To Tell or Not to Tell:
Essays on Corporate Financial Disclosure

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

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1 Introduction

To tell or not to tell: that is the question.

Though not essentially a question about life or death as its original version is for the hero protagonist Hamlet in the famous tragedy (Shakespeare, 2010, Act III, Scene I), this core question forms the point of departure for research of the corporate financial disclosure. The research area has attracted a significant amount of attention from the accounting research community already since the 1980's. Indeed, the financial disclosure is regarded as crucial for a functioning modern capital market. Healy and Palepu (2001) proposes in their review article that financial disclosure crucial to help to solve two problems within one economy:

1) the information asymmetry between entrepreneurs, current investors, incumbent management and potential investors

2) the agency problem between the management as corporate insiders and external investors.

Analogously, a more recent summary survey on financial reporting environment by Beyer et al. (2010) also suggests that accounting information, the very information subject to disclosure, plays two important roles in market-based economies. The authors name these two roles as

1) "the ex-ante or valuation role", which addresses the above-mentioned information asymmetry problem

2) "the ex-post or stewardship role", which addresses the agency problem respectively

The information asymmetry problem arises, as the name suggests, from the different level of information the corporate insider and the external investor possess. The disclosure, of course, helps to ease this problem by communicating the private information from one party to the other, leveling the playing field. The "lemon problem", as named in Akerlof (1970) suggests that the information asymmetry can potentially lead to the break-down of a functioning market if left unaddressed. Healy and Palepu (2001) mention three possible solutions to address the problem: a) optimal contracting to incentivize full-disclosure; b) regulation to mandate full-disclosure; or c) utilizing financial intermediaries to facilitate private information production.

The agency problem arises from the misalignment of the interests of active management and investors due to separation of control (e.g., Jensen and Meckling, 1976; Fama, 1980). As outside investors usually don't take an active management role in the corporation, the management could behave so to solely serve its own interests neglecting any possible harm to those of the investors. Similarly an entrepreneurial-manager could also harm the interests of debt investors by increasing the risk-taking of the corporation. Optimal contracting to align the interests of the parties is identified as one of the solutions to this problem. The contracting itself, however, frequently requires disclosure of information to allow monitoring of the compliance.

The three essays in this dissertation focus on the first function of disclosure. They explore different aspects of corporate financial disclosure in its function of reducing information asymmetry suggested by Healy and Palepu (2001). These include:

- Conditions and incentives that drive voluntary corporate disclosure, especially the role of information quality in the voluntary disclosure decision.

- Different dimensions of disclosure and disclosure decisions (e.g., selection of communication medium, complexity of the language used) and the interdependency of the disclosure dimensions regarding the decision making of corporate voluntary disclosure.

- The formation of collective preference towards and its possible impact on mandatory disclosure regulation.

- The impact of enforcement as possible explanation for empirically observed clusters in regulation regimes in different economies.

The research methods utilized in this dissertation include both the theoretical and the empirical approach. On the one hand, I employ the method of game theoretical modeling to illustrate possible decision making processes regarding voluntary disclosure and the formation of collective preference towards mandatory disclosure regulation regimes in essays in Chapter 2 and 4 respectively. On the other hand, I draw conclusions based on empirical observations regarding the actual corporate disclosure behavior with regards to different dimensions of disclosure and the corresponding different discretion over decisions.

I start with an essay addressing the questions "would corporate insiders voluntarily disclose information and under what conditions would they do so?" The adverse selection effect in a situation of information asymmetry would induce good individuals on the market to separate from the bad by voluntarily revealing information. As already discussed in Akerlof (1970) in the context of economics, and more specificity in the context of disclosure in Grossman and Hart (1980), Grossman (1981) and Milgrom (1981), this separation mechanism would lead to "market-wide" full disclosure – the so called "unraveling principle". The idea implies that, despite the initial information asymmetry, the party in possession of private information will eventually disclose it and the problem of information asymmetry is then resolved.

Since the suggestion of "unraveling principle", a wide range of literature has evolved to establish possible conditions under which the "unraveling principle" is not fulfilled and therefore the withholding of private information can be expected. These conditions include

a) the existence of costs for disclosure (e.g., Verrecchia, 1983, 1990; Richardson, 2001; Jorgensen and Kirschenheiter, 2003)

b) the uncertainty over the endowment of private information (e.g., Dye, 1985; Jung and Kwon, 1988; Penno, 1997; Pae, 2005); or the amount of private information that can be disclosed each individually or in aggregation (Ebert et al., 2014)

c) the credibility (or lack of credibility) of the disclosure (e.g., Hughes, 1986; Newman and Sansing, 1993; Gigler, 1994)

d) the different interpretation of the signal (e.g., Dye, 1998; Fishman and Hagerty, 2003)

e) the unknown response of investors to disclosure (e.g., Suijs, 2007; Ebert and Schneider, 2014)

f) the uncertainty in management's disclosure incentives (e.g., Einhorn, 2007)

In most of these studies, a management with intention to maximize the corporate valuation faces the question whether to disclose a piece of information to an external investor with rational expectations.

In the case of existence of disclosure costs, investors rationally interpret the lack of information disclosure as a signal of possession of bad information and adjust the firm's valuation downwards accordingly. The management, however, trade-off between the adverse effect on a firm's valuation in the event of non-disclosure with the costs the firm may incur in case of disclosure. The results are the partial disclosure situation where firms with bad news worse than a certain threshold choose to withhold information and profit from avoidance of disclosure costs.

In the case of uncertainty about information endowment, the management lacks a method to credibly communicate the non-endowment of information. Firms that do receive negative information have the possibility to imitate the non-endowing firms by withholding information. Since external investors cannot distinguish the two possibilities when they observe a firm that does not reveal private information, they form an average valuation considering both possibilities. Such an average pricing thus creates an incentive for those firms with bad news to remain silent and profit from the mixed-pricing valuation.

The studies addressing the credibility of disclosure emphasize the fact if the disclosure is not seen as credible by investors (i.e. the management has the probability of disclosing false information), then the informational content of the disclosure can be strongly discounted – possibly to the extent that disclosure or withholding information is not seen as different signals by the investors. In general, the relevant analytical research can be classified into one of the two types (Beyer et al., 2010): 1) research utilizing cheap-talk models and 2) research utilizing costly state falsification models. Both types of models take the assumption that the management can produce untruthful disclosure. The differentiating factors between the two are the difference in the cost for such mis-representation. While cheap talk models assume a cost-free mis-presentation, costly state falsification models generally assume a positive cost for untruthful disclosure. Under the assumption that the management can produce false disclosure at no cost, the investor would completely discount the informational content of such disclosure and make no distinction between disclosure and non-disclosure. In response, the management might as well choose to remain silent since disclosure does not make any difference to the investors anyway (e.g., Stocken, 2000). If there is a positive cost for the management to disclose untruthfully, the management may trades-off from the benefits from a untruthful disclosure with information better than it actually possesses against the potential costs for such a mis-representation. A partial-disclosure can thus be reached from such a trade-off (e.g., Einhorn and Ziv, 2012).

Research focusing on the "different interpretation of the signal" or an "unknown response to disclosure" both rely on the uncertainty how investors would react to a piece of disclosed information – namely the management cannot be certain whether the disclosed information would be interpreted as good news or bad news and how the investor would interpret non-disclosure. Therefore the management would weigh up the options. Either 1) disclosure of the information with the probability, that the information is regarded as bad or 2) withhold the information, which may be interpreted as possessing bad information. This trade-off causes non-disclosure in certain circumstances.

Most research discussed above typically assumes that the management seeks to maximize the firm's value when deciding on their disclosure behavior and that the investors also hold the correct view on the management's desire for share-price maximization. However, extant literature has demonstrated this is not always necessarily the case. For example, Aboody and Kasznik (2000) have demonstrated that the management has incentives to lower the stock price prior to their receiving stock options as a variable compensation. Evidence suggests they accelerate the disclosure of bad news and hold back the disclosure of good news in such a situation. In addition, the existence of different audiences for the market could also lead to management having incentives to hide good news and disclosing bad news. For example, if the management can not disclose its private information to the investors without preventing potential competitors observing the same disclosure, then it would have to consider the negative impact of luring in potential competition by disclosing good news. Depending on the strength of the potential competition, the management may well have an incentive to hide good news instead of bad news. If the investors are uncertain in which direction the management intends to manipulate the firm value by disclosure behavior, managers with one disclosure intention may seek to pool with managers with disclosure incentives in the opposite direction (Einhorn, 2007).

The first essay in Chapter 2 extends the discussion regarding conditions under which the unraveling principle does not apply. As a further extension to the model proposed by Dye (1985), the essay introduces the quality of the information, i.e. the reliability of such information to forecast the future firm value, as a second piece of disclosable information. In addition to the uncertainty of information endowment, the model also includes the uncertainty of information quality as a second variable. The model results illustrate two opposing effects of information quality on management's disclosure decisions. While firms with high information quality tend to be more reluctant in disclosing bad news, an increase of the overall level of information quality in the economy would actually facilitate the disclosure of bad news.

The research on conditions for voluntary full disclosure (or the conditions for which the

full disclosure does not occur) indicates that individuals manage their disclosure behavior by trading off any benefits with the costs of the disclosure.

However, in reality, the decision that management faces is more complicated than a single "disclose or withhold" decision. In fact, multiple decisions need to be made, once the management decide to disclose a specific piece of information. These include:

1. the precision of the information: the management can disclose the information as accurately as it can or it may choose to disclose the information in a less precise manner. For example, the management may announce the estimate of expected revenue growth (provided the information is internally available to the management) or it can just disclose a range or even only a trend of the prognosis.

2. the timeliness of the disclosure: the management can decide whether to disclose the information once it's available (e.g. in an ad-hoc disclosure) or wait and disclose the information later (e.g. within a quarterly financial report).

3. the communication channel: traditionally, one may naturally think of annual (and quarterly) reports as the medium through which the management communicates information to the investors. However these reports are only one example of the ways in which information can be disseminated today. In fact, nowadays, a management may use many other ways of communication as well. Some examples include analyst conferences / calls, press conferences and press releases, other forms of voluntary reports, e.g. sustainability report, and more recently the social media[1], such as Twitter for information dissemination (Blankespoor et al., 2014).

4. the readability of textual information (if the disclosure is made in a textual format): if the communication of information is done in textual form, the management can also choose how the text is drafted. To convey the same information it may write

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[1]Saxton (2012) provides a critical review about the research on the use of new media for external accounting information.

the text simply and concisely and make it easily understandable or it may also use long complex expressions to obstruct a reader's understanding.

5. the sentiment of textual information: the sentiment of a text is another linguistic characteristic the management can use to influence any communication. It describes the polarity of the wording in the text. For example, to communicate the information that the sales level is unchanged compared to last quarter. The management may chose to use the expression: "fail to grow" which is more negative than the expression "remain stable".

These dimensions illustrate the complexity of the disclosure decisions why any management faces. One may wonder if these decision dimensions are indeed utilized by management and if so, what impacts do differences in each of these dimensions may have and what are the incentives for the management actually to utilize these dimensions strategically. Extant literature provides quite some evidences that these dimensions have impacts on decision-relevant factors such as litigation risks and cost of capital. Therefore any management also has incentives to consider all these factors strategically in their disclosure decisions.

Researchers hypothesize that the management takes the litigation risks into consideration when deciding on the precision of their forward looking disclosures, e.g. earnings forecast. When facing higher litigation risks, management are thought to give less precise information to reduce the risk of being sued for providing false information. Skinner (1994) and Baginski and Hassel (1997), for example, provide evidence that firms tend to release less precise earnings forecasts when they have poor performance. Since firms are more likely to be sued following a performance drop and the associated drop in stock price, these studies provide indirect evidence linking the litigation risks to management's specific decision regarding disclosure precision. In addition, Baginski et al. (2002) also provide evidence that Canadian firms, operating under a legal environment with less litigation risks compared to U.S. firms, provide more precise forecasts both in bad news periods and in good news pe-

riods. This research demonstrates strong evidence that managers do decide strategically on disclosure precision, taking account of any potential litigation risks.

Regarding the timeliness of the disclosure, extant research also provides evidence linking it to the litigation risks and litigation costs. Skinner (1997) investigates the relationship between the timeliness of adverse earning news disclosure with the probability of investor lawsuits and with the costs, i.e. settlement amount, resulting from such litigations. His findings suggest that though timely disclosure is not directly linked to a reduction of lawsuit probability, it does reduce the litigation costs. In addition, theoretical research suggests that timely disclosure helps to decrease the information asymmetry between the corporate insider and the capital markets. Thus a more timely disclosure could help a company benefit from a lower cost of capital. Empirical evidence regarding this effect is mixed. Botosan and Plumlee (2002) examine the relationship between the cost of equity capital and diverse disclosure characteristics. They find, among others, that a timely disclosure is associated with a higher cost of equity capital. They argue, these results can be due to the increased volatility of stock price due to elevated level of short-term trading on timely disclosed information. Gietzmann and Ireland (2005), however, find a negative association between the costs of capital and the timeliness of disclosure after controlling for the accounting policy of the sample firms. Given the correlation between the timeliness of disclosure, the litigation risks and the cost of capital, any management should have an interest to manage this disclosure dimension actively.

To communicate the information to investors or other stakeholders, the management has multiple channels available. Depending on the properties of the communication channels, the management also makes an implicit decision regarding the target audience group, the timeliness of the disclosure and the credibility of the information. For example, prior to the Regulation Fair Disclosure (Reg FD), information disclosed on the analyst earnings calls, was typically either impossible or difficult for smaller investors to access. Through the enactment of Reg FD in 2000, such selective disclosure is now strongly limited. Still, through the use of different information media, the management may

also implicitly influence the timeliness of the disclosure. Compared with the annual or quarterly financial reports which are published only once or four times a year, the press release, for example, can be made available at a much higher frequency. This means that the management has a better way to disclose information it wishes to communicate to the public in a timely fashion. In addition, compared to a single press release, the annual report typically has a larger scope of content and contains financial statements which need to be audited by an external auditor. These factors result in a long delay between the fiscal year end and the date of publication of the respective annual report, making the disclosure even less timely. On the other hand, information published as a part of financial statement in an annual report could be seen as more credible compared with information published using other channels due to the required audit by an independent auditor[2].

If the information is disclosed in textual form, the complexity of the text may also be used to influence the communication and the reception of such information. The Incomplete Revelation Hypothesis (Bloomfield, 2002, p. 234) suggests that an information recipient weighs up between the costs of extracting information from data and the potential benefits of such data. The more complex the text is, the higher effort, thus the higher costs, the individual will need to exert to extract the information the text conveys. Hence the complexity of the text and the poor comprehension may deter the effective communication and reception of the underlying information. In addition, research also indicates that easily understood text improves investors' perception of and their reliance on the underlying information itself (Rennekamp, 2012). Research in psychology suggests that the so called processing fluency will positively influence information recipients' belief that they can rely on such information for decision making (Shah and Oppenheimer, 2007). Given the effects that easily comprehensible text has on the cognition of information, the management may choose to manipulate the readability of textual disclosure strategically. A possible example of such a concept would be in the disclosure of negative information.

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[2]Mercer (2004) suggests, for example, that the levels of external and internal assurance is one of the factors that influence how investors assess the credibility of management disclosures.

One may hypothesize that the management may choose to disclose such information so as to reduce possible litigation risks but at the same time increase the complexity of the text so as to reduce the negative impacts of such information on investors' perception and thus the share-price.

Similar to the text readability, the sentiment of the textual information may also have an impact on the reception of the information conveyed by the text. Extant literature provides evidence that the sentiment of textual disclosure, e.g. president's letter, analyst report, Management Discussion and Analysis (MD&A) in the annual report, has effects on expected returns (e.g., Abrahamson and Amir, 1996; Davis et al., 2012; Twedt and Rees, 2012). Given these influences, the management may also strategically use the sentiment of the textual information along with other disclosure dimensions to influence investors' perception of communicated information.

It is to be noted that these possible decisions on the disclosure dimensions are conditional on the decision of disclosing the information. However, existing disclosure regulation may impede the discretion the management has when making the decisions regarding the disclosure of a specific piece of information. In particular, disclosure regulation exists which mandates the disclosure of specific information. Current regulation typically put emphasis on the fact that the information is disclosed in a timely and not misleading manner. For example, the Securities Exchange Act of 1934 requires an "ad-hoc" disclosure by filing Form 8-K if certain defined triggering events occur. It also obligates the firms to make the disclosure within four business days after the occurrence of such events[3]. Similarly, the German Securities Trading Act, Wertpapierhandelsgesetz (WpHG), stipulates in Section 15 for domestic issuers of financial instruments must, without undue delay, publish all inside information which directly concerns that issuer. The WpHG defines the inside information as any specific information about circumstances which are not public knowledge, which would be likely to have a significant effect on the stock exchange or market price of the insider security, should the information become publicly known.

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[3]Disclosure with aims to satisfy Reg FD requirement is subject to more stricter time-line requirement.

However, the regulation typically leaves larger discretion to the management as to how the actual text passage should be written when making such a disclosure. Thus, when facing regulatory requirements to disclose certain information, management may have even stronger incentives to utilize other less regulated dimensions to better manage the impact of such mandatory disclosure.

Previous research mostly looked into the individual disclosure dimensions separately. But as illustrated above, management may well make a holistic decision on how it uses the disclosure dimensions based on the potential impact of the underlying information and on the discretion it has regarding each dimension. The second essay in Chapter 3 explores just this interdependence between the disclosure dimensions. In particular, it aims to investigate the management disclosure decisions especially with regards to increasingly negative information in periods of financial distress. It also aims to provide empirical evidence on how the management utilizes the dimension "textual readability" and "sentiment" conditional on the discretion they have regarding the "disclose vs. withhold" decision on a specific piece of information. When facing a certain piece of information, the management may firstly need to understand if it is obliged to disclose such information in a timely fashion due to legal requirement. If such information falls into the scope of mandatory disclosure, the management may need to use the textual readability and sentiment more intensively as an alternative to manage the impact of such information compared with a piece of information that is voluntarily disclosed by management. In the latter case, the management already has the discretion to withhold such information but nevertheless chooses to disclose such information. In this case, the management may also see less incentive to cloud the news actively by employing overly complex text or to sugarcoat the news with more positive sentiment as it already has the possibility to withhold the information altogether.

The essay provides some empirical evidence supporting the hypothesis that management strategically uses the available discretion they have to smooth "the disclosure of negative information" over a long period of time, possibly avoiding concentrated burst of negative

news as the financial performance declines. Contrary to the disclose vs. withhold decision itself, evidence suggests that the management does not consistently utilize disclosure sentiment to sugarcoat negative information. On average, firms with elevated degree of financial distress also have more negative sentiment in the disclosure. It also suggests that the management uses different textual sentiment for different subject matters. Disclosure on subject matters under mandatory disclosure regulations is surprisingly more negatively phrased compared to those which are made largely voluntarily by nature. This suggests that managements appear to be more concerned about litigation risk mitigation than immediate negative capital market impact caused by negatively perceived information. In contrast to the sentiment, there was only weak and inconsistent evidence suggesting a strategic use of readability to hinder the comprehension of bad news. Also the sample produced no evidence that the management strategically uses the readability to compensate their lack of discretion for disclosure with topics within the scope of voluntary disclosure. All in all, the results provide a mixed picture on management's disclosure behavior as a multi-dimensional decision. On the one hand, it provides evidence that the management shapes different disclosure dimensions differently, e.g. smoothing out the number of disclosures for negative news whilst being more forthcoming on the sentiment dimension, possibly to address different concerns, i.e. negative capital market reactions for concentrated bad news disclosure vs. increasing litigation risks for over-optimistic statements. However, little evidence emerged that would support the initial hypothesis that the management uses its larger discretion on qualitative disclosure dimensions to compensate its lack thereof in the actual disclosure vs withhold decision for certain subject matters.

As already discussed above, limits exist for management's disclosure decisions. The legal requirements on disclosure constitute such a significant limit. In fact, it is undisputed that regulations on disclosure exist in major economies around the world. Despite the existence of such regulations, it is not automatically obvious why a mandatory disclosure is necessary. As suggested by the literature studying the incentives for (or against) voluntary disclosure, management trades off the benefits against the disadvantages from the disclosure and choose the best level of voluntary disclosure accordingly.

Hence, a large volume of extant literature exists around the question which can justify the existence of disclosure regulation. That is what can be achieved by mandatory disclosure which cannot be achieved with a lack of the regulation or can only be achieved less efficiently, e.g. with more costs in total. One might argue, the aggregated individual choices of voluntary disclosure is not socially optimal. Watts and Zimmerman (1986) argue, for example, the accounting information has the characteristics of public goods. The production of such information has positive externalities as it can not only benefit existing stockholders but can also be used by potential investors as well. Left without regulation, the voluntary disclosure could lead to a lower disclosure level than socially desirable (e.g. Dye, 1990; Admati and Pfleiderer, 2000). Also, other scholars (e.g. Fishman and Hagerty, 1989) argue financial disclosure could also create negative externalities. In addition, as Leuz (2010) states, the socially optimal level of disclosure is likely to be context and firm-specific and depends on the goal of reporting regulation. Together with the possible existence of both positive and negative externalities, it is hard to rationalize why a regulation on disclosure could yield socially better results than voluntary disclosure. Hence it is difficult to justify the existence of mandatory disclosure regulation solely using the argument of externalities.

A second argument prior research puts forward is that the regulation on mandatory disclosure could help management to commit to a desired disclosure level. This is particularly the case when investors need to make a decision prior to the actual disclosure of information or when management has the possibility to revise their decision on information disclosure after the investors have made their investment decisions. In both cases, if management cannot creditably commit to a certain disclosure level ex ante, investors would take consideration of the possible adverse behavior of the management by means of price protection. Private contracting could help to ease the problem. However, compared with a mandatory disclosure regime, it has two disadvantages. First of all, private contracting is only limited to monetary penalty in case of breach of contract. The maximum possible penalty is thus subject to the wealth of the contracting parties (Shavell, 1986).

Another argument the extant literature provides is that the regulation provides cost savings by providing a standardized form of disclosure. If firms all have similar forms of information for disclosure, the standardization can help to facilitate the understanding of the information and make the cross-firm comparison easier (Leuz, 2010). In addition, a standardization may help to reduce the costs firms otherwise would have to incur individually for negotiating the disclosure with various parties.

In addition, prior research also argues that disclosure regulation may help to mitigate the principle-agent problem and the related dead weight loss due to consumption of private benefits by management (Leuz, 2010). If such private rent seeking activities are costly, then social losses are related to such behavior (Shleifer and Wolfenzon, 2002). By establishing a mandatory disclosure regulation, the increased transparency might help the company owners to better contract with and monitor the management, which in term will reduce the social losses due to private rent seeking by the management.

Given the arguments discussed above, one might reach conclusion that the regulation is indeed necessary. Under this assumption, the question about how the optimal regulation can be designed should arise naturally. This leads to a series of questions about regulation choices that need to be answered to design a specific regulation. For example, what and how much information should fall into the scope of mandatory disclosure? Who should regulate the disclosure? How much discretion should the management have? How timely does the disclosure need to be? How is the enforcement mechanism to be designed so as to ensure firms adhere to the regulation? The combination of these regulation choices forms the characteristics of a certain regulation regime. Thus, a large amount of accounting research has been dedicated to the question of finding optimal regulation choices [4]. Parallel to the theoretical search for the optimal design, empirical observations (Leuz, 2010; La Porta et al., 2006) suggests that quite different disclosure regulation regimes exist across different economies and countries. In addition, certain patterns in regulation choices can also be observed among the different economies. Leuz et al. (2003) and Leuz

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[4]See Leuz (2010) for a discussion regarding extant literature about different regulation choices.

(2010) divide over 40 countries into three clusters: one cluster of countries have outsider economies with high levels of disclosure regulation and strong enforcement institutions and the other two clusters of countries have insider economies with less disclosure and less strong legal enforcement.

From these empirical observations, questions arise on

1) how such different regulation regimes came to existence?

2) how are such regulation regimes formed so that they exhibit such differences between clusters as well as similarities within the clusters?

Extant researches offer several possible explanations such as legal origin, cultural and geographical regions (Malmendier, 2009) as well as the existence of regulatory complementarity (Leuz, 2010) which explains the existence of particular characteristics of regulation choices to be observed together in an economy. However, to date, there has been no extensive research on what factors drive a country to choose one specific set of regulation characteristics over another set. Nor is there a comprehensive understanding on how such regulation choices are formed in an economy (Leuz, 2010).

The third essay in chapter 4 explores just this aspect and discusses a possible process for the formation of a collective preference towards a certain mandatory disclosure regulation. Compared to previous literature in this line of research (e.g. Bertomeu and Magee, 2014b; Bertomeu and Cheynel, 2013), it explicitly models the influence of an *imperfect* enforcement regime as an institutional parameter on the formation of collective preference and the resulting implicit level of transparency that would be preferred collectively.

The main results from the essay are threefold. Firstly, it showcases the alignment function of an imperfect enforcement during the formation of collective preferences of the firms. Contrary to the intuitive view that high quality and low quality firms would favor different levels of strict mandatory regulation, the imperfect enforcement actually leads to an aligned preference for those two groups towards the same level of regulation, when

the potential penalty from non-compliance is not high enough. Secondly, the alignment function of enforcement seems to be stable even in a setting with disclosure costs, enforcement penalty and mandatory disclosure. Thirdly, in addition to this alignment function, a positive relationship exists between the enforcement strength and the collectively preferred level of regulation. Also, the implicit overall transparency based on the collectively preferred regulation level also increases when the enforcement strength increases. The result provides a possible explanation for the empirical observation that economies with more stringent disclosure regulation also tend to have stronger legal enforcement in places. (Leuz et al., 2003; Leuz, 2010).

The remainder of the dissertation is structured as following. Chapter 2, 3 and 4 present the three essays each with a detailed introduction and literature review on the relevant fields of research, the research method and the results. Chapter 5 then provides an overall summary of all the research results and how they are related to each other within the scope of financial disclosure research, thus, concluding the dissertation.

2 Essay on conditions for voluntary disclosure: impact of information quality[5] [6]

2.1 Introduction

Early research on voluntary disclosure suggested that the adverse selection effect due to the information asymmetry would lead to full disclosure. In particular, this idea was formalized under the "unraveling principle" by early work of e.g., Grossman and Hart (1980), Grossman (1981) and Milgrom (1981). Since then analytical research has been trying to identify incentives that obviate full disclosure as casual empiricism suggests that firms do withhold some information (Verrecchia, 2004).

Several major drivers for not reaching full disclosure have since then been identified.[7] One of such major drivers was identified by Verrecchia (1983) as the proprietary costs – costs which the management incurred when disclosing its private information. Subsequently, multiple works expended the model or suggested alternatives to cover extensions such as variable proprietary costs (e.g., Richardson, 2001), costly and cost-free disclosure (e.g., Dye, 1986) or multiple costly disclosable signals (e.g., Kirschenheiter, 1997; Pae, 2005). A second explanation can be found in the heterogeneous investors on the market. Different

[7]See the reviews from Beyer et al. (2010), Verrecchia (2001) and Dye (2001) for a detailed overview.

types of investors may interpret non-disclosure differently, resulting in a non-disclosure equilibrium (e.g., Dye, 1998). A third alternative theory sees the uncertainty about the endowment of disclosable non-proprietary forward looking information as the driver of non-disclosure. Firstly suggested by Dye (1985), this proposition was also subsequently deepened and expanded by other researchers (e.g., Jung and Kwon, 1988).

Following this line of research, this essay presents a further extension of research focusing on uncertainty of information endowment as a factor hindering full disclosure. It extends the prior work by introduction of the additional uncertainty of quality of endowed information. It aims to demonstrate the effect for information quality on the incentives for the voluntary disclosure. The paper demonstrates a pooling equilibrium within a setting where it is publicly known that there are two types of firms on the market with different information quality regarding a private signal indicating future firm value. While the prior distribution of the information quality type among the firms is known, the investor cannot directly observe the type of a specific firm. The management is assumed to have a discretion on whether to disclose its private information. However, it is bonded by telling the true information should it decide to reveal the information. In the model setting, the management has the choice not only to disclose a privately observed signal about future firm value but also to choose whether to disclose its own quality of information. It can be shown by means of a game theoretic analysis that both types of firms would have incentives to take advantage of investor's uncertainty regarding information quality (by withholding information regarding precision type) to mask bad news regarding future firm value.

Similar to this essay, the work by Hughes and Pae (2004) also modeled "information quality" as a piece of disclosable private information. However different to their work, this essay models the signal regarding future firm value as a separate piece of information in addition, while Hughes and Pae assumed it to be publicly known.

Penno (1996) also had a focus on the information quality in his paper. His work mainly focused on management's ex ante choice of signal precision of a second public signal

conditional on a first public signal, where the signal precision remained undisclosed at all time. The model proposed in this paper, however, focuses rather on the disclosure decision of such signal precision in conjunction with the disclosure decision of the signal itself. The management does not have an endogenous choice of precision level in this model. This corresponds to a setting where a long-term decision regarding the sophistication of firm's internal information acquisition system and prognostication technology (and hence the forecast they generate) was already made previously and the management only has the choice of disclosing the precision without any mean to influence the precision in short term.

The results of this model suggest some interesting implications regarding the impacts of information quality on management's choice on voluntary disclosure. It shows, a high information quality can have both positive and negative impacts on disclosure. On the positive side, an increase of the prior probability of the firm type with a higher information quality in the overall population reduces the disclosure thresholds and facilitates disclosure. On the negative side, however, firm type with a higher information quality has a higher disclosure threshold compared with firm type with a lower information quality. Thus, firms with higher information quality are more prone to withhold less severe bad news compared to firms with lower information quality.

The remainder of this essay is organized as following: Section 2.2 illustrates the basic model setup. Section 2.3 describes the equilibrium followed by some corollaries derived from the equilibrium. In Section 2.4, I derive some corollaries from the model by means of comparative statistics. The last section concludes the essay by summarizing the findings of the essay. It also highlights the essay's implication for disclosure regulation and draw a possible research question for further empirical tests.

2.2 Model setup

2.2.1 Basic settings

The basic setting of the model is similar to that proposed in Verrecchia (1983) which utilized a setting where an investor seeks to acquire a firm. Prior to the acquisition, the management observes a private noisy signal regarding the firm's going concern value with a certain probability. In case the management does observe such a signal, it has discretion regarding disclosure (or non-disclosure) of such signal. The investor updates his expectation of firm's going concern value based on management's disclosure behavior and the signal, should it be disclosed, and price the firm at his updated expectation of firm's going concern value. Consistent with the Verrecchia model, it is assumed that the management's interest is perfectly aligned with the current shareholders' interests by means of a proper incentive compatible compensation contract. Hence the management would choose the disclosure policy so as to maximize the transaction price. In addition, it is also assumed that a high quality auditing service is in place to assure that the management would only tell the true signal and signal precision, should it decide to disclose the relevant information.[8] Contrary to the Verrecchia model, there is no disclosure related costs modeled in this paper. This means, the investor prices the firm at its updated expected going concern value no matter if a disclosure has occurred. In addition, the model in this paper explicitly allows differentiation of information quality by introducing two firm types with different signal precision.

Next I'll provide a detailed description of the model setting as well as some comments on how the model setting can be interpreted empirically.

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[8]The truth-telling condition is realistic in respect of the situation for voluntary forward looking disclosure. While a disclosure is not mandated, deliberately releasing false information could lead to negative legal consequences for the management. In addition, if such information is released in scope of an audited financial report, a high quality auditing service could also hinder the deliberate wrongful reporting to some degree.

2.2.2 Model details

An investor seeks to acquire a firm engaging in risky projects. He values the firm based on the expected going concern value U at the time of acquisition. It is public knowledge that the random variable U follows a normal distribution with

$$U \sim \mathcal{N}(\theta, h^{-1}), \tag{2.1}$$

with $\theta \in \Re$ and $h > 0$. That is, θ is the mean and h is the precision of the normal distribution. The true realization of the going concern value U is unknown and unobservable to anyone prior to the acquisition. This setting resembles cases when the projects the firms engage in have a long time horizon for a uncertain return to materialize. The results of such projects would have material impact on the going concern value of the firm. However, if the transaction takes place before the investment horizon, the true going concern value is not available at time of transaction.

Prior to the acquisition and the valuation decision by investors, with a certain probability the management privately observes a signal on the firm's value. The management receives the private information not for certain, as this is dependent on how the firm acquires and generates usable information for forecast the successfulness of the projects. Real life examples reflecting such a setting are e.g. how well a firm acquires market intelligence and assesses the potential reception of its own products on the future market. In the most extreme case, a company with a dysfunctional marketing function may only produce rudimentary market intelligence and thus providing no useful private information to the management at all.

The random variable R is a state variable regarding the endowment of such private information by the management. When $R = 0$, the management does not receive such private information. When $R = 1$, the management then receives such a piece of private

information. The variable R follows a Bernoulli distribution, defined as

$$
R = \begin{cases} 0 & \text{with } Pr(R=0) = \psi, \\ 1 & \text{with } Pr(R=1) = 1 - \psi, \end{cases} \tag{2.2}
$$

with $0 < \psi < 1$.

In the case $R = 1$, the management receives a noisy signal $V = v$ as a realization of the random variable $V = U + \varepsilon$, which is an unbiased estimator of U with an independent noise term ε. The noise ε follows a finite mixture distribution of normals defined as

$$
(\varepsilon \mid Q = H, R = 1) \sim \mathcal{N}(0, s_H^{-1}), \tag{2.3}
$$

$$
(\varepsilon \mid Q = L, R = 1) \sim \mathcal{N}(0, s_L^{-1}), \tag{2.4}
$$

with precision $s_H > s_L > 0$.

The random variable Q is also a state variable that indicates that precision type of the signal. It follows the following conditional distribution with support $q \in \{H, L\}$, defined as

$$
Q = \begin{cases} H & \text{with } Pr(Q=H \mid R=1) = \frac{\pi}{1-\psi}, \\ L & \text{with } Pr(Q=L \mid R=1) = \frac{1-\psi-\pi}{1-\psi}, \end{cases} \tag{2.5}
$$

with $0 < \pi < 1$.

One may ask why the type of the signal precision is stochastic. After all, if the management receives a private signal, should it not be able to observe the quality of such signal as well? Indeed, from the perspective of a management of a specific firm, this is not stochastic. However, this is not case from the perspective of the investor. Since she can not observe if the management has acquired private information, she can also not observe whether such information is of high quality or low quality.

Table 2.1 summarizes the probability distribution of the variables R and Q.

		0	1	marginal probability
		R	
	H	ι	π	$\iota + \pi$
Q	L	$\psi - \iota$	$1 - \pi - \psi$	$1 - \iota - \pi$
	marginal probability	ψ	$1 - \psi$	1

Table 2.1: Probability distribution of R and Q

In addition, since the noise term is assumed independent, consistent with prior research settings (e.g., Verrecchia, 1983; Penno, 1996; Richardson, 2001), it is valid that

$$Cov(U, \varepsilon \mid Q = H, R = 1) = Cov(U, \varepsilon \mid Q = L, R = 1) = 0. \tag{2.6}$$

Consequently, V defined as $V = U + \varepsilon$ also follows a finite mixture distribution of normals with

$$(V \mid Q = H, R = 1) \sim \mathcal{N}(\theta, h^{-1} + s_H^{-1}), \tag{2.7}$$

$$(V \mid Q = L, R = 1) \sim \mathcal{N}(\theta, h^{-1} + s_L^{-1}). \tag{2.8}$$

The variable Q is a type indicator which enables the differentiation of those firms which observe a signal of higher quality (*Type H*) and those firms which observe a signal with lower quality (*Type L*). The difference of the quality is modeled as the difference in the precision (i.e., s_H or s_L) of the noise ε conditional on the firm type. Given the assumption of $s_L < s_H$, the signal variance of a *Type H* firm is smaller than the signal variance of a *Type L* firm. (i.e., it is mathematically valid that $Var(V \mid Q = H) < Var(V \mid Q = L)$, as $h^{-1} + s_H^{-1} < h^{-1} + s_L^{-1}$.) This therefore models the better signal quality of a *Type H* firm compared with a *Type L* firm. The assumed Bernoulli distribution of the type indicator variable Q means that the probability of the investor encountering a *Type H* firm is π. Figure 2.1 illustrates the distribution of the signal V.

Aside from two exceptions, all variable distributions and the corresponding parameters above are assumed to be public information. The management can however privately

$$(V \mid Q = H) \sim \mathcal{N}(\theta, h^{-1} + s_H^{-1})$$

$$(V \mid Q = L) \sim \mathcal{N}(\theta, h^{-1} + s_L^{-1})$$

θ

V
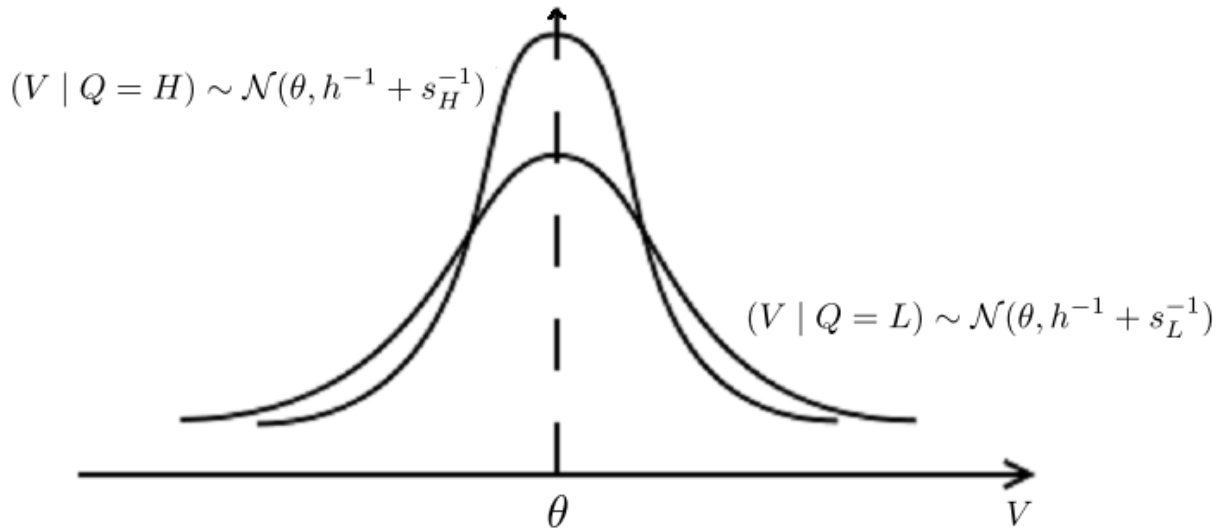
Figure 2.1: Distribution of the signal V

observe the realization of the signal $V = v$. In addition, should the management receives a signal, the precision of the signal (i.e., the realization of the variable Q) is also only privately known to the management.[9]

The signal V can be interpreted as some sort of forecast about the future success of the risky projects the firm engages in, which determines the firm's going concern value. The forecast is generated firm internally by means of some implemented information acquisition system and prognostication technology (e.g., enterprise risk management system, market research, cost controlling, financial budgeting process). However, such information acquisition systems would not be able to capture all relevant information fully. Nor would the implemented prognostication technology be capable for a perfectly correct forecast. Thus, such a forecast is always confined by an inherent forecast error compared with the true firm's value. The error term ε within the signal $V = U + \varepsilon$ thus captures this inherent forecast error. Since the inherent error only results from the incomplete information and imperfect prognostication technology, it does not change the underlying future success of

---

[9]This assumption corresponds to scenarios in which outside investors can not observe the firm's previous efforts in installing an information acquisition system internally and information about the installation and the quality of such system is not yet made public to outside investors. This could often be the case regarding the method a firm utilizes to research for and analyze data in order to predict the success of their business projects. For example, it is commonly unobservable for outside investors how a firm acquires market intelligence and how it estimates the underlying market and economic development which has impacts on the demand of its products unless the management specifically discusses such methods.

the risky projects. Hence the error term ε has a zero mean. However, the quality of such a forecast can vary significantly. Some firms with a sophisticated prognostication technology and rigorous internal process might generate far more precise and reliable information than other firms which do not exercise such sophistication in planning. And even for firms putting similar energy into the process to generate this forward looking information, different amount of available inputs might end up with forecasts which are differently precise and reliable. In addition, the model also explicitly take into consideration the case when no forecasts is or can be generated. This is for example the case, when firms do not have any prognostication technology or process in place to make forecasts. This can also be the case when firms fail to generate a forecast despite their efforts because they lack a significant amount of data or the established prognostication technology or process is rendered extremely ineffective due to external shock. For example, during the years of financial crisis, casual empirical evidence suggests firms regard it difficult to impossible to provide forecasts on upcoming operation due to extreme insecurity of the economical environment (Ruhwedel et al., 2009).

The state variable Q therefore modifies such a difference in forecast precision and reliability explicitly.[10] Based on the model setting, it can be shown that the correlation of the signal to the going concern value of a *Type H* firm with better signal quality is higher than that of a *Type L* firm.[11] This can be interpreted that the more precise signal of a *Type H* firm has a higher quality. In addition, the state variable R modifies explicitly the case whether or not a signal can be observed successfully.

