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ESG Metrics in Management Compensation Systems: An Agency Theory Perspective

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Summary: With growing public and policy-makers' attention to environmental, social, and governance (ESG) disclosures, a natural question is how management compensation systems should include ESG metrics. This paper selectively reviews and discusses insights from agency theory on the design of optimal management compensation systems. Key insights are: (i) Metrics should only be included if they are incrementally informative about the manager's effort. (ii) The relative weights on the metrics depend on their signal-to-noise ratio and on the correlation with other financial and non-financial metrics. (iii) The size of the weights on metrics cannot be interpreted as reflecting their relative importance to the firm. (iv) Attaining congruity between metrics and benefits may require a priori counter-intuitive weights on the metrics.

Keywords: Agency theory, ESG metrics, explicit incentive contracts, LEN-model, management compensation system, multitask agency problems

ESG-Metriken in Managementanreizsystemen aus Agency-theoretischer Sicht

Zusammenfassung: Die zunehmende Bedeutung von "Environmental, Social, and Governance" (ESG) Aspekten wirft Fragen nach der Einbindung von ESG-Kennzahlen in Anreizsysteme für das Management auf. Der Beitrag diskutiert diesbezüglich ausgewählte Ansätze der Agency-Theorie. Zentrale Ergebnisse sind: (i) Kennzahlen sollten nur einbezogen werden, wenn sie informativ über die Arbeitsleistung sind. (ii) Das relative Gewicht einer Kennzahl hängt von deren "Signal-to-Noise" Verhältnis und der Korrelation mit anderen finanziellen und nicht-finanziellen Kennzahlen ab. (iii) Die Höhe der Kennzahlengewichte kann nicht als Ausdruck der relativen Bedeutung finanzieller oder nicht-finanzieller Aspekte für das Unternehmen angesehen werden. (iv) Kongruenz zwischen Metriken und Zielerreichung für das Unternehmen kann kontraintuitive Gewichtungen von Metriken im Anreizsystem erfordern.

Stichwörter: Agency-Theorie, ESG Metriken, explizite Anreizverträge, LEN-Modell, Managemententlohnungsverträge, Multitask Agency Probleme

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1. Introduction

With an ever-growing public attention to environmental, social and governance (ESG) matters and the increasing availability of ESG data through voluntary and mandatory reporting, companies face the question how to best design management compensation systems to align the interests of management with those of shareholders and potentially other stakeholders.

In practice, management compensation systems of large companies are quite complex. Such systems typically define financial and non-financial metrics, including ESG matters; targets and achievements toward these targets; calculation of compound metrics; short-term and long-term remuneration; bonuses and share-based compensation, pension benefits; malus, claw-back and termination provisions.

For example, Heidelberg Materials, a large manufacturer of building materials located in Germany, modified its management remuneration system in 2023, applicable as of 2024, to increase the focus of management on sustainability, among others.[1] Key elements are an annual bonus as a short-term incentive and a long-term bonus through virtual shares. The annual bonus includes a CO2 component, which is used as a multiplier on profit, capturing the annual achievement against a CO2 emission target. Another component relates to health and safety. The long-term bonus includes financial metrics, EBIT, ROIC and TSR, and an ESG target, each weighted with exactly 25 percent.[2] The ESG target is determined by the supervisory board and includes a reduction of CO2 emissions over a three-year period.

Surveys of management compensation systems suggest that contracts like this example are quite common.[3] While management compensation systems are highly sophisticated, they usually include few metrics and also simple weights – such as the four equally weighted metrics determining long-term compensation at Heidelberg Materials – or multiplicative aggregation of metrics when determining compensation. There are many possible reasons for such compensation systems, including the link to firms' business strategies, profitability, demands and suggestions by investors and other stakeholder expectations, individual characteristics of managers, conformity pressure to practices of industry peer firms, and so on.[4] However, despite the increased attention to ESG issues, "there is still a substantial number of firms that exclude ESG information from contracts, even when they indicate commitments to ESG via business models, costly activities, and disclosures."[5]

The aim of the paper is to selectively review and discuss what insights agency theory can contribute to the design of optimal management compensation systems, particularly whether to include ESG metrics at all, which metrics to include, in what form and with what weights.

