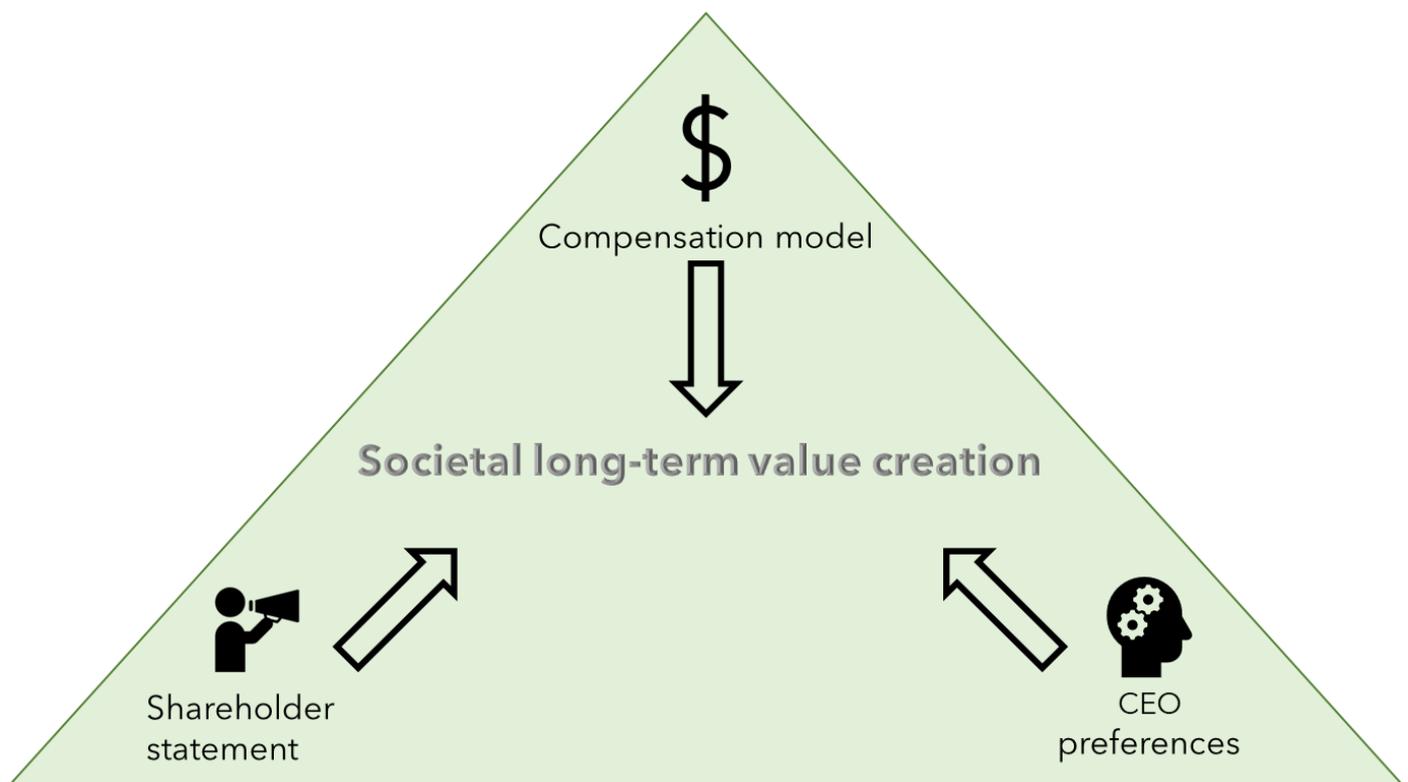
Dependent variable: Amount invested in clean product	(1) Higher bonus for dirty product	(2) Equal bonus	(3) Higher bonus for clean product
Adjusted R2	0.016	0.015	0.016
Residual Std. Error	11.342 (df = 941)	11.527 (df = 1006)	10.555 (df = 1045)
F-statistic	6.110*** (df = 3; 941)	6.013*** (df = 3; 1006)	6.817*** (df = 3; 1045)

Source: Source: SEO Amsterdam Economics (2022). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

5 Conclusion

Pay matters: setting compensation incentives for R&D and clean production increases investment in R&D and clean production. Preference matters: participants with an ESG-oriented view on business invest more in clean production. Pressure matters: shareholder statements shape allocation of resources. Aligning these three improves societal long-term value creation.

Figure 5.1 Alignment of compensation model, shareholder statement, and CEO preferences contributes to societal long-term value creation



Source: SEO Amsterdam Economics (2022).

Both the compensation model and the shareholder statement influence production decisions of participants in our experiment. Our findings suggest that a compensation model with a higher bonus for long-term production increases R&D investment. A compensation model with a larger focus on ESG increases investment in clean production in general. Furthermore, the shareholder statement also influences resource allocation. With a long-term shareholder statement or with a pro-social shareholder statement, participants allocate more resources to R&D and clean production, respectively. Finally, preferences also influence allocation decisions. However, preferences seem to have limited influence on the effect on the compensation models and shareholder statements, with some exceptions. This indicates that a compensation model with a long-term focus or an ESG focus influences participants with different preferences to the same extent. The same holds for a compensation model with an ESG focus, participants with different preferences respond in a similar way to a change in compensation.