---

[10]The model abstracts the quality difference of the generated forward-looking information into only two types in a non-revolving single-period setting. This corresponds to the interpretation of "relative difference". One may argue, in the real world of repeated disclosure decisions, the investors could infer the sophistication of prognostication technology and the process from previous disclosure. However, the relative sophistication of an once established technology compared with other possible technologies could change over time as alternative technologies develop. In addition, even if firms utilize same method and put in same effort in generating forward looking information. Other factors like the availability of inputs may still have an impact on the reliability of end results. Hence the type of the firm as modeled in the setting does not necessary need to be stable over time. This thus counters a correct conjecture of the firm type by investors even in a repeated game setting.

[11]It can be easily shown that $Corr[U, V \mid Q = H, R = 1] > Corr[U, V \mid Q = L, R = 1]$. See Appendix A for a detailed demonstration.

Prior to the transaction, with a probability of ψ, the management receives private information regarding realization of the signal. In case, a signal is received, the management also observes the quality of such a signal privately. It can then decide whether it reveals the signal with its corresponding quality.[12] In case the management fails to receive a signal, it has no other choice but to remain silent. Based on the public information and the disclosure choices the investor observes, he then prices the firm accordingly. The transaction is subsequently conducted.

It is worth emphasizing that the management can not credibly communicate to the public that it fails to observe a signal. This setting is similar to that used by Dye (1985). Because the management which receives a private signal may still choose to remain silent, the investors will not be able to distinguish such firms from the case where no private information is received at all. Therefore when the investor observes a non-disclosing firm, he thus has uncertainty not only regarding the endowment of the private forward looking information but also regarding the quality of such information in case of information endowment. In case the management does receives a signal, it however has two separate decisions to make. It can decide whether to disclose the signal it receives and it can also decide independently whether it communicates the quality of such information. If it decides to communicate either piece of the information, the management implicitly reveals the fact that it actually is endowed with the private signal. On the one hand, it is straightforward if a management is able to communicate the quality of a piece of private information, it is also in possession of such information. On the other hand, if a management discloses it is in possession of such information, it should also be able to comment on the quality of such information based on the inputs and methods utilized to generate the information.

---

[12]Under the current model setting, the management is assumed not to have the option to actively undertake other actions apart from disclosure decisions. This explicitly excludes actions that management could undertake to improve the true expected value of the going concern value, e.g., via operational improvements, after it observes the (potentially unsatisfactorily negative) signal. This is especially the case when there is only insufficient time to implement such actions or the effects of such actions would not unfold before the transaction takes place. As many operation improvement actions do take substantial amount of time to plan and implement and their effects take long time to materialize, such an assumption appears to be reasonable.

The possible actions of the two parties are summarized in the timeline shown in Figure 2.2.

In case the management receives
a signal, it makes two decisions:
whether to disclose the signal
and whether to communicate the
quality of the signal.

$\longrightarrow t$

$t = 0$ $t = 1$ $t = 2$

With a probability of $1 - \psi$, the   Based on the public available in-
management observes a private   formation, the investors prices
signal and its quality.   the firm at the updated going
concern value and the transac-
tion takes place at this place.

Figure 2.2: Model timeline, Chapter 2

Since there are two pieces of disclosable information, the management has four alternatives regarding its disclosure strategy. These strategies are denoted as:

- Full disclosure $D^F(V = v, Q = q \in \{H, L\})$,

- Partial disclosure of only the firm type regarding information quality $D^S(Q = q \in \{H, L\})$,

- Partial disclosure of only the observed signal realization $D^V(V = v)$,

- Non-disclosure of either the signal or the signal precision $D^N(\emptyset)$.

2.3 Description of the equilibrium

2.3.1 Exclusion of partial disclosure strategies as dominated strategies

Since disclosure of either the signal or of the signal precision implicitly communicates management's possession of the forward looking information, the investor has the certainty about the information endowment under both partial disclosure strategies. In addition,

as there are no disclosure costs modeled here, the unraveling principle formulated by e.g., Grossman and Hart (1980), Grossman (1981) and Milgrom (1981) would apply for both partial disclosure strategies. This suggests, no pooling equilibrium over the signal realization would exist if the type of the firm regarding the signal precision ($Q = H$ or $Q = L$) is disclosed to the investor. Nor would there be a pooling equilibrium over the signal precision, if the realized signal is disclosed.

The first claim asserts the partial disclosure of the signal precision (D^S) is dominated by the full disclosure strategy. The intuition is straight forward. The investor rules out the possibility of the management's having no signal due to the disclosure of signal precision. Therefore, for each type of signal precision, an investor conjecture the least possible signal realization should he not observes its disclosure. This conjecture leads to the disclosure of all signal realizations but the least favorable one. Since the support of the signal realization is defined on the whole space of real number, a full disclosure yields in equilibrium. This assertion leads formally to:

Proposition 2.3.1. *Partial disclosure of only the signal precision will never be chosen over full disclosure in equilibrium.*

Proof. See Appendix B for a detailed proof. □

The second claim asserts the partial disclosure of the signal realization (D^V) is also dominated by the full disclosure strategy. The intuition behind it is also straightforward. Given the disclosed signal realization, investor is certain that it faces either a firm with high quality signal or a firm with low quality signal. Assume firstly, the disclosed signal is higher than the prior expectation of the going concern value, then a high quality signal prompts a more "intensive" upwards update of the expectation and results in a higher updated going concern value. A firm with high signal quality will always prefer the disclosure of the signal quality in this case. If the investor observes no disclosure of the signal quality, he then conjectures the low quality correctly. Analogously, if the realization of the signal is below the prior expectation of the going concern value, a firm with low signal

quality will always prefer the disclosure of the signal quality to mitigate the degree of downwards update. In the case of non-disclosure of the signal quality, the investor also conjectures the high signal quality correctly. Therefore, this claim leads to

Proposition 2.3.2. *Partial disclosure of only the signal realization will never be chosen over full disclosure in equilibrium.*

Proof. See Appendix C for a detailed proof. □

2.3.2 Non-disclosure in equilibrium

This section demonstrates an equilibrium in which disclosure of neither the signal nor the signal precision is undertaken for some realization of signal V for both firm types H and L. In particular, I show there exists for *Type H* (*Type L*) firm a threshold value v_H (v_L) so that the firms withhold both their signal realization and their type regarding signal precision, when the realization of the signal is below the respective threshold.

The existence of such an equilibrium is based on *two conditions*:

1. For all $v \leq v_H$ for a *Type H* firm and for all $v \leq v_L$ for a *Type L* firm, a price resulting from the non-disclosure strategy is higher than a price resulting from the full disclosure strategy, as the two partial disclosure strategies are dominated by the full disclosure strategy.

2. When encountering a non-disclosing firm, the investor correctly conjectures that either the firm has endowed no signal at all and can not make any disclosure or the firm is in possession of a signal, in which case the firm is either a *Type H* firm with a signal realization below v_H or a *Type L* firm with a signal realization below v_L.

To prove the existence, some preliminary results are necessary. Firstly, I will derive the pricing functions for the full-disclosure and non-disclosure strategies.

For ease of notation, Let w_H denote the term $\frac{s_H}{s_H+h}$ and w_L denote the term $\frac{s_L}{s_L+h}$. Let $f_H(.)$ denote the probability density function (p.d.f.) of a normal distribution with mean θ and variance $h^{-1} + s_H^{-1}$ and $F_H(.)$ denote its corresponding cumulative distribution function (c.d.f.). Let $f_L(.)$ denote the p.d.f. of a normal distribution with mean θ and variance $h^{-1} + s_L^{-1}$ and $F_L(.)$ denote its corresponding c.d.f. Let $\Omega_H(v_H)$ denote the term $\frac{f_H(v_H)}{F_H(v_H)} h^{-1}$ and $\Omega_H(v_L)$ denote the term $\frac{f_L(v_L)}{F_L(v_L)} h^{-1}$.

Lemma 2.3.3. *If a firm discloses both its signal realization and its type regarding the signal precision, the investor would price the firm based on the conditional expected going concern value as:*

$$P(D^F) = \begin{cases} \mathbb{E}[U \mid V = v, Q = H, R = 1] = (1 - w_H)\theta + w_H \cdot v \text{ for Type H firm,} \\ \mathbb{E}[U \mid V = v, Q = L, R = 1] = (1 - w_L)\theta + w_L \cdot v \text{ for Type L firm.} \end{cases} \tag{2.9}$$

Proof. See Appendix D for a detailed proof. □

Lemma 2.3.4. *For the case of non-disclosure, the investor would not be able to distinguish whether the management has received a private signal at all. No would he be able to distinguish the two types regarding signal precision for the possibility that the management does receives a private signal. Therefore, he would have to price such a firm based on a mixed expectation of Type H firm with realization $v \leq v_H$, Type L firm with realization $v \leq v_L$ and possibility that firm has no private signal at all. Hence,*

$$P(D^N) = \mathbb{E}[U \mid (V \leq v_H, Q = H, R = 1) \vee (V \leq v_L, Q = L, R = 1) \vee (R = 0)]$$
$$= \theta - \pi \cdot \Omega_H(v_H) - (1 - \pi - \psi) \cdot \Omega_L(v_L), \tag{2.10}$$

Proof. See Appendix E for a detailed proof. □

For the equilibrium to exist, Condition 1 provided at the beginning of this subsection would suggest the following two inequalitis need to be valid simultaneouslsy :

$$P(D_N) \geq \mathbb{E}[U \mid V = v, Q = H, R = 1], \tag{2.11}$$

$$P(D_N) \geq \mathbb{E}[U \mid V = v, Q = L, R = 1]. \tag{2.12}$$

Inserting Equation (2.9) and (2.10) into Inequality (2.11), it then can be rewritten as:

$$\theta - \pi \cdot \Omega_H(v_H) - (1 - \pi - \psi) \cdot \Omega_L(v_L) \geq (1 - w_H)\theta + w_H \cdot v \tag{2.13}$$

Besides, Condition 2 would require that the investor correctly infers the realization of the signal should be smaller than the threshold value v_H in case of a *Type H* firm. Hence:

$$v_H \geq v$$

$$(1 - w_H)\theta + w_H \cdot v_H \geq (1 - w_H)\theta + w_H \cdot v. \tag{2.14}$$

Equalizing the Left Hand Side (LHS) of Inequality (2.14) with Inequality (2.13), the following equation then yields. It needs to be valid in equilibrium.

$$\theta - \pi \cdot \Omega_H(v_H) - (1 - \pi - \psi) \cdot \Omega_L(v_L) = (1 - w_H)\theta + w_H \cdot v_H. \tag{2.15}$$

Similarly, the following Equation in regard of *Type L* firm also needs to be valid in equilibrium at the same time.

$$\theta - \pi \cdot \Omega_H(v_H) - (1 - \pi - \psi) \cdot \Omega_L(v_L) = (1 - w_L)\theta + w_L \cdot v_L. \tag{2.16}$$

To establish the existence of the equilibrium described at the beginning of the section, I will proof the existence of the two threshold levels v_H and v_L so that both the equations (2.15) and (2.16) are valid at the same time.

Proposition 2.3.5. *There exist unique threshold values v_H and v_L so that an equilibrium exists when non-disclosure strategy is chosen by the firm if the realization of V is smaller than v_H for a Type H firm or the realization of V is smaller than v_L for a Type L firm.*

Proof. Given the equations (2.15) and (2.16), it is straightforward that the Right Hand Side (RHS) of both equations are equal. This leads to the following equation:

$$(1 - w_H)\theta + w_H \cdot v_H = (1 - w_L)\theta + w_L \cdot v_L$$

$$w_H \cdot (v_H - \theta) = w_L \cdot (v_L - \theta) \tag{2.17}$$

$$v_L = \frac{w_H}{w_L}v_H + (1 - \frac{w_H}{w_L})\theta \tag{2.18}$$

Rearranging the terms in Equation (2.15), I prove the existence of a v_H that makes the following equation valid:

$$\pi\Omega_H(v_H) + (1 - \psi - \pi)\Omega_L(v_L) + w_H \cdot v_H - w_H\theta = 0 \tag{2.19}$$

by showing the following properties of the Equation in Appendix F:

  i. The LHS of Equation (2.19) is monotonic increasing in v_H.

  ii. The LHS of Equation (2.19) has the boundary value $-\infty$ for $v_H \to -\infty$.

  iii. The LHS of Equation (2.19) has the boundary value $+\infty$ for $v_H \to +\infty$.

If the above three conditions are satisfied, the function curve representing the LHS of Equation (2.19) will always have a unique zero regarding v_H. Given the relationship demonstrated by the equation (2.18), there exists always a corresponding v_L for a given v_H. $\qquad\square$

The driver of this result is the trade-off that a firm endowed with low precision information faces under the model setting. A firm with low precision information below the a priori expectation faces a dilemma between two possible actions: on the one hand it would like to pool with the firms that does not endow a signal at all by non-disclosing, thus reducing the downwards updating of its firms value. On the other hand, however, by withholding the signal, it also creates an opportunity for a firm endowed with high

precision information below the a prior expectation to pool with it as well. Since the investor would evaluate a high precision bad signal with more severity, hence a *Type H* firm with bad signal always seeks pooling with both firms with no information endowment as well as the the low type firms. A *Type L* firm in turn would like to pool with firm with no information endowment while keeping the *Type H* firm from pooling with them. The lack of the possibility to credibly communicate the type of the firm regarding the information precision without revealing the status of information endowment means the *Type L* firm has to trade off between the two options and decides whether it wants to be pooled with firms with no information endowment to its favor but also with *Type H* firm to its dis-favor at the same time or to disclose both the signal and precision and eliminate the pooling possibility altogether. The resulting disclosure threshold v_L indicates the value of the signal realization where a *Type L* is just indifferent between the two options. Correspondingly, the disclosure threshold v_H indicates the value of the signal realization where a *Type H* firm is just indifferent from disclosing the signal and its type and separate from the firms of its type with worse realizations or withholding both information and be pooled with silent *Type L* firms and firms which does not observe a signal.

In addition to the existence of such an equilibrium. It can also be shown that:

Corollary 2.3.6. *The threshold values v_H and v_L are always below the a priori expectation of the going concern value U: $\mathbb{E}[U] = \theta$. That is, it is always valid that $v_H < \theta$ and $v_L < \theta$.*

Proof. By rearranging the terms in Equation (2.15), it can be shown that

$$v_H = \theta - w_H^{-1}(\pi \cdot \Omega_H(v_H) + (1 - \psi - \pi) \cdot \Omega_L(v_L)). \tag{2.20}$$

Since it's valid that $w_H^{-1}(\pi \cdot \Omega_H(v_H) + (1 - \psi - \pi) \cdot \Omega_L(v_L)) > 0$, it is obvious that $v_H < \theta$.

Similarly, I can show $v_L < \theta$ by rearranging the terms in Equation (2.16) to:

$$v_L = \theta - w_L^{-1}(\pi \cdot \Omega_H(v_H) + (1 - \psi - \pi) \cdot \Omega_L(v_L)). \qquad (2.21)$$

$\square$

Furthermore, the relationship of the two threshold values v_H and v_L also follows the following property:

Corollary 2.3.7. *The threshold value for a Type H firm with higher signal precision is always higher than that for a Type L firm with a lower signal precision: $v_H > v_L$.*

Proof. Given the assumption in Section 2.2: $s_H > s_L > 0$ and $h > 0$, it is trivial that $w_H > w_L$. Since w_H is larger than w_L and both v_H and v_L are smaller than θ, it is straightforward to derive from equation (2.17) that $v_H > v_L$. $\square$

Two implications can be directly derived from this equilibrium. Firstly, the model results suggest firms only have incentives to withhold information if they observe negative private forward looking information. This is consistent with some prior empirical study regarding asymmetrical disclosure with favor for good news than bad news (e.g., Penman, 1980). Secondly, contrary to prior research (e.g., Verrecchia, 1990), this model suggests a firm with better information quality would be more likely to withhold negative forward looking information as the threshold level of withholding information is higher than that of the firms with lower information precision.

2.4 Comparative statistics

In this section, I further analysis the impact of the changes of some exogenous variables on the equilibrium described above. In particular, I will show the impact of a change in the probability of non-information endowment: $Pr(R = 0) = \psi$ on the disclosure thresholds. Also, I will demonstrate the impact of the change in the conditional probability of receiving a high signal quality: $Pr(Q = H \mid R = 1) = \pi$ on the disclosure thresholds.

2.4.1 Impact of the probability for information (non-)endowment

The existence of the non-disclosure for signal realization under the disclosure thresholds relies on investors' uncertainty about manager's endowment of a private signal. To form a price for a non-disclosing firm, the investor mixes the unupdated prior expectation of the going concern value for a firm with no information endownment with the updated going concern value for a firm with bad signal realizations below the disclosure threshold. The probability of information endowment serves as the weight in this mixed pricing. If the probability that a firm does not receive the private information increases, then the weight for the higher unupdated prior expectation increases in the mixed-pricing accordingly, leading to an increase of the non-disclosure price. This increase, in turn, makes the non-disclosure more attractive. Hence some firms with low signal realization which previously chose to disclose the signal now choose to withhold the signal, leading to an increase of the disclosure threshold. Following this logic, Dye (1985) shows that an increased probability of firm not receiving the signal leads to higher disclosure threshold. The same intuition also holds for the settings in this paper, where two different signal types are modeled. It can be shown that

Corollary 2.4.1. *An increase in the probability ψ of firm not receiving a private signal , increases non-disclosure thresholds for both firms endowing a high quality signal: v_H, and for firms endowing a high quality signal: v_L.*

Proof. See Appendix G for a detailed proof. □

2.4.2 Impact of the probability for high quality signal

A further follow-up question would be, what the relationship of the disclosure thresholds (i.e., v_H and v_L) to the proportion of the firms with higher information precision in the population (i.e., $Pr(Q = H) = \pi$) is. This is particularly interesting to understand how a structure change regarding the firm types on precision in the total population of firms

can influence the disclosure behavior. Such a change is possible under several scenarios. One possible scenario is the gradual establishment of new (and hence more sophisticated) information acquisition system and prognostication technology. At the beginning, such technology is only available and practiced by a small amount of pioneers within the overall population. With time, this technology spreads gradually to a larger group of firms. One prominent example in the recent time is the introduction and prevalence of the so called "big data analytics" in the area of business and market intelligence. As new technology for data mining, storage and analytics arises, firms adopting the approach to better understand their customers might be able to make much better forecast on their business development. As an example, the mail order company Otto utilizes a special software to analyze the over 300 million data records generated per week to better forecast the demand of its entire product portfolio (Fischermann and Hamann, 2013). Though currently still partially seen as hype by some (Buhl et al., 2013), the gradual adoption of the "big data analytics" would by a wide range of corporations would certainly imply a higher portion of firms with better ability to generate information regarding of their future business development.

Another similar scenario is when the regulator introduces incentives for firms to adopt certain better information acquisition system and prognostication technology while still allowing the firm to opt out for non-adoption. This might lead to an increased portion of firms shifting towards the more sophisticated better information acquisition system and prognostication technology while some others still remain with the older system and technology.

To investigate if a higher proportion of *Type H* firms in the population (i.e., π) would have impacts on the threshold values of disclosure, it is necessary to look into the algebraic sign of the derivatives $\frac{\partial v_H}{\partial \pi}$ and $\frac{\partial v_L}{\partial \pi}$ respectively.

Corollary 2.4.2. *Both derivatives $\frac{\partial v_H}{\partial \pi}$ and $\frac{\partial v_L}{\partial \pi}$ are negative. Hence, the increase of the proportion of firms with higher information precision in the population would lead to an decrease of the disclosure threshold levels under these parameter settings. Consequently,*

the increase of the proportion of firms with lower information precision in the population would lead to an increase of the disclosure threshold levels.

Proof. See Appendix H for a detailed proof. □

Corollary 2.4.2 provides an interesting extension on how uncertainty of information endowment might influence the disclosure, initially suggested by Dye (1985). Corollary 2.4.2 above suggests that an improved "average" signal quality in the overall firm population by an increased probability of endowment of high-precision information would lead to an improvement in disclosure.

At the first glance, this result might seem a bit against the intuition that increased information precision does not hinder the disclosure of bad news. One might think that overall better information quality in the population of the firms may mean that the investors put more weight on the bad news when updating their expectation. This would in turn lead to firms choosing non-disclosure even for less severe bad news and hence increase the disclosure thresholds.

However, the reason behind the decrease of the disclosure thresholds is the very same trade-off that leads to the existence of the disclosure thresholds described in section 2.3. The increased proportion of *Type H* firms means the investors would give more weights to the possibility of encountering a *Type H* firm when forming the price of a non-disclosing firm. This means, the non-disclosure becomes less attractive for the *Type L* firm which leads to the decrease of the disclosure threshold v_L. Since the decrease of v_L leads to a lower average firm value of *Type L* firms in the non-disclosure pool, the non-disclosure becomes less attractive for *Type H* firms as well, which explains the decrease of the disclosure threshold v_H.

The results are also consistent with Dye (1985)'s results recapped in Corollary 2.4.1. Indeed. we can regard the probability of not receiving information the same as receiving a completely unreliable and hence useless information. Technically, it means the probability

of information non-endowment is the same as having a third firm type which receives a information with zero precision. Hence the increase of probability of information non-endowment also decreases the "average" information quality in the firms' population and therefore hinders the disclosure.

2.5 Concluding remarks

This essay presents an extension of the classical voluntary disclosure models which analyze the disclosure decisions of firms when the unraveling principle does not apply. It introduces the uncertainty about the information quality in addition to the uncertainty about information endowment developed as cause of non-disclosure in prior literature. Thus it enriches also the disclosable information set from one piece (only the signal) to two separate pieces (the signal and its quality). It shows, under the condition that firms can not credibly claim non-information endowment while disclosing the quality of information they would have endowed, there exist two disclosure thresholds for each of the firm types. Both type of the firms will collectively remain silent, should the signal realization be lower than the corresponding disclosure threshold of their respective firm type.

The model indicates that the threshold values for a firm with higher precision information as well as for a firm with lower precision information are below the a priori expectation of the firm's value, suggesting firm's incentive to mask only "bad news" in absence of any disclosure costs.

In addition, the model yields some results regarding the relationship between the information quality and the disclosure incentives. It suggests a management endowed with higher-precision information is more prone to withhold bad information compared to a management endowed with lower-precision information, as the threshold value for disclosure of a higher information precision firm is higher than that of a lower information precision firm. However, an increase of the proportion of higher information precision firms within the overall population would lead to an decrease of thresholds both for firms

with higher information quality and for firms with lower information quality, mitigating the negative effect of higher information quality on the disclosure of "bad news". These results have some implications on how advancement in method and technology in information gathering, analyzing and thus ability in generating more reliable forecasts about firms' future performance may have on the disclosure behavior the management exhibits. That is, the initial introduction of a new method / technology that improves the information quality available to a small portion of firms might reduce the willingness for voluntary disclosure, thus possibly leading to less overall transparency in the economy. On the other hand, with the commoditization of such technology, the willingness to disclosure might eventually increase again, potentially improve the transparency subsequently.

For regulators, implications can be drawn from this essay especially for regulation regarding disclosure of certain forward looking information that is bond with high management discretion even under a mandatory disclosure regime such as risk disclosure. In such fields, it is not only necessary to mandate the disclosure of the information, but also important to regulate the information quality. Due to high management discretion, the disclosure obligation alone would not be able to rule out the impact of voluntary disclosure incentives on the disclosure behavior[13]. Consequently, if regulators are aiming for reduction of information asymmetry by increased disclosure, regulations should also be put in place to improve the overall information quality in firm's population. This would help to mitigate the reluctance for firms to release high quality information when such information is of "bad news" nature.

Naturally, the presented model results are only valid under certain assumptions. Apart from the fairly common "truthful disclosure" assumption in a large amount of voluntary disclosure (Beyer et al., 2010), the model also has two other key assumptions:

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[13]Indeed, the information content of such mandatory disclosure was contested by both academia, practitioner and regulator. For example, the informational content of mandatory risk disclosure in Germany was questioned by Dobler (2005). Its analogous counterpart in the U.S. – the risk factor disclosure has been criticized to be boilerplate, not readable and unreliable (e.g., ICAEW, 2011; Johnson, 2010). Also, the Securities and Exchange Commission (SEC) stated in one of its interpretation of commission guidance regarding MD&A that boilerplate disclaimers and generic language generally are not helpful in providing useful information (Securities and Exchange Commission, 2003).

1. not only the signal itself but also the signal precision is not commonly observable

2. the management does not act on the private signal, especially in the case of negative signal, to actively correct the course and to increase the odds of positive outcome for the projects

I argued for the validity for the assumption when introducing the model setting with the arguments that the effort the management invest into generating forward looking information and the method it utilizes is not commonly observable to outsiders. This is true in a single period setting. However, if one extends the setting to multiple-periods, this assumption may not hold true. In particular, if the signal precision was disclosed in previous periods, the investor may reasonably assume that the same signal precision persists to this period as well. This is particularly true regarding the method and technology a firms uses to generate such forward looking information. Once it's disclosed that a firm systematically uses a certain technology to forecast the success of its business, this information will be considered by the investors even if the firm does not make disclosure regarding the use of such technology in the subsequent reporting periods.[14]

The validity of the second assumption relies on the timing of the signal reception by the management and the intended transaction. I argue that the time between these two events is so short that management does not have possibility to undertake any corrective actions in case of receiving a bad signal. One may argue this does not necessary reflects the typical time line of a transaction in reality. However, this is a not so uncommon assumption in extant literature focusing on the disclosure decision. In fact, this setting helps to focus on management's disclosure decision. The effect of such private signal feeding back to management's business steering actions does not rule out a subsequent realization of a new signal reflecting the effects of such activity and the management thus faces the same decision whether to disclose the private signal.

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[14]For example, online retailers like Amazon do not repeatedly state the fact that they systematically use the data from customer interactions to understand the demand. Still, we perceive the consistent use of such technology by the firms.

This essay identifies a possible research topic for future empirical work: to look into the relationship of information quality and the "degree of badness" of the associated information disclosed. The model suggested for "bad news" of certain degree, one might only observe disclosure with low information quality, i.e., realization of signal $V = v$ in the interval $[v_L, v_H]$. To test the fitness of the model in real word, an empirical study can be utilized to test if increased degree of "badness" of information is associated with increased degree of "vagueness" of information quality in disclosure behavior when management has a high degree of discretion or when the disclosure is pure voluntary. In addition, the model also suggests that the gradual introduction of new technology or method to better predict a firm's future business development would result in an decrease in disclosure threshold and therefore an increase of disclosure level overall. Given the current trend of "big data analytics" being introduced into different industries, one may also test the hypothesis between the degree of the prevalence of "big data analytics" is positively associated with the degree of disclosure in the economy.

3 Essay on interdependency of disclosure dimensions: disclosure under financial distress [15]

3.1 Introduction

Voluntary disclosures by firms are shaped by multiple disclosure incentives. These incentives, stemming for example from capital markets considerations, managerial opportunism, product market considerations (Healy and Palepu, 2001) and institutional context such as the risk of litigation and degree of corporate governance (Beyer et al., 2010), vary both cross-sectionally and over time. As firms, and the environment in which they operate, evolve, some of these incentives may grow in importance and some may recede. Previous literature on voluntary disclosures and their implications for investors controls for the effect of extraordinary events (e.g., Cao and Narayanamoorthy, 2011; Rogers and Stocken, 2005) or uses these events to identify changes in disclosure incentives. For example, Lang and Lundholm (2000) find that firms increase voluntary disclosure activity before seasoned equity offerings in order to hype the stock price. For the comparable setting of Initial Public Offerings (IPOs), Guo et al. (2004) find that proprietary costs negatively affect the amount of product-related information given in prospectuses (also Jog and McConomy, 2003). And Rogers and Buskirk (2009) show that firms which experience litigation are likely to adjust their voluntary disclosures afterwards.

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[15]The content of this chapter is based on my working paper co-authored by Dr. Michael Ebert and Dr. Dennis Voeller entitled "The impact of financial distress on management's disclosure behavior and the interdependencies of disclosure characteristics" in 2013. I wish to extend my appreciation to my co-authors for the work that we did together. Also I gratefully acknowledge their permission to include the content of the working paper into my dissertation.

As one of such events, the financial distress is found to affect voluntary disclosures in a less predictable way. For example, Frost (1997) examines the press releases (PR) of UK firms that received modified auditor's reports in the time period of 1982 to 1990. She uses the receipt of modified audit report as a proxy for distress. Compared with non-distressed firms of similar size in the same industry, she shows that distressed firms generally disclose more information than non-distressed firms. In particular she shows that, although firms in financial distress are forthcoming about adverse news, they also disseminate overly optimistic disclosures. To some extent in line with Frost's results, Holder-Webb and Cohen (2007) show that firms indeed increase the level of voluntary disclosure upon entering financial distress. However, Holder-Webb and Cohen suggest that only those distressed firms that eventually recover sustain the increased disclosure level after the initial distress period. The disclosure level of the other firms in their sample ebbs after the initial onset of the distress. Finally, in contrast to Frost (1997), Boo and Simnett (2002) report that firms in financial distress engage in selective disclosures, which means they tend to provide good news while withholding bad news.

Viewed together, these results from previous literature seem to be ambiguous regarding firms' disclosure behavior when in financial distress. This ambiguity could indicate two differences between financial distress and other significant events. First, financial distress is likely to be a gradual development, possibly over several years, rather than a unique event. However, most previous studies only differentiate between distressed and non-distressed firms, i.e. they regard financial distress as a binary variable. Secondly, previous studies do not address the complexity of multiple dimensions of disclosure decisions. Since the management may face different constraints and costs manipulating such properties of a piece of disclosed information, interdependencies among the disclosure dimensions may also exist. Thus, measuring the disclosure with a one-dimensional proxy may hinder the examination of such interdependencies. Both of these two aspects will be addressed in this essay. We analyze a large sample of over 15,000 press releases by firms that filed for bankruptcy between 2008 and 2012 in the United States. To capture the variation in disclosure incentives over time, we consider press releases from up to ten

years before the bankruptcy filings. Together with a continuous proxy variable, the use of such panel data could allows us to capture the change in disclosure behavior with the development of the degree of financial distress in a corporation. To take the different degree of discretion the management may face when making disclosure decision for different type of information, we also differentiate press releases containing content that is likely to be subject to mandatory disclosure regulation from such press releases that are most likely made public voluntarily by the management. To do so, we review the content of each of these press releases and classify the press releases into one of 17 categories based on the subject matter involved in the press releases. Further we divide each of these 17 categories into two classes: a class containing subject matter which is typically subject to the mandatory disclosure regulation and the other class containing all other subject matter which is less likely to fall under mandatory disclosure regulation. This approach allows us to differentiate management's possible strategic disclosure behavior more easily. Since any management may face different levels of discretion over disclosure and different litigation risks regarding these two different classes of disclosable information, the management may well exhibit different disclosure behavior towards these two classes of subject matter. Additionally, in order to capture the interdependencies between the different disclosure dimensions and the influence of different degrees of decision discretion, we measure the disclosures in three dimensions: disclosure quantity, readability and sentiment. We use multiple variables, including those widely used in extant research in linguistics, to proxy for these disclosure dimensions in oder to ensure the robustness of the results. Further more, to account for the difference in disclosure behavior regarding good and bad news that firms may exhibit (Boo and Simnett, 2002), we also distinguish between good news PR and bad news PR when measuring the aforementioned disclosure dimensions.

The main findings of the papers are in several aspects. First of all, in contrast to the results suggested by Frost (1997) the quantity of disclosure a firm makes annually does not seem to be dependent on the financial performance and the degree of distress of the firm. This is also true when only positive or negative press releases are included in the analysis. In addition, the lack of association between disclosure quantity and degree of

financial distress also persists for analysis based solely on press releases which are most likely disclosed voluntarily by management ()due to the type of subject matter). However, when analyzing another sub-sample of press releases which are most likely disclosed due to mandatory regulation, evidence suggests that the quantity of such a disclosure is associated with the degree of financial distress and firms' financial performance. An increase in the degree of financial distress (and decrease of financial performance respectively) is associated with an increasing number of bad news press releases and decreasing number of good news press releases. These results on disclosure quantity in total provide evidences suggesting that managements strategically use their discretion for information which is not within the scope of mandatory disclosure regulation to smooth out the total quantity of disclosure between "good times" and "bad times". Secondly, though text readability can be used strategically to influence the comprehension of information, there was only very weak and partially inconsistent evidence on its use strategically in responses to financial distress. In addition, there was no evidence showing a difference in the readability between mandatory and voluntary disclosures. Thirdly, some evidence from the analysis suggests that the degree of financial distress has an impact on the sentiment of the textual disclosure. In general, the movement of sentiment coincides with the degree of financial distress, meaning that the sentiment becomes more negative with the onset of financial distress. In addition, evidence suggests that the management are more conservative (using less positive sentiment) when communicating information under mandatory disclosure compared to communicating information which is revealed voluntarily. Viewed together, the evidence provides a mixed picture on management's strategic decisions on different disclosure dimensions and the interdependency of such dimensions. All in all, the management seems to be more forthcoming in communicating bad information using the sentiment than to actually communicate more in quantity. In addition, evidence suggests that the managements do use their decision discretion. On the one hand, they seem to use the discretion that they have to smooth the overall quantity of communication for both good and bad news over time despite the fluctuation in firms' financial performance and degree of financial distress, seemingly to "hide the severity of the onset financial distress"

when possible. On the other hand, they are more conservative in terms of sentiment when communicating subject matter under mandatory disclosure regulation compared to disclosure that is made voluntarily. This behavior could be a result of managements trying to mitigate any litigation risk.

The remainder of this essay is organized as follows: Section 3.2 provides a review of relevant literature and derives the main hypothesis for our empirical testing; Section 3.3 outlines the data source and provides rationales for the proxies used; Section 3.4 illustrates the regression models utilized in our analysis; Section 3.5 provides key empirical findings and discussions about possible interpretations of these findings; finally, Section 3.6 summarizes the findings and concludes the paper.

3.2 Hypotheses development and empirical predictions

3.2.1 Financial distress

Formulating expectations about the effect of financial distress on observable reporting decisions via its effect on reporting incentives requires a definition of financial distress. In accordance with previous literature we understand financial distress as a state where operating cash flows are insufficient to cover current obligations (Purnanandam, 2008; Whitaker, 1999; Wruk, 1990). Note that in this definition financial distress is not the same as insolvency. Firms are in financial distress but not insolvent as long as they still have the resources to meet current obligations, for example through inventory depletion or divestitures (Hendel, 1996; Lasfer et al., 1996), forgoing NPV-positive investments (Froot et al., 1993) or technical default, i.e., the violation of debt covenants (Purnanandam, 2008). However, the longer it takes to resolve financial distress the higher the risk of insolvency as firms exhaust their liquidity reserves. Although a company is technically not insolvent, it will typically exhibit weakening financial performances and a tightening

liquidity during such a period. If a firm cannot make the turnover out of the financial distress, then the insolvency will mark the endpoint of a development which starts with a situation where operating cash flows are insufficient to meet current obligations. Along this development, the increasing degree of financial distress is marked by increasing liquidity constraints and worsening financial performance.

3.2.2 Dimensions of disclosure decisions

The discretion inherent in a company's voluntary disclosures creates multi-faceted decisions which have to be accommodated in this empirical research. Changes in disclosure incentives might reflect in various dimensions of corporate disclosures. One approach to reduce this complexity is to capture different aspects of disclosure in a single uni-dimensional measure. Examples are Botosan (1997), who self-constructed a disclosure score capturing the quantity of disclosures made via annual reports, or Healy et al. (1999), who used a publicly available disclosure index to represent the overall quality of all disclosures by a given firm. However, the use of a uni-dimensional score bears the risk of conceptually over-simplifying the relation between disclosures and other variables of interest (e.g., Beattie et al., 2004; Beretta and Bozzolan, 2004, 2008). It seems particularly inadequate, if one is interested in the strategic disclosure decisions by management and the interdependency between the decisions with respect to the different dimensions. For example, if the management may have different degrees of discretion in these decision dimensions and hence may use its discretion in one dimension to compensate for the lack of another. Therefore, our approach is to concentrate on such traits of voluntary disclosure that provide scope for strategic disclosure management: ***disclosure quantity***, ***readability*** and ***sentiment***.

Disclosure quantity   The quantity of voluntary disclosures can be seen as the aggregated result from a series of disclose vs. non-disclose decisions made by management for every piece of private information it holds. These decisions are likely to depend on the expected

effect of the disclosure. Existing literature on disclosure quantity indicates for example, that it is associated with the degree of information asymmetry on the capital market and hence with costs of capital (e.g., Botosan, 1997). Other studies find that disclosure quantity is correlated with the degree of litigation risk (e.g., Skinner, 1994; Baginski et al., 2002; Brown et al., 2005; Campbell et al., 2011). Although we do not suggest that management strategically sets disclosure quantity, e.g., the number or press releases for a given year ex ante, we consider it the result of the aforementioned series of individual strategic disclosure decisions. Therefore, ex post, the disclosure quantity reflects the management's strategic disclosure decisions.

Readability of textual disclosure   Readability as a strategic aspect of disclosure decisions follows from the Incomplete Revelation Hypothesis (IRH). The IRH suggests that "statistics that are more costly to extract from public data are less completely revealed by market prices" (Bloomfield, 2002, p. 234). In principle, the IRH proposes that the more costly it is to extract information from data, the fewer market participants are willing to do so and then trade on this information. Hence, information that is more costly to extract induces a weaker price reaction compared to other information. Management with significant concerns might impede the comprehension of such bad news by complicating its disclosure in order to mitigate the negative effects of the disclosure on the capital market. Bloomfield (2002) suggests that cognitive costs are an important part of total costs, i.e. the cognitive difficulty of extracting information from a given data set. The cognitive difficulty of information extraction should be related to the readability of these disclosures. Beyond the cost/benefit trade-off indicated by the IRH, Rennekamp (2012) finds that readability may also affect investors' perception of and reliance on information. Her experiments show that investors subconsciously attribute emotions associated with the difficulty of extracting information to the information itself. Hence, information which is easy to extract from data is perceived as more positive than the same information which is difficult to extract. Likewise, ease of extraction, i.e. high readability of the data, appears to increase the willingness to consider the information relevant. Based on exist-

ing research we consider the readability of press releases a strategic decision variable for management. For example, in extant research Li (2008) and Dempsey et al. (2012) found a negative correlation between reported earnings and the readability of annual reports, which could indicate that reporting entities try to shroud bad news in complicated speech or in large amounts of irrelevant text.

To measure the readability of the textual content, we employ readability indices for the English language – Flesch Kincaid Grade Level (FKG) and Gunning Fog Index (FOG). These metrics are well established in linguistic research and were also explored in prior empirical disclosure research (e.g., Li, 2008; Dempsey et al., 2012). Both metrics provide a quantitative indication of the complexity of a textual paragraph by giving an estimation of how many years of school education an average person needs in order to understand the relevant text.

Sentiment of textual disclosure The sentiment of a disclosure describes the polarity of its wording, i.e. whether the wording is rather positive, negative or neutral. Prior research indicates that the sentiment of narrative disclosures is incorporated in price reactions. For example Abrahamson and Amir (1996) report that the sentiment of presidents' letters as part of annual reports has incremental explanatory power in an earnings-return-regression, indicating that expected returns are sensitive to the tone of narration (also Davis and Tama-Sweet, 2012). Their findings are confirmed by Twedt and Rees (2012) with respect to the sentiment expressed in analyst reports. Because the language used in press releases, or in virtually all narrative parts of a firm's disclosures, is unregulated, we consider sentiment a strategic decision variable for management. This point of view is supported by prior research. Smith and Taffler (1995) report experimental results based on real annual reports which suggest that chairmen of the board use sentiment strategically to cloud bad news in their written statements included with the annual reports. More recently Davis et al. (2012) report that the sentiment of earnings press releases and MD&As is correlated with capital market based reporting incentives. The authors take this to indicate strategic use of sentiment.

In line with the prior research, we measure the text sentiment by measuring the relative frequency of words with positive and negative connotations in the textual disclosure. We use two different sets of dictionaries to identify such words with positive or negative connotation.[16]

3.2.3 Interdependency of the disclosure dimensions

As presented above, it shall be noted that the three dimensions capture different choices made by management. The quantity of press releases is the result of consecutive decisions to disclose or withhold new private information. Readability and sentiment on the other hand are determined *conditionalyl* on a decision to disclose the information. Whilst the disclose vs withhold decision impacts fundamentally on whether a certain piece of private information is made public, the latter two decisions could influence the reception of the disclosed information by the investors.

In addition, the management has very different degrees of discretion when making decisions on each of the disclosure dimensions. With regard to the disclose vs. withhold decision (and hence indirect the quantity of the disclosure), management often needs to take the mandatory disclosure regulation into consideration when it becomes aware of a specific piece of information. For certain types of information such as quarterly earnings, a management almost has zero discretion. For other types of information, it may have some limited discretion on whether to disclose the information. This may be the case if the underlying event or information does not fall under the items listed under Security and Exchange Commission (SEC) Form 8-K current report. The management may have some discretion if the event is of importance to security-holders and therefore needs to be disclosed. In particular, information regarding business development such as acquisition or loss of clients and orders are not specifically listed as reportable items in form 8-K,

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[16]The measurement of the text sentiment including the dictionary based identification of words with positive and negative connotation are discussed later in the sub-section 3.4.3.

but may well be of importance for the valuation of the firm. Such factors allow a certain degree of management discretion in terms of disclosure decision[17].

