Mirko S. Heinle

Essays on Accounting Disclosure and the Use of Stock Price in Incentive Contracts

Mirko S. Heinle

ESSAYS ON ACCOUNTING DISCLOSURE AND THE USE OF STOCK PRICE IN INCENTIVE CONTRACTS

Inauguraldissertation
zur Erlangung des akademischen Grades eines
Doktors der Wirtschaftswissenschaften
der Universität Mannheim

Dekan:	Prof. Dr. Hans H. Bauer
Referent:	Prof. Dr. Christian Hofmann
Korreferent:	Prof. Dr. Dirk Simons
Tag der muendlichen Pruefung:	28. Oktober 2009

TABLE OF CONTENTS

LIST OF FIGURES

List of Tables

ACKNOWLEDGMENTS

Eine Doktorarbeit ist, wie sicherlich alle grossen Herausforderungen, vor allem ein Kampf mit sich selbst; ich konnte mich glücklich schätzen, diesen nicht alleine führen zu müssen.

Herrn Prof. Dr. Christian Hofmann danke ich von vollem Herzen für die Betreuung. Vom Studium in Hannover, über den Beginn des Promotionsstudiums in Tübingen, der Mitarbeiterstelle in Mannheim und letztlich dem Abschluss der Dissertation in Philadelphia, war und ist er mit seinem unermüdlichen Ansporn ein Vorbild. Sowohl die Doktorarbeit als auch meine persönliche Entwicklung haben viel von ihm profitiert.

Den Tag im Büro mit lautem Lachen zu beginnen, zu verbringen und zu beenden, verdanke ich Steffen Reichmann, ich hätte nicht um mehr bitten können. Für die Möglichkeit, sich morgens auf den Tag im Büro zu freuen und bis spät abends mit einem guten Gefühl zu bleiben, danke ich Anna Rohlfing. Martin Arnegger danke ich für lange Gespräche und die Kraft sich selbst zu reflektieren.

Das Wissen, mich in jedem der vielen Tiefs dieser langen Arbeit auf meine Freunde verlassen zu können, hat es mir ermöglicht, immer wieder aufzustehen. Für viel Aufmunterung danke ich Frank Spitzer, dafür den Weg von Hannover nach Tübingen zu finden Stefan Kontny, Ramin Marquardt und Nicki Saris und dafür immer da zu sein, wenn es darauf ankommt, Moritz Römer. Mein Dank an euch kennt keine Grenzen!

Für endlose, bedingungslose und unglaubliche Unterstützung danke ich meiner Familie. Meiner Mutter Viera Nesporova dafür mich noch immer aufzuheben, wenn ich falle, meinem Vater Rudolf Heinle dafür meinen Horizont immer und immer zu erweitern, meinem Stiefvater Thilo Litzkuhn dafür mir zu zeigen wie hilfsbereit ein Mensch sein kann und meinen Schwestern Janna Nesporova und Marga Heinle dafür immer an mich zu glauben. Letztlich danke ich von vollem Herzen Jacqueline Boccanfuso, ohne Sie wäre ich nicht wer und wo ich jetzt bin.

INTRODUCTION

The separation of ownership and control in corporations leads to a well documented agency problem between the shareholders and the management of publicly traded companies. Besides direct monitoring of management activities, companies try to compensate managers in a way such that their interests are aligned with those of the shareholders. The design of compensation contracts to efficiently mitigate the "stewardship problem" has attracted researchers' interest.[1] Theoretical results in this area of research suggest, for example, that all available performance measures should be used in a contract, as long as they are (conditionally) informative about the actions chosen by management. Empirical evidence, on the other hand, shows that a shift in the 1990s lead to a situation where for a major fraction of CEOs, stock price performance is the dominant determinant of their compensation and the "sensitivity deriving from cash compensation is generally swamped by that deriving from stock and stock option portfolios".[2] This shift is somewhat puzzling as theory predicts that stock price does not aggregate the available information in a way to provide the best incentives for a firm's management. This intuitive result stems from the different objectives capital market participants and shareholders have. While the former are estimating future risk and returns, the latter try to infer past managerial actions. For this reason, the weights capital markets apply to certain pieces of information do not reflect the weights shareholders would assign to the same information in incentive contracts.

One explanation for the heavy reliance on stock prices is that they are readily observable measures which can be used without costs. More important however is probably the existence of information which cannot be used in a contract but is used by capital markets. Contractual information has to be verifiable to some extent, information used to form expectations does not.

---

[1] Prendergast (1999) provides a review of a large body of this literature.

[2] Bushman/ Smith (2001, 242).

Hence, using prices in contracts enables the current shareholders to indirectly contract on information that otherwise could not be used. This information can come from a variety of sources. To formulate their expectations about future risk and returns, capital markets rely on different providers of information; analysts provide forecasts and analyses, financial press publishes facts and opinions, some investors have private information, and finally companies themselves provide extensive information through corporate disclosure.

This thesis studies the interplay of changes in accounting disclosure and the solution to the stewardship problem. I develop theoretical models that try to explain the different decisions managers, current shareholders, and potential shareholders face. The models incorporate different interdependent aspects of the decision to disclose information, the design of contracts between current shareholders and the corporation's management, and the aggregation of information into price.

The first essay builds on the observation, that firms use information in compensation contracts which is not available to capital market participants.[3] Potential investors on the other hand, as described above, use information that cannot be used in a contract to form their expectations. While this information is of forward-looking nature, it is often informative about the actions a firm's management chose in the past. Straightforward examples are a manager's reputation or the success of an organizational change. I classify contractible and non-contractible information as "hard" and "soft" information.[4] Disclosing different types of information has a different impact on the value of stock price as a measure of management's performance. In this setting, I study the value of disclosing supplemental information from a stewardship perspective. My investigation is motivated by ongoing calls for more corporate

[3] E.g., Hayes/ Schaefer (2000)

[4] Petersen (2004) provides a discussion about the characteristics of hard and soft information.

disclosure of soft information[5] and a change of the view of accounting disclosure. At the end of the 19th century shareholders began to hold diversified portfolios and modern financial reporting emerged because investors collectively demanded "help in managing the new social relationships [...] between them and management."[6] However, over time companies were asked to provide more forward-looking information to increase the efficiency of capital markets for allocating capital. In the current "Conceptual Framework for Financial Reporting"[7] the FASB even expresses the view that providing information that helps potential investors in valuing a company also helps current investors in evaluating management's past action choices. I present conditions under which this is not the case but disclosure is detrimental to the expected cash flow. I show that the disclosure of both hard and soft information then leads to a loss in production. Firms could react to this by decreasing their voluntary disclosure which terminally might even reduce the informativeness of stock prices about future cash flows.

The second essay incorporates findings that the composition of companies' shareholders influences the level of disclosure and managerial incentives. Empirical studies suggest that institutional investors can be characterized by the length of their investment horizon and their portfolio turnover.[8] So called "dedicated" institutions have a long-term view,"quasi-indexers" use indexing for their portfolio decisions, and the third group, "transient" investors, are interested in short-term trading gains. While the first essay investigated the value of disclosure from the perspective of dedicated investors, the second essay analyzes the effect of institutional investors potentially having a short-term investment horizon, e.g., they might sell their shares before

[5] Seligman (1995, 610) even states that the

> "past two decades have witnessed a significant expansion of what must be disclosed by all registrants [...] This expansion can be termed the 'soft information revolution' in the mandatory disclosure system".

[6] Bryer (1993, 649).

[7] See Financial Accounting Standards Board (2006).

[8] E.g., Bushee (1998).

realizing cash flows from production. Here, I can expand the investigation of the valuation of disclosure and study the trade-off arising from a more efficient solution to the stewardship problem and potential trading gains. I focus on transient institutional investors and study the relation between market microstructure, disclosure, and managerial incentives. The model predicts that managerial incentives can decrease with higher market liquidity because the transient investor trades off gains from disclosing information (a more efficient solution to the stewardship problem) with expected costs (foregoing potential trading gains based on private information). I can show that this particular group of investors might prefer to withhold information even though disclosure would increase production. My results suggest that insider trading increases the informativeness of stock prices but it might only do so if one treats disclosure as exogenous. While a dedicated investor would disclose information if it helps mitigating the incentive problem, an investor who is interested in short-term trading gains might prefer to keep the information private. Following my results, empirical studies investigating the relations between liquidity, insider trading, and managerial incentives should control for the composition of the firm's investor base and the level of disclosure.

A different approach to gain insights about corporate disclosure and managerial incentives is employed in the third essay. While I focused on the value of disclosure for different types of investors in the first two essays, I now examine the relative weights placed on price and non-price measures in compensation contracts. One prediction of agency theory is that the relative weights assigned to two measures in a contract are functions of the relative "signal-to-noise" ratios of the respective measures. Recent studies suggest that observed contracts do not behave as predicted when examining changes in the measures' variances.[9] The measures that are usually investigated are price and some accounting measure. The tested hypothesis are derived by agency-theoretic models with two generic performance measures and capital markets' role in

[9] See Core/ Guay/ Verrecchia (2003).

aggregating information as well as the possibility that firms write contracts over more than just one accounting measure are usually not included. Furthermore, the noise in accounting measures is often proxied by the variance of a published accounting measure (e.g., annual earnings). I show that incorporating the price formation process and allowing for multiple contractible accounting measures can significantly affect the derived hypotheses. The first setting I employ is one in which only a public accounting report and price are available for contracting. This is descriptive of a company using stock price and annual earnings in the compensation contract with their CEO. The model predicts that the relative weight on the accounting report as well as the relative incentives stemming from it can increase in the report's variance. The reason for this effect is that the report is used for both, setting incentives and evaluating the firm. In a second setting I show the robustness of the result. Here, I allow for an additional contractible measure that is kept private and find a similar result. The relative weight placed on the private measure can increase in the variance of the public report. This result is confirmed when I consider the incentives stemming from non-price measures relative to those from price. Summarizing, my results suggest that the observed increase in accounting measures' relative weight in their noise does not necessarily countradicts the importance of agency theory in explaining compensation contracts. I finally suggest an alternative setting to test the influence of agency theory on compensation contracts: changes in the level of disclosure. Here, I am able to derive non-ambiguous predictions: the difference in the incentive weights of the disclosed measure relative to price will be higher for firms which disclose measures with higher idiosyncratic noise.

I summarize conclusions from the three essays in the final chapter.

REFERENCES

Bushman, R.M. and A.J. Smith (2001) "Financial Accounting Information and Corporate Governance," *Journal of Accounting and Economics* 32, 237–333.

Bushee, B.J. (1998) "The Influence of Institutional Investors on Myopic R&D Investment Behavior," *Accounting Review* 73, 305-333.

Bryer, R.A. (1993) "The Late Nineteenth-Ccentury Revolution in Financial Reporting: Accounting for the Rise of Investor or Managerial Capitalism?," *Accounting, Organizations and Society* 18, 649-690.

Core, J.E., W.R. Guay, and R.E. Verrecchia (2003) "Price vs. Non-Price Performance Measures in Optimal CEO Compensation Contracts," *Accounting Review* 78, 957-981.

Financial Accounting Standards Board (2006) "PRELIMINARY VIEWS - Conceptual Framework for Financial Reporting: Objective of Financial Reporting and Qualitative Characteristics of Decision-Useful Financial Reporting Information," available at http://www.fasb.org/draft/pv_conceptual_framework.pdf.

Hayes, R.M. and S. Schaefer (2000) "Implicit Contracts and the Explanatory Power of Top Executive Compensation for Future Performance," *RAND Journal of Economics* 31, 273-293.

Petersen, M.A. (2004) "Information: Hard and Soft," *working paper*.

C. Prendergast (1999) "The Provision of Incentives in Firms," *Journal of Economic Literature* 37, 7-63.

Seligman, J. (1995) *The Transformation of Wall Street*, Northeastern University Press, Boston, MA.

ESSAY 1:
SOFT INFORMATION AND THE STEWARDSHIP VALUE OF ACCOUNTING DISCLOSURE*

* The paper was written with Christian Hofmann (University of Mannheim). The authors are thankful for comments from Stan Baiman, Robert Göx, Thomas Pfeiffer, Stefan Reichelstein and participants at research seminars at the Annual Meeting of the German Academic Association for Business Research (VHB), the IV. Summer School on Accounting 2008, and at the Wharton School. Christian Hofmann gratefully acknowledges financial support for this project from the Deutsche Forschungsgemeinschaft (HO 2430/3-1).

1. INTRODUCTION

Standard setters and regulators justify reporting and disclosure requirements by the demand of capital owners for decision-useful information (O'Connell 2007, 217). Following the argumentation applied by FASB and IASB, a greater volume of timely information enhances market efficiency and decreases the cost of capital. More recently, regulators require firms to increase the disclosure of soft information.[1] Soft information "includes less certain information known to an issuer, such as projections and other forward-looking information" (SEC Commissioner R.Y. Roberts 1994). More generally, we define soft information as information that cannot be verified and, thus, cannot be used in a contract between two parties (i.e., the information is non-contractible).[2] This definition covers such diverse examples as information on sales forecasts, the progress of an investment project (Choi, Kristiansen and Nahm 2007), management reputation (Stocken and Verrecchia 1999), and the closeness of the relation between a firm and its bank (Liberti 2003).

We argue that while disclosing information to investors may improve price informativeness, disclosure of soft information can be detrimental to firm owners from a stewardship perspective. More specifically, we identify conditions under which the value of publicly reported information is negative. Key to the negative value is the dilution of managerial incentives as a consequence of a noisier and less congruent market price that results when the disclosed information is impounded in the price. Therefore, gains in price informativeness come at the expense of firm value.

Disclosure of soft information is pervasive. For example, Tsao (2002) notes that "a company's own filings to the Securities & Exchange Commission are filled with revealing

---

[1] Examples refer to the introduction of the "soft harbor rule" in 1979 and its reform in 1995, which both tried to encourage the disclosure of forward looking information, Seamons and Rouse (1997).

[2] Similarly, Petersen (2004, 2) defines soft information as "information which is difficult to completely summarize in a numeric score."

information about prospects for sales and profits." Empirical evidence suggests that soft information in earnings announcements is value relevant (Davis, Piger and Sedor 2007) and affects price volatility (Demers and Vega 2008). Besides firm disclosures, analysts' reports and press-related statements release further soft information to investors (Tetlock, Saar-Tsechansky and Macskassy 2008).

Understanding the stewardship value of accounting disclosures is important because regulators frequently presume complementarity between stewardship and decision-usefulness. For example, the IASB recently announced that "... the Board agreed that stewardship or accountability should not be a separate objective of financial reporting by business entities in the converged framework" (IASB 2005, para. 24). More specifically, the IASB claims that "financial information directed at the primary objective of providing information useful for investment [...] is useful for other purposes, including assessing management's stewardship" (IASB 2005, para. 24). Bushman, Engel and Smith (2006) provide supportive evidence for this claim. On the contrary, theoretical analysis by Gjesdal (1981), Paul (1992), and Feltham and Xie (1994) emphasizes potential conflicts between stewardship and decision-usefulness; e.g., Gassen (2008) provides supportive evidence for this view. By identifying conditions where extensive mandatory disclosure of soft information destroys firm value, our study yields important insights to the regulator.

Given that market prices aggregate any information available to investors, by using the firm's market price as a performance measure in the contract with the manager, firm owners are able to indirectly contract on otherwise non-contractible information (Bushman and Indjejikian 1993).[3] In situations where the accounting system internally generates soft information (e.g., a

[3] This statement hinges on the contracting usefulness of soft information. Whereas, e.g., information on the success of an in-house training program or the success of implementing a new software are straightforward examples of useful signals, forward-looking information can be useful as well. Even though participants in an agency would most likely not want to sign a contract on pure expectations, prospective information often contains information about past performance. For example,

> Information that may be informative about the manager's effort, but that may not be contractible, includes information about the relative performance of the firm within the industry and information about the manager's reputation.

report that compiles "soft facts" that may be important to investment decisions or projections that are necessary when preparing financial statements), this result suggests that it can be beneficial for firm owners to publicly report this soft information (e.g., by including the information in the management report). However, it is unclear at this point whether firm owners should disclose the entire amount or merely a subset of the soft information. In this regard, our results shed light on optimal firm-level disclosure policy.

This study first contributes to the discussion on the economic consequences of mandatory disclosure. In particular, we address the disclosure of soft information and identify the incremental stewardship value of varying the quantity of publicly reported information. By identifying conditions under which a larger quantity of disclosed information yields a negative value, we establish that increasing mandatory disclosure of soft information can decrease firm value. Secondly, we present a rationale for the firm not to follow a full-disclosure strategy but rather to commit ex ante to withhold some information from capital market participants. More specifically, given that soft information is available to investors from other sources outside the firm, there exist conditions where it is beneficial to not disclose supplemental (hard or soft) information. In this respect, the study contributes to the discussion on voluntary disclosure.[4] More generally, we contribute to the ongoing discussion on the relation of stewardship and decision-usefulness. In particular, our results support the opponents of the IASB's proposal to drop stewardship as a separate objective of financial accounting.

In our analysis, an agent performs multiple tasks and is evaluated using multiple performance measures. While we only consider performance measures that are (conditionally) informative

---

(Stocken and Verrecchia 1999)

Likewise,

> ... analysts can help interpret the implication of a newly announced technology development for future performance; and corporate disclosures can provide facts and explanations to confirm or deny speculations, predictions, and forecasts made by analysts. (Chen, Cheng and Lo 2006, 2)

[4] In this regard, we neglect differences between mandatory and voluntary disclosure regimes. We thank Stefan Reichelstein for pointing out this issue.

about the agent's actions, only a subset of these signals can be used by the principal in the contract with the agent (i.e., only a subset of the generated signals is contractible information). In addition, a subset of the generated signals are publicly reported to capital market participants.[5] Investors use all information available (including non-contractible information) to form expectations about firm value. In the model, the gross market price is equal to investors' expectation about the firm's terminal payoff conditional on the available information and their beliefs about the actions selected by the agent. To simplify the analysis, we assume the principal is risk neutral, the agent has exponential utility and quadratic effort cost, the performance measures are normally distributed, and the compensation contract is restricted to be a linear function of the contractible performance measures, including market price.[6] We determine the value of publicly reported (supplemental) information by comparing the expected net payoff to the principal under two information systems; the information systems differ regarding the disclosure of a single performance measure. This disclosure value is used to assess the economic consequences of increasing mandatory requirements regarding the disclosure of soft information and to investigate the firm's decision to voluntarily disclose information.

Our results indicate that the disclosure value depends on the type of information that is to be disclosed (i.e., whether it is contractible or non-contractible information) and the amount and type of information already available to the investors. For example, the principal is, in general, indifferent regarding the disclosure of contractible information if investors have only contractible information plus no more than a single non-contractible signal. However, the principal can have strict preferences regarding the disclosure of contractible information if investors receive multiple non-contractible signals. Likewise, the principal weakly benefits from a publicly

[5] Hayes and Schaefer (2000) provide empirical evidence that supports the hypothesis that firms' contracts include performance measures that are only observable by the contracting parties and that these measures are informative about the firm's future prospects.

[6] Core, Guay and Verrecchia (2003) and Leone, Wu and Zimmerman (2006) provide empirical evidence suggesting that managerial contracts include both accounting information (e.g., annual earnings) and market price as performance measures.

reported non-contractible performance measure if this signal is the only non-contractible information released to the investors. However, given that the investors receive non-contractible information (e.g., from analysts), the principal can be strictly worse off if she discloses a supplemental non-contractible signal.

Key to a potentially negative disclosure value is that investors' aggregation of information for pricing purposes differs from the aggregation that is optimal for the incentive contract with the agent (Paul 1992, Feltham and Xie 1994) and that the non-contractibility of information prevents the principal from adjusting and undoing investor aggregation. The difference in aggregation yields two reasons for a detrimental effect of disclosure on the principal's expected net payoff. First, while the impact of more disclosure on the sensitivity of price to the agent's action is ambiguous, disclosing more information weakly increases price volatility. Intuitively, the principal is worse off if disclosure yields a smaller signal-to-noise ratio. Secondly, disclosure can reduce the congruity of market price relative to the firm's terminal value, yielding a less efficient effort allocation across tasks. In particular, non-congruity increases if, e.g., relative to the firm's terminal value, the supplemental information is less congruent than the initial information. Importantly, disclosing contractible information affects the weights assigned by investors to the available information (including the weights assigned to the non-contractible information)[7] and may result in a smaller signal-to-noise ratio or a less congruent market price. Due to the non-contractibility of some of the information that is available to the investors, the principal is unable to undo any changes to the investors' aggregation of information into price that are induced by the disclosure decision.[8] Thus, the divergence in the aggregation of the performance measures combined with the non-contractibility of disclosed performance measures

[7] Chen et al. (2006) observe that investors' reliance on other sources of information varies with corporate disclosure.

[8] Note that both losses to the principal's expected net payoff are robust to changes in the capital-market setting. In particular, the losses also arise in settings where investors have asymmetric information. For example, we can show that the same effects occur in a Kyle (1985)-type capital market, where one trader is better informed than the rest of the market.

causes the negative disclosure value.

Several implications follow from our findings. First, our results are in stark contrast to the commonly held view that the usefulness of market price as a performance measure increases with the degree to which it measures firm value. For example, according to Healy and Palepu (2001, 422) "stock compensation is more likely to be an efficient form of remuneration for managers and owners if stock prices are a precise estimate of firm values." Secondly, our results emphasize that the value of publicly reported soft information crucially depends on the magnitude of soft information already available to investors. Then, depending on the type of incentive problem faced by firm owners, changes in mandatory disclosure requirements for soft and hard information can leave some firms worse off. Finally, non-verifiable soft information is presumably more sensitive to unproductive actions as compared with hard (accounting) information. Then, disclosing (more) soft information reduces the congruency of market price, relative to firm value. While investors in their pricing can factor out the impact of window dressing activities on their expectations of future firm value, managers will nevertheless be motivated to exert window dressing effort (Fischer and Verrecchia 2000). Assuming that earnings management is a proxy for the management of soft information, we expect to observe a positive relation between the disclosure of soft information and the extent of earnings management.

Regarding prior work on disclosure and incentive contracting, our work is most closely related to that of Feltham and Xie (1994), Bushman and Indjejikian (1993), and Christensen and Feltham (2000). While Feltham and Xie (1994) establish a non-negative value of additional performance measures in a multi-task setting, we find that disclosing additional contractible and non-contractible performance measures can have a negative value. Bushman and Indjejikian (1993) assume that market price includes private information to investors, and that increased disclosure can reduce investors' incentives to privately acquire information. Hence, similar to our result, increased disclosure can have a negative value in their setting. Different to our focus on the disclosure of ex post-information, Christensen and Feltham (2000) consider incentives to motivate the agent to disclose pre-decision information. Finally, our result that accounting information and stock price are only used simultaneously if stock price contains non-contractible information about the agent's action is consistent with Baiman and Verrecchia (1995).

Our work is also related to the literature on reasons for partial disclosure. In addition to explanations based on, e.g., the proprietary nature of superior information (Verrecchia 1983), uncertainty about the existence of information (Dye 1985), and uncertainty about the type of information (Teoh and Kwan 1991), our results indicate that the concurrent usage of information to address managerial incentive problems can provide a complementary rationale for partial disclosure. While the literature on partial disclosure usually discusses the ex post decision to disclose information (i.e., after the information is generated), Guay and Verrecchia (2007) show that it is valuable for the firm to commit ex ante to a full disclosure strategy if the goal is a high stock price. To the contrary, our results indicate that it can be optimal to commit ex ante to a partial disclosure strategy if the objective is to provide efficient incentives to a manager; it is straightforward that this increase in efficiency will also lead to a higher expected stock price in equilibrium.

The remainder of the paper is organized as follows. In Section 2, we present the basic model, discuss investors' pricing, and derive optimal contracts when the principal uses market price as the sole performance measure in the contract with the agent. In Section 3, we determine the value of publicly reported non-contractible performance measures. In Subsection 3.1, the principal discloses a single performance measure (e.g., manager's reputation) and in Subsections 3.2 she considers the disclosure of supplemental non-contractible information (e.g., the success of adopting a new software). Section 4 extends the analysis from 3.2 by investigating the disclosure of supplemental non-contractible information in a multi-task setting. Finally, Section

5 analyzes disclosure value of contractible information, given that the investors also receive non-contractible information. Conclusions are presented in Section 6.

2. BASIC NOTATION AND MODEL STRUCTURE

2.1 Agent's Actions, Performance Measures, and Price Formation

At date 0, the principal, acting on behalf of the firm's long term risk neutral owners, hires an agent to provide effort at date 1 in return for compensation at date 2. The agent expends costly effort that influences the payoff to the principal, and his choice of effort level is represented by the $a \in \mathbb{R}$. We assume a linear relation between effort and the firm's terminal payoff[9], i.e.,

$$x = b\,a + \varepsilon_x,$$

where $b \in \mathbb{R}$ represents the productivity of the agent's effort and $\varepsilon_x \sim N(0, \sigma_x^2)$ represents random events beyond the agent's control. The agent's personal cost of effort $\kappa(a)$ is assumed to be

$$\kappa(a) = \tfrac{1}{2}\, a^2.$$

At date 2, information system η generates m_s performance measures and releases this information to the principal and to investors. Performance measures are either publicly reported to investors (i.e., public performance measures) or undisclosed and only released to the principal (i.e., "internal" performance measures). To keep the model as parsimonious as possible we initially assume that the generated performance measures can not be used in the contract between principal and agent (i.e., only soft information is generated). As the undisclosed information can neither be used by the principal in the contract with the agent nor by investors when updating their beliefs about the terminal payoff we can neglect these measures and assume that all m_s measures of soft information are publicly reported. We assume a linear relation between effort and performance, i.e.,

---

[9] Alternatively, x may also represent the firm's future market price. We choose the term payoff to distinguish market price at date 2 from firm value.

$$y_i = m_i\, a + \varepsilon_i, \qquad i = 1, ..., m_s,$$

where m_i represents the sensitivity of performance measure i to the agent's effort, ε_i is a normally distributed noise terms with $\varepsilon_i \sim N(0,\sigma_i^2)$ and variance σ_i^2. The noise of each performance measure reflects uncontrollable events that affect the firm's payoff plus inaccuracy of the accounting system (i.e., measurement error). Specifically, the noise is assumed to be

$$\varepsilon_i = \varepsilon_x\, \rho_{ix} + \varepsilon_{\mu i}, \qquad i = 1, ..., m_s,$$

where ρ_{ix} characterizes the correlation of performance measures i to the output and $\varepsilon_{\mu i}$ represents measurement error inherent in measure i, with $\varepsilon_{\mu i} \sim N(0,\sigma_{\mu i}^2)$, $\sigma_{\mu i}^2$ is the variance matrix of the measurement-related noise term, $\mathrm{Cov}[\varepsilon_x,\varepsilon_{\mu i}] = 0$, and $\mathrm{Cov}[\varepsilon_{\mu i},\varepsilon_{\mu j}] = \rho_{ij}\, \sigma_{\mu i}\, \sigma_{\mu j}$. Thus $\sigma_i^2 = \rho_{ix}^2\, \sigma_x^2 + \sigma_{\mu i}^2$ and $\mathrm{Cov}[y_i,y_j] = \rho_{ix}\, \rho_{jx}\, \sigma_x^2 + \rho_{ij}\, \sigma_{\mu i}\, \sigma_{\mu j}$, $i = 1, ..., m_s$, where $\rho_{ix}^2\sigma_x^2$ is the output-related noise inherent in performance measure I.