Our conclusions are elaborated on below. In the first paragraph, we discuss the baseline results. Before the start of the experiment, we formulated the five hypotheses presented in Chapter 3. The hypotheses are about the baseline effect of shareholder statements and compensation model without taking individual preferences into account. Our experiment yields results with which we are able to accept or reject the hypotheses.

5.1 Baseline results

Hypothesis 1: Participants with a higher bonus for long-term production allocate more resources to R&D than participants with a higher bonus for short-term production.

These estimated coefficients suggest that participants with a higher bonus for long-term production allocate more resources to R&D than participants with a higher bonus for short-term production. This effect is present both in the case when there is risk and no risk regarding R&D production. Furthermore, the effect is statistically significant, regardless of the shareholder statement given. The tests yield significant results and thus confirm the hypothesis. Setting a higher bonus for long-term production improves R&D investment. In our experimental setting, the total units invested in R&D increase by 9-22 percent, with an average of 14 percent, depending on the risk setting and shareholder statement.

Hypothesis 2: Participants with a pro long-term shareholder statement allocate more resources to R&D than participants with a pro short-term statement, keeping the compensation model constant.

The estimated coefficients show that a pro long-term shareholder statement raises the allocation of resources to R&D compared to a pro short-term statement, keeping the compensation model constant. This effect is present both in the case when there is risk and no risk regarding R&D production. The t-tests yield significant results and thus confirm the hypothesis. On average, a long-term shareholder statement leads to an increase in the number of units devoted to R&D by 27 percent, with a range of 17 - 33 percent, depending on the risk setting and the compensation model.

Hypothesis 3: Participants with a higher bonus for the product without a cost to society allocate more resources to the production of this product than participants who receive an equal bonus for the product with and without cost to society.

In our experiment, participants with a higher bonus for the product without a cost to society allocate more resources to clean production than participants who receive an equal bonus for dirty and clean production. This is regardless of the statement made by the shareholders. All tests yield significant results and thus the hypothesis is accepted. A clean compensation model increases the investment in clean production by 10 percent on average.

Hypothesis 4: Participants with a higher bonus for the product with a cost to society allocate more resources to the production of this product than participants who receive an equal bonus for both products.

The estimated coefficients show that participants with a higher bonus for the dirty product (with a cost to society, i.e. negative externalities) allocate more resources to dirty production than participants who receive an equal bonus for both products. For participants who receive a pro-profit shareholder statement, the amount of resources allocated to the clean product decreases insignificantly when dirty production is rewarded less. Participants who receive a pro-social statement do allocate significantly more resources to clean production when clean production is equally

rewarded to dirty production; the units invested in clean production increase by approximately 5 percent. As the first t-test yields a non-significant result while the second t-test is significant; the hypothesis is partially accepted.

Hypothesis 5: *Participants with a pro-social shareholder statement allocate more resources to the product without a cost to society than participants with a pro-profit statement, keeping the compensation model constant.*

Data analysis shows that participants with a pro-social shareholder statement allocate more resources to the product without a cost to society compared to participants with a pro-profit statement. This is the case under all three types of compensation models. On average, the effect of a pro-social shareholder statement on the number of units devoted to clean production is 10 percent. Therefore, we conclude that the hypothesis is accepted.

Overall, the combination of the compensation model and the shareholder statement with a long-term focus leads to a 43 percent higher investment in R&D, compared to a compensation model and shareholder statement favouring short-term profits over long-term profits. In the setting with uncertainty about the success of R&D investments, this effect is 45 percent.

The alignment of the compensation model and shareholder statement focused on clean production increases investment in clean production by 26 percent, compared to a compensation model focused on dirty production and a pro-profit shareholder statement.

5.2 The effect of preferences

In Chapter 4 we also evaluate whether the effect of different compensation models and shareholder statements differs between groups with different measured preferences. To this end, we divide the participants in two groups based on the median level of time/risk/social preferences in the sample. Additionally, we divide the participants in two groups based on how ESG focused their view on business is. In general, we conclude that the preferences affect allocation and outcomes, but the effect of a new compensation model is similar for different groups with different preferences.

Time preference

In a world without risk, long-term oriented participants react stronger to long-term bonuses than short-term oriented participants when there is a short-term shareholder statement. Bonuses and shareholder statements with a long-term focus are effective in raising investment in R&D for both short-term and long-term oriented participants. However, with a short-term shareholder statement, a long-term bonus has a larger effect on long-term oriented participants than on short-term oriented participants. With a long-term shareholder statement there is no significant difference. Furthermore, there is no statistically different effect of the shareholder statement for long-term or short-term oriented people. Thus, both types of people react similarly to shareholder statements.