Unlike the disclose vs. withhold decision, the readability and sentiment of textual disclosure are much less subjective to regulation on mandatory disclosure. Most current regulations on disclosure focus on the timely disclosure of certain information. Such regulations do not come with specific requirements for the form in which the information should be disclosed. The regulation does not specify any linguistic characteristics of the text such as wording, complexity or connotation of the text for disclosure in textual form. Therefore the management enjoys a considerably higher degree of discretion when deciding on these two disclosure dimensions.

Given the large difference in the degree of discretion the management has regarding the three disclosure dimensions, we hypothesize a substitutive effect between the disclosure quantity (as an aggregative measure of disclose/withhold decisions in a particular time period) and the readability and sentiment of the textual disclosure. That is, if a specific piece of information is subject to mandatory disclosure, the management would utilize the dimension readability and sentiment more intensively to compensate their limited discretion over the decision on whether to disclose or withhold the information. Thus, the management may use text complexity and sentiment to mitigate or amplify the effect of the disclose vs. withhold decision.

To provide empirical evidence for this interdependency, when forming our hypothesis, we explicitly distinguish between such press releases which by nature are highly likely to be in scope of existing mandatory disclosure regulation (e.g., press releases regarding earnings reports, impending stock market transactions or change of board or senior executive

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[17]However, Form 8-K does include "Section 8 Other Events" where a company can report events that are not specifically called for by Form 8-K but are considered by the firm to be of importance to security holders. In addition, SEC Rule 10b-5 makes it unlawful for management to omit to state a material fact which, by its omission, makes (possible prior) statements misleading. These rules poses as litigation risks for management if it fails to disclose material information. Hence, though the management may enjoy certain discretion regarding disclosure decision, such discretion may well be limited. The nature of the information based on which the management may ex post justify their non-disclosure decision may be challenged by a plaintiff.

members) from such press releases which are of low likelihood to be in scope of the mandatory disclosure.

In addition to the differentiation between High-Likelihood-Mandatory (HLM) disclosure press releases and Low-Likelihood-Mandatory (LLM) disclosure press releases, we also explicitly differentiate between good news and bad news disclosure when forming our hypothesis. Extant research already indicates that not only the quantity but also content of the disclosure have impacts on the prevailing capital market environment.. Kothari et al. (2009) suggest that such impacts should not be viewed as unidirectional. Their study provides evidence that the impact of disclosure is directional depending on the content of the disclosure. That is, disclosure containing favorable and uncertainty-reducing content affects the firm's cost of capital in an opposite direction than disclosure containing unfavorable and uncertainty-increasing content. Also, Ge and Lennox (2011) find evidence suggesting that firms do not necessary engage a symmetric strategy when deciding on disclosure of good vs. bad news. In a setting with impending equity fund acquisition, their findings suggest the firms strategically suppress bad news disclosure on the one hand whilst they don't necessarily boost good news disclosure on the other hand. Given the different effects good news and bad news disclosure may have and how prior evidence suggests the management may use different strategies depending on the disclosure content, we explicitly formulate our hypothesis for good news disclosure and bad news disclosure separately.

Disclosure quantity The first set of hypotheses focuses on the disclosure dimension "quantity". As discussed before, this dimension is an aggregated measure of a series of disclose vs. withhold decisions as management receives new information. We choose to use the number of press-releases in a year as a proxy for this dimension. In addition, as discussed above, we formulate four hypotheses – one for HLM disclosure press releases conveying good news, one for LLM disclosure press releases conveying good news, one for HLM disclosure press releases conveying bad news and one for LLM disclosure press releases conveying bad news.

However, using the number of the press releases as a proxy brings an empirical difficulty: by observing the number of press releases, only the frequency with which the management decides to disclose its private information can be observed. If there are no (or few) press releases, it is unclear whether management has made a conscious decisions to withhold information or there is simply has no private information to disclose. As discussed above, this is particularly the case for bad news disclosure as management may seek to mask or delay bad news disclosure with the hope that a disclosure may not be necessary if subsequent developments are positive again. To ensure that the observation of low numbers of press releases is a reliable proxy for management's conscious decision to withhold information, we specifically included firms that went into bankruptcy between Q2 2008 and Q1 2012 in our samples and analyze their press releases up to 10 years before their bankruptcy filing.[18] By doing so, we make sure that our sample include data from time periods when the management of the firms probably received bad news. That is, in the years prior to the bankruptcy, the firms shall experience financial distress to some degree that gradually led the firms to bankruptcy.[19] Therefore, in this time period, the management should have an increased likelihood of experiencing bad private news; especially in the time period directly before the bankruptcy filing. In addition, to estimate the existence of such disclosable information, we use the *annual average of abnormal return* as a proxy for the firm's financial performance and *Altman's Z-score* (Altman and Hotchkiss, 2006) as a proxy for firms' degree of financial distress in that year. We assume that managements for firms with good financial performance naturally have a large amount of disclosable good news and a small amount of bad news. Similarly, managements for firms with poor financial performance may have a large amount of disclosable bad news and a small amount of disclosable good news.

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[18]Wherever the data availability allows it, we include the entire time series of 10 years for firms in sample. However, as not all independent and dependent variables used in the specified regression models are always available for the whole 10-year-period, we keep the firms in the sample as long as available data accounts for at least five years in the 10-year-period.

[19]Naturally, the speed of descent into bankruptcy differs depending on the variety of circumstances for the initial financial distress. To mitigate this effect, we use two proxies to estimate the severity of financial distress.

As discussed above, for press releases which are highly likely to be mandatory, the management has very limited discretion to withhold the information as it receives such information internally. Hence we hypothesize, that

H1a1: *The annual number of bad news press releases which are highly likely to be mandatory, increases with decreasing financial performance of the firm.*

H1a2: *The annual number of good news press releases which are highly likely to be mandatory, increases with increasing financial performance of the firm.*

Contrary to the High-Likelihood-Mandatory press releases, information that is not directly and unambiguously within scope of mandatory disclosure is subject to management discretion for disclosure. Therefore, independent of the actual quantity of disclosable adverse private information, the management may choose to suppress the disclosure of such information to capital market. Therefore, we hypothesize that

H1b1: *The annual number of bad news press releases which have low likelihood of being mandatory is not associated with the financial performance of the firm.*

Management might follow two possible strategies for their disclosure decisions in the case of good news which is not directly governed by mandatory disclosure rules. Since the management has the incentive to positively surprise the capital market and improve the share prices, it may not actively suppress the news and disclose such good news as it is acquired by the management. In this case, we hypothesize that:

H1b2i: *The annual number of good news press releases which have low likelihood of being mandatory increases with increasing financial performance of the firm.*

Alternatively, the management may also chooses to smooth the amount of such press releases, exhibiting a similar behavior as income smoothing. To do so, the management could simply choose not to increase good news disclosures even in time when it does receive increased levels of positive private information. With this strategy, the management can avoid the downside of having to provide less good news during times of unsatisfactory

firm performance. The rationale is the reduction of such good news disclosure itself could be interpreted negatively by capital market. In this case, we hypothesize:

H1b2ii: *The annual number of good news press releases releases which have low likelihood of being mandatory is not associated with the financial performance of the firm.*

Readability of textual disclosure Unlike the disclosure quantity, the readability of the textual disclosure is not subject to stringent disclosure regulation no matter whether the disclosed information falls in scope of mandatory disclosure or not. Consequently, the management can always strategically manipulate this dimension to hinder the comprehension of bad news (facilitate the comprehension of good news respectively). In conjunction with IRH, we build the following hypothesis in general:

 H2: *The readability of press releases decreases with decreasing financial performance of the firm.*

In addition, since the management is limited in its discretion on disclose vs. withhold decision for HLM press releases, it may use readability to compensate this lack of discretion. Therefore, we hypothesis

H2a1: *Compared to all press releases, the readability of press releases which are highly likely to be mandatory is worse for a certain degree of financial distress.*

In line with the hypothesis we made regarding the readability of all press releases, we assume a similar behavior towards both good and bad news in regards to readability:

H2a2i: *Compared to all good news press releases, the readability of good news press releases which are highly likely mandatory is worse for the same degree of financial distress.*

H2a3: *Compared to all bad news press releases, the readability of bad news press releases which are highly likely mandatory is worse for the same degree of financial distress.*

In addition, for good news HLM disclosure, the management may alternatively follow another strategy. Since IRH suggests that the simplicity of the textual information facilitates its understanding and increase its impacts on recipients. The management may choose to use simple language without consideration of the current financial performance of the firm. For this disclosure strategy, we formulate the alternative hypothesis for the readability of good news HLM disclosure press releases that

H2a2ii: *Compared to all good news press releases, the readability of good news press releases which are highly likely to be mandatory is not significantly different for the same degree of financial distress.*

Sentiment of textual disclosure   Similar to the readability of textual disclosure, management enjoys a higher discretion when deciding on the sentiment of the disclosed text. Evidence from prior literature suggests the sentiment of textual disclosure contains incremental information on management's evaluation of firms' current performance and expected future development. More precisely, Davis and Tama-Sweet (2012) suggest that the textual sentiment of earnings announcements convey additional information about management's perception of the underlying performance of the firm. They indicate a positive association between firms' future performance and the sentiment (positivity) of the corresponding earnings announcement. Consistent with prior literature, we assert a negative association between financial distress and disclosure sentiment whereas the management conveys the information about increasing distress with increasing pessimistic sentiment.

H3: *The sentiment of press releases becomes more negative with an increasing degree of financial distress.*

Analogous to hypotheses developed for disclosure readability, we also expect management to use their discretion regarding sentiment to compensate for the lack of flexibility in the

disclose/withhold decision for content that falls within the scope of mandatory disclosure. Therefore, we assert that the management uses a more positive sentiment for HLM disclosure to compensate for their lack of discretion to suppress bad news.

H3a1: *Compared to all press releases, the sentiment of press releases which are highly likely to be mandatory are more optimistic for a certain degree of financial distress.*

H3a2i: *Compared to all good news press releases, the sentiment of good news press releases which are highly likely to be mandatory are more optimistic for a certain degree of financial distress.*

H3a3: *Compared to all bad news press releases, the sentiment of bad news press releases which are highly likely to be mandatory are more optimistic for a certain degree of financial distress.*

Also, for the sentiment of good news press releases, we have the alternative hypothesis that the management do not behave differently regarding mandatory and voluntary disclosure. Since both type of disclosure contains positive news, the management has no need to manage the sentiment of one type differently than the other. Hence the alternative hypothesis is:

H3a2ii: *Compared to all good news press releases, the sentiment of good news press releases which are highly likely to be mandatory is not significantly different for a certain degree of financial distress.*

3.2.4 Other factors which affect disclosure decision that need to be controlled for

The essay focuses on the interrelations between the onset of financial distress and management's strategic decisions on disclosure. Hence, it is also necessary to control for other factors other than financial distress which may influence the disclosure behavior.

Four broad categories of such factors have been identified in the literature (e.g., Healy and Palepu, 2001; Beyer et al., 2010): capital markets based incentives (e.g., Lang and Lundholm, 1993; Clarkson et al., 1994; Lang and Lundholm, 2000), incentives based on opportunistic utility maximization (e.g., Brennan, 1999; Baik et al., 2011; Aboody and Kasznik, 2000), incentives based on expected litigation costs (e.g., Francis et al., 1994; Skinner, 1994, 1997; Baginski et al., 2002; Johnson et al., 2007) and product market based incentives (e.g., Clarkson et al., 1994; Harris, 1998).

Therefore the regression models we specify will have include proxies for each of these four factors as control variables.

3.3 Data and sample selection

Since we seek to explain how financial distress affects disclosure incentives by looking at discretionary properties of voluntary disclosure, we need to identify with sufficient certainty firms in financial distress. According to its definition financial distress is a gradual process, which leads to insolvency if firms find no effective counter measures. Thus, in order to identify firms in financial distress with a sufficient likelihood, we start by identifying all firms that filed for bankruptcy with the U.S. SEC between Q2 2008 and Q1 2012. The restriction to this period is due to data availability. We need to cover a sufficiently long period before bankruptcy (10 years) and for business years prior to 1998 the necessary data was severely limited. By checking for the existence of any 8-K filings reporting item 1.03 we identified 495 firms in total. From these we excluded firms which filed for bankruptcy outside the U.S. jurisdiction, firms which were put into receivership or conservatorship, and firms from the financial services industry because of the different regulatory frame for these firms. We also excluded firms which ceased operations without filing for bankruptcy. This leaves a sample of 334 non-financial services firms.

Based on the specific bankruptcy filing date, we then extracted the annual financial data for the 10 years prior to bankruptcy from the Standard & Poor's Compustat Global

Datenbank (Compustat)/Center for Research in Security Prices (CRSP) merged database. Based on these data we calculated Altman's Z-score (Altman and Hotchkiss, 2006) for each firm-year with available data. To qualify for our final sample we required sufficient data to calculate at least five Z-scores in the respective ten year period. Thus we had to drop another 219 firms, yielding a final sample of 115 firms[20]. As a second measure of the firms' financial performance, we calculated the annual average daily return for each firm in the sample based on the data extracted from CRSP US Stock Database. Similar to the z-score, only firms with sufficient historical data to calculate for the average daily return for five years are qualified to remain in the sample set. This selection further reduced the number of firms in sample to 92 firms.

We collected all available press releases for ten years prior to the bankruptcy filing date from LexisNexis for those 92 firms. We focus on PR as a disclosure channel because it portrays two aspects relevant to our research questions. Firstly, unlike annual reports or conference calls, press releases are not directed towards any particular stakeholder group. Instead, press releases are used to disseminate information aimed at the financial community, consumers, competitors, the general public and others alike. Thus, we expect them to be sensitive to changes in all previously identified disclosure incentives. Second, press releases are not regulated by any sort of formal standards. This allows disclosing firms a large amount of discretion over the quantity and content of said releases.

In order to identify only press releases by the actual firms we searched LexisNexis' Company Press Releases that stated the firm name explicitly as source or, when no source was given, as contact. In cases where firms changed their names during the search period, the search included the old names too. Since Company Press Releases covers a variety of wire services, we had LexisNexis ignore exact duplicates. Nevertheless, due to the way wire services handle the texts, the raw sample still contained duplicates which we identified using a scripted filter. In particular we marked all PRs where the first 30 characters of the

---

[20]The 115 refers to the number of the firms in the sample. However it does not account for the total number of data points we have, since we use a panel data out of these 115 firms, each firm can generate up to 10 data points depending on the data availability.

headlines were identical and whose release dates differed by less than two days. Of those marked we kept only the earliest because only they potentially introduced private information to the market. In addition, during the categorization process described below, we manually excluded any duplicate not identified by the automatic filter.

Within the sample of press releases, topics range from a product announcement aimed at retail customers to earnings announcements with complete quarterly financial statements. Obviously disclosure discretion is affected by the particular underlying event. For example, firms are entirely free to decide whether they want to release a product announcement or not. They are not entirely free, though, to decide whether they want to announce quarterly earnings or a public offering. Wile firms even in the latter cases have discretion over readability and sentiment, they do have to disclose the respective facts. Since Regulation Fair Discloure (Reg FD), public firms in the U.S. are prohibited from making selective disclosures of value-relevant information, making it more likely that firms choose press releases as a disclosure outlet for what are, in fact, mandatory disclosures. This has the potential to taint our results regarding potential effects of financial distress on the quantity of disclosures. In order to distinguish entirely voluntary press releases from those which may have been mandated by securities regulation, we manually sorted PRs into categories based on their content. The categories are an amended version of those used by Lang and Lundholm (2000). Additional categories were included for significant events, which we could not include in one of the original categories (e.g., PRs related to bankruptcy filings or to the reception of take-over bids). In total we end up with 17 categories. Based on the properties of each of these categories, we further match each of the 17 categories into one of the two possible classes: *High-Likelihood-Mandatory* and *Low-Likelihood-Mandatory*. As above, this process is based on the subject matter of each category of press release, i.e. how likely it is that the subject discussed in a category of press releases fall within the scope of the mandatory disclosure regulation. As an example, the category *earnings announcement* is classified as *High-Likelihood-Mandatory* while the category *business development* is classified as *Low-Likelihood-Mandatory*. A detailed description of each category, a descriptive statistic for the press release in each category

as well as its classfication is shown in Appendix I.

Because we expect management to behave differently with respect to good news and bad news disclosures during the onset of financial distress, we also differentiate the press-releases into good news and bad news disclosure. To identify whether a press-release conveys a piece of good news or bad news, we estimate the cumulative abnormal return in a three-day window around the date of the press-release of the specific firm's stock. To calculate the abnormal return, we estimate the normal return of the firm for each date where a press-release is issued. To do so, we first estimate the normal return for the firm using a simple market model which estimates the correlation between market return and the return of the share for the firm:

$$Rtr_{i,t} = \beta_0 + \beta_1 Rtr_{m,t} + \epsilon_{i,t}. \tag{3.1}$$

with $Rtr_{i,t}$ denoting the specific daily return of the firm i on the date t and $Rtr_{m,t}$ denoting the daily market return on the date t. To estimate the coefficients for firm i in year t, we use an estimation window of one year (i.e. all return data for firm i in year $t-1$)[21] and use the National Association of Securities Dealers Automated Quotations (NASDAQ)-Index as a proxy for the market return. Using the estimated coefficients, we calculate the normal return for a specific firm and date and form the daily abnormal return thereafter. The cumulative abnormal return is then calculated as the sum of the daily abnormal returns for the time frame from one day prior to press release date to one day after the press release. Press releases which are associated with a positive abnormal return are coded as good-news, while press releases with negative abnormal return are coded as bad news.

Naturally, manual coding is highly subjective; particular so if labor is divided between three authors in order to economize on time. To ensure a consistent coding of all press releases with respect to content category, we coded the first five firms together and developed coding guidelines for the PRs encountered there. After this training period each

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[21]We require a minimum number of 100 daily returns for the estimation. Firms with insufficient market return data for estimation are excluded from the sample.

author coded a share of the firms independently. If the guideline did not suffice to code a particular PR, again all authors would discuss the matter and amend the guidelines. The final coding guideline is shown in appendix J.

For example, we encountered the following press release from the firm *Focus Enhancements, Inc.*:

Market Wire December 14, 2006 Thursday 3:03 AM GMT

Focus Enhancements Receives FCC Approval for DS-OFDM UWB Modulation Technique; Approved DS-OFDM Modulation Allows Full Use of the UWB Spectrum Without Waiver, Providing 880 Mbps Rates to UWB Designers and Users LENGTH: 1232 words DATELINE: CAMPBELL, CA; Dec 14, 2006

Focus Enhancements, Inc. (NASDAQ: FCSE) announced *it has received Federal Communications Commission (FCC) approval* for its unique Ultra Wideband (UWB) DS-OFDM(TM) modulation scheme. This approval was granted without waiver restrictions that are currently being applied to the WiMedia Standard UWB technology.

DS-OFDM UWB radios will be able to use all or any part of the 3.1 gigahertz (GHz) to 10.6 GHz spectrum allocated by the FCC. UWB rates and distances will be significantly increased using DS-OFDM architecture.

"While several WiMedia companies have received FCC approval for UWB technology, none have done so without waiver – until now," said Tom Hamilton, executive vice president and general manger of Focus Enhancements' semiconductor group. "Focus Enhancements has the FCC approval necessary to accomplish its goal to deliver longer distances and faster wireless transfer rates for manufacturers of consumer electronics and personal computer peripherals used worldwide."

"The ability to use DS-OFDM has several significant advantages in the UWB space," said Michael Ngo, vice president of engineering of Focus Enhancements' semiconductor group. "In the U.S., Talaria(TM), our wireless UWB technology which uses

DS-OFDM, will be able to access all 7 GHz of the available UWB spectrum. In Europe, where it looks like UWB will be restricted to the frequency range between 6 GHz and 10 GHz, we will be able to use all 4 GHz of the allocated frequency; and in Japan, we can use all 3 GHz allocated between 7 GHz and 10 GHz."

... (further paragraphs of the press release with introduction of the UWB technology and its benefits omitted)

During the coding process, the author in charge of press releases from *Focus Enhancements* was not sure if the aforementioned press release should be classified into the category "business development" or the category "other". During one of the review meetings for the coding, all three authors reviewed this press release and decided together that this press release mainly provided information about one of the principal technologies used in the firms' products. As the firm provided electronic products in production, conversion and transmission of videos within the technology industry, the approval decision made by the regulatory body could have material impact for the use of such technology in the firm's product and thus the successful launch and promotion of its products.[22] Therefore, we decided to classify this press release into the category "business development". In addition, we also updated the coding guideline for category "business development" to include: *PRs about decision of a governmental regulatory body, such as Federal Aviation Administration (FAA), Federal Communications Commission (FCC), Food and Drug Administration (FDA) about the product or operation of the firm. However, this does not include decisions of regulatory bodies for stock exchange or other financial market supervisory bodies regarding the security of the firm.*[23]

In addition, due to unavailability of certain data on the independent variables used in our regression models (specified in the next section) for some firms or years, further press

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[22]Indeed, a subsequent press release of *Focus Enhancements* on January 16, 2007 also refers to UWB technology as one of the determinants for the acceptance of its TV-out semiconductors in portable media players.

[23]See appendix J for the detailed coding guideline for each press release category.

releases have dropped out of the sample, resulting to a final sample size of 163.230 press releases for 689 firm-years in total.

3.4 Research design

We set up regression models with the quantity, the readability, and the sentiment of disclosure as dependent variables.

3.4.1 Disclosure quantity

For disclosure quantity as the dependent variable, the regression model is specified by:

$$
\begin{aligned}
NOYEARLYPRS_{i,t} =& \beta_0 + \beta_1 RTRANNUAL_{i,t} + \beta_2 ZSCORE_{i,t} + \beta_3 ANFOLL_{i,t} \\
& + \beta_4 CEOTEN_{i,t} + \beta_5 TAKEOVERBID_{i,t-1} + \beta_6 SUBOFF_{i,t} \\
& + \beta_7 LNASSETS_{i,t} + \beta_8 HERFIND_{i,t} + \delta_i + \gamma_t + \epsilon_{i,t}. \quad (3.2)
\end{aligned}
$$

A summary description for all variables can be found in table 3.1 below.

The variable $NOYEARLYPRS_{i,t}$ denotes the number of press releases for a specific firm-year. The subscripts i and t denote the respective firm and year.

We use two proxies to estimate the degree of financial distress. The variable $RTRANNUAL_{i,t}$ denotes the annual average of daily return of the stock for firm i in year t. We use the return as an overall indicator for firm's financial performance and proxy for financial distress because firms in financial distress are also very likely to experience poor financial performance and low return period on capital market. The variable $ZSCORE_{i,t}$ denotes the level of financial distress as measured by Altman's Z-score (Altman and Hotchkiss, 2006) for the firm i based on the financial data for the year t. The data required to

Table 3.1: Variable description

Variable Name	Variable Description
$NOYEARLYPRS_{i,t}$	Annual number of the press releases of firm i for year t; proxy for the disclosure quantity
$RTRANNUAL_{i,t}$	Annual average of the daily return of the stock for firm i in year t; proxy for financial distress via financial performance measurement
$ZSCORE_{i,t}$	Altman's Z-score for firm i based on the financial data of the firm in year t; proxy for financial distress
$ANFOLL_{i,t}$	Average number of analysts issuing an analyst earnings forecast in the year t for the firm i; proxy for information asymmetry on the capital market
$CEOTEN_{i,t}$	The tenure of the CEO of firm i in the year t calculated as number of years since the incumbent CEO assumes the office till year t; measurement for management entrenchment and therefore used as proxy for risk of job loss for the management
$TAKEOVERBID_{i,t-1}$	Dummy variable, taking value one, if the firm i had received a take-over bid in the year $t-1$, otherwise taking the value zero; proxy for risk of job loss for the management
$SUBOFF_{i,t}$	Dummy variable; it takes the value one, if the firm i had made any public offering or private placement of its security. Otherwise it takes the value zero; proxy to control for any event-triggered change in disclosure behavior due to regulatory requirement for security issuance
$LNASSETS_{i,t}$	Logarithm of the assets for firm i in year t; control for firm's size
$HERFIND_{i,t}$	Herfindahl Hirschman Index of the industry in which firm i is classified into based on its SIC code for the year t; proxy for the degree of competition in the industry
$RS_{i,t}$	Average readability score of all press releases for firm i in year t, measured by one of the two scores based on prior linguistic research; proxy for the disclosure readability
$SENTIMENT_{i,t}$	Average sentiment score of all press releases for firm i in year t, calculated based one of two dictionaries for word sentiment used in prior linguistic and disclosure research; proxy for disclosure sentiment
$\beta_0..\beta_8$	Regression coefficients
δ_i	Company fixed effect for firm i, to control for company specific effects that is constant for a specific firm across the time horizon of the studied data
γ_t	Time fixed effect for the year t, to control for macroeconomic effects that apply to all firms in one specific year
$\epsilon_{i,t}$	Errors and residuals

calculate the annual average daily returns is extracted from CRSP database and the data required to calculate the Altman's Z-score is extracted from the Compustat/CRSP merged database.

To control for capital market based incentives, we use the variable $ANFOLL_{i,t}$ which denotes the degree of analyst following of a specific firm. The variable is calculated as the average number of analysts issuing an analyst annual earnings forecast in the year t for the firm i. We choose this proxy to control for the overall information asymmetry ov the firm on the capital market. The number of analysts following the firm reflects the attention a firm receives from the analysts which in turn have positive effects on reducing the information asymmetry. Such an analyst forecast is typically issued and subsequently updated monthly. Therefore the average is calculated out of the monthly number of analysts issuing the forecast for the year t. In case no record can be located in the Institutional Brokers' Estimate System (I/B/E/S) database for a specific firm in the sample for a specific year, the variable is set to zero for that specific firm-year, as we assume no analyst issued a forecast the firm in this case.

To control for incentives resulting from opportunistic utility maximization of managers, we use two proxies for the degree of management's concern about losing the job. The variable $CEOTEN_{i,t}$ captures the tenure of a firm's CEO in years. To obtain the CEO tenure, we calculate the difference between the announcement date and the date of CEO appointment as recorded in the Compustat Execucomp database. The CEO tenure is a frequently used proxy for management entrenchment in prior studies. And the risk of job loss is expected to be negative correlated with the increase of management entrenchment. The variable $TAKEOVERBID_{i,t-1}$ represents a dummy variable which takes the value 1 if there has been a takeover bid in the year $t-1$ for firm i. It is set to the value 0 otherwise. The take-over bids are identified by the Thomson Reuters' SDC-Platinum Merger & Acquisition (SDC-Platinum) database. A take-over bid would mean elevated risks of the current management team to lose their jobs.

Another control variable is denoted by the dummy variable $SUBOFF_{i,t}$ which is set to

1 if there has been any public offering or private placement of stocks or bonds for firm i in year t. This variable intends to control for any event-triggered special regulatory requirements on disclosure when firms issue new securities.

The variable $LNASSETS_{i,t}$ denotes the size of the firm in form of the logarithm of its total assets as extracted from the Compustat/CRSP merged database.

To control for the impact from product market considerations, we use the variable $HERFIND_{i,t}$. It denotes the Herfindahl Hirschman Index (HHI) of the industry into which firm i is classified based on Standard Industrial Classification (SIC)-Code for the year t. The HHI is one of the established key figures measuring the concentration of the market and hence the competitiveness at the industrial level. This figure is used by the U.S. Department of Justice (DoJ) in issues of antitrust and merger enforcement (United States Department of Justice and Federal Trade Commission, 2010). Also, research in other fields such as economics (e.g., Nawrocki and Carter, 2010) and finance (e.g., Gaspar and Massa, 2006) also uses this index as proxy for the market competition. The HHI is calculated as the summed square of the market share of all firms within the industry. The HHI increases with the market concentration, indicating a reduced competition on the product market. At its extreme, a HHI with the maximal value 1 indicates a complete monopoly and zero competition. The variable is calculated based on the extracted data about the revenues of all firms for 1998 to 2011 from the Compustat/CRSP Merged Database. The firms are sorted into industries based on their two digit SIC-Code and the HHI and market share is then calculated based on the corresponding revenues of the firms per industry.

The heterogeneity between companies is controlled by a company-fixed effect, denoted with δ_i. The varaible γ_t represents a control variable for the time-fixed effect.

3.4.2 Disclosure readability

For the readability of the press releases as the dependent variable, the regression model is specified by:

$$
\begin{aligned}
RS_{i,t} =& \beta_0 + \beta_1 RTRANNUAL_{i,t} + \beta_2 ZSCORE_{i,t} + \beta_3 FRACTIONHL_{i,t} + \beta_4 ANFOLL_{i,t} \\
& + \beta_5 CEOTEN_{i,t} + \beta_6 TAKEOVERBID_{i,t-1} + \beta_7 SUBOFF_{i,t} + \beta_8 LNASSETS_{i,t} \\
& + \beta_9 HERFIND_{i,t} + \delta_i + \gamma_t + \epsilon_{i,t}.
\end{aligned}
\tag{3.3}
$$

$RS_{i,t}$ is the annual readability score of the press releases for the firm i in year t. To calculate this score, we first calculate the individual readability score for each press release. Then the average of the readability scores of all press releases of each firm-year is calculated as a data point. We measure the readability with two commonly used scores in the linguistic research: the FKG (e.g., Dempsey et al., 2012) and the FOG (e.g., Li, 2008). Originally created in 1975 in a study for the U.S. navy as a readability measure[24], the FKG is tailored to American academic English and returns the school grade necessary for an average student to understand a given text. It is calculated as

$$
\begin{aligned}
FKG =\ & 0.39 \times \left(\frac{\text{total number of words}}{\text{total number of sentences}} \right) \\
& + 11.8 \times \left(\frac{\text{total number of syllables}}{\text{total number of words}} \right) - 15.59
\end{aligned}
\tag{3.4}
$$

We use this measure for its ease of interpretation as a grade level.

The FOG is structurally comparable to the FKG. It also returns a metric interpretable as a grade level, but with a different weighing of average words per sentence and average

---

[24]See Kincaid et al. (1975) for a detailed description of the development of the index as well as the ability of the index value to represent the required grade level for reading comprehension.

syllables per word. The FOG is calculated as[25]

$$FOG = 0.4 \times \left(\frac{\text{total number of words}}{\text{total number of sentences}} + \frac{\text{total number of complex words}}{\text{total number of words}} \right) \quad (3.5)$$

Text with FOG above 18 is seen as unreadable; A value within the range 14-18 suggests very difficult readable text; 12-14 ideally readable; 10-12 acceptable and 8-10 childish (Li, 2008).

Compared to FOG, the FKG is considerably more widely used. The United States Department of Defense has incorporated the measure into one of its standard (DOD MIL-M-38784B) for writing technical manuscripts (United States Department of Defense, 1995). It is also used by other governmental agencies such as the Internal Revenue Service, the Social Services Administration (DuBay, 2007, p. 93) and the Department of Administrative Services of Oregon. In addition, the FKG is incorporated as a standard feature of Microsoft Office Word, suggesting its wide use. Therefore, we decided to use the FKG as our main measure and the FOG as a secondary measure for robustness check on the results. We use a Perl function from the Lingua::EN:Fathom package to calculate FKG and FOG for all press releases in our sample.[26] Since we have the scores calculated by a computer program, we need to make sure that the texts are free of clutter. Therefore, we strip the press releases from tables and disclaimers. Since LexisNexis returns plain, unstructured text documents, Perl is not able to recognize tables automatically and counts headlines and cell entries in tables as words and sentences. This would distort the first fraction in the Equation (3.4). We avoid this by removing the tables manually. Likewise, disclaimers regarding forward-looking information do not vary for a given firm and they tend to be dictated by the legal department of the firm. Thus, they are not under management's discretion and decrease the informativeness of readability scores. Again, as the text documents contain no computer-readable markups, we manually removed the disclaimers before feeding the texts to Perl.

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[25]Complex words are defined as words with three or more syllables.

[26]See http://search.cpan.org/dist/Lingua-EN-Fathom/lib/Lingua/EN/Fathom.pm for further information.

In addition to the same independent variables utilized in the model of disclosure quantity, $FRACTIONHL_{i,t}$ is added to denote the fraction of High-Likelihood-Mandatory press releases compared to the total amount of press releases for a firm-year. This is calculated as a percentage of number of press releases which are categorized in HLM categories among the total number of press release of that firm in a year. This variables is used to measure the different strategies management may follow in response to the difference in the discretion over their disclosure decision.

3.4.3 Disclosure sentiment

For the sentiment of the press releases as dependent variable, a similar regression model is used:

$$
\begin{aligned}
SENTIMENT_{i,t} =& \beta_0 + \beta_1 RTRANNUAL_{i,t} + \beta_2 ZSCORE_{i,t} + \beta_3 FRACTIONHL_{i,t} \\
& + \beta_4 ANFOLL_{i,t} + \beta_5 CEOTEN_{i,t} + \beta_6 TAKEOVERBID_{i,t-1} \\
& + \beta_7 SUBOFF_{i,t} + \beta_8 LNASSETS_{i,t} + \beta_9 HERFIND_{i,t} \\
& + \delta_i + \gamma_t + \epsilon_{i,t}.
\end{aligned}
\tag{3.6}
$$

The variable $Sentiment_{i,t}$ is the annual average of the sentiment score of all press releases for firm i in the year t. To measure the sentiment of the press releases, we calculate the sentiment score based on two established dictionaries: the Harvard IV-4 TagNeg[27] and the FIN list by Lougharn and Mcdonald (2011). Both scores measure the sentiment of a text passage by measuring the relative frequency of positive words net negative words identified in a dictionary.[28] Both scores are calculated based on the following formula[29]

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[27]This dictionary is implemented in the popular linguistic analysis program General Inquirer.

[28]One downside of such a method based on word match with a pre-defined dictionary is the limitation to solely the word-level sentiment. However, the sentiment of a text is not only a matter of word choice but also a matter of choice of phrases and sentence structure. Current common research methods, including the one used in this study, operate only at a word-level (Boudoukh et al., 2013). But they are not sufficient to capture further text sentiment at a phrase level. This also includes problems such as double negative phrases, which would be captured falsely as negative by this method.

[29]The formula assumes that 'neutral' words which don't fall into positive or negative category carry no

with a higher score suggesting more positive sentiment of the analyzed text:

$$\text{Sentiment score} = \frac{\text{Number of positive words} - \text{Number of negative words}}{\text{Number of positive words} + \text{Number of negative words}}$$

However the two dictionaries were developed with focus for different textual context. The IV-4 was initially developed for textual analysis in context of psychology and sociology. On the contrary, the FIN list was specially developed to analyze the textual sentiment in a business communication. Obviously, which words are categorized as negative has a strong impact on the resulted sentiment score. Lougharn and Mcdonald (2011) argues that the IV-4 dictionary is less appropriate for textual analysis of business writing due to its original design purpose. Therefore, we will primarily use the sentiment score based on the Fin list as our proxy for disclosure sentiment. Since the Harvard IV-4 dictionary was widely used in extant literature (e.g., Tetlock, 2007; Tetlock et al., 2008; Davis and Tama-Sweet, 2012), we use it as a secondly proxy to examine the robustness of our results. We use a self-programmed script to calculate the sentiment score based on FIN-List and the polarity packet in the program R to calculate the sentiment score based on Harvard IV-4 List.

3.5 Results and implications

3.5.1 Descriptive statistics

The table 3.2 provides an overview of the descriptive statistics of the data points we have in the final sample. In total, we have a panel-data of 689 data points out of 16.230 press releases from 92 firms.

On average, the firms published roughly 24 press releases annually or 2 press releases a month. It is noticeable that the number of good news and bad news press releases is

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incremental information regarding the sentiment of the text and thus excludes them from the calculation of relative frequency or 'net positiveness' of the text.

Table 3.2: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
NOYEARLYPRS	23.556	16.253	1	164	689
NOYEARLYPRS_P	12.017	9.638	0	81	689
NOYEARLYPRS_N	11.517	9.346	0	83	689
NOYEARLYPRS_HL	9.898	5.795	0	45	689
NOYEARLYPRS_LL	13.657	13.505	0	133	689
GUNANN	18.407	2.484	10.405	28.588	689
GUNANN_P	18.394	2.635	10.256	29.902	683
GUNANN_N	18.434	2.684	10.207	28.962	641
KINCAIDANN	14.829	2.302	7.646	24.307	689
KINCAIDANN_P	14.817	2.434	7.475	25.482	683
KINCAIDANN_N	14.865	2.489	7.486	24.413	641
SENTANN	0.491	0.167	-0.274	0.872	689
SENTANN_P	0.492	0.166	-0.274	0.872	683
SENTANN_N	0.493	0.166	-0.274	0.872	641
FINANN	0.004	0.008	-0.027	0.03	689
FINANN_P	0.004	0.009	-0.034	0.036	683
FINANN_N	0.004	0.008	-0.027	0.034	641
RTRANNUAL	0	0.003	-0.007	0.009	689
ZSCORE	1.837	4.856	-16.733	20.84	689
ANALFOLL	2.827	4.376	0	28.917	689
CEOTEN	6.994	8.269	0	55	689
TAKEOVERBID	0.071	0.257	0	1	689
SUBOFF	0.271	0.445	0	1	689
LNASSETS	5.586	1.818	1.265	10.399	689
HERFIND	814.679	669.657	251.227	4608.572	689

NOYEARLYPRS denotes the number of press releases per firm-year; NOYEARLYPRS_P denotes the number of good news press releases per firm-year; NOYEARLYPRS_N denotes the number of bad news press releases per firm-year; NOYEARLYPRS_HL denotes the number of press releases which are classified as Highly Likely Mandatory per firm-year; NOYEARLYPRS_LL denotes the number of press releases which are classified as Low Likely Mandatory per firm-year; GUNNING_ANN denotes the average FOG of all press releases of a firm-year; GUNNING_ANN_P denotes the average FOG of good news press releases of a firm-year; GUNNING_ANN_N denotes the average FOG of bad news press releases of a firm-year; KINCAID_ANN denotes the average FKG of all press releases of a firm-year; KINCAID_ANN_P denotes the average FKG of good news press releases of a firm-year; KINCAID_ANN_N denotes the average FKG of bad news press releases of a firm-year; SENTANN denotes the average sentiment score of all press releases in a firm-year calculated based on the Harvad IV-4 dictionary; SENTANN_P denotes the average sentiment score of good news press releases in a firm-year calculated based on the Harvad IV-4 dictionary; SENTANN_N denotes the average sentiment score of bad news press releases in a firm-year calculated based on the Harvad IV-4 dictionary; FINANN denotes the average sentiment score of all press releases in a firm-year calculated based on the Fin-Neg list; FINANN_P denotes the average sentiment score of good news press releases in a firm-year calculated based on the Fin-Neg list; FINANN_N denotes the average sentiment score of bad news press releases in a firm-year calculated based on the Fin-Neg list; RTRANNUAL denotes the annual average of daily stock return per firm-year; ZSCORE denotes the Z-Score based on the financial data of a firm-year; ANFOLL denotes the number of analysts that follows the firm in a year; CEOTEN denotes the tenure defined as years in position of the CEO per firm-year; TAKEOVERBID is a dummy variable taking the value 1 if there was a takeover bid for the firm in the previous year and 0 otherwise; SUBOFF is a dummy variable taking the value 1 if there was a capital rise via public offering or private placement and 0 otherwise; LNASSETS denotes the logarithm of firm size based on the book value of the assets per firm-year; HERFIND denotes the Herfindahl Hirschman Index per firm-year.

distributed quite evenly on average, accounting for 12 press releases annually each.

Both the FKG (and FOG) are at noticeable high level with an average of 14.8 (18.5), a minimum of 7.6 (10.4) and a maximum of 24.3 (28.5) respectively. This suggests that the press releases are typically complex and require a college education for good comprehension. These results are in-line with similar prior studies: though not analyzing press releases, prior literature with focus on readability of firms' annual reports produced similar results. Dempsey et al. (2012) reported an average of 12.8 (minimum: 6.5; maximum: 20.5) for the FKG of 1,573 annual reports in his sample. Using FOG as a measure, Li (2008) reported an average of 19.2 for 55,719 annual reports in his sample, which also underlines the complexity of the corporate financial disclosure. Also noticeable, the average readability scores (both FKG and FOG) of good news press releases and bad news press releases do not differentiate largely from the overall average. This seems to suggest the management doesn't intentionally increase the readability of good news information so as to facilitate the understanding, contradicting the suggestion by IRH.

The average sentiment scores of both good news press releases and bad news press releases are similar to the average of all press releases. This is the case for the scores calculated based on both the IV-4 and FIN list. As the means of the scores are positive, this may suggest that the management try to keep the sentiment positive no matter whether the subject matter is of good or bad news nature.

3.5.2 Regression analysis

Disclosure quantity

First of all, we test our hypothesis regarding the disclosure quantity. We run the regressions without differentiation between press releases in HLM and LLM classes. Table 3.3 provides an overview of the test results.