The capital market is assumed to consist of homogeneous rational investors who set the price equal to the expected value of the firm conditional on all available information.[10,11] We assume that the signals are disclosed without additional error.[12] As the performance measures follow a normal distribution, the price will be a linear aggregation of the available accounting reports. Hence, the (gross) market price, its variance, and its sensitivity to the agent's effort choice are characterized by

$$\pi(\eta) = E[x|\eta] = \pi_o(\hat{a},\eta) + \textstyle\sum_{i=1}^{m_s} \alpha_i(\eta) y_i, \tag{1a}$$

with

[10] This setting is equivalent to Feltham and Xie (1994) and similar to the market maker's behavior in Kyle (1985). Note that our results hold under the assumption of an incomplete market with private information amongst investors. Then, the information that is impounded into price through the trading decisions of informed investors can be viewed as public soft information.

[11] A possible question at this point refers to the consequences if the principal (strategically) chooses not to release some signals (we thank Stan Baiman for this observation). The capital market participants know about the set of public signals. In our setting, the principal decides about the disclosure before she learns the outcome of the performance measures. Thus, by observing the disclosure decision, investors learn nothing regarding the realization of the signals.

[12] This assumption is common in the literature on discretionary disclosure, where disclosure is often assumed to be truthful. For a review of this literature see Verrecchia (2001).

$$\sigma_\pi^2(\eta) \equiv \text{Var}[\pi|y_1,...,y_{m_s}], \quad \text{and} \tag{1b}$$

$$m_\pi(\eta) \equiv \partial \text{E}[\pi]/\partial a, \tag{1c}$$

where $\hat{a}$ denotes the investors' expectations regarding the agent's action, π_o a constant, and α_i the weight of report y_i in price. Observe that the weights $\alpha_i(\eta)$ and market price $\pi(\eta)$, its volatility $\sigma_\pi^2(\eta)$, and its sensitivity to the agent's effort choice all vary with information system η.[13] The constant π_o depends on $\hat{a}$ as the investors take their ex ante expectation about the reports into account when forming price. We will treat price as a generic performance measure in the analysis of the optimal contract and discuss the resulting price and its characteristics in section 3.

2.2 Agent's Compensation, Preferences, and Optimal Actions

At date 0, the principal offers the agent a linear contract $z = (f,v_\pi)$, where f is the agent's fixed wage and v_π the incentive rate for market price. Hence, the agent's compensation w, given price π, and contract z is

$$w(\pi,z) = f + v_\pi\, \pi.$$

We assume that the agent's preferences are represented by a negative exponential utility function, with

$$u(z,a) = -\exp[-r(w - \kappa(a))],$$

where r is the coefficient of his absolute risk aversion.

Maximizing the expected utility is equivalent to maximizing the certainty equivalent, which is characterized by

$$\begin{aligned} \text{CE}(z,a) &= \text{E}[w|z,a] - \kappa(a) - \tfrac{1}{2}\, r\, \text{Var}[w|z] \\ &= f + v_\pi\, (\pi_o + m_\pi\, a) - \tfrac{1}{2}\, a^2 - \tfrac{1}{2}\, r\, v_\pi^2\, \sigma_\pi^2. \end{aligned} \tag{2}$$

The agent chooses a to maximize his certainty equivalent. Differentiating (2) with respect to a, given contract z, provides the following characterization of the agent's action choices.

---

[13] However, in order to simplify notation, whenever the result is unambiguous we omit the reference regarding the impact of information system η on α_i, π, m_π, and σ_π^2.

Lemma 1: Given contract $z = (f, v_\pi)$, the agent's optimal action choices are characterized by

$$a^\dagger(v_\pi) = m_\pi\, v_\pi. \qquad (3)$$

Proof: Differentiating (2) with respect to a, and solving the first-order conditions for this variable results in the optimal action choices as specified in (3).

Observe that the weights for non-contractible information (i.e., the weights for the public soft information) are given by the investors' aggregation (i.e., α_i). With respect to these signals, by selecting v_π the principal can only vary the intensity of the incentives but not the aggregation of the different reports.

2.3 Principal's Contract Choice

When the principal offers contract z to the agent, she has to take into account that the agent provides unobservable effort and chooses whether to accept the contract. The actions that are induced by z are characterized by (3). Also, the agent will only participate in the firm if his contract z is such that it provides him with his reservation wage, which is scaled to equal zero, i.e.,

$$CE(z, a^\dagger) \geq 0. \qquad (4)$$

The principal is assumed to be risk neutral with respect to the terminal value of the firm. She is interested in maximizing the expected terminal value net of the agent's compensation[14], i.e.,

$$\Pi(a,z,\eta) = \mathrm{E}[x - w|a,z,\eta]. \qquad (5)$$

The principal chooses z such as to maximize (5) subject to (4) and (3). Substituting (3) into (2), choosing f such that $CE(z,a^\dagger) = 0$, and substituting $f^\dagger$ and (3) into (5) gives the principal's unconstrained decision problem:

$$\Pi(v_\pi,\eta) = b\, m_\pi\, v_\pi - \tfrac{1}{2}\, m_\pi^2\, v_\pi^2 - \tfrac{1}{2}\, r\, v_\pi^2\, \sigma_\pi^2. \qquad (6)$$

[14] We assume the principal to act in the interest of the long-term shareholders. The latter are not interested in short-term prices but in the firm's terminal value. The same assumption is made by Baiman and Verrecchia (1995) and Feltham and Xie (1994), for a study on the effects of firm owners' short-term interests on incentive contracts and disclosure decisions see Heinle/ Hofmann (2009).

Proposition 1 shows the solution to the principal's decision problem.[15]

Proposition 1: The optimal incentive rate and the principal's expected net payoff are characterized by

$$v_\pi^\dagger = Q^{-1}\, b\, m_\pi, \tag{7a}$$

$$\Pi^\dagger(\eta) = \tfrac{1}{2}\, Q^{-1}\, b^2\, m_\pi^{\,2}, \tag{7b}$$

with $Q = m_\pi^{\,2} + r\, \sigma_\pi^{\,2}$.

Using market price, the principal can indirectly contract on non-contractible information. The solution in (7a) and (7b) is identical to Section V in Feltham and Xie (1994) where the principal does not use contractible information other than price in the contract with the agent. The relative weights of the public signals in the price formation define m_π as well as $\sigma_\pi^{\,2}$ and are given by the aggregation α_i chosen by investors when inferring the firm's terminal value. As noted above, given information system η, the principal can not choose the weight on individual reports but can only choose the weight of price in the contract. To summarize, given that the principal uses market price when contracting with the agent the aggregation of public signals by investors directly affects the principal's expected net payoff. As will become obvious from the next section, when aggregating public information, the investors are ignorant regarding the impact of their aggregation on the principal's surplus.

3. Value of Disclosing Soft Information to investors

Varying the set of performance measures that are reported to investors will, in general, alter the aggregation of information in price and affect the optimal incentive rate as well as the principal's expected net payoff. Following, the the value of disclosing information to investors depends on the price formation and the initially available public information.

Let η_o represent the initial information system with a set of publicly reported performance

[15] The propositions are proven in Appendix A.

measures. Next, consider η_s that is identical to η_o except for an additional publicly reported performance measure y_s. The value of disclosing y_s to investors (i.e., the disclosure value) follows from comparing the expected net payoff to the principal under η_o and η_s. In particular:

Definition 1: The value of an additional, publicly reported performance measure y_s is given by

$$V^{\dagger}(y_s|\eta_o) \equiv \Pi^{\dagger}(\eta_s) - \Pi^{\dagger}(\eta_o). \tag{8}$$

Following (8), in general, the disclosure value of the supplemental performance measure will depend on the nature of the incentive problem, the characteristics of y_s, and the set of further disclosed performance measures (characterized by η_o). To gain insight into the value of an additional, publicly reported performance measure, we subsequently consider several special cases. In Section 3.1, we consider the baseline setting where the performance measure under study is the only information that is released to investors. This setting will be extended in Section 3.2 where we considers the disclosure of supplemental non-contractible information.

3.1 Disclosure of a Single Performance Measure

To illustrate the value of disclosing a single type of information to investors, the simplest case to consider is one in which there is only one performance measure. More specifically, $y_1 = m\, a + \rho_{1x}\varepsilon_x + \varepsilon_{\mu 1}$, where $\rho_{1x}\varepsilon_x$ is output-related fluctuation reflected in y_1 and $\varepsilon_{\mu 1}$ is measurement noise, with $\varepsilon_x \sim \mathrm{N}(0,\sigma_x^2)$, $\varepsilon_{\mu 1} \sim \mathrm{N}(0,\sigma_{\mu 1}^2)$, and $\mathrm{Cov}[\varepsilon_{\mu 1},\varepsilon_x] = 0$; $\sigma_1^2 \equiv \mathrm{Var}[y_1] = \rho_{1x}^2\sigma_x^2 + \sigma_{\mu 1}^2$ is the variance of performance measure y_1. Under η_0, no information regarding the firm's terminal payoff is publicly reported. On the other hand, under η_1, y_1 is disclosed to investors. As we, initially, only consider non-contractible information, the expected payoff to the principal equals zero under information system η_0. The only information about the agent's effort can not be used by either capital market participants or the principal.

Table 1.1
Disclosure of a Single Performance Measure

η_0 - no public performance measure

$$\pi(\eta_0) = b\hat{a} = 0, \tag{T1.1a}$$

$$\sigma_\pi^2(\eta_0) = 0, \tag{T1.1b}$$

$$m_\pi(\eta_0) = 0, \tag{T1.1c}$$

$$a^\dagger = 0, \tag{T1.1d}$$

$$v_1^\dagger = 0, \tag{T1.1e}$$

$$\Pi^\dagger(\eta_0) = 0, \tag{T1.1f}$$

η_1 - disclosure of y_1 with $\rho_{1x} \neq 0$

$$a^\dagger(v_\pi) = \alpha^* \, m \, v_\pi, \tag{T1.2a}$$

$$\pi(y_1|\eta_1) = (m^2 + r\,\sigma_\pi^2/\alpha^{*2})^{-1}\, b^2 m^2 + \alpha^*\,(y_1 - \mathrm{E}[y_1|\hat{a},z,\eta_1]), \tag{T1.2b}$$

$$\sigma_\pi^2(\eta_1) = 0, \tag{T1.2c}$$

$$m_\pi(\eta_1) = 0, \tag{T1.2d}$$

$$v_\pi^\dagger = 1/\alpha^*(m^2 + r\,\sigma_\pi^2/\alpha^{*2})^{-1}\, b\, m, \tag{T1.2e}$$

$$\Pi^\dagger(\eta_1) = \tfrac{1}{2}\,[m^2 + r\,(\rho_{1x}^2\sigma_x^2 + \sigma_{\mu 1}^2)]^{-1}\, b^2 m^2, \tag{T1.2f}$$

with $\alpha^* = (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1}\,\rho_{1x}$,

$\sigma_\pi^2(\eta_1) = (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1}\,\rho_{1x}^2\,\sigma_x^2$, and

$\mathrm{E}[y_1|\hat{a},z,\eta_1] = (m^2 + r\,\sigma_\pi^2/\alpha^{*2})^{-1}\, b\, m^3$.

Table 1.1 shows price, its characteristics as a performance measure, the incentive rate, and the expected net payoff to the principal under information systems η_0 and η_1. (T1.1a - f) illustrate that the principal cannot directly use the performance measure if y_1 is soft information. Hence, if, under η_0, y_1 is not disclosed, the principal cannot motivate the agent to exert effort such that her expected net payoff as well as the market price are equal to zero. To the contrary, with η_1, i.e., given that non-contractible information is disclosed, y_1 is impounded in price. Hence, the principal can indirectly contract on y_1. As the performance measure follows a normal distribution, in computing the price the investors correct the information for the unconditional mean and weight the information according to their covariance with the terminal value, scaled by the information's precision. Following (T1.2b), y_1 is impounded in price if it is assigned a non-zero weight α^*, i.e., if it is informative about uncontrollable events that affect the firm's terminal payoff (i.e., if $\rho_{1x} \neq 0$). Additionally, (T1.4e) and (T1.4f) show that disclosing y_1 enables the principal to induce agent effort and results in a positive expected net payoff to the principal.[16] Proposition 2 summarizes the results regarding the disclosure value of a single performance measure.

Proposition 2: Disclosing soft information is strictly valuable to the principal if it is informative about uncontrollable events that affect the firm's terminal payoff (i.e., $V^{\dagger}(y_1|\eta_0) > 0$ if $\rho_{1x} \neq 0$).

The proof follows directly from substituting (T1.1f) and (T1.2f) into (8).

Following Proposition 2, the principal has strict preferences for disclosing y_1 if it is impounded into price. Key to this result is that under η_0 market price is not used in the agent's contract. Therefore, while disclosing y_1 affects investors' inference regarding the firm's terminal payoff and, thus, market price, by setting $v_\pi = 0$ under η_1 the principal can always mimic the solution to the incentive problem under η_0. Hence, there is no downside in disclosing y_1.

Notably, this result generalizes to settings where η_0 generates multiple performance measures but discloses no information and where η_1 is identical to η_0 except that it publicly reports either one or several of the performance measures that are generated by η_0. Likewise, the result generalizes to settings where multiple tasks are assigned to the agent and contractible information is publicly reported. Intuitively, both, the disclosure of a single or multiple performance measures result in a market price that varies with disclosed information, thus introducing an option for the principal to indirectly contract on this information; on the other hand, abandoning the option does not prevent the principal from offering the same incentive contract to the agent as under η_0.

3.2 Disclosing Supplemental Non-contractible Information

The preceding analysis provides a simple model to illustrate that disclosing a single performance

---

[16] Interestingly, since price is an equivalent statistic to soft information, the expected net payoff to the principal is identical to the expected surplus if y_1 were directly contractible.

measure is weakly beneficial to the principal. In this subsection we consider a simple setting where disclosing supplemental, non-contractible information can be detrimental to the principal.

To illustrate this result, we extend the previous model by assuming that there are two non-contractible performance measures $y_i = m\,a + \rho_{ix}\varepsilon_x + \varepsilon_{\mu i}$, $i=1,2$, where $\varepsilon_{\mu i} \sim N(0,\sigma_{\mu i}^2)$, $\mathrm{Cov}[\varepsilon_{\mu i},\varepsilon_x] = 0$, and $\mathrm{Cov}[\varepsilon_{\mu 1},\varepsilon_{\mu 2}] = \rho\,\sigma_{\mu 1}\sigma_{\mu 2}$.[17] While η_1 only discloses the initial performance measure (i.e., y_1), η_2 also discloses a supplemental performance measure (i.e., y_1 and y_2). Thus, $V^{\dagger}(y_2|\eta_1)$ reflects the disclosure value of supplemental non-contractible information (i.e., the value of additional, publicly reported soft information). Suppose that the supplemental signal is (conditionally) informative about the agent's actions. Moreover, if this signal is also contractible, using it in the contract with the agent is (weakly) beneficial to the principal. However, additional, publicly reported non-contractible information can yield starkly different results.

3.2.1 Price-relevance

Even if the supplemental signal is (conditionally) informative about the agent's action, investors will not always use this information in their pricing. Lemma 2 summarizes conditions under which y_2 is not used in the price setting process.

Lemma 2: Investors do not use supplemental information y_2 to set the price if $(\rho_{2x}\,\sigma_{\mu 1} - \rho\,\rho_{1x}\,\sigma_{\mu 2})\,\sigma_{\mu 1} = 0$. This condition holds, for example, if:

(i) both signals are not informative about the firm's terminal payoff (i.e., $\rho_{1x} = \rho_{2x} = 0$);

(ii) the supplemental signal is not informative about either the firm's terminal payoff or the measurement error of the initial signal (i.e., $\rho_{2x} = \rho = 0$);

(iii) the initial signal is informative about the firm's terminal payoff and contains no measurement error (i.e., $\rho_{1x} \neq 0$ and $\sigma_{\mu 1}^2 = 0$);

[17] Assuming that y_2 has the same sensitivity to the agent's action as y_1 (i.e., $\partial E[y_1]/\partial a = \partial E[y_2]/\partial a$) is without loss in generality, since we can always generate an equivalent statistic ψ_2 to $y_2' = m'a + \rho_{2x}\varepsilon_x + \varepsilon_2$ with an arbitrary $m' \in \mathbb{R}$, such that ψ_2 has the same sensitivity as y_1.

(iv) both signals are equally informative about the firm's terminal payoff and the conditional measurement error of the initial signal is zero (i.e., $\rho_{1x} = \rho_{2x}$ and $\sigma_{\mu 1} - \rho\, \sigma_{\mu 2} = 0$).

In general, y_2 is not price relevant if y_1 is a sufficient statistic for y_1 and y_2 with respect to x. In particular, in (i) and (ii), y_2 is not informative about the firm's terminal payoff. Then, from the market's perspective, its only purpose is to reduce measurement noise that is included in y_1. However, if y_1 is not used in the first place (i.e., $\rho_{1x} = 0$) or y_2 is not informative about y_1's measurement error ($\rho = 0$), y_2 will not be considered in price setting. Interestingly, this includes the special case of a noiseless performance measure (i.e., $\sigma_2^2 = 0$). Case (iii) characterizes a setting where y_1 perfectly reveals x such that, consequently, price perfectly reflects terminal payoffs. Finally, case (iv) describes a setting where y_2 is merely a garbling of y_1.

If any condition outlined in Lemma 2 holds, y_2 is not used to derive the firm's price. Then, given that y_2 is non-contractible information, the principal can neither directly nor indirectly use the supplemental performance measure in the contract with the agent.

Assuming that neither condition outlined in Lemma 2 holds, using the model's parameterization in (1a) and (1b) gives the sensitivity of market price to the agent's action (i.e., $\partial \mathrm{E}[\pi|\eta_2]/\partial a$) and price volatility (i.e., $\sigma_\pi^2(\eta_2)$), which are characterized by

$$\partial \mathrm{E}[\pi|\eta_2]/\partial a = Q^{-1}\, m\, (\rho_{1x}\sigma_{\mu 2}^2 - \rho\, (\rho_{1x} + \rho_{2x})\, \sigma_{\mu 1}\sigma_{\mu 2} + \rho_{2x}\sigma_{\mu 1}^2)\, \sigma_x^2, \tag{9a}$$

$$\sigma_\pi^2(\eta_2) = Q^{-1}\, (\rho_{1x}^2\sigma_{\mu 2}^2 - 2\, \rho\, \rho_{1x}\, \rho_{2x}\, \sigma_{\mu 1}\sigma_{\mu 2} + \rho_{2x}^2\sigma_{\mu 1}^2)\, \sigma_x^4, \tag{9b}$$

where $Q \equiv (\rho_{1x}^2\sigma_x^2 + \sigma_{\mu 1}^2)(\rho_{2x}^2\sigma_x^2 + \sigma_{\mu 2}^2) - (\rho_{1x}\rho_{2x}\sigma_x^2 + \rho\, \sigma_{\mu 1}\sigma_{\mu 2})^2$. Observe that both figures are key to the solution of the principal's decision problem under η_2.

3.2.2 Disclosure Value

Since both performance measures y_i, $i = 1,2$, are non-contractible, the solution to the principal's problem with η_1 is the same as the solution in Section 3.1 (Table 1.1). In particular, the principal's expected net payoff is characterized by (T1.2f). On the other hand, using the parameterization for η_2 in (7b) gives the principal's expected net payoff as

$$\Pi^{\dagger}(\eta_2) = ½ \frac{b^2 m^2}{m^2 + r\sigma_\pi^2 \left(\frac{m}{\partial \mathrm{E}[\pi|\eta_2]/\partial a} \right)^2}, \tag{10}$$

where $\partial \mathrm{E}[\pi|\eta_2]/\partial a$ is given by (9a) and $\sigma_\pi^{\;2}$ is given by (9b). Substituting (T1.2f) and (10) into (8) and simplifying yields the value of disclosing y_2, given disclosure of y_1, as

$$V^{\dagger}(y_2|\eta_1) = ½ \frac{b^2 r \sigma_1^2 \sigma_\pi^2}{((\partial \mathrm{E}[\pi|\eta_2]/\partial a)^2 + r\sigma_\pi^2)(m^2 + r\sigma_1^2)} \left(\frac{(\partial \mathrm{E}[\pi|\eta_2]/\partial a)^2}{\sigma_\pi^2} - \frac{m^2}{\sigma_1^2} \right). \tag{11}$$

Suppose that the conditions outlined in Lemma 2 do not hold, i.e., supplemental information is impounded in price. Then, following (11), the sign of its disclosure value depends on the market prices' signal-to-noise ratios under η_2 versus η_1 (Kim and Suh 1991; Lambert 2001). In particular, disclosing supplemental information is beneficial to the principal if the signal-to-noise ratio with η_2 is larger than the signal-to-noise ratio with η_1 (i.e., if $\partial \mathrm{E}[\pi|\eta_2]/\partial a \,/\, \sigma_\pi > m \,/\, \sigma_1$). In general, given that the supplemental information is impounded in price, disclosure of y_2 increases price volatility (i.e., $\sigma_\pi^{\;2}(\eta_2) > \sigma_\pi^{\;2}(\eta_1) = \sigma_1^{\;2}$ if Lemma 2 does not hold), whereas the impact of disclosure on the sensitivity of market price to the agent's action is ambiguous. Proposition 3 summarizes necessary and sufficient conditions under which disclosing supplemental information y_2 is detrimental to the principal.

Proposition 3: A divergent informativeness of the initial versus the supplemental performance measure regarding the firm's terminal payoff is a necessary condition for a negative value of supplemental, publicly reported information (i.e., $\rho_{1x} \neq \rho_{2x}$). Sufficient conditions for a negative disclosure value include, for example, modest measurement error in the initial performance measure and a relatively more payoff-informative supplemental performance measure with

(i) no measurement error (i.e., $\sigma_{\mu 1}^{\;2} < (1-\rho_{1x}^{\;2})\, \sigma_x^{\;2}$, $\rho_{2x}^{\;2} > \rho_{1x}^{\;2} + \sigma_{\mu 1}^{\;2}/\sigma_x^{\;2}$, and $\sigma_{\mu 2} = 0$);

(ii) unrelated measurement error (i.e., $\sigma_{\mu 1}^{\;2} < (1-2\,\rho_{1x}/\rho_{2x})\, \sigma_{\mu 2}^{\;2} + (\rho_{2x}^{\;2}-\rho_{1x}^{\;2})\, \sigma_x^{\;2}$, $\rho_{2x} > 2\,\rho_{1x} >$

0, and ρ = 0).

In settings (i) and (ii), volatility increases with disclosure because (a) the initial performance measure is subject to only modest measurement error and (b) the supplemental performance measure is substantially more informative about terminal payoffs than the initial signal.[18] If the supplemental performance measure is substantially more informative about the firm's terminal payoff than the initial performance measure, investors assign a relatively larger weight to the former signal (i.e., α_2^* versus α_1^*), yielding a lower sensitivity of price to the agent's action. Consequently, the additional, publicly reported signal decreases the signal-to-noise ratio of market price and, according to (11), has a negative disclosure value.

Fundamental to Proposition 3 is that investors are ignorant regarding the impact of their pricing on the principal's expected net payoff. Intuitively, whereas the principal would assign a relatively larger weight to y_1 (because of its modest measurement error), investors place a relatively larger weight on y_2 (because of its higher payoff informativeness). It is this divergence in the aggregation of the performance measures (Paul 1992, Feltham and Xie 1994) that causes the negative disclosure value. Interestingly, this chain of reasoning holds for the case where the supplemental signal possesses no measurement error (Proposition 3 (i)) and the case where its measurement error is unrelated to the measurement error of the initial signal (Proposition 3 (ii)).[19]

Observe that Proposition 3 holds as long as market price is used as the sole performance measure in the agent's contract. Key to this result is that investors aggregate information regardless of its contractibility, i.e., the weight α_i^* assigned to y_i is not affected by this signal's contractibility. On the other hand, if either the initial or the supplemental performance measure

[18] Observe that volatility increases in the performance measure's payoff informativeness. Intuitively, for a more informative signal, price varies to a larger extent with the disclosed signal.

[19] Note that these additional conditions affect the cutoff-values for the measurement error of the initial signal and the supplemental signal's payoff informativeness.

is contractible, disclosure value for the supplemental signal will be non-negative. With at least one contractible performance measure, by varying the incentive rate for this signal the principal can induce any relative weights for both, the contractible signal and market price, including the weights that she would choose if both signals were contractible.

While Section 3 considered the disclosure of supplemental non-contractible information in a single-task setting, we investigate the value of supplemental non-contractible information in a multi-task setting in the following section. Finally, Section 5 considers the disclosure value of contractible information, given that non-contractible information is publicly reported.

4. VALUE OF DISCLOSURE IN A TWO-TASK SETTING

We now consider a simple model that starkly illustrates how, in a multi-task setting, supplemental, publicly reported non-contractible information can be detrimental to the principal. While in previous sections the principal only had to care about setting effort-level incentives, she also cares about the allocation of effort across different tasks in a multi-task setting. To keep the model as simple as possible, we extend the previous model by considering a second (potentially) productive task, such that

$$x = b_1\, a_1 + b_2\, a_2 + \varepsilon_x,$$

where $a_i \in \mathbb{R}$ represents the agent's choice of effort level and $b_i \in \mathbb{R}$ represents the productivity of the agent's effort in task i, $i = 1,2$. We assume the agent's personal cost of effort $\kappa(a_1,a_2)$ is

$$\kappa(a) = \tfrac{1}{2}\,(a_1^2 + a_2^2).$$

Let $\pi(\eta_k) = \mu_{k1}\, a_1 + \mu_{k2}\, a_2 + \varepsilon_{k\pi}$ represent market price given information system η_k, k=1,2, where the sensitivity to the agent's actions (i.e., μ_{k1} and μ_{k2}) and the noise in price (i.e., $\varepsilon_{k\pi}$) all depend on η_k. More specifically, the parameters depend on the aggregation weights implied by η_k. Using this parameterization in (2) and (5), Table 1.2 summarizes the agent's certainty equivalent, his choice of effort, the principal's unconstrained decision problem, the optimal incentive rate, and the principal's expected net payoff.

Table 1.2
Two-task Agency Conflict

$\mathrm{CE}(z,a) = f + v_{k\pi}(\pi_o + \mu_{k1} a_1 + \mu_{k2} a_2) - ½ (a_1^2 + a_2^2) - ½ r v_{k\pi}^2 \sigma_{k\pi}^2$,	(T2a)
$a_i^{\dagger}(v_\pi) = \mu_{ki} v_{k\pi}, \ i = 1,2$,	(T2b)
$\Pi(v_\pi,\eta) = (b_1 \mu_{k1} + b_2 \mu_{k2}) v_{k\pi} - ½ (\mu_{k1}^2 + \mu_{k2}^2) v_\pi^2 - ½ r v_\pi^2 \sigma_\pi^2$,	(T2c)
$v_\pi^{\dagger} = Q_k^{-1}(b_1 \mu_{k1} + b_2 \mu_{k2})$,	(T2d)
$\Pi^{\dagger}(\eta) = ½ Q_k^{-1}(b_1 \mu_{k1} + b_2 \mu_{k2})^2$,	(T2e)
with $Q_k = \mu_{k1}^2 + \mu_{k2}^2 + r \sigma_\pi^2$	

The solution to our two-task problem with a single performance measure is equivalent to Feltham/ Xie (1994). Our focus, however, is the value of disclosure when price is used as a performance measure. We assume that the two actions a_1 and a_2 influence two aggregate, non-contractible performance measures $y_i = m_{i1}a_1 + m_{i2}a_2 + \rho_{ix}\varepsilon_x + \varepsilon_{\mu i}$, i=1,2, where $\varepsilon_{\mu i} \sim \mathrm{N}(0,\sigma_{\mu i}^2)$, $\mathrm{Cov}[\varepsilon_{\mu i},\varepsilon_x] = 0$, and $\mathrm{Cov}[\varepsilon_{\mu 1},\varepsilon_{\mu 2}] = \rho\, \sigma_{\mu 1}\sigma_{\mu 2}$.[20] As in the previous model, while η_1 only discloses an initial performance measure (i.e., y_1), η_2 also discloses a supplemental performance measure (i.e., y_1 and y_2). Hence, $V^{\dagger}(y_2|\eta_1)$ continues to reflect the disclosure value of supplemental non-contractible information.