In a world with risk, there is no significant difference in the effect of the compensation model between long-term and short-term oriented participants. This is the case in both the group with the short-term shareholder statement and in the group with the long-term shareholder statement. Moreover, long-term oriented participants do not significantly differ in the amount invested in R&D from short-term oriented participants, both in the short-term bonus group as in the long-term bonus group.

The evidence for a different effect of a compensation model between long-term and short-term oriented participants seems to be limited in our experimental setup. In addition, there is no statistically significant difference in the effect of the shareholder statement between the two groups.

Risk preference

For both the risk-averse and the risk-loving groups, a long-term focused shareholder statement has a large positive effect. The effect of the long-term bonus is similar for both risk-averse and risk-oriented participants. This is the case both with a long-term shareholder statement and with a short-term shareholder statement. Risk-averse and risk-loving oriented participants seem to react the same to the new long-term focused compensation model.

We measure a difference between the amount invested in R&D between the two groups. Risk-loving participants who receive a long-term shareholder statement invest significantly more in R&D than risk-loving participants who receive a short-term shareholder statement. Additionally, the effect of the long-term shareholder statement is significantly larger for risk-loving people in the short-term bonus treatment. This difference is not present in the long-term bonus group.

There is no statistically significant difference between risk-loving and risk-averse participants on the compensation model. Furthermore, there is limited evidence that risk-loving participants invest more in R&D than risk-averse participants. This is only in the case when participants receive a long-term shareholder statement.

Altruism

We measure no statistically significant difference in the number of resources devoted to clean production and in the effect of the compensation model between low-altruistic and high-altruistic participants. For both low-altruistic and high-altruistic participants, the shift from an equal compensation model to a clean compensation model significantly increases the amount invested in clean production. A shift from a dirty to an equal compensation model also increases the amount invested in clean production, but this increase is only significant for high-altruistic participants. However, low-altruistic and high-altruistic participants do not react significantly different to the compensation model.

In all cases, a pro-social shareholder statement does have a positive effect on the amount invested in clean production for both low-altruistic as high-altruistic participants. In all three compensation model groups, there is no statistical difference in the effect of the pro-social shareholder statement for high-altruistic or low-altruistic participants.

Low-altruistic and high-altruistic participants react similarly to a new compensation model and to shareholder statements.

ESG focus

Participants who believe business should focus more on ESG-related goals, invest more resources in clean production than participants who focus on non-ESG goals. However, bonuses work for both groups in increasing investment in clean production. When shifting from a dirty to an equal compensation model, the amount invested in clean production is also positive but only significant for participants with a low ESG view under a pro-social shareholder statement.

There is no significant difference between the effect of a pro-social shareholder statement and a higher bonus for clean production for participants with a low and a high ESG view. With a pro-profit shareholder statement,

participants with a high ESG view invest significantly more in clean production than participants with low ESG views, but there is still no difference of the effect of the compensation model. In all cases, a pro-social shareholder statement increases the amount invested in clean production.

A pro-social shareholder statement does not affect the amount invested in clean production by participants with a low ESG view and participants with a high ESG view differently. In all cases, it raises investment. There is also no difference between how the two groups react to a new compensation model. However, with a pro-profit statement participants with a high ESG view do invest more in clean production.

5.3 Bottom line

The objective of this research is to analyse how a CEO compensation model can contribute to creating long-term financial value and non-financial value. Based on the research in this report, we conclude the following.

- Incentives work. Participants in the lab experiments (executives) make different choices for investment in R&D and clean production depending on the compensation model assigned to them
- Incentives lead to different allocations for different types of executives and for executives in different settings. Patience, risk-aversion or pro-social preferences, or an ESG-focused view on business, or having profit-oriented shareholders; all these aspects do not change the fact that different compensation incentives affect executive behaviour.
- Participants that have an ESG-focused view on business more often choose to invest in clean production, regardless of their compensation model.
- Participants with pro-ESG shareholders invest more in clean production, regardless of their compensation model. Participants with long-term oriented shareholders invest more in R&D, regardless of their compensation model.
- The experiments show that there are various channels to influence investment in R&D or clean production. Namely, incentives for the executive (compensation model), characteristics of the executive (ESG-focused view on business), and the context in which the executive operates (shareholder focus). These channels can be additive: the participants who invest most in clean production, have a pro-ESG compensation model, have an ESG-focused view on business, and have pro-ESG shareholders.
- These conclusions suggest that various governance instruments have a role in supporting firms' ESG performance, varying from engagement with and voting behaviour of long-term/pro-ESG shareholders, to the selection and nomination of executives, to executive compensation. A practical follow-up question is how to organise the interplay between these instruments and let the executive, the shareholder, and the supervisory board all take their roles.

