Disclosure Regulations and Financial Reporting Requirements: An Analysis of Two Tools for Enhancing Firm Value

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Abstract

This paper examines the role of disclosure regulations and financial reporting requirements in enhancing the value of disclosing firms. Disclosure regulations refer to regulations that require disclosure of information that the firm has voluntarily decided to acquire (conditional disclosure), while reporting requirements refer to regulations that require firms to acquire certain information and disclose it (unconditional disclosure). In this paper, acquisition of information is endogenous, and information has value for the firm’s operations and for reducing the costliness of information asymmetry in the capital markets. By focusing on the acquisition of information stage, the paper provides insights into the unique role played by each of the two regulatory tools, which, otherwise, would serve a similar purpose (inducing full disclosure). The paper shows that requiring firms to report information cannot strictly enhance their values, unless this requirement has a real effect on their operations. This suggests that reporting requirements cannot be valuable for the sole purpose of reducing the firm’s cost of capital, but can serve as a tool to discipline firms’ investment activity. This result is consistent with the observation that a main source of reporting requirements is IPO’s, where firms commit to ex-post provide periodic financial reports about their uses of the capital raised. In contrast, disclosure regulation can be beneficial without affecting the real activity of firms. In fact, it is shown that the efficiency of disclosure regulation is robust when information is used to reduce the level of information asymmetry in the capital market, but not when the information has real effect on the firms operations.

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1 Introduction

Much of the theoretical research on disclosure and reporting regulations in financial accounting focuses on the value of these regulations in inducing firms to disclose information that has value to outsiders to the firm (externalities) or in reducing agency costs.\(^1\) The purpose of this paper is to provide insights into the value of disclosure and reporting regulations for the disclosing firms, themselves, in their interaction with the capital markets. In this paper, disclosure regulations refer to regulations that require the disclosure of information that the firm has voluntarily chosen to acquire (conditional disclosure), while reporting requirements refer to regulations that require firms to acquire certain information and disclose it (unconditional disclosure). To the best of my knowledge, a clear distinction and comparison between these two regulatory tools has not been made in the literature. A straightforward reason for that is that the distinction between disclosure regulations and reporting requirements does not emerge when firms are exogenously endowed with information.\(^2\) In our analysis, information acquisition is endogenous. By focusing on the firms’ decisions to collect information, the paper is able to provide insights into the unique role played by each of the two regulatory tools, which, otherwise, would serve a similar purpose (inducing full disclosure).

The analysis is conducted in the context of a single-firm economy, where the firm is considering acquiring and disclosing information that is potentially useful in three dimensions; for the firm’s internal operations (e.g. for decision making purposes), in reducing the costs of information asymmetry in the capital markets, and in allowing investors to monitor the firm’s performance. The firm chooses the levels of information collection and disclosure so as to maximize the actual consumption of its current shareholders (that is, the ex-post firm value). This means that the firm takes into account welfare redistribution effects in its decisions to acquire and disclose information. Consequently, the regulation of these activities has the potential to enhance the firm’s ex-ante value. The purpose of this analysis is to gain an understanding of the conditions under which each set of regulations is efficient in the sense of increasing ex-ante firm value relative to a setting in which the regulation is not imposed.\(^3\)

We begin by showing that requiring a firm to report information cannot enhance its ex-ante value unless the commitment to report the information changes the firm’s productive actions. This implies that requiring firms to provide financial reports cannot be valuable if

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\(^1\)See Leuz and Wysocki (2008) and Beyer et al. (2010) for reviews of the relevant literature.

\(^2\)For example, if one assumes that with probability one firms are exogenously endowed with information, then mandating disclosure of the information and requiring reporting of it is equivalent. If, instead, one assumes that information is observed with positive probability and with complementary probability it does not, then requiring reporting is not feasible.

\(^3\)In this paper, ex-ante firm value measures social welfare.
the regulation’s sole purpose is to reduce the firm’s cost of capital. More broadly, of the three potential roles of information examined here, requiring the reporting of information can be strictly efficient only with respect to performance information. The anticipation of disclosure of performance information can discipline firms to make more efficient operational decisions. In contrast, mandating the disclosure of information that the firm voluntarily acquires can enhance firm value even without affecting the firm’s productive actions. This is because the commitment to disclose observed information changes the market reaction to the absence of disclosure. As a result, mandating disclosure may be efficient in the context of all three roles of information. The analysis proceeds by investigating the desirability of mandating disclosure of information that is useful internally; then the efficiency of mandating disclosure of information that reduces asymmetry of information is examined. Lastly, we investigate the roles of both mandating disclosure and requiring reporting in the context of performance information.