Note that Lemma 2 continues to apply in this setting. Key to this result is that investors are only interested in the signals' payoff-informativeness, which is not affected by the agent's effort choices. More generally, while the weight for y_1 under η_1 is given by $\alpha^* = (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1} \rho_{1x}$ (see Table 1.1), using (1a), with η_2 the weights for both signals are given by

$$\alpha_1^* = Q^{-1}(\rho_{1x}\, \sigma_{\mu 2} - \rho\, \rho_{2x}\, \sigma_{\mu 1})\, \sigma_{\mu 2}\, \sigma_x^2, \tag{12a}$$

$$\alpha_2^* = Q^{-1}(\rho_{2x}\, \sigma_{\mu 1} - \rho\, \rho_{1x}\, \sigma_{\mu 2})\, \sigma_{\mu 1}\, \sigma_x^2, \tag{12b}$$

where $Q \equiv (\rho_{1x}^2\sigma_x^2 + \sigma_{\mu 1}^2)(\rho_{2x}^2\sigma_x^2 + \sigma_{\mu 2}^2) - (\rho_{1x}\rho_{2x}\sigma_x^2 + \rho\, \sigma_{\mu 1}\sigma_{\mu 2})^2$. Applying these weights to the performance measures determines how the agent's actions influence market price.

[20] For simplicity, $m_{ij} \geq 0$, $i, j = 1,2$.

Subsequently, to illustrate our results, we first consider a setting where the agent is risk-neutral (Subsection 4.1) before considering the setting with a risk-averse agent (Subsection 4.2).

4.1 Disclosure Value with a Two-task Risk-neutral Agent

With a risk-neutral agent, the principal's objective is to motivate an efficient effort allocation across tasks. Note that if the gross payoff to the principal is non-contractible information, then risk neutrality is not sufficient to achieve the first-best result (Feltham and Xie 1994). Moreover, with both information systems η_1 and η_2, given non-contractible performance measures y_1 and y_2, market price is the sole contractible performance measure. Substituting $r \to 0$ in (T2e) yields the principal's expected net payoff, given by

$$\Pi^{\dagger}(\eta_k) = ½\, Q_k^{-1}\,(b_1\,\mu_{k1} + b_2\,\mu_{k2})^2,\ \ k = 1,2, \tag{13}$$

with $Q_k \equiv \mu_{k1}^2 + \mu_{k2}^2$. Substituting (13) for $k = 1,2$ into (8) and simplifying yields the value of the additional, publicly reported performance measure y_2, i.e.,

$$V^{\dagger}(y_2|\eta_1) = ½\, Q_1^{-1} Q_2^{-1}\, A_{12}\,[A_{b1}\,(b_1\mu_{21} + b_2\mu_{22}) + A_{b2}\,(b_1\mu_{11} + b_2\mu_{12})], \tag{14}$$

where $A_{bk} \equiv b_1\mu_{k2} - b_2\mu_{k1}$ is the measure of non-congruity for market price $\pi(\eta_k)$, relative to the firm's terminal payoff, and $A_{12} \equiv \mu_{12}\mu_{21} - \mu_{11}\mu_{22}$ is the measure of alignment between market prices $\pi(\eta_1)$ and $\pi(\eta_2)$ as implied by information system η_k (Feltham and Wu 2000).

Disclosure value of y_2 depends in a non-trivial way on the measures of non-congruity for the two information systems.[21] For example, if the market price that is induced by the initial performance measure is perfectly congruent (i.e., if $A_{b1} = 0$), (14) simplifies to $V^{\dagger}(y_2|\eta_1) = -½ Q_2^{-1} A_{b2}^2 \le 0$. Then, disclosing a supplemental performance measure that yields a non-congruent price (i.e., a signal with $A_{b2} \neq 0$) is detrimental to the principal. Key to this result is that risk neutrality and a perfectly congruent market price under η_1 are sufficient to achieve the first-best result. On the other hand, while disclosing a supplemental performance measure improves market price's informativeness regarding the firm's terminal payoff, the expected net

[21] Note that the two measures of non-congruity and the measure of alignment are functionally related.

payoff to the principal declines if this signal is not congruent. Secondly, disclosing a supplemental performance measure is of no value to the principal if it is perfectly aligned with the initial signal (i.e., if $A_{12} = 0$). Given two aligned public signals, market price's measure of non-congruity is identical to the non-congruity for either signal. With risk neutrality, however, price congruency is the single driver of inefficiencies in the agency.

More generally, price congruency depends on the weights assigned to public information. Using the signals' weights under η_1 and η_2 (Table 1.1, (12a), and (12b)) in (1a) yields a functional relation between market price, the agent's actions, and payoff and measurement noise. Table 1.3 summarizes these relations for η_1 and η_2 along with expressions for the price sensitivity to the agent's actions.

Table 1.3
Market Price and Price Sensitivity Under η_1 and η_2

η_1 - disclosure of y_1

$$\pi(\eta_1) = \pi_o(\eta_1) + (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1} \rho_{1x} m_{11} a_1 + (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1} \rho_{1x} m_{12} a_2 + \alpha^* (\rho_{1x}\varepsilon_x + \varepsilon_{\mu 1}), \quad \text{(T3.1a)}$$

$$\mu_{11} \equiv (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1} \rho_{1x} m_{11}, \quad \text{and} \quad \mu_{12} \equiv (\rho_{1x}^2 + \sigma_{\mu 1}^2/\sigma_x^2)^{-1} \rho_{1x} m_{12}. \quad \text{(T3.1b)}$$

η_2 - disclosure of y_1 and y_2

$$\begin{aligned}\pi(\eta_2) = \pi_o(\eta_2) &+ Q^{-1} [(\rho_{1x} \sigma_{\mu 2} - \rho \rho_{2x} \sigma_{\mu 1}) \sigma_{\mu 2} m_{11} + (\rho_{2x} \sigma_{\mu 1} - \rho \rho_{1x} \sigma_{\mu 2}) \sigma_{\mu 1} m_{21}] \sigma_x^2 a_1 \\ &+ Q^{-1} [(\rho_{1x} \sigma_{\mu 2} - \rho \rho_{2x} \sigma_{\mu 1}) \sigma_{\mu 2} m_{12} + (\rho_{2x} \sigma_{\mu 1} - \rho \rho_{1x} \sigma_{\mu 2}) \sigma_{\mu 1} m_{22}] \sigma_x^2 a_2 \\ &+ Q^{-1} [\rho_{1x}^2 \sigma_{\mu 2}^2 - \rho \rho_{1x} \rho_{2x} \sigma_{\mu 1} \sigma_{\mu 2} + \rho_{2x}^2 \sigma_{\mu 1}^2 - \rho \rho_{1x} \rho_{2x} \sigma_{\mu 1} \sigma_{\mu 2}] \sigma_x^2 \varepsilon_x \\ &+ Q^{-1} \sigma_x^2 [(\rho_{1x} \sigma_{\mu 2} - \rho \rho_{2x} \sigma_{\mu 1}) \sigma_{\mu 2} \varepsilon_{\mu 1} + (\rho_{2x} \sigma_{\mu 1} - \rho \rho_{1x} \sigma_{\mu 2}) \sigma_{\mu 1} \varepsilon_{\mu 2}], \quad \text{(T3.2a)}\end{aligned}$$

$$\mu_{21} \equiv Q^{-1} [(\rho_{1x} \sigma_{\mu 2} - \rho \rho_{2x} \sigma_{\mu 1}) \sigma_{\mu 2} m_{11} + (\rho_{2x} \sigma_{\mu 1} - \rho \rho_{1x} \sigma_{\mu 2}) \sigma_{\mu 1} m_{21}] \sigma_x^2, \text{ and} \quad \text{(T3.2b)}$$

$$\mu_{22} \equiv Q^{-1} [(\rho_{1x} \sigma_{\mu 2} - \rho \rho_{2x} \sigma_{\mu 1}) \sigma_{\mu 2} m_{12} + (\rho_{2x} \sigma_{\mu 1} - \rho \rho_{1x} \sigma_{\mu 2}) \sigma_{\mu 1} m_{22}] \sigma_x^2, \quad \text{(T3.2c)}$$

with $Q \equiv (\rho_{1x}^2\sigma_x^2 + \sigma_{\mu 1}^2)(\rho_{2x}^2\sigma_x^2 + \sigma_{\mu 2}^2) - (\rho_{1x}\rho_{2x}\sigma_x^2 + \rho\, \sigma_{\mu 1}\sigma_{\mu 2})^2$.

Substituting (T3.1b), (T3.2b), and (T3.2c) into (14) yields a non-trivial expression for the value of the additional, publicly reported performance measure y_2. The sign of $V^\dagger(y_2|\eta_1)$ is, in general, ambiguous. Assuming that y_2 is used by investors in pricing the firm's terminal payoff (i.e., assuming that Lemma 2 does not apply), while disclosing supplemental information y_2 can be beneficial to the principal, for emphasis, we focus on conditions under which the disclosure value will be negative:

Proposition 4: Suppose the agent is risk-neutral; an additional, publicly reported performance measure has a negative disclosure value, for example, if:

(i) the initial performance measure is congruent with the terminal payoff (i.e., $b_1/b_2 = m_{11}/m_{12}$);

(ii) one of the agent's tasks is window dressing that only affects the supplemental performance measure (i.e., $b_i = m_{1i} = 0$ and $m_{2i} \neq 0$ for either i=1 or i=2);

(iii) measurement error is unrelated, the supplemental performance measure covaries positively with the firm's terminal payoff and responds relatively more strongly to effort in the second task than does the initial performance measure, which, in turn, responds relatively more strongly to effort in the second task than does the firm's terminal payoff (i.e., $\rho = 0$, $\rho_{2x} > 0$, and $m_{21}/m_{22} < m_{11}/m_{12} < b_1/b_2$).

Key to the negative disclosure value is the effect of disclosing y_2 on the congruency of market price, relative to the firm's terminal payoff. In particular, Proposition 4 identifies sufficient conditions under which disclosure of both, the initial plus the supplemental performance measure yields a less congruent price than does disclosure of merely the initial performance measure. For example, this holds in Proposition 4 (i) with a perfectly congruent initial performance measure, implying a likewise perfectly congruent market price. As a corollary, disclosure value will be negative if the initial performance measure is perfectly congruent in the sense that it does not respond to window dressing (Proposition 4 (ii)). Finally, Proposition 4 (iii) gives an example where the initial performance measure is non-congruent (e.g., it responds relatively more strongly to effort in the second task than does the firm's terminal payoff), but the supplemental performance measure is even less congruent (e.g., the relative response to effort in the second task is even more pronounced as compared with the initial signal). Here, any (positive) weighting of the two signals in the investors' pricing yields a less congruent market price than the weighting of merely the initial performance measure.

Note that the latter result is in stark contrast to the result for a two-task setting with contractible performance measures. There, releasing a non-aligned second performance measure is sufficient to achieve the first-best result. While in the latter setting it is the principal who selects the relative weights for the performance measures, in our setting it is the investors that weight the signals via their pricing. In particular, with contractible performance measures, the principal selects a *negative* weight for the supplemental performance measure (yielding a perfectly congruent total performance measure), while, due to the positive covariance between the supplemental performance measure and the firm's terminal payoff, the investors choose a *positive* weight.

4.2 Disclosure Value with a Two-task Risk-averse Agent

We now consider a simple model that integrates both reasons for a negative disclosure value, i.e., the market price is either noisier or less congruent as a consequence of the disclosure of a supplemental, non-contractible performance measure. The agent controls two tasks and there are two aggregate, non-contractible performance measures. Hence, the model is the same as the model in the previous subsection, except that the agent is risk averse. For illustration, we assume that the initial performance measure is perfectly congruent (i.e., $A_{b1} = b_1 m_{12} - b_2 m_{11} = 0$), the supplemental performance measure, in general, responds differently to the second task (i.e., $m_{21} = b_1$ and $m_{22} > 0$), the noise variables have unit variance (i.e., $\sigma_x^2 = \sigma_{\mu 1}^2 = \sigma_{\mu 2}^2 = 1$), and measurement error is unrelated (i.e., $\rho = 0$). Proposition 5 characterizes two settings under which disclosing supplemental information y_2 will be detrimental to the principal.

Proposition 5: Suppose the agent is risk-averse; an additional, publicly reported performance measure has a negative disclosure value, for example, if:

(i) the agent's productivity is identical across tasks, the supplemental performance measure responds more strongly to effort in the second task than does the initial measure, and both signals are equally but limitedly informative regarding the firm's terminal payoff (i.e., $b_1 = b_2 = b$, $m_{22} > b$, $\rho_{1x} = \rho_{2x} = \rho_x$, and $\rho_x^2 < \underline{\rho}_x$);

(ii) the agent's second task is a window-dressing activity and the supplemental performance measure strongly responds to this activity (i.e., $b_2 = 0$ and $m_{22}^2 > r\,\rho_{x2}^{-1}\,[2\,\rho_{1x}(1+\rho_{1x}^2) - \rho_{2x}(\rho_{1x}^2 + \rho_{2x}^2)]$).

In the setting described by Proposition 5 (i), publicly reporting the supplemental performance measure results in a non-congruent price. However, given identical weights for both signals, market price's measure of non-congruity is unaffected by the payoff-informativeness of the two signals (i.e., ρ_x). On the contrary, price volatility is strictly monotonically increasing in payoff-informativeness. Thus, for a low informativeness, strong effort incentives (i.e., $v_\pi^\dagger$) result. Given that strong incentives amplify the consequences for the firm's terminal payoff of differences in the performance measure's congruity, a large downside of disclosing the supplemental signal exists, thus resulting in the negative disclosure value.

Likewise, in the setting of Proposition 5 (ii), price is non-congruent if supplemental information is publicly reported. On the other hand, depending on the signals' payoff-informativeness, disclosing both signals may yield a larger signal-to-noise ratio. While a non-congruent performance measure results in an inefficient effort allocation, the agent demands a risk premium to bear the performance measure inaccuracy. Therefore, disclosing supplemental information is detrimental to the principal if the loss in inefficient effort allocation exceeds the gains in risk premium. This is the case, if the supplemental performance measure strongly responds to the window-dressing activity.

5. Value of Disclosing Contractible Information

So far, the analysis addressed the value of supplemental, publicly reported non-contractible information. Subsequently, we will consider the value of disclosing *contractible* information in addition to other non-contractible information. Introducing hard information to our model provides the principal with an additional instrument to control the agent's choice of effort, as she can design a contract that includes both, the hard information and price. To illustrate the differences, we extend the model in Subsection 3.2 by considering a contractible performance measure $y_c = m\,a + \rho_{cx}\varepsilon_x + \varepsilon_{\mu c}$ plus two non-contractible performance measures $y_i = m\,a + \rho_{ix}\varepsilon_x + \varepsilon_{\mu i}$, i=1,2, where $\varepsilon_{\mu j} \sim \mathrm{N}(0,\sigma_{\mu j}^2)$, j=1,2,c, $\mathrm{Cov}[\varepsilon_{\mu j},\varepsilon_x] = 0$, $\mathrm{Cov}[\varepsilon_{\mu 1},\varepsilon_{\mu 2}] = \rho\,\sigma_{\mu 1}\sigma_{\mu 2}$, and $\mathrm{Cov}[\varepsilon_{\mu i},\varepsilon_{\mu c}] = \rho_{ci}\,\sigma_{\mu c}\sigma_{\mu i}$. While η_2 publicly reports both non-contractible performance measures (i.e., y_1 and y_2), η_3 also discloses the contractible performance measure (i.e., y_c). Thus, $V^{\dagger}(y_c|\eta_2)$ reflects the value of additional, publicly reported contractible information. Analogue to Section 2 we will first treat price as a generic performance measure and substitute the respective parameters subsequently. Again, let $\pi(\eta_k) = \mu_k\,a + \varepsilon_{k\pi}$ represent market price given information system η_k, k=2,3. The agent's compensation w, given price π, contractible information y_c, and contract z is given by

$$w(\pi,y_c,z) = f + v_\pi\,\pi + v_c\,y_c.$$

Substituting this expression into (2) provides following characterization of the agent's certainty equivalent,

$$\mathrm{CE}(z,a) = f + v_\pi\,(\pi_o + \mu_k\,a) + v_c\,m_c\,a - \tfrac{1}{2}\,a^2 - \tfrac{1}{2}\,r\,(v_\pi^2\,\sigma_{k\pi}^2 + v_c^2\,\sigma_c^2 + 2\,v_c\,v_\pi\,\sigma_{ck\pi}),$$

where $\sigma_{ck\pi} \equiv \mathrm{Cov}[\pi_k,y_c]$ is the correlation between price π_k and the contractible performance measure y_c. Table 1.4 summarizes the agent's effort choice, the principal's unconstrained decision problem, the optimal incentive rate, and the principal's expected net payoff. Again, the solution to the principal's problem with two performance measures equals that in Feltham/ Xie (1994) with two generic performance measures. Here, the principal uses all available measures to most efficiently balance effort incentives and risk she imposes on the agent.

Table 1.4
Agency Conflict with Price and one Contractible Measure

$a^{\dagger}(v_{\pi}) = \mu_k\, v_{k\pi} + m_c\, v_c,$ (T4a)

$\Pi(v_{\pi},\eta) = b\,(\mu_k\, v_{k\pi} + m_c\, v_c) - ½\,(\mu_k\, v_{k\pi} + m_c\, v_c)^2 - ½\, r\,(v_{\pi}^2\,\sigma_{k\pi}^{\;2} + v_c^2\,\sigma_c^{\;2} + 2\, v_c\, v_{\pi}\,\sigma_{ck\pi}),$ (T4b)

$v_{\pi}^{\;\dagger} = Q_k^{\;-1}\, b\,(\mu_k\,\sigma_c^{\;2} - m_c\,\sigma_{ck\pi}),$ (T4c)

$v_c^{\;\dagger} = Q_k^{\;-1}\, b\,(m_c\,\sigma_{k\pi}^{\;2} - \mu_k\,\sigma_{ck\pi}),$ (T4d)

$\Pi^{\dagger}(\eta) = ½\, Q_k^{\;-1}\, b^2\,(m_c^{\;2}\,\sigma_{k\pi}^{\;2} + \mu_k^{\;2}\,\sigma_c^{\;2} - 2\, m_c\,\mu_k\,\sigma_{ck\pi}),$ (T4e)

with $Q_k = m_c^{\;2}\,\sigma_{k\pi}^{\;2} + \mu_k^{\;2}\,\sigma_c^{\;2} - 2\, m_c\,\mu_k\,\sigma_{ck\pi} + r\,(\sigma_c^{\;2}\,\sigma_{\pi}^{\;2} - \sigma_{ck\pi})$

Note that, following Proposition 2, disclosing a single non-contractible performance measure has no value to the principal. Likewise, disclosing contractible information is, in general, of no value if the performance measure is publicly reported in addition to a *single* non-contractible performance measure.[22] Key to this result is that the principal can always use the contractible performance measure to undo this signal's impact on market price; the "filtered" market price, however, is an equivalent statistic to market price in the setting where the contractible performance measure is not publicly reported. However, disclosing a contractible performance measure in addition to *multiple* non-contractible performance measures yields starkly different results.

Similar to Subsection 3.2, using the model's parameterization in (1a), Lemma 3 summarizes conditions under which y_c is not used in the price setting process.

Lemma 3: The capital market does not use supplemental information y_c to set the price if

$$\rho_{cx} = (1-\rho^2)^{-1}\,[(\rho_{c2} - \rho\,\rho_{c1})\,\rho_{2x}/\sigma_{\mu 2} + (\rho_{c1} - \rho\,\rho_{c2})\,\rho_{1x}/\sigma_{\mu 1}]\,\sigma_{\mu c}.$$

This condition holds, for example, if:

(i) all three signals are not informative about the terminal payoff (i.e., $\rho_{1x} = \rho_{2x} = \rho_{cx} = 0$);

(ii) the supplemental signal is not informative about either the firm's terminal payoff or the measurement error of the initial signals (i.e., $\rho_{c1} = \rho_{c2} = \rho_{cx} = 0$);

[22] The only exception refers to the knife-edge case where the non-contractible information is no longer impounded in price, given the disclosure of the contractible information. Then, the principal is weakly worse off.

(iii) at least one non-contractible signal is informative about the firm's terminal payoff and contains no measurement error (i.e., $\rho_{ix} \neq 0$ and $\sigma_{\mu i}^2 = 0$ for i=1 or i=2);

(iv) the non-contractible signals are identical (i.e., $\rho_{1x} = \rho_{2x}$, $\sigma_{\mu 1} = \sigma_{\mu 2}$, $\rho_{c1} = \rho_{c2}$, and $\rho = 1$).

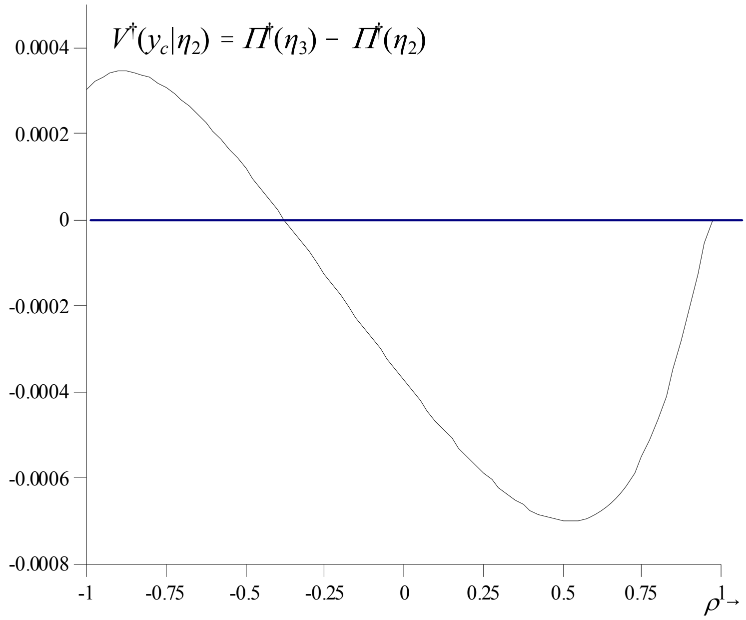
Observe the similarity between the conditions in Lemma 3 and those in Lemma 2. More specifically, the line of reasoning for Lemma 3 parallels the logic to Lemma 2. In particular, if any condition outlined in Lemma 3 holds, y_c is not used to derive the firm's price and the value of disclosing y_c is zero.

Note that information systems η_2 and η_3 are identical except for the induced market price. Thus, the performance comparison of η_2 and η_3 relies on the sensitivity of market price to the agent's action and price's (conditional) variance. Similar to Subsection 3.2, given that supplemental information is impounded in price, disclosure of y_c (weakly) increases price volatility (i.e., $\sigma_\pi^2(\eta_3) \geq \sigma_\pi^2(\eta_2)$ if Lemma 3 does not hold). On the contrary, the impact of disclosing y_c on both, the sensitivity of market price and the correlation between market price and the contractible performance measure, is ambiguous. Hence, in general, publicly reporting an additional contractible performance measure can be both beneficial and detrimental to the principal.

Applying the model's parameterization to (8), using (T4c), (T4d), and (T4e), results in an expression for the disclosure value $V^{\dagger}(y_c|\eta_2)$. However, using this expression to identify cutoff-values yields rather complex closed-form solutions. Hence, we employ a numerical example to demonstrate that, with multiple non-contractible performance measures, the principal can have strict preferences regarding the disclosure of additional contractible information.

Figure 1.1 illustrates these preferences. Here, $m = b = 1$, $r = 1$, $\sigma_{\mu 1} = \sigma_{\mu 2} = \sigma_{\mu c} = \sigma_x = 1$, $\rho_{1x} = 1/8$, $\rho_{2x} = ½$, $\rho_{cx} = \rho_{c1} = \rho_{c2} = 1/10$.

Figure 1.1
Value of a Publicly Reported Contractible Performance Measure y_c
Given the Disclosure of Two Non-contractible Performance Measures Under η_2



In the example, besides three knife-edge conditions, the principal is not indifferent regarding the disclosure of contractible information. More specifically, the principal benefits from publicly reporting y_c if measurement error of the two non-contractible performance measures is highly correlated (i.e., for large values of $|\rho|$). With η_2, for a relatively negative correlation, the investors assign a negative weight to one signal, yielding a weak sensitivity of market price to the agent's action. On the other hand, for a large positive correlation, a high volatility results. In both cases, disclosure of y_c under η_3 increases the sensitivity of market price to the agent's action, which is particularly beneficial in case of a relatively negative correlation.

Notably, unlike disclosure of a contractible performance measure in settings with either no or merely a single publicly reported, non-contractible performance measure, the principal has strict preferences for disclosing contractible information in settings with multiple public, non-contractible performance measures. Then, the value of disclosing contractible information depends on the information already available to the capital market. Intuitively, disclosure affects the investors' inferences regarding the firm's terminal payoff, the weights that they assign to the disclosed performance measures and, as a consequence, the sensitivity and (conditional) variance of market price. As the numerical example illustrates, the performance comparison of disclosure versus non-disclosure can go either way. Proposition 6 summarizes necessary conditions for the principal to have a strict preference regarding the disclosure of an additional contractible performance measure.

Proposition 6: Suppose that information system η_s is identical to information system η_o, except for the additional disclosure of a contractible performance measure y_c; necessary conditions for the principal to have a strict preference regarding the disclosure or non-disclosure of a contractible performance measure (i.e., $V^{\dagger}(y_c|\eta_o) \neq 0$) include,

(i) η_o publicly reports at least two non-contractible performance measures;

(ii) disclosure of y_c alters investors' aggregation of information into price (i.e., $\alpha_c^*(\eta_s) \neq 0$, $\alpha_i^*(\eta_s) \neq \alpha_i^*(\eta_o)$ for at least one $i \in \{1,2\}$);

(iii) with η_o, the principal uses market price π in the contract with the agent (i.e., with η_o, $v_\pi^* \neq 0$).

Note that Proposition 6 carries forward to a multi-task setting. There, altered weights imply a (weak) change in the market price's congruency with the firm's terminal payoff. Similarly, the change in congruency can be beneficial as well as detrimental to the principal. For example, suppose agent risk-aversion is negligible. Then, the value of disclosure will be negative if the contractible performance measure and price are not aligned with η_o, but they are aligned with η_s.

As a corollary to Proposition 6, if the new information is price relevant (i.e., $\alpha_c^*(\eta_s) \neq 0$), the principal will have strict preferences regarding its disclosure. However, while price informativeness weakly increases as a consequence of the additional information that is available to investors, disclosing contractible information can leave the principal strictly worse off.

6. CONCLUDING REMARKS

In this paper, we examine the economic consequences of disclosing different types of information to the capital market. Our study is motivated by the recently proposed focus on decision-usefulness as the primary objective of financial accounting and the ongoing demand for more disclosure of soft information. In our analysis, market price serves as a performance measure in the contract between a risk neutral principal and a risk and effort averse agent. We extend a standard multi-task LEN-model to include the firm's market price and investigate the relation between price efficiency and solution of an agency conflict. More specifically, we investigate the disclosure of additional soft and hard information from a stewardship perspective.