To provide more context, we briefly describe the changing regulatory requirements on ESG matters, particularly those in the European Union. From 2024, public-interest companies are required to disclose a sustainability report prepared under the European

1 See Heidelberg Materials (2024).
2 See also Bouwens (2024) for a more extensive discussion of long-term incentives in an ESG context.
3 See, e.g., PwC (2022) with a survey of over 600 senior leaders in nine countries; Ritz (2022) with European and U.S. energy companies; Ikram et al. (2023) with S&P 500 companies; Dell'Erba & Ferrarini (2024) with a survey of the 300 largest listed companies in Europe.
4 See, e.g., Derchi et al. (2023).
5 Friedman & Ormazabal (2024), p. 11.

Sustainability Reporting Standards (ESRS). This requirement will extend to other large companies as of 2025. The underlying premise is that more disclosure, and thus transparency, of ESG metrics will change the behavior of the companies regarding ESG matters. The ESRS include some 1,100 individual quantitative and qualitative disclosures, which will be available as performance metrics in the ESG domain and are candidates to be used in management compensation systems.

The general disclosures in ESRS 2 require detailed information about the integration of sustainability-related performance in incentive schemes of management and supervisory boards. These include a description of characteristics of the incentive schemes, possible targets and benchmarks, the percentage of variable remuneration that depends on sustainability-related targets and impacts, among others (ESRS 2, GOV-3). ESRS E1 on climate change specifically requires disclosure of how climate-related considerations are included in the remuneration and the percentage of the annual remuneration that is linked to climate change (ESRS E1.13). Similar, but typically less detailed, disclosures have been enacted or are discussed in many other countries worldwide. Whereas these disclosure requirements aim to change companies' behavior indirectly, the EU also attempted to *require* companies to link directors' variable management compensation to the fulfilment of the climate transition plan. Eventually, this proposal was dropped.[6]

The remainder of this paper is organized as follows. The next section reviews fundamental insights from formal agency theory on management compensation. We begin with a standard agency model and the informativeness principle which governs the use of additional metrics. We then extend the basic setting by considering multidimensional aspects (like many efforts, financial and non-financial preferences), options for aggregating many signals into a single performance measure and different techniques of modeling agency relationships, which may suggest different conclusions about benefits of integrating metrics into a compensation system. Section 3 discusses examples of research that deal with optimal weights on financial and ESG metrics somewhat more formally to highlight the underlying economic tradeoffs. We present and derive results from a multitask LEN model, which can yield counterintuitive recommendations for the use of ESG metrics. We then discuss other (linear) approaches, including private information of the agent and market incentives. Section 4 briefly concludes.

2. Fundamental agency theory and ESG-based compensation

2.1 Basic settings

Incentive systems essentially define a set of performance measures and a function that maps the realization of these measures into managerial compensation systems. Given the large number of possible ESG data points that firms should collect and report, the question is which data points and in which way these data points should be included in the set of performance measures that determine managerial compensation systems. In the following, we review findings in agency theory that address this question.[7]

6 See the proposal for a European Corporate Sustainability Due Diligence Directive (CSDDD) from 2022. The final version of the CSDDD from July 2024 does not include such a requirement.

7 There are numerous textbooks on agency theory, e.g., Laffont & Martimort (2002).

Consider a standard one-period agency setting with a risk neutral principal and a risk averse agent.[8] The agent chooses an unobservable effort, where more effort shifts the probability distribution of the firm's outcome to the right, i.e., higher outcomes become more likely. If this outcome is verifiable, it is a natural performance measure. The principal chooses a compensation function that specifies the agent's remuneration depending on the realized outcome. The stronger the compensation varies with the outcome, the greater is the agent's incentive to work hard, but the riskier compensation also reduces the agent's utility, so that the principal must promise a higher compensation. The compensation function together with the level of the manager's effort characterize the endogenous solution to this problem.