Table 3.3: Regression analysis – disclosure quantity: overall results

VARIABLES	(1) NOYEARLYPRS	(2) NOYEARLYPRS_P	(3) NOYEARLYPRS_N
RTRANNUAL	50.38	116.3	-65.77
	(138.848)	(99.69)	(111.9)
ZSCORE	-0.20	-0.109	-0.0903
	(0.127)	(0.0681)	(0.0773)
ANALFOLL	0.71*	0.256	0.448*
	(0.411)	(0.248)	(0.240)
CEOTEN	0.14	0.130	0.0151
	(0.136)	(0.0851)	(0.0848)
TAKEOVERBID	1.87	0.449	1.454
	(1.911)	(0.990)	(1.472)
SUBOFF	4.71***	2.807**	1.931**
	(1.718)	(1.080)	(0.961)
LNASSETS	3.82***	2.057***	1.756**
	(1.151)	(0.637)	(0.710)
HERFIND	-0.00	8.81e-05	-0.000452
	(0.003)	(0.00134)	(0.00156)
Constant	-8.55	-0.728	-7.824
	(9.324)	(4.639)	(5.812)
Observations	689	689	689
Number of cik	92	92	92
Adjusted R-squared	0.132	0.112	0.118
F test	4.385	5.445	3.494
P-value of F model	1.17e-06	2.14e-08	4.07e-05

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

NOYEARLYPRS denotes the number of press releases per firm-year; NOYEARLYPRS_P denotes the number of good news press releases per firm-year; NOYEARLYPRS_N denotes the number of bad news press releases per firm-year.

Overall, the total disclosure quantity measured by the number of press releases seems not to be directly influenced by the financial performance and the degree of financial distress.[30] This picture remains when good news press releases and bad news press releases are studied separately. Conventional expectation may suggest that firms face bad news more frequently than good news when the financial distress worsens, which then leads to an increase in disclosable bad news and decrease in disclosable good news. The lack of association between the total disclosure quantity and the financial distress may firstly be explained by the change of composition of good news vs bad news among the disclosable news in the course of deepening financial distress without substantial change of total quantity of disclosable information. However, the lack of such an association for the split samples of only good-news (respectively bad news) press releases may be a first indicator that management strategically smooth the quantity of press releases to maintain a steady level of disclosure quantity.

A second examination of the press releases with the distinction between HLM and LLM classes sheds more light on this hypothesized behavior. Table 3.4 provides an overview of the regression on disclosure quantity where we run the regressions on split samples – one containing only press releases which are highly likely mandatory and one containing low likely mandatory press releases. Regression (4) to (6) in table 3.4 are estimated based on press releases which are classified into the HLM category, whilst regression (7) to (9) are estimated based on press releases in the category LLM. The first regression of the three-regression-set is based on both positive and negative press releases. The second is based solely on a split sample of positive press releases. And the third is based on a split sample of negative press release.

Regression (5) and (6) suggest that the disclosure quantity for HLM press releases is associated with financial performance and the degree of distress. In concrete, The good news disclosure quantity is positively associated with the financial performance and (contrary to the hypothesis) weakly significant (at 10% level) positively associated with the degree

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[30]In Regression (1), the coefficients for both average annual return and the Z-score are not significantly different than zero.

of financial distress. The bad news disclosure quantity is negatively associated with the financial performances and positively associated with the degree of financial distress. In contrast to this, regression (8) and (9) suggest that the quantity of press releases classified in LLM categories are not influenced by the financial performance or degree of financial distress. Consistent with Hypothesis H1a1, this evidence suggests the change of disclosure quantity is mainly driven by HLM disclosure, where the management has little discretion to suppress bad news. However, for subject matters for which the management has large degree of discretion, the quantity of press releases is unrelated to the degree of financial distress. This is consistent with Hypothesis H2a1 and H2a2. Put togehter, the findings suggest that the management does strategically manage the disclosure quantity when it has the discretion. In particular, it seems to smooth the fluctuation of good and bad news using contents for which it has more decision discretion over the disclose vs. withhold decision.

Table 3.4: Regression analysis – disclosure quantity: split sample with distinction between Highly Likely Mandatory (HLM) press releases and Low Likely Mandatory (LLM) press releases

VARIABLES	(4) NOYEARLYPRS_HL	(5) NOYEARLYPRS_HL_P	(6) NOYEARLYPRS_HL_N	(7) NOYEARLYPRS_LL	(8) NOYEARLYPRS_LL_P	(9) NOYEARLYPRS_LL_N
RTRANNUAL	113.4	223.9***	-97.72*	-63.06	53.10	-112.9
	(65.75)	(40.83)	(51.51)	(102.4)	(56.47)	(68.65)
ZSCROE	-0.112**	-0.0539*	-0.0653**	-0.0836	-0.0202	-0.0656
	(0.0516)	(0.0301)	(0.0279)	(0.0887)	(0.0502)	(0.0441)
ANFOLL	0.0938	0.0555	0.0450	0.612	0.262	0.351*
	(0.116)	(0.0654)	(0.0752)	(0.386)	(0.198)	(0.195)
CEOTEN	-0.0219	-0.0226	0.00351	0.165	0.0306	0.135**
	(0.0511)	(0.0306)	(0.0368)	(0.109)	(0.0626)	(0.0611)
TAKEOVERBID	1.057*	1.118**	-0.111	0.817	0.566	0.230
	(0.589)	(0.510)	(0.455)	(1.737)	(0.921)	(1.025)
SUBOFF	1.598***	0.642*	0.908***	3.117**	1.544**	1.561*
	(0.490)	(0.380)	(0.257)	(1.414)	(0.698)	(0.788)
LNASSETS	1.500***	0.647**	0.885***	2.315***	1.414***	0.894*
	(0.420)	(0.254)	(0.245)	(0.851)	(0.467)	(0.464)
HERFIND	-0.00118	-0.000726	-0.000449	0.000829	0.000351	0.000470
	(0.00133)	(0.000748)	(0.000685)	(0.00162)	(0.000918)	(0.000786)
Constant	-0.757	-0.459	-0.504	-7.794	-4.419	-3.347
	(3.798)	(2.188)	(2.016)	(6.721)	(3.227)	(3.940)
Observations	689	689	689	689	689	689
Number of cik	92	92	92	92	92	92
Adjusted R-squared	0.096	0.097	0.064	0.096	0.076	0.085
F test	3.138	3.607	2.631	5.124	3.796	4.795
P-value of F model	0.000173	2.58e-05	0.00138	7.01e-08	1.20e-05	2.42e-07
Firm-fixed effects	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

NOYEARLYPRS_HL denotes the number of press releases which are classified in Highly-Likely-Mandatory (HLM) categories based on subject matter per firm-year; NOYEARLYPRS_HL_P denotes the number of good news press releases which are classified in HLM categories per firm-year; NOYEARLYPRS_HL_N denotes the number of bad news press releases which are classified in HLM categories per firm-year; NOYEARLYPRS_LL denotes the number of press releases which are classified in Low-Likely-Mandatory (LLM) categories based on subject matter per firm-year; NOYEARLYPRS_LL_P denotes the number of good news press releases which are classified in LLM categories per firm-year; NOYEARLYPRS_LL_N denotes the number of bad news press releases which are classified in LLM categories per firm-year.

Disclosure readability

We further investigate the association between the readability of textual disclosure and the degree of financial distress. In particular, we aim to examine whether the management uses its discretion in readability to compensate the lack of discretion when making disclosure decisions with subject matters which are in scope of mandatory disclosure. Table 3.5 presents an overview of the results. Regression (10) and (11) are estimated based on FKG and FOG as dependent respectively for all press releases. Regression(12) and (13) are estimated based on FKG and FOG respectively with only good news press releases. And analogously, the regression (14) and (15) are estimated using only bad news press releases.

Regression (10) and (11) reveal some weak evidence that the complexity of the press releases is associated with the financial performance and degree of financial distress. However it shows a somewhat inconsistent picture. On the one hand, both readability scores are negatively associated with the annual average daily return, indicating increasing readability with increasing financial performance. On the other hand, they are positively associated with z-score, indicating decreasing readability with ease of financial distress. Together this suggests an inconclusive test result whether Hypotheses H2 can be confirmed. There seems to be no clear evidence that the management strategically steer the readability of the textual disclosure in a whole based on the firm's financial performance and financial health. To further examine whether the management specially tailors the readability of HLM press releases so as to compensate their lack of discretion for the disclose vs. withhold decision, we use the dependent variable $FRACTIONHL$ ($FRACTIONHL\_P$ and $FRACTIONHL\_N$ respectively for good news and bad news split samples). If the management treats the readability of HLM press releases differently than that of the LLM, the loading of these variables should be significantly different than zero. Regression (10) to (15) reveal however that the loading is only significant at a weak 10% level in one instance.

Overall the empirical evidence from this sample doesn't support the hypothesis that the management systematically manages the readability depending on the financial performance or its financial health. In addition, no evidence can be found to support the hypothesis that the management systematically takes its advantage of high discretion over disclosure readability to compensate its lack of discretion over the disclose vs. withhold decision when facing a subject matter that falls under mandatory disclosure regulation.

Disclosure sentiment

Textual sentiment is another disclosure dimension where the management enjoys a high degree of discretion. The regression analysis about the impact of financial distress on the disclosure choice of sentiment is presented in Table 3.6. Regression (16) and (17) are estimated based on the sentiment score calculated based on the IV-4 dictionary and the FIN list respectively. Regression (18) and (19) are estimated using only good news press releases. Regression (20) and (21) are estimated using only bad news press releases.

Consistent with H3, the Z-score is positively associated with the sentiment score of the press releases for 5 of 6 regression models. This indicates, overall, the textual sentiment as a disclosure characteristic is informative regarding firm's degree of distress. Interestingly, this effect is prevalent not only for good news but also for bad news disclosure, indicating that the management does not seem to strategically use this dimension to soften bad news disclosure in times of increased financial distress.

Regarding the difference in treatment between HLM and LLM press releases, all regressions presented significant loadings for the variable "proportion of HLM press releases" (variable $FRACTIONHL$, $FRACTIONHL\_P$ and $FRACTIONHL\_N$ respectively). However, surprisingly, the coefficients of this variable are consistently negative across all 6 regressions, indicating HLM press releases are actually more pessimistic than LLM press releases. This indicates, in contrast to the original hypotheses in H3a1 to H3a3, that the

Table 3.5: Regression analysis – disclosure readability

VARIABLES	(10) GUNANN	(11) KINCAIDANN	(12) GUNANN_P	(13) KINCAIDANN_P	(14) GUNANN_N	(15) KINCAIDANN_N
RTRANNUAL	-57.30**	-47.28*	-50.61	-44.58	-35.66	-21.12
	(28.621)	(25.76)	(33.16)	(30.07)	(39.22)	(35.08)
ZSCORE	0.04**	0.0308*	0.0575**	0.0460**	0.0299*	0.0232
	(0.018)	(0.0169)	(0.0229)	(0.0218)	(0.0175)	(0.0158)
FRACTIONHL	-0.39	-0.592				
	(0.579)	(0.516)				
FRACTIONHL_P			-0.492	-0.731*		
			(0.435)	(0.385)		
FRACTIONHL_N					-0.126	-0.375
					(0.578)	(0.519)
ANALFOLL	-0.05	-0.0370	-0.0570	-0.0411	-0.0116	-0.00957
	(0.031)	(0.0245)	(0.0378)	(0.0307)	(0.0346)	(0.0287)
CEOTEN	0.02	0.0236	0.0148	0.0165	0.0312	0.0279
	(0.032)	(0.0301)	(0.0363)	(0.0332)	(0.0335)	(0.0321)
TAKEOVERBID	-0.27	-0.205	-0.391	-0.306	-0.212	-0.138
	(0.233)	(0.208)	(0.243)	(0.214)	(0.305)	(0.277)
SUBOFF	0.16	0.117	0.157	0.109	0.0451	0.0197
	(0.186)	(0.168)	(0.209)	(0.188)	(0.214)	(0.196)
LNASSETS	0.03	0.0684	-0.0522	-0.0337	-0.0481	0.0303
	(0.209)	(0.179)	(0.226)	(0.194)	(0.223)	(0.200)
HERFIND	0.00	0.000227	0.000130	0.000227	0.000294	0.000328
	(0.000)	(0.000431)	(0.000617)	(0.000586)	(0.000354)	(0.000330)
Constant	17.74***	14.08***	18.65***	15.00***	17.58***	13.97***
	(1.523)	(1.329)	(1.599)	(1.384)	(1.769)	(1.592)
Observations	689	689	683	683	641	641
Number of cik	92	92	92	92	90	90
Adjusted R-squared	0.281	0.301	0.195	0.213	0.282	0.297
F test	4.619	4.495	3.577	3.542	5.395	5.766
P-value of F model	3.15e-07	5.16e-07	2.16e-05	2.51e-05	1.83e-08	4.70e-09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

GUNANN denotes the average FOG of all press releases of a firm-year; KINCAIDANN denotes the average FKG of all press releases of a firm-year; GUNANN_P denotes the average FOG of good news press releases of a firm-year; KINCAIDANN_P denotes the average FKG of good news press releases of a firm-year; GUNANN_N denotes the average FOG of bad news press releases of a firm-year; KINCAIDANN_N denotes the average FKG of bad news press releases of a firm-year; FRACTIONHL denotes the percentage share of HLM press releases in the total number of press releases of a firm-year; FRACTIONHL_P denotes the percentage of good news HLM press releases in the total number of good news press releases of a firm-year; FRACTIONHL_N denotes the percentage of bad news HLM press releases in the total number of bad news press releases of a firm-year.

Table 3.6: Regression analysis – disclosure sentiment

VARIABLES	(16) SENTANN	(17) FINANN	(18) SENTANN_P	(19) FINANN_P	(20) SENTANN_N	(21) FINANN_N
RTRANNUAL	-0.82	-0.0367	-1.029	0.0257	-1.649	-0.0537
	(1.824)	(0.0734)	(1.775)	(0.0958)	(1.892)	(0.0919)
ZSCORE	0.00**	0.000106*	0.00256**	0.000122**	0.00243**	9.57e-05
	(0.001)	(5.43e-05)	(0.00113)	(5.98e-05)	(0.00110)	(6.85e-05)
FRACTIONHL	-0.14***	-0.00668***				
	(0.041)	(0.00161)				
FRACTIONHL_P			-0.106***	-0.00340**		
			(0.0276)	(0.00149)		
FRACTIONHL_N					-0.0697**	-0.00796***
					(0.0313)	(0.00130)
ANALFOLL	0.00	-0.000107	0.00276	-3.79e-05	0.00158	-0.000209*
	(0.002)	(7.48e-05)	(0.00213)	(9.33e-05)	(0.00206)	(0.000116)
CEOTEN	0.00	-1.81e-05	0.000231	-1.92e-05	0.000956	-3.85e-05
	(0.002)	(9.24e-05)	(0.00198)	(0.000107)	(0.00207)	(9.61e-05)
TAKEOVERBID	-0.01	-0.00121*	-0.00747	-0.00118	-0.00611	-0.00131
	(0.014)	(0.000717)	(0.0144)	(0.000828)	(0.0148)	(0.000946)
SUBOFF	-0.01	0.000761	-0.0140	0.000396	-0.00976	0.00114*
	(0.010)	(0.000489)	(0.0102)	(0.000546)	(0.0103)	(0.000589)
LNASSETS	0.03**	-0.000905*	0.0267**	-0.000817	0.0314**	-0.000975
	(0.012)	(0.000539)	(0.0123)	(0.000553)	(0.0124)	(0.000685)
HERFIND	0.00	-1.95e-06*	2.23e-05	-1.73e-06	1.78e-05	-2.93e-06***
	(0.000)	(1.13e-06)	(1.81e-05)	(1.54e-06)	(1.76e-05)	(1.00e-06)
Constant	0.35***	0.0172***	0.329***	0.0136***	0.294***	0.0200***
	(0.073)	(0.00451)	(0.0768)	(0.00494)	(0.0848)	(0.00631)
Observations	689	689	683	683	641	641
Number of cik	92	92	92	92	90	90
Adjusted R-squared	0.152	0.111	0.152	0.067	0.148	0.132
F test	3.506	4.059	3.670	2.672	3.626	4.446
P-value of F model	2.91e-05	2.98e-06	1.47e-05	0.000971	1.89e-05	6.95e-07

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

SENTANN denotes the average net positive sentiment of all press releases in a firm-year measured based on IV-4 dictionary. FINANN denotes the average net positive sentiment of all press releases in a firm-year measured based on the FIN list. SENTANN_P denotes the average net positive sentiment of good-news press releases in a firm-year measured based on IV-4 dictionary. FINANN_P denotes the average net positive sentiment of all good-news press releases in a firm-year measured based on the FIN list. SENTANN_N denotes the average net positive sentiment of bad-news press releases in a firm-year measured based on IV-4 dictionary. FINANN_N denotes the average net positive sentiment of all bad-news press releases in a firm-year measured based on the FIN list.

management doesn't actually seek to use positive sentiment to soften their mandatory disclosure where they have less discretion to suppress the disclosure of the information itself. Instead, the management actually uses a more pessimistic textual sentiment despite their discretion. This observation might be explained by incentives other than "masking bad news".

The intension to mitigate possible "litigation risks" might be one possible explanation for such disclosure behavior. Rogers et al. (2011) suggest that earnings announcements, among diverse other types of corporate disclosure instruments, e.g., SEC filings, non-earning related press releases, non-earning related conference call, etc., are the most often cited disclosure in plaintiffs' allegation during rule 10b-5 shareholder lawsuits. Also Davis et al. (2012) suggests capital market reacts more sensitively to earnings announcements than information disclosed in MD&A section of firm's 10-K filing. Since a significant price change can lead to potential plaintiffs' arguing for damages in a possible lawsuit, the earnings announcement brings a higher risk compared to other disclosure. Rogers et al. (2011) further demonstrate evidence that overly optimistic earnings announcements are significantly associated with increased probability of being suited in a 10b-5 private litigation.

In our sample, earnings announcements and earnings related press releases construct over one-third of the press releases within the HLM class. In addition, press releases concerning a public traded security or an emission of such a security instrument also construct roughly 16% of the press releases within HLM class. An overly optimistic sentiment in such communication could subject the management to high litigation risks. Realizing such risks, the management could overweigh this factor compared to possible benefits from sugarcoating disclosure using optimistic sentiment. The consequence of such a disclosure behavior would be that the HLM press releases exhibit a more negative sentiment compared with LLM press releases for a given degree of financial distress,

Thus, the evidence from this sample suggests the management does not seem to op-portunistically use their discretion in sentiment choice to compensate the lack of such

discretion when making disclose vs. withhold decision. In fact, the evidence seems to be in line with the conjecture that the management puts more concern on possible litigation risks when deciding on the textual sentiment for the disclosure.

3.6 Concluding remarks

This essay examines the impact of financial distress on management's disclosure behavior. Novel to previous literature with the similar research question, it takes a more differentiated approach regarding the different dimensions of the corporate financial disclosure. Apart from the traditional measurement regarding the quantity of disclosed information, it also examines other dimensions such as the readability and the sentiment. In addition, it aims to examine the interdependencies management's disclosure behavior exhibits towards these dimensions because the management faces different constraints in its decision discretion. Whilst disclosure regulations put strong obligation on management to timely disclose certain information, the rules regarding the style of presentation of such information are more ambiguous. In particular, the management has a large degree of discretion to influence the readability and sentiment of the textual disclosure.

The press releases in the sample contain a diverse type of contents, some of which do not fall under mandatory disclosure requirement with a high probability. Hence this sample allows us to capture management's strategic disclosure behavior regarding to the different discretion over the disclosure decision. In addition, the sample constructs a panel data of 10 years for firms that eventually bankrupted. This allowed us to capture the change of disclosure behavior in accordance to the development of the degree of financial distress.

Overall, the study produced a mixed result regarding the management's strategic disclosure behavior.

First of all, evidence from the sample suggests the management strategically uses its discretion for subject matters which are not subject to disclosure regulation to smooth

the total quantity of disclosure. In particular, the evidence suggests the management maintains the level of disclosure independent of the financial performance and the degree of financial distress for topics which do not typically fall under mandatory disclosure. On the other hand, the disclosure level of content which is typically subject to the mandatory disclosure regulation does vary depending on the financial performance of the firm.

Secondly, only little evidence supports the notion that the management strategically use readability as a textual characteristic to exacerbate readers' comprehension of bad news as the degree of the financial distress and the financial performance worsen. In addition, no evidence suggests the management would strategically use readability in a way to compensate its lack of discretion on subjects over which it has little discretion for the disclose vs. withhold decision.

Thirdly, the evidence suggests the disclosure sentiment becomes more negative as the degree of financial distress intensifies. It also suggests that the management seems to be more "forthcoming" in revealing bad sentiment than revealing bad news when it faces increasing degree of financial distress. In contrast to the readability, the management seems to treat press releases in scope of mandatory disclosure differently than those which are disclosed largely voluntarily. However, contrary to the initial hypothesis, the management generally uses more negative sentiment for mandatory disclosure for a certain degree of financial distress compared to its voluntary disclosure in the same time period. This suggests, instead of sugarcoating the bad news it is obliged to disclose with positive sentiment, the management tends to use a more negative sentiment instead. One plausible explanation to such phenomena is the elevated litigation risk an overly optimistic disclosure may bring with itself. Compared to the disclosure on other subject matters, press releases on earnings announcements and public traded security may attract more attention from the capital market and therefore expose the firm to more litigation risks if they are phrased overly optimistically. As press releases with these subject matters construct a large portion of the subsample containing press releases within scope of mandatory disclosure, the management may intentionally use more negative sentiment for such disclosure to reduce

litigation risks. Though not confirming the initial hypothesis, the sample provides some evidence supporting the assertion that the management strategically uses the sentiment as a disclosure dimension. However the evidence suggests the management seems to put more concern in reducing litigation risks than clouding bad news.

Overall, this study provides mixed evidence to the question if and how the management strategically shapes the firm's financial disclosure when facing the onset of financial distress. On one hand, the management seems to use its discretion when deciding on voluntary disclosure to smooth the overall disclosure quantity of bad news during the worsening of firm's financial performance. On the other hand, it doesn't seem to strategically use the readability and the sentiment of textual disclosure to compensate its lack of discretion regarding the disclose vs. withhold decision for subject matter within scope of mandatory disclosure.

4 Essay on formation of mandatory disclosure regulation: impact of enforcement [31] [32]

4.1 Introduction

Mandatory disclosure requirements are arguably one of the most important institutional features shaping firms' financial reporting. However, the accounting literature coherently concludes that not only accounting standards but various institutional features determine financial reporting outcomes (e.g., Ball et al., 2003; Hope, 2003; Leuz and Wysocki, 2008; Holthausen, 2009; Beyer et al., 2010; Christensen et al., 2013). While this is certainly the case, we still miss a theoretical understanding of how institutional aspects affect certain characteristics of accounting standards in the first place. In this study, we take a step in this direction and examine how enforcement affects managers' collective preference toward the mandatory disclosure regulation. While enforcement is difficult to quantify empirically, the least we need is a better theoretical foundation of how these two important institutional features relate to each other. This seems to be of particular importance as enforcement received increasing attention in the recent empirical literature, e.g., related to the adoption of International Financial Reporting Standards (IFRS) (Daske et al., 2008; Holthausen, 2009; Landsman et al., 2012; Christensen et al., 2013).

The objective of this study is to provide theoretical guidance on how enforcement affects managers' preferences, and how enforcement changes the extent of mandatory disclosure preferred by managers. We demonstrate that informed managers exert political influence toward more extensive mandatory disclosure if enforcement tightens, i.e., the probability of detecting non-compliant behavior increases. Thereby, enforcement might not only induce compliant behavior, but also align preferences of low and high quality firms if low quality firms remain non-complaint. That is, even if the enforcement fails to induce a compliant firm behavior, a tighter enforcement still results in a collective preference toward more extensive mandatory disclosure. Based on this alignment effect, we also demonstrate that disclosure costs reinforce the positive relationship and that a tighter enforcement leads to a substitution of voluntary disclosure by mandatory disclosure if both disclosure channels are endogenously determined. Overall, we show that differences in enforcement affect managers' collective preference which should be of interest to standard setters and regulators. We show that they face different levels of opposition or support with regard to proposed reforms on mandatory disclosure regulation depending on the heterogeneity of the strength of enforcement in their jurisdictions.[33]

We first develop a base model that consists only the essential features and later extend this setting. The economy is populated by managers that are privately informed about their firm's future cash flows. Managers are endowed with shares and sell their stake to investors in a competitive market. Managers are thus aligned with current shareholders' interests and are interested in a high market price of the firm consequently. We further assume that managers are the dominant group exerting influence on properties of the mandatory disclosure rule. That is, all managers collectively agree upon a disclosure threshold, and each manager has one vote in the process. The resulting threshold is determined by majority ruling and becomes "mandatory" for all firms afterwards. Thereby, the underlying disclosure regime is asymmetric, meaning that the information about expected future cash flows below a certain threshold have to be disclosed, whereas the information about ex-

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[33]For example, IFRS were introduced in a one-size-fits-all fashion in the European Union (EU) through the Regulation (EC) No. 1606/2002 (IAS Regulation) of 2002, while enforcement is subject to the individual member states of the EU inducing heterogeneity in enforcement strength (e.g., Berger, 2010).

pected future cash flows above the threshold are not reported until they are realized (e.g., Bertomeu and Magee, 2011; Bertomeu and Cheynel, 2013; Bertomeu and Magee, 2014b). This kind of disclosure requirements are common in impairment accounting, where private information have to be disclosed by an asset impairment if expected future cash flows from an asset fall below a certain threshold, e.g., the lower of cost or market (e.g., Basu, 1997; Göx and Wagenhofer, 2009; Beyer, 2013).[34] Further, managers can decide to be compliant or non-compliant as we assume the enforcement of the regulation to be imperfect. The enforcement strength is modeled as a probability of successfully detecting firms' non-compliant disclosure behavior that is strictly below 100%. Exposed non-compliant firms face a regulatory penalty depending on the potential damage that would have been caused, should the misconduct not be revealed by enforcement. In addition, they are forced to reveal their true firm value in addition.

Our main results show that, tighter enforcement leads to a higher consensus mandatory disclosure level in equilibrium, even if low quality firms have incentives to be non-compliant. We suggest that the role of enforcement is more complex then just inducing compliant disclosure behavior. We find that the inherent imperfection of the enforcement further leads to an alignment of interests between low and high quality firms, if low quality firms have incentives to be non-compliant and abstain from disclosure. Therefore, preferences of managers of low quality firms are aligned with preferences of managers of firms of higher quality who are not mandated to disclose under an asymmetric disclosure regime. Both groups do not intend to disclose private information in response and agree on the level of mandatory disclosure that maximizes their non-disclosure pooling price. If enforcement tightens, low quality firms form a coalition with high quality firms advocating for more extensive mandatory disclosure and take the risk of getting exposed and

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[34]Accounting standards applying similar principles for accounting for fixed assets can be found both in Europe and in the United States. International Accounting Standard (IAS) 36, for example, requires an impairment test for all assets that do not fall in scope of other IAS or International Financial Reporting Standards (IFRS). Thus, it obligates an impairment in case the carrying amount of an asset is above the recoverable amount. Similarly, the Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) 360-10-35-17 also mandates that an impairment loss for a long-lived asset or asset group should be recorded if the carrying amount is not recoverable and exceeds its fair value.

penalized ex-post. As long as these two groups represent a majority, the relation between enforcement and the mandatory disclosure level is positive in equilibrium.

We then extend the base model and introduce voluntary disclosure as an additional disclosure channel. The positive relation between the enforcement and the managers' collective preference toward mandatory disclosure largely persists when both disclosure channels are endogenously determined. However, disclosure costs start to play a stronger role when we include voluntary disclosure because the disclosure costs have impacts on firms' voluntary disclosure choice. We find that disclosure costs reinforce the positive effect of enforcement. Only if disclosure costs are low, such that voluntary disclosure dominates mandatory disclosure and firms of higher quality fully separate by voluntary disclosure, the deliberation over mandatory disclosure becomes obsolete and we find no direct relationship in equilibrium.

Our work in general is related to the literature studying the influence of institutional factors on financial reporting (e.g., Ball et al., 2003; Bushman and Piotroski, 2006; Ball et al., 2008; Christensen et al., 2013). We agree that long-term institutional features lead to differences in firms' individual reporting behavior. However, we also argue that financial market regulation, or disclosure regulation in our case, is related to other long-term institutional features, and that we have to consider these relations as they feed back into firms' preferences toward financial market regulation in the first place. It is not completely novel to study the collective preferences to explain why certain regulations emerge. For example, Stigler (1971) requested quite early that economists should establish a better understanding for a rational theory of political behavior. Taking this into consideration, a more recent stream of theoretical literature advocates for a more positive approach and consider the mandatory disclosure regulation to be endogenously shaped. Closely related to our study, Bertomeu and Magee (2014a) develop a framework where managers determine their preferred mandatory disclosure rule by majority rolling. In equilibrium, mandatory disclosure is asymmetric, mandating greater levels of disclosure over unfavorable economic events. Bertomeu and Magee (2014b) study the evolution

of disclosure regulation while explicitly modeling preferences of applicants and standard setters in the political standard setting process. Thereby, standard-setters preferring high levels of disclosure induce regulatory cycles. In a similar manner, Bertomeu and Cheynel (2013) discuss the implications of different institutional structures and resulting mandatory disclosure when accounting standards emerge endogenously from an institutional bargaining process. Bertomeu and Magee (2011) study the influence of macroeconomic cycles on mandatory disclosure where regulators are subject to political pressures and respond to cyclical demands by borrowers and lenders. These studies are immensely helpful as they provide insights with respect to various aspects of the formation of disclosure regulation.

However, in these models enforcement is either explicitly modeled to be perfect, or implicitly assumed to be perfect by not considering it in the scope of the models. We add to this literature by explicitly relaxing the conventional assumption of the perfect enforcement. This approach allows us to take a closer look at the relationship between enforcement and managers' preference toward disclosure regulation and derive possible explanations how and why the two institutional settings — the degree of mandatory disclosure requirement and the scrutiny of enforcement mechanism — are often observed as positively correlated (Leuz et al., 2003; Leuz, 2010).

Finally, our study relates to studies such as Guay and Verrecchia (2007), Göx and Wagenhofer (2009), or Königsgruber (2012) who identify conditions for disclosure regulation or enforcement such that outcomes of specific decision problems are socially desirable, e.g., firms' capital allocation or debt financing decisions. Further, Friedman and Heinle (2014) develop a model where a regulator sets the strength of enforcement, i.e., the probability that a firm has to report truthfully. The authors compare individualized and one-size-fits-all forms of enforcement and show that one-size-fits-all enforcement is more welfare efficient than its individualized counterpart due to less wasteful lobbying. While these studies consider the social objective function of regulators as decisive, we follow the former stream of literature and take managers' self-interest as a given. Therefore, the consensus

disclosure rule that emerges from our setting does not need to be socially optimal.

The remainder of the chapter is organized as follows: Section 4.2 provides the basic setting and the timeline of events. Section 4.3 presents our base model, where we model the mandatory disclosure as the only disclosure channel. We then introduce voluntary disclosure and disclosure costs throughout Section 4.4. We shortly summarize our results and provide additional comparative statics in Section 4.5. Section 4.6 finally concludes the chapter.
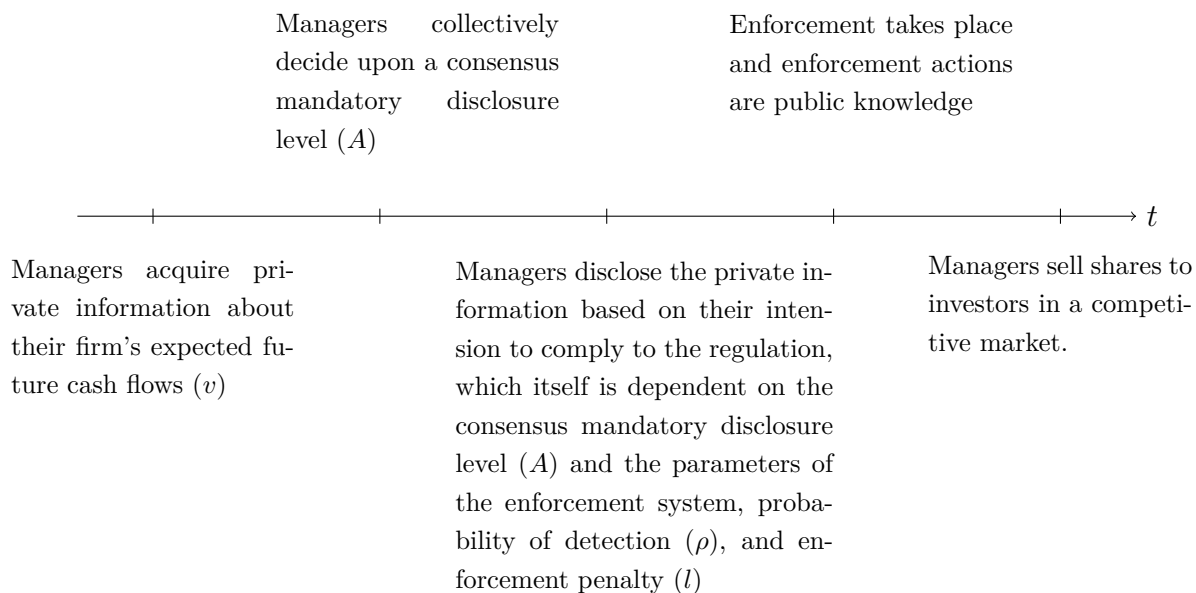
4.2 Model setting

We develop our base model based on the timeline of events described in Figure 4.1. In this time sequence, we assume that the managers endow the private information first. Then based on their private information and their intention to sell their endowed equity in the firms, they act and seek to exert influence on the existing mandatory disclosure regulation regime by engaging in the deliberation process to change the existing disclosure threshold.

4.2.1 Agents

Our model economy is populated by a continuum of firms with a total mass normalized to one. The firms are operated by risk-neutral managers that acquire private information about the underlying firm value v. Thereby, a firm's value is equal to its expected value of the future cash flows and is represented by an uniformly distributed random variable $v \in [0, 1]$ (e.g., Bertomeu and Cheynel, 2013; Bertomeu and Magee, 2014b). We assume that the managers are endowed with a share in their firm and investors acquire ownership of the firm in a competitive market before cash flows are realized.[35] The managers seek

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[35]The concrete size of manager-endowed equity is not material for the model setting. Instead, the model setting that managers do own certain amount of equity of the firms and that they seek to sell these equity is of importance. This setting ensures the alignment of interests between the managers and the current shareholders, as the managers would naturally seek to maximize the firm's valuation.

Figure 4.1: Model timeline, Chapter 4

Managers collectively decide upon a consensus mandatory disclosure level (A)

Enforcement takes place and enforcement actions are public knowledge

$\longrightarrow t$

Managers acquire private information about their firm's expected future cash flows (v)

Managers disclose the private information based on their intension to comply to the regulation, which itself is dependent on the consensus mandatory disclosure level (A) and the parameters of the enforcement system, probability of detection (ρ), and enforcement penalty (l)

Managers sell shares to investors in a competitive market.

to sell their shares during the transaction and the firms continue their operation under a going concern assumption. Therefore, managers prefer a high selling price and thus, act in the best interest of their firms' current shareholders. Before the managers sell their shares, they may have to provide a disclosure about the firm value depending on the requirements by the mandatory disclosure regime. We assume that a mandatory disclosure regime exists and the managers can exert influence on the properties of the disclosure rule.

4.2.2 Disclosure rule

The mandatory disclosure regime is assumed to be asymmetric and has an existing regulation threshold A (e.g., Bertomeu and Magee, 2011; Bertomeu and Cheynel, 2013; Bertomeu and Magee, 2014b).[36] An asymmetric disclosure means that information indicating future cash flows below a certain threshold has to be disclosed but information

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[36]The formation of the preferred type of the disclosure rule is out of the scope of this paper. We refer to Bertomeu and Magee (2014a) for an analysis.

indicating expected future cash flows above the threshold is not reported until the cash flows are realized. The asymmetric disclosure requirements are a widespread attribute of accounting standards. A classical example is the impairment accounting (e.g., Basu, 1997; Göx and Wagenhofer, 2009; Beyer, 2013). Clearly, in reality, the impairment approach does not apply to all types of assets and it clearly does not apply to the entire firm. However, if certain assets of a firm need to be impaired because the management receives information that the carrying amount of these assets are above the recoverable amount of the assets, then an impairment of the assets needs to be undertaken. Such an impairment could then also have a negative impact on the firm's overall value, especially if the size of the impairment is substantial compared to the overall size of the firm. In our model setting, the asymmetric disclosure regime requires a firm to disclose private information about its expected future cash flows if the private information indicates a firm value below the prescribed mandatory threshold level, $v < A$. If the private information indicate a firm value above or equal to the prescribed mandatory threshold level, $v \geq A$, the firm can not convey private information to the market by mandatory disclosure. Overall, the mandatory disclosure regime fosters disclosure of "bad" news by promoting early disclosure of low expected firm values, $v < A$, while delaying the disclosure of "good" news[37], $v \geq A$. This model setting reflects a simplification of the beforehand discussed asset impairment in principle, where the impairment of individual assets may also influence the overall value of the firm.

4.2.3 Enforcement

With respect to enforcement, we relax the explicit or implicit assumption of perfect enforcement from prior research. We model enforcement as imperfect, and define enforcement strength as the probability of detecting firms' non-compliant disclosure behavior,

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[37]The delayed disclosure of good news in a future time and the subsequent effect of such disclosure are not in scope of this study and thus not explicitly modeled.

denoted as $\rho \in (0,1)$.[38] With the probability ρ, a firm's non-compliant behavior is uncovered and the firm has to disclose the true underlying value in response. With a probability $(1-\rho)$, a firm successfully avoids mandated disclosure. The parameter ρ constitutes any set of potential actions by regulators, auditors, or administrations affecting the probability of revealing firms' non-compliant behavior. A higher ρ might represent a more stringent interpretation of current rules by enforcement bodies, a change in legislation, or an increase of enforcement ressources.

In case non-compliant behavior is detected, the firm faces a regulatory penalty which is not recoverable for potential investors. Further, we assume that the regulatory penalty reflects the severity of misconduct, or the potential damage to the investors from the misconduct. This is in line with empirical evidence suggesting that the SEC and the DoJ impose monetary penalties that increase with shareholders' losses, the amount of time required to resolve the enforcement action, and the presence of fraud charges (Karpoff et al., 2007). In our case, this translates to the potential damage of an investor arising from non-compliant disclosure behavior.[39] We define regulatory penalties as $l = \alpha(P_{ND} - P_D)$ with $P_{ND} > P_D$ for firms that attempt to avoid mandatory disclosure but were detected. P_{ND} is an investor's valuation of a non-disclosing firm, P_D is an individual firm's valuation in case of orderly disclosure, and α is a scaling factor, with $\alpha > 0$.[40]

4.2.4 Deliberation

Before managers' disclosure decision, they engage in a deliberation about their collectively preferred mandatory threshold. The consensus threshold A is set by a voting process and the outcome is binding for all firms. Within the deliberation, each manager has one "vote",

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[38]Friedman and Heinle (2014) model enforcement actions as we do in our model. However, they compare one-size-fits-all and individual enforcement probabilities for certain types of firms with respect to their effects on social welfare, which is out of the scope of this paper.

[39]We also want to thank Alfred Wagenhofer and Stefan Wielenberg for suggesting this type of regulatory penalty to us.

[40]Please note that non-compliance in our model setting means that a firm does not disclose although it is obliged to disclose. We do not consider earnings management as for instance in Dye (2002). Also, we defer a more detailed discussion of the newly introduced pricing schemes to Section 4.3.1.

each opinion counts with equal weight, and managers who are indifferent are assumed to abstain from voting. The consensus mandatory threshold is set by majority ruling and a proposed change of the mandatory threshold is only accepted if it receives a higher proportion of supporting managers than opposing managers. Further, we assume that the deliberative process is evolutionary and establishes a "motion" toward a consensus threshold as presented by Plott (1967). That is, managers propose *marginal* changes to the "existing state". If neither an increasing proposal, nor a decreasing proposal receives a majority support, the deliberation ends with the current "existing state" as the consensus regulation representing the collectively preferred threshold A^*.

Our assumptions portrait a rule-setting process where preparers are the dominant group in the process determining the final rule. This is in line with the argumentation by Bertomeu and Magee (2014a) who outline that the visibility and the influence of preparers on standard-setting bodies is indeed strong in the US. Similar observations have been made with regard to the standard-setting process of the IASB (Giner and Arce, 2012; Jorissen et al., 2012). However, from a chronological viewpoint, we examine the formation of managers' collective preference before political players engage in bargaining processes. One has to keep this limitation in mind when referring to our model. We do not provide a detailed model of the decision process within policy-making bodies, and we do not intend to speak to the optimality of the design of a deliberative process as for example Bertomeu and Cheynel (2013).

4.2.5 Disclosure decision and selling the firm

Based on the consensus mandatory disclosure regulation A^*, and the enforcement parameters, ρ and α, managers decide to disclose or not to disclose. Thereby, managers who are subject to the mandatory regulation either comply with regulation and disclose or do not comply with regulation and remain silent, taking the chance of getting exposed by enforcement. Please note that non-disclosure does not mean that firms do not disclose at all. For instance, they are still obliged to provide a financial report. However, firms are

not going to disclose any private information, e.g., about an impending asset impairment that has to be conducted. Subsequently, enforcement actions take place and are common knowledge afterwards. With a probability of ρ, non-compliant firms are detected. Uncovered firms pay the regulatory penalty l and disclose their underlying firm value. At last, managers sell their shares to investors in a competitive market, while firms continue their operation under a going concern assumption in the future.[41]

4.3 Base model

In the base model, we focus on the essentials and assume that there are no costs attached to disclosure, and, apart from mandatory disclosure, there is no possible way to credibly[42] disclose private information[43]. Therefore, firms above the mandatory threshold are not only not required to disclose, but are also not able to disclose either. We are going to relax these assumptions later on.[44] Our discussion follows the solution strategy by backwards induction. We start with managers' conjecture about the investors' pricing scheme based on the investors' conjecture of managers' equilibrium disclosure behavior. We then shift our attention to the managers' expectations about the potential selling price before they engage in the deliberative process. These expectations are the basis for managers' individual preferences. Finally, we determine managers' collective preference as the outcome of the iterative deliberation.