We find that while publicly reported additional information improves price efficiency, the impact of more disclosed information on the principal's expected net payoff is ambiguous. Hence, we present a rationale for partial disclosure that is complementary to proprietary costs or uncertainty concerning the quantity of information. Contrary to much of the earlier work on partial disclosure, rather than withholding information ex post because it draws a bad picture of the firm (and thus leads to a lower stock-price), the principal commits ex ante (i.e., before the information is generated) to not disclose the information. In our setting, withholding information is valuable because the contracting usefulness of market price decreases as a consequence of the disclosure.

Based on our findings, we conclude that stewardship and decision-usefulness are potentially conflicting objectives of financial accounting. This is consistent, e.g., with empirical evidence provided by Gassen (2008). Thus, abandoning stewardship as a separate objective of financial accounting and mandating further disclosure of soft information by standard setters and regulators can result in lower productivity and reduced firm value. Also, firms can be compelled to offset the negative consequences of mandatory disclosure by reducing their amount of voluntary disclosure. Likewise, it can be optimal for firms to disclose aggregated soft information (if possible) instead of detailed information.

Our findings have implications for empiricists, standard setters, and regulators. Given that non-contractible information is not verifiable and, thus, prone to window dressing by managers, disclosing (more) soft information will result in a re-allocation of effort from productive to non-productive tasks. Moreover, increasing the level of disclosure yields a noisier price. Hence, assuming a mandatory disclosure regime, we expect to observe a larger relative weight on accounting earnings as compared to stock price after more comprehensive requirements for disclosure of soft information are in effect. In a similar vain, increased mandatory requirements can result in a reduction of the amount of voluntary disclosure, including the disclosure of hard information. Finally, standard setters frequently change disclosure standards one at a time. Our results, however, indicate that the "value of a standard" crucially depends on the standards that are already in place. In general, adjusting a standard in the sense of increasing demand for disclosing either hard or soft information can destroy firm value.

APPENDIX A
PROOFS

Proposition 1: Differentiating (6) with respect to v_π and solving the first order condition for v_π gives (7a). Substituting (7a) yields the principal's expected net payoff as characterized by (7b)

■

Lemma 2: Applying the model's parameterization to (1a) yields the following weights that are assigned to the two non-contractible signals by the investors:

$$\alpha_1^* = Q^{-1}\,(\rho_{1x}\,\sigma_{\mu2} - \rho\,\rho_{2x}\,\sigma_{\mu1})\,\sigma_{\mu2}\,\sigma_x^2, \tag{A.1a}$$

$$\alpha_2^* = Q^{-1}\,(\rho_{2x}\,\sigma_{\mu1} - \rho\,\rho_{1x}\,\sigma_{\mu2})\,\sigma_{\mu1}\,\sigma_x^2, \tag{A.1b}$$

where $Q \equiv (\rho_{1x}^2\sigma_x^2 + \sigma_{\mu1}^2)(\rho_{2x}^2\sigma_x^2 + \sigma_{\mu2}^2) - (\rho_{1x}\rho_{2x}\sigma_x^2 + \rho\,\sigma_{\mu1}\sigma_{\mu2})^2$. Following (A.1b), the weight assigned to the supplemental information y_2 will be zero if $(\rho_{2x}\,\sigma_{\mu1} - \rho\,\rho_{1x}\,\sigma_{\mu2})\,\sigma_{\mu1} = 0$. Settings (i) to (iv) describe conditions under which the weight will be zero. ■

Proposition 3: Substituting (9a), (9b), and $\rho_{1x} = \rho_{2x} = \rho_x$ into (11) and simplifying yields the value of disclosing y_2, given disclosure of y_1 as

$$V^\dagger(y_2|\eta_1) = ½\,\frac{b^2m^2r\sigma_{\mu1}^2(\sigma_{\mu1} - \rho\sigma_{\mu2})^2}{[m^2 + r(\sigma_{\mu1}^2 + \rho_x^2\sigma_x^2)][(m^2(\sigma_{\mu1}^2 - 2\rho\sigma_{\mu1}\sigma_{\mu2} + \sigma_{\mu2}^2) + rQ]} \geq 0,$$

with $Q \equiv (\rho_x^2\sigma_x^2 + \sigma_{\mu1}^2)(\rho_x^2\sigma_x^2 + \sigma_{\mu2}^2) - (\rho_x^2\,\sigma_x^2 + \rho\,\sigma_{\mu1}\sigma_{\mu2})^2$. Since $V^\dagger(y_2|\eta_1) \geq 0$, $\rho_{1x} \neq \rho_{2x}$ is a necessary condition. (i) Substituting (9a), (9b), and $\sigma_{\mu2} = 0$ into (11) and simplifying yields

$$V^\dagger(y_2|\eta_1) = ½\,\frac{b^2m^2r[\sigma_{\mu1} + (\rho_{1x}^2 - \rho_{2x}^2)\sigma_x^2]}{[m^2 + r\rho_{2x}^2\sigma_x^2][m^2 + r(\sigma_{\mu1}^2 + \rho_{1x}^2\sigma_x^2)]}. \tag{A.2}$$

The numerator in (A.2) is negative if $\sigma_{\mu1} + (\rho_{1x}^2 - \rho_{2x}^2)\,\sigma_x^2 < 0$. Solving this condition for ρ_{2x}^2 yields the cutoff value for the payoff-informativeness of the second performance measure. Since $\rho_{2x} \in [-1,1]$, this cutoff value must be strictly smaller than 1 for a non-empty solution set. Solving the latter condition for $\sigma_{\mu1}^2$ results in the cutoff value for the measurement error of the first performance measure. (ii) Substituting (9a), (9b), and $\sigma_{\mu 2} = 0$ into (11) and simplifying yields

$$V^{\dagger}(y_2|\eta_1) = \tfrac{1}{2}\,\frac{b^2 m^2 r \rho_{2x}\sigma_{\mu 1}^2[\rho_{2x}\sigma_{\mu 1}^2(\sigma_{\mu 1}^2+\sigma_{\mu 2}^2)+(\rho_{1x}-\rho_{2x})^2\rho_{2x}\sigma_{\mu 1}^2\sigma_x^2+2(\rho_{1x}-\rho_{2x})Q]}{[m^2+r(\sigma_{\mu 1}^2+\rho_{1x}^2\sigma_x^2)][m^2(\rho_{1x}\sigma_{\mu 2}^2+\rho_{2x}\sigma_{1x}^2)^2+r(\rho_{1x}^2\sigma_{\mu 2}^2+\rho_{2x}^2\sigma_{\mu 1}^2)Q]}, \qquad \text{(A.3)}$$

where $Q = \rho_{1x}^2\,\sigma_{\mu 2}^2\,\sigma_x^2 + \sigma_{\mu 1}^2(\sigma_{\mu 2}^2 + \rho_{2x}^2\,\sigma_x^2)$. The denominator in (A.3) is positive; the numerator is negative if

$$\sigma_1^2\,[2\,\rho_{1x}\,\sigma_{\mu 2}^2 + \rho_{2x}(\sigma_{\mu 1}^2 - \sigma_{\mu 2}^2 + (\rho_{1x}^2 - \rho_{2x}^2)\sigma_x^2)] < 2\,\rho_{1x}^2\,(\rho_{2x} - \rho_{1x})\,\sigma_{\mu 2}^2\,\sigma_x^2. \qquad \text{(A.4)}$$

For $\rho_{2x} > \rho_{1x} > 0$, the right hand side of (A.4) is positive. Thus, the numerator is negative if the left hand side of (A.4) is negative, i.e.,

$$2\,\rho_{1x}\,\sigma_{\mu 2}^2 + \rho_{2x}(\sigma_{\mu 1}^2 - \sigma_{\mu 2}^2 + (\rho_{1x}^2 - \rho_{2x}^2)\sigma_x^2) < 0.$$

Solving the latter condition for $\sigma_{\mu 1}^2$ yields the cutoff value for the measurement error of the first performance measure. Finally, for $\rho_{2x} > 2\,\rho_{1x}$ this cutoff value is positive, yielding a non-empty solution set. ■

Propositions 4: (i) First, substitute (T3.1b), (T3.2b), and (T3.2c) into (14) to obtain an expression for the value of the additional, publicly reported performance measure. (i) Substituting $m_{11}/m_{12} = b_1/b_2$ yields

$$V^{\dagger}(y_2|\eta_1) = -\tfrac{1}{2}\,Q^{-1}\,b_1^2\,(b_1 m_{22} - b_2 m_{21})^2\,\sigma_{\mu 1}^2\,(\rho_{2x}\,\sigma_{\mu 1} - \rho\,\rho_{1x}\,\sigma_{\mu 2})^2 \le 0. \qquad \text{(A.5)}$$

Interestingly, the value is zero, e.g., if the second performance measure is perfectly congruent with the firm's terminal payoff (i.e., $b_1/b_2 = m_{21}/m_{22}$) and if the second performance measure is not impounded in the price (i.e., $\rho_{2x}\,\sigma_{\mu 1} - \rho\,\rho_{1x}\,\sigma_{\mu 2} = 0$, see Lemma 2). (ii) For example, substituting $b_2 = m_{12} = 0$ into the expression for disclosure value yields

$$V^{\dagger}(y_2|\eta_1) = -\tfrac{1}{2}\frac{m_{22}^2 b_1^2 \sigma_{\mu 1}^2(\rho_{2x}\sigma_{\mu 1} - \rho\rho_{1x}\sigma_{\mu 2})^2}{m_{22}\sigma_{\mu 1}^2(\rho_{2x}\sigma_{\mu 1} - \rho\rho_{1x}\sigma_{\mu 2})^2 + [m_{11}\sigma_{\mu 2}(\rho_{1x}\sigma_{\mu 2} - \rho\rho_{2x}\sigma_{\mu 1}) + m_{21}\sigma_{\mu 1}(\rho_{2x}\sigma_{\mu 1} - \rho\rho_{1x}\sigma_{\mu 2})]^2},$$

which is non-positive. In particular, disclosure value will be negative if the supplemental information is impounded in the price. (iii) Substituting $\rho = 0$ into the expression for disclosure value yields

$V^{\dagger}(y_2|\eta_1)$ =

$$-\tfrac{1}{2}\;\frac{\Lambda_{12}\rho_{2x}\sigma_{\mu1}^{2}\,[(b_1(m_{21}\Lambda_{b1}+m_{11}\Lambda_{b2})+b_2(m_{22}\Lambda_{b1}+m_{12}\Lambda_{b2}))\rho_{2x}\sigma_{\mu1}^{2}+2(b_1m_{11}+b_2m_{12})\Lambda_{b1}\rho_{1x}\sigma_{\mu2}^{2}]}{(m_{11}^{2}+m_{12}^{2})[(m_{21}^{2}+m_{22}^{2})\rho_{2x}^{2}\sigma_{\mu1}^{4}+2(m_{11}m_{21}+m_{12}m_{22})\rho_{1x}\rho_{2x}\sigma_{\mu1}^{2}\sigma_{\mu2}^{2}+(m_{11}^{2}+m_{12}^{2})\rho_{1x}^{2}\sigma_{\mu2}^{4}]},$$

where $\Lambda_{12} = m_{11}m_{22} - m_{12}m_{21}$, $\Lambda_{b1} = b_1m_{12} - b_2m_{11}$, and $\Lambda_{b2} = b_1m_{22} - b_2m_{21}$ are the measures of alignment and non-congruity, respectively, for the non-contractible performance measures. Disclosure value will be negative if $\Lambda_{12} > 0$, $\Lambda_{b1} > 0$, $\Lambda_{b2} > 0$, and $\rho_{2x} > 0$. Evaluation of the conditions for the measures of alignment and non-congruity yields the relation of the sensitivities of the performance measures and the tasks' productivity. ■

Propositions 5: Substituting the model's parameterization into (7b) and (8) yields an expression for the value of the additional, publicly reported performance measure. (i) Substituting $b_1 = b_2 = b$ and $\rho_{1x} = \rho_{2x} = \rho_x$ results in the expression for the disclosure value for this setting. The disclosure value is negative if

$$\rho_x^{2} < \underline{\rho}_x \equiv \frac{2b^2(b-m_{22})^2 - r[(b+m_{22})^2+4bm_{22}]}{r[4b(-2b+m_{22})+(b+m_{22})^2]},$$

where $\rho_x = \underline{\rho}_x$ yields $V^{\dagger}(y_2|\eta_1) = 0$. Finally, $m_{22} > b$ ensures that the numerator of the above expression is positive. (ii) Substituting $b_2 = 0$ in the expression for the disclosure value, setting the numerator equal to zero and solving the equation for m_{22}^2 yields

$$\underline{m}_{22}^{2} \equiv m_{22}^{2} = r\,\rho_{x2}^{-1}\,[2\,\rho_{1x}(1+\rho_{1x}^{2}) - \rho_{2x}(\rho_{1x}^{2}+\rho_{2x}^{2})].$$

The slope of $V^{\dagger}(y_1|\eta_2)$ at $m_{22}^2 \equiv \underline{m}_{22}^2$ is negative; thus, disclosure value is negative if $m_{22}^2 > \underline{m}_{22}^2$.

■

Lemma 3: Applying the model's parameterization to (1a) yields the following weights that are assigned to the contractible signal y_c and the two non-contractible signals y_i, i=1,2 by the investors:

$$\alpha_c^{*} = Q^{-1}\,[(1-\rho^2)\rho_{cx}\,\sigma_{\mu1}\,\sigma_{\mu2} - ((\rho_{c1}-\rho\,\rho_{c2})\rho_{1x}\,\sigma_{\mu2} + (\rho_{c2}-\rho\,\rho_{c1})\rho_{2x}\,\sigma_{\mu1})\sigma_c]\,\sigma_{\mu1}\,\sigma_{\mu2}\,\sigma_x^{2}, \quad \text{(A.6a)}$$

$$\alpha_1^* = Q^{-1}\,[(1-\rho_{c2}^2)\rho_{1x}\,\sigma_{\mu 2}\,\sigma_c - ((\rho_{c1}-\rho\,\rho_{c2})\rho_{cx}\,\sigma_{\mu 2} + (\rho-\rho_{c1}\rho_{c2})\rho_{2x}\,\sigma_c)\sigma_{\mu 1}]\,\sigma_{\mu 2}\,\sigma_c\,\sigma_x^2, \quad \text{(A.6b)}$$

$$\alpha_2^* = Q^{-1}\,[(1-\rho_{c1}^2)\rho_{2x}\,\sigma_{\mu 1}\,\sigma_c - ((\rho_{c2}-\rho\,\rho_{c1})\rho_{cx}\,\sigma_{\mu 1} + (\rho-\rho_{c1}\rho_{c2})\rho_{1x}\,\sigma_c)\sigma_{\mu 2}]\,\sigma_{\mu 1}\,\sigma_c\,\sigma_x^2, \quad \text{(A.6c)}$$

where Q is the determinant of $\mathbf{\Sigma}_p$. Following (A.6a), the weight assigned to the supplemental contractible information y_c will be zero if $(1-\rho^2)\rho_{cx}\,\sigma_{\mu 1}\,\sigma_{\mu 2} - ((\rho_{c1}-\rho\,\rho_{c2})\rho_{1x}\,\sigma_{\mu 2} + (\rho_{c2}-\rho\,\rho_{c1})\rho_{2x}\,\sigma_{\mu 1})\sigma_c = 0$. Settings (i) to (iv) describe conditions under which the weight will be zero. ■

Proposition 6: Proof is by contradiction. (i) If there is only a single publicly reported non-contractible signal, by subtracting appropriately weighted contractible performance measures, the principal obtains a filtered market price that only reflects the non-contractible information. This result holds for an arbitrary number of disclosed contractible performance measures. Therefore, disclosure does not change the characteristics of the set of contractible performance measures. (ii) Suppose that disclosure does not affect investors' aggregation of information into price. Then, the principal can filter out the impact of the additional, contractible information from market price and obtains a filtered price that is an equivalent statistic to the initial market price where the supplemental information is not disclosed. (iii) If the principal does not initially use market price in the contract with the agent, disclosure will not deteriorate the characteristics of the set of contractible performance measures. Here, disclosure value is non-negative. ■

REFERENCES

Baiman, S. and R.E. Verrecchia (1995) "Earnings and Price-based Compensation Contracts in the Presence of Discretionary Trading and Incomplete Contracting," *Journal of Accounting and Economics* 20, 93-121.

Bushman, R., E. Engel, and A. Smith (2006) "An Analysis of the Relation between the Stewardship and Valuation Roles of Earnings," *Journal of Accounting Research* 44, 53-83.

Bushman, R.M. and R.J. Indjejikian (1993) "Stewardship Value of 'Distorted' Accounting Disclosures," *Accounting Review* 68, 765-782.

Chen, X., Q. Cheng, and K. Lo (2006) "Are Analyst Research and Corporate Disclosures Complements or Substitutes?" *working paper*.

Choi, J.P., E.G. Kristiansen, and J. Nahm (2007) "Communication of Soft Information to Lenders: Credibility and Reputation," *working paper*.

Christensen, P.O. and G.A. Feltham (2000) "Market Based Performance Measures and Disclosure of Private Management Information in Capital Markets," *Review of Accounting Studies* 5, 301-329.

Core, J.E., W.R. Guay, and R.E. Verrecchia (2003) "Price vs. Non-Price Performance Measures in Optimal CEO Compensation Contracts," *Accounting Review* 78, 957-981.

Davis, A., J. Piger, and L. Sedor (2007) "Beyond the Numbers: Managers' Use of Optimistic and Pessimistic Tone in Earnings Press Releases," *working paper*.

Demers, E. and C. Vega (2008) "Soft Information in Earnings Announcements: News or Noise?" *working paper*.

Dye, R.A. (1985) "Disclosure of Nonproprietary Information," *Journal of Accounting Research* 23, 123-145.

Feltham, G.A. and J. Xie (1994) "Performance Measure Congruity and Diversity in Multi-Task Principal/Agent Relations," *Accounting Review* 69, 429-453.

Feltham, G.A. and M.G.H. Wu (2000) "Public Reports, Information Acquisition by Investors, and Management Incentives," *Review of Accounting Studies* 5, 155–190.

Fischer, P. and R. Verrecchia (2000) "Reporting Bias," *Accounting Review* 75, 229–245.

Gassen, J. (2008) "Are Stewardship and Valuation Usefulness Compatible or Alternative Objectives of Financial Accounting?" *working paper*.

Gjesdal, F. (1981) "Accounting for Stewardship," *Journal of Accounting Research* 19, 208-231.

Guay, W. and R.E. Verrecchia (2007) "Conservative Disclosure," *working paper*.

Hayes, R.M. and S. Schaefer (2000) "Implicit Contracts and the Explanatory Power of Top Executive Compensation for Future Performance," *RAND Journal of Economics* 31, 273-293.

Healy, P.M. and K.G. Palepu (2001) "Information Asymmetry, Corporate Disclosure, and the Capital Markets: A Review of the Empirical Disclosure Literature," in *Journal of Accounting and Economics* 31, 405-440.

Heinle, M.S and C. Hofmann (2009) "Transient Institutional Investors, Incentives, and Disclosure," *working paper*.

International Accounting Standards Board - IASB (2005) "*Agenda Paper 8A, 19 October 2005, Information for Observers,*" available at http://www.iasb.org/NR/rdonlyres/C936AA1E-FE3A-4A7F-BE06-60644C9DA7E6/0/Oct050510ob08a.pdf.

Kim, S.K. and Y.S. Suh (1991) "Ranking of Accounting Information Systems for Management Control," *Journal of Accounting Research* 29, 386-396.

Kyle, A.S. (1985) "Continuous Auctions and Insider Trading," *Econometrica* 53, 1315-1335.

Lambert, R.A. (2001) "Contracting Theory and Accounting," *Journal of Accounting and Economics* 32, 3-87.

Leone, A.J., J.S. Wu, and J.L. Zimmerman (2006) "Asymmetric Sensitivity of CEO Cash Compensation to Stock Returns," *Journal of Accounting and Economics* 42, 167-192.

Liberti, J.M. (2003) "Initiative, Incentives and Soft Information How Does Delegation Impact the Role of Bank Relationship Managers?" *working paper*.

O'Connell, V. (2007) "Reflections on Stewardship Reporting," *Accounting Horizons* 21, 215-227.

Paul, J.M. (1992) "On the Efficiency of Stock-based Compensation," *Review of Financial Studies* 5, 471-502.

Petersen, M.A. (2004) "Information: Hard and Soft," *working paper*.

Seamons, Q.F. and R.W. Rouse (1997) "How to Use Soft Harbor to Report 'Soft' Information," *Journal of Corporate Accounting and Finance* 9, 81-90.

Stocken, P.C. and R.E. Verrecchia (1999) "Performance Monitoring and Financial Disclosure Choice," *Journal of Institutional and Theoretical Economics* 155, 214-232.

Teoh, S.H. and C.Y. Kwan (1991) "Nondisclosure and Adverse Disclosure as Signals of Firm Value," *Review of Financial Studies* 4, 283-313.

Tetlock, P.C., M. Saar-Tsechansky, and S. Macskassy (2008) "More Than Words: Quantifying Language to Measure Firms' Fundamentals," *Journal of Finance* 63, 1437 - 1467.

Tsao, A. (2002) "When a Stock's Rating and Target Collide," *BusinessWeek Online*.

Verrecchia, R.E. (1983) "Discretionary Disclosure," *Journal of Accounting and Economics* 5, 179-194.

Verrecchia, R.E. (2001) "Essays on Disclosure," *Journal of Accounting and Economics* 32, 97-180.

ESSAY 2:
TRANSIENT INSTITUTIONAL INVESTORS, INCENTIVES, AND DISCLOSURE*

* The paper was written with Christian Hofmann (University of Mannheim).

1. Introduction

The composition of a firm's investor base seems to have a significant influence on various characteristics of the firm itself. As institutional ownership of common stock constantly increased over the years, institutions now control more than half of the equity market (e.g., Almazan/ Hartzell/ Starks 2005, Gompers/ Metrick 2001, Kang/ Liu 2008). With some estimates even reaching up to over 70% (Gillan/ Starks 2007), the influence these investors have on the way corporations are led and organized attracted academic interest. Findings indicate that institutional investors influence firms' corporate governance through different channels, directly by monitoring the management and indirectly through trading of the firms' shares (Gillan/ Starks 2007 provide an overview of the evolution of shareholder activism). First, compared to diverse individual investors, institutions, as specialized blockholders of companies' shares, are better able to directly monitor the firms' management and, hence, mitigate the agency problem between shareholders and managers (e.g., Hartzell/ Starks 2003). A second channel that has been identified is the trading behavior of institutional investors (e.g., Ferreira/ Laux/ Markarian 2008, Smith/ Swan 2008). Due to the possibly large amount of shares these investors hold their trading decisions can influence stock prices, which might have disciplinary effects on management through stock based compensation and an increased probability of being replaced after large sell-offs by institutional investors (Gillan/ Starks 2007, 56).

While researchers and practitioners seem to agree that institutional investors have an influence on the companies in which they hold a large fraction of shares, the assumed influence ranges from overemphasizing short-term earnings to helping build long-term value by actively taking part in the firm. Bushee (1998 and 2001) showed that while institutional investors on average focus on long-term value, a certain group of institutional investors has a short-term investment horizon. This group of institutional investors is indicated by a high portfolio turnover as well as highly diversified portfolio holdings and is classified as *transient institutions*.[1] Empirical studies show that the presence of transient institutions as firms' investors leads to an overweighting of near-term earnings in price (which induces incentives for the management to increase earnings, potentially at the cost of long-term value) and excess volatility in the stock price (see Bushee 2004). Furthermore, current research provides evidence that boards of directors account for implicit incentives (arising by transient institution's trading) in CEO compensation contracts by altering the weight on earnings in cash bonuses (Dikolli/ Sedatole/ Kulp 2009).

A different set of studies indicates that transient institutions have superior information about future stock returns, they actively trade on this information (Hogan/ Grant 2009, Yan/ Zhang 2009), and some of the information is impounded into price (e.g. Piotroski/ Roulstone 2003). It is widely believed that a higher informativeness of the stock price with regard to future cash flows makes it a better performance measure to control a company's management. Following this rationale the existence of transient institutions as blockholders of a firm's shares should, ceteris paribus, increase the informativeness of price and, hence, make the stock price more valuable as a performance measure in management's compensation contracts. Kang/ Liu (2008) provide empirical results that support this intuition by showing that pay-performance sensitivity (PPS) of management's compensation is positively related to the probability of insider trading. Smith/ Swan (2008) provide further support by showing that institutional trading increases PPS. Even though they support the notion that institutional trading increases the informativeness of price, Ferreira/ Laux/ Markarian (2008) find that institutional trading is negatively related to PPS. They argue that their results provide evidence for institutional trading (and therefore a more informative price) acting as a substitute to pay for performance.

While information that is published will be fully incorporated into price, it will be only

[1] Bushee (1998, 307).

partially recognized in price if it is communicated indirectly through the trading decisions of some informed investors (see, e.g., Grossman/ Stiglitz 1980, Kyle 1985). Following this rationale, shareholders who are interested in monitoring their company's management to increase the long-term value of the company should commit to publish information that is valuable for performance measurement. Hollander et al. (2008) support this by showing that firms' levels of disclosure are positively related to the PPS of managerial compensation. On the other hand, not disclosing information or only disclosing it to a certain group of investors enables (some) current shareholders to trade on this information and possibly gain from these trades. Accordingly, Bushee et al. (2003) find that firms with higher institutional ownership tend to provide closed rather than open conference calls (hence, only granting a certain group of their shareholders access to some information). Hollander et al. (2008) present findings which suggest that firms with high institutional ownership prefer less voluntary disclosure. Finally, Bushee (2004) summarizes his work on different kinds of investors and states that transient institutions are attracted to companies with investor relation activities geared towards forward-looking information, persistent earnings growth (so that surprises have greater impact) and greater liquidity (which allows to move in and out of stocks).

The literature mentioned above seems to support Core (2001) who emphasizes the endogenous relationship between a firm's disclosure policy and its management's incentives. On the one hand we can observe that informed trading increases price informativeness, making price a more valuable performance measure. On the other hand it was shown that transient institutional investors focus on short-term earnings and prefer lower levels of disclosure. We add to the literature by studying the interplay of market microstructure (e.g., the liquidity available in the market), investor characteristics (e.g., their trading horizon), and managerial incentives. Theoretical research shows that due to different objectives of prospective and current investors, a more informative price with regard to future stock returns does not have to provide better information regarding past effort choices (e.g. Feltham/ Xie 1994, Heinle/ Hofmann 2009). Incorporating the possibility that shareholders might not hold all their shares in the long run, we can show that even in situations where disclosing information would enhance the informativeness of stock price with regard to both, management's effort choices and future returns, it might be withheld. The choice whether to disclose or not depends on the market microstructure and the characteristics of the performance measure. In this choice, the transient investor trades off an improved solution to the stewardship problem (long-term value) and expected trading gains (short-term value). And while a range of rational expectation models predict the informativeness of the price to be independent of the liquidity noise[2] we show that including the decision to publish accounting information leads to a connection between informativeness and uncertainty.