The principal uses the relation between effort and the probabilities of the outcome to determine the compensation function. The better a particular outcome indicates that a desired effort has been chosen, the higher the compensation for this outcome. Analytically, this is expressed by the so-called "likelihood ratio." An important insight is that the outcome per se is not necessarily the best performance measure. There can be other metrics (or signals) that are more informative about the manager's effort, say for instance a metric that directly tracks effort, whereas the outcome is a noisier metric, influenced by effort, but typically dependent on other effects outside the firm's or the manager's control.

Now assume there are one or more verifiable metrics besides (or instead of) the outcome. According to the informativeness principle (Holmstrom, 1979), it is beneficial to include an additional metric if (and only if) it is *incrementally informative* about the agent's effort.[9] That is the case if the conditional distribution of the additional metric (i.e., the probability distribution of the metric given the outcome or another metric) also depends on the agent's effort. The additional metric in the compensation system improves motivation and risk sharing, but it may be costly to collect the metric. The principal uses the metric in the contract if the expected benefit of doing so exceeds its costs.

2.2 Multidimensional variables

The basic agency setting has been extended in several directions. One extension is to consider multidimensional efforts, for example, that the agent takes actions that affect either financial or ESG metrics or both.[10] Such metrics can be included in the optimal contract, based on their incremental informativeness, even if neither party has, say, "green" preferences. Metrics may also pick up the underlying causality, for instance, if short-term and long-term metrics are used. Putting intuitive weights on them would likely result in over-incentives. Similarly, the firm's outcome can be multidimensional. The owners of the firm (jointly "the principal") may have preferences over multiple outcomes, for example, financial and climate-related outcomes. Then the principal must aggregate these outcomes into one joint multidimensional outcome and induce effort(s) by the agent to maximize the expected multidimensional outcome. In multiperiod models, different discount rates generate another conflict of interest.

8 For expositional simplicity, we focus on a risk neutral principal to exclude pure risk sharing motives for contracting between the principal and the agent.

9 Antle & Demski (1988) provide a neat illustration in an accounting context.

10 See Holmstrom & Milgrom (1991). One can assume that financial and ESG efforts are taken independently of each other, or that the agent has to allocate a fixed attention to the different tasks. See, e.g., Gabel & Sinclair-Desgagné (1993) for an early application to environmental performance.

Managers may have multidimensional preferences as well. Besides monetary compensation they may exhibit intrinsic preferences for short-term and long-term compensation elements and for ESG outcomes, which need to be taken into account when designing optimal compensation systems.[11] For example, a manager may have an intrinsic strong interest in reducing pollution, thus favoring clean but expensive investments. To mute this interest, the board might need to provide even negative incentives, which might be interpreted as a "Pollute more!" target by investors.

These generalizations do not change the basic tradeoffs from agency theory, yet they make it difficult, if not impossible, to gain more detailed insights on optimal compensation systems in practice. Questions such as the following arise: Is there a combined performance measure consisting of a linear combination of all single measures, is this function multiplicative or additive, is it a complex convolution of all metrics, and so on? To illustrate, if future financial ESG opportunities are impounded in shareholder value, they should not be incentivized twice by including the original ESG measure on these opportunities in the compensation system. In other words, the informativeness principle alone does not provide sufficient guidance for determining an optimal contract in such instances. In practice, management contracts include only selected key metrics, although many more would qualify for inclusion. This raises the concern that aspects that are not included by metrics in the contract are not pursued.[12]

2.3 Special case: linear aggregation

There are special settings in which more explicit results can be derived. For example, under specific assumptions on the probability distributions, the optimal contract uses a single performance metric that is a linear aggregate of several individual metrics.[13] The weights for the metrics depend on their signal-to-noise ratios, i.e., the sensitivity of the expected value of each metric with respect to the agent's effort, divided by the metric's variance. A metric receives more (less) weight in the combined performance measure if its precision is higher (lower), all else equal. If two metrics are highly positively correlated, one can be used to reduce the overall noise of both metrics, which can even require a negative weight on a metric that has a positive correlation with the firm's performance.