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Appendix A Additional information experimental design

Appendix A.1 Additions to pilot experiment

Compared to the pilot version of this experiment, which was performed in Q1 and Q2 of 2021, this experiment contains a few additions. These are:

- The question on the view on business (intrinsic motivation)
- Shareholder statements
- Different bonus parameters for status quo in long-term experiment to better differentiate control group from treatment group
- Treatment group in long-term experiment now has a high long-term bonus and a low short-term bonus, compared to an equal bonus for short-term and long-term production in the pilot version.
- Treatment group in ESG experiment with a higher bonus for the product with a cost to society is added
- More focused selection of participants to represent CEO characteristics.

Appendix A.2 Background questions

We used the following questions to measure preferences and the view on business.

Risk preference

How do you see yourself: are you a person who is generally willing to take risks, or do you try to avoid taking risks? Please use a scale from 0 to 10, where a 0 means you are "completely unwilling to take risks" and a 10 means you are "very willing to take risks".

Time preference

How do you see yourself: Are you a person who is generally willing to give up something today in order to benefit from that in the future?

Please use the scale from 0 to 10, where a 0 means you are "completely unwilling to give up something today" and a 10 means you are "very willing to give up something today".

Altruism

Imagine the following situation: you win £1,000 in a lottery. Considering your current situation, how much would you donate to charity?

Values between 0 and 1,000 are allowed.

Please use whole numbers (e.g. 5) and avoid decimal numbers (e.g. 5,4 or 5.4).

How would you assess your willingness to share with others without expecting anything in return, for example, your willingness to give to charity? (on a scale from 0-10)

View on business

In your view, on which three objectives should businesses focus? (Rank the answers) (Presented in randomised order)

- Brand image
- Climate change
- Emissions reduction
- Fair labour
- Long-term profits
- Providing living wages
- Sales growth
- Satisfying shareholder demands
- Short-term profits
- Social inequality
- Supporting local communities
- Technological innovation

Appendix A.3 Production functions

Long-term production

The production function for the experiment with R&D is as follows:

Table A.1 Output setting long-term production

Input production period 1	50	40	30	20	10	0
Input R&D for period 2	0	10	20	30	40	50
Output period 1	360	330	300	200	100	0
Additional output period 2	80	160	240	250	260	270

Source: Source: SEO Amsterdam Economics (2022).

A variant on this includes uncertainty in the success of the investment in R&D. The additional output in period 2 is either 80 or 580 units of the product. The chance of success is higher if the investment in R&D is higher.

Table A.2 Output setting long-term production under uncertainty

Input production period 1	50	40	30	20	10	0
Input R&D for period 2	0	10	20	30	40	50
Probability 80 additional output period 2	100 %	84 %	68 %	66 %	64 %	62 %
Probability 580 additional output period 2	0 %	16 %	32 %	34 %	36 %	38 %

Source: Source: SEO Amsterdam Economics (2022).

ESG

For every 10 resources allocated to Product 1, other participants have their final compensation reduced by 25 points, which equals €0.0125. However, if there are 100 participants in total, if all other 99 participants allocate 10 resources to Product 1, the loss is equal to €1.24. If all respondents allocate 20 resources to Product 1, the loss is €2.48 per respondent, et cetera.

The output is as follows.

Table A.3 Output setting production environmental-friendly production

Input production Product 1	50	40	30	20	10	0
Input production Product 2	0	10	20	30	40	50
Output Product 1	360	330	300	200	100	0
Output Product 2	0	75	150	225	240	255

Source: Source: SEO Amsterdam Economics (2022).

Appendix A.4 Compensation models

Long-term production

There are two different reward schemes in the setting of long-term production. This incentive design also applies to the variant with uncertainty about the success of R&D investments.

Table A.4 Incentive design setting long-term production

Compensation scheme	Intuition	Fixed wage	Bonus production period 1	Bonus production period 2
Status quo, no risk (1.1)	Short-term production is rewarded more than long-term production	6000 pts	0.55 pts per £ revenue	0.15 pts per £ revenue
Treatment, no risk (1.2)	Long-term production is rewarded more than short-term production	6000 pts	0.15 pts per £ revenue	0.55 pts per £ revenue
Status quo, risk (1.3)	Short-term production is rewarded more than long-term production, risky return on R&D	6000 pts	0.55 pts per £ revenue	0.15 pts per £ revenue
Treatment, risk (1.4)	Long-term production is rewarded more than short-term production, risky return on R&D	6000 pts	0.15 pts per £ revenue	0.55 pts per £ revenue

Source: SEO Amsterdam Economics (2022).

ESG

There are three different reward schemes in the setting of long-term production.

Table A.5 Incentive design setting environmental-friendly production

Compensation scheme	Intuition	Fixed wage	Bonus production Product 1	Bonus production Product 2
Status quo (2.1)	Dirty and clean production are rewarded equally	0 pts	1 pts per £ revenue	1 pts per £ revenue
Treatment (2.2)	Clean production is rewarded more than dirty production	0 pts	0.7 pts per £ revenue	1.2 pts per £ revenue
Treatment (2.3)	Dirty production is rewarded more than clean production	0 pts	1.2 pts per £ revenue	0.7 pts per £ revenue

Source: SEO Amsterdam Economics (2022).