Some other analytical studies investigate the combination of market microstructure and a firm's internal moral hazard problem. Holmstrom/ Tirole (1993) focus on the production of private information by an informed outside investor. By endogenizing the information acquisition activity they can show that (given an unchanged disclosure environment) the informativeness of price increases with the amount of trading motivated by uncertain liquidity needs. Our results show that while in markets with low liquidity some information will be made public the same does not hold true for high liquidity. This leads to a reverted relationship between liquidity and informativeness. Baiman/ Verrecchia (1996) study a setting in which a firm's manager is able to obtain insider information and trade on this information. In their setting, disclosure always diminishes the amount of information about the manager's action and price as a performance measure becomes less valuable. The disclosure decision trades off this effect with an increased liquidity (and a decreasing cost of capital) following the announcement of disclosure. In contrast, empirical evidence suggests that information about managerial action

[2] See, e.g., Baiman/ Verrecchia (1995) and Feltham/ Wu (2000).

in price increases following firm's disclosure[3] and that "private information trading is most evident when large positions in firms are taken by [...] large institutions" (Bushee/ Goodman 2004, 292). While not including the market microstructure Bushman/ Indjejikian (1993) show that in the light of solving the stewardship problem distorted accounting information might be preferred. This includes, first, noisy measures (to induce private information acquisition) and, second, biased measures (to balance different managerial activities). We include the liquidity of the market and can show that the effectiveness of managerial incentives indirectly depend on liquidity as it influences the investor's disclosure and trading decisions.

In chapter 2 we describe the model under non-disclosure of the generated performance report. We then investigate the effect of disclosing the report and determine the value of disclosure in chapter 3. Here, we present conditions under which making the report public decreases the expected utility of the transient investor because even though it would increase long-term value the disclosure diminishes short-term trading profits. We draw conclusions in chapter 4.

2. Investor's Private Information

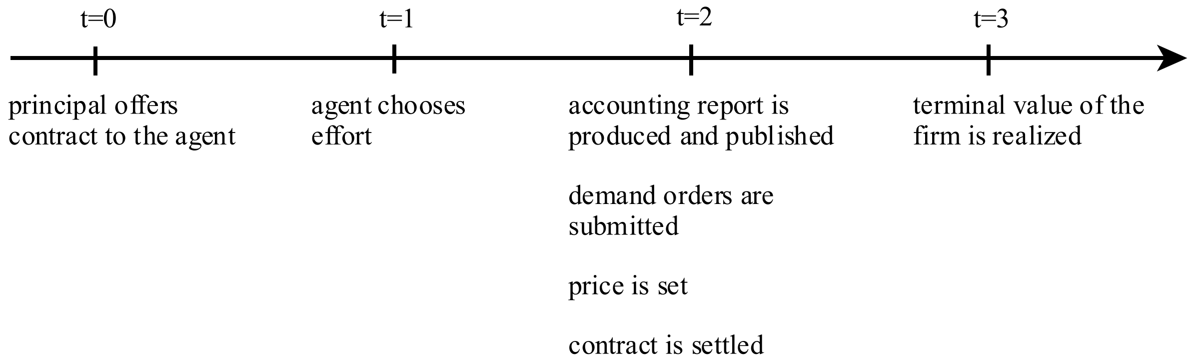
2.1 Basic Structure of the Model

At date 0, the principal, acting on behalf of the firm's risk neutral shareholders[4], hires an agent to provide productive effort at date 1 in return for compensation at date 2. The agent expends personally costly effort that influences the payoff to the principal realized at date 3 and his choice of effort level is represented by a. The firm is priced on a capital market at date 2. The timing of events is illustrated in Figure 2.1.

[3] See, e.g., Craighead/ Magnan/ Thorne (2004).

[4] We will use the terms shareholder, principal, and (transient institutional) investor interchangeable throughout the paper.

Figure 2.1
Timeline



To facilitate the further analysis we assume that at date 0 the principal offers the agent a linear contract $z = (f,v)$, where f is the agent's fixed wage and v the incentive rate for market price p. As a result, the agent's compensation w, given price p and contract z, is

$$w(p,z) = f + v\,p.$$

We assume a linear relationship between the agent's effort and the firm's terminal payoff[5], i.e.,

$$x = b\,a + \varepsilon_x,$$

where b is the productivity of the agent's effort with respect to the terminal value of the firm, and $\varepsilon_x \sim N(0,\sigma_x^2)$ represents uncontrollable events.

At date 2, a non-contractible report is released that is informative about the manager's choice of effort and the uncontrollable events that affect the firm's payoff. We assume a linear relationship with respect to effort, i.e.,

$$y = m\,a + \varepsilon_i,$$

m represents the sensitivity of the performance report to the agent's effort level and ε_i a noise term that captures uncertainty associated with the measurement of the agent's actions. The accounting report imperfectly captures uncontrollable events that influence the output, specifically we assume

[5] Alternatively, one could also think of the firm's future payoff as the firm's stock price in the future. We choose the term payoff to distinguish stock price at date 2 from firm value at date 3.

$\varepsilon_i = \rho\ \varepsilon_x + \varepsilon_\mu$

with $\mathrm{Cov}[\varepsilon_x,\varepsilon_\mu] = 0$.

ρ represents the correlation of the performance measure to the output and ε_μ uncontrollable events that affect the precision of the accounting system, with $\varepsilon_\mu \sim \mathrm{N}(0,\sigma_\mu^2)$. Thus, $\mathrm{Var}[y] = \mathrm{Var}[\varepsilon_i] \equiv \sigma_i^2 = \rho^2\sigma_x^2 + \sigma_\mu^2$, where $\rho^2\sigma_x^2$ is the output related noise inherent in the performance measure.

2.2 Price Formation

We investigate the influence of an institutional investor's trading opportunities on managerial incentives. For this reason we choose to model the capital market along the lines of Kyle (1985). Here, the market consists of three different groups of participants: First, current shareholders who have access to the released report and trade based on their superior information. Second, uninformed traders who trade for liquidity reasons. Third, competitive market makers who only observe the total demand order and set the price equal to the expected value. This setting is descriptive of a situation in which one investor has superior information and has a relatively high market share so that his trades have a significant impact on the quantity traded. Contrary to the capital market model of Grossman/ Stiglitz (1980) the informed investor accounts for his influence on price in his trading strategy.[6] The Grossman/ Stiglitz (1980) setting represents a market with a large number of informed investors where the influence every single investor has on price is negligible. In our setting, knowing that demand is influenced by the informed trader the market tries to infer the private information from the total demand order. But as some investors trade due to unknown liquidity needs and the individual demand orders are not observable, the market makers can not glean all the information from demand.

To further emphasize the informational advantage of the institutional investor we assume that

[6] The insider's behavior in the Kyle (1985) model is comparable to the behavior of a monopolist on a product market. In his production decision the monopolist takes hte influence his own produced quantity has on the price into consideration and limits his production to increase the price.

she can observe both accounting report y and the action a chosen by the agent.[7] At t=2 the price is set and the risk neutral informed investor chooses her trading strategy to maximize her expected trading profits, conditional on the observed accounting report and the action chosen by the agent, while also considering her influence on stock price. Specifically, her expected utility at t=2 is characterized by[8]

$$E[u_I(\underline{x},p)|y,a] = \alpha_0\, E[\underline{x}|y,a] + \alpha_1\, (E[p|y,a] - E[\underline{x}|y,a]), \tag{1}$$

with $\underline{x} = x - f - v\,p$.

$\underline{x}$ denotes the terminal value net of the granted compensation to the agent, α_0 denotes the fraction of the company's shares the investor owns in t=0, and α_1 denotes the fraction of the company's shares she sells in t=2.[9]

The competitive market makers set the price equal to the expected value of future returns, conditional on all information they have. To simplify the analysis we assume that if the firm does not disclose report y the only available information is the total demand order d. To preclude market makers from making expected gains or losses, the price must satisfy the condition

$$p = E[\underline{x}|d]. \tag{2}$$

Total demand d is the sum of the liquidity traders' demand d_L and the informed investors sales α_1 so that $d = d_L - \alpha_1$. While the liquidity traders' demand is assumed to follow a normal distribution, $d_L \sim N(0,\sigma_L^2)$, the informed investor chooses her demand conditional on the observed report. As is usual in rational expectation equilibrium models, we assume that all actors on the capital market expect linear pricing and trading rules, which are confirmed in equilibrium. Hence,

---

[7] We assume that both types of information (y and a) constitute "soft" information, i.e., non-verifiable information which can not be used in a contract. See Heinle/ Hofmann (2009) for a discussion of soft and hard information in agency contracts.

[8] As intertemporal consumption is not an issue, we assume that all actors do not discount future payoffs.

[9] Note that we do not restrict the amount of shares the investor is trading, specifically, she could purchase further shares of the company. As is usual in the Kyle (1985) model, the market makers absorbe any over- or undersupply of shares such that going short or long in the firm's shares is possible.

$$p = \pi_f + \pi_d\, d, \quad \text{and} \tag{3a}$$

$$\alpha_1 = \theta_f + \theta_y\, y \tag{3b}$$

where π_f and θ_f are fixed amounts of the share price and the share sales, respectively, π_d is the sensitivity with which the market reacts to demand orders (following Kyle 1985 π_d^{-1} can be interpreted as the market depth, i.e. "the order flow necessary to induce price to rise or fall by one dollar"[10]), and θ_y is the sensitivity with which the transient investor reacts to the accounting report. Maximizing (1) with respect to α_1 given that (2) holds leads to following characterization of the equilibrium on the capital market.

Corollary 1[11]: Given accounting report y, the market maker's price function and the informed investor's trading strategy are characterized by

$$\pi_f = ((b - m\,\sigma_L\,\sigma_i^{-1})\hat{a} - f + v\,\pi_d\,\alpha_0)\,(1+v)^{-1}, \tag{4a}$$

$$\pi_d = \tfrac{1}{2}\,\rho\,\sigma_x^2\,(\sigma_L\,\sigma_i\,(1+v))^{-1}, \tag{4b}$$

$$\theta_f = (b\,(\hat{a}-a)\sigma_L\,\sigma_i - (\hat{a}+a)\,m\,\sigma_L^2)\,(\rho\,\sigma_x^2)^{-1} + v\,\alpha_0\,(1+v)^{-1}, \tag{4c}$$

$$\theta_y = -\,\sigma_L/\sigma_i, \tag{4d}$$

where $\hat{a}$ denotes the market makers' expectation about the agent's effort choice.

The equilibrium is similar to the well known results from Kyle (1985). Here, the privately informed investor trades more aggressively on her information when she can hide it better due to higher uncertainty (σ_L^2) about liquidity traders' demand (as can be seen in 4d). In her trading strategy, the investor accounts for the influence of the agent's effort choice on both the accounting report (i.e., $-(\hat{a}+a)\,m\,\sigma_L^2$) and production (i.e., $b\,(\hat{a}-a)\sigma_L\,\sigma_i$). While the investor can observe the agent's effort choice, it remains unobservable to the market. The inclusion of the market makers' expectation concerning the effort choice in the investor's trading strategy displays that she tries to use her full information advantage against the market. The equilibrium

[10] Kyle (1985, 1319).

[11] All Proofs can be found in Appendix A.

has a further similarity to Holmstrom/ Tirole (1993), where all actors inlcude the influence of the agent's incentive compensation in their decision. Different from Holmstrom/ Tirole (1993) is that in our model the privately informed investor is initially endowed with some of the firm's shares. Increasing the fraction of shares she sells will decrease the stock price and, hence, decrease the incentive payment to the agent. This, given the initial endowment and the contractual weight on price, fixed effect is corrected for by the market makers in (4a).

The following subsections will investigate the compensation contract between investors and the agent. This contract will depend on the characteristics of price as a performance measure, where the sensitivity of price with respect to the agents actions ($\partial \mathrm{E}[p]/\partial a \equiv m_p$) and the volatility of the normalized stock price ($\mathrm{Var}[p] \equiv \sigma_p^2$) are most important. Lemma 1 characterizes the market price of the firm and it's characteristics in equilibrium.

Lemma 1: Given trading strategies and price formation as stated in (4a-d), the market value of the firm, its variance and its sensitivity to the agent's effort choice are given by

$$p = (1+v)^{-1} [\tfrac{1}{2} b (\hat{a}+a) - \tfrac{1}{2} m \sigma_L \sigma_i^{-1} (\hat{a}-a) - f + \tfrac{1}{2} \rho \sigma_x^2 (\sigma_i^{-2} \varepsilon_i + (\sigma_L \sigma_i)^{-1} d_L)], \quad (5a)$$

$$\sigma_p^2 = \tfrac{1}{2} \rho^2 \sigma_x^4 [(1+v)^2 \sigma_i^2]^{-1}, \quad (5b)$$

$$m_p = \tfrac{1}{2} (b + m \sigma_L \sigma_i^{-1}) (1+v)^{-1}. \quad (5c)$$

As stated above, the market includes the investor's expected amount of trading in the price formation, which leads to a price that is independent of the investor's initial endowment with shares. Because both the investor and the market makers are interested in the terminal value of the firm net of the agent's compensation, the fixed fee f is deducted and price is scaled by $(1+v)^{-1}$. As usual in Kyle-type models, the informed trader reveals exactly half of his information to the market. While the fixed fee to the agent is commonly known, all other parameters display the information the market gathers from the total demand. The agent's productivity is weighted with the average of the market's expectation and the principal's observation of the agent's effort If the market makers' expectation regarding the agent's effort choice are met, the agent's influence on the accounting report is excluded from price. The last term in (5a) displays the effect the accounting report and the noise traders' demand have on price. An increase in demand is interpreted by the market makers as positive inside information such that both the noise term in the accounting report and the liquidity traders' demand increase price.

The variance of stock price (5b) derives from two sources, namely the liquidity traders' uncertain demand (i.e., d_L) and the informed investor's reaction ($\theta_y\, y$) to the observed value of the accounting report. The market maker's reaction to the total demand order weakens with an increasing uncertainty about liquidity traders' demand. This leads the investor to trade more aggressively on her superior information. Similar to the original Kyle model, these two effects exactly offset each other such that the variance of stock price is independent of the uncertainty about liquidity. If the accounting report is not informative about terminal value (i.e., ρ=0), the market makers will not react to the demand order and the price will just be a constant ($\sigma_p^2 = 0$ if ρ=0). On the other hand, if the accounting report is fully revealing output uncertainty (σ_μ^2=0), the variance of stock price equals half of the variance of terminal value (scaled by $(1+v)^{-2}$)

As the market makers cannot observe the agent's choice of effort a they form unconditional expectations $\hat{a}$ regarding his choice. Hence, the sensitivity of stock price with regard to the agent's action derives only through the transient investor's trading decision who can observe the actual effort choice ($a^\dagger$). This is manifested in two terms: first, the informed investor reveals half of his information about terminal value (½ b), second, the investor trades based on his observation of the accounting report (½ $m\, \sigma_L\, \sigma_i^{-1}$). Both the variance of price and it's sensitivity to the agent's actions are scaled by the incentive rate.

2.3 Agent's Preferences

The agent chooses his effort level in t=1 to receive compensation in t=2. We assume that the agent's preferences with regard to compensation and his level of effort are represented by a negative exponential utility function, with

$$u_A(z,a) = -\exp[-r(w - \kappa(a))],$$

where r is the coefficient of his absolute risk aversion and the personal cost of effort $\kappa(a)$ is assumed to be

$$\kappa(a) = \tfrac{1}{2}\, a^2.$$

Similar to Holmstrom/ Tirole (1993) and Calgano/ Heider (2008) we normalize the stock price for contracting purposes such that

$$\begin{aligned} \beta &= (1+v)\, p, \\ &= \tfrac{1}{2}\, b\, (\hat{a}+a) - \tfrac{1}{2}\, m\, \sigma_L\, \sigma_i^{-1}\, (\hat{a}-a) - f + \tfrac{1}{2}\, \rho\, \sigma_x^2\, \sigma_i^{-2}\, \varepsilon_i + \tfrac{1}{2}\, \rho\, \sigma_x^2\, (\sigma_L\, \sigma_i)^{-1}\, d_L \end{aligned}$$

This normalization is merely a linear transformation of stock price and, hence, has the same information content as price itself. However, the variance of the normalized price is independent of the chosen incentive weight and such facilitates the following analysis. While the fixed fee is not affected by this transformation, the incentive weight on price and normalized price differ. The agent's compensation w, given normalized price β and contract z, is then

$$w(\beta,z) = f + \upsilon\, \beta,$$

$$\text{with} \quad \upsilon = v\, (1+v)^{-1},$$

where υ is the incentive rate for the normalized market price β. Maximizing the expected utility is equivalent to maximizing the certainty equivalent, which is characterized by

$$\begin{aligned} \mathrm{CE}(z,a) &= \mathrm{E}[w|z,a] - \kappa(a) - \tfrac{1}{2}\, r\, \mathrm{Var}[w|z] \\ &= f + \upsilon\, m_\beta\, a - \tfrac{1}{2}\, a^2 - \tfrac{1}{2}\, r\, \upsilon^2\, \sigma_\beta^2\,. \end{aligned} \tag{6}$$

where m_β is the sensitivity of the normalized price to the agents actions ($m_\beta \equiv \partial \mathrm{E}[\beta]/\partial a = \tfrac{1}{2}\,(b + m\, \sigma_L\, \sigma_i^{-1})$) and σ_β^2 is the volatility of the normalized stock price ($\sigma_\beta^2 \equiv \mathrm{Var}[\beta] = \tfrac{1}{2}\, \rho^2 \sigma_x^4\, \sigma_i^{-2}$). The agent chooses a to maximize his certainty equivalent. Differentiating (6) with respect to a, given contract z, provides the following characterization of the agent's action choice:

$$a^\dagger(\upsilon) = \upsilon\, m_\beta. \tag{7}$$

2.4 Principal's Contract Choice

We assume that the principal acts on behalf of the transient institutional investor. This is descriptive of a situation where the $(1-\alpha_0)$ shares of the firm which are not held by the institutional investor belong to atomistic shareholders who do not exercise any influence on the board such that the contract with the CEO is written in the interest of the dominant institutional investor.[12]

When the principal offers contract z to the agent, she has to take into account that the agent provides non-contractible effort and only accepts the contract if he does not have a better alternative. The actions that are induced by z are characterized by (7). Also, the agent will only participate in the firm if his contract z is such that it provides him with his reservation wage, which is scaled to equal zero, i.e.,

$$CE(z,a^{\dagger}) \geq 0. \tag{8}$$

The investor is assumed to be risk neutral with respect to the terminal value of the firm and her trading gains. She is interested in maximizing her expected utility, stemming from (*i*) the terminal value of the firm and (*ii*) trading gains:

$$\Pi(a,z) = \mathrm{E}_0[(\alpha_0 - \alpha_1)(x - f - \upsilon\,\beta) + \alpha_1\, p\,|a,z]. \tag{9}$$

The transient investor's expected utility in t=0 is derived by the fraction of the net terminal value of the firm she expects to hold, i.e., $\mathrm{E}_0[(\alpha_0 - \alpha_1)(x - f - \upsilon\,\beta)]$, and the payment she expects to receive for selling shares, i.e., $\mathrm{E}_0[\alpha_1\, p]$. We denote the principal's ex ante expected utility with the index 0 to emphasize that while she chooses α_1 as described in (3b), (4c), and (4d), her choice will be conditioned on the information she observes in t=2. Hence, in t=0, she forms an (unconditional) expectation with regard to her later choice.

As depicted in (4c), the principal corrects for the agent's first moment influence on the

[12] Including other shareholders that influence the contract with the agent in our model would need a specification of, first, their utility and, second, the process which determines the contract. However, as in our model the agent's actions can be perfectly anticipated by the market and we do not distinguish between short-term and long-term effort, the contract chosen by a transient investor will equal the choice of a dedicated investor.

accounting report and trades based on the observation about risk. Assuming that the market makers can observe the contract between principal and agent, in equilibrium the expected action choice will equal the solution to (7). Even though the mean of all noise terms is zero, the investor expects to benefit from her superior information. This results because she can profit from both positive and negative deviations from the mean by buying additional or selling more shares.

In designing the contract, the principal incorporates that this choice influences the expectations of the market concerning the agent's effort. She chooses z such as to maximize (9) subject to (7), (8), and the expected equity market equilibrium. Substituting (7) into (6), choosing f such that $CE(z,a^{\dagger}) = 0$, and substituting $f^{\dagger}$, $a^{\dagger}(\upsilon) = \upsilon\, m_{\beta}$, (3a), and (3b) into (9) gives the principal's unconstrained decision problem:

$$\Pi(\upsilon,\alpha_0) = \alpha_0\,(b\, m_{\beta}\, \upsilon - \tfrac{1}{2}\,(m_{\beta}^2 + r\,\sigma_{\beta}^2)\,\upsilon^2) + \tfrac{1}{2}\,\rho\,\sigma_x^2\,\sigma_L\,\sigma_i^{-1}. \qquad (10)$$

The investor accounts for her full initial holding of the firm's net terminal value, i.e., $\alpha_0\,(b\, m_{\beta}\,\upsilon - \tfrac{1}{2}\,(m_{\beta}^2 + r\,\sigma_{\beta}^2)\,\upsilon^2)$, as in equilibrium the expected stock price of the firm is equal to the expected net terminal value, and, hence, neither selling nor buying shares changes the investor's fraction of the net terminal value. However, the chance to profit from her informational advantage increases her expected utility. These possible trading gains, i.e., $\tfrac{1}{2}\,\rho\,\sigma_x^2\,\sigma_L\,\sigma_i^{-1}$, increase in the depth of the market. The higher the uncertainty about liquidity traders' demand, the higher the expected trading gains. More noise in demand enables the investor to better hide her information which leads to more aggressive trading and higher expected profits. Taking into account all the effects of her contract choice, the solution to the principal's problem is characterized by Proposition 1.

Proposition 1: Given the price characterized in Corollary 1 and the principal's unconstrained decision problem in (10), the optimal incentive rate and the principal's second-best expected net payoff are

$$\upsilon^\dagger \quad = b\, m_\beta\, Q^{-1}, \tag{11a}$$

$$\Pi^\dagger(\alpha_0) \;= \tfrac{1}{2}\, \alpha_0\, b^2\, m_\beta^2\, Q^{-1} + \tfrac{1}{2}\, \rho\, \sigma_x^2\, \sigma_L\, \sigma_i^{-1}, \tag{11b}$$

with $Q = (m_\beta^2 + r\, \sigma_\beta^2)$.

The incentive weight in (11a) displays the solution to a common principal-agent relationship with a generic performance measure. Note that the optimal incentive weight on price is independent of the investor's initial endowment with shares. This indicates that the investor is interested to most efficiently solve the agency problem, and is the result of a price that is independent of the investor's initial holdings. Intuitively, the solution to maximizing the expected value of the whole firm equals that for maximizing a share of the firm when receiving the equal share of profits and costs. This is the case because we abstract from any monitoring activities or transaction costs when designing the contract. Including either in our model would lead to a situation where the institutional investor would have to bear the full costs of these activities but would only receive a fraction of the benefits.

The second-best expected net payoff to the investor in (11b) is the sum of the expected net profit of the agency relationship and of trading on the equity market. As is usual, (11a) and the first term in (11b) both depend on the sensitivity of the performance measure to the agent's action ("signal") and the variance of the performance measure ("noise"). In our setting these parameters are determined endogenously through the equilibrium stock price. Proposition 2 characterizes the signal-to-noise ratio of the normalized stock price.

Proposition 2: The signal-to-noise ratio of the normalized stock price is given by

$$m_\beta^2/\sigma_\beta^2 \;= \tfrac{1}{2}\, (b\, \sigma_i + m\, \sigma_L)^2\, (\rho^2 \sigma_x^4)^{-1}. \tag{12}$$

As described above, the variance of price is independent of the unertainty about liquidity traders' demand. However, increasing the latter leads to more aggressive trading by the investor which positively influences the impact of the agent's effort on price through its influence on the accounting report. This leads to the effect that the signal-to-noise ratio of the normalized stock price increases in the uncertainty about liquidity traders' demand. An increase in the measurement noise of the report (i.e., an increase in σ_i while σ_x remains constant) also leads to an increase in the signal-to-noise ratio. The reason for this is different from the argumentation above. Both the variance and the sensitivity of stock price decrease in the measurement noise, but the former effect dominates the latter. When the measurement noise increases, the investor's signal is less informative about terminal value and, in her trading decision, she reacts less aggressively to changes of the accouting report. Her fixed amount of trading with regard to the ex ante expected terminal value of the firm (i.e., $b\ a$) remains constant though, leading to the described increase of the signal-to-noise ratio.

3. DISCLOSING THE REPORT TO THE MARKET

The preceding analysis assumed that the accounting report is released only to insiders of the firm (the principal) who can use it to gain from trading on the stock market. We characterized the resulting incentive contract, the expected utility of the transient investor, and finally, the effects of the investor's initial endowment in the firm. This chapter will investigate the expected utility when the formerly private information is communicated to the stock market. Finally, we will compare the results for both settings and derive conditions under which disclosure of the private information is preferred. To distinguish these two cases we will use η_1 to depict the firm's information system without disclosure and η_2 for the information system with public disclosure. We will denote the price, incentive weight on price, and the expected utility to the principal with the index 2 to denote the respective variables under information system η_2.

3.1 Price Formation and Optimal Contract

If the firm discloses the accounting report y and the market makers can directly observe it (information system η_2), in equilibrium, there is no information asymmetry between actors on the capital market. In this case, the demand orders do not convey any further information to the market makers, hence, they will set the price based only on the observed report y. This leads to following characterization of the price and its characteristics.

Corollary 2: If report y is published to the market, stock price, its variance, sensitivity to the agent's effort choice, and signal-to-noise ratio are characterized by

$$p_2 = \mathrm{E}[x|y] = \pi_{f2} + \pi_y\, y, \tag{13a}$$

$$\mathrm{Var}[p_2] \equiv \sigma_{p2}^2 = \rho^2\, \sigma_x^4\, \sigma_i^{-2}\,, \tag{13b}$$

$$\partial \mathrm{E}[p_2]/\partial a \equiv m_{p2} = \pi_y\, m, \quad \text{and} \tag{13c}$$

$$m_{p2}^2/\sigma_{p2}^2 = m^2/\sigma_i^2, \tag{13d}$$

with

$$\pi_{f2} = \hat{a}\,(b - \pi_y\, m) \qquad \text{and}$$

$$\pi_y = \rho\, \sigma_x^2\, \sigma_i^{-2}.$$

As the report and the terminal value follow a normal distribution, in weighting the report the market makers account for the unconditional mean and weight the report with its variance and the covariance to the terminal value. The resulting sensitivity to the agent's action displays that the market makers are unable to directly observe the agent's action so that it influences price only through its effect on the report. The weighting of y in price is merely a linear transformation of y and, hence, the signal-to-noise ratio of price equals the respective measure of the accounting report. Note that $\sigma_i^2 = \sigma_\mu^2 + \rho^2\, \sigma_x^2$ and, hence, the signal-to-noise ratio is decreasing in the output uncertainty.

The contract between principal and agent can now be written on price without the need for a normalization, such that

$$w(p_2,z,\eta_2) = f_2 + v_2\, p_2 \qquad \text{and}$$

$$a^\dagger(v_2) = v_2\, m_{p2}. \tag{14}$$

The main difference to the setting in the last section is displayed in the expected utility to the investor. As there is no informational advantage concerning the terminal value of the firm she is unable to trade on superior information. As the risk neutral investor is indifferent between selling and holding her shares, she can now be characterized as a dedicated shareholder, interested in the long-term value of the firm. Her expected utility is given by

$$\Pi_2(a,z) = \alpha_0 \, \mathrm{E}[x - w|a,z]. \tag{15}$$

The solution to the principal's problem is a straightforward application of the well known moral hazard problem with one performance measure. Proposition 3 summarizes the principal's unconstrained decision problem, the optimal weight on price, and the principal's resulting expected utility.