A linear combination of single metrics also arises in agency models that assume non-verifiability of the metrics. The solution are relational contracts,[14] which require the contract to be self-enforcing, that is, it must be in the principal's interest to adhere to the contract despite the non-verifiability of the metrics. This is usually captured by extending the agency relationship over more than one period, so that the agent can threaten to terminate the relationship with the principal if the principal breaches the contract. Kvaløy & Olson (2023) show for such a setting that the optimal contract is based on a combined metric, specifically, a linear weighted aggregate of all individual metrics. With some additional as-

11 Agency theory has proven to be versatile that it can also include non-monetary preferences such as prosocial behavior (Bénabou & Tirole, 2006), trust (Sliwka, 2007), among others. For ESG preferences see Friedman et al. (2021) and the literature cited therein. See also the discussion below in section 3.

12 See, e.g., Bebchuk & Tallarita (2022).

13 See Banker & Datar (1989), Amershi et al. (1990).

14 See Levin (2003).

sumptions about probability distributions, the weights depend positively on the precision of the individual metrics.

2.4 Generalized distribution approach

In standard agency models, the distributions of outcomes and metrics depend on the agent's efforts, which are the focus of the analysis. However, the choice of efforts essentially determines probability distributions of the outcomes. The generalized distribution approach drops the parameterization completely,[15] and the agent directly chooses among the probability distributions of outcomes rather than the parameters that shape the distributions. As a consequence, there is no role for an outcome or a metric to inform about an effort. For models with binary outcome and binary effort this is immediately obvious. For general distributions, in particular, continuous probability distributions, the agent's disutility function is difficult to specify over the whole support.[16] The appeal of the generalized distribution approach lies in the elegant way to capture multitask issues, which it does by essentially dropping all variables representing individual tasks.

Interestingly, the informativeness principle, as stated above, does no longer hold: If the outcome is available for contracting, there is no benefit to including additional metrics in the optimal contract. Such inclusion is only beneficial if the outcome is not contractible and if the metrics are informative about the outcome (and not about an effort).[17] Yet it seems that further research is needed to get more insights about the robustness of insights derived from this setting.

2.5 Common agency

ESG-related issues can also be modeled as a problem where two principals (e.g., shareholders and another stakeholder or a regulator that cares about externalities) want to provide incentives for managerial actions. Such settings can be addressed with common agency models.[18] For example, Sinclair-Desgagné (2020) studies such a model with two principals and suggests a mechanism based on contingent monitoring and clawbacks to overcome the problem of low-powered incentives in equilibrium.

3. LEN models with ESG preferences

The basic findings in the agency literature provide only high-level results on the shape and structure of optimal ESG contracts. To develop specific insights requires more structure imposed on the agency model. One often-used model is the multitask LEN[19] model, which makes three critical assumptions: it assumes (i) *Linear* compensation contracts, (ii) *Exponential* utility functions of the principal and the agent, and (iii) *Normally* distributed random variables (noise). It should be noted that assuming exponential utilities and normal distributions would not render a linear compensation function optimal. However, linear (or at least partially linear) compensation schemes are predominantly used in practice.

15 See Bonham (2024), Bonham & Riggs-Cragun (2024a).
16 For an application to ESG issues see Bonham & Riggs-Cragun (2024b).
17 See Bonham & Riggs-Cragun (2024a).
18 See Bernheim & Whinston (1986).
19 See, e.g., Holmstrom & Milgrom (1987) and Spremann (1987).

Superimposing such a linear functional form, the LEN model can provide insights in the underlying economic effects and tradeoffs.