The effect that mandating disclosure has on market reaction to the absent of disclosure may have an indirect effect on the firm incentive to acquire information that is useful internally. Consider, for example, a firm that contemplates conducting a demand survey for one of its products. If disclosure of the survey results is voluntary, and disclosure has the potential of enhancing the price of the firm in the market, then the firm may choose to conduct the survey even if the costs of conducting it exceed the benefits for the firm’s operations (Shavell, 1994; Pae, 1999; Kanodia, 2006). Shavell (1994) shows that mandating disclosure of the survey results leads to social efficiency because it completely eliminates the firm’s over-investment in information that stems from the option to disclose it. This result, however, depends crucially on the assumption that the firm does not have superior knowledge of the demand for its product before conducting the survey. It is shown here that when this assumption is relaxed, mandating disclosure may actually reduce firm value. The reason is that requiring the firm to disclose the survey results may deter the firm from conducting the survey when the market is overly optimistic about product demand.

We next examine the value of mandating disclosure for reducing the cost of information asymmetry in the capital markets. The idea that committing to full disclosure may lead to a reduction in the discount that investors apply to firm price in the presence of an adverse selection problem is not new (e.g. Mahoney, 1995; Rock, 2002, Guay and Verrecchia, 2007; Göx and Wagenhofer, 2009). However, it is not clear whether this desirable effect also results when a firm’s information endowment is endogenously determined. It is possible, in this case,

\[4\text{With the exception of section 2, costs of disclosing proprietary information are not considered in this paper. Information about product demand may be proprietary leading to disclosure costs. In general, it can be expected that disclosure costs make disclosure regulations less desirable.} \]
that the positive effect of disclosure regulation on the firm’s cost of capital will be swamped by the effect that the regulation has on the amount of information collected by the firm. In a model that incorporates a cost of information asymmetry it is shown that mandating disclosure is efficient, no matter how much it reduces the firm’s level of information acquisition. This is because the higher level of information acquisition under a voluntary disclosure regime not only requires a greater expenditure of resources for information collection, but also exacerbates the problem of information asymmetry. This result is robust to the level of private information that the firm has before making the information acquisition decision. An implication of this result is that mandating disclosure may strictly enhance firm value even if a voluntary disclosure regime would result in full disclosure of the firm’s information.

Lastly, we investigate which of the two regulatory tools, if any, is efficient with respect to information about firm performance. When the investment decision is made after the firm sets the level of information acquisition, whether it is optimal to mandate disclosure of the performance information or require firms to report it depends on the level of private information the firm has. In contrast, when the investment decision is made prior to when the firm sets the level of information acquisition, mandating disclosure is not efficient, while requiring firms to report the investment performance is efficient if the firm productivity is sufficiently high and the cost of acquiring the information is sufficiently low. This suggests that reporting requirements may be beneficial to firms by serving as a long-term commitment to ex-post acquire and disclose information about past activities. This is consistent with the observation that a main source of obligation to provide periodic financial reports is IPO’s, where firms commit to provide future reports on the performance of their uses of the capital raised. The results here are related to Kanodia and Lee (1998). Kanodia and Lee show that if the only purpose of reporting requirements is to allow the capital market to make a more accurate assessment of the firm’s future cash flows, then it is socially optimal not to release these reports. They also show that such reports are beneficial in disciplining a firm’s investment made prior to the release of these reports. There are a few crucial differences between the results in Kanodia and Lee (1998) and the results here. First, Kanodia and Lee (1998) use a different benchmark. In their paper, a reporting requirement is efficient if it leads to higher efficiency than no disclosure at all. In addition, risk aversion is a key component in their model. Specifically, requiring firms to report information inhibits efficient risk transfer between shareholders and investors, where the former are assumed to be more risk-averse than the latter. Here, in contrast, we adopt a risk neutral framework and the reporting requirement is efficient if it leads to higher firm value compared to when disclosure

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6 This is the Hirshleifer effect (Hirshleifer, 1971).
is voluntary and when disclosure is mandatory. Second, in Kanodia and Lee (1998) the firm can choose the precision of the reported information. By choosing to report noisy information, firms can, in effect, avoid reporting. In the analysis here it is assumed that the accuracy of the report is exogenously determined (for example by the regulator) and so is not a choice variable for the firm. In this sense, a reporting obligation here is a more rigid requirement, and thus harder to justify as a means for improving firm value. Consequently, in contrast to Kanodia and Lee (1998), imposing a reporting requirement here is efficient in a robust way, only when the investment decision is made prior to the acquisition of information.