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[41]Therefore, the true underlying cash flows are not observed in the near future, which prevents a possible subsequent claim from the investor after the transaction, should the true underlying cash flows can be observed shortly after the transaction.

[42]The setting in the base model allows managers to successfully remain silent even if they are supposed to make mandatory disclosure with a positive probability. The action of 'illegally withholding private information" is certainly deceptive. However, if a manager chooses (or is forced to) make a disclosure, the disclosure about the firm's value below threshold A is truthful. Hence, the act of disclosure itself still remains creditable.

[43]Both disclosure costs and voluntary disclosure will be added later in the model extension. We also demonstrate that the existence (or lack of) disclosure costs does not alter the main results and implication of our models

[44]We introduce voluntary disclosure alongside disclosure costs in Section 4.4 as an additional disclosure channel.

4.3.1 Investors' pricing scheme

We start with managers' conjecture about the investors' pricing scheme. The investors potentially face three different types of firms: (1) firms that comply with disclosure regulation and disclose, (2) firms that first do not comply with disclosure regulation but are successfully uncovered and disclose, and (3) firms that do not disclose private information. The investors' disclosure price for compliant firms, denoted as P_D, is simply the true firm value v. The investors' disclosure price for non-compliant and enforced firms, denoted as P_D^e, is equal to the true firm value v minus the regulatory penalty l. Finally, the investors' non-disclosure price, denoted as P_{ND}, is a potential pooling price because the non-disclosure interval might contain a mixture of firm types – firms of higher quality that do not have to disclose, and low quality firms that should have disclosed under the regulation but remained silent after all.

Under the asymmetric disclosure rule, low quality firms with an expected firm value below the disclosure threshold, $v < A$, are supposed to disclose. However, imperfect enforcement leaves these firms the opportunity to pool with high quality firms by being non-complaint conditional on successfully avoiding the enforcement. Therefore, it is the low quality firms' choice, if they intend to pool with firms above the threshold, and, whether P_{ND} is a pooling price consequentially. Firms below the mandatory threshold do not disclose as long as their net benefits of non-compliant behavior are positive, or put differently, as long as their expected selling price under non-compliant behavior is higher than their disclosure price under compliant behavior. That is, if $\rho P_D^e + (1-\rho)P_{ND} > P_D$, then firms with $v < A$ do not comply with disclosure regulation, take the risk of getting enforced, and pool with high quality firms. After substituting P_D^e with $P_D - \alpha(P_{ND} - P_D)$, the previous condition translates to $(1 - (1+\alpha)\rho)[P_{ND} - P_D] > 0$.

We first assume that $(1 - (1+\alpha)\rho)$ is positive, then the expected net benefits of non-compliant behavior are positive as long as the expected non-disclosure price is greater than the expected disclosure price of a low quality firm, i.e., $P_{ND} > P_D$. We can show

that there are two equilibria satisfying this condition depending on the existing mandatory threshold A. The first equilibrium's conditions are given in Lemma 4.3.1. If an economy shows a relatively low mandatory threshold, then the pooling non-disclosure price is larger than any low quality firm's disclosure price. Therefore, all firms below the mandatory threshold have incentives to be non-compliant. The non-disclosure set covers the whole domain of firm values and no firm intends to disclose.[45] Consequentially, the equilibrium non-disclosure price is a pooling price, where the expected cash flows of non-compliant low quality firm and high quality firms are weighted by their relative probability of encountering them in the mixture.

Lemma 4.3.1. *For all firms with $v < A$ it holds that $P_{ND} > P_D$, and no firm with $v \in [0, A]$ discloses, if $(1 - (1 + \alpha)\rho) > 0$ and $A \leq \frac{1 - \sqrt{1-\rho}}{\rho}$.*

Proof. See Appendix L for a detailed proof. □

The second equilibrium exists, if an economy shows a relatively high mandatory threshold. Then, there exists a group of medium quality firms below the mandatory threshold A that have incentives to disclose. However, there still is a group of low quality firms that remains non-compliant. For medium quality firms it is beneficial to separate, because their disclosure price is higher than the pooling non-disclosure price in this case. In other words, the condition $P_{ND} > P_D$ is not valid for all firms below the mandatory threshold, $v < A$. Therefore, one non-disclosure set contains low quality firms with $v \in [0, v_m]$ that intend to pool with high quality firms, where v_m is the critical firm value where $P_{ND} = P_D$, and $v_m < A$. The other non-disclosure interval contains high quality firms above the mandatory threshold A that are not able to disclose, $v > A$. Therefore, the equilibrium non-disclosure price is again a pooling price, where the expected cash flows of non-compliant low quality firm and high quality firms are weighted by their relative probability of encountering them in the mixture. However, the domain of low quality

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[45]Please note that this does not mean that no disclosure is observable ex-post as some firms get enforced to show their true firm value.

firms in the mixture depends on the cutoff v_m, and not A itself. This finding is stated in Lemma 4.3.2.

Lemma 4.3.2. *For all firms $v < v_m$ it holds that $P_{ND} > P_D$, where $v_m = \frac{-(1-A)+\sqrt{2-2A-\rho+\rho A^2}}{1-\rho}$, and no firm with $v \in [0, v_m]$ discloses, if $(1 - (1+\alpha)\rho) > 0$ and $\frac{1-\sqrt{1-\rho}}{\rho} < A < 1$. Firms with $v \in [v_m, A]$ disclose under these conditions.*

Proof. See Appendix M for a detailed proof. □

We now assume that $(1 - (1 + \alpha)\rho)$ is zero or negative instead. Then, the expected net benefits of non-complaint behavior are non-negative as long as the expected non-disclosure price is smaller than the expected disclosure price of a low quality firm, i.e., $P_{ND} < P_D$.[46] In this case, enforcement might incentivize firms with $P_{ND} < v < A$ not to disclose by providing a "premium" on non-compliant behavior as the regulatory penalty $l = \alpha(P_{ND} - P_D)$ would be negative for these firms. However, non-compliance is not an equilibrium behavior as there exists a group of low quality firms with $v < P_{ND}$ that have incentives to be compliant. The disclosure of these firms of lowest quality raises the expected non-disclosure pooling price which again leads to more low quality firms separating through compliant disclosure. This leads to an unraveling motion that results in full unraveling of all low quality firms from the bottom up. Lemma 4.3.3 states this finding.

Lemma 4.3.3. *For all firms with $v < A$ it holds that $P_D < P_{ND}$, and firms with $v \in [0, A]$ disclose, if $(1 - (1+\alpha)\rho) \leq 0$.*

Proof. See Appendix N for a detailed proof. □

Therefore, we identified three possible equilibria, two pooling equilibria and one separating equilibrium, depending on the non-compliance coefficient $(1 - (1+\alpha)\rho)$ which affects

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[46]We assume that managers of low quality firms do not comply and abstain from disclosing their private information if $(1 - (1+\alpha)\rho)$ equals zero.

managers' disclosure behavior and thus, investors' pricing. The coefficient represents combinations of the probability of enforcement actions and the severity of the regulatory penalty which essentially describes the effectiveness of the enforcement system. For example, if $\rho < \frac{1}{1+\alpha}$, enforcement does not induce full compliant disclosure behavior, i.e., $(1 - (1+\alpha)\rho) > 0$. Nevertheless, more severe regulatory penalties, i.e., a higher α, increases the probability of compliant behavior all other things held constant.[47] We find two possible pooling equilibria in this case, where low quality firms are non-compliant and intend to pool with high quality firms that have to remain silent. Thereby, either all low quality firms are non-compliant, or only some of them are non-compliant depending on the mandatory threshold. However, if $\rho > \frac{1}{1+\alpha}$, and thus, $(1 - (1+\alpha)\rho) \leq 0$, we arrive at a full separation equilibrium, where low quality firms actually comply with disclosure regulation, and high quality firms remain silent as prescribed. We state the respective equilibrium pricing schemes in Lemma 4.3.4. Despite the disciplinary influence, enforcement seems to offer room for a potential pooling of firms when we consider its inherent imperfection. This is something we are going to elaborate on in the upcoming sections.

Lemma 4.3.4. *Investors' pricing schemes are in equilibrium:*

$$P_D(v) = v,$$

$$P_D^e(v, \rho, \alpha) = v - l = P_D - \alpha(P_{ND} - P_D),$$

$$P_{ND}(A, \rho) = \begin{cases} \frac{1-A}{(1-A)+A(1-\rho)}\frac{(A+1)}{2} + \frac{A(1-\rho)}{(1-A)+A(1-\rho)}\frac{A}{2} & , \text{ if } (1 - (1+\alpha)\rho) > 0, A \leq \frac{1-\sqrt{1-\rho}}{\rho}, \\[2ex] \frac{1-A}{(1-A)+v_m(1-\rho)}\frac{(A+1)}{2} + \frac{v_m(1-\rho)}{(1-A)+v_m(1-\rho)}\frac{v_m}{2} & , \text{ if } (1 - (1+\alpha)\rho) > 0, A > \frac{1-\sqrt{1-\rho}}{\rho}, \\[2ex] \frac{A+1}{2} & , \text{ if } (1 - (1+\alpha)\rho) \leq 0. \end{cases}$$

Proof. See Appendix O for a detailed proof. □

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[47]For example, if α equals zero then enforcement has to be perfect, or ρ equal to one, to induce full compliance. However, if α is larger than zero, then ρ might be smaller than one to induce compliant behavior as long as $\rho > \frac{1}{1+\alpha}$.

4.3.2 Managers' expectations

Next, we derive managers' expected selling prices which form the basis for their individual preferences in the deliberative process. We refer to firms above the mandatory threshold, $v \geq A$, as high quality firms and denote their expected price as E_{HQ}. We further denote the expected price of a low quality firm with $v < A$ as E_{LQ}. Then the following Lemma 4.3.5 summarizes the expected selling prices for each of these groups in equilibrium.

Lemma 4.3.5. *Managers' expected selling prices are in equilibrium:*

$$E_{HQ}(A, \rho) = P_{ND}$$

$$E_{LQ}(A, \rho, v) = \begin{cases} P_D, \text{ if } (1 - (1 + \alpha)\rho) \leq 0, \\ P_D, \text{ if } (1 - (1 + \alpha)\rho) > 0, v_m < v < A, A > \frac{1 - \sqrt{1-\rho}}{\rho}, \\ \rho P_D^e + (1 - \rho)P_{ND}, \text{ otherwise.} \end{cases}$$

Proof. See Appendix P for a detailed proof. $\square$

4.3.3 Formation of a collective preference

The managers' collective preference toward mandatory disclosure is determined by an iterative process. The iteration either starts with a proposed increase or a proposed decrease of the existing mandatory threshold. Let us assume that an increase of the threshold is proposed, hence $\Delta A > 0$. We can classify firms into three distinct groups: (1) managers whose firms are subject to mandatory disclosure before and after the regulation change, $v \in [0, A)$, (2) managers whose firms are not subject to mandatory disclosure before the increase but are subject to it afterwards, $v \in [A, A + \Delta A)$, (3) managers whose firms are not subject to mandatory disclosure before and after the increase, $v \in [A + \Delta A, 1]$. An analogous classification arises if we assume a decrease of the mandatory threshold as illustrated in Figure 4.2.

Figure 4.2: Illustration of groups of managers in the deliberative process

(a) Proposed increase: $\Delta A > 0$ (b) Proposed decrease: $\Delta A < 0$
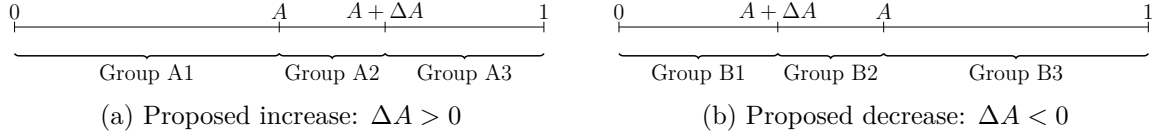
Note: Figure 4.2 shows the different groups of managers for a proposed increase or decrease of the mandatory threshold in the deliberative process. Group A1 and B1 (A3 and B3) are (not) subject to mandatory disclosure before and after the acceptance of the proposal, while Group A2 and B2 are either subject to mandatory disclosure before but not after the acceptance of the proposed change, or vice versa.

Whether a group supports a proposed regulation change or not depends on the expected change of their selling prices. A proposal is only supported if the expected difference in a firm's valuation is positive, meaning that a firm's price is expected to be higher under the new regulation than under the current regulation, otherwise it is rejected. The preferences of groups of managers as illustrated in Figure 4.2 can be summarized as follows:

Proposed increase ($\Delta A > 0$):

$$\text{Group A1: } E_{LQ}(A + \Delta A, \rho) - E_{LQ}(A, \rho), \text{ if } v \in [0, A),$$

$$\text{Group A2: } E_{LQ}(A + \Delta A, \rho) - E_{HQ}(A, \rho), \text{ if } v \in [A, A + \Delta A),$$

$$\text{Group A3: } E_{HQ}(A + \Delta A, \rho) - E_{HQ}(A, \rho), \text{ if } v \in [A + \Delta A, 1].$$

Proposed decrease ($\Delta A < 0$):

$$\text{Group B1: } E_{LQ}(A + \Delta A, \rho) - E_{LQ}(A, \rho), \text{ if } v \in [0, A + \Delta A),$$

$$\text{Group B2: } E_{HQ}(A + \Delta A, \rho) - E_{LQ}(A, \rho), \text{ if } v \in (A + \Delta A, A],$$

$$\text{Group B3: } E_{HQ}(A + \Delta A, \rho) - E_{HQ}(A, \rho), \text{ if } v \in [A, 1].$$

It follows directly from the group preferences that managers subject to mandatory disclosure regulation before and after a proposed change, $v \in [0, A)$ if $\Delta A > 0$, and $v \in [0, A + \Delta A)$ if $\Delta A < 0$, have the same functional form irrespective of the direction of

the proposed change, i.e., they vote in the same way. The same is true for managers that are not subject to mandatory disclosure regulation before and after a proposed change, $v \in [A + \Delta A, 1]$ if $\Delta A > 0$, and $v \in [A, 1]$ if $\Delta A < 0$. Further, the iteration of marginal changes imposes only marginal changes to the existing state $(\Delta A \to 0)$. The voting power of the middle group therefore converges to zero as the group size shrinks and their preferences are immaterial for the decision whether a proposed change is accepted or not. Thus, the outcome of the deliberative process is determined by the group preferences of low quality and high quality firms before and after each iterative step.[48] The remaining two groups correspond to our earlier definition of high quality firms $(v \geq A)$ and low quality firms $(v < A)$.

Therefore, we have to take a closer look at the preferences of low and high quality firms in order to determine the deliberation outcome. We have shown in Section 4.3.1 that there are low quality firms abstaining from disclosure if the non-compliance coefficient is positive. Further, low quality firms that still comply are indifferent to any proposed changes and do not participate in the deliberation.[49] We can show that group preferences of non-compliant low quality firms and high quality firms toward the mandatory threshold are aligned and point in the same direction as long as the non-compliance coefficient are positive.[50] In other words, the respective low quality and high quality firms collectively agree upon a consensus mandatory threshold during the deliberation process.

Proposition 4.3.6. *The managers of non-compliant, low quality firms and managers of high quality firms have aligned preferences toward a proposed change of the mandatory threshold A, if $(1 - (1 + \alpha)\rho) > 0$. Both either support or reject a proposal together.*

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[48] As we assume that the deliberative process is evolutionary and establishes a "motion" as described by Plott (1967), our deliberative process leads to local optima. However, low quality and high quality firms remain dominating the deliberative process as long as the proposed change is smaller or equal to 0.5 as otherwise middle group firms represent the majority.

[49] The group of compliant low quality firms exists if $(1 - (1 + \alpha)\rho) > 0, v_m < v < A$, and $A > \frac{1 - \sqrt{1 - \rho}}{\rho}$. However, they are indifferent to any marginal change of the mandatory threshold as their preference is focused on their disclosure price. Further, in equilibrium this group of firms disappears as A approaches A^*.

[50] That is, $E_{LQ}(A + \Delta A, \rho) - E_{LQ}(A, \rho)$ equals $(1 - (1 + \alpha)\rho)[E_{HQ}(A + \Delta A, \rho) - E_{HQ}(A, \rho)]$. Therefore, as long as $(1 - (1 + \alpha)\rho) > 0$ holds, group preferences have the same algebraic sign.

Proof. See Appendix Q for a detailed proof. □

In the deliberative process, low quality firms intend to maximize their expected selling price E_{LQ}, which positively depends on the pooled non-disclosure price P_{ND}. High quality firms intend to maximize the non-disclosure price itself as $E_{HQ} = P_{ND}$. It follows that A^* is the argument that maximizes P_{ND} and therefore, the expected selling prices of both groups.

Proposition 4.3.7. *The preferences of the managers of low quality firms and managers of high quality firms are aligned and single peaked at $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$, if $(1 - (1+\alpha)\rho) > 0$.*

Proof. See Appendix R for a detailed proof. □

However, if the non-compliance coefficient is zero or negative, $(1 - (1+\alpha)\rho) \leq 0$, preferences of low and high quality firms are not aligned. While low quality firms have incentives to comply and disclose, high quality firms intend to increase the mandatory threshold to achieve a higher non-disclosure price. Therefore, low quality firms are indifferent to proposed changes leaving high quality firms in charge of determining the threshold. As low quality firms are consequentially not in the mixture of non-disclosing firms, an unraveling motion sets in, which leads to $A^* = 1$. All firms are mandated to disclose under the equilibrium consensus threshold and all firms have incentives to comply, leading to full and truthful disclosure by all firms.

Proposition 4.3.8. *The managers of high quality firms determine the mandatory threshold A, if $(1 - (1+\alpha)\rho) \leq 0$. The resulting consensus threshold leads to full and truthful disclosure with $A^* = 1$.*

Proof. See Appendix S for a detailed proof. □

4.3.4 Discussion

We have shown that the firms' disclosure behavior as well as the managers' collective preference toward mandatory disclosure depend on the effectiveness of the enforcement system. Intuitively, an increase of the probability of detecting non-compliant behavior ρ or the regulatory penalties α increases the likelihood that low quality firms comply with the disclosure regulation and separate from non-disclosing high quality firms holding everything else constant. Put differently, the likelihood that the non-compliance coefficient is negative increases in ρ and α. However, only if the non-compliance coefficient is non-positive, i.e., $1 - (1 + \alpha)\rho \leq 0$, low quality firms disclose accordingly under any proposed disclosure regulation, and high quality firms face no opposition against a proposal increasing the mandatory threshold.[51] High quality firms start supporting an increase of the mandatory threshold until all firms are mandated to disclose, $A^* = 1$. Additionally, all firms have incentives to comply in equilibrium, which leads to full and truthful disclosure by all firms. This constitutes a familiar result from voluntary disclosure models where full unraveling is not hindered (a recent overview is provided by Beyer et al., 2010). In case enforcement is strong enough to induce compliant behavior in the first place, there are no costs attached to disclosure preventing full unraveling. Interestingly, Bertomeu and Magee (2014a) assume enforcement to be perfect, which implies a negative non-compliance coefficient and full compliant behavior, while still preventing a full unraveling result. However, their model includes verification costs depending on the mandatory threshold which are incurred by all firms. Firms disclose truthfully under the threshold but also have an incentive to hold the consensus threshold below the median as otherwise verification costs increase. We would reach a similar result if we add this kind of verification costs to our model.
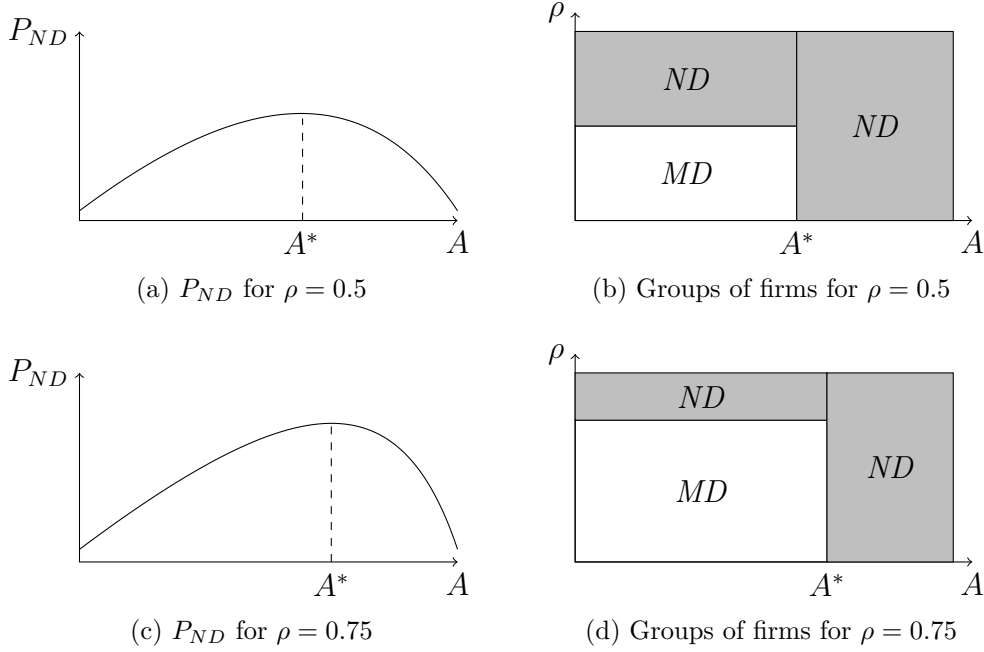
One of our main findings is that an imperfect enforcement aligns firms' preferences as long as the enforcement does not induce a full compliant behavior, i.e, the non-compliance

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[51]The exception is the one firm at the threshold itself. However, its voting power is marginal as outlined before.

coefficient is positive, $(1 - (1 + \alpha)\rho) > 0$. The imperfect enforcement offers the low quality firms a possibility to pool with firms of higher quality in the non-disclosure set. The preferences of both low and high quality firms with regard to the mandatory threshold A are aligned in maximizing their non-disclosure pooling price P_{ND}. Technically, the non-compliance coefficient ensures that the weight on the non-disclosure price is positive in the expected selling price of low quality firms. We also show that there exists a steady state disclosure threshold A^* because of two countervailing effects in the non-disclosure price. For example, if an increase in the threshold is proposed, the expected value of both non-complying low quality firms and high quality firms increase which indicates a motion toward $A = 1$. However, the probability of actually encountering a high quality firm decreases with an increasing threshold as fewer high quality firms remain in the mixture. Since the non-disclosure price P_{ND} is a mixture of the valuation of the non-complying low quality firms and the that of the high quality firm weighted by their relative frequency, a trade-off is necessary when the non-disclosure price needs to be maximized via choosing the optimal regulation threshold. It is this trade-off that leads to the existence of an interior solution at the optimal regulation level A^* and an equilibrium threshold below 1. Similar to Bertomeu and Magee (2014a), the consensus threshold maximizes the non-disclosure price. However, the underlying firm behavior differs because non-compliance is not an option in their setting. Additional to their separating equilibrium under perfect enforcement, we find a pooling equilibrium, where high quality firms do not disclose, and low quality firms do not comply with disclosure regulation and do not intend to convey private information to the market either.

In contrast to the full compliance situation, the consensus threshold does depend on enforcement strength ρ, and we are able to perform comparative statics on the consensus threshold A^*. Enforcement strength influences the consensus regulation level through the probability weights contained in the non-disclosure pooling price. An increase in the probability of detecting non-compliant behavior leads to an increase of the probability of encountering a high quality firm in the mixture of non-disclosing firms since it increases the probability of low quality firm to actually disclose. Therefore, tighter enforcement

Figure 4.3: Illustration of possible equilibria under aligned preferences

(a) P_{ND} for $\rho = 0.5$

(b) Groups of firms for $\rho = 0.5$

(c) P_{ND} for $\rho = 0.75$

(d) Groups of firms for $\rho = 0.75$

Note: Figure 4.3(a) and 4.3(c) illustrate the non-disclosure price (P_{ND}) for different levels of enforcement strength ($\rho = 0.5$, and $\rho = 0.75$). Figure 4.3(b) and 4.3(d) show groups of managers and their disclosure after enforcement actions. The gray areas indicate non-disclosing firms (ND), while the blank areas indicate disclosing firms that mandatorily disclose (MD). A^* is the respective consensus mandatory threshold in equilibrium.

offsets the negative impact of A on the weight, i.e., the probability of encountering a high quality firm decreases in the threshold. This allows managers to shift the threshold to a higher A^* in equilibrium and to exploit the positive effect of the increased threshold on the expected value of both non-complying low quality firms and high quality firms. Based on Proposition 4.3.7, we can shown that the optimal disclosure thresholds A^* is monotonically increasing in ρ. Hence, all else equal, tighter enforcement shifts the collective preference toward more extensive mandatory disclosure compared to a case with weak enforcement. Low quality firms actually prefer a more extensive disclosure regime, while they do not intend to follow the consensus rule in the end. We illustrate the pooling non-disclosure price and the equilibrium mandatory threshold under two different levels of enforcement strength in Figure 4.3, while Proposition 4.3.9 summarizes this result.

Proposition 4.3.9. *Ceteris paribus, if low quality firms have incentives to be non-compliant, i.e., $1 - (1 + \alpha)\rho > 0$, tighter enforcement (ρ) results in a collective preference*

toward more extensive disclosure under the assumption of only mandatory disclosure without disclosure costs.

Proof. See Appendix T for a detailed proof. □

4.4 Voluntary disclosure and disclosure costs

For the rest of the analysis, we focus on cases where the non-compliance coefficient is positive, i.e., $(1-(1+\alpha)\rho) > 0$. That is, low quality firms have incentives to be non-compliant and the alignment of interest is potentially present.[52] However, in the base model managers are only able to provide financial information through mandatory reports, e.g., 10-K fillings, managers are in general able to voluntarily convey private information to investors through other disclosure channels. Therefore, we extend our model by introducing voluntary disclosure, which allows us to study the interplay of mandatory and voluntary disclosure in our setting.

To prevent full unraveling, managers face economic losses when disclosing private information to the public. A prominent example for such losses is the release of proprietary information to current and potential competitors (e.g., Verrecchia, 1983). We denote disclosure costs as c, with $c > 0$, and assume that these costs are the same for mandatory and voluntary disclosure. The underlying rational is that costs of gathering information, e.g., the costs resulting from the process to collect information, or, costs of making potential proprietary information public, are the same irrespective of the disclosure channel. Disclosure costs lead to the existence of a lower bound, or a voluntary threshold, which we denote as v_l (e.g., Verrecchia, 1983, 1990; Kirschenheiter, 1997; Richardson, 2001; Pae,

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[52]Karpoff et al. (2008) provide a rough estimate of α for the US on pp. 599-600, where α is the ratio of losses in share values from legal penalties to the share price adjustment due to more accurate financial information, i.e., $\alpha = 0.882/0.2453 = 0.3596$. Based on $\rho > \frac{1}{1+\alpha}$, the non-compliance coefficient would be positive as long as the SEC does not successfully prosecute more than 73.55% of all actual non-compliances cases on average during 1978-2002, which seems unlikely. This highlights the importance of these cases.

2005). Managers with expected cash flows below this threshold do not intend to disclose voluntarily, whereas managers above this threshold disclose voluntarily, and incur disclosure costs.

To structure the following analysis, we use the voluntary threshold v_l and the "existing state" of the mandatory threshold A to identify constellations with differing disclosure incentives. Afterwards, we discuss potential dynamics that might evolve out of the deliberative process. These dynamics occur if the process iterates toward a consensus mandatory threshold and the consequentially "updated state" affects the endogenous voluntary threshold such that the deliberative motion changes toward a different focal point. Figure 4.4 illustrates the three possible constellations under the assumption of non-compliant behavior by low quality firms. First, the voluntary threshold might be larger than the mandatory threshold and exceeds the upper bound of the support of the distribution of firm values, $v_l > 1$. No firm chooses to disclose voluntarily, which leads to a situation as described in the base model but with disclosure costs. Second, the voluntary threshold might be larger than the mandatory threshold but below one, $A \leq v_l \leq 1$. Therefore, firms above the voluntary threshold v_l disclose independently from the mandatory threshold A, and disclosure regulation only remains relevant for firms with a value below the mandatory threshold A. Third, the voluntary threshold might be below the mandatory threshold but above the lower bound of the support of the distribution of firm values, $0 \leq v_l < A$. Firms above the voluntary threshold separate through voluntary disclosure while firms below the voluntary disclosure abstain from disclosure.[53]

4.4.1 Absence of voluntary disclosure ($1 < v_l$)

We begin with the case where the voluntary threshold v_l is above one, and voluntary disclosure is too costly leaving firms no incentives to disclose voluntary. As we assume that the non-compliance coefficient is positive, i.e., $(1 - (1 + \alpha)\rho) > 0$, firms below the

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[53]Please note that the case where the voluntary threshold is smaller than the lower bound of the support of the distribution of firm values, $v_l < 0$, is excluded by the assumption of positive disclosure costs.

Figure 4.4: Possible constellations under mandatory and voluntary disclosure

(a) No voluntary disclosure ($1 < v_l$)

(b) Voluntary disclosure ($A' \leq v_l \leq 1$)

(c) Voluntary disclosure ($0 \leq v_l < A'$)
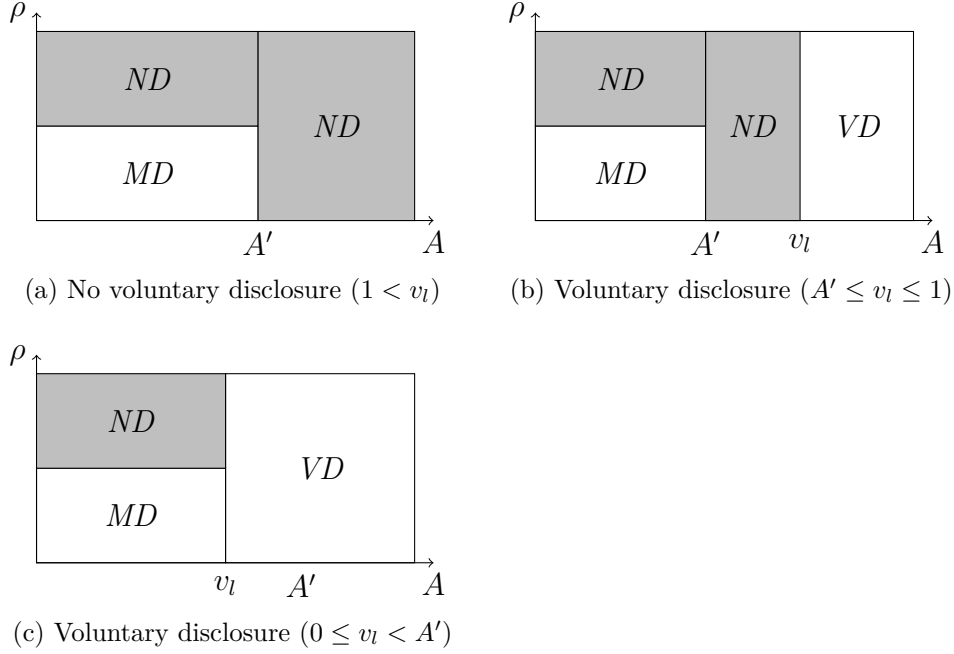
Note: Figure 4.4 illustrates groups of managers and their disclosure after enforcement actions, where A is the mandatory threshold, v_l the voluntary threshold, and ρ is the probability of detection. The gray areas indicate non-disclosing firms (ND), while the blank areas indicate disclosing firms that either mandatorily disclose (MD), or voluntarily disclose (VD).

mandatory threshold do not comply, and abstain from disclosure. Similar to the base model, it is again beneficial for high quality firms to remain silent, and for low quality firms to be non-compliant in order to pool with high quality firms. Consequentially, conjectures about the investors' pricing scheme show only minor changes. Disclosure costs do not affect the non-disclosure price from the base model, which remains at $\tilde{P}_{ND} = P_{ND}$. Previous disclosure prices for compliant and non-compliant firms are simply reduced by disclosure costs, i.e., $\tilde{P}_D = P_D - c$ and $\tilde{P}_D^e = P_D^e - c$.

Based on the investors' pricing scheme, we state the necessary condition for the absence of voluntary disclosure in Lemma 4.4.1. Intuitively, if disclosure costs exceed a certain level, firms abstain from disclosure. The costs cut-off decreases in enforcement strength ρ as more low quality firms are going to be exposed making it less beneficial to bear disclosure costs in order to separate. No further condition is necessary to ensure the absence of voluntary disclosure if disclosure costs exceed 0.5.

Lemma 4.4.1. *For all firms with $v \in [0,1]$, it holds that $\tilde{P}_{ND} \geq \tilde{P}_D$, if $c > v - \frac{1}{2}(A + \frac{1-A}{1-\rho A})$ and $(1 - (1+\alpha)\rho) > 0$.*

Proof. See Appendix U for a detailed proof. $\quad\square$

Preferences of high quality firms remain as in the base model, $\tilde{E}_{HQ} = \tilde{P}_{ND}$, and preferences of low quality firms are again a mixture of the non-compliant disclosure price $\tilde{P}_D^e$ and the non-disclosure pooling price $\tilde{P}_{ND}$, i.e., $\tilde{E}_{LQ} = \rho \tilde{P}_D^e + (1-\rho)\tilde{P}_{ND}$. As managers' preferences are hardly affected, the alignment of preferences of low and high quality firms persists. That is, managers of low and high quality firms have aligned preferences because changes of $\tilde{E}_{HQ}$ and $\tilde{E}_{LQ}$ have the same algebraic sign with respect to a change in A as long as $(1 - (1+\alpha)\rho) > 0$.[54] Therefore, low and high quality firms still determine the outcome of the deliberative process. The majorities' preference is unchanged, and we can show that the consensus threshold A^* is still reached under the assumption of disclosure costs in the absence of voluntary disclosure. We can also show that the case condition remains satisfied irrespective of the existing state of A until the optimal disclosure threshold $\tilde{A}^*$ is reached in the iterative process.

Proposition 4.4.2. *If the voluntary threshold is above 1, $1 < v_l$, and preferences of managers of low quality and medium quality firms are aligned, i.e., $(1 - (1+\alpha)\rho) > 0$, then their preferences are single peaked at $\tilde{A}^* = A^* = \frac{1-\sqrt{1-\rho}}{\rho}$.*

Proof. Following the owners' ex-ante pricing scheme, both types of owners maximize $\tilde{P}_{ND}(A, \rho)$ that is equal to $P_{ND}(A, \rho)$ from the base model. Thus, it holds that $\tilde{A}^* = A^* = \frac{1-\sqrt{1-\rho}}{\rho}$. $\quad\square$

The resulting mandatory threshold is equal to the one derived in the base model, and the underlying mechanisms are as discussed in Section 4.3.4. Our interim result that tighter enforcement results in a collective preference toward more extensive mandatory disclosure

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[54]Please note that $\tilde{E}_{LQ}$ equals $(1+\alpha)\rho \tilde{P}_D + (1 - (1+\alpha)\rho)\tilde{P}_{ND}$, which leads to the alignment condition of $(1 - (1+\alpha)\rho) > 0$.

also holds. Further, the mandatory threshold does again not depend on disclosure costs although we introduced disclosure costs to the model. The intuition behind this is rather simple. In both settings we assumed that low quality firms do not comply with disclosure regulation leaving them focused on the non-disclosure price. High quality firms had no possibility to disclose in the base model. However, they abstain from voluntary disclosure in this setting due to high disclosure costs. As in the base model, both groups maximize their joint non-disclosure pooling price which makes disclosure costs irrelevant for the consensus mandatory threshold. Therefore, in a setting where only mandatory disclosure is present, disclosure costs have no influence on firms' collectively preferred mandatory threshold.

Proposition 4.4.3. *Ceteris paribus, if no voluntary disclosure is present, $1 < v_l$, and preferences of managers of low quality and high quality firms are aligned, i.e., $(1 - (1 + \alpha)\rho) > 0$, then tighter enforcement (ρ) results in a collective preference toward more extensive disclosure, while disclosure costs c have no influence.*

Proof. See Appendix T for a detailed proof. $\square$

4.4.2 Mandatory below the voluntary threshold ($A \leq v_l \leq 1$)

If we assume that the mandatory threshold is below the voluntary threshold, disclosure prices are identical to the ones from the previous case. We simply relabel them to $\check{P}_D$ and $\check{P}_D^e$ respectively. The non-disclosure price $\check{P}_{ND}$ is again a mixed price, where investors weight the expected value of firms that are above the mandatory threshold but below the voluntary threshold, $A < v < v_l$, and the expected value of firms that are below the mandatory threshold and avoided enforcement, $v < A$.

$$\check{P}_{ND}(A, \rho) = \frac{v_l - A}{(v_l - A) + A(1 - \rho)} \frac{1}{2}(A + v_l) + \frac{A(1 - \rho)}{(v_l - A) + A(1 - \rho)} \frac{1}{2} A. \quad (4.1)$$

In contrast to the base model, we now have to consider preferences of three groups of managers when determine the consensus mandatory threshold (see, Figure 4.4(b)): (1) Managers of high quality firms with a value above the voluntary threshold. (2) Managers of medium quality firms with a value above the mandatory threshold but below the voluntary threshold, $A \leq v < v_l$. (3) Managers of low quality firms with a value below the mandatory threshold. Lemma 4.4.4 states expectations of managers' of low, medium, and high quality firms.

Lemma 4.4.4. *Managers' expected selling prices are in equilibrium:*

$$\check{E}_{HQ} = \check{P}_D,$$

$$\check{E}_{MQ} = \check{P}_{ND},$$

$$\check{E}_{LQ} = \rho \check{P}_D^e + (1 - \rho) \check{P}_{ND}.$$

Proof. Managers of high quality firms disclose irrespective of the regulation level and thus, expect to receive the disclosure price, $\check{E}_{HQ}$.

Managers of medium quality firms do not disclose voluntarily but are also not mandated to disclose. They expect to be priced at the non-disclosure price, $\check{E}_{MQ}$.

Managers of low quality firms do not comply with disclosure regulation following our assumption of a positive non-compliance coefficient. Their exceptions $\check{E}_{LQ}$ are a mixture of the non-compliant disclosure price $\check{P}_D^e$ and the non-disclosure pooling price $\check{P}_{ND}$ weighted by the probability of detection (and non-detection respectively). □

Before we determine the consensus mandatory threshold, we have to derive the equilibrium voluntary threshold. The threshold finds its way into managers' preferences and constitutes this voluntary disclosure case. It has to hold in equilibrium that firms below the voluntary threshold do not intend to disclose, while firms above the threshold want to disclose. Based on this condition, we derive the voluntary threshold v_l provided in Lemma

4.4.5. The voluntary threshold also provides some intuition of how the endogenous voluntary threshold connects the three voluntary disclosure cases. First, disclosure costs have to be below a certain level such that some high quality firms disclose voluntarily. Second, the mandatory threshold has to be below a certain level in order to not surpass the endogenous voluntary threshold.

Lemma 4.4.5. *There exists a voluntary threshold $v_l = A\rho + c + \sqrt{A^2\rho^2 + c^2 - A^2\rho}$, if A, ρ, and c satisfy the conditions stated in Table 4.1, where $\underline{B} = (1 - c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ and $\overline{B} = (1 - c) + \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$.*

Table 4.1: Conditions for v_l satisfying $A \leq v_l \leq 1$

	$0 < \rho \leq 1 - \left(\frac{c}{1-c}\right)^2$	$1 - \left(\frac{c}{1-c}\right)^2 < \rho \leq \frac{1}{4c}$	$\frac{1}{4c} < \rho < 1$
$0 < c \leq \frac{1}{3}$	$A \leq 2c$	$A \leq 2c$	$A \leq \underline{B}$
$\frac{1}{3} < c \leq \frac{1}{2}$		$A \leq \underline{B}$ or $\overline{B} \leq A \leq 2c$	

Proof. See Appendix V for a detailed proof. $\square$

Finally, managers' preferences and the voluntary threshold allow us to determine the managers' consensus threshold. Managers of high quality firms disclose voluntarily and are therefore indifferent toward the mandatory threshold. More interestingly, the remaining groups of managers of medium and low quality firms show a similar alignment as we have seen in the base model or in the previous section. Following Lemma 4.4.4, these groups again focus on maximizing the non-disclosure price $\check{P}_{ND}$ as long as the enforcement setting fulfills the condition of a positive non-compliance coefficient, i.e., $(1-(1+\alpha)\rho) > 0$. Therefore, the alignment mechanism is still at work despite the use of voluntary disclosure in this setting. Medium and low quality firms are aligned within the deliberative process, and there exists an optimal regulation level which we state in Proposition 4.4.6.