Proposition 3: If the price is set according to (13a), the principal's unconstrained decision problem, the optimal incentive rate, and the principal's expected net payoff are characterized by

$$\Pi_2(v_2) = \alpha_0 \left(b\, m_{p2}\, v_2 - ½ \,(m_{p2}^2 + r\, \sigma_{p2}^2)\, v_2^2\right), \tag{16a}$$

$$v_2^\dagger = b\, m\, Q_2^{-1}\, \pi_y^{-1}, \tag{16b}$$

$$\Pi_y^\dagger = ½\, \alpha_0\, b^2\, m^2\, Q_2^{-1}, \tag{16c}$$

$$\text{with } Q_2 = m^2 + r\, \sigma_i^2.$$

The expected utility in (16c) is identical to a situation in which the principal could directly contract on y because the signal-to-noise ratio of price equals that of the accounting report. Again, the initial endowment with shares does not affect the investor's contractual choice.

3.2 Value of Disclosing the Report

To investigate the effect of disclosing report y to the capital market, we compare the expected utility to the principal under the two different information systems, when y is either kept private or is disclosed to the market.

Definition 1: The incremental value of disclosing report y to the capital market is

$$\mathrm{V}(\eta_2|\eta_1) \equiv \Pi_2^\dagger - \Pi^\dagger. \tag{17}$$

To gain further insight into the value of disclosure, Corollary 3 characterizes the solution to

(17) under two settings where (i) the accounting report does not provide information about effort chosen by the agent ($m = 0$) and (ii) there is no uncertainty about noise traders' demand orders ($\sigma_L^2 = 0$).

Corollary 3:

(i) If the performance measure is not informative about a, the incremental value of disclosing y to the market is

$$V(\eta_2|\eta_1) \quad = - \Pi^{\dagger}.$$

(ii) If the market makers could directly observe the individual demand orders, the incremental value of disclosing y to the market is

$$V(\eta_2|\eta_1) \quad = \Pi_2^{\dagger}.$$

In setting (i), under information system η_2, the market only gains information about the uncertainty of the terminal value but not about the agent's effort choice. This makes the price not informative about a and the principal will not be able to induce any effort. Hence, disclosing y has the effect of destroing both, gains of trading and any incentives for the agent to provide productive effort. In setting (ii) the principal can not gain anything from trading on her private information because her trades are observable. In this case she would not trade and no information would be impounded into price under η_1. Disclosing the report then leads to a more efficient price to display both the future value and past effort choices.

These two settings show the two effects of disclosing the accounting report, on the one hand, the severity of the stewardship problem is changed because the characteristics of price as a performance measure change (its sensitivity and noise). On the other hand, disclosing the formerly private measure destroys the expected gains of trading in the company's stock. Proposition 4 characterizes the value of disclosing report y.

Propostition 4: The incremental value of disclosing report y to the stock market is

$$V(\eta_2|\eta_1) \quad = \tfrac{1}{2}\alpha_0 b^2 r \frac{2m^2\rho^2\sigma_x^4 - (b\sigma_i + m\sigma_L)^2\sigma_i^2}{(m^2 + r\sigma_i^2)((b\sigma_i + m\sigma_L)^2 + 2r\rho^2\sigma_x^4)} - \tfrac{1}{2}\rho\sigma_x^2\sigma_L\sigma_i^{-1} \tag{18a}$$

$$= \tfrac{1}{2}\,\alpha_0\, b^2\, r\, \sigma_i^2\, \sigma_\beta^2(m^2/\sigma_i^2 - m_\beta^2/\sigma_\beta^2)\, Q^{-1}\, Q_2^{-1} - \tfrac{1}{2}\,\rho\, \sigma_x^2\, \sigma_L\, \sigma_i^{-1}. \tag{18b}$$

The last term in (18) describes the transient investor's loss under η_2 relative to η_1 due to diminished expected trading profits. The first term in the incremental value of disclosure describes the stewardship value of disclosing y. If this term is positive (negative), the principal's ability to control the agent's effort is higher under η_2 (η_1). Essential for the sign of this term is the difference of the signal-to-noise ratios of stock price under η_2 and η_1, as can be seen from the second characterization of the value of disclosure (18b). This difference is weighted by the investor's intitial endowment with shares of the firm. If the signal signal-to-noise ratio of price increases when disclosing y, a higher initial endowment makes it more likely that the investor prefers disclosing y and foregoing trading profits. If the principal cannot increase the informativeness of stock price with regard to the agent's effort choice she has a strict preference for not disclosing the internal measure because it will diminish both short-term trading gains and long-term firm value. Corollary 4 provides a sufficient condition for a negative value of disclosing the internal measure.

Corollary 4: The incremental value of disclosing y to the market is negative if the market's liquidity exceeds a certain threshold, specifically

$$\sigma_L^2 > \tau_L = 2\,\rho^2\,\sigma_x^4\,\sigma_i^{-2}. \tag{19}$$

The signal-to-noise ratio of stock price under information system η_1 is increasing in the accounting report's sensitivity m at an increasing rate with the uncertainty about noise traders' demand. If the liquidity uncertainty is sufficiently high, the information content of price is always higher when the accounting report is not published which is due to the informed investor's aggressive trading on her superior information. For the disclosure of y to increase the signal-to-noise ratio of price $\sigma_L < \tau_L$ is a necessary but not sufficient condition. Corollary 5 provides the necessary and sufficient condition under which disclosing the measure increases the signal-to-noise ratio of price and, hence, is beneficial to the principal from a stewardship perspective.

Corollary 5: To increase the signal-to-noise ratio of price by disclosing y, the liquidity uncertainty has to be below and sensitivity of the disclosed accounting report above a certain (positive) threshold, specifically

$$\sigma_L^2 < \tau_L \qquad \text{and} \tag{20a}$$

$$m \; > \tau_m = b\,\sigma_i^2 \; (2^{½} \rho\, \sigma_x^2 - \sigma_i\, \sigma_L)^{-1}. \tag{20b}$$

Given that condition (20a) holds, the accounting report still has to be sufficiently sensitive to the agent's effort choice. While the signal-to-noise ratio under η_2 is solely influenced by the accounting report, under η_1 it increases in both, the sensitivity of the accounting report and the productivity. To increase the principal's ability to control the agent's effort, the disclosed report's sensitivity has to cover both influences. The threshold for m increases in the productivity of the agent's effort and in the influence of the report on price without disclosure. The variance of price increases with the output uncertainty under both disclosure regimes, if y is disclosed however, the sensitivity of price to a also increases in σ_x^2. This leads to a lower threshold level for disclosure to increase the signal-to-noise ratio of price. Hence, a higher output uncertainty leads to a higher incremental value of disclosing.

While increasing the stewardship-value of the only contractible performance measure (the stock price) is a necessary condition for disclosure being preferred by the transient investor it is not a sufficient condition as it does not take into account the loss of trading gains. The expected profits from trading on private information are driven by the extend of the informational advantage of the insider. The lower the measurement noise of the accounting report and the higher the volatility of liquidity traders' demand, the more valuable is the information for trading purposes. The severity of the agency conflict under both disclosure regimes also depends on these parameters. As shown in Corollary 4 the value of price as a performance measure under η_1 increases in σ_L. Hence, higher liquidity uncertainty leads to a higher incremental loss to the principal when disclosing *y* due to both sources of profits, production and trading.

While the productivity of the agent's effort and the sensitivity of the accounting report to do not affect the expected trading profits, they do affect the solution to the stewardship problem. Figure 2.2 illustrates the relation between the value of disclosure and the sensitivity of the report to the agent's actions when condition (20b) holds. Here, $b = r = \alpha_0 = \rho = \sigma_x = 1$, $\sigma_i = 2$, and $\sigma_L = 1/10$:

Figure 2.2
Value of Disclosing Report *y* and
Report's Sensitivity to the Agent's Action

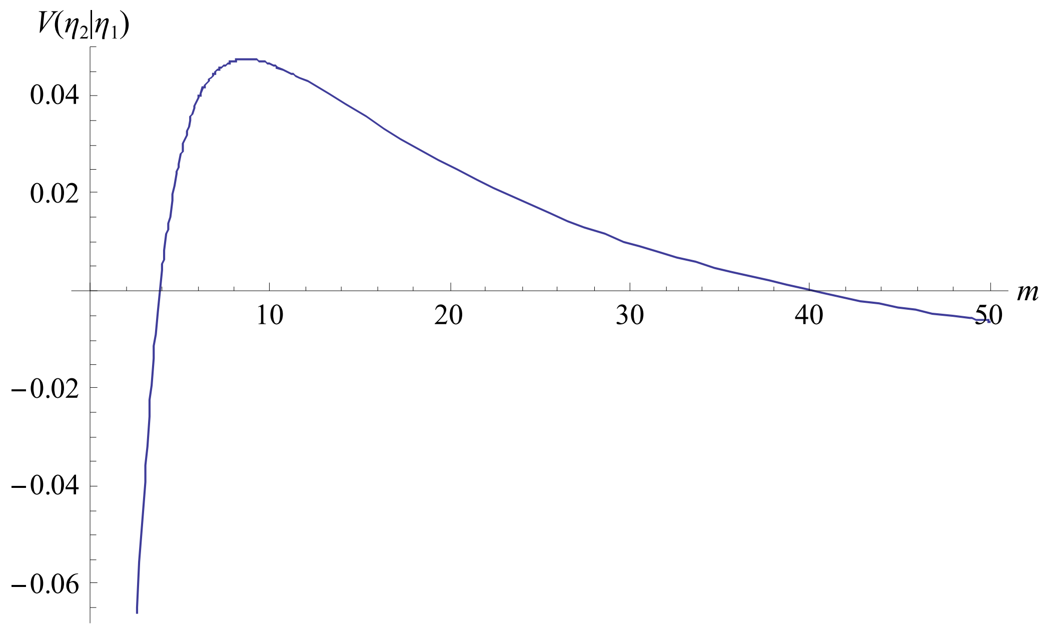
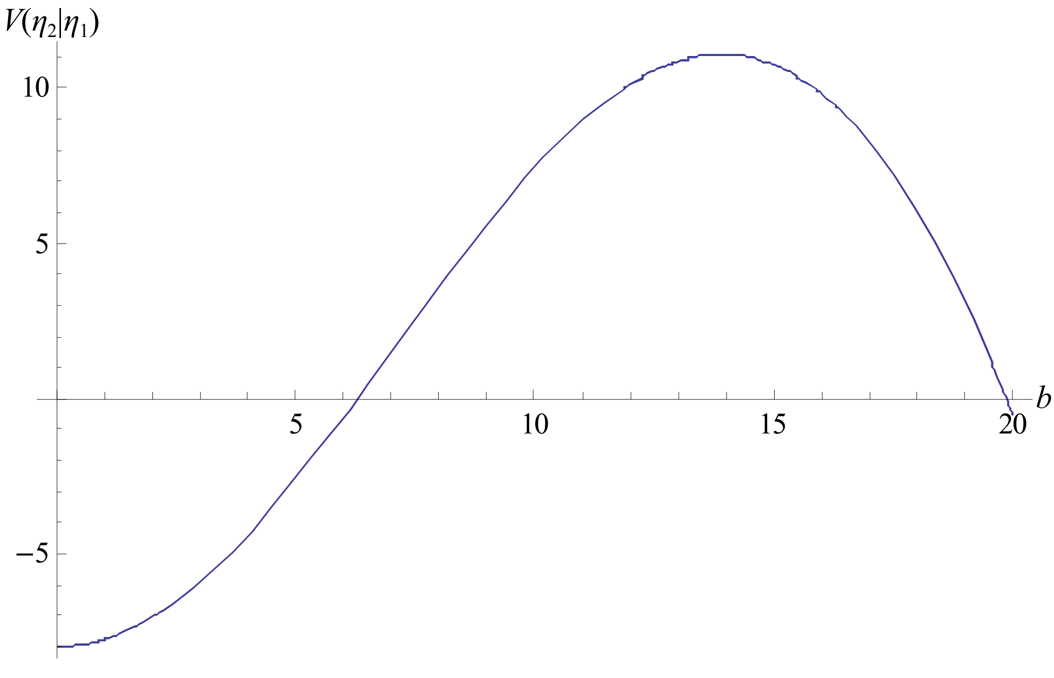


Figure 2.2 illustrates that the incremental value of disclosing *y* to the market initially increases in the accounting report's sensitivity to the agent's actions but decreases for higher values of *m*. The reason for the initial increase is that with $m = 0$ the investor loses all profits when disclosing the measure, as Corollary 3 (*i*) shows, and the value of disclosure is negative. When *m* grows larger the signal-to-noise ratio under η_2 increase more than under η_1, increasing the value of disclosure. However, as the report's sensitivity further increases, the principal is able to extract

higher net expected payoffs from the agency relationship under both regimes and the difference between the signal-to-noise ratios decreases. As *m* approaches infinity there is no stewardship value from disclosing the report, hence, the loss of disclosing *y* equals the loss due to missed trading profits.

The productivity of the agent's actions influences the value of disclosure in a similar way, but with different reasons. With a productivity of zero, only the expected profits from trading are relevant and the disclosure leads to a loss. Increasing the productivity increases the relative weight of the productive output in the investor's objective function. As long as conditions (20a) and (20b) hold, the value of disclosure is positive. Due to the investor's trading based on the observed effort choice weighted by the productivity, further increases of *b* have a positive impact on the signal-to-noise ratio without disclosure and, hence, lead to a negative value of disclosure for high value of *b*. Figure 2.3 illustrates this relation, here, $r = \alpha_0 = \rho = \sigma_x = 1$, $m = 10$, $\sigma_i = 2$, and $\sigma_L = 1/10$:

Figure 2.3
Value of Disclosing Report *y*
and Productivity



The two last discussions both indicate that for high values of either the report's sensitivity or the agent's productivity, disclosure is not preferred. Both effects rely on changes in the signal-to-noise ratio of price and, hence, the decision to withhold information is preferred by both, short-term and long-term investors. This changes if the uncertainty with respect to output is considered. While, again, high values of this parameter lead to a negative value of disclosure, the reason lies in the foregoing of high expected trading gains. The signal-to-noise ratio of price decreases under both disclosure regimes but it decreases more heavily when y is disclosed, leading to a situation where dedicated shareholders might prefer disclosure of the accounting report while transient investors would prefer to keep the report private to profit from trading on this piece of information. More specifically, disclosing the accounting report would improve both the informativeness of price with regard to future cash flows (the market makers can directly use y and do not have to rely on the information in demand) and the informativeness with regard to the agent's effort choice. The transient investor, however, only partly takes into account the effect of disclosing y on the productive effort because she is also interested in potentially profiting from private information and, hence, will withhold the accounting report. Not disclosing the report will lead to a lower pay-performance sensitivity as the noise in price is higher and the following optimal incentive weight lower.

4. CONCLUDING REMARKS

This study investigates the relationship between disclosure policy, market microstructure, and management incentives. Focusing on the role of transient institutions we predict less disclosure in (highly) liquid markets. This result is due to the investor's possible interest in short-term trading gains at the cost of setting incentives for long-term productive effort. It is known that information can be withheld because the informativeness of price with regard to management's actions might not increase monotonously in the informativeness of price with regard to future payoffs (e.g., Heinle/ Hofmann 2009). However, we present results that indicate that information might be kept private even though it would increase both kinds of informativeness. To be more precise, the information might be withheld because it would increase the market knowledge about the uncertain future cash flows and, hence, diminish profits from trading on superior information. Our results are supported by empirical studies showing that transient institutions lead to a focus on short-term earnings (thus, less weight on long-term financial information) and high volatility in the stock price, are attracted to companies with investor relation activities geared toward providing forward-looking information (Bushee 2004), and that institutional investors reduce the amount of voluntary disclosure (Hollander et al. 2008). While not being the primary focus of our study, our results indicate that the occurrence of transient institutions as investors can lead to lower managerial incentives. Here, two opposing effects can be distinguished. First, holding constant the disclosure regime, the occurrence of informed trading increases the information content of price and will increase managerial incentives. However, endogenizing the decision to disclose or withhold information can turn this relation around. With a high uncertainty about future cash flows, disclosing accounting information can increase the signal-to-noise ratio of price and lead to higher managerial incentives. Transient investors who are interested in short-term trading profits will prefer to give up productive effort to increase their total expected profits by keeping information private.

Our results add to the understanding of the role of institutions as part of the investors of companies and increase the insights derived from empirical studies. While some papers investigate the relation between liquidity and informativeness of stock using the probability of insider trading as a proxy for informativeness[13], we show that the assumed relationship might not hold true when including the decision to disclose or withhold information. Incorporating this decision our results suggest that price can be more informative with less insider trading. This

[13] E.g., Kang/ Liu (2008).

happens because the market is only able to extract some information from insider trades, while the whole information gets conveyed when the information is publicly disclosed. Furthermore, our results support the notion that studies which investigate the relation between disclosure and the fraction of shares held by institutional investors could be shaped by controlling for possible differences in the type of institutional investor, e.g., in line with Bushee (1998).

However, we stress that we did not include possible interactions between liquidity and disclosure (cf. Diamond/ Verrecchia 1991 show that disclosure can increase liquidity). Including this effect might lead to a situation where transient investors would like to disclose some information to increase liquidity but withhold other information to trade on. Bushman/ Indjejikian (1995) present results along similar lines. They show that a corporate insider has incentives to disclose some information to prevent outside investors to become privately informed, but keep other information private, to increase his trading profits. Another caveat is that we did not include a link between the decision to become endowed with shares in the first place. Here, an interaction between the fraction held by an instiutional investor and the amount of information he is able to extract from the firm might be important to consider. Extending our model to capture similar effects will influence the value of disclosure and may provide further insights.

APPENDIX A
PROOFS

Corollary 1: The investor maximizes (1) by choosing α_1. Substituting (3a) in (1), differentiating the result with respect to α_1 and solving the first-order conditions for this variable leads to

$$\theta_f \;=\; (-b\,a + f + \alpha_0\, v\, \pi_d + \theta_y\, m\, a + (1+v)\,\pi_f)\,(2\,\pi_d\,(1+v))^{-1} \quad \text{and}$$

$$\theta_y = \; -\sigma_x^2\, \rho\, \sigma_f^{-2}\,(2\,\pi_d\,(1+v))^{-1}$$

Substituting these solutions into (2) and assuming $\pi_d > 0$ yields the characterized equilibrium■

Lemma 1: Substituting $d = d_L - \alpha_1$, (3b), and (4a-d) in (3a) yields (5a). Computing the variance of (5a) gives (5b). Differentiating (5a) with respect to a yields (5c). ■

Proposition 1: Differentiating (10) with respect to v and solving the first-order condition for this variable results in (11a). Substituting the result in (10) yields (11b). ■

Corollary 2: Given report $y = m\,a + \rho\,\sigma_x + \varepsilon_\mu$ and normally distributed noise terms,

$$\mathrm{E}[x|y] = \hat{a}\,(b - \pi_y\, m) + \rho\,\sigma_x^2\,\sigma_i^{-2}\,y. \quad ■$$

Proposition 3: Substituting (14) into (6), choosing f such that $CE(z,a^\dagger) = 0$, and substituting $f_2^\dagger$ and $a^\dagger(v_2) = v_2\, m_{p2}$ into (15) yields (16a). Differentiating (16a) with respect to v_2 and solving the first-order condition for this variable results in (16b). Substituting the result in (16a) yields (16c). ■

Corollary 4: Setting $m^2/\sigma_i^2 < m_\beta^2/\sigma_\beta^2$ and solving for σ_L^2 yields (19). ■

Corollary 5: Substituting $m = \tau_m$ in (18) yields $V(\eta_2|\eta_1) = 0$. Taking the derivative of $V(\eta_2|\eta_1)$ with respect to m and substituting $m = \tau_m$ yields $\frac{\partial V(\eta_2|\eta_1)}{\partial m} = \frac{b\left(\sqrt{2}\sigma_i\sigma_L - 2\rho\sigma_x^2\right)}{\rho\sigma_i\sigma_L\sigma_x^2 - \sqrt{2}\rho^2\sigma_x^4} > 0$, given $\sigma_L{}^2 < \tau_L$ ■

REFERENCES

Almazan, A., J.C. Hartzell, and L.T. Starks (2005) "Active Institutional Shareholders and Costs of Monitoring: Evidence from Executive Compensation," *Financial Management* 34, 5-34.

Baiman, S. and R.E. Verrecchia (1995) "Earnings and Price-based Compensation Contracts in the Presence of Discretionary Trading and Incomplete Contracting," *Journal of Accounting and Economics* 20, 93-121.

Baiman, S. and R.E. Verrecchia (1996) "The Relation among Capital Markets, Financial Disclosure, Production Efficiency, and Insider Trading," *Journal of Accounting Research* 34, 1-22.

Bushee, B.J. (1998) "The Influence of Institutional Investors on Myopic R&D Investment Behavior," *Accounting Review* 73, 305-333.

Bushee, B.J. (2001) "Do Institutional Investors Prefer Near-Term Eamings over Long-Run Value?," *Contemporary Accounting Research* 18, 207-46.

Bushee, B.J. (2004) "Identifying and Attracting the "Right" Investors: Evidence on the Behavior of Institutional Investors," *Journal of Applied Corporate Finance* 16, 28-35.

Bushee, B.J. and T.H. Goodman (2007) "Which Institutional Investors Trade Based on Private Information About Earnings and Returns?," *Journal of Accounting Research* 45, 289-321.

Bushee, B.J., D.A. Matsumoto, and G.S. Miller (2003) "Open versus Closed Conference Calls: The Determinants and Effects of Broadening Aaccess to Disclosure," *Journal of Accounting and Economics* 34, 149-180.

Bushman, R.M. and R.J. Indjejikian (1993) "Stewardship Value of 'Distorted' Accounting Disclosures," *Accounting Review* 68, 765-782.

Calcagno, R. and F. Heider (2008) "Market based CEO pay, aggregation of information and short-termism in the stock market," *working paper*.

Core, J.E. (2001) "A Review of the Empirical Disclosure Literature: Discussion," *Journal of Accounting & Economics* 31, 441-456.

Craighead, J.A., M.L. Magnan, and L. Thorne (2004) "The Impact of Mandated Disclosure on Performance-Based CEO Compensation," *Contemporary Accounting Research* 21, 369-398.

Dikolli, S.S., K.L. Sedatole, and S.C. Kulp (2009) "Transient Institutional Investors and CEO Contracting," *The Accounting Review* forthcoming.

Feltham, G.A. and J. Xie (1994) "Performance Measure Congruity and Diversity in Multi-Task Principal/Agent Relations," *Accounting Review* 69, 429-453.

Feltham, G.A. and M.G.H. Wu (2000) "Public Reports, Information Acquisition by Investors, and Management Incentives," *Review of Accounting Studies* 5, 155–190.

Ferreira, M.A., P.A. Laux, and G. Markarian (2008) "Institutional Trading, Information and Executive Compensation," *working paper*.

Gillan, S.L. and L.T. Starks (2007) "The Evolution of Shareholder Activism in the United States," *Journal of Applied Corporate Finance* 19, 54-73.

Gompers, P.A. and A. Metrick (2001) "Institutional Investors and Equity Prices," *The Quarterly Journal of Economics* 116, 229-259.

Grossman, S.J. and J.E. Stiglitz (1980) "On the Impossibility of Informationally Efficient Markets," *American Economic Review* 70, 393-408.

Hartzell, J.C. and L.T. Starks (2003) "Institutional Investors and Executive Compensation," *The Journal of Finance* 58, 2351-2374.

Heinle, M.S. and C. Hofmann (2009) "Soft Information and the Stewardship Value of Accounting Disclosure," *working paper*.

Hogan, B.R. and J.E.S. Grant (2009) "Institutional Investor Ownership Changes Surrounding Firm Restatement Disclosure Levels," *working paper*.

Hollander, S., M. Pronk, and E. Roelofsen (2008) "Disclosure choices during earnings conference calls," *working paper*.

Holmstrom, B. and J. Tirole (1993) "Market Liquidity and Performance Monitoring," *Journal of Political Economy* 101, 678-709.

Kang, Q. and Q. Liu (2008) "Stock Trading, Information Production, and Executive Incentives," *Journal of Corporate Finance* 14, 484-498.

Kyle, A.S. (1985) "Continuous Auctions and Insider Trading," *Econometrica* 53, 1315-1335.

Piotroski, J.D. and D.T. Roulstone (2003) "The Influence of Analysts, Institutional Investors, and Insiders on the Incorporation of Market, Industry, and Firm-Specific Information into Stock Prices," *Accounting Review* 79, 1119-1151.

Smith, G.S. and P.L. Swan (2008) "Will the Real Monitors Please Stand Up? Institutional Investors and CEO Compensation," *working paper*.

Yan, X., Z. Zhang (2009) "Institutional Investors and Equity Returns: Are Short-term Institutions Better Informed?," *Review of Financial Studies*, 22, 893-924.

ESSAY 3:
THE USE OF PRICE AND ACCOUNTING INFORMATION IN COMPENSATION CONTRACTS

1. INTRODUCTION

Agency theory started to being used in managerial accounting in the 1970s[1]. Following this introduction it "has been one of the most important theoretical paradigms in accounting during the last 20 years" (Lambert 2001, 3). Along with analytical studies and the insights provided by their models, empirical incentive compensation studies "began by explaining practice but now test agency-theoretic hypotheses" (Zimmerman 2001, 417). A substantial part of both types of research (analytical and empirical) considers a trade-off between risk and incentives. Agency theory predicts a negative relation between the uncertainty in performance measures and their usage in incentive contracts. However, the empirical evidence on this topic is mixed and there exists evidence which suggests that the weight a performance measure receives in a contract can increase in the noise associated with that measure.[2] While absolute weights of individual measures are not directly observable and, hence, difficult to test, a different approach is to consider the relative weights of performance measures in compensation contracts. Banker/ Datar (1989) developed a model which shows that the relative contractual weights on performance measures are a function of their "signal-to-noise ratio", i.e., the ratio of the marginal effect of the agent's effort on the measure and the variance of the measure. Beginning with Lambert/ Larcker (1987) this prediction gained empirical attention and support. But while agency theory makes predicitions about incentives stemming from the total wealth of a manager, early studies investigated manager's incentives stemming from cash pay only.[3]

More recently, Core/ Guay/ Verrecchia (2003) studied the relative incentive weights on price and non-price measures in CEOs' total compensation. They do so using two somewhat different approaches. As a first approach, they regress the unexpected change in CEO compensation on

---

[1] For a review of that literature see, e.g., Baiman (1982).

[2] For a review and discussion of this literature see Prendergast (2002).

[3] Bushman/ Smith (2001) provide a review of empirical studies on relative incentive weights and criticize the investigation of cash pay only.

annual price and accounting performance. Here, they use the change in earnings per share as the measure of accounting performance. Opposite to theoretical results, their findings indicate that "the relative weight on price and non-price performance measures in total compensation increases with the ratio of the variances" (Core/ Guay/ Verrecchia 2003, 972). They further confirm this finding by replacing the change in earnings per share by a measure *orthogonal* (i.e., uncorrelated) to stock price. This measure takes into account that the choice of accounting measures used in compensation contracts is not observable and the variance of the measure is estimated as the variance of changes in earnings per share that are not explained by stock returns. In a second approach, Core/ Guay/ Verrecchia (2003) estimate the incentives stemming from price and non-price measures. Theoretically, the incentives provided by a measure derive from the product of the measure's incentive weight with its sensitivity to the CEO's effort choice. By calculating the optimal incentive weights and substituting terms, Core/ Guay/ Verrecchia (2003) are able to replace the relative incentives provided by price and non-price measures with "the ratio fo the variation in total compensation explained by the two performance measures" (Core/ Guay/ Verrecchia 2003, 962). This second approach confirms the prior analysis by finding that incentive ratio is positively related to the variance ratio. Again, the variance of the non-price measures is proxied by the variance of changes in earnings per share that are not explained by stock returns.