3.1 Financial and environmental effort

In the following, we present some surprising, counter-intuitive results, following Datar et al. (2001) and Kasmanhuber (2023). A risk neutral principal derives utility from the operative cash flow $\widetilde{C}$ and from an environmental ("green") impact $\widetilde{P}$, resulting from efforts by the agent. The principal's utility function is

$$Z = E\left[\widetilde{C}\right] - \gamma E\left[\widetilde{P}\right],$$

where $\gamma \geq 0$ denotes a parameter weighting the green preferences. For instance, the owner prefers high expected cash flows but dislikes pollution, which is weighted in by γ. The agent can influence these two cash flows individually by choosing positive operative (a) and green efforts (e). These efforts translate into cash flow and environmental impact as follows:

$$\widetilde{C} = c_a a + c_e e + \widetilde{\varepsilon}_c \quad \text{and} \quad \widetilde{P} = p_a a + p_e e + \widetilde{\varepsilon}_e.$$

c_a and c_e denote the cash flow impact of the operative and the green effort, p_a, p_e represent the environmental impact of a and e, and $\widetilde{\varepsilon}_c$, $\widetilde{\varepsilon}_e$ are normally distributed noise terms with zero expectation and positive variance. Assume $c_a > 0$, $p_a > 0$, $p_e < 0$, whereas c_e can assume either sign. Thus, the operative effort increases both expected cash flows and expected pollution, while more green effort decreases the expected environmental burden. The cash flow impact of e can be positive if consumers value green activities and are willing to pay higher prices to compensate for the additional costs of green activities.

Both utility components C and P are unobservable, and the firm operates an internal accounting system providing two metrics, y_c and y_p, with the following properties:

$$\widetilde{y}_c = g_{ca} a + g_{ce} e + \widetilde{\delta}_c \quad \text{and} \quad \widetilde{y}_p = g_{pa} a + g_{pe} e + \widetilde{\delta}_p.$$

y_c is a financially oriented metric (e.g., earnings), while y_p represents a green metric. Assume $g_{ca} > 0, g_{pa} > 0$ and $g_{pe} < 0$, whereas g_{ce} can have either sign. $\widetilde{\delta}_c$ and $\widetilde{\delta}_p$ are normally distributed random variables with zero mean and positive variance, respectively.

The agent incurs an additive quadratic disutility from exerting efforts,

$$D(a, e) = \tfrac{a^2}{2} + \tfrac{e^2}{2}.$$

The principal maximizes the expected utility subject to the agent's participation and effort choice constraints. Under the LEN assumptions, the incentive wage is linear and additive,

$$s(y_c, y_p) = \alpha + \beta_c y_c + \beta_p y_p,$$

with fixed salary α and incentive parameters β_c and β_p. The agent's utility can be represented by the certainty equivalent

$$CE = E[\widetilde{s}] - r\mathrm{Var}[\widetilde{s}]/2 - D,$$

where $r > 0$ denotes the agent's absolute risk aversion and the participation constraint is $CE \geq 0$.

For a given set of incentive parameters, the agent's optimal action choices are

$$\hat{a} = \beta_c g_{ca} + \beta_p g_{pa} \text{ and } \hat{e} = \beta_c g_{ce} + \beta_p g_{pe}.$$

Inserting these efforts into the principal's expected utility determines the optimal incentive parameters, with the fixed salary α chosen such that $CE = 0$ holds.

In a multitask setting, the solution is driven not only by the tradeoff between motivation and risk sharing but also by the congruity between the structure of first-best and second-best actions and performance measures.[20] Given the binary structure of the model (two actions, two metrics, and two parameters for incentives), the principal can induce the first-best action choice (a^*, e^*) by solving the two equations in two unknowns (β_c, β_p):[21]

$$\hat{a} = \beta_c g_{ca} + \beta_p g_{pa} = a^* \text{ and } \hat{e} = \beta_c g_{ce} + \beta_p g_{pe} = e^*.$$