Proposition 4.4.6. *If the existing mandatory threshold is below the voluntary threshold, $A \leq v_l \leq 1$, and preferences of managers of low quality and medium quality firms are aligned, i.e., $(1 - (1 + \alpha)\rho) > 0$, then their preferences are single peaked at $\check{A}^* = \frac{c}{\sqrt{1-\rho}}$.*

Proof. See Appendix W for a detailed proof. □

In line with the previous settings, tighter enforcement results in a collective preference toward more extensive mandatory disclosure even if voluntary disclosure is actually observed alongside mandatory disclosure. As long as a majority of managers is aligned in maximizing the pooled non-disclosure price, the underlying mechanisms from the base model are still functional. However, in contrast to the previous cases, disclosure costs affect the consensus threshold in equilibrium. While managers still maximize the non-disclosure price, disclosure costs find their way into the maximization because of the endogenous voluntary threshold. The reason is that firms bear the costs of voluntary disclosure if they intend to separate from firms of lower quality. An increase of disclosure costs shifts the voluntary threshold v_l to a higher level and more medium quality firms between the existing mandatory threshold and the increased voluntary threshold are in the pool of non-disclosing firms. This positive effect on the expected average cash flow in the mixture leaves room for increasing the mandatory threshold similar to what we have seen with respect to enforcement strength in the base model. In principle, disclosure costs increase the probability of encountering a medium quality firm as more firms of high quality abstain from disclosure staying in the pool of medium quality firms, while enforcement strength decreases the probability of encountering a low quality firm as more firms are uncovered. Therefore, the consensus mandatory threshold is both positively related to the enforcement strength and the level of disclosure costs in this setting.

Proposition 4.4.7. *Ceteris paribus, if voluntary disclosure and mandatory disclosure are observed, i.e., $A \leq v_l \leq 1$, and preferences of managers of low quality and medium quality firms are aligned, i.e., $(1-(1+\alpha)\rho) > 0$, then the collectively preferred mandatory threshold is positively related to enforcement strength ρ (disclosure costs c), such that an increase in enforcement strength (disclosure costs) lead to a collective preference toward more extensive mandatory disclosure.*

Proof. See Appendix X for a detailed proof. □

4.4.3 Mandatory above the voluntary threshold ($0 \leq v_l < A$)

In the previous case, disclosure costs incentivized a group of medium quality firms to abstain from disclosure. However, if disclosure costs fall short of a certain level, i.e., $c < \frac{1}{2}A$, the voluntary threshold shifts below the mandatory threshold. Some firms below the mandatory threshold "voluntarily" comply with disclosure regulation. This essentially eliminates any group of non-disclosing high quality firms which have been available for pooling with non-compliant low quality firms in the previous cases. Consequentially, the non-disclosure price is simply the average firm value of a firm below the voluntary threshold under a uniform distribution, i.e., $\frac{1}{2}v_l$ with $v_l = 2c$. As the expected selling prices and thus, the group preferences do not depend on A anymore, voluntary disclosure then dominates mandatory disclosure in a sense that disclosing managers are indifferent to any change in mandatory disclosure regulation. No change of the regulation level occurs during the collective deliberative process, and a proposed marginal change of the mandatory threshold neither finds a majority support, nor a majority reject. In equilibrium, firms above the voluntary threshold separate themselves from firms below the voluntary threshold by voluntary disclosure, and the existent mandatory threshold remains. However, full unraveling is hindered by disclosure costs.[55]

4.4.4 Potential dynamics

We used the endogenous voluntary threshold v_l and the existing state of the mandatory threshold A to structure our analysis. However, as a consequence some case conditions are also endogenous meaning that dynamics might occur if the deliberative process iterates toward a consensus mandatory threshold. For example, while the voluntary might be above the mandatory threshold but below one, satisfy conditions of Section 4.4.2 at the beginning of the iteration, the voluntary threshold might surpass the mandatory threshold during the process leading to a constellation as described in Section 4.4.3. We elaborate on

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[55]We provide a more detailed and formal discussion in the Appendix Y.

intuition behind these dynamics based on the parameters: disclosure costs, enforcement strength, and the existing state of the mandatory threshold. We further provide a more detailed and technical analysis of how the consensus mandatory disclosure level is derived under different parameter constellations in Appendix Z.

Figure 4.5: Scenario overview

(a) Scenarios

(b) Equilibrium thresholds
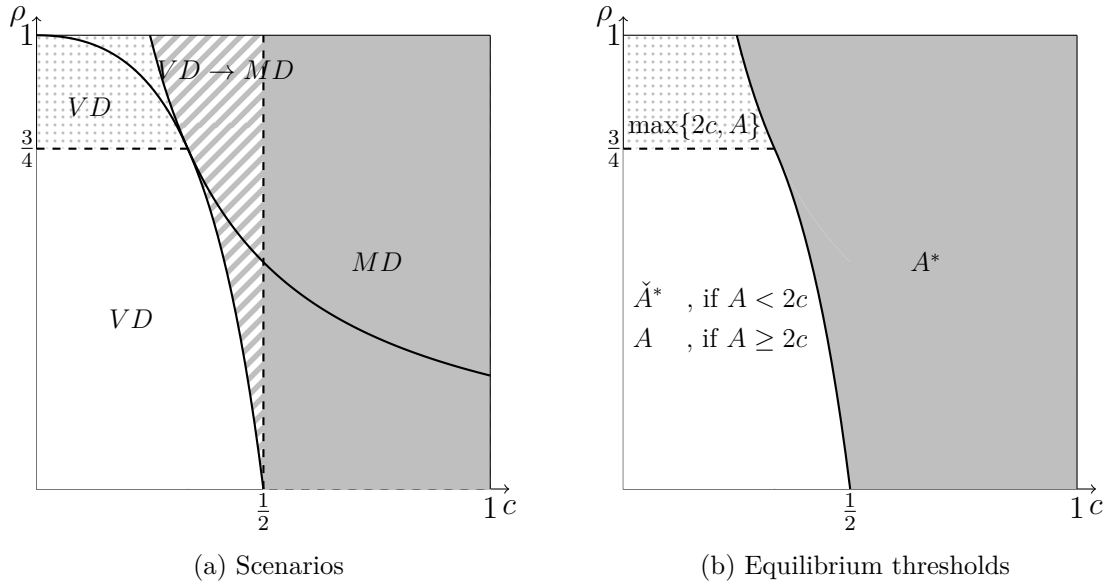
Note: Figure 4.5(a) provides an overview of the scenarios described in Section 4.4.1 to 4.4.3 depending on constellations of enforcement strength ρ and disclosure costs c. The gray and the lined area represent constellations, where only mandatory disclosure (MD) is present at the end of iterative process and A^* is reached as derived in Section 4.4.1. However, only in the gray area voluntary disclosure is absent from the beginning on. The dotted area and the blank area represent constellations, where voluntary disclosure (VD) is present alongside mandatory disclosure. The dotted area thereby illustrates constellations, where mandatory disclosure gets dominated by voluntary disclosure during the process as described in Section 4.4.3. The blank area depicts constellations, where the consensus threshold $\check{A}^*$ from Section 4.4.2 might be reached as long as disclosure costs are sufficiently high to ensure deliberation, otherwise voluntary disclosure dominates mandatory disclosure during the process as in Section 4.4.3. Figure 4.5(b) shows the possible equilibrium thresholds depending on ρ, c, and A.

Figure 4.5 provides an overview of the three cases based on disclosure costs c, and enforcement strength ρ as well as possible equilibrium thresholds. The gray area indicates that voluntary disclosure is deemed too costly and voluntary disclosure is not observed. While disclosure costs are alone able to rule out voluntary disclosure, i.e., $c > 0.5$, the "existing" state of the mandatory threshold in combination with disclosure costs, and enforcement strength might also lead to the absence of voluntary disclosure, i.e., the lined area with $c < 0.5$. Either, the voluntary threshold exceeds one from the beginning based

on the given parameters, or, voluntary disclosure is present at first but the deliberative process starts iterating toward the consensus threshold $\check{A}^*$ leading to a constellation where the voluntary threshold v_l eventually exceeds one. These are situations where disclosure costs crowd out voluntary disclosure in the end. The critical costs for abstaining from voluntary disclosure decreases in enforcement strength as less non-compliant low quality firms remain in the mixture of non-disclosing firms lowering the benefits from separation through voluntary disclosure. Therefore, in the gray and the lined area the consensus threshold is equal to the threshold in the absence of voluntary disclosure A^* derived in Section 4.4.1.

However, if disclosure costs are sufficiently low, then voluntary disclosure is used additionally as described in Sections 4.4.2 and 4.4.3. We have shown that in situations described in Section 4.4.2, the deliberative process starts iterating toward $\check{A}^*$. But in order to satisfy the case conditions, disclosure costs must not fall below a certain threshold, i.e., $c > A/2$. Otherwise, we end up in a situation described in Section 4.4.3, where the mandatory threshold is dominated by voluntary disclosure, and no deliberation takes place. The major difference between the two voluntary disclosure areas highlighted in Figure 4.5 is that if disclosure costs are high enough at the beginning of the iteration, $c > A/2$, the consensus threshold $\check{A}^*$ from Section 4.4.2 is only reached without being dominated by the voluntary threshold v_l, and without violating $c > A/2$ in the lower left area. However, in the upper left area the iteration ends at $A = 2c$ as the combination of high enforcement strength and low disclosure costs lowers the voluntary threshold to such an extent that the mandatory threshold is going to be dominated eventually, $v_l < A$. In other words, during the iterative process there is a switch of cases leading to an end of the iteration in the dotted area.

4.5 Discussion of results and empirical considerations

4.5.1 Enforcement strength and regulatory penalties

The proposed model establishes a relationship between the strength of enforcement and managers' preference toward mandatory disclosure by allowing enforcement to be imperfect. Our first intuitive finding is that the enforcement system has to offer some leeway in exploiting this imperfection in order to make a difference. If the probability of uncovering non-complaint behavior or the expected regulatory penalty are severe enough in combination, then firms simply comply with disclosure regulation. Thereby, the probability of inducing compliance increases with enforcement strength and with the severity of the regulatory penalty as one might expect.

However, an interesting case arises if enforcement is not strong enough and fails to induce compliant firm behavior. Low quality firms are not going to comply with the regulation and abstain from disclosure taking the chance of being exposed afterwards. We identified situations, where non-compliant low quality firms pool with a group of firms of higher quality that is not subject to mandatory disclosure and does not disclose voluntarily. Imperfect enforcement aligns the preferences of these groups and both intend to maximize their pooled non-disclosure price. Based on this alignment, Proposition 4.3.9, Proposition 4.4.3, and Proposition 4.4.7 show a positive relation between the probability of detecting firms' non-compliant disclosure behavior and the preferred level of mandatory disclosure. Therefore, our model predicts that informed managers exert influence on regulators toward more extensive mandatory disclosure if the probability of detecting non-compliant behavior increases. While enforcement strength is difficult to quantify empirically, we expect that a majority of managers is willing to accept disclosure rules fostering more extensive mandatory disclosure in case enforcement is exogenously tightened, e.g., by enforcement changes as described by Christensen et al. (2013).

4.5.2 Disclosure costs

Our findings are largely independent from adding voluntary disclosure to the model as long as voluntary disclosure does not dominate mandatory disclosure, i.e., net benefits from separating through voluntary disclosure are positive. That is, costs of disclosure are low while the probability of detection is high making it attractive for a large number of managers to use voluntary disclosure, $v_l < A$. However, our findings suggest a positive relationship between disclosure costs and and managers' preference toward mandatory disclosure as long as voluntary disclosure is observed. Therefore, our model predicts that managers should be willing to accept more extensive mandatory disclosure if disclosure costs are high in comparison. For example, managers of firms in a high competitive environment, e.g., facing comparably high proprietary costs of disclosure, should be willing to accept more mandatory disclosure than firms in a low competitive environment. However, this does not mean that firms disclose more under a competitive environment. On the contrary, we predict that firms would abstain from disclosure but advocate for more extensive mandatory disclosure rules for all firms which might force some low quality firms to disclose due to enforcement actions.

Further, all other things equal, the marginal effect of enforcement strength on the consensus threshold increases in disclosure costs. Thus, an increase in enforcement strength e.g., by introducing a new layer of oversight, leads to a stronger push toward more extensive mandatory disclosure if disclosure costs are high instead of low. For example, if enforcement strength is increased by a country-wide shock, then we expect the willingness to accept more extensive mandatory disclosure to be higher for firms that belong to the industry with more fierce competition. Second, a similar effect is present when we look at the influence of enforcement strength on the effect of disclosure costs. The mandatory threshold is more sensitive with respect to disclosure costs in an environment that features strong enforcement compared to an environment that features weak enforcement. Therefore, enforcement strength and disclosure costs are in a complementary relation in this respect.

However, if firms completely abstain from voluntary disclosure, disclosure costs simply drop out of the firms' optimization. That is, in a setting where only mandatory disclosure is present, disclosure costs should have no influence on managers' collectively preferred mandatory threshold anymore.

4.5.3 Transparency

During our analysis, we mainly concentrated on the collective preference toward mandatory disclosure and thus, transparency induced by mandatory disclosure. We also want to take a look at how enforcement strength affects the overall transparency level in the alignment equilibria.[56] We introduce a transparency score $T(A^*)$ that provides the proportion of disclosing firms in equilibrium. If no voluntary disclosure is present, it is the proportion of non-compliant low quality firms that is uncovered. We call this "transparency from mandatory disclosure". If voluntary disclosure is present, then $T(A^*)$ is the sum of the proportion of uncovered low quality firms and the proportion of voluntarily disclosing high quality firms. We call the latter summand "transparency from voluntary disclosure".

$$
T(A^*) = \begin{cases} \rho A^*(\rho, c, \alpha) & \text{, if } 1 < v_l, \\ \rho A^*(\rho, c, \alpha) + (1 - v_l(A^*, \rho, c, \alpha)) & \text{, if } 0 \leq v_l \leq 1. \end{cases} \tag{4.2}
$$

It is straightforward that transparency from mandatory disclosure increases with enforcement strength. On the one hand, increasing enforcement strength results in a higher consensus mandatory disclosure level such that more firms are in the scope of mandatory disclosure. On the other hand, increasing enforcement strength also increases the probability of uncovering non-compliant low quality firms, which then have to disclose

---

[56]As indicated before, if enforcement induces compliant behavior, the consensus threshold is one in equilibrium and all firms comply and disclose.

accordingly.[57] The voluntary threshold is weakly increasing in enforcement strength and thus, transparency from voluntary disclosure either remains constant or decreases.[58] However, even if we consider a parameter setting where the voluntary threshold increases, the negative effect on transparency from voluntary disclosure is more than offset by the positive effect from transparency from mandatory disclosure. The reason is that an increase in enforcement strength leads to an increase in the mandatory threshold and thus, the non-disclosure price. This makes it less beneficial for firms of higher quality to disclose voluntarily. However, in line with empirical evidence (e.g., Bushman et al., 2004), the positive effect of enforcement strength on transparency from mandatory disclosure is larger then the negative effect on transparency from voluntary disclosure leading to an overall increase in corporate transparency.

4.6 Concluding remarks

In this paper, we examine the relationship between enforcement and managers' collective preference toward mandatory disclosure. We propose a model where informed managers endogenously determine a consensus disclosure threshold of an asymmetric disclosure rule that gets mandatory for all firms. Managers focus on their short-term preferences and prefer the mandatory threshold that maximizes their firms' current market price. As a novel aspect, we relax the conventional assumption of perfect enforcement and managers face a positive probability that non-compliant disclosure behavior remains undetected, while a detection leads to a regulatory penalty depending on the severity of misconduct in response.

Our results show that the role of enforcement is more complex then just inducing com-

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[57]The increasing effect of the optimal mandatory threshold A^* is not observable if the mandatory threshold does not dependent on enforcement strength as in Section 4.4.3. However, the fact that the mandatory threshold remains constant is not harmful to the increase of transparency from mandatory disclosure.

[58]The voluntary threshold shown in Section 4.4.3 does not depend on enforcement strength and remains constant.

pliant firm behavior. The inherent imperfection of enforcement induces an alignment of preferences between low and high quality firms as long as the non-compliance coefficient is positive for low quality firms. That is, if low quality firms have incentives to withhold private information, their preferences are aligned with managers of firms of higher quality who do not intend or do not have the means to credibly disclose private information under an asymmetric disclosure regime. Both groups agree on the level of mandatory disclosure that maximizes their non-disclosure pooling price.

Based on our findings, we show that informed managers exert political influence toward more extensive mandatory disclosure if enforcement tightens. Interestingly, the positive relationship persists if low quality firms have incentives to be non-compliant. Low quality firms form a coalition with high quality firms advocating for more extensive mandatory disclosure ex-ante, and take the risk of getting exposed and penalized ex-post. The positive relation between enforcement and mandatory disclosure largely remains if mandatory disclosure and voluntary disclosure are both endogenously determined. Based on the alignment effect, we predict that disclosure costs reinforce the positive relationship and that tighter enforcement leads to a substitution of voluntary disclosure by mandatory disclosure. Only if disclosure costs are low such that firms of higher quality fully separate by voluntary disclosure, then a deliberation over mandatory disclosure is needless.

While preparers might constitute an influential group in accounting standard setting, we emphasize that the model does not offer a general theory of standard-setting, e.g., we do not provide a detailed model of the decision process within policy-making bodies. Therefore, the model does not provide an answer with regard to the optimal design of a deliberative process (see, Bertomeu and Cheynel, 2013). However, our results do provide a first intuition of how financial statement preparers act in the light of imperfect enforcement. Further, we assume enforcement parameters to be exogenous. From a policy makers' point of view it might be desirable to determine the optimal combination of the enforcement system and disclosure regulation. However, one would need to incorporate political agendas when answering this question, which we leave for future research.

5 Summary, conclusions and closing remarks

This dissertation focuses on the topic corporate financial disclosure and explores several aspects of the disclosure research centering on disclosure's function to mitigate information asymmetry between corporate insiders, e.g. the management, the current block shareholders, and the outsiders, e.g. the retail investors, the potential future investors. Overall, it seeks to enrich the research regarding the management's disclosure behavior with the purpose of reducing such information asymmetry. As the title of this dissertation suggests, my dissertation focuses on management's decision regarding disclosure of private information. Contrary to what one might infer from the phrase "to tell or not to tell", such a decision, or put more accurately, decisions, are far more complex than a simple "yes or no" decision. Apart from the decision about "whether to tell", the management may also consider and decide on aspects like "how to tell" and "when to tell". It might even decide to go one step further and to actively exert influence on the frame conditions in an economy that set boundaries and limit its discretion over decision in the question of financial disclosure. My dissertation presents three essays, each of which addresses factors that have impacts on one of these aforementioned aspects of decision regarding corporate financial disclosure. Each of these three essays intends to answer one or several distinctive research questions relevant to one of these aspects.

I start with an essay in Chapter 2 to address one of the fundamental questions resulting from information asymmetry: *"Will corporate insiders voluntarily disclose their private information?"*. In particular, it explores the impact of information quality on such a fundamental "yes or no" decision regarding corporate disclosure. Following a long stream of extant research on conditions that hinder a full revelation, the essay discusses the impact

of the difference in information quality on the willingness of management's voluntary disclosure. Since the quality of the information has impacts on the reliability and relevance of such information for potential receivers, it may as well influence the disclosure decision the management makes. In fact, the results from the essay provide an explanation about how the management's decision for voluntary disclosure can be influenced by the information quality. Moreover, the results from the essay indicate that such an impact is twofold. On the one hand, firms with relatively higher quality information may be more reluctant to release negative information, as this would have stronger negative impacts for such firms. On the other hand, when the overall information quality in the economy improves, that is if more firms are expected to possess high quality information, then firms would be more willing to voluntarily disclose their private information overall. The results of this essay shed some light on a potential impact from an improvement in the methodology or technology to gather information and provide more reliable forecasts might have on the disclosure behavior of the management. The model results predict that the improvement of information quality might initially hinder the disclosure and thus aggravate the information asymmetry first. But as more and more firms in the overall population adopt such improvement in information quality, the management would be more willing to disclose negative information, thus subsequently alleviating the overall information asymmetry.

However, the implications about disclosure behavior drawn from such a class of models[59] underlie multiple restrictions when applied to real-life disclosure behavior. Two of them are the overly simplified modeling of the disclosure into a disclose vs withhold decision and the lack of consideration of limitation on decision freedom due to mandatory disclosure regulation. Therefore, I continue to address the question of "how to disclose" in the second essay in the next chapter. Chapter 3 seeks to examine the real-life disclosure behavior with an explicit differentiation of disclosure decisions into multiple dimensions. In addition, I explicitly take the difference in the discretion over the disclosure decision for these different dimensions into consideration. It aims to address the questions *"How is the*

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[59]It refers to the analytical models with voluntary disclosure modeled as the sole possibility for communicating information and with focus on disclose vs. withhold decision.

voluntary disclosure decision influenced by the limitation through mandatory disclosure regulation?", *"To what extend are the decisions influenced given the multi-dimensional decision problem?"* and *"What is the interdependency between the decisions towards each disclosure dimension?"* The results from the essay provide some evidence supporting the notion that the management strategically uses its decision discretion. In particular, it seems to smooth the overall quantity of disclosure using its discretion. However, the hypothesized interdependency between the disclosure dimensions due to the differences in limitation of the decision discretion could not be confirmed by the results. Instead, the management seems to focus on different targets when making decisions regarding different dimensions. Contrary to the disclosure quantity, evidence suggests the management may focus more on the mitigation of litigation risks when deciding on the textual sentiment of the disclosure.

While the first two essays in my dissertation focus on management's disclosure decision itself, the third essay in Chapter 4 extends the analysis further to how the management exerts influence on the formation of disclosure regulation which sets boundaries for its disclosure decision. In particular, the essay focuses on the formation of firms' (and managements') collective preference towards mandatory regulation level. It addresses the questions *"How could the process of forming collective preference towards mandatory disclosure be?"*, *"What impacts can other institutional parameters such as enforcement have in the formation of such collective preference?"* and *"How would the implicit overall transparency react to a change in enforcement and the resulting change in collective preference, if such preference is mostly implemented as disclosure regulation?"* The model results suggest a high relevance of enforcement parameter on the collective preference towards mandatory disclosure. The imperfection in the enforcement can align the preferences of different groups of firms which otherwise would have conflicting interests. Moreover, a strong enforcement also facilitates effect for the formation of a more rigid mandatory disclosure regulation. And as a result, an increase of enforcement strength could also facilitate the increase of overall transparency in the economy.

Apart from addressing the research questions discussed above, several testable hypothesis and questions for further research also emerged from the results of the essays.

To verify the model results regarding the impact of information quality on disclosure. Empirical tests may be conducted to test the severity of observed bad news disclosure in association with the quality of such information or in association of the quality of the methods that produced such information. In addition, hypothesis could also be drawn to test the association between the introduction of new technology or method, e.g. new informational system or new valuation method, that facilitate generation of higher quality information and the frequency / severity of voluntarily disclosed negative information.

Regarding the possible impacts of the financial distress on the disclosure behavior, further empirical tests with an extended sample including matched-pair samples, may improve the generalizability of the results from Chapter 3. In addition, further investigations can be focused more to the two qualitative dimensions. For textual readability, the follow-up research question could be "Does management strategically use the dimension textual readability? And if so, what are the main drivers for managements' choice of readability, given the financial performance of the firms does not seem to be one of the main drivers?". For textual sentiment, further empirical tests can be conducted to verify the hypothesized management's priority on litigation risk mitigation.

To test the model results regarding the impact of enforcement on the preference formation for mandatory disclosure, one may specifically investigate the lobbying behavior of industrial associations and firms. One research question directly resulting from the proposed alignment function from imperfect enforcement is "whether one could typically observe aligned or close positions being lobbied for by industrial associations or do firms typically exhibit vastly different positions in their lobbying approach?" Also, another interesting empirical question would be whether evidence exists that supports an association between the enforcement strength in an economy and the position regarding mandatory disclosure that is being lobbied for.

Appendices

A Proof of a higher signal correlation of a *Type H* firm

Firstly, the two conditional correlations $Corr[U,V \mid Q=H, R=1]$ and $Corr[U,V \mid Q=L, R=1]$ need to be calculated. Since U is normally distributed and V follows a finite mixture distribution of normals, the bivariate vector $(U,V)^T$ also follows a bivariate finite mixture distribution of normals with

$$
\left(\begin{pmatrix} U \\ V \end{pmatrix} \mid Q=H \right) \sim \mathcal{N} \left(\begin{pmatrix} \theta \\ \theta \end{pmatrix}, \begin{pmatrix} h^{-1} & h^{-1} \\ h^{-1} & h^{-1}+s_H^{-1} \end{pmatrix} \right) \tag{A.1}
$$

$$
\left(\begin{pmatrix} U \\ V \end{pmatrix} \mid Q=L \right) \sim \mathcal{N} \left(\begin{pmatrix} \theta \\ \theta \end{pmatrix}, \begin{pmatrix} h^{-1} & h^{-1} \\ h^{-1} & h^{-1}+s_L^{-1} \end{pmatrix} \right) \tag{A.2}
$$

Given this bivariate finite mixture distribution of normals for vector $(U,V)^T$, the conditional correlation for a *Type H* firm can be easily calculated as:

$$
\begin{aligned}
Corr[U,V \mid Q=H, R=1] &= \frac{Cov[U,V \mid Q=H, R=1]}{\sqrt{Var[U]} \cdot \sqrt{Var[V \mid Q=H, R=1]}} \\
&= \frac{h^{-1}}{\sqrt{h^{-1}} \cdot \sqrt{h^{-1}+s_H^{-1}}} \\
&= \sqrt{\frac{h^{-1}}{h^{-1}+s_H^{-1}}} \\
&= \sqrt{\frac{s_H}{s_H+h}} \\
&= \sqrt{1 - \frac{h}{s_H+h}}.
\end{aligned} \tag{A.3}
$$

Similarly, it is valid that

$$
Corr[U,V \mid Q=L, R=1] = \sqrt{1 - \frac{h}{s_L+h}}. \tag{A.4}
$$

Per assumption, s_H is larger than s_L and $h > 0$. Hence it is valid that

$$s_H > s_L$$

$$\frac{h}{s_H + h} < \frac{h}{s_L + h}$$

$$1 - \frac{h}{s_H + h} > 1 - \frac{h}{s_L + h}$$

$$\sqrt{1 - \frac{h}{s_H + h}} > \sqrt{1 - \frac{h}{s_L + h}}$$

$$Corr[U, V \mid Q = H, R = 1] > Corr[U, V \mid Q = L, R = 1] \tag{A.5}$$

As a result, the signal of a *Type H* firm have a higher correlation to the firm's going concern value than the signal of a *Type L* firm.

B Proof of Corollary 2.3.1

For the ease of notation in this section, let w_H denote the term $\frac{s_H}{s_H + h}$ and w_L denote the term $\frac{s_L}{s_L + h}$.

Given an arbitrary interval $\mathcal{V}_s \subseteq \Re$, the updated going concern value for a partial disclosure of only the signal precision $Q = H$ for any $V = v$ realized within this interval $\mathcal{V}_s$ can be calculated as $\mathbb{E}[U \mid v \in \mathcal{V}_s, Q = H, R = 1] = (1 - w_H) \cdot \theta + w_H \cdot \mathbb{E}[V \mid v \in \mathcal{V}_s, Q = H, R = 1]$. It is obvious that there is a subset $\hat{\mathcal{V}}_s \subset \mathcal{V}_s$ where it is valid for all $\hat{v} \in \hat{\mathcal{V}}_s$ that $\hat{v} > \mathbb{E}[V \mid v \in \mathcal{V}_s, Q = H, R = 1]$. Since the updated going concern value under a full disclosure for such realizations $\mathbb{E}[U \mid V = \hat{v}, Q = H, R = 1] = (1 - w_H) \cdot \theta + w_H \cdot \hat{v}$ is larger than that under a partial disclosure, these firms would then chose to separate themselves from the pool and switch over to full disclosure. The original interval now contracts to $\mathcal{V}_s \backslash \hat{\mathcal{V}}_s$. Continuing the above argumentation, the interval would contract to $\emptyset$ in the end. Hence, there exists no interval in $\Re$, where a partial disclosure of only the signal precision would be more advantageous than a full disclosure. This is also valid for firms with lower signal precision ($Q = L$).

C Proof of Corollary 2.3.2

For the ease of notation in this section, let w_H denote the term $\frac{s_H}{s_H+h}$ and w_L denote the term $\frac{s_L}{s_L+h}$.

Suppose there existed an arbitrary real number $v_v \in \Re$, for which both *Type H* firm and *Type L* firm would withhold their types and only disclose the realization of the signal $V = v_v$. The updated going concern value for such a partial disclosure of only the signal realization can be calculated as $\mathbb{E}[U \mid V = v_v, Q = H, R = 1] \cdot Pr(Q = H \mid V = v_v, R = 1) + \mathbb{E}[U \mid V = v_v, Q = L, R = 1] \cdot Pr(Q = L \mid V = v_v, R = 1)$. Let τ denotes the conditional probability $Pr(Q = H \mid V = v_v, R = 1)$. Then the term can be rewritten as following:

$$
\begin{aligned}
&\mathbb{E}[U \mid V = v_v, Q = H, R = 1] \cdot Pr(Q = H \mid V = v_v, R = 1) \\
&\quad + \mathbb{E}[U \mid V = v_v, Q = L, R = 1] \cdot Pr(Q = L \mid V = v_v, R = 1) \\
&= ((1 - w_H)\theta + w_H v_v) \cdot \tau + ((1 - w_L)\theta + w_L v_v) \cdot (1 - \tau) \\
&= ((1 - w_H)\tau + (1 - w_L)(1 - \tau))\theta + (w_H \cdot \tau + w_L(1 - \tau))v_v. \qquad \text{(C.1)}
\end{aligned}
$$

Given $s_L < s_H$ as defined in model setup, it is obvious that $1 - w_L > 1 - w_H$ and $w_L < w_H$. Starting from this point, a series of algebraic manipulations can lead to the result $(1 - w_H)\theta + w_H \cdot v_v > ((1 - w_H)\tau + (1 - w_L)(1 - \tau))\theta + (w_H \cdot \tau + w_L \cdot (1 - \tau))v_v$

for any $\tau \in [0, 1)$, if $v_v > \theta$:

$$(1 - \tau)((1 - w_H) - (1 - w_L))(\theta - v_v) > 0$$

$$(1 - \tau)[((1 - w_H) - (1 - w_L))\theta - ((1 - w_H) - (1 - w_L))v_v] > 0$$

$$(1 - \tau)[((1 - w_H) - (1 - w_L))\theta + (w_H - w_L)v_v] > 0$$

$$(1 - \tau)((1 - w_H) - (1 - w_L))\theta + (1 - \tau)(w_H - w_L)v_v > 0$$

$$((1 - \tau)(1 - w_H)\theta - (1 - \tau)(1 - w_L)\theta + ((1 - \tau)w_H - (1 - \tau)w_L)v_v > 0$$

$$(1 - w_H)\theta - \tau(1 - w_H)\theta - (1 - \tau)(1 - w_L)\theta + w_H \cdot v_v - \tau w_H \cdot v_v - (1 - \tau)w_L \cdot v_v > 0$$

$$(1 - w_H)\theta + w_H \cdot v_v > ((1 - w_H)\tau + (1 - w_L)(1 - \tau))\theta + (w_H\tau + w_L(1 - \tau))v_v.$$

Therefore, in case the signal realization is above the a priori expectation ($V = v_v > \theta$), it is true that $\mathbb{E}[U \mid V = v_v, Q = H, R = 1] > \mathbb{E}[U \mid V = v_v, R = 1]$ or $(1 - w_H)\theta + w_H \cdot v_v > ((1 - w_H)\tau + (1 - w_L)(1 - \tau))\theta + (w_H \cdot \tau + w_L(1 - \tau))v_v$ respectively. This means the *Type H* firm would have a higher price valuation under the full disclosure compared with the valuation under the partial disclosure of the signal realization only, inducing it to leave the pooling equilibrium.

In consequence, the firm with higher signal precision would leave the partial disclosure to full disclosure in such a case. Correspondingly, the conditional probability after updating is $\tau = Pr(Q = H \mid V = v_v > \theta, R = 1) = 0$. Since the relationship shown above holds for all $\tau \in [0, 1)$, the equilibrium stays that the *Type H firm* would prefer full disclosure than partial disclosure of only the signal realization. Similarly, it can be shown that firm with lower signal precision (*Type L* firm) would have incentive to switch to full disclosure in case $v_v < \theta$.

Consolidating the results from above, it is obvious that there exists no pooling over the signal precision for any $v_v \neq \theta$. In case of $v_v = \theta$, both types of the firms are indifferent between partial disclosure of only the signal realization and the full disclosure as no updating of the expectation would take place in such a case. All in all, there is no $v_v \in \Re$

where a partial disclosure of only the signal would be favored over full disclosure.

D Proof of Lemma 2.3.3

Given the bivariate finite mixture distribution of normals for vector $(U, V)^T$ as shown in (A.1) and (A.2) in Appendix A, the following conditional expectation is valid:

$$
\begin{aligned}
\mathbb{E}[U \mid V = v, Q = H, R = 1] =& \mathbb{E}[U \mid Q = H, R = 1] + \frac{Cov[U, V \mid Q = H, R = 1]}{Var[V \mid Q = H, R = 1]} \\
& \cdot (v - \mathbb{E}[V \mid Q = H, R = 1]) \\
=& \theta + \frac{h^{-1}}{h^{-1} + s_H^{-1}} \cdot (v - \theta) \\
=& \theta + \frac{h^{-1}}{h^{-1} + s_H^{-1}} \cdot v - \frac{h^{-1}}{h^{-1} + s_H^{-1}} \cdot \theta \\
=& \frac{s_H^{-1}}{h^{-1} + s_H^{-1}} \cdot \theta + \frac{h^{-1}}{h^{-1} + s_H^{-1}} \cdot v \\
=& \frac{h}{s_H + h} \cdot \theta + \frac{s_H}{s_H + h} \cdot v \\
=& (1 - w_H) \cdot \theta + w_H \cdot v
\end{aligned}
$$

Similarly, it is valid that

$$
\mathbb{E}[U \mid V = v, Q = L, R = 1] = (1 - w_L) \cdot \theta + w_L \cdot v.
$$

E Proof of Lemma 2.3.4

In the case of non-disclosure, the investor can not distinguish three different possible scenarios. The first one is the possibility, when the firm has received no private information and thus can't make disclosure about the signal or about the signal quality. The second possibility is a *Type H* firm with realization below its corresponding threshold value v_H. And the third possibility is a *Type L* firm with realization of the signal below its

corresponding threshold value v_L. In math, this is espressed by $\mathbb{E}[U \mid (V \leq v_H, Q = H, R = 1) \vee (V \leq v_L, Q = L, R = 1) \vee (R = 0)]$. A simple algebraic manipulation then yields:

$$\mathbb{E}[U \mid (V \leq v_H, Q = H, R = 1) \vee (V \leq v_L, Q = L, R = 1) \vee (R = 0)]$$

$$= \mathbb{E}[U \mid (V \leq v_H, Q = H, R = 1)] \cdot Pr(Q = H \wedge R = 1)$$

$$+ \mathbb{E}[U \mid (V \leq v_L, Q = L, R = 1)] \cdot Pr(Q = L \wedge R = 1)$$

$$+ \mathbb{E}[U \mid R = 0] \cdot Pr(R = 0) \tag{E.1}$$

Since $(U, V)^T$ is bivariate finite mixture normal distributed, the conditional expectation of U with a truncated $V \mid v \leq v_H, Q = H, R = 1$ can be calculated as:

$$\mathbb{E}[U \mid V \leq v_H, Q = H, R = 1] = \frac{h}{s_H + h} \cdot \theta + \frac{s_H}{s_H + h} \cdot \mathbb{E}[V \mid V \leq v_H, Q = H, R = 1]$$

$$= \frac{h}{s_H + h} \cdot \theta + \frac{s_H}{s_H + h} \cdot (\theta - \frac{\phi(\frac{v_H - \theta}{\sqrt{h^{-1} + s_H^{-1}}})}{\Phi(\frac{v_H - \theta}{\sqrt{h^{-1} + s_H^{-1}}})} \cdot \sqrt{h^{-1} + s_H^{-1}})$$

$$= \theta - \frac{\phi(\frac{v_H - \theta}{\sqrt{h^{-1} + s_H^{-1}}})}{\Phi(\frac{v_H - \theta}{\sqrt{h^{-1} + s_H^{-1}}})} \cdot \sqrt{(h^{-1} + s_H^{-1})^{-1} \cdot h^{-2}}$$

$$= \theta - \frac{f_H(v_H)}{F_H(v_H)} \cdot h^{-1}$$

$$= \theta - \Omega_H(v_H) \tag{E.2}$$

Similarly,

$$\mathbb{E}[U \mid V \leq v_L, Q = L, R = 1] = \theta - \Omega_L(v_L) \tag{E.3}$$

In addition, it is straightforward that $\mathbb{E}[U \mid R = 0] = \mathbb{E}[U] = \theta$ as no information is received to update the prior expectation.

Now, I insert Equation (E.2), Equation (E.3) and $\mathbb{E}[U \mid R = 0] = \theta$, as well as $Pr(Q =$

$H \wedge R = 1) = \pi$, $Pr(Q = L \wedge R = 1) = 1 - \pi$ and $Pr(R = 0) = \psi$ as defined in section 2.2 into Equation (E.1). It then turns into:

$$\mathbb{E}[U \mid (V \leq v_H, Q = H, R = 1) \vee (V \leq v_L, Q = L, R = 1) \vee (R = 0)]$$

$$= (\theta - \Omega_H(v_H)) \cdot \pi + (\theta - \Omega_L(v_L)) \cdot (1 - \psi - \pi) + \theta \cdot \psi$$

$$= \theta - \pi \cdot \Omega_H(v_H) - (1 - \pi - \psi) \cdot \Omega_L(v_L) \tag{E.4}$$

F Proof of the existence of v_H

For the ease of notation, let LHS of (2.19) be denoted as $\mathcal{L}(v_H)$.

Lemma F.1. *Property i: The LHS of Equation* (2.19) *is monotonic increasing in* v_H.

Proof. To prove Property i, I calculate the derivative of $\mathcal{L}(v_H)$ towards v_H:

$$\frac{\partial \mathcal{L}(v_H)}{\partial v_H} = \pi \frac{\partial \Omega_H}{\partial v_H} + (1 - \psi - \pi) \frac{\partial \Omega_L}{\partial v_L} \frac{\partial v_L}{\partial v_H} + w_H$$

$$= \pi(h \cdot \Psi_H(v_H) - 1) + (1 - \psi - \pi)(h \cdot \Psi_L(v_L) - 1) \frac{w_H}{w_L} + w_H \tag{F.1}$$

with

$$\Psi_H(v_H) = h^{-1} - \frac{s_H}{h + s_H}(v_H - \theta)\frac{h^{-1}f_H(v_H)}{F_H(v_H)} - \left(\frac{h^{-1}f_H(v_H)}{F_H(v_H)}\right)^2$$

$$= Var[U \mid v \leq v_H, Q = H, R = 1]$$

and

$$\Psi_L(v_L) = h^{-1} - \frac{s_L}{h + s_L}(v_L - \theta)\frac{h^{-1}f_L(v_L)}{F_L(v_L)} - \left(\frac{h^{-1}f_L(v_L)}{F_L(v_L)}\right)^2$$

$$= Var[U \mid v \leq v_L, Q = L, R = 1]$$

Verrecchia (1983) cites Heckman (1979) to show that the variance of U conditional on an

upwards truncated V has the property of $\frac{1}{s_H+h} \leq \Psi_H(v_H) \leq h^{-1}$. Utilizing this property, it can be shown that

$$\frac{1}{h+s_H} \leq \Psi_H(v_H) \leq h^{-1}$$
$$\frac{h}{s_H+h} - 1 \leq h \cdot \Psi_H(v_H) - 1 \leq 1 - 1$$
$$-\frac{s_H}{s_H+h} \leq h \cdot \Psi_H(v_H) - 1 \leq 0$$
$$-w_H \leq h \cdot \Psi_H(v_H) - 1 \leq 0 \tag{F.2}$$

Analogously, it is also valid that

$$-w_L \leq h \cdot \Psi_L(v_L) - 1 \leq 0 \tag{F.3}$$

Combing the Inequation (F.2) and (F.3) with equation (F.1), it can be shown that $\frac{\partial \mathcal{R}(v_H)}{\partial v_H} \in [\psi \cdot w_H, w_H]$, meaning $\mathcal{L}(v_H)$ is monotonic increasing in v_H. $\qquad\square$

Lemma F.2. *Property ii: The LHS of Equation* (2.19) *has the boundary value* $-\infty$ *for* $v_H \to -\infty$.