Overall, the results suggest that disclosure regulations can be used to reducing the asymmetry of information in the capital market, albeit with a possibly undesirable negative effect on firms’ real activity. In contrast, reporting requirements can be used to enhance the firm’s real activity, while as a by product, having a desirable effect on the firm’s cost of capital.

The reminder of the paper is organized as follows. Section 2 provides a necessary condition for reporting requirements to improve firm value. Section 3 studies the efficiency of mandating disclosure of information that is useful internally, while section 4 examines the efficiency of mandating disclosure in the context of information that reduces the asymmetry of information in the capital market. Section 5 investigates the roles of mandating disclosure and requiring reporting in the context of performance information, and section 6 provides concluding remarks. All proofs not in the text are relegated to the Appendix.

2 A Necessary Condition for Reporting Requirements to Improve Firm Value

As a first step in the analysis, we lay out the general framework in the paper, and provide a necessary condition for reporting requirement to be welfare enhancing. In subsequent sections we develop this framework by adding more structure in order to examine, more closely, the role of regulations in specific contexts.

We start by laying out the timeline, which consists of one period and three dates (zero, one, and two). The timeline is given in Figure 2.1.
At the beginning of the period (date zero) the firm is established by a risk neutral individual (referred to as the manager), who operates it for one period and sells it to investors in the capital market at the end of the period. The objective of the manager is to maximize the proceeds from selling the firm. The firm produces uncertain cash flows $\tilde{v}$, $v \in [v, \bar{v}]$, $\bar{v} > v$, which is realized after the end of the period, and is consumed by the shareholders of the firm at that time.\footnote{Throughout the paper tildes signify random variables.} We discuss later how the firm's cash flows are generated. At date 1, the manager considers acquiring a verifiable signal $\tilde{y}$ that, if acquired, entails stochastic costs and benefits to the firm. If the manager does not acquire the signal then he necessarily makes no disclosure at date 2. But, if he acquires the signal, then he observes the information at date 2 (end of the period) and can disclose it to investors at that time. It is assumed that disclosure is truthful but the manager cannot credibly convey to the market that he had acquired no information. Investors set the firm price at the end of date 2 (end of the period), denoted by $P$, based on all the information available to them at that time. Let $I_0$ denote all the information, other than possibly the realization of $\tilde{y}$, that is available to investors at the end of the period. The firm price conditional on no disclosure is denoted by $P_{\phi}$, where $P_{\phi} : I_0 \to \mathbb{R}$, and the firm price conditional on disclosure is denoted by $P(y)$, where $P(y) : \{y, I_0\} \to \mathbb{R}$. It is assumed that investors are rational and that the capital market is competitive, so that investors break even on average. In this section it is not necessary to be more explicit about the costs and benefits of information, about how price is determined, or about what additional private information is available to the manager.

We define the firm value, denoted by $\pi$, as the expected social value of the firm at the beginning of the period. Since investors break even on average, the value of the firm can be
expressed as the expected firm price. That is,

$$\pi = E[\tilde{P}]$$.

(2.1)

In more generality, the firm value is defined as the expected proceeds for the manager from the firm. The expected proceeds may be different than the expected firm price if the manager consumes part of the firm’s cash flows prior to the sale (as in section 3), or if the manager has the option to liquidate the firm instead of selling it in the capital market (as in section 4). That investors break even means that on average the firm price reflects all the cost and benefits of the information. However, on any particular case the price may not reflect all the actual costs and benefits of the information, leading the manager to take inefficient collection and disclosure decisions.

The standard definition of firm’s cost of capital is that it is equal to $E[\bar{v}] - E[\tilde{P}]$. The definition of firm value in (2.1) captures the cost of capital of the firm. This approach is chosen because, by our assumption that investors break even, the cost of capital is a real social cost.