Appendix B Additional results

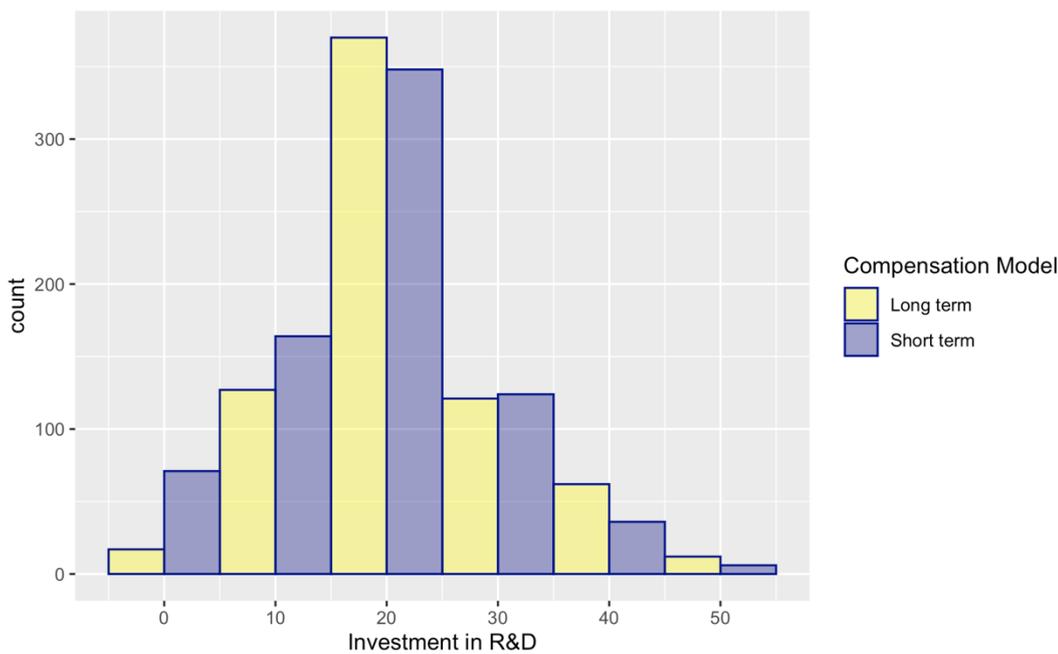
This appendix provides additional results on the outcomes of the experiment.

Table B.1 Summary statistics

Variables	Mean	Median	SD	Min	Max
Age	39.19	36	12.08	19	84
Gender ²⁸	0.54	1	X	0	1
Student ²⁹	0.15	0	X	0	1
Risk preference	5.73	6	1.95	0	10
Time preference	7.05	7	1.74	0	10
Altruism 1	78.75	50	114.82	0	1000
Altruism 2	6.21	7	6.21	0	10