Core/ Guay/ Verrecchia (2003) offer three explanations for their findings: (i) observed contracts are not optimal because they are either not in equilibrium or because CEOs take private posistions in stock; (ii) effort incentives are not the main driver of compensation contracts, which are driven by project selection instead; and (iii) the proxies for relative variance rather capture relative sensitivity than noise. We offer a different view and theoretically show that even if effort incentives are the main concern and noise is measured correctly, the relative weight of non-price measures can increase in their variance. We derive this result by developing a model which distinguishes between different types of noise (measurement error of accounting information and uncertainty related to the fundamental value of the firm) and allow the contract to include more than one non-price measure. Changing the noise captured in one measure leads to adjustments of all incentive weights. An increase in the variance of non-price measures can then result in an increasing relative weight. We relate our analysis to proxies used in empirical studies and develop comparative static results with regard to published performance measures and performance measures that are not published and are not correlated to price. Finally, we suggest a different setting to test the agency prediction: the change in relative incentive weights before and after a change in the firm's disclosure policy. Here, we are able to derive a non-ambiguous result with regard to the noise in an additionally disclosed report. This method could be applied in a cross-sectional context where changes in mandatory disclosure regulation lead to increased disclosure but where the noise in the additionally disclosed information varies across industries.

Our analysis is motivated by observations that firms use more than one financial or non-financial measure in compensation contracts (e.g., Ittner/ Larcker/ Rajan (1997) find that the average number of financial (non-financial) measures used in annual bonus contracts is 1.7 (2.3)) and that firms use information to reward top executives that is not observable to outsiders.[4] However, there is overwhelming empirical support for the use of price measures in incentive contracts (Core/ Guay/ Verrecchia 2003 report that "for over 75 percent of the CEOs, the incentives provided by stock price are approximately 12 times greater than the incentives provided by performance measures orthogonal to price."). One explanation for these findings is the "costliness or impossibility of contracting directly on the investors' other information can

[4] See, e.g., Hayes/ Schafer (2000). Ittner/ Larcker/ Rajan (1997, 234) state that

> much of the information contained in non-financial measures about current managerial actions may not even be reflected in current stock price because of its private or proprietary nature (e.g. internal customer satisfaction surveys or research and development results).

make it desirable to contract on the firm's market price" (Feltham/ Wu 2000, 155). For this reason, we include performance measures which are publicly observable but cannot be directly used in the contract between shareholders and management. Straightforward examples of such measures are the progress of investment projects and management reputation. Theory predicts that the aggregation of information in price does not equal the optimal aggregation of information for incentive purposes which provides the basic tension in our model (see, e.g., Feltham/ Xie 1994 and Heinle/ Hofmann 2009a).

The remainder of this paper is organized as follows. Section 2 introduces the basic model structure and describes a setting with a generic price and a single contractible accounting measure (e.g., accounting earnings). In section 3, we characterize the price if the accounting report is published and investigate the relative weights placed on the accounting measure and price. Here we show that the relative incentive weight on earnings can increase in its noise. Because we are not able to investigate measures that are orthogonal to price in the just described setting, we introduce a second contractible accounting measure which is not publicly disclosed in section 4. Here we can show that the incentive weight of the undisclosed accounting information relative to price can increase in different measures of noise of the disclosed information. If the variance of the disclosed earnings report is used to proxy for the noise in non-price measures, one would conclude that the relative weight of these measures increases in their noise. We extend this notion by showing that the aggregated weight on the contractible reports relative to price can increase in the noise of either the published or the private measure. Section 5 investigates the change in relative weights if the amount of disclosed information increases (keeping the set of contractible measures constant). Here we derive a non-ambiguous relation between noise and the change in relative weight. Following, we suggest that this change can be used to test whether agency theory is descriptive about observed contracts. Section 6 concludes.

2. BASIC MODEL STRUCTURE

2.1 Performance Measures and Price Formation

At date 0, the principal, acting on behalf of the firm's long term[5] risk neutral owners, hires an agent to provide productive effort at date 1 in return for compensation at date 2. The agent's effort influences the firm's terminal payoff[6] where we assume a linear relation, i.e.,

$$x = b\,a + \varepsilon_x,$$

where $b \in \mathbb{R}$ represents the productivity of the agent's effort a and $\varepsilon_x \sim N(0, \sigma_x^2)$ represents random events beyond the agent's control. The agent bears a personal cost of effort $\kappa(a)$ which we assume to be quadratic with

$$\kappa(a) = \tfrac{1}{2}\,a^2.$$

At date 2, information system η generates N performance measures and releases (subsets of) these reports to the principal and to investors. Performance measures are either publicly reported to investors (i.e., public performance measures) or undisclosed and only released to the principal (i.e., private performance measures). In addition, the information is either contractible (i.e., hard) or non-contractible (i.e., soft).[7] Applying both classifications, we distinguish between public performance measures of hard information, public measures of soft information, and undisclosed performance measures of hard information.[8] We assume a linear relation between effort and performance, i.e.,

$$y_i = m_i\,a + \varepsilon_i, \qquad i = 1,...,N,$$

where m_i represents the sensitivity of performance measure i to the agent's effort level and ε_i is

[5] We assume long term firm owners to exclude any trading on firm internal measures. This assumption is also made by Baiman/ Verrecchia (1995), Feltham/ Xie (1994), and Heinle/ Hofmann (2009a). For a study on the effects of firm owners' short-term interests on incentive contracts and disclosure decisions see Heinle/ Hofmann (2009b).

[6] Alternatively, x may also represent the firm's future market price. We choose the terms payoff, terminal value, and output to distinguish market price at date 2 from firm value at date 3.

[7] A discussion about the existence of soft and hard information is provided by Heinle/ Hofmann (2009a).

[8] Without loss in generality, we neglect undisclosed soft information. Signals including this type of information can neither be used by the principal in the contract with the agent nor by investors when updating their beliefs about the terminal payoff.

a normally distributed noise term with $\varepsilon_i \sim N(0,\sigma_i^2)$. The noise of each performance measure reflects uncontrollable events that affect the firm's payoff (i.e, output uncertainty) plus inaccuracy of the accounting system (i.e., measurement error). Specifically, the noise inherent in performance measure i is assumed to be

$$\varepsilon_i = \rho_i\, \varepsilon_x + \varepsilon_{\mu i}, \qquad i = 1,...,N,$$

where ρ_i characterizes the correlation of performance measure i to the output x and $\varepsilon_{\mu i}$ represents measurement error, with $\varepsilon_{\mu i} \sim N(0,\sigma_{\mu i}^2)$. To facilitate the following analysis we assume that all noise terms are independently distributed, i.e., $Cov[\varepsilon_x,\varepsilon_{\mu i}] = Cov[\varepsilon_{\mu i},\varepsilon_{\mu j}] = 0$, $i,j = 1,...,N$, thus $\sigma_i^2 = \rho_i^2\, \sigma_x^2 + \sigma_{\mu i}^2$. We will also restrict the analysis to cases in which all measures have a non-negative correlation to the terminal value and a positive sensitivity with regard to the agent's actions.

To focus on the driving forces of the results we will employ a very simple price formation process, equivalent to Feltham/ Xie (1994) and Heinle/ Hofmann (2009a). Here, the capital market is assumed to consist of homogeneous rational investors who set the price equal to the expected value of the firm conditional on all available information: the publicly reported performance measures.[9] As the performance measures follow a normal distribution, in computing the expected terminal value the investors correct the information for the unconditional mean and weight the information according to their covariance with the terminal value, scaled by the reports' precision. Thus, the market price will be linear in the available public reports and will also be normally distributed. Assuming that information system η discloses N_p reports (with $N_p<N$), price π can be specified as

$$\pi(\eta) = E[x|\eta] = \pi_o(\hat{a}) + \sum_{i=1}^{N_p} \alpha_i y_i, \tag{1}$$

where $\hat{a}$ denotes the investors' expectations regarding the agent's action, π_o a constant, and α_i

[9] The signals that are made public are disclosed without additional error. This assumption is common in the literature on discretionary disclosure, where disclosure is often assumed to be truthful. For a review of this literature see Verrecchia (2001).

the weight of report y_i in price.

2.2 Agent's Preferences and Effort Choice

To keep the model as parsimonious as possible we initially consider a setting with only one contractible non-price measure (e.g., accounting earnings) and treat price as a generic performance measure (we investigate the characteristics of stock price in the subsequent sections). At date 0, the principal offers the agent a linear contract $z = (f,v_c,v_\pi)$, where f is the agent's fixed wage, v_c (v_π) the incentive rate for the contractible report (market price). The agent's compensation w, given contractible information y_c, price π, and contract z is

$$w(y_c,\pi,z) = f + v_c\, y_c + v_\pi\, \pi.$$

We assume that the agent's preferences are represented by a negative exponential utility function, with

$$u(z,a) = -\exp[-r(w - \kappa(a))],$$

where r is his coefficient of absolute risk aversion. Given a linear combination of normally distributed measures in the agent's compensation, maximizing the expected utility is equivalent to maximizing the certainty equivalent, which is characterized by

$$\begin{aligned} \text{CE}(z,a) &= \text{E}[w|z,a] - \kappa(a) - \tfrac{1}{2}\, r\, \text{Var}[w|z] \qquad (2)\\ &= f + v_\pi\, \pi_o(\hat{a}) + (v_c\, m_c + v_\pi\, m_\pi)\, a - \tfrac{1}{2}\, a^2 \\ &\qquad - \tfrac{1}{2}\, r\, (v_c^2\, \sigma_c^2 + v_\pi^2\, \sigma_\pi^2 + 2\, v_c\, v_\pi\, \sigma_{\pi c}), \end{aligned}$$

where m_π denotes the sensitivity of stock price to the agent's action (i.e., $m_\pi = \partial\text{E}[\pi]/\partial a$), σ_π^2 the variance of stock price, and $\sigma_{\pi c}$ the covariance between the contractible measure and price. The agent chooses a to maximize his certainty equivalent which results in the following characterization of the agent's action choice.

Lemma 1: Given contract $z = (f,v_c,v_\pi)$, the agent's optimal action choice is characterized by

$$a^\dagger(v_c,v_\pi) = m_c\, v_c + m_\pi\, v_\pi. \qquad (3)$$

Proof: Differentiating (2) with respect to a, and solving the first-order condition for this variable results in the optimal action choice as specified in (3).

2.3 Principal's Preferences and Optimal Contract

When the principal offers contract z to the agent, she has to akes into account that the agent can decide whether to accept the contract and that he will choose his level of unobservable effort in order to maximize his expected utility. The actions that are induced by z are characterized by (3). The agent will only participate in the firm if his contract z is such that it provides him with his reservation wage, which is scaled to equal zero, i.e.,

$$CE(z,a^{\dagger}) \geq 0. \tag{4}$$

The principal is assumed to be risk neutral with respect to her expected utility. More specifically, she is interested in maximizing the expected terminal value of the firm net of the agent's compensation, i.e.,

$$\Pi(a,z,\eta) = \mathrm{E}[x - w|a,z,\eta]. \tag{5}$$

The principal chooses z such as to maximize (5) subject to (4) and (3). Substituting (3) into (2), choosing f such that $CE(z,a^{\dagger}) = 0$, and substituting $f^{\dagger}$ and (3) into (5) gives the principal's unconstrained decision problem:

$$\Pi(v_c,v_\pi,\eta_1) = b\,(v_c m_c + v_\pi m_\pi) - ½\,(v_c m_c + v_\pi m_\pi)^2 - ½\,r\,(v_c^2\,\sigma_c^2 + v_\pi^2\,\sigma_\pi^2 + 2\,v_c\,v_\pi\,\sigma_{\pi c}). \tag{6}$$

The solution to the principal's decision problem in this formulation equals that in a standard agency relationship with two generic performance measures.

Lemma 2: The optimal incentive weights of the accounting measure and price in the contract with the agent are characterized by

$$v_c^{\dagger} = b\,(m_c\,\sigma_\pi^2 - m_\pi\,\sigma_c^2)\,Q^{-1}, \tag{7a}$$

$$v_\pi^{\dagger} = b\,(m_\pi\,\sigma_c^2 - m_c\,\sigma_\pi^2)\,Q^{-1}, \tag{7b}$$

with $Q = m_c^2\,\sigma_\pi^2 + m_\pi^2\,\sigma_c^2 + r\,\sigma_c^2\,\sigma_\pi^2 - (2\,m_c\,m_\pi\,\sigma_{\pi c} + r\,\sigma_{\pi c}^2)$.

Proof: Differentiating (6) with respect to v_c and v_π, and solving the two first-order conditions for the two variables results in the optimal incentive weights as specified in (7a) and (7b).

As is usual in agency theory we derive the result, that the principal increases the weight on a (price or non-price) measure if it is more informative about the agent's actions. This is in contrast to the weighting of information in price where information is aggregated to predict the future cash flows of the firm. This divergence of weights arises from different objectives of capital market participants and the principal. While the former try to calculate the firm's value (which includes the realization of output uncertainty), the principal tries to detect the agent's action (with as little noise as possible). We investigate the price setting mechanism and the characteristics of price as a performance measure in the following section.

3. RELATIVE INCENTIVE WEIGHTS WITH A SINGLE NON-PRICE MEASURE

For the price to be used in the contract there has to be information impounded into price that cannot be directly contracted on (public soft information). Assume that information system η_1 provides and publicly discloses one contractible ($y_c = m_c a + \rho_c \varepsilon_x + \varepsilon_{\mu c}$) and one non-contractible ($y_s = m_s a + \rho_s \varepsilon_x + \varepsilon_{\mu s}$) report.[10] Given that both measures are informative about the terminal value of the firm, actors on the capital market use both measures to derive the price. Given the normally distributed noise terms, the (gross) market price is characterized by

$$\pi(\eta_1) = \mathrm{E}[x|y_c, y_s] = \pi_o + \alpha_c y_c + \alpha_s y_s, \tag{8a}$$

with $\pi_o = (b - \alpha_c m_c - \alpha_s m_s)\, \hat{a}$,

$$\alpha_c = \Theta^{-1} \rho_c \sigma_x^2 \sigma_{\mu s}^2, \tag{8b}$$

$$\alpha_s = \Theta^{-1} \rho_s \sigma_x^2 \sigma_{\mu c}^2, \quad \text{and} \tag{8c}$$

$$\Theta = \sigma_c^2 \sigma_s^2 - (\rho_c \rho_s \sigma_x^2)^2.$$

Note that, as discussed above, the investors' aggregation of information (i.e., α_c and α_s) does not reflect the reports' sensitivities to the agent's action but instead is solely determined by the

[10] Note that while disclosing soft information is weakly beneficial for the principal, disclosing the contractible report in this setting does not have (either positive or negative) value to the principal. For a study on the stewardship value of accounting disclosures see Heinle/ Hofmann (2009a).

respective measurement errors ($\sigma_{\mu c}^2$ and $\sigma_{\mu s}^2$) and their covariance with the firm's terminal payoff ($\rho_c\, \sigma_x^2$ and $\rho_s\, \sigma_x^2$).

From (7a) and (7b) it is obvious that the incentive weights assigned to both the contractible performance measure and price crucially depend on the characteristics of stock price and, hence, on the publicly available information. Table 3.1 summarizes the relevant characteristics of price and the incentive weights under information system η_1.

Table 3.1
Characteristics of Price and Incentive Weights under η_1

Price Characteristics

$$m_\pi = \Theta^{-1}\, \sigma_x^2\, (m_c\, \rho_c\, \sigma_{\mu s}^2 + m_s\, \rho_s\, \sigma_{\mu c}^2), \tag{T1.1a}$$

$$\sigma_\pi^2 \equiv \mathrm{Var}[\pi | y_c, y_s] = \Theta^{-1}\, \sigma_x^4\, (\rho_c^2\, \sigma_{\mu s}^2 + \rho_s^2\, \sigma_{\mu c}^2), \tag{T1.1b}$$

Incentive Weights

$$v_c^\dagger = b\, (m_c\, \rho_s - m_s\, \rho_c)\, \sigma_x^2\, \Theta\, \Omega^{-1}, \tag{T1.2a}$$

$$v_\pi^\dagger = b\, (m_s\, \sigma_c^2 - m_c\, \rho_c\, \rho_s\, \sigma_x^2)\, \Theta\, \Omega^{-1}, \tag{T1.2b}$$

with $\Theta = \sigma_c^2\, \sigma_s^2 - (\rho_c\, \rho_s\, \sigma_x^2)^2$ and

$\Omega = \rho_s\, \sigma_{\mu c}^2\, \sigma_x^2\, (m_c^2\, \sigma_s^2 + m_s^2\, \sigma_c^2 - 2\, m_c\, m_s\, \rho_c\, \rho_s\, \sigma_x^2 + r\, (\sigma_c^2\, \sigma_s^2 - \rho_c^2\, \rho_s^2\, \sigma_x^4)).$

The characterization in Table 3.1 shows that the sensitivity of the firm's stock price to the agent's action choice depends on the publicly available information. Given that both measures are positively correlated to the terminal value, we expect to observe an increasing sensitivity of price to the agent's action if the sensitivity of either performance measure increases. The absolute incentive weights given in (T1.2a) and (T1.2b) enable us to derive the following relative weights placed on the accounting measure and price.

Corollary 1[11]: The optimal weight placed on the accounting measure relative to price is given by

[11] Proofs are provided in Appendix A.

$$v_c^\dagger / v_\pi^\dagger \;=\; \frac{m_c\rho_s - m_s\rho_c}{m_s\sigma_c^2 - m_c\rho_c\rho_s\sigma_x^2}\;\sigma_x^2.$$

Corollary 1 shows how the principal weights accounting earnings and price to provide optimal incentives to the agent. Note that the relative weight of the measures depends on the sensitivities of both the contractible and the non-contractible report with regard to the agent's action and the terminal value. Increasing a measure's sensitivity to the agent's effort choice will lead to a higher relative weight, as the principal profits from increasing the level of effort the agent supplies. Altering the informativeness about terminal value of either measure will also lead to a change in the relative weights. This results because both measures covary through their capturing of output related uncertainty. We are specifically interested in the behavior of the relative weights with regard to changes in the measures' noise. Consider the case in which the contractible measure is not impounded into price because it is not informative about the terminal value of the firm.

Corollary 2: If the earnings report is not informative about the terminal value its relative weight in the contract is decreasing in its noise.

Banker/ Datar (1989) showed that the relative weight of two non-correlated measures is equal to the ratio of the measures' signal-to-noise ratios. Hence, if the earnings report is not impounded into price (because it in not informative about terminal value), its relative weight in the contract will decrease with increasing noise. This result holds, as long as there is no correlation among the measures. If the measure is impounded into price, the ratio of the measures' sensitivity to the agent's action and the correlation to terminal value become important (i.e., m_i/ρ_i).

Proposition 1: An increase in the idiosyncratic noise inherent in accounting earnings will lead to an increasing relative weight in the incentive contract if $m_s/\rho_s > m_c/\rho_c$.

The reason underlying the result in Proposition 1 is that the extent to which the principal uses the contractible measure in the contract is influenced by how informative the measure is itself and how much it is being used in stock price, both vary with the measurement noise $\sigma_{\mu c}^2$. An increase in this noise makes the earnings report less informative about terminal value, hence, the capital market participants will decrease the weight they apply to the contractible measure and increase the weight they apply to the non-contractible measure. From (T1.2a) it is obvious, that the absolute weight on accounting earnings is negative if $m_s/\rho_s > m_c/\rho_c$. Hence, the earnings report is used to filter out risk from stock price.[12] When, due to an increase of $\sigma_{\mu c}^2$, the earnings report receives less weight in price, the principal will reduce the amount of risk filtering and the ratio of the incentive weights will increase. This result show that endogenizing the price formation process in a theoretical model leads to the conclusion that the relative weight of a measure in a compensation contract can increase in its noise. Additionally, the stated relation between the sensitivities and correlations of the two measures indicates that the uncontractible information which is impounded into price is relatively more informative about the agent's effort. This situation suggests that stock price is an important performance measure and will receive a relatively high weight in the compensation contract, which is confirmed by the sample of Core/ Guay/ Verrecchia (2003).

Besides analyzing the ratio of the contractual weights of price and non-prise measures, Core/ Guay/ Verrecchia (2003) further investigate the relative incentives deriving from these two sources. The incentives stemming from both can be characterized as the product of the respective contractual weight and the sensitivity to the agent's effort (i.e., $v_\pi^\dagger\, m_\pi$ and $v_c^\dagger\, m_c$). Corollary 3 shows that the result from Proposition 1 holds when the ratio of incentives is considered.

Corollary 3: An increase in the idiosyncratic noise inherent in accounting earnings increases the ratio of incentives from accounting earnings and price if $m_s/\rho_s > m_c/\rho_c$.

[12] While Core/ Guay/ Verrecchia (2003) find a positive relation between unexpected change in cash pay and change in earnings per share, they cannot find a positive relation between total compensation and earnings per share (Core/ Guay/ Verrecchia 2003 report an insignificant negative relation). This could be explained by the use of earnings to filter risk from price.

The explanation of corollary 3 equals the discussion of Proposition 1. It shows that if the stated relation between the two measures' sensitivities to the agent's action and correlations to the terminal value holds and the measurement noise in the accounting earnings report increases, the principal will employ a less negative weight on this measure. Following, the ratio of of incentives deriving from non-price and price measures increases in the idiosyncratic noise of the non-price measure.

While Core/ Guay/ Verrecchia (2003) investigate the incentives arising from a measure orthogonal to price, the discussion so far could only show an increase of the contractual weight of a non-price measure in its noise when the measure itself is incorporated into price, and, hence, correlated with the latter. To align our model with the available empirical results, we extend the analysis in the following section to a setting with an additional internal contractible measure, which is not correlated with price. This measure might be kept private to the firm because of its proprietary nature.[13]

4. Relative Incentive Weights with Multiple non-Price Measures

This section extends the previous analysis by allowing the principal to contract on multiple accounting reports, which are potentially private to the firm. As noted above, the use of multiple performance measures in compensation contracts seems to be descriptive (e.g., Ittner/ Larcker/ Rajan 1997). We choose the following setting to investigate the relative weights of non-price measures that are orthogonal to stock price. Assume that information system η_2 provides one measure of soft (y_s) and two measures of hard information (y_c and y_f). While the soft information is disclosed, only one of the two contractible measures (y_c) is made public and the other one remains private to the firm (y_f). To ensure that the internal measure and price do not covary, we

[13] Berger/ Hann (2007) provide evidence that managers keep information private if its disclosure is associated with high proprietary costs.

assume it is not correlated to terminal value (i.e., $\rho_f = 0$).[14] Panel A of Table 3.2 summarizes the three measures provided by η_2.

Table 3.2
Reports and Incentive Weights under η_2

Panel A: Reports provided by η_2

$$y_f = m_f\, a + \varepsilon_{\mu f},$$
$$y_c = m_c\, a + \rho_c\, \varepsilon_x + \varepsilon_{\mu c}, \qquad \text{and}$$
$$y_s = m_s\, a + \rho_s\, \varepsilon_x + \varepsilon_{\mu s}.$$

Panel B: Incentive Weights

$$v_c^{\dagger} = b\,(m_c\,\rho_s - m_s\,\rho_c)\,\sigma_x^2\,\sigma_{\mu f}^2\,\Theta\,\Phi^{-1}, \tag{T2.1a}$$
$$v_f^{\dagger} = b\,m_f\,\rho_s\,\sigma_x^2\,\sigma_{\mu c}^2\,\Theta\,\Phi^{-1}, \tag{T2.1b}$$
$$v_\pi^{\dagger} = b\,(m_s\,\sigma_c^2 - m_c\,\rho_c\,\rho_s\,\sigma_x^2)\,\sigma_{\mu f}^2\,\Theta\,\Phi^{-1}, \tag{T2.1c}$$

with
$$\Theta = (\sigma_{\mu c}^2 + \rho_c^2\,\sigma_x^2)\,(\sigma_{\mu s}^2 + \rho_s^2\,\sigma_x^2) - (\rho_c\,\rho_s\,\sigma_x^2)^2,$$
$$\Omega = \rho_s\,\sigma_{\mu c}^2\,\sigma_x^2\,(m_c^2\,\sigma_s^2 + m_s^2\,\sigma_c^2 - 2\,m_c\,m_s\,\rho_c\,\rho_s\,\sigma_x^2 + r\,(\sigma_c^2\,\sigma_s^2 - \rho_c^2\,\rho_s^2\,\sigma_x^4)), \text{ and}$$
$$\Phi = m_f^2\,\rho_s\,\sigma_x^2\,\sigma_{\mu c}^2\,\Theta + \sigma_{\mu f}^2\,\Omega.$$

The set of public measures is the same under η_1 and η_2, hence, the relevant characteristics of stock price are characterized in (T1.1a) and (T1.1b). Different from η_1, the principal can now include three measures in the incentive contract. Taking into account the altered incentive and individual rationality constraints and maximizing her expected net profit leads to the three optimal incentive weights specified in Panel B of Table 3.2. As a first step, we investigate the ratio of the weights the private measure and stock price receive in the contract. To compare our results to Core/ Guay/ Verrecchia (2003), we also study the incentives deriving from all non-price measures relative to the incentives from price.[15] Corollary 4 summarizes these two expressions.

[14] This assumption also prevents capital market participants from being interested in the internal measure. If it was correlated to terminal value and compensation was disclosed at the time of price formation, investors could infer the value of y_f and include this information when setting the price.

[15] We do not analyze the sum of the contractiual weights on the accounting reports relative to price, i.e., $(v_c^{\dagger} + v_f^{\dagger})/v_\pi^{\dagger}$, because the two contractible accounting reports y_c and y_f might be measured in different scales or units (i.e., accounting earnings and through-put time).

Corollary 4:

(i) The optimal weight placed on the private contractible report relative to price is given by

$$v_f^\dagger / v_\pi^\dagger = \frac{m_f \rho_s \sigma_x^2 \sigma_{\mu c}^2}{(m_s \sigma_c^2 - m_c \rho_c \rho_s \sigma_x^2)\sigma_{\mu f}^2}. \tag{9a}$$

(ii) The ratio of incentives stemming from all non-price measures and price is given by

$$\frac{v_c^\dagger m_c + v_f^\dagger m_f}{v_\pi^\dagger m_\pi} = \frac{m_f^2 \rho_s \sigma_{\mu c}^2 + m_c(m_c \rho_s - m_s \rho_c)\sigma_{\mu f}^2}{(m_s \rho_s \sigma_{\mu c}^2 + m_c \rho_c \sigma_{\mu s}^2)(m_s \sigma_c^2 - m_c \rho_c \rho_s \sigma_x^2)} \frac{\theta}{\sigma_{\mu f}^2}. \tag{9b}$$

Corollary 4 (i) shows that, intuitively, the relative weight of the internal measure increases with its sensitivity to the agent's actions (because the signal-to-noise ratio of the internal measure increases), whereas it decreases in the non-contractible measure's sensitivity. As the latter increases, price becomes a more valuable performance measure and will receive higher weight in the contract. This happens because the capital market's aggregation of reports is independent from their sensitivity to the agent's actions. By altering the sensitivity of the public information, the aggregation of the different reports in price does not change but only the sensitivity of price is affected. In (ii) we compare the incentives the agent derives from his compensation that is based on accounting performance ($v_c^\dagger m_c + v_f^\dagger m_f$) and that is based on stock price performance ($v_\pi^\dagger m_\pi$). The relative incentives stemming from non-price measures increase in the sensitivities of both contractible accounting reports (because they become more informative) but decrease in the sensitivity of the public soft information (as price becomes more informative and the non-price measures are less employed). Another straightforward observation is that an increasing measurement noise in the unpublished accounting report ($\sigma_{\mu f}^2$) decreases the relative incentives stemming from non-price measures, similar to the change in (9a). Here, the unpublished accounting report becomes less informative about the agent's action choice and this change has no effect on the informational content of the published measures and, hence, on price. Following, the prinicpal decreases the incentive weight on y_f and both, the relative weight and the incentives stemming from y_f are reduced.