The firm’s cash flows is determined by the manager’s decisions together with a random state of nature. Specifically, $v = v(a, e, \theta)$, where $a$ is productive action that the manager takes; $e, e = \{0, 1\}$ is the manager’s decision to acquire the signal ($e = 0$), or to not acquire the signal ($e = 1$); and $\theta$ is a random state of nature. The result in this section can be demonstrated in a general way, where $a$ can be a vector and where the manager conditions his actions on his private information about $\theta$ and $e$. However this complicates the exposition without adding to the analysis. For simplicity we treat $a$ as a scalar and assume that, conditional on the manager’s disclosure decision, his equilibrium action is completely conjectured by investors (i.e. from investors’ perspective at date 2 $a$ is not a random variable). It is assumed that all the costs and benefits of disclosure of information are captured by the end of the period price rather than the firm’s cash flows. For example, disclosure of information may reduce the premium that investors charge for the asymmetry of information, or if investors are risk averse, the premium they charge for risk. The analysis would not change if, in addition, the disclosure decision affects $\bar{v}$ (e.g. due to costs of disclosing proprietary information). It is assumed that the magnitudes of the costs and benefits from collection and disclosure of information are determined exogenously and cannot be affected by the firm.

We are interested in analyzing the conditions under which each of three regimes; discretionary disclosure regime, mandatory disclosure regime, and reporting regime, is firm value maximizing (also referred to as efficient or as optimal). Under discretionary disclosure regime
the firm has the discretion to decide whether to acquire the signal, and if the firm decides to acquire the signal, whether to disclose it. Under mandatory disclosure regime, the firm has the discretion to decide whether to acquire the signal, but if the firm decides to acquire the signal, it must disclose it.\footnote{Throughout the paper, the terms disclosure regulations and mandatory disclosure are used interchangeably; and so are the terms discretionary disclosure and voluntary disclosure.} Under reporting regime the firm is required to acquire and disclose the signal. We use the superscripts $D$, $M$, and $R$ to represent the economy operating under discretionary disclosure regime, mandatory disclosure regime, and reporting requirement regime, respectively. Let $a_D$ denote the manager’s equilibrium productive action under discretionary regime, given that he acquires and discloses the signal, and let $a_R$ denote the manager’s equilibrium productive action under reporting regime. We first state the result of this section and then prove it and discuss it further.

**Proposition 1.** A necessary condition for reporting regime to strictly improve firm value relative to firm value under discretionary disclosure regime is that $a_D \neq a_R$.

To understand why this is true consider the manager’s decision to acquire information and disclose it. The manager has three alternatives; he can acquire the information and disclose it to the capital market (acquire and disclose), he can acquire the information but not disclose it (acquire and not disclose), or he can choose not to acquire the information (not acquire). Regulation restricts the set of alternatives that the manager can choose from. Specifically, when disclosure is mandatory the manager is restricted to choose between acquire and disclose and not acquire. He cannot choose to acquire and not disclose. When there is reporting requirement of the information, the manager must choose acquire and disclose.

Our definition of firm value, given in (2.1), suggests that the manager’s objective to maximize ex-post market price is tied to the ex-ante efficient behavior, which is maximization of expected market price. Therefore, restricting the manager’s behavior cannot be optimal, unless doing so affects the distribution of prices that the manager faces in his acquisition and disclosure decisions. In the context of reporting regime the commitment to acquire and disclose information can affect firm prices only through an effect on the manager’s productive action. This is because, there are three endogenous parameters in the model; acquisition decision, disclosure decision, and productive action decision. Given that the acquisition and disclosure decisions are determined by the regime (acquire and disclose), commitment can affect prices only through its effect on productive action.

In the context of mandating disclosure, in contrast, the commitment to disclose any acquired information can affect the distribution of prices even without affecting the firms’
productive action. This is because under mandatory disclosure regime only the disclosure decision is bounded by the regime. The commitment to disclose can affect prices through its effect on investors’ interpretation of the firm’s decision not to acquire information. Specifically, when disclosure is mandatory absent disclosure conveys a different message to the market than when disclosure is voluntary and the firm is allowed to conceal unfavorable information (Dye, 1985).