Proof. I start the proof by some algebraic manipulation of the LHS of (2.19):

$$\pi\Omega_H(v_H) + (1 - \psi - \pi)\Omega_L(v_L) + w_H \cdot v_H - w_H\theta$$
$$= \pi\Omega_H(v_H) + (1 - \psi - \pi)\Omega_L(v_L) + w_H \cdot (v_H - \theta)$$

Utilizing the relationship $w_H \cdot (v_H - \theta) = w_L \cdot (v_L - \theta)$, shown in equation (2.17), the term

can further be rewritten as:

$$\pi\Omega_H(v_H) + (1 - \psi - \pi)\Omega_L(v_L) + w_H \cdot (v_H - \theta)$$

$$=\pi\Omega_H(v_H) + \pi w_H(v_H - \theta) + (1 - \psi - \pi)\Omega_L(v_L) + (1 - \psi - \pi)w_L(v_L - \theta) + \psi w_H(v_H - \theta)$$

$$=\pi[\Omega_H(v_H) + w_H(v_H - \theta)] + (1 - \psi - \pi)[\Omega_L(v_L) + w_L(v_L - \theta)] + \psi w_H(v_H - \theta)$$

$$=\pi[h^{-1} - \Psi_H(v_H)]\Omega_H(v_H)^{-1} + (1 - \psi - \pi)[h^{-1} - \Psi_L(v_L)]\Omega_L(v_L)^{-1} + \psi w_H(v_H - \theta)$$

$$\text{(F.4)}$$

Further more, using the L'Hospital rule, the the boundary value of $\Omega_H(v_H)$ for $v_H \to -\infty$ can be calculated as:

$$
\begin{aligned}
\lim_{v_H \to -\infty} \Omega_H(v_H) &= \lim_{v_H \to -\infty} \frac{f_H(v_H)}{F_H(v_H)} h^{-1} \\
&= \lim_{v_H \to -\infty} \frac{\frac{\partial f_H(v_H)h^{-1}}{\partial v_H}}{\frac{\partial F_H(v_H)}{\partial v_H}} \\
&= \lim_{v_H \to -\infty} \frac{-\frac{v_H - \theta}{s_H^{-1} + h^{-1}} f_H(v_H)h^{-1}}{f_H(v_H)} \\
&= \lim_{v_H \to -\infty} -\frac{v_H - \theta}{s_H^{-1} + h^{-1}} h^{-1} \\
&= +\infty.
\end{aligned}
\tag{F.5}
$$

Similarly, it can be shown that $\lim_{v_L \to -\infty} \Omega_L(v_L) = +\infty$ as well. Based on equation (2.18), it is also straightforward that $\lim_{v_H \to -\infty} v_L = -\infty$. Therefore, combining the two results, it is also clear valid that $\lim_{v_H \to -\infty} \Omega_L(v_L(v_H)) = +\infty$.

Based on the results that $\lim_{v_H \to -\infty} \Omega_H(v_H) = +\infty$ and the fact that $h^{-1} - \Psi_H(v_H) \in [-w_H, 0]$, it is straightforward that

$$
\begin{aligned}
&\lim_{v_H \to -\infty} \pi[h^{-1} - \Psi_H(v_H)]\Omega_H(v_H)^{-1} \\
&= \pi \cdot \lim_{v_H \to -\infty} [h^{-1} - \Psi_H(v_H)] \cdot \lim_{v_H \to -\infty} \Omega_H(v_H)^{-1} \\
&= 0
\end{aligned}
\tag{F.6}
$$

Similarly, it can be shown that

$$\lim_{v_H \to -\infty} (1 - \psi - \pi)[h^{-1} - \Psi_L(v_L)]\Omega_L(v_L)^{-1}$$

$$= (1 - \psi - \pi) \cdot \lim_{v_H \to -\infty} [h^{-1} - \Psi_L(v_L)] \cdot \lim_{v_H \to -\infty} \Omega_L(v_L)^{-1}$$

$$= (1 - \psi - \pi) \cdot \lim_{v_L \to -\infty} [h^{-1} - \Psi_L(v_L)] \cdot \lim_{v_L \to -\infty} \Omega_L(v_L)^{-1}$$

$$= 0 \tag{F.7}$$

Combining the results from Equaitions (F.4) with (F.6) and (F.7), it boundary value of the LHS of equation (2.19) then can be calculated as

$$\lim_{v_H \to -\infty} \mathcal{L}(v_H) = 0 + 0 + (-\infty)$$

$$= -\infty \qquad \square$$

Lemma F.3. *Property iii: The LHS of Equation* (2.19) *has the boundary value* $+\infty$ *for* $v_H \to +\infty$.

Proof. To prove the boundary value, I first calculate the boundary values of $\Omega_H(v_H)$ and $\Omega_L(v_L)$ in case $v_H \to +\infty$ or $v_H \to +\infty$:

$$\lim_{v_H \to +\infty} \Omega_H(v_H) = \lim_{v_H \to +\infty} \frac{f_H(v_H)}{F_H(v_H)} h^{-1}$$

$$= \frac{0}{1} h^{-1}$$

$$= 0 \tag{F.8}$$

Analogously, it is clear that $\lim_{v_L \to +\infty} \Omega_H(v_L) = 0$. Based on equation (2.18), it is also straightforward that $\lim_{v_H \to +\infty} v_L = +\infty$. Therefore, combining the two results, it is also

clear valid that

$$\lim_{v_H \to +\infty} \Omega_L(v_L(v_H)) = \lim_{v_L \to +\infty} \Omega_L(v_L)$$

$$= 0 \tag{F.9}$$

Inserting the results from equations (F.8) and (F.9) into $\lim_{v_H \to +\infty} \mathcal{L}(v_H)$, it can be shown that

$$\lim_{v_H \to +\infty} \mathcal{L}(v_H) = \pi \lim_{v_H \to +\infty} \Omega_H(v_H) + (1 - \psi - \pi) \lim_{v_H \to +\infty} \Omega_L(v_L) + w_H \lim_{v_H \to +\infty} v_H - w_H \theta$$

$$= \pi \cdot 0 + (1 - \psi - \pi) \cdot 0 + \infty + w_H \theta$$

$$= +\infty \qquad \square$$

G Proof of Corollary 2.4.1

To prove the positive association between v_H and ψ, I investigate the derivative of $\frac{\partial v_H}{\partial \psi}$. Firstly, I establish that

Lemma G.1. *The derivatives $\frac{\partial v_H}{\partial \psi}$ and $\frac{\partial v_H}{\partial \psi}$ have the same algebraic sign.*

Proof. Deriving both sides of equation (2.18) towards ψ yields:

$$\frac{\partial v_L}{\partial \psi} = \frac{w_H}{w_L} \frac{\partial v_H}{\partial \psi} \tag{G.1}$$

Since both w_H and w_L are positive, both derivatives thus have the same algebraic sign. $\quad\square$

Secondly, it can be demonstrated that

Lemma G.2. $\frac{\partial v_L}{\partial \psi} > 0$, *for all $\psi > 0$ and all $v_L < \theta$.*

Proof. To calculate the derivative $\frac{\partial v_L}{\partial \psi}$, I derive both sides of the equation (2.19) towards ψ:

$$\pi \cdot \frac{\partial \Omega_H}{\partial v_H} \frac{\partial v_H}{\partial \psi} + (-1)\Omega_L + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L} \frac{\partial v_L}{\partial \psi} + w_H \cdot \frac{\partial v_H}{\partial \psi} = 0$$

$$\pi \cdot \frac{\partial \Omega_H}{\partial v_H} \frac{w_L}{w_H} \frac{\partial v_L}{\partial \psi} + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L} \frac{\partial v_L}{\partial \psi} + w_L \cdot \frac{\partial v_L}{\partial \psi} = \Omega_L$$

$$(\pi \cdot \frac{\partial \Omega_H}{\partial v_H} w_L + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L} w_H + w_L w_H) \frac{\partial v_L}{\partial \psi} = w_H \Omega_L$$

$$(\pi \cdot w_L(h\Psi_H - 1) + (1 - \psi - \pi) \cdot w_H(h\Psi_L - 1) + w_L w_H) \frac{\partial v_L}{\partial \psi} = w_H \Omega_L$$

$$(\pi \cdot w_L(1 - h\Psi_H) + (1 - \psi - \pi) \cdot w_H(1 - h\Psi_L) - w_L w_H) \frac{\partial v_L}{\partial \psi} = -w_H \Omega_L \qquad \text{(G.2)}$$

Based on inequation (F.2) and (F.3), it is obvious that $0 \le \pi \cdot w_L(1 - h\Psi_H) \le \pi w_L w_H$ and $0 \le (1 - \psi - \pi) \cdot w_H(1 - h\Psi_L) \le (1 - \psi - \pi)w_L w_H$. Therefore, it is valid for the sum $(\pi \cdot w_L(1 - h\Psi_H) + (1 - \psi - \pi) \cdot w_H(1 - h\Psi_L) - w_L w_H)$ that

$$- w_L w_H \le (\pi \cdot w_L(1 - h\Psi_H) + (1 - \psi - \pi) \cdot w_H(1 - h\Psi_L) - w_L w_H) \le -\psi w_L w_H \quad \text{(G.3)}$$

Since $-w_H \Omega_L$ is also smaller than zero, it is straightforward that $\frac{\partial v_L}{\partial \psi} > 0$. $\qquad \square$

From the two lemmas G.1 and G.2, it is obvious that both $\frac{\partial v_L}{\partial \psi}$ and $\frac{\partial v_H}{\partial \psi}$ are positive.

H Proof of Corollary 2.4.2

To investigate the derivatives $\frac{\partial v_H}{\partial \pi}$ and $\frac{\partial v_L}{\partial \pi}$, some lemmas are needed. I will firstly show and prove some necessarily lemmas before I show the algebraic sign of the two derivatives at the end of this section.

Lemma H.1. *The derivative of v_H towards π: $\frac{\partial v_H}{\partial \pi}$ has the same algebraic sign as the derivative of v_L towards π: $\frac{\partial v_L}{\partial \pi}$.*

Proof. Deriving both sides of equation (2.18) towards π yields:

$$\frac{\partial v_L}{\partial \pi} = \frac{w_H}{w_L}\frac{\partial v_H}{\partial \pi} \tag{H.1}$$

Since both w_H and w_L are positive, both derivatives thus have the same algebraic sign. $\qquad\square$

Lemma H.2. *The derivative $\frac{\partial v_L}{\partial \pi}$ has the same algebraic sign as the algebraic sign of the term $\Omega_L(v_L) - \Omega_H(v_H)$.*

Proof. I derivate both sides of equation (2.19) towards π, yielding:

$$\Omega_H(v_H) + \pi \cdot \frac{\partial \Omega_H}{\partial v_H}\frac{\partial v_H}{\partial \pi} + (-1)\Omega_L(v_L) + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L}\frac{\partial v_L}{\partial \pi} + w_H \cdot \frac{\partial v_H}{\partial \pi} = 0$$

$$\pi \cdot \frac{\partial \Omega_H}{\partial v_H}\frac{w_L}{w_H}\frac{\partial v_L}{\partial \pi} + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L}\frac{\partial v_L}{\partial \pi} + w_L \cdot \frac{\partial v_L}{\partial \pi} = \Omega_L(v_L) - \Omega_H(v_H)$$

$$(\pi \cdot \frac{\partial \Omega_H}{\partial v_H}w_L + (1 - \psi - \pi) \cdot \frac{\partial \Omega_L}{\partial v_L}w_H + w_L w_H)\frac{\partial v_L}{\partial \pi} = w_H[\Omega_L(v_L) - \Omega_H(v_H)]$$

$$(\pi \cdot w_L(h\Psi_H - 1) + (1 - \psi - \pi) \cdot w_H(h\Psi_L - 1) + w_L w_H)\frac{\partial v_L}{\partial \pi} = w_H[\Omega_L(v_L) - \Omega_H(v_H)]$$

$$-w_H^{-1}(\pi \cdot w_L(1 - h\Psi_H) + (1 - \psi - \pi) \cdot w_H(1 - h\Psi_L) - w_L w_H)\frac{\partial v_L}{\partial \pi} = \Omega_L(v_L) - \Omega_H(v_H)$$

$$\tag{H.2}$$

Based on the inequation (G.3) as well as $w_H > 0$, it is obvious that the LHS of the equation above is positive. Hence, the derivative $\frac{\partial v_L}{\partial \pi}$ has the same algebraic sign as the term $\Omega_L(v_L) - \Omega_H(v_H)$. $\qquad\square$

Lemma H.3. *The algebraic sign $\Omega_L(v_L) - \Omega_H(v_H)$ of can be determined by the algebraic sign of the term $\sigma_L^{-1}\frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)} - \sigma_H^{-1}\frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)}$ with $\sigma_L = \sqrt{s_L^{-1} + h^{-1}}$, $\sigma_H = \sqrt{s_H^{-1} + h^{-1}}$, $\tilde{v}_L = \frac{v_L - \theta}{\sigma_L}$, $\tilde{v}_H = \frac{v_H - \theta}{\sigma_L}$, $\phi(.)$ denoting the pdf of the standard normal distribution and $\Phi(.)$ denoting the cpf of the standard normal distribution.*

Proof. Starting from the denotation of $\Omega_L(v_L) = \frac{f_L(v_L)}{F_L(v_L)}h^{-1}$ and $\Omega_H(v_H) = \frac{f_H(v_H)}{F_H(v_H)}h^{-1}$,

some algebraic transformations yield:

$$\Omega_L(v_L) - \Omega_H(v_H) = \frac{f_L(v_L)}{F_L(v_L)}h^{-1} - \frac{f_H(v_H)}{F_H(v_H)}h^{-1}$$

$$= \frac{f_L(v_L) \cdot F_H(v_H) - f_H(v_H) \cdot F_L(v_L)}{F_L(v_L) \cdot F_H(v_H)} \cdot h^{-1} \qquad (\text{H.3})$$

Since it is valid by definition that $F_L(v_L) \cdot F_H(v_H) > 0$, the algebraic sign of $\Omega_L(v_L) - \Omega_H(v_H)$ is identical with the algebraic sign of the term $f_L(v_L) \cdot F_H(v_H) - f_H(v_H) \cdot F_L(v_L)$ in the numerator of the RHS of Equation (H.3). The standardization of the p.d.f. and c.d.f. and some further algebraic transformations of the term then yield:

$$f_L(v_L)F_H(v_H) - f_H(v_H)F_L(v_L) = \sigma_L^{-1}\phi(\tilde{v}_L)\Phi(\tilde{v}_H) - \sigma_H^{-1}\phi(\tilde{v}_H)\Phi(\tilde{v}_L)$$

$$= \Phi(\tilde{v}_L)\Phi(\tilde{v}_L)[\sigma_L^{-1}\frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)} - \sigma_H^{-1}\frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)}] \qquad (\text{H.4})$$

Since the c.p.f. of the standard normal distribution is larger than zero, it is obvious that the algebraic sign of the term $\sigma_L^{-1}\frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)} - \sigma_H^{-1}\frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)}$ then determines the algebraic sign of $\Omega_L(v_L) - \Omega_H(v_H)$. $\qquad\square$

Lemma H.4. *It is valid in equilibrium that* $\tilde{v}_L = \frac{\sigma_L}{\sigma_H}\tilde{v}_H$. *In addition, it is valid that* $\frac{\sigma_L}{\sigma_H} > 1$.

Proof. From the equation (2.17), it can be shown that

$$w_H(v_H - \theta) = w_L(v_L - \theta)$$

$$\frac{s_H}{s_H + h}(v_H - \theta) = \frac{s_L}{s_L + h}(v_L - \theta)$$

$$\frac{h^{-1}}{h^{-1} + s_H^{-1}}(v_H - \theta) = \frac{h^{-1}}{h^{-1} + s_L^{-1}}(v_L - \theta)$$

$$\frac{1}{\sqrt{h^{-1} + s_H^{-1}}}\frac{(v_H - \theta)}{\sqrt{h^{-1} + s_H^{-1}}} = \frac{1}{\sqrt{h^{-1} + s_L^{-1}}}\frac{(v_L - \theta)}{\sqrt{h^{-1} + s_L^{-1}}}$$

$$\frac{1}{\sigma_H}\tilde{v}_H = \frac{1}{\sigma_L}\tilde{v}_L$$

$$\tilde{v}_L = \frac{\sigma_L}{\sigma_H}\tilde{v}_H \qquad (\text{H.5})$$

In addition, it is straightforward from the definition that

$$s_L < s_H$$

$$s_L^{-1} > s_H^{-1}$$

$$\sqrt{s_L^{-1} + h^{-1}} > \sqrt{s_H^{-1} + h^{-1}}$$

$$\sigma_L > \sigma_H$$

$$\frac{\sigma_L}{\sigma_H} > 1 \tag{H.6}$$

□

Lemma H.5. *Let $\omega(\tilde{v}_L)$ denote $\frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)}$ and $\omega(\tilde{v}_H)$ denote $\frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)}$, it can be shown that $\omega(\alpha \cdot \tilde{v}) < \alpha \cdot \omega(\tilde{v})$ for any α as a constant with $\alpha > 1$ and for any given $\tilde{v} < 0$.*

Proof. Following well known properties of normal distribution, Verrecchia (1983) cites Heckman (1979) to show that first derivative of the function $\omega(\tilde{v}) \cdot h^{-1}$ is negative[60]. In addition, Verrecchia (1983) cites Heckman (1979) and Sampford (1953) to show that the second derivate of $\omega(\tilde{v}) \cdot h^{-1}$ is positive. Thus the function $\omega(\tilde{v}) \cdot h^{-1}$ is a convex function which decreases in $\tilde{v}$ monotonically. Since h^{-1} is positive, the function $\omega(\tilde{v})$, being a positive transformation, is also a convex monotonic decreasing function in $\tilde{v}$,

Further, if I draw a line with -45 degree slope through the point $(0, \omega(0))$ in a coordination system with the horizontal axis standing for the value of $\tilde{v}$ and the vertical axis standing for the function value, I can show that the convex curve representing the function $\omega(\tilde{v})$ is below the line for the interval $\tilde{v} \in (-\infty, 0)$. To demonstrate this, I prove two properties of the function $\omega(\tilde{v})$:

1. For a certain $\tilde{v} < 0$, the distance from the -45 degree slope line to the function curve is positive.

---

[60]See also Appendix F for a detailed discussion on this property in a similar constallation.

2. The distance from the -45 degree slope line to the function curve converges to a positive constant.

The downward line with -45 degree slope has the functional term, $\omega(0) - \tilde{v}$. Therefore, the distance to the function curve of $\omega\tilde{v}$ from the line can be calculated by the term $\omega(0) - \tilde{v} - \omega(\tilde{v})$. To prove the first property, I evaluate the term at $\tilde{v} = -1$, yielding $\omega(0) + 1 - \omega(-1) = .272749285 > 0$.

To prove the second property, I calculate the boundary value $\lim_{\tilde{v} \to -\infty}[\omega(0) - \tilde{v} - \omega(\tilde{v})]$. Using L'Hospital rule, it can be shown that:

$$
\begin{aligned}
\lim_{\tilde{v} \to -\infty}[\omega(0) - \tilde{v} - \omega(\tilde{v})] &= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} - \tilde{v} - \frac{\phi(\tilde{v})}{\Phi(\tilde{v})}\Big] \\
&= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} - \frac{\tilde{v} \cdot \Phi(\tilde{v}) + \phi(\tilde{v})}{\Phi(\tilde{v})}\Big] \\
&= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} - \frac{\Phi(\tilde{v}) + \tilde{v} \cdot \phi(\tilde{v}) - \tilde{v} \cdot \phi(\tilde{v})}{\phi(\tilde{v})}\Big] \\
&= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} - \frac{\Phi(\tilde{v})}{\phi(\tilde{v})}\Big] \\
&= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} - \frac{\phi(\tilde{v})}{-\tilde{v} \cdot \phi(\tilde{v})}\Big] \\
&= \lim_{\tilde{v} \to -\infty}\Big[\frac{\phi(0)}{\Phi(0)} + \frac{1}{\tilde{v}}\Big] \\
&= \frac{\phi(0)}{\Phi(0)} > 0
\end{aligned}
\tag{H.7}
$$

Given the two properties above as well as the fact that the $\omega(\tilde{v})$ is a convex decreasing function, the functional curve is always below the -45 degree slope line that passes through the point $(0, \omega(0))$. From this, it can be derived that $\omega(\alpha \cdot \tilde{v}) < \alpha \cdot \omega(\tilde{v})$ for any α as a constant with $\alpha > 1$ and for any given $\tilde{v} < 0$. $\qquad\square$

Lemma H.6. *For any $\tilde{v}_L < \tilde{v}_H < 0$, it is valid that $\sigma_L^{-1}\frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)} - \sigma_H^{-1}\frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)} < 0$.*

Proof. Utilizing the Lemmas H.4 and H.5, I can show that

$$\sigma_L^{-1} \frac{\phi(\tilde{v}_L)}{\Phi(\tilde{v}_L)} - \sigma_H^{-1} \frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)} = \sigma_L^{-1} \frac{\phi(\frac{\sigma_L}{\sigma_H}\tilde{v}_H)}{\Phi(\frac{\sigma_L}{\sigma_H}\tilde{v}_H)} - \sigma_H^{-1} \frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)}$$

$$< \sigma_L^{-1} \frac{\sigma_L}{\sigma_H} \frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)} - \sigma_H^{-1} \frac{\phi(\tilde{v}_H)}{\Phi(\tilde{v}_H)} = 0 \qquad \square$$

Combining now the results from Lemmas H.2, H.3 and H.6, it can be demonstrated that $\frac{\partial v_L}{\partial \pi} < 0$ is valid. In addition, adding the results from Lemma H.1, it is also true that $\frac{\partial v_H}{\partial \pi} < 0$.

I Categories of press release

Once the press releases are extracted, each press release is then manually classified into one of the following categories based on the main content of the press release.

1. *Earnings announcements* includes only press releases with audited or non-audited preliminary financial information with quarterly or annual earnings or a forecast of such. This could cover, for example, financial figures including "earnings", "earnings per share", "EBIT" or "EBITDA".

2. *Other financial KPIs, but not earnings related* includes press releases of audited or non-audited preliminary other financial figures which are typically a part of the income statements, balance sheet or cash flow statement. This could cover, for example, financial figures such as sales or costs figures.

3. *Non-financial KPIs* include such press releases which do not cover any financial figure usually reported in a balance sheet, an incoming statements or a cash flow statement. However the announced underlying business incidents may affect future earnings. An example could be reports on order backlog.

4. *Business development* includes press releases related to an internal change of the business organization, the business strategy or the business condition. Typically it conveys information on decisions regarding future production capacity change, significant development or change of product lines and closing of large business contracts. Example for press releases in this category are announcements about installation of new machinery in the manufacturing industry or expansion of fleet vessels in the logistics industry, labor cuts, entrance into strategic alliance, grant of patents, entrance into new business or closing of sales contract to a major customer.

5. *Acquisitions or Sales of subsidiaries* includes press releases about planned or executed acquisition of a separate legal entity and sale of a subsidiary or a business

division to a third party. Examples could be the announcements about a closed deal for acquiring a third party firm.

6. *Private financing* includes press releases about planned or executed financing transactions that do not involve the use of potential publicly tradable securities. It also includes press releases that reveal any modification on pre-existing financing agreements. Typical examples of press releases in this category are regarding a new credit with a bank, a modification of covenants or other forms of capital injection by a private investor.

7. *Public offering* includes press releases about planned or executed public offering of debt or equity securities. It can also includes press releases regarding any modification on conditions of pre-exisiting securities as well as other announcements directly related to the securities of a company. Examples for press releases in this category include announcement of an upcoming IPO/ SEO, solicitation statements for the change of interests conditions of debt securities currently in circulation, press releases about a rating change or an analyst recommendation as well as statements made due to insider trading regulation.

8. *Dividends* includes press releases relating to dividend. Examples could be quarterly dividend announcement or announcement about pause of dividend payment.

9. *Bid received* includes press release about any take-over/ acquisition proposal the company receives as the target from a third party firm.

10. *Bid given* includes press release about any take-over/ acquisition proposal the company raises to a third party firm as the potential acquirer.

11. *Management buy outs* includes press release about buy out proposals raised by the management team of the firm.

12. *Board or executive personnel change* includes press releases about executed or planned personnel changes of board members or company executives. Examples for this category can be announcements about the appointment of a executive or the retirement

announcement of a board member. Only personnel changes in the top management level are sorted into this category.

13. *Reporting process related* includes press releases about changes or events relevant for the production or auditing of financial reports. Examples here are announcements about restatements, change of accounting methods for specific items in the financial statements or auditor changes.

14. *Bankruptcy related* includes statements doubting the going concern of the firm or press releases related to bankruptcy filing and subsequent bankruptcy proceedings. Examples for this category are announcements about going concern qualification of auditors, about the filing for bankruptcy or the court ruling for continued operations under chapter 11.

15. *Analyst conference/ investor presentation* includes press releases about conducted or upcoming investor relations events targeting analysts and investment professionals. Typical examples in this categories are announcements about upcoming quarterly earnings conference calls for analysts or announcement about an upcoming company presentation at an investor relations event hold by an investment bank or security firm.

16. *Marketing* includes press releases clearly addressed to the end customers. This is especially the case for firms in entertainment, retail or consumer goods industries where the firm's end customers are usually the consumers. Typical example of announcements in this category are those about the release of a new product.

17. *Other* includes all other announcements which do not fall into one of the above category. Typical examples for press releases in this category includes announcements about an industry award the firm receives or presents, about charity events or about third party reviews of the products of the company.

J Coding guidelines

To ensure maximal degree of consistency for the categorization of the press releases, a coding guideline is also developed to guide the categorization process. The guide line is a set of rules how press releases with the most often encountered subject matters are to be categorized into the categories. For each category, the rules are listed below.

1. *Earnings announcements* includes

    - PRs about current earnings and forecasts on future earnings

    - PRs about earnings, which include other quarterly or yearly financial statement information, including possible forward looking statement,

    - PRs involving any form of earning numbers, incl. EBIT, EBITDA and Operating Incoming

2. *Other financial KPIs, but not earnings related* includes

    - Statements about impairment charges

3. *Non-financial KPIs*

4. *Business development* includes

    - PRs related to an internal change of the business organization, the business strategy or the business condition

    - PRs regarding contracts with material customers

    - PRs related to change of product lines

    - For pharmaceutic firms,PRs regarding filing for new drug application

    - PRs about co-operations or strategic alliance with other firms

- PRs about reaching a sales agreement or subsequent fulfillment of the delivery

- PRs about reaching an agreement about labor contract with trade union is to be classified under business development

- PRs about new investments to expand business or divestment (i.e. sale of assets)

- PRs about a patented technology licensed for third parties to be used

- PRs about grant of a patent (or other positive decisions of patent agency towards awarding a patent)

- PRs about increased R&D activity / budget

- PRs about decision of a governmental regulatory body, such as FAA, FCC, FDAabout the product or operation of the firm. However, this does not include decisions of regulatory bodies for stock exchange or other financial market supervisory bodies regarding the security of the firm.

5. *Acquisitions or Sales of subsidiaries* includes

    - PRs about sale of business or subsidiary

6. *Private financing* includes

    - For financing related PRs, only if it's clear that the PR deals with a private financing instrument will the PR be classified under "private financing". (see also public financing)

    - PRs about agreements to modify debt covenants of non-securitized debt capital instruments

7. *Public offering* includes

    - PRs about rating or change of rating

- For financing related PRs, if at least part of it is related to public financing, it is to be classified under public financing. If it is unclear, whether it is public or private, it is still to be classified under public financing. (mandatory disclosure requirement as driver)

- PRs in compliance with insider trading regulations (e.g. regarding compliance with 10b5-1 rule)

- PRs about inclusion of equity instrument into a stock index

- Public offering of equity and debt capital are classified under public financing

- PRs about agreements to modify debt covenants of securitized debt capital instruments (e.g. bonds)

- PRs about stock split or reverse stock split

- For PRs regarding discussion on annual meeting, if no specific main information can be identified, the PR is to be classified under public financing

- PRs about extension of expiration date for offer to exchange security instruments are classified under public financing

- PRs about delisting of stocks

- PRs about shareholder derivative lawsuits against company insider

8. *Dividends* includes

    - PRs about dividend payment or change of dividend payment

9. *Bid received* includes

    - PRs about a proxy fight

10. *Bid given*

11. *Management buy outs*

12. *Board or executive personnel change* includes

   - PRs about personnel changes of board or top executive members

13. *Reporting process related* includes

   - PRs about change of auditors is to be classified under reporting process related

   - PRs about delay of pre-announced announcement dates for earnings announcement is classified under reporting process related

14. *Bankruptcy related* includes

   - PRs about bankruptcy containing info about accompanying restructuring measures within scope of Chapter 11

   - PRs about going concern qualification announcements

   - PRs about legal proceedings in bankruptcy process

15. *Analyst conference/ investor presentation* includes

   - PRs about conferences or presentation in front of (with clear indication) analysts, investment bankers or other financial community

   - PRs about conference call to discuss quarterly or annual financial results

   - PRs about CEO / executives discussing the state of the company (i.e. as a kind of general status update) in front of financial community

   - PRs about upcoming earnings announcement

16. *Marketing* includes

   - PRs about the price increase due to inflation of raw material price targeted to customers

17. *Other* includes

  - PRs about a future announcement (i.e. announcement about a date of a
    further announcement)

  - Reminder announcements (Reminder = a PR about the same subject matter
    on the same newswire service and dates differentiate more than two days)

  - PRs about lawsuit settlement

  - PRs about external studies about the effectiveness of company's products

  - PRs about receiving of research grant

  - PRs about change of compensation of executives / board

K Descriptive statistics about the press releases categories

The following table provides an overview of the composition of press releases included in
the sample

Table K.1: Descriptive statistics of the press releases

Category	Likelihood of mandatory disclosure	Number of press releases
Earnings announcements	HLM	2,545
Other financial KPIs, but not earnings related	HLM	486
Non-financial KPIs	LLM	147
Business development	LLM	3,088
Acquisitions or Sales of subsidiaries	HLM	614
Private financing	HLM	259
Public offering	HLM	1,058
Dividends	HLM	381
Bid received	HLM	35
Bid given	HLM	32
Management buy outs	HLM	1
Board or executive personnel change	HLM	1,240
Reporting process related	HLM	147
Bankruptcy related	HLM	22
Analyst conference/ investor presentation	LLM	2,804
Marketing	LLM	1,127
Other	LLM	2,244
Total HLM		6,820
Total LLM		9,410
Total PRs		16,230

L Proof of Lemma 4.3.1

Firms with $v < A$ prefer to be non-compliant and not to disclose as long as the manager's expected payoff from non-compliant behavior is higher than from compliant disclosure. Using the pricing schemes provided in Lemma 4.3.4 and assuming that $(1 - (1 + \alpha)\rho) > 0$, this translates to:

$$\rho P_D^e + (1 - \rho)P_{ND} > P_D$$

$$\rho[P_D - \alpha(P_{ND} - P_D)] + (1 - \rho)P_{ND} > P_D$$

$$(1 - \alpha\rho - \rho)P_{ND} > (1 - \alpha\rho - \rho)P_D \tag{L.1}$$

$$P_{ND} > P_D$$

$$\frac{1}{2}(A + \frac{1 - A}{1 - \rho A}) > v, \forall v < A. \tag{L.2}$$

The inequality is always satisfied if $\frac{1}{2}(A + \frac{1-A}{1-\rho A}) \geq A$ for any $v < A$. Therefore, we solve the latter inequality to get the condition stated in Lemma 4.3.1.

$$\frac{1}{2}(A + \frac{1 - A}{1 - \rho A}) > A$$

$$\frac{1 - A}{1 - \rho A} > A$$

$$1 - A > A(1 - \rho A)$$

$$\rho A^2 - 2A + 1 > 0 \tag{L.3}$$

Per definition, it is valid that $\rho > 0$, which yields the following inequalities

$$A > \frac{1 + \sqrt{1 - \rho}}{\rho} \vee A < \frac{1 - \sqrt{1 - \rho}}{\rho} \tag{L.4}$$

Starting with $\frac{1+\sqrt{1-\rho}}{\rho}$, we can demonstrate that $\frac{1+\sqrt{1-\rho}}{\rho} > 1$. It follows from the definition of $\rho \in [0, 1]$ that $\frac{1}{\rho} > 1$ and $\frac{\sqrt{1-\rho}}{\rho} > 0$. Therefore, the sum out of the two is larger than or

equal to one. Hence, it is valid that

$$\frac{1 + \sqrt{1-\rho}}{\rho} > 1. \tag{L.5}$$

Second, we can show that $\frac{1-\sqrt{1-\rho}}{\rho} \in (\frac{1}{2}, 1)$. We first derive the derivative of $\frac{1-\sqrt{1-\rho}}{\rho}$:

$$\begin{aligned}
\frac{\partial \frac{1-\sqrt{1-\rho}}{\rho}}{\partial \rho} &= \frac{1}{2} \cdot \frac{2 - 2\sqrt{1-\rho} - \rho}{\sqrt{1-\rho} \cdot \rho^2} \\
&= \frac{1}{2} \cdot \frac{(1-\rho) - 2\sqrt{1-\rho} + 1}{\sqrt{1-\rho} \cdot \rho^2} \\
&= \frac{1}{2} \cdot \frac{(\sqrt{1-\rho} - 1)^2}{\sqrt{1-\rho} \cdot \rho^2} \geq 0
\end{aligned} \tag{L.6}$$

In addition, we examine the boundary value of $\frac{1-\sqrt{1-\rho}}{\rho}$ on the interval $\rho \in [0, 1]$. Using L'hospital's rule, it holds that

$$\lim_{\rho \to 0} \frac{1 - \sqrt{1-\rho}}{\rho} = \lim_{\rho \to 0} \frac{-\frac{1}{2}\frac{1}{\sqrt{1-\rho}}(-1)}{1} = \frac{1}{2} \tag{L.7}$$

Further, it is straight forward that

$$\lim_{\rho \to 1} \frac{1 - \sqrt{1-\rho}}{\rho} = 1 \tag{L.8}$$

Equation (L.6) shows that $\frac{1-\sqrt{1-\rho}}{\rho}$ is monotonically increasing, while Equation (L.7) and (L.8) provide the boundary values $\frac{1}{2}$ and 1, respectively. Hence it is valid that

$$\frac{1 - \sqrt{1-\rho}}{\rho} \in (\frac{1}{2}, 1], \rho \in [0, 1]. \tag{L.9}$$

Since A is defined on the domain of $[0, 1]$, our starting inequality solves to $A \leq \frac{1-\sqrt{1-\rho}}{\rho}$.

M Proof of Lemma 4.3.2

If $(1-(1+\alpha)\rho) > 0$ and $\frac{1-\sqrt{1-\rho}}{\rho} < A < 1$, there might exist some firms with $v_m < v < A$ in the upper region of the interval $[0, A]$ who prefer to be compliant and disclose. We show their existence in equilibrium by proving the existence of the threshold v_m. Firms with $v_m < v < A$ receive a disclosure price of $P_D = v$ in case of compliance. The expected price in case of non-compliance is then $P_{ND} = \frac{1-A}{(1-A)+v_m(1-\rho)}\frac{(A+1)}{2} + \frac{v_m(1-\rho)}{(1-A)+v_m(1-\rho)}\frac{v_m}{2}$. The threshold v_m is the firm value equalizing both prices, i.e., $v = v_m$:

$$\frac{1 - A^2 + v_m^2(1-\rho)}{2(1-A) + 2v_m(1-\rho)} \overset{!}{=} v_m$$

$$2v_m^2(1-\rho) + 2(1-A)v_m = 1 - A^2 + v_m^2(1-\rho)$$

$$(1-\rho)v_m^2 + 2(1-A)v_m + A^2 - 1 = 0$$

$$v_m = \frac{-(1-A) + \sqrt{2 - 2A - \rho + \rho A^2}}{1-\rho} \vee v_m = \frac{-(1-A) - \sqrt{2 - 2A - \rho + \rho A^2}}{1-\rho} \quad \text{(M.1)}$$

As the second term is negative, the solution is $v_m = \frac{-(1-A)+\sqrt{2-2A-\rho+\rho A^2}}{1-\rho}$. To further ensure that $v_m < A$, we solve the following inequality:

$$\frac{-(1-A) + \sqrt{2 - 2A - \rho + \rho A^2}}{1-\rho} \overset{!}{<} A$$

$$\sqrt{2 - 2A - \rho + \rho A^2} < (1-\rho)A + (1-A)$$

$$2 - 2A - \rho + \rho A^2 < (1 - A\rho)^2$$

$$A^2\rho^2 + (1 - A^2 - 2A)\rho + 2A - 1 > 0$$

$$\rho < \frac{-1 + 2A}{A^2} \vee \rho > 1 \quad \text{(M.2)}$$

Since ρ is smaller than one per definition, the above condition reduces to $\rho < \frac{-1+2A}{A^2}$, or $\rho A^2 - 2A + 1 < 0$, which is exactly the opposite of the conditions stated in Inequality (L.3). Solving this inequality yields $\frac{1-\sqrt{1-\rho}}{\rho} < A \leq 1$. Overall, if $\frac{1-\sqrt{1-\rho}}{\rho} < A \leq 1$, there exists a threshold $v_m = \frac{-(1-A)+\sqrt{2-2A-\rho+\rho A^2}}{1-\rho}$ with $v_m < A$, such that firms with $v < v_m$ have incentives to be non-compliant and to remain silent. Whereas firms with $v_m \leq v \leq A$

have incentives to be compliant and to disclose.

N Proof of Lemma 4.3.3

If we assume $(1-(1+\alpha)\rho) < 0$, the Inequality (L.1) solves to $P_{ND} < P_D$, or $\frac{1}{2}(A+\frac{1-A}{1-\rho A}) < v$ respectively. Combined with $v < A$, the condition leads to the interval $(\frac{1}{2}(A + \frac{1-A}{1-\rho A}), A)$. Firms within this interval would have an incentive to be non-compliant and not to disclose. The interval is not an empty set if the lower bound is indeed smaller than the upper bound. As discussed in Appendix M, $\frac{1}{2}(A + \frac{1-A}{1-\rho A}) < A$ can be translated to $\frac{1-\sqrt{1-\rho}}{\rho} < A \leq 1$.

However, even if this condition holds, firms with a value below $\frac{1}{2}(A + \frac{1-A}{1-\rho A})$ would have incentive to comply and to disclose their private information. Therefore, the expected pooling price of non-compliant firms with $v < A$ and firms above the mandatory threshold would increase as firms of low quality separate. This again leads to an increase of the lower-bound of the previous interval leading to more low quality firms separating through disclosure. In equilibrium, all firms with $v < A$ have incentives to be compliant and to disclose their firms' value.

If $0 \leq A \leq \frac{1-\sqrt{1-\rho}}{\rho}$ holds, the interval $(\frac{1}{2}(A + \frac{1-A}{1-\rho A}), A)$ is an empty-set, and all firms with $v < A$ have incentives to be compliant from the very beginning. Thus, in equilibrium, all firms with $v < A$ have incentives to comply and to disclose their private information.

O Proof of Lemma 4.3.4

Based on the four possible scenarios regarding firms' compliant or non-compliant behavior, we summarize the equilibrium pricing schemes. Firms with $v < A$ that comply to the regulation receive their fair valuation, $P_D = v$. Firms with $v < A$ that do not comply and have been uncovered by enforcement receive their fair valuation minus the regulatory penalty, $P_D^e = v - l = P_D - \alpha(P_N D - P_D)$. Firms with $v < A$ that do not comply

and have not been uncovered, and firms with $v \geq A$ receive the non-disclosure pooling price that depends on the compositions of non-disclosing firms in the pool. In case $(1 - (1 + \alpha)\rho) \leq 0$, only firms with $v \geq A$ are in the pool, leading to $P_{ND} = \frac{A+1}{2}$. In case $(1 - (1 + \alpha)\rho) > 0$ and $A \leq \frac{1 - \sqrt{1-\rho}}{\rho}$, in addition to firms with $v \geq A$, firms with $v < A$ do not disclose with a probability of $1 - \rho$. Therefore, the non-disclosure pooling price is $P_{ND} = \frac{1-A}{(1-A)+A(1-\rho)} \frac{(A+1)}{2} + \frac{A(1-\rho)}{(1-A)+A(1-\rho)} \frac{A}{2}$. In case $(1 - (1 + \alpha)\rho) > 0$ and $A > \frac{1 - \sqrt{1-\rho}}{\rho}$, in addition to firms with $v \geq A$, firms with $v < v_m$ do not disclose with a probability of $1 - \rho$. Therefore, the non-disclosure pooling price is $P_{ND} = \frac{1-A}{(1-A)+v_m(1-\rho)} \frac{(A+1)}{2} + \frac{v_m(1-\rho)}{(1-A)+v_m(1-\rho)} \frac{v_m}{2}$, with $v_m = \frac{-(1-A)+\sqrt{2-2A-\rho+\rho A^2}}{1-\rho}$.

P Proof of Lemma 4.3.5

Regarding high quality firms, the expected price of a high quality firm is the equilibrium non-disclosure price P_{ND} as these firms are not able to credibly convey information to the market outside of mandatory disclosure.

Regarding low quality firms, there are two types of low quality firms depending on the non-compliance coefficient defined in the previous section. Firms that comply with disclosure regulation and disclose as expected regulatory penalties are too severe, and firms that do not comply and try to avoid disclosure. Compliant firms simply expect to receive their fair valuation in the form of their disclosure price P_D. However, non-compliant firms are willing to take the risk of getting exposed by enforcement and pool with high quality non-disclosing firms. Therefore, a non-compliant firm is ex-post valued with either its true value minus the regulatory penalty, P_D^e, or, with the non-disclosure pooling price P_{ND}. Since managers are ex-ante uncertain if enforcement actions take place, managers use the probability of getting uncovered to weight both cases, ρ or $(1 - \rho)$, respectively.