Assuming a risk neutral agent, this is also the principal's optimal solution as only the congruity problem must be solved.[22] If **G** denotes the matrix of the performance coefficients g, this system can be written as follows:

$$\underbrace{\begin{bmatrix} g_{ca} & g_{pa} \\ g_{ce} & g_{pe} \end{bmatrix}}_{\equiv \boldsymbol{G}} \cdot \begin{bmatrix} \beta_c \\ \beta_p \end{bmatrix} = \begin{bmatrix} a^* \\ e^* \end{bmatrix}.$$

The solution is given by[23]

$$\begin{bmatrix} \beta_c \\ \beta_p \end{bmatrix} = \boldsymbol{G}^{-1} \cdot \begin{bmatrix} a^* \\ e^* \end{bmatrix} = \underbrace{\left(g_{ca} g_{pe} - g_{ce} g_{pa}\right)^{-1}}_{\equiv \text{Det}} \cdot \begin{bmatrix} g_{pe} & -g_{pa} \\ -g_{ce} & g_{ca} \end{bmatrix} \cdot \begin{bmatrix} a^* \\ e^* \end{bmatrix} = \begin{bmatrix} \frac{g_{pe}}{\text{Det}} a^* - \frac{g_{pa}}{\text{Det}} e^* \\ -\frac{g_{ce}}{\text{Det}} a^* + \frac{g_{ca}}{\text{Det}} e^* \end{bmatrix}.$$

Thus, the optimal incentive parameters are linear functions of the first-best action choices

$$\beta_c = h_{ca} a^* + h_{ce} e^* \qquad \left(h_{ca} = \frac{g_{pe}}{\text{Det}}, h_{ce} = -\frac{g_{pa}}{\text{Det}}\right),$$

$$\beta_p = h_{pa} a^* + h_{pe} e^* \qquad \left(h_{pa} = -\frac{g_{ce}}{\text{Det}}, h_{pe} = \frac{g_{ca}}{\text{Det}}\right).$$

While the h-coefficients are solely governed by the properties of the metrics (i.e., the g-coefficients), the first-best actions are solely determined by the impact factors and the incentive weight γ by

$$a^* = c_a - \gamma p_a \text{ and } e^* = c_e - \gamma p_e.$$

20 See for more details Feltham & Xie (1994), Datar et al. (2001).
21 See Budde (2007) for a more general version.
22 Renting the firm to the manager is not an option since C and P are unobservable.
23 To guarantee existence we assume $g_{ca} g_{pe} \neq g_{ce} g_{pa}$, otherwise the determinant Det is undefined.

3.2 Results

A priori, one would expect a positive financial parameter $(\beta_c > 0)$ and a negative environmental parameter $(\beta_p < 0)$. The punishment of negative environmental effects provides an incentive to increase the environmental effort and a disincentive for raising the operative effort too much. However, the incentive parameters stated above are sums of two factors with potentially different signs, so the sign of the sum is not straightforward. For example, assume that the environmental synergies are positive ($c_e > 0$ and $g_{ce} > 0$). Then

$$\text{Det} < 0, h_{ca} > 0, h_{ce} > 0, h_{pa} > 0 \text{ and } h_{pe} < 0.$$

The incentive parameter β_p is positive if

$$\beta_p = h_{pa}a^* + h_{pe}e^* > 0 \Rightarrow -g_{ce}a^* + g_{ca}e^* < 0 \Rightarrow \frac{g_{ca}}{g_{ce}} < \frac{a^*}{e^*}.$$

If the ratio of the financial performance sensitivities g_{ca}/g_{ce} is less than the ratio of the first-best actions a^*/e^*, the owner chooses a positive incentive parameter for the environmental performance measure, which implies a *reward* for pollution (although the owner dislikes pollution). Intuitively, a financial incentive alone is not sufficient to establish the preferred relation between operational and environmental activities if g_{ca}/g_{ce} falls below the congruence requirement given by a^*/e^*. A negative value $\beta_p < 0$ magnifies this incongruence as it decreases operational effort and increases green effort. The only way to achieve congruence then is to reward pollution, implying an increase in a and a decrease in e.