In the following analysis we focus on the efficiency of regulation with respect to information that is beneficial in one of three ways; for the firm’s internal operations (e.g. as an input in the firm’s decision making process), as a way for communicating the firm value in order to reduce the costliness of the asymmetry of information in the capital market, or as an ex-post measure for the firm’s performance. Information that is useful for the firm’s internal operations is information that once collected by the firm, the firm can make use of it to increase its cash flows. It does not, however, reflect on how the firm decided to use it (this role is left for performance information). For example, suppose that the demand for the firm’s product is determined exogenously and that by gaining knowledge of it the firm can better adjust its operations to efficiently accommodate the actual demand. While investors can make use of the firm’s disclosure of the actual demand to adjust their beliefs about the future cash flows of the firm, this information does not tell investors how the firm makes use of the information in its productive decisions. The cost of asymmetry of information between the manager and the capital market is defined here as the difference between the expected proceeds for the manager under the status quo and the hypothetical expected proceeds if investors could observe all the information that is available to the manager. In our single-firm economy context, one can interpret the discount that investors apply to the firm price as an idiosyncratic risk premium, or as a liquidity premium (e.g. Amihud and Mendelson, 1986; Diamond and Verrecchia, 1991). Although in general information can be beneficial in more than one way, dealing with each case separately helps identifying the source of the necessity of regulation. It is assumed that in all cases the information is also useful for investors in updating their beliefs about the future cash flows of the firm. Among the three uses of information, only the one with respect to performance information reporting regime has the potential of strictly improve firm value. This is because only in this case the ex-ante commitment to report the information can affect the actions of the manager, who anticipates disclosure. In the context of mandatory disclosure, more analysis is necessary in order to evaluate the efficiency in each of the three cases.

The next section examines the efficiency of mandating disclosure in the context of information that is useful for the firm’s operations, and section 4 examines the efficiency of mandating disclosure in the context of information that is useful for reducing the asymmetry
of information in the market. Section 5 investigates the efficiency of reporting regime and mandatory regime in the context of performance information.

3 Mandating Disclosure of Information that is Useful Internally

The sequence of events in this section is presented in Figure 3.1.

![Timeline for Section 3](image)

At date zero the manager and investors share common priors about the firm’s cash flows, \( \tilde{v} \), under the status quo. At date 1 (acquisition stage) the manager privately observes the set \( \tilde{b}, \tilde{s} \), where \( \tilde{b} \) is net benefit (cash flows) that the firm obtains, in addition to \( \tilde{v} \), if it acquires a verifiable signal \( \tilde{y} \), and \( \tilde{s} \) is information about the realization of \( \tilde{y} \). The net benefit \( \tilde{b}, \tilde{b} \in [b, \bar{b}], b < \bar{b} \) represents operational benefits that the firm can obtain by using the signal for internal purposes (e.g. for decision making purposes) less the cost of acquiring the signal.\(^9\) The net benefit can be either positive (representing net value) or negative (representing net cost). After learning \( [\tilde{b}, \tilde{s}] \) the manager chooses whether to acquire the signal. If he acquires the signal, he receives it at date 2, and the net benefit \( \tilde{b} = b \) is realized and consumed by the manager (or paid by him if it is net cost) at that time. The assumption that the net benefit is consumed by the manager is convenient because the firm price under this assumption is a function only of investors’ beliefs about \( \tilde{v} \).\(^{10}\) Having the signal at hand the manager can

\(^9\)In general, \( \tilde{y} \) can be thought of as a bi-dimensional signal that provides operational information, but also reflects on \( \tilde{v} \). Besides acknowledging the benefit that the firm has from observing the operational dimension of \( \tilde{y} \), we suppress this dimension and concentrate on the information content of \( \tilde{y} \) with respect to \( \tilde{v} \). Consequently, \( \tilde{s} \) provides information only about this dimension of \( \tilde{y} \).

\(^{10}\)Kanodia (2006) makes a similar assumption that short term returns are consumed directly and privately by the firm’s shareholders. The analysis would not change if instead the net benefit is left in the firm and investors price it correctly. The uncertainty of investors about the realization of the net benefit is
disclose the signal to investors, who in turn use it to update their beliefs about $\tilde{v}$ when setting the firm price at the end of date 2 (end of the period). Investors are risk neutral and set the price to be equal to their expectation for the firm’s cash flows, based on all the information that is available to them.