Q Proof of Proposition 4.3.6

If $A > \frac{1-\sqrt{1-\rho}}{\rho}$, low-quality firms with $v_m < v < A$ comply with the regulation and disclose. These firms expect to receive their disclosure price $P_D = v$ and have no incentive to participate on the deliberative process about A. Low-quality firms that show non-compliant behavior receive in expectation $E_{LQ} = (1+\alpha)\rho P_D + (1 - (1+\alpha)\rho)P_{ND}$. Therefore, the price difference for such a low quality firm before and after a proposed change of A can be calculated as $E_{LQ}(A+\Delta A, \rho) - E_{LQ}(A, \rho) = (1 - (1+\alpha)\rho) \cdot (P_{ND}(A+\Delta A, \rho) - P_{ND}(A, \rho))$. Since the high quality firms expect to receive the non-disclosure price P_{ND}, the preferences of high quality firms and non-compliant low quality firms are aligned in case the factor $1 - (1+\alpha)\rho$ is positive.

R Proof of Proposition 4.3.7

We first assume that $A \leq \frac{1-\sqrt{1-\rho}}{\rho}$. Based on Lemma 4.3.4, the non-disclosure price is $P_{ND} = \frac{1-A}{(1-A)+A(1-\rho)}\frac{(A+1)}{2} + \frac{A(1-\rho)}{(1-A)+A(1-\rho)}\frac{A}{2} = \frac{1}{2}(A + \frac{1-A}{1-\rho A})$. The first-order derivative of P_{ND} toward A is:

$$
\begin{aligned}
\frac{\partial P_{ND}}{\partial A} &= \frac{1}{2} + \frac{1}{2} \cdot \frac{-(1-A\rho) - (1-A)(-\rho)}{(1-A\rho)^2} \\
&= \frac{1}{2} - \frac{1}{2} \cdot \frac{1-\rho}{(1-A\rho)^2} \\
&= \frac{1}{2}(1 - \frac{1-\rho}{(1-A\rho)^2})
\end{aligned}
\tag{R.1}
$$

We further investigate the algebraic sign of the derivative within the interval of $A \in [0,1]$. It is straight forward that it depends on the algebraic sign of $1 - \frac{1-\rho}{(1-A\rho)^2}$:

$$
1 - \frac{1-\rho}{(1-A\rho)^2} \overset{!}{\geq} 0
$$

$$
1 - \rho \leq (1-A\rho)^2
$$

$$
\rho A^2 - 2A + 1 \geq 0 \tag{R.2}
$$

Per definition, it's valid that $\rho > 0$, therefore Inequation (R.2) yields

$$A \geq \frac{1 + \sqrt{1 - \rho}}{\rho} \vee A \leq \frac{1 - \sqrt{1 - \rho}}{\rho}. \tag{R.3}$$

Combining Equation (R.3) with Equation (L.5), and Equation (L.9) from Appendix L, it is straight forward that $\frac{\partial P_{ND}}{\partial A} \geq 0$ for $A \in [0, \frac{1 - \sqrt{1 - \rho}}{\rho}]$ and $\frac{\partial P_{ND}}{\partial A} \leq 0$ for $A \in [\frac{1 - \sqrt{1 - \rho}}{\rho}, 1]$. Therefore P_{ND} is single peaked in the interval $A \in [0, 1]$, reaching its maximum at $A^* = \frac{1 - \sqrt{1 - \rho}}{\rho}$ for $A \leq \frac{1 - \sqrt{1 - \rho}}{\rho}$, with $P_{ND}(A^*) = \frac{1 - \sqrt{1 - \rho}}{\rho}$.

Let us now assume that $\frac{1 - \sqrt{1 - \rho}}{\rho} < A \leq 1$. The non-disclosure price then is $P_{ND} = \frac{1 - A}{(1 - A) + v_m(1 - \rho)} \frac{(A + 1)}{2} + \frac{v_m(1 - \rho)}{(1 - A) + v_m(1 - \rho)} \frac{v_m}{2} = \frac{\sqrt{\rho A^2 + 2 - \rho - 2A} + A - 1}{1 - \rho}$. The first-order derivate of P_{ND} toward A has the form:

$$
\begin{aligned}
\frac{\partial P_{ND}}{\partial A} &= \frac{2\rho A - 2}{2(1 - \rho)\sqrt{\rho A^2 - 2A - \rho + 2}} + \frac{1}{1 - \rho} \\
&= \frac{(\rho A - 1) + \sqrt{\rho A^2 - 2A - \rho + 2}}{(1 - \rho)\sqrt{\rho A^2 - 2A - \rho + 2}}
\end{aligned} \tag{R.4}
$$

To find the maximum, we further solve the inequality

$$(\rho A - 1) + \sqrt{\rho A^2 - 2A - \rho + 2} \overset{!}{\geq} 0$$

$$\sqrt{\rho A^2 - 2A - \rho + 2} \geq 1 - \rho A$$

$$\rho A^2 - 2A - \rho + 2 \geq 1 - 2\rho A + \rho^2 A^2$$

$$\rho(1 - \rho)A^2 - 2(1 - \rho)A + (1 - \rho) \geq 0$$

$$\rho A^2 - 2A + 1 \geq 0 \tag{R.5}$$

This inequality resembles the same results from Inequality (R.2). Hence, the same results yield where P_{ND} is monotonic decreasing in interval $\frac{1 - \sqrt{1 - \rho}}{\rho} < A \leq 1$, with $P_{ND} \to \frac{1 - \sqrt{1 - \rho}}{\rho}$ for $A \to \frac{1 - \sqrt{1 - \rho}}{\rho}$. Taken together, the maximum of the non-disclosure price is reached at $A^* = \frac{1 - \sqrt{1 - \rho}}{\rho}$ for the complete domain of A, with $A \in [0, 1]$.

S Proof of Proposition 4.3.8

If $1 - (1 + \alpha)\rho \leq 0$, all firms with $v < A$ comply in equilibrium and expect $E_{LQ} = P_D = v$. A change in the mandatory threshold A has no impact on their expected price. Therefore, low quality firms do not participate on the deliberative process. Firms with $v \geq A$ expect $E_{HQ} = \frac{A+1}{2}$, which is increasing in A. Hence, high quality firms participate in the deliberative process and solely decide the resulting consensus level of mandatory disclosure regulation. Since E_{HQ} is increasing in A, the equilibrium threshold is $A^* = 1$.

T Proof of Proposition 4.3.9 and 4.4.3

To demonstrate that $A^* = \frac{1 - \sqrt{1-\rho}}{\rho}$ is monotonically increasing in ρ if $(1 - (1 + \alpha)\rho > 0)$, we examine the algebraical sign of the first-order derivative toward ρ:

$$
\begin{aligned}
\frac{\partial A^*}{\partial \rho} &= \frac{1}{2} \cdot \frac{2 - 2\sqrt{1-\rho} - \rho}{\sqrt{1-\rho} \cdot \rho^2} \\
&= \frac{1}{2} \cdot \frac{(1-\rho) - 2\sqrt{1-\rho} + 1}{\sqrt{1-\rho} \cdot \rho^2} \\
&= \frac{1}{2} \cdot \frac{(\sqrt{1-\rho} - 1)^2}{\sqrt{1-\rho} \cdot \rho^2} \geq 0
\end{aligned}
\tag{T.1}
$$

Hence, tighter enforcement results in a collective preference toward more extensive disclosure all else equal.

U Proof of Lemma 4.4.1

Analogous to the base model, we derive the condition for low quality firms to be non-compliant and not to disclose, and high quality firms to abstain form voluntary disclosure

as well. Therefore, the following conditions have to be satisfied cumulatively:

$$\text{For } v \leq A\text{: } \tilde{P}_D < \rho \tilde{P}_D^e + (1 - \rho)\tilde{P}_{ND} \tag{U.1}$$

$$\text{For } A < v \leq 1\text{: } \tilde{P}_D < \tilde{P}_{ND} \tag{U.2}$$

Inequality (U.1) can be solved to $\tilde{P}_D < \tilde{P}_{ND}$, if $1 - (1 + \alpha)\rho > 0$. We further solve the inequality to establish the conditions required for the Lemma.

$$v - c < \frac{1}{2}(A + \frac{1 - A}{1 - \rho A})$$
$$c > v - \frac{1}{2}(A + \frac{1 - A}{1 - \rho A}) \tag{U.3}$$

Since the inequality needs to be valid for all $v \in [0, 1]$, we set $v = 1$ yielding: $c > 1 - \frac{1}{2}(A + \frac{1-A}{1-\rho A})$. Further, $1 - \frac{1}{2}(A + \frac{1-A}{1-\rho A})$ is monotonic decreasing in $\rho \in [0, 1]$ and single peaked with a local minimum at $A = \frac{1 - \sqrt{1-\rho}}{\rho}$, and local maxima at $A = 0$ and $A = 1$. Hence, the term is maximized at $A = 0$ and $A = 1$ with $\rho = 0$, where the maximum is 0.5. Therefore, if disclosure cost are higher than 0.5, no further condition is necessary on ρ and A to ensure the absence of voluntary disclosure.

V Proof of Lemma 4.4.5

Based on the investors' beliefs, the following three conditions have to be fulfilled in equilibrium:

$$\check{P}_D \geq \check{P}_{ND}, \forall v \in [v_l; 1],$$
$$\check{P}_{ND} \geq \check{P}_D, \forall v \in [A; v_l],$$
$$\check{P}_{ND} \geq \rho \check{P}_D^e + (1 - \rho)\check{P}_{ND}, \forall v \in [0; A]. \tag{V.1}$$

By algebraic manipulation of the latter equation, the conditions above translate to:

$$\check{P}_{ND}(A, \rho) < \check{P}_D(c), \forall v \in [v_l; 1],$$

$$\check{P}_{ND}(A, \rho) \geq \check{P}_D(c), \forall v \in [0; v_l].$$

Starting with firms below the voluntary threshold, $v < v_l$, our starting condition is:

$$\check{P}_D < \check{P}_{ND}$$

$$v - c < \frac{v_l - A}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}(A + v_l) + \frac{A(1 - \rho)}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}A$$

$$v < \frac{v_l - A}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}(A + v_l) + \frac{A(1 - \rho)}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}A + c \qquad \text{(V.2)}$$

The voluntary threshold is the firm value that is equal to the right hand side of the inequality:

$$\frac{v_l - A}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}(A + v_l) + \frac{A(1 - \rho)}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}A + c = v_l$$

$$\frac{v_l - A}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}(A + v_l) + \frac{A(1 - \rho)}{(v_l - A) + A(1 - \rho)} \cdot \frac{1}{2}A = v_l - c \qquad \text{(V.3)}$$

$$(v_l - A) \cdot \frac{1}{2}(A + v_l) + A(1 - \rho) \cdot \frac{1}{2}A = (v_l - c)[(v_l - A) + A(1 - \rho)]$$

$$\frac{1}{2}(v_l^2 - A^2) + \frac{1}{2}(A^2 - A^2\rho) = v_l^2 - A\rho v_l - cv_l + A\rho c$$

$$v_l^2 - (2A\rho + 2c)v_l + A^2\rho + 2A\rho c = 0 \qquad \text{(V.4)}$$

Solving the equation above yields two solutions: $v_l = A\rho + c + \sqrt{A^2\rho^2 + c^2 - A^2\rho}$ or $v_l = A\rho + c - \sqrt{A^2\rho^2 + c^2 - A^2\rho}$, if

$$A^2\rho^2 + c^2 - A^2\rho \geq 0$$

$$c \geq \sqrt{\rho(1 - \rho)}A$$

$$A \leq \frac{c}{\sqrt{\rho(1 - \rho)}} \qquad \text{(V.5)}$$

is fulfilled. The larger solution of the two possible v_l is relevant in this case as we intend to identify a threshold such that firms with a value below the threshold favor non-disclosure.

The interval $v < A\rho + c - \sqrt{A^2\rho^2 + c^2 - A^2\rho}$ is included in the interval $v < A\rho + c + \sqrt{A^2\rho^2 + c^2 - A^2\rho}$, making the latter one binding. We further need to verify that the case condition $A \leq v_l \leq 1$ is fulfilled. The necessary condition for $A \leq v_l$ is:

$$A \leq A\rho + c + \sqrt{A^2\rho^2 + c^2 - A^2\rho}$$

$$A - Ap - c \leq \sqrt{A^2\rho^2 + c^2 - A^2\rho}$$

$$(A - Ap - c)^2 \leq A^2\rho^2 + c^2 - A^2\rho$$

$$A^2\rho^2 + c^2 - A^2\rho \geq A^2\rho^2 + 2cA\rho - 2A^2\rho + c^2 - 2cA + A^2$$

$$0 \geq 2cA\rho - A^2\rho - 2cA + A^2$$

$$0 \geq A(2c - A)(\rho - 1). \tag{V.6}$$

Since it's valid by definition that $\rho - 1 \leq 0$ and $A \geq 0$, it is necessary that $2c - A \geq 0$, or $A \leq 2c$. This condition is consistent with the requirement stated by Inequation (V.5) as $\sqrt{\rho(1 - \rho)} \in [0, \frac{1}{2}]$ for $\rho \in [0, 1]$. Further, we need to ensure that $v_l \leq 1$:

$$A\rho + c + \sqrt{A^2\rho^2 + c^2 - A^2\rho} \leq 1$$

$$\sqrt{A^2\rho^2 + c^2 - A^2\rho} \leq 1 - A\rho - c$$

$$A^2\rho^2 + c^2 - A^2\rho \leq (1 - A\rho - c)^2$$

$$A^2\rho^2 + c^2 - A^2\rho \leq A^2\rho^2 + 2cA\rho - 2A\rho + c^2 - 2c + 1$$

$$A^2\rho - 2A\rho + 2cA\rho - 2c + 1 \geq 0 \tag{V.7}$$

Therefore, any $A \in \mathbb{R}$ solves this inequality, if the following condition is fulfilled:

$$4\rho^2(1-c)^2 - 4\rho(1-2c) \le 0$$

$$4\rho^2((1-c)^2 - \frac{(1-2c)}{\rho}) \le 0$$

$$((1-c)^2 - \frac{(1-2c)}{\rho}) \le 0$$

$$\rho \le \frac{1-2c}{(1-c)^2}$$

$$\rho \le \frac{(1-c)^2 - c^2}{(1-c)^2}$$

$$\rho \le 1 - (\frac{c}{1-c})^2$$

$$\rho + (\frac{c}{1-c})^2 \le 1$$

$$\rho \le 1 - (\frac{c}{1-c})^2 \tag{V.8}$$

The enforcement parameter ρ does only satisfy the above condition as long as $1 - (\frac{c}{1-c})^2 \ge 0$, or $c \le 0.5$. However, if $c < 0.5$, Inequality (V.7) solves to

$$A \le \frac{2\rho(1-c) - \sqrt{4\rho^2(1-c)^2 - 4\rho(1-2c)}}{2\rho} \vee A \ge \frac{2\rho(1-c) + \sqrt{4\rho^2(1-c)^2 - 4\rho(1-2c)}}{2\rho}$$

$$A \le \frac{2\rho(1-c) - 2\sqrt{\rho^2(1-c)^2 - \rho(1-2c)}}{2\rho} \vee A \ge \frac{2\rho(1-c) + 2\sqrt{\rho^2(1-c)^2 - \rho(1-2c)}}{2\rho}$$

$$A \le \frac{2\rho(1-c) - 2\rho\sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}}{2\rho} \vee A \ge \frac{2\rho(1-c) + 2\rho\sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}}{2\rho}$$

$$A \le (1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \vee A \ge (1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$$

$$\tag{V.9}$$

To verify that the set of A is not empty, we examine the conditions required for ρ and c for the above inequalities. First, we examine the inequality $A \le (1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$.

In order to yield a non-empty set for A, it is required that

$$(1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \geq 0$$

$$(1-c)^2 \geq (1-c)^2 - \frac{(1-2c)}{\rho}$$

$$0 \leq \frac{(1-2c)}{\rho}$$

$$0 \leq (1-2c)$$

$$c \leq \frac{1}{2} \tag{V.10}$$

Second, we examine the inequality $A \geq (1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$. In order to yield a non-empty set for A, it is required that

$$(1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \leq 1$$

$$\sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \leq c$$

$$(1-c)^2 - \frac{(1-2c)}{\rho} \leq c^2$$

$$1 - 2c - \frac{(1-2c)}{\rho} \leq 0$$

$$\rho(1-2c) - (1-2c) \leq 0$$

$$(\rho-1)(1-2c) \leq 0$$

$$(1-2c) \geq 0$$

$$c \leq \frac{1}{2} \tag{V.11}$$

Overall, there are two possible sets of constellations depending on ρ which lead to a non-empty set of A, where $A \leq v_l < 1$: (1) $\rho + (\frac{c}{1-c})^2 \leq 1$ and $A \leq 2c$, with $c \leq \frac{1}{2}$, (2) $\rho + (\frac{c}{1-c})^2 \geq 1$ and $A \leq 2c$, with $c \leq \frac{1}{2}$ and either $A \leq (1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$, or $(1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \leq A \leq 1$.

To further analyze the constraints on the parameters c and ρ in the second set of cases, we further discuss the relationship between $2c$ and $(1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$ or $(1-$

$c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$ respectively. First, we start with the comparison between $2c$ and $(1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$.

$$2c \overset{!}{<} (1-c) - \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$$

$$3c - 1 < -\sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$$

$$1 - 3c > \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \tag{V.12}$$

To ensure a non-empty set for c, that the LHS has to be larger than zero, i.e., $c < \frac{1}{3}$. Under this condition, the inequality can be solved further to

$$1 - 6c + 9c^2 > (1-c)^2 - \frac{(1-2c)}{\rho}$$

$$1 - 6c + 9c^2 > 1 - 2c + c^2 - \frac{(1-2c)}{\rho}$$

$$-4c + 8c^2 > -\frac{(1-2c)}{\rho}$$

$$-4c(1-2c) > -\frac{(1-2c)}{\rho}$$

$$-4c > -\frac{1}{\rho}$$

$$4c < \frac{1}{\rho}$$

$$\rho < \frac{1}{4c} \tag{V.13}$$

Second, we compare $2c$ with $(1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}}$.

$$(1-c) + \sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} \overset{!}{<} 2c$$

$$\sqrt{(1-c)^2 - \frac{(1-2c)}{\rho}} < 3c - 1 \tag{V.14}$$

To ensure a non-empty set for c, that the RHS has to be larger than zero, i.e., $c > \frac{1}{3}$.

Under this condition, the inequality can be solved further to

$$(1-c)^2 - \frac{(1-2c)}{\rho} < 9c^2 - 6c + 1$$

$$-\frac{(1-2c)}{\rho} < 8c^2 - 4c$$

$$\frac{(1-2c)}{\rho} > 4c(1-2c)$$

$$\frac{1}{\rho} > 4c$$

$$\rho < \frac{1}{4c} \tag{V.15}$$

Comparing $1 - (\frac{c}{1-c})^2$ with $\frac{1}{4c}$, it can be shown that $1 - (\frac{c}{1-c})^2 \leq \frac{1}{4c}$ for all $c > 0$:

$$1 - (\frac{c}{1-c})^2 \overset{!}{\leq} \frac{1}{4c}$$

$$\frac{(1-c)^2 - c^2}{(1-c)^2} \leq \frac{1}{4c}$$

$$\frac{(1-2c)}{(1-c)^2} \leq \frac{1}{4c}$$

$$4c(1-2c) \leq (1-c)^2$$

$$4c(1-2c) - (1-c)^2 \leq 0$$

$$4c - 8c^2 - 1 + 2c - c^2 \leq 0$$

$$9c^2 - 6c + 1 \geq 0$$

$$(3c-1)^2 \geq 0$$

$$c \in \mathbb{R} \tag{V.16}$$

We summarize the three possible sets of parameter constellations that satisfy the case condition $A < v_l < 1$ below, where $\underline{B} = (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ and $\overline{B} = (1-c) + \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$.

	$0 < \rho \leq 1 - (\frac{c}{1-c})^2$	$1 - (\frac{c}{1-c})^2 < \rho \leq \frac{1}{4c}$	$\frac{1}{4c} < \rho < 1$
$0 < c \leq \frac{1}{3}$	$A \leq 2c$	$A \leq 2c$	$A \leq \underline{B}$
$\frac{1}{3} < c \leq \frac{1}{2}$		$A \leq \underline{B}$ or $\overline{B} \leq A \leq 2c$	

W Proof of Proposition 4.4.6

To analyze if $\check{E}_{MQ}$ is single peaked on $A \in [0,1]$, we derive the first-order derivative of $\check{E}_{MQ}$ toward A:

$$\frac{\partial \check{E}_{MQ}}{\partial A} = \rho + \frac{1}{2} \cdot \frac{2A\rho^2 - 2A\rho}{\sqrt{A^2\rho^2 + c^2 - A^2\rho}}$$

$$= \rho + \frac{A\rho(\rho - 1)}{\sqrt{A^2\rho^2 + c^2 - A^2\rho}} \tag{W.1}$$

We continue to investigate the algebraic sign of the derivative. For the derivative to be positive, it is necessary that

$$\rho + \frac{A\rho(\rho - 1)}{\sqrt{A^2\rho^2 + c^2 - A^2\rho}} \overset{!}{\geq} 0$$

$$\frac{A(1 - \rho)}{\sqrt{A^2\rho^2 + c^2 - A^2\rho}} \leq 1$$

$$A^2(1 - \rho)^2 \leq A^2\rho^2 + c^2 - A^2\rho$$

$$A^2 - 2A^2\rho + A^2\rho^2 \leq A^2\rho^2 + c^2 - A^2\rho$$

$$A^2 - A^2\rho \leq c^2$$

$$A^2 \leq \frac{c^2}{1 - \rho}$$

$$0 \leq A \leq \frac{c}{\sqrt{1 - \rho}} \tag{W.2}$$

Hence, $\check{A}^* = \frac{c}{\sqrt{1-\rho}}$ maximizes $\check{E}_{MQ}$ for $A \geq 0$. We repeat the procedure for $\check{E}_{LQ}$ and take the first-order derivative of $\check{E}_{LQ}$ toward A:

$$\frac{\partial \check{E}_{LQ}}{\partial A} = (1 - (1 + \alpha)\rho) \frac{\partial \check{P}_{ND}}{\partial A}$$

$$= (1 - (1 + \alpha)\rho) \frac{\partial \check{E}_{MQ}}{\partial A} \tag{W.3}$$

Under the assumption of $(1 - (1 + \alpha)\rho) > 0$, it holds that $\check{A}^* = \frac{c}{\sqrt{1-\rho}}$ is the argument that maximizes $\check{E}_{LQ}$.

X Proof of Proposition 4.4.7

To investigate the influence enforcement strength ρ on managers' equilibrium preference toward mandatory disclosure, we determined the first-order derivative of $\check{A}^*$ toward ρ.

$$\frac{\partial \check{A}^*}{\partial \rho} = \frac{c}{2(1-\rho)^{\frac{3}{2}}} > 0, \text{ where } \rho \in (0,1), \text{ and } c > 0. \tag{X.1}$$

The direct influence of disclosure cost c on the equilibrium preference toward mandatory disclosure is analogous determined by the first-order derivative of $\check{A}^*$ toward c.

$$\frac{\partial \check{A}^*}{\partial c} = \frac{1}{\sqrt{(1-\rho)}} > 0, \text{ where } \rho \in (0,1), \text{ and } c > 0. \tag{X.2}$$

Y Discussion of Section 4.4.3 ($0 \le v_l < A$)

We derive the investors' pricing scheme and the respective voluntary disclosure threshold under the assumption that $0 \le v_l < A$. The compliant and non-compliant disclosure prices are denoted as $\hat{P}_D$ and $\hat{P}_D^e$, the non-disclosure price as $\hat{P}_{ND}$. Since all firms with an expected value between v_l and A disclose voluntarily, investors conjecture correctly that non-disclosing firms are below the threshold v_l and successfully avoided enforcement. Hence, the updated pricing schemes are given by $\hat{P}_D = v-c$, $\hat{P}_D^e = v-c-l$, and $\hat{P}_{ND} = \frac{1}{2}v_l$. From a manager's perspective, firms with a value above the voluntary disclosure threshold disclose irrespective of the regulation level, and their expected selling price is simply:

$$\hat{E}_{HQ} = \hat{P}_D = v - c. \tag{Y.1}$$

Managers of low quality firms with a value below the voluntary disclosure threshold have to weight two possibilities when forming a belief about the expected selling price. Either, firms do not comply to mandatory disclosure requirements and are uncovered, which happens with a probability of ρ. Or, firms successfully avoid disclosure with a probability

of $1 - \rho$. This leads to:

$$\hat{E}_{LQ} = \rho\hat{P}_D^e + (1 - \rho)\hat{P}_{ND}$$
$$= (1 + \alpha)\rho\hat{P}_D + (1 - (1 + \alpha)\rho)\hat{P}_{ND}. \tag{Y.2}$$

In equilibrium, investors' beliefs about the managers' disclosure behavior have to be correct. Therefore, it has to hold that firms with a value above the voluntary disclosure threshold disclose and firms with a value below the voluntary disclosure threshold remain silent. Based on these beliefs, we derive the voluntary disclosure threshold v_l for this situation. For any firm with an expected value below the threshold v_l, the price the firm expects resulting from non-compliance has to be higher than their disclosure price. This translates to:

$$\hat{P}_D < (1 + \alpha)\rho\hat{P}_D + (1 - (1 + \alpha)\rho)\hat{P}_{ND}$$
$$\hat{P}_D < \hat{P}_{ND}$$
$$v - c < \frac{1}{2}v_l$$
$$v < \frac{1}{2}v_l + c \tag{Y.3}$$

Investors infer correctly that they face a firm with a value below the threshold v_l when encountering a non-disclosing firm, which translates to $v < v_l$. We equalize the right hand side of the previous inequality with $v < v_l$ to secure the validity of both inequalities:

$$v_l = \frac{1}{2}v_l + c$$
$$v_l = 2c \tag{Y.4}$$

In addition, since the case condition dictates $0 \leq v_l < A$, it needs to be valid that $0 \leq c < \frac{A}{2}$. The same condition results for firms with an expected value above or equal to the threshold v_l, where the starting condition is $\hat{P}_D \geq \hat{P}_{ND}$. In order to discuss the deliberative process, we again turn to the expected selling prices stated in Equation (Y.1) and Equation (Y.2). In case the voluntary disclosure threshold is below the mandatory

disclosure threshold and $0 \leq c < \frac{A}{2}$, no alignment of preferences is present based on $\hat{E}_{HQ}$ and $\hat{E}_{LQ}$. A proposed marginal change of the mandatory disclosure threshold A neither finds a majority support, nor a majority reject. No change of the regulation level occurs during the collective deliberation as individual selling prices do not depend on A. Firms above the voluntary disclosure threshold separate themselves by voluntary disclosure from firms below the voluntary disclosure threshold.

Z Case discussion for Section 4.4.4

In Section 4.4.1 to Section 4.4.3, we identified three distinct cases depending on parameter constellations of c, ρ and A. However, as A and v_l are endogenously determined, there are parameter constellations, where A and v_l stop satisfying the initial case conditions during the iterative process. Therefore, the iterative motion might change toward a different mandatory threshold or stop as indicated in Section 4.4.3. We next provide a detailed discussion based on the parameter constellations of c and ρ, which leads to the six cases indicated below. Further, Figure Z.1 illustrates the various constellation similar to what we show in the paper. We will examine the iterative motion case by case.

	$\rho \leq 1 - (\frac{c}{1-c})^2 \wedge \frac{3}{4} < \rho \leq 1$	$\rho \leq 1 - (\frac{c}{1-c})^2 \wedge \rho \leq \frac{3}{4}$	$1 - (\frac{c}{1-c})^2 < \rho \leq \frac{1}{4c}$	$\frac{1}{4c} < \rho \leq 1$
$0 < c \leq \frac{1}{3}$	Case VI		Case IV	Case II
$\frac{1}{3} < c \leq \frac{1}{2}$	n/a	Case V	Case III	
$\frac{1}{2} < c \leq 1$		Case I		

Z.1 Case I

We have established in Appendix V that $c > \frac{1}{2}$ is sufficient to ensure $v_l > 1$. No firm voluntarily discloses and the final mandatory threshold is $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$ as discussed in Section 4.3.3.

Figure Z.1: Case overview
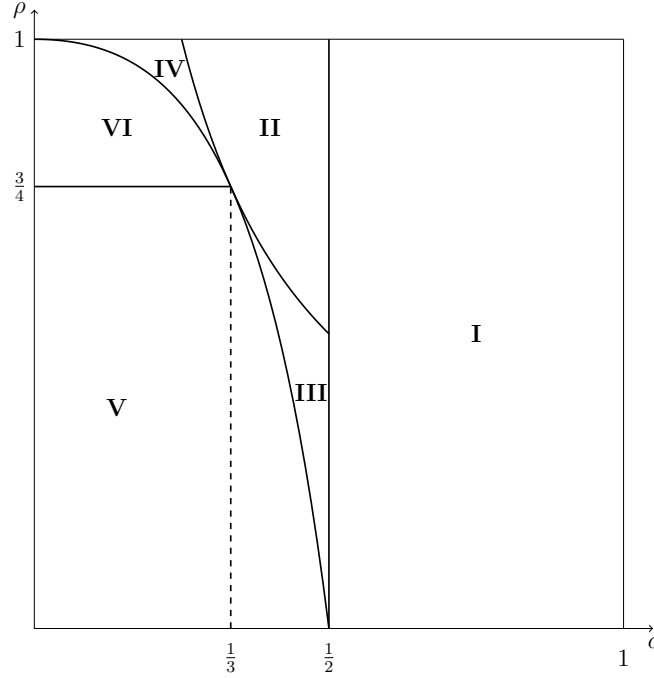
Z.2 Case II

We have also shown in Appendix V that v_l depends on A, if $\frac{1}{4c} < \rho \leq 1$. Further, we demonstrated in the same Appendix that the condition $A \leq (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ needs to be satisfied such that $v_l < 1$, otherwise $v_l > 1$. If $v_l > 1$, no firm voluntarily discloses and the consensus mandatory threshold is $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$ as discussed in Section 4.3.3. However, if A satisfies the condition, i.e., $A \leq (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$, and the conditions $c \leq \frac{1}{2}$ as well as $\frac{1}{4c} < \rho$ hold, v_l initially falls in the interval $A \leq v_l \leq 1$. We have shown in Section 4.4.2 that the mandatory threshold then iterates toward $\check{A}^* = \frac{c}{\sqrt{1-\rho}}$. The deliberation continues as long as the condition $A \leq (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ is satisfied. However, the inequality $\frac{c}{\sqrt{1-\rho}} \leq (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ translates to $\rho = 1 - \frac{c^2}{(1-c)^2}$ and $0 < c < \frac{1}{2}$, or $\rho = 1 - \frac{c^2}{(1-c)^2}$ and $\frac{1}{2} < c < 1$, respectively. Equation (V.16) in Appendix V shows that these conditions yield an empty set with the case condition $\rho > \frac{1}{4c}$. Therefore, the mandatory threshold $\check{A}^*$ cannot be reached without causing v_l to exceed one in the deliberation. Once $v_l > 1$, no firm voluntarily discloses and the process

iterates toward $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$ as discussed in Section 4.3.3. In addition, the inequality $A^* > (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ can be solved to $0 < c \le \frac{1}{2}$ and $1 - \frac{c^2}{(1-c)^2} < \rho \le 1$, or $\frac{1}{2} < c \le 1$ and $0 < \rho \le 1$. Therefore, A^* can be reached without violating the conditions for $v_l > 1$ under the given parameter settings of Case II. Therefore, $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$ yields from the deliberative process as the final mandatory threshold. Summing up, both possibilities lead to a constellation where $v_l > 1$, and the final mandatory threshold is A^*.

Z.3 Case III

In Appendix V, we have shown that $v_l > 1$, if $\underline{B} < A < \overline{B}$, where $\underline{B} = (1-c) - \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$ and $\overline{B} = (1-c) + \sqrt{(1-c)^2 - \frac{1-2c}{\rho}}$. In this case, no firm voluntarily discloses and the consensus mandatory threshold is $A^* = \frac{1-\sqrt{1-\rho}}{\rho}$ as discussed in Section 4.3.3. In addition, the inequality $\underline{B} < \frac{1-\sqrt{1-\rho}}{\rho} < \overline{B}$ solves to $1 - (\frac{c}{1-c})^2 < \rho < 1$ and $0 < c \le \frac{1}{2}$ such that A^* satisfies $\underline{B} < A^* < \overline{B}$. However, if $A \le \underline{B}$ or $\overline{B} \le A \le 2c$, then $A \le v_l \le 1$. In this case, A iterates toward $\check{A}^*$ as discussed in Section 4.4.2. It can be shown that the inequality $\check{A}^* \le \underline{B}$ solves to $\rho = 1 - \frac{c^2}{(1-c)^2}$ and $0 < c < \frac{1}{2}$, or $\rho = 1 - \frac{c^2}{(1-c)^2}$ and $\frac{1}{2} < c < 1$, which yields an empty set under the parameter setting of Case III. Similarly, the inequality $\check{A}^* \ge \overline{B}$ solves to $0 < c \le \frac{1}{2}$ and $\frac{-1+2c+3c^2}{8c^2} + \frac{1}{8}\sqrt{\frac{1-4c+14c^2-20c^3+9c^4}{c^4}} \le \rho < 1$. Under the condition on c of Case III, i.e., $\frac{1}{3} < c \le \frac{1}{2}$, the term $\frac{-1+2c+3c^2}{8c^2} + \frac{1}{8}\sqrt{\frac{1-4c+14c^2-20c^3+9c^4}{c^4}}$ falls into the interval $[\frac{3}{4}, \frac{\sqrt{3}}{2})$. However, for $\frac{1}{3} < c \le \frac{1}{2}$, the term $\frac{1}{4c}$ falls into the interval $[\frac{1}{2}, \frac{3}{4})$. Since the parameter settings of Case III dictates that $\rho < \frac{1}{4c}$, $\check{A}^* \ge \overline{B}$ solves to an empty set. As both $\check{A}^* \le \underline{B}$ and $\check{A}^* \ge \overline{B}$ solve to an empty set under the parameter settings of Case III, $\check{A}^*$ would lead to $v_l > 1$. The iterative motion that initially starts iterating toward $\check{A}^*$ changes toward A^* once $v_l > 1$ during the process. Summing up, both possibilities lead to a constellation where $v_l > 1$, and the final mandatory threshold is A^*.

Z.4 Case IV

Under the parameter settings of Case IV, $c \leq \frac{1}{3}$ and $1 - (\frac{c}{1-c})^2 < \rho \leq \frac{1}{4c}$, we can show based on Inequality (V.12) and (V.13) from Appendix V that $2c < \underline{B}$. Further, if $A \geq 2c$, we arrive at the setting discussed in Section 4.4.3, where the voluntary threshold $v_l = 2c$ falls below A. Therefore, voluntary disclosure dominates mandatory disclosure and a deliberation over A becomes needless. Hence, the current state A is the final mandatory threshold. If instead $A < 2c$ holds, the inequality $A < 2c < \underline{B}$ leads to the setting discussed in Section 4.4.2, where $A < v_l < 1$. In this case, deliberation starts toward $\check{A}^*$. However, as discussed before, $\check{A}^*$ lies within the interval $(\underline{B}, \overline{B})$, meaning that A exceeds the boundary $2c$ before reaching $\check{A}^*$ during the iteration. As soon as A reaches $2c$, the voluntary threshold v_l falls below A, which constitutes the situation discussed in Section 4.4.3. Since no firm has interest to further participate in the deliberative process, the process ends at $A = 2c$, which constitutes the final mandatory threshold. Summing up, both possibilities lead to a constellation where $v_l \leq A < 1$ as discussed in Section 4.4.3. If $A \geq 2c$, the current state mandatory threshold is also the final mandatory threshold, if $A < 2c$ the iteration ends at $A^* = 2c$, which is the final mandatory threshold.

Z.5 Case V

Under the parameter settings of Case V, $\rho \leq 1 - (\frac{c}{1-c})^2$ and $c \leq \frac{1}{2}$, we have shown by Inequality (V.8) in Appendix V that $v_l < 1$ holds. However, if $A \geq 2c$, the parameter settings leads to the situation as discussed in Section 4.4.3, where $v_l < A$. In this case, no deliberation takes place and the current state of the mandatory threshold is the final mandatory threshold. If $A < 2c$, the parameter settings leads to the situation as discussed in Section 4.4.2, where $A \leq v_l \leq 1$. The iterative motion starts toward $\check{A}^*$, and we can

show that $\check{A}^*$ is reached without violating the condition $\check{A}^* < 2c$:

$$\check{A}^* = \frac{c}{\sqrt{1-\rho}} \overset{!}{<} 2c$$

$$\frac{1}{\sqrt{1-\rho}} < 2$$

$$\frac{1}{2} < \sqrt{1-\rho}$$

$$\frac{1}{4} < 1-\rho$$

$$\rho < \frac{3}{4}$$

Thus, $\check{A}^* = \frac{c}{\sqrt{1-\rho}}$ is the final mandatory threshold. Summing up, the final mandatory threshold after the deliberative process is either A, if $A \geq 2c$, or $\check{A}^*$, if $A < 2c$.

Z.6 Case VI

Under the parameter settings of Case V, it holds that $v_l < 1$, and the iteration starts toward $\check{A}^*$. However, we have previously shown that $\check{A}^*$ is above the boundary of $2c$ given $\rho \geq \frac{3}{4}$. The iterative motion starts toward $\check{A}^*$, and reaches the boundary $A = 2c$. v_l falls below A and the deliberative process stops at $A = 2c$, which again constitutes the final mandatory threshold. If $A \geq 2c$, the parameter settings leads to the situation the situation as discussed in Section 4.4.3, where $v_l < A$. In this case, no deliberation takes place and the current state mandatory threshold is the final mandatory threshold. If $A < 2c$, the parameter settings leads to the situation the situation as discussed in Section 4.4.2, where $A \leq v_l \leq 1$. In contrast to Case V, $\check{A}^*$ is above the boundary $2c$ under the parameter setting of Case VI. Therefore, the iterative motion starts toward $\check{A}^*$, and reaches the boundary $A = 2c$. v_l falls below A and the deliberative process stops at $A = 2c$. Summing up, the final mandatory threshold after the deliberative process is either A, if $A \geq 2c$, or $2c$, if $A < 2c$.

AA Proofs for Section 4.5.2

The influence of disclosure cost on the equilibrium mandatory threshold is in Appendix X. Further, the influence of disclosure cost c on the sensitivity of the collective preference with regard to enforcement strength ρ is determined by the first-order derivative of $\frac{\partial \check{A}^*}{\partial \rho}$ toward c.

$$\frac{\partial(\frac{\partial \check{A}^*}{\partial \rho})}{\partial c} = \frac{1}{2(1-\rho)^{\frac{3}{2}}} > 0, \text{ where } \rho \in (0,1), \text{ and } c > 0. \tag{AA.1}$$

The influence of enforcement strength ρ on the sensitivity of the collective preference with regard to disclosure cost c is determined by the first-order derivative of $\frac{\partial \check{A}^*}{\partial c}$ toward ρ.

$$\frac{\partial(\frac{\partial \check{A}^*}{\partial c})}{\partial \rho} = \frac{1}{2(1-\rho)^{\frac{3}{2}}} > 0, \text{ where } \rho \in (0,1), \text{ and } c > 0. \tag{AA.2}$$

AB Proofs for Section 4.5.3

First, we demonstrate that the transparency score function T is increasing in ρ if $1 < v_l$. The transparency score is $T = \rho \cdot \frac{1-\sqrt{1-\rho}}{\rho} = 1 - \sqrt{1-\rho}$. The first-order derivative toward ρ is $\frac{\partial T}{\partial \rho} = \frac{1}{2\sqrt{1-\rho}}$, which is positive. Second, if $A \le v_l \le 1$, the transparency score takes the algebraic form:

$$
\begin{aligned}
T &= \rho \cdot \check{A}^*(\rho, c, \alpha) + (1 - v_l(\check{A}^*, \rho, c, \alpha)) \\
&= \rho \cdot \frac{c}{\sqrt{1-\rho}} + (1 - \frac{c\rho + c\sqrt{1-\rho} + \sqrt{c^2(1-\rho)^2}}{1-\rho}) \\
&= \frac{\rho c}{\sqrt{1-\rho}} + (1 - (\frac{c}{\sqrt{1-\rho}} + c)) \\
&= 1 - c\sqrt{1-\rho} - c
\end{aligned}
$$

The first-order derivative of T toward ρ, $\frac{\partial T}{\partial \rho} = \frac{c}{2\sqrt{1-\rho}}$, is strictly positive, which implies a positive relation between enforcement strength and transparency. The first-order

derivative of $\rho A^*(\rho, c, \alpha)$ toward ρ is $\frac{\partial \rho A^*}{\partial \rho} = \frac{(2-\rho)c}{2(1-\rho)^{\frac{3}{2}}}$, which is again positive. It is also noticeable that v_l depends on ρ in this case, taking the form $v_l(\check{A}^*) = \frac{c}{\sqrt{1-\rho}} + c$. The first-order derivative toward ρ is $\frac{\partial v_l(\check{A}^*)}{\partial \rho} = \frac{c}{2(1-\rho)^{\frac{3}{2}}}$, which is also positive. Third, if $0 \le v_l < A$, the voluntary disclosure threshold v_l does not depend on ρ. The transparency score has the form: $T = \rho \cdot A^* + (1 - 2c)$, with the first-order derivative toward ρ, $\frac{\partial T}{\partial \rho} = A^*$, being positive. Please note that A^* does not depend on ρ in this case. Therefore, an increasing enforcement strength also leads to an increase in the transparency score. Overall, in all three cases the transparency score is positively associated with the enforcement strength.

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