A greater weight γ for green incentives leads to a smaller ratio a^*/e^* (ceteris paribus) and a higher likely punishment for pollution $(\beta_p < 0)$, due to

$$\frac{\partial a^*}{\partial \gamma} = -p_a < 0 \text{ and } \frac{\partial e^*}{\partial \gamma} = -p_e > 0.$$

Intuitively, with a greener preference one would expect both the financial incentive parameter β_c and the green incentive parameter β_p to decrease (the latter occurs because pollution gets more punished or less rewarded). But whether this really holds, depends on the specific parameters.

Consider positive environmental synergies (Det < 0), then the intuition regarding β_p holds because

$$\frac{\partial \beta_p}{\partial \gamma} = -\underbrace{p_a}_{>0}\underbrace{h_{pa}}_{>0} - \underbrace{p_e}_{<0}\underbrace{h_{pe}}_{<0} < 0.$$

However, the change of β_c over γ is given by

$$\frac{\partial \beta_c}{\partial \gamma} = -p_a h_{ca} - p_e h_{ce},$$

which can assume either sign. It is positive (for Det < 0) if the inequality

$$-p_e h_{ce} > p_a h_{ca} \Leftrightarrow -\frac{p_e}{p_a} > \frac{h_{ca}}{h_{ce}} = -\frac{g_{pe}}{g_{pa}} \Rightarrow \left|\frac{p_e}{p_a}\right| > \left|\frac{g_{pe}}{g_{pa}}\right|$$

holds, implying that financial incentives may increase for larger green preferences. The economic intuition is as follows: Higher green preferences call for lower operative efforts and higher green efforts, which reduces the ratio a^*/e^*. The reduction of the green incentive parameter $(\partial\beta_p/\partial\gamma < 0)$ decreases the ratio $\hat{a}/\hat{e}$ of the efforts. However, this may be insufficient to satisfy the owner's congruence requirement if the ratio of performance sensitivities $|g_{pe}/g_{pa}|$ is small compared to the ratio of real impacts $|p_e/p_a|$. In this case, the focus is more on boosting the environmental effort. A reduction of financial incentives does not achieve this – it reduces the operative effort, but with positive environmental synergies the environmental effort also decreases. Thus, the principal elevates financial incentives $(\partial\beta_c/\partial\gamma > 0)$ to increase the environmental effort because of the positive environmental synergies.

Overall, this brief analysis illustrates that determining management compensation systems can be quite challenging, as a priori intuitive arguments may not hold in an in-depth analysis, due to the intricate interdependencies between efforts and metrics.[24]

3.3 Private information multitask models

Some models introduce private information by the manager, which causes another conflict of interests between principal and agent (hidden information models).

Baron (2008) studies a setting in which a firm's ESG activities are embedded in a market context when investors first decide about dividing their budget between private social investing (by directly giving money to the same institutions that would receive a firm's ESG investments) and investing in firms which conduct both operative and ESG actions. Investors that become shareholders contract with the manager. Shareholders derive utility from two outcomes, financial profit and the level of an ESG activity, both of which are verifiable and available as metrics for contracting. Before contracting, managers are privately informed about their ability to manage the firm's operations. Thus, the model entails hidden pre-contract information of the agent. Baron (2008) shows that the agent's compensation depends on both profits and the ESG level in the optimal (linear) contract, and the incentive parameter attached to the ESG metric depends in a complex way on the distortions stemming from adverse selection.

Chaigneau & Sahuguet (2024) analyze a model with risk neutral actors, a board and a manager, in which the board determines the management contract. The contract can be based on the firm's cash flows, its market price and imperfect measures of two ESG investments. The manager obtains private information about the productivity of the actions before making the investment decisions. The operating effort is binary, and the manager can make two observable ESG investments that generate social output valued by the firm's board and investors in the market. The investment expenditures reduce the firm's expected cashflows, but the manager incurs no private disutility from the investments.