As in the previous section, $P(y)$ represents the firm price when disclosure of the signal $\tilde{y} = y$ occurs, and $P_\phi$ represents the price when disclosure does not occur. We have $P(y) = E[\tilde{v}|y]$. It is assumed that higher value of $s$ imply higher value of $y$, and that higher values of $y$ imply higher values of $v$. Prior to date 2, $P(y)$ is a random variable, because $y$ is random. It is useful to concentrate on the ex-post firm price as the variable of interests. Consider the following change of variable

$$p = P(y).$$

At the beginning of the period the manager and investors share common prior belief about $\tilde{p}$. Let $f$ be the probability distribution function of $\tilde{p}$, and $F$ be its cumulative distribution function. It is assumed that $f(p) > 0$ for all $p \in [p, \bar{p}]$, where $v \leq p < \bar{p} \leq \tilde{v}$. The relation $v \leq p, \bar{p} \leq \tilde{v}$ captures that expectation of $\tilde{v}$ cannot be outside its domain, and $p < \bar{p}$ implies that the signal has some information content with respect to the firm’s cash flows.

While the manager and investors share common priors beliefs about $\tilde{p}$ at the beginning of the period, at the acquisition stage (date 1), the manager learns $\tilde{s}$ and thus has superior information about $\tilde{p}$. This is a distinct feature of the analysis here from the standard case in the literature. If the signal is acquired, at date 2 the manager learns the realization of $\tilde{p}$, and investors know it if the manager decides to disclose the signal.\footnote{There is no loss of generality by assuming that $\tilde{y}$ completely reveals $\tilde{v}$. Consequently, one can think of $\tilde{p}$ as $\tilde{v}$. We derive the analysis here in terms of $\tilde{p}$ because it allows us to use the model here, with different interpretation, in the next section.}

When disclosure does not occur, investors set $P_\phi$ to be equal to the expected value of $\tilde{v}$, conditional on no disclosure. Since by the law of iterated expectations $E[\tilde{p}|I] = E[E[\tilde{v}|y]|I] = E[\tilde{v}|I]$, where $I$ is some set of events, estimation of $\tilde{v}$ can be replaced by estimation of $\tilde{p}$. Accordingly, $P_\phi$ is equal to the market expectations for $\tilde{p}$ conditional on no disclosure. Since $P_\phi$ is based on prior information it can be perfectly conjectured at the beginning of the period.

The probability distribution function of $\tilde{b}$ is $h$, $h(b) > 0$ for all $\tilde{b} \in [b, \bar{b}]$, and its cumulative distribution function is $H$. It is assumed that $\tilde{b}$ is independent of the other variables in important in this model, because it assures that investors uncertain about whether the signal was obtained, and consequently, it allows for partial disclosure equilibrium. The assumption that investors correctly price it is nevertheless reasonable if, for example, the net benefit is reflected in earnings, but the aggregation of items in earnings does not allow investors to fully invert the net benefit.
the model. Let \( g, g(s) > 0 \) for all \( \bar{s} \in [s, \bar{s}] \) be the probability distribution function of \( \bar{s} \).

Because the results in the previous section suggest that reporting regime cannot be strictly optimal in the context of information that is useful internally or in the context of information that reduces information asymmetry in the capital market, the analysis in this section and in section 4 focuses on the two remaining regimes; mandatory disclosure (M) and discretionary disclosure (D). The price absent disclosure is denoted by \( P^M_\phi \) under mandatory regime, and by \( P^D_\phi \) under discretionary regime. Since when disclosure occurs the price is determined irrespectively of the regime in place, we will continue to denote the price conditional on disclosure by \( p \) under all regimes, without any superscript.

In this setting, disclosure per se has no social value. Disclosure strategy affects firm value only through its effect on the manager’s incentive to acquire information. The manager chooses an acquisition strategy and a disclosure strategy to maximize the sum of the net benefit, \( \tilde{b} \), and the price of the firm at date 2. From a social efficiency perspective (firm value maximization), it is optimal that the manager acquires information if and only if, \( \tilde{b} \geq 0 \).