Source: SEO Amsterdam Economics (2022), based on 3004 observations

Figure B.1 Distribution investment in R&D for the long-run no-risk treatment

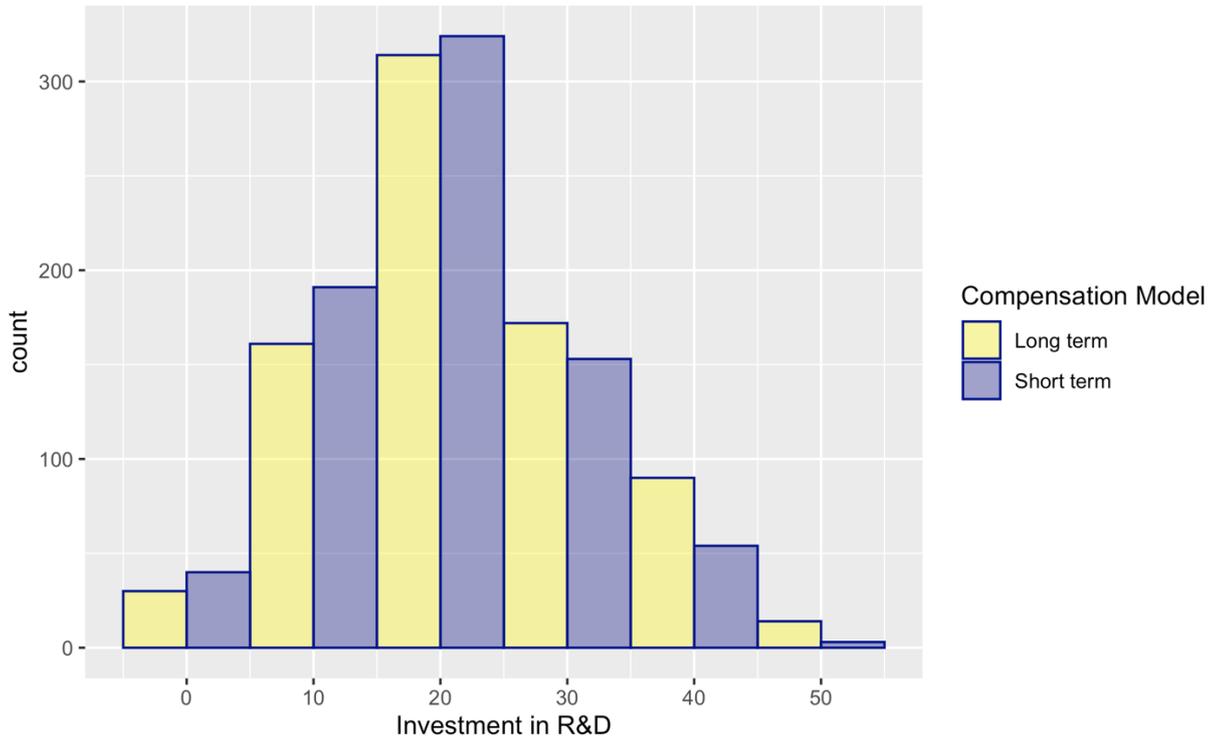


Source: SEO Amsterdam Economics (2022), based on 1458 observations

²⁸ Female = 1, Male = 0

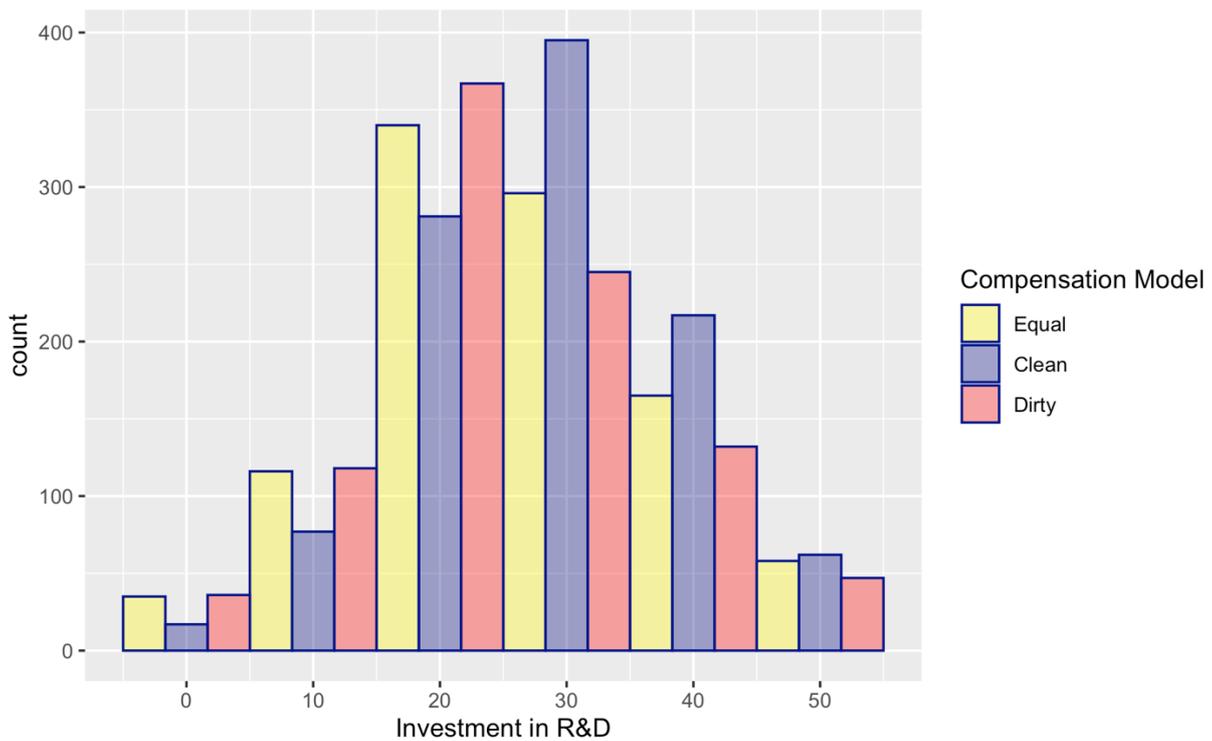
²⁹ Student = 1, otherwise 0

Figure B.2 Distribution investment in R&D for the long-run risk treatment



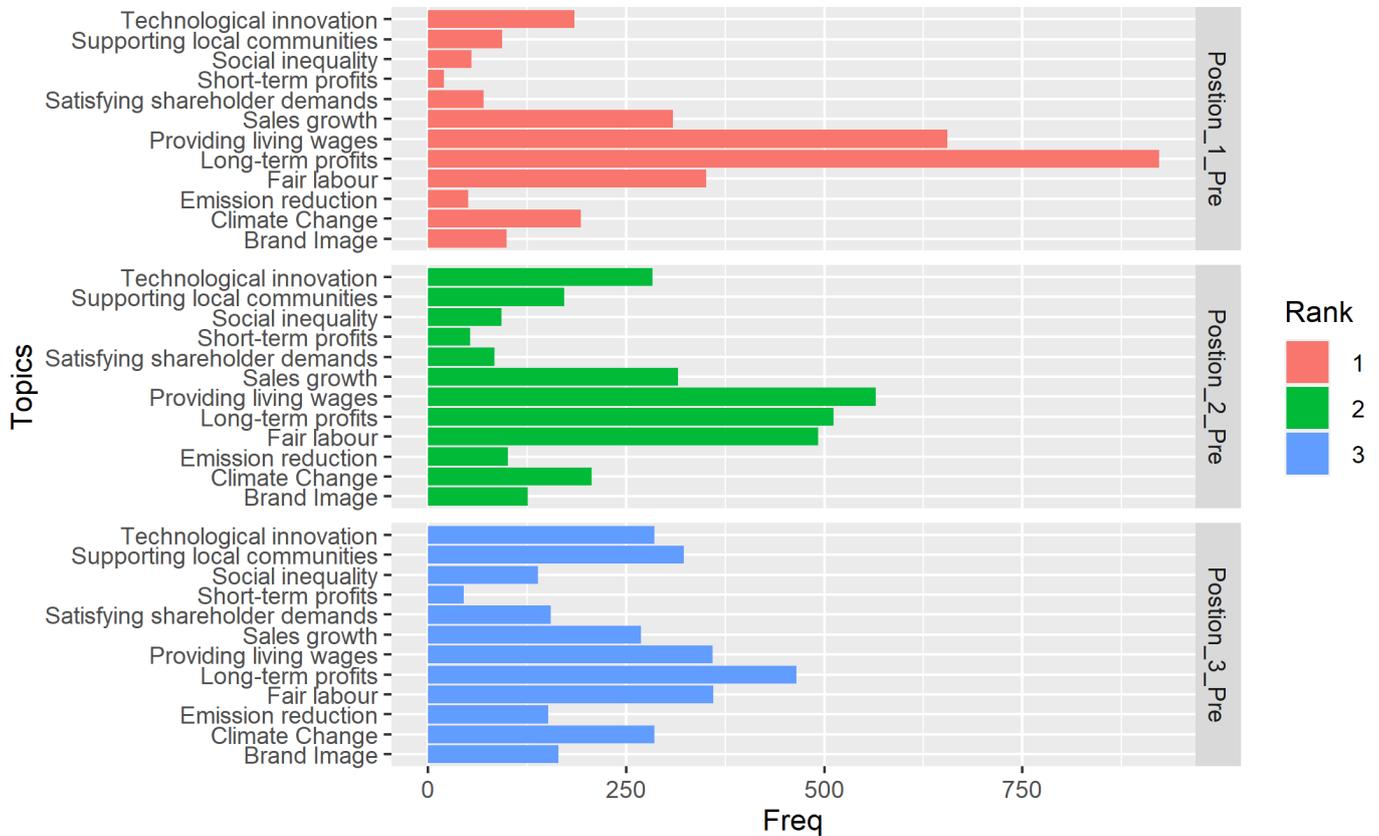
Source: SEO Amsterdam Economics (2022), based on 1546 observations

Figure B.3 Distribution investment in product 2 (clean) for the ESG treatment



Source: SEO Amsterdam Economics (2022), based on 3004 observations

Figure B.4 Distribution of view of business before the experiment



Source: SEO Amsterdam Economics (2022), based on 3004 observations

Table B.2 Logistic regressions for the estimates the probability of being in the revenue-maximising point

Dependent variable: Revenue-maximising investment in R&D or clean product (1/0)	Model in box 4.1	Model in box 4.2	Model in box 4.3
Long-term bonus	0.095** (0.037)	-0.053 (0.036)	
Long-term shareholder statement	0.095*** (0.036)	-0.056 (0.036)	
Long-term bonus and Long-term shareholder statement	-0.076 (0.052)	0.061 (0.050)	
Equal Bonus			0.038 (0.029)