To compare our results with Core/ Guay/ Verrecchia (2003), we are particularly interested in comparative static results regarding the noise inherent in the reports. Proposition 2 summarizes our results with regard to the relative weight placed on the undisclosed measure.

Proposition 2: The weight on the internal measure relative to stock price increases

(i) in output uncertainty,

(ii) in the public report's measurement noise if $m_s/\rho_s > m_c/\rho_c$.

Proposition 2 summarizes conditions under which a measure that is used for contracting purposes, but which is orthogonal to stock price, receives a higher contractual weight relative to price. Part (i) shows that this happens if output uncertainty increases. As we do not change the correlation coefficients and the measurement noise of the public reports, increasing the output uncertainty makes the public reports more informative about terminal value and, hence, leads to a higher weight of the public reports in price. While that increases both the signal (sensitivity to the agent's actions) and noise (variance) of price, the latter effect dominates the former. This leads to a decreasing value of price as a performance measure. The same holds true for published hard information. As the stewardship value of the undisclosed measure is not affected by an increasing output uncertainty (due to $\rho_f = 0$) its relative weight increases.

Part (ii) shows that the relative weight on the orthogonal measure can increase with an increase of the measurement noise in the disclosed measure. When the condition in (ii) holds, i.e., $m_s/\rho_s > m_c/\rho_c$, price receives a positive weight in the contract and, as mentioned above, the disclosed accounting report is used to filter noise from stock price. If the measurement noise in this measure increases, the principal reduces its weight and increases the weight on the other available performance measures (price and the internal accounting report). However, the increase is more pronounced for the undisclosed accounting report because price becomes less useful as a performance measure as less noise can be filtered out. Hence, the conditional signal-to-noise ratio of price decreases while the undisclosed measure's signal-to-noise ratio is not affected by the increase in noise.

Summarizing, the results of Proposition 2 show that if the variance of non-price measures is proxied by the (observable) variance of a published report, an increase in the measured variance can lead to an increasing relative weight on the non-price measure which is orthogonal to price. This holds true even if the parts of the published reports variance increase that are not affected by changes in the variance of the underlying economic value. Following, empirical findings that the relative weight of orthogonal non-price measures increases with the variance of non-price measures (proxied by the variance of a public measure) can not necessarily be seen as evidence against agency theory.

The previous analysis focused exclusively on the contractual relative weight of an orthogonal measure. To complete the analysis, Proposition 3 shows that the above stated relation between the relative incentives and measurement noise in the public contractible measure continues to hold.

Proposition 3: The ratio of incentives stemming from non-price measures and price increases in the published accounting report's measurement noise if $m_s/\rho_s > m_c/\rho_c$.

Proposition 3 confirms the prior results and shows that if the stated relation between the public non-contractible and the public contractible measure holds, the agent will receive relatively higher incentives from non-price measures than from price when the noise in the public accounting measure increases. We specifically refer to noise that is not explained by changes of the output uncertainty because we believe that this part of noise better reflects noise that is empirically testable. The explanation for this result equals that of Proposition 2 (ii). The increase will be more sharply now because in addition to increasing the weight on the private measure and decreasing the weight on price, the principal will also increase the weight on the public measure of hard information. This happens because the latter is used to filter out noise of price and, hence, receives negative weight in the contract. As the extent to which noise can be filtered from price decreases, the measure is used less, which means the principal applies a lower negative weight on the measure. Summarizing, the stated relation between the ratio of contractual weights on non-price measures and price as well as the ratio of incentives stemming from these two sources can increase in the noise of non-price measures if the latter is proxied by the noise of a public measure. This shows that endogenizing the formulation of price can turn around standard predictions of agency theory and lead to the empirical findings documented by Core/ Guay/ Verrecchia (2003).

5. Changes in Disclosure Policy as an Alternative Setting to Test Agency Predictions

The previous discussion indicates that the impact of an increase in noise on the relative weights applied to and stemming from various measures used in a contract depends on the sensitivities of the respective measures to the agent's effort choice. We investigated this problem under different information systems, however, we kept the set of public available measures constant. The set of available measures has an impact on the characteristics of price, so it will change the optimal weight applied to the measures used in the contract. This section introduces a different setting to test the predicions of agency theroy: a change in the amount of disclosed reports. While the basis for our investigation is information system η_2, we will introduce a change in the set of disclosed measures. Specifically, information system η_3 only discloses the measure of soft information (y_s), keeping both contractible measures private to the firm (y_c and y_f). Table 3.3 provides the optimal weights placed on the two contractible measures and price under η_3.

Table 3.3
Incentive Weights under η_3

$$v_c^{\ddagger} = b\,(m_c\,\sigma_s^2 - m_s\,\rho_c\,\rho_s\,\sigma_x^2)\,\rho_s\,\sigma_x^2\,\sigma_{\mu c}^2\,\sigma_{\mu f}^2\,\Theta\,\Phi^{-1}, \tag{T3.1a}$$

$$v_f^{\ddagger} = b\,m_f\,\rho_s\,\sigma_x^2\,\sigma_{\mu c}^2\,\Theta\,\Phi^{-1}, \tag{T3.1b}$$

$$v_\pi^{\ddagger} = b\,(m_s\,\sigma_c^2 - m_c\,\rho_c\,\rho_s\,\sigma_x^2)\,\sigma_s^2\,\sigma_{\mu c}^2\,\sigma_{\mu f}^2\,\Theta\,\Phi^{-1}, \tag{T3.1c}$$

with $\Theta = (\sigma_{\mu c}^2 + \rho_c^2\,\sigma_x^2)\,(\sigma_{\mu s}^2 + \rho_s^2\,\sigma_x^2) - (\rho_c\,\rho_s\,\sigma_x^2)^2$,

$\Omega = \rho_s\,\sigma_{\mu c}^2\,\sigma_x^2\,(m_c^2\,\sigma_s^2 + m_s^2\,\sigma_c^2 - 2\,m_c\,m_s\,\rho_c\,\rho_s\,\sigma_x^2 + r\,(\sigma_c^2\,\sigma_s^2 - \rho_c^2\,\rho_s^2\,\sigma_x^4))$, and

$\Phi = m_f^2\,\rho_s\,\sigma_x^2\,\sigma_{\mu c}^2\,\Theta + \sigma_{\mu f}^2\,\Omega$.

Note, that the optimal weight on the internal measure y_f is the same under the two information systems η_2 and η_3. Price π and the two contractible measures y_c and y_f provide a sufficient statistic for y_c, y_f, and y_s under both information systems. Hence, the information about the agent's effort choice the principal can derive under the two information system remains constant and, as y_f is not correlated to either price or y_c, its weight is not affected by the disclosure decision. The optimal weights specified in (T2.1a and c) as well as in (T3.1a and c) can be used to derive the following characterization of the weight on y_c relative to price under (i) information system η_2, (ii) information system η_3, and (iii) the difference between these two ratios.

Corollary 5:

(i) The contractual weight of report y_c relative to π under η_2 is given by:

$$v_c^{\dagger}/v_\pi^{\dagger} = \frac{(m_c\rho_s - m_s\rho_c)\sigma_x^2}{(m_s\rho_c - m_c\rho_s)\rho_c\sigma_x^2 + m_s\sigma_{\mu c}^2}. \tag{10a}$$

(ii) The contractual weight of report y_c relative to π under η_3 is given by:

$$v_c^{\ddagger}/v_\pi^{\ddagger} = \frac{(m_c\rho_s - m_s\rho_c)\rho_s\sigma_x^2 + m_c\sigma_{\mu s}^2}{(m_s\rho_c - m_c\rho_s)\rho_c\sigma_x^2 + m_s\sigma_{\mu c}^2}\,\frac{\rho_s\sigma_x^2}{\sigma_s^2}. \tag{10b}$$

(iii) change in relative weights after disclosure of y_c is given by

$$\Delta(\eta_2,\eta_3) \quad = v_c^{\dagger}/v_\pi^{\dagger} - v_c^{\ddagger}/v_\pi^{\ddagger} = \frac{-m_s\rho_c\sigma_x^2}{(m_s\rho_c - m_c\rho_s)\rho_c\sigma_x^2 + m_s\sigma_{\mu c}^2}\frac{\sigma_{\mu s}^2}{\sigma_s^2}. \tag{10c}$$

Note, that the relative incentive weights on the earnings report and price under both information systems are not influenced by the accounting report y_f that remains private to the firm. The existence of this report influences the incentive weights on the other available measures to the same extent, such that it does not influence the ratio of incentive weights. The difference between the relative weight on accounting earnings and price under the two information systems derives from the change in the disclosure regime. While η_2 discloses accounting earnings, η_3 withholds this report. When designing the incentive contract, the principal takes the effect of disclosing the earnings report on price into account which is expressed by the difference of the ratios under the two information systems (10c). The relative weight placed on the published accounting report decreases if it is disclosed and then used to filter out noise from price, i.e., if $m_s/\rho_s > m_c/\rho_c$. Proposition 4 characterizes how the change in relative weights reacts to changes in the noise of the additionally disclosed measure.

Proposition 4: The difference in relative weights placed on non-price measures after and before the disclosure of an additional report increases in the published reports measurement noise.

Note that the result in Proposition 4 is independent of the signal-to-noise ratios of the different available measures (given our assumptions about positive correlation to the terminal value and positive sensitivities to the agent’s effort choice). If our model does describe the underlying drivers of incentive weights in compensation contracts, we would expect that, ceteris paribus, if firms change their disclosure policy (e.g., because of a change in mandatory disclosure requirements) and optimally adjust the contract, the difference in the incentive weights of the disclosed measure relative to price will be higher for firms which disclose measures with higher idiosyncratic noise.

6. Concluding Remarks

In this paper we examined the behavior of optimal relative weights of price and non-price measures in linear incentive contracts. Empirical research is conducted under the prediction that the relative weights are an increasing function of the relative signal-to-noise ratios. Assuming that the sensitivity remains constant, this leads to the hypothesis that the relative weight of a measure decreases in its variance. This prediction is usually developed in a model with two generic measures, where one is interpreted as some accounting performance measure (e.g., accounting earnings) and the other one as the firm's stock price. We show that this prediction does not hold true if the price formatting process in endogenized and one allows for more than one accounting performance measure. Specifically, we find that the contractual weights of and the incentives derived from non-price measures relative to price can increase in the noise of non-price measures.

While empirical studies interpret the increase of relative weights in their noise as evidence that effort incentives are not the primary determinant of contracts, we show that even in a setting without investment project selection problems increasing relative weights can be obtained. The reason for this lies in endogenizing the price formation. Altering the characteristics of a public report impacts the value of price as a performance measure in incentive contracts. Both changes have an effect on the optimal aggregation of all available and contractible measures in the contract. These can finally lead to the explained increase in the relative incentive weights. Furthermore, our results show that one cannot simply assume a constant sensitivity of all performance measures (especially price), if the variance of the measure is changed. We propose an alternative setting to test the agency hypothesis: investigating the change of relative weights with regard to different disclosure regimes. If the idiosyncratic noise of a measure can be identified, the suggested measure provides a non-ambiguous relation between the measurement noise and the change in relative incentive weights. While there is evidence on changes in the pay-performance relation due to greater transparency, future research could investigate effects of increased disclosure on relative incentive weights and relate the findings to agency theory.

APPENDIX A
PROOFS

Corollary 1: Dividing (T1.2a) by (T1.2b) yields (8). ■

Corollary 2: Setting $\rho_c = 0$ in (8) and taking the derivative with regard to $\sigma_{\mu c}{}^2$ yields $\frac{\partial v_c^\dagger / v_\pi^\dagger}{\partial \sigma_{\mu c}^2} = -\frac{m_c \rho_s \sigma_x^2}{m_s \sigma_{\mu c}^2}$. ■

Proposition 1: Taking the derivative of (8) with regard to $\sigma_{\mu c}{}^2$ yields $\frac{\partial v_c^\dagger / v_\pi^\dagger}{\partial \sigma_{\mu c}^2} = \frac{m_s \sigma_x^2 (m_s \rho_c - m_c \rho_s)}{(m_s \sigma_c^2 - m_c \rho_c \rho_s \sigma_x^2)^2}$.

Substituting $m_s/\rho_s > m_c/\rho_c$ proofs the claim. ■

Corollary 3: Dividing the product of (T1.2a) and m_c by the product of (T1.2b) and (T1.1a) and rearranging terms provides

$$\frac{v_c^\dagger m_c}{v_\pi^\dagger m_\pi} = \frac{m_c (m_c \rho_s - m_s \rho_c)\theta}{(m_s \rho_s \sigma_{\mu c}^2 + m_c \rho_c \sigma_{\mu s}^2)(m_s \sigma_c^2 - m_c \rho_c \rho_s \sigma_x^2)} \tag{A.1}$$

Taking the derivative of (9) with regard to $\sigma_{\mu c}{}^2$ and substituting $m_s/\rho_s > m_c/\rho_c$ proofs the claim■

Table 3.2, Panel B: Denote the vector $\mathbf{y}' = (y_c, y_f, \pi)$ such that $\mathbf{y} \sim N(\mathbf{m}\, a, \boldsymbol{\Sigma})$, with $\mathbf{m}' = (m_c, m_f, m_\pi)$ and Covariance matrix $\boldsymbol{\Sigma}$, further denote the vector of incentive weights $\mathbf{v}' = (v_c, v_f, v_\pi)$. Following, the agent's compensation is characterized by

$$w(\mathbf{y}, z) = f + \mathbf{v}'\,\mathbf{y}.$$

Using this notation leads to the follwing characterization of the agent's certainty equivalent

$$\mathrm{CE}(z,a) = f + v_\pi\, \pi_o(\hat{a}) + \mathbf{v}'\mathbf{m}\, a - ½\, a^2 - ½\, r\, \mathbf{v}'\boldsymbol{\Sigma}\,\mathbf{v} \tag{A.2}$$

Differentiating (A.2) with respect to a, and solving the first-order condition for this variable results in following optimal action choice:

$$a^\dagger(\mathbf{v}) = \mathbf{v}'\mathbf{m}. \tag{A.3}$$

Besides the incentive compatibility constraint, the principal also has to take the individual rationality constraint, as specified in (4), into account when she offers contract z to the agent.

The principal chooses z such as to maximize (5) subject to (4) and (A.3). Substituting (A.3) into (A.2), choosing f such that $CE(z,a^{\dagger}) = 0$, and substituting $f^{\dagger}$ and (A.3) into (5) gives the principal's unconstrained decision problem:

$$\Pi(\mathbf{v},\eta_2) = b\,\mathbf{v}'\mathbf{m} - \tfrac{1}{2}\,\mathbf{v}'\mathbf{m}\mathbf{m}'\mathbf{v} - \tfrac{1}{2}\,r\,\mathbf{v}'\boldsymbol{\Sigma}\,\mathbf{v}. \qquad \text{(A.4)}$$

Taking the derivative of (A.4) with respect to **v** and solving for these variables results in

$$\mathbf{v}^{\dagger} = b\,\mathbf{m}\,\mathbf{Q}^{-1}, \qquad \text{(A.5)}$$

with $\mathbf{Q} = \mathbf{m}\mathbf{m}' - r\,\boldsymbol{\Sigma}$.

Subsituting (T1.1a) and (T1.1b) in (A.5) provides the solutions in (T2.1a-c) ■

Corollary 4: Dividing (T2.1a) by (T2.1c) yields (9a), dividing the sum of (T2.1a) and (T2.1b) by (T2.1c) provides the solution in (9b). ■

Proposition 2: Taking the derivative of (9a) with regard to

(i) σ_x^2 yields $\dfrac{\partial v_f^{\dagger}/v_\pi^{\dagger}}{\partial\sigma_{\mu c}^2} = \dfrac{m_f m_s \rho_s}{(m_s\sigma_c^2 - m_c\rho_c\rho_s\sigma_x^2)^2}\,\dfrac{\sigma_{\mu c}^4}{\sigma_{\mu f}^2} > 0.$

(ii) $\sigma_{\mu c}^2$ yields $\dfrac{\partial v_f^{\dagger}/v_\pi^{\dagger}}{\partial\sigma_{\mu c}^2} = \dfrac{m_f\rho_c\rho_s(m_s\rho_c - m_c\rho_s)}{(m_s\sigma_c^2 - m_c\rho_c\rho_s\sigma_x^2)^2}\,\dfrac{\sigma_x^4}{\sigma_{\mu f}^2}$, substituting $m_s/\rho_s > m_c/\rho_c$ proofs the claim.

■

Proposition 3: Taking the derivative of (9b) with regard to $\sigma_{\mu c}^2$ yields

$$\frac{\partial(v_c^{\dagger}m_c + v_f^{\dagger}m_f)/(v_\pi^{\dagger}m_\pi)}{\partial\sigma_{\mu c}^2} = \frac{\rho_s}{m_s\sigma_{\mu f}^2}\left(\frac{(m_s\rho_c - m_c\rho_s)\sigma_x^2(m_f^2\rho_c\rho_s\sigma_x^2 + m_c m_s\sigma_{\mu f}^2)}{(m_s\sigma_{\mu c}^2 + (m_s\rho_c - m_c\rho_s)\rho_c\sigma_x^2)^2} + \frac{m_c\sigma_{\mu s}^2(m_f^2\rho_c\sigma_{\mu s}^2 + (m_s\rho_c - m_c\rho_s)m_s\sigma_{\mu f}^2)}{(m_s\rho_s\sigma_{\mu c}^2 + m_c\rho_c\sigma_{\mu s}^2)^2}\right)$$

substituting $m_s/\rho_s > m_c/\rho_c$ proofs the claim. ■

Corollary 5:

(i) Dividing (T2.1a) by (T2.1c) yields (10a),

(ii) dividing (T3.1a) by (T3.1c) yields (10b), and

(iii) (10c) is given by the difference of (10a) − (10b). ■

Proposition 4: Taking the derivative of (10c) with regard to $\sigma_{\mu c}{}^2$ yields

$$\frac{\partial \Delta(\eta_2,\eta_3)}{\partial \sigma_{\mu c}^2} = \frac{m_s^2 \rho_c \sigma_x^2}{(m_s \sigma_{\mu c}^2 + (m_s \rho_c - m_c \rho_s) \rho_c \sigma_x^2)^2} \frac{\sigma_{\mu s}^2}{\sigma_s^2} > 0.$$ ■

REFERENCES

Baiman, S. (1982) "Agency Rresearch in Managerial Accounting: A Survey," *Journal of Accounting Literature* 1, 154–213.

Baiman, S. and R.E. Verrecchia (1995) "Earnings and Price-based Compensation Contracts in the Presence of Discretionary Trading and Incomplete Contracting," *Journal of Accounting and Economics* 20, 93-121.

Banker, R. and S. Datar (1989) "Sensitivity, Precision, and Linear Aggregation of Signals for Performance Evaluation," *Journal of Accounting Research* 27, 21-39.

Berger, P.G. and R.N. Hann (2007) "Segment Profitability and the Proprietary and Agency Costs of Disclosure," *Accounting Review* 82, 869-906.

Bushman, R. and A. Smith (2001) "Financial Accounting Information and Corporate Governance," *Journal of Accounting & Economics* 32, 237–333.

Core, J.E., W.R. Guay, and R.E. Verrecchia (2003) "Price vs. Non-Price Performance Measures in Optimal CEO Compensation Contracts," *Accounting Review* 78, 957-981.

Feltham, G.A. and M.G.H. Wu (2000) "Public Reports, Information Acquisition by Investors, and Management Incentives," *Review of Accounting Studies* 5, 155–190.

Feltham, G.A. and J. Xie (1994) "Performance Measure Congruity and Diversity in Multi-Task Principal/Agent Relations," *Accounting Review* 69, 429-453.

Hayes, R.M. and S. Schaefer (2000) "Implicit Contracts and the Explanatory Power of Top Executive Compensation for Future Performance," *RAND Journal of Economics* 31, 273-293.

Heinle, M.S and C. Hofmann (2009a) "Soft Information and the Stewardship Value of Accounting Disclosure," *working paper*.

Heinle, M.S and C. Hofmann (2009b) "Transient Institutional Investors, Incentives, and Disclosure," *working paper*.

Ittner, C., D. Larcker, and M. Rajan (1997) "The Choice of Performance Measures in Annual Bonus Contracts," *Accounting Review* 72, 231–255.

Lambert, R.A. (2001) "Contracting Theory and Accounting," *Journal of Accounting and Economics* 32, 3-87.

Lambert, R. and D. Larcker (1987) "An Analysis of the Use of Accounting and Market Measures of Performance in Executive Compensation Contracts," *Journal of Accounting Research* 25, 85–125.

Prendergast, C. (2002) "The Tenuous Tradeoff Between Risk and Incentives," *Journal of Political Economy* 110, 1071–1102.

Verrecchia, R.E. (2001) "Essays on Disclosure," *Journal of Accounting and Economics* 32, 97-180.

Zimmerman, J.L. (2001) "Conjectures Regarding Empirical Managerial Accounting Research," *Journal of Accounting and Economics* 32, 411-427.

CONCLUSION

This thesis investigates the relation between accounting disclosure and the solution to the stewardship problem in corporations. While all essays incorporate managements' compensation contracts, the first two essays study the value of disclosure to different types of current shareholders and the third essay focuses on the relative weighting of price and non-price measures in contracts.

Companies try to address the agency conflict, arising through the delegation of control from shareholders to management, by designing compensation contracts that align managements' interests with those of the firm owners. Empirical research shows that firms' use a variety of performance measures[1], some which are publicly observable and that others remain private to the firm.[2] However, empirical studies also suggest that recent compensation contracts are heavily based on stock price performance.[3] Standardsetters, on the other hand, demand increases in the level of corporate disclosure and also demand access to more forward-looking or "soft" information. Certainly, disclosing more information (weakly) improves the market's efficiency in displaying the value of the firm.

The first essay focuses on the current shareholders' ability to mitigate the stewardship problem and provides results that indicate that disclosing more information can be harmful to firm owners even in the absence of concerns about disclosing proprietary information. The reason lies in the non-contractible nature of information which is impounded into price. If all information could be contracted on, there is no need to use price as a performance measure. When soft information is available this crucially changes. Now, the firm owners' ability to set incentives for their management depends on the information available to capital market

[1] See Ittner/ Larcker/ Rajan (1997).

[2] See Hayes/ Schaefer (2000).

[3] See Core/ Guay/ Verrecchia (2003).

participants and its aggregation into price. Disclosing soft information can lead to a stock price which is less informative about management's action choices and, hence, be harmful to current shareholders. My results suggest that in response to a mandatory disclosure of soft information, firms might reduce their voluntary disclosure of both soft and hard information. This could finally oppose standardsetters' intention and harm the informativeness of price with regard to future cash flows.

The value of accounting disclosure for firm owners could also be affected by investors' potential trading gains in case the information is kept private. Empirical studies provide evidence that a certain group of institutional investors is interested in short-term trading gains. These "transient" investors are characterized by a high portfolio turnover and a short investment horizon. The second essay investigates the value of disclosure from the view of these instiutional investors. I show that they face additional costs when disclosing information by foregoing potential trading gains. This can lead to situations in which information is kept private even though its disclosure would be valuable from a stewardship perspective. The investor faces a trade-off between a more efficient solution to the agency problem and short-term trading profits. The endogenous decision to disclose or withhold information can lead to an inverse relation between market liquidity and the informativeness of stock price with regard to management's actions. More liquidity allows the investor to benefit more from private information which, in turn, increases the cost of disclosure. If the investor's endowment with firm shares is not too high or the report which is to be disclosed does not sufficiently improve managment's incentives, the investor prefers the information to remain private. This result suggests that empirical studies, testing the relation between pay-for-performance sensitivity and the liquidity of capital markets, should control for the composition of a firm's investor base.

Empirical studies that test agency-theoretic predictions usually derive the hypotheses from highly stylized models. One central prediction is that the relative weights assigned to two measures in a compensation contract are a function of the measures' relative "signal-to-noise" ratios. While the sensitivity of a measure with regard to management's actions is unobservable, the noise can be proxied by the variance of observable measures. A common test is whether the relative weights assigned to accounting measures and stock price behave as predicted by agency theory. Current studies show, however, that the relative weights can increase in their respective noise. The third essay focuses on this prediction. Allowing for the facts that stock price is rationally determined on capital markets and that companies use both publicly observable and private measures in compensation contracts, I show that, under realistic situations, the weight on non-price measures can increase in proxies for their noise. The sign of the change depends on the sensitivity of the different measures with regard to management's actions. Even allowing for measures that are uncorrelated to stock price and investigating the relative incentives stemming from price and non-price measures provides this result. I suggest a different setting to empirically test whether compensation contracts behave accordingly to agency theory: the relative weights assigned to price and non-price measures before and after a change in corporate disclosure. Here, I derive an expression which provides a non-ambiguous relation between the noise in disclosed accounting reports and the difference in relative weights.

Summarizing, my results indicate that the different interests current and potential shareholders have leads to far reaching impacts of the disclosure of accounting information. The simple statement that more information is always better does not hold and changes of mandatory disclosure can lead to losses for different types of current investors as well as for potential investors.

References

Ittner, C., D. Larcker, and M. Rajan (1997) "The choice of performance measures in annual bonus contracts," *Accounting Review* 72, 231–255.

Hayes, R.M. and S. Schaefer (2000) "Implicit Contracts and the Explanatory Power of Top Executive Compensation for Future Performance," *RAND Journal of Economics* 31, 273-293.

Core, J.E., W.R. Guay, and R.E. Verrecchia (2003) "Price vs. Non-Price Performance Measures in Optimal CEO Compensation Contracts," *Accounting Review* 78, 957-981.

MIRKO STANISLAV HEINLE

The Wharton School, University of Pennsylvania
3620 Locust Walk
Philadelphia, PA 19104
Mobile: +1 925 – 360 8292
E-mail: miheinle@wharton.upenn.edu

EDUCATION

University of Mannheim, Germany
August 2007 – October 2009
Degree: Dr.rer.pol.
Title of the Thesis: Essays on Accounting Disclosure and the Use of Stock Price in Incentive Contracts
Advisor: Prof. Dr. Christian Hofmann

University of Tubingen, Germany
October 2005 – July 2007
Doctoral Studies at the Graduate School for Economics and Management

University of Hanover, Germany
October 2000 – April 2005
Degree: Diplom-Oekonom
Major: Business Administration and Economics

PROFESSIONAL EXPERIENCE

University of Pennsylvania, USA
January 2009 – July 2010
Visiting Lecturer

University of Mannheim, Germany
August 2007 – December 2008
Research & Teaching Assistant

University of Tubingen, Germany
Spring 2006 and Spring 2007
Teaching Assistant

University of Hannover, Germany
Fall 2001
Teaching Assistant

PUBLICATIONS

"Agencytheoretische Ansätze im Managerial Accounting und ihre Anwendung im Supply Chain Management" with Christian Hofmann, in *Zeitschrift für Betriebswirtschaft*

"Soft-Information and the Stewardship Value of Accounting Disclosure" with Christian Hofmann, in *Operations Research Spectrum*