24 Kasmanhuber (2023) provides additional analyses of extensions, e.g., by including risk sharing.

The key driver of the results is an assumed difference between the ESG preferences of the board and the shareholders. To illustrate, we use the symbols from the previous LEN model section, but redefine P as the (now positively connotated) social performance of the firm. The board's utility function (gross of the manager's remuneration) is

$$Z = E\left[\widetilde{C}\right] + \gamma_B E\left[\widetilde{P}\right]$$

with $\gamma_B \geq 0$ as the board's preference for social output. Investors value social output with a parameter $\gamma_I \geq 0$. The market price M is the weighted sum of expected cashflows and expected social output,[25]

$$M = E\left[\widetilde{C}\right] + \gamma_I E\left[\widetilde{P}\right].$$

If $\gamma_B = \gamma_I$, the market price essentially mirrors the board's preferences. Then, it is optimal to tie the manager's compensation solely to the market price (the incentive parameter is chosen to induce high productive effort). There is no need for incentives attached to the firm's cash flow or any metrics of ESG performance. If $\gamma_B < \gamma_I$, then the incentives provided by the market price are too strong from the board's perspective. To curb the incentives to boost ESG investments, a positive weight on cash flows becomes optimal, as ESG investments reduce expected cash flows. Yet the weights on ESG metrics are still zero.

In contrast, if $\gamma_B > \gamma_I$, the market price provides too little ESG investment incentives. Then the optimal contract includes ESG metrics, whereas cash flows are not incentivized.[26] The ESG incentive weights fine-tune and complement incentives based on the market price. They need not necessarily be large to fulfill this role, in particular, they do not represent the relative importance of ESG and financial outcomes.

4. Conclusions

This paper provides a review and discussion of the insights that agency theory can offer regarding the design of management compensation systems, specifically, which metrics to include and the weights with which they enter the compensation. The following key insights emerge from this analysis:

(1) In the standard agency theory, a necessary condition for including a metric is that it is incrementally informative about the agent's effort. The expected benefit of inclusion must exceed the cost of reporting the metric. However, as the effort space increases, the more relevant becomes the principal's objective and the weights with which metrics enter this objective.

(2) The relative weights of the metrics depend on their signal-to-noise ratios, which is the sensitivity of each metric with respect to the agent's effort divided by the metric's variance (noise). Thus, a highly relevant metric, if it is very imprecise, receives a low weight. This relationship receives empirical support by Ittner et al. (1997) and by Cohen et al. (2023) who find that managerial compensation is, on average, little

25 All expectations in Z and M depend on the information available to the board and the market respectively.

26 Chaigneau & Sahuguet (2024) assume that the weight attached to cash flows must be nonnegative, which is akin to a limited liability assumption for the agent.

sensitive to ESG performance measures, which they attribute to a possibly low signal-to-noise ratio.

(3) More generally, the weights on financial and on ESG metrics are often interpreted by outsiders as reflecting the relative importance boards (representing their shareholders and possibly other stakeholders) would attach to these metrics. However, agency theory suggests otherwise. The weights depend on their signal-to-noise ratio and on their correlation with other metrics, in which case a highly correlated metric may optimally receive very low or even negative weight, despite the fact that it individually signals a positive performance. For example, if future ESG opportunities, measured by a separate metric, are increasing shareholder value, they should not be incentivized twice.

(4) Attaining congruity between metrics and the principal's benefits from the actions may lead to unexpected and perhaps a priori counterintuitive results. For example, there are settings in which the principal needs to reward pollution in the management compensation system although the principal fundamentally dislikes it. The reason is to avoid over-inducing pollution abatement.

Within the boundaries of this paper, we can only scratch the surface of analyzing optimal incentive structures in the context of ESG. Yet a main insight is that one should be cautious to quickly present recommendations for the design of incentive structures as the economics could be less obvious as they seem at first glance. From a broader perspective, agency theory is but one of several theories that can speak to management compensation issues.[27] Thus, there are even more considerations that should be made when determining or assessing management compensation systems.

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27 See Winschel and Stawinoga (2019) for a literature review on sustainable management compensation systems.

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