Higher bonus for clean product			0.155*** (0.029)
Pro-social shareholder statement			0.099*** (0.030)
Equal Bonus and Pro-social shareholder statement			-0.006

			(0.042)
Higher bonus for clean product and Pro-social shareholder statement			-0.075*
			(0.041)
Constant	0.417***	0.453***	0.209***
	(0.026)	(0.026)	(0.021)
Observations	1,458	1,546	3,004
Log Likelihood	-1,053.097	-1,097.509	-1,923.061
Akaike Inf. Crit.	2,114.193	2,203.018	3,858.121

Source: SEO Amsterdam Economics (2022). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

Table B.3 Mean input in product 2 for participants with low ESG view

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	23.0	=	24.1	+	27.2
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	25.0	+	27.0	+	29.6

Source: SEO Amsterdam Economics (2022), based on 1848 observations

Table B.4 Mean input in product 2 for participants with high ESG view

	Higher bonus for dirty product		Equal bonus		Higher bonus for clean product
Pro-profit shareholder statement	24.8	=	25.8	+	27.8
	↓ +		+ ↓		+ ↓
Pro-social shareholder statement	27.7	=	28.3	+	30.2

Source: SEO Amsterdam Economics (2022), based on 1156 observations

Table B.5 Participants with high ESG views invested 2.8 more in clean production than participants with low ESG views in the pro-profit group.

Dependent variable: Amount invested in clean product	(1)	(2)
	Pro-social statement	Pro-profit statement
High ESG view	1.738 (1.112)	2.765*** (0.990)
Equal bonus	1.125 (0.946)	2.000** (0.866)
Higher bonus for clean product	4.229*** (0.944)	4.603*** (0.863)
High ESG view * Equal bonus	-0.054 (1.543)	-1.459 (1.391)
High ESG view * Higher bonus for clean product	-1.162 (1.522)	-2.121 (1.373)
Constant	23.010*** (0.687)	24.948*** (0.622)
Observations	1,513	1,491
Adjusted R2	0.019	0.025
Residual Std. Error	11.687 (df = 1507)	10.570 (df = 1485)
F-statistic	6.708*** (df = 5; 1507)	8.497*** (df = 5; 1485)

Source: SEO Amsterdam Economics (2022). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Table B.6 Participants with a high ESG view do not statistically differ in the amount they invest in clean product from participants with a low ESG view holding the compensation model constant.

Dependent variable: Amount invested in clean product	(1)	(2)	(3)
	Higher bonus for dirty product	Equal bonus	Higher bonus for clean product
High ESG view	1.738 (1.078)	1.684 (1.055)	0.576 (0.942)
Pro-social shareholder statement	1.938** (0.943)	2.812*** (0.917)	2.312*** (0.839)
High ESG view * Pro-social shareholder statement	1.026 (1.513)	-0.378 (1.499)	0.068 (1.340)
Constant	23.010*** (0.667)	24.136*** (0.640)	27.239*** (0.586)
Observations	945	1,010	1,049

Dependent variable: Amount invested in clean product	(1) Higher bonus for dirty product	(2) Equal bonus	(3) Higher bonus for clean product
Adjusted R2	0.017	0.014	0.010
Residual Std. Error	11.334 (df = 941)	11.529 (df = 1006)	10.589 (df = 1045)
F-statistic	6.547*** (df = 3; 941)	5.926*** (df = 3; 1006)	4.561*** (df = 3; 1045)

Source: SEO Amsterdam Economics (2022). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10.

Table B.7 Males tend to invest less in R&D when there is a long-term shareholder statement, without uncertainty in the success of R&D

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Gender: male	-1.649 (1.052)	-1.910 * (0.945)
Long-term bonus	3.286 ** (1.020)	0.564 (0.916)
Gender: male * Long-term bonus	0.865 (1.519)	3.286 * (1.345)
Constant	16.995*** (0.688)	22.132 *** (0.653)
Observations	709	748
Adjusted R2	0.031	0.017
Residual Std. Error	10.04 (df = 705)	9.169 (df = 744)
F-statistic	8.653*** (df = 3;705)	5.304** (df = 3;744)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10. Only participants that reported a gender are included in this analysis.

Males tend to invest less in R&D when there is a short-term shareholder statement, with uncertainty in the success of R&D

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Gender: male	-2.468 * (1.025)	-1.484 (1.020)
Long-term bonus	2.739 ** (1.005)	2.098 * (0.961)

Dependent variable: Amount invested in R&D	(1) Short-term statement	(2) Long-term statement
Gender: male * Long-term bonus	-0.458 (1.432)	-0.003 (1.438)
Constant	18.306 *** (0.727)	23.378 *** (0.668)
Observations	755	787
Adjusted R2	0.031	0.012
Residual Std. Error	9.832 (df= 751)	10.02 (df = 783)
F-statistic	9.092*** (df = 3;751)	4.149** (df = 3;783)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10. Only participants that reported a gender are included in this analysis.

Table B.8 Gender does not affect the level of investment in clean production, there is evidence that suggests males react stronger to a higher bonus for the clean product

Dependent variable: Amount invested in clean product	(1) Pro-social statement	(2) Pro-profit statement
Gender: male	-1.815 (0.974)	-1.834 (1.085)
Equal bonus	1.532 (0.928)	0.860 (1.034)
Higher bonus for clean product	2.126 * (0.908)	2.561 * (0.998)
Gender: male * Equal bonus	-0.216 (1.360)	0.605 (1.498)
Gender: male * Higher bonus for clean product	3.620 ** (1.350)	2.746 (1.492)
Constant	26.885 *** (0.655)	24.510 *** (0.732)
Observations	1488	1511
Adjusted R2	0.026	0.018
Residual Std. Error	10.57 (df = 1482)	11.69 (df = 1505)
F-statistic	8.82*** (df = 5;1482)	6.686*** (df = 5;1505)

Source: SEO Amsterdam Economics (2022). Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. The adjusted R-squared in the table is relatively low as the dependent variable is measured in steps of 10. Only participants that reported a gender are included in this analysis.



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