In the following analysis, the equilibrium is determined. In this paper only pure strategies are considered. The equilibrium is determined by first determining the manager’s disclosure strategy. We then use the disclosure strategy to determine the manager’s acquisition strategy. Lastly, the manager’s disclosure and acquisition strategies are employed in order to calculate the firm’s price conditional on no disclosure \( P_\phi \). The analysis starts by solving for the equilibrium when disclosure is discretionary.

**Disclosure equilibrium under discretionary disclosure regime**

When disclosure is voluntary the manager chooses to disclose information that he possesses if and only if, \( p \geq P^D_\phi \). Otherwise, if \( p < P^D_\phi \), the manager conceals the information and the firm price is \( P^D_\phi \). Also, since \( P^D_\phi \) is the expectation for \( \tilde{p} \) when no disclosure occurs, \( P^D_\phi \in [p, \bar{p}] \). Therefore \( P^D_\phi \) is a threshold level of disclosure below which the manager conceals acquired signals. This lower tailed disclosure strategy is similar to the disclosure strategy in the standard case in the literature, where the information endowment of the manager is uncertain (e.g. Dye, 1985; Jung and Kwon, 1988).

**Acquisition equilibrium under discretionary disclosure regime**

Given the disclosure strategy of the manager, if he acquires the signal, the firm price at date 2 will be the higher of \( p \) and \( P^D_\phi \). Let \( DP(s) \) be the date 1 expectations of the manager for the firm price conditional on observing \( \tilde{s} = s \), given that he acquires the signal. Then \( DP(s) \equiv E [\max (\tilde{p}, P_\phi) | s] \). If the manager does not acquire the signal, the certain price is \( P^D_\phi \). Hence the manager acquires the signal if and only if,

\[ \text{It is assumed that if indifferent, the manager acquires and disclose the information. This assumption has no importance for the results.} \]
\[ DP(s) - P^D_\phi + b \geq 0. \] (3.1)

The term \( DP(s) - P_\phi \) represents a deviation from the (ex-ante) efficient acquisition level. When the deviation from the efficient acquisition rule is positive (negative), it is said that the manager over-invests (under-invests) in information acquisition. Because efficiency is determined in this setting solely by the level of acquisition of information, the optimal regime is the one that minimizes the expected deviation from the efficient level of acquisition.

\( DP(s) - P_\phi \) represents the value of acquiring the signal due to the option to disclose it (and favorably enhancing firm price). Because \( DP(s) - P^D_\phi \) represents an option its value is positive for every \( s \) (i.e., \( DP(s) - P^D_\phi \geq 0, \forall s \)).

In order to determine the price when no disclosure occurs, it is convenient to express the acquisition activity in terms of the probability of acquisition conditional on observing \( \tilde{s} = s \). Let \( \alpha(s) \) denote the ex-ante probability that a manager who observes \( \tilde{s} = s \) acquires information. The acquisition rule in (3.1) implies that the manager acquires information if and only if, \( \tilde{b} = b \) is greater than \( P^D_\phi - DP(s) \). Using the cdf of \( \tilde{b} \) we have

\[
\alpha^D(s) = \begin{cases} 
0, & P^D_\phi - DP(s) > \tilde{b} \\
1 - H[P^D_\phi - DP(s)] & P^D_\phi - DP(s) \in [b, \tilde{b}] \\
1, & P^D_\phi - DP(s) < b
\end{cases}
\] (3.2)

\( \alpha^D \), is an increasing function (because \( H \) and \( DP \) are increasing). Therefore, as the manager’s private information about \( \tilde{p} \) (i.e., \( \tilde{s} \)) is more favorable, the manager is more likely to acquire information.

Using the characterization of the manager’s acquisition strategy, it is possible to determine \( P^D_\phi \). Given that disclosure does not occur, investors know that either the manager did not acquire information, or he acquired information but the information was unfavorable (lower than \( P^D_\phi \)). Conditional on the manager not acquiring information, investors’ expectation for \( \tilde{p} \) is given by

\[
E[\tilde{p} | \{s, b\} \notin A^D] = \frac{\int_s E[\tilde{p} | s] (1 - \alpha^D(s)) g(s) ds}{\int_s (1 - \alpha^D(s)) g(s) ds},
\]

and conditional on the manager acquiring information but not disclosing it, investors’ ex-
Expectation for $\tilde{p}$ is given by

$$E[\tilde{p} | A^K, \tilde{p} < P^K] = \frac{\int F(P^K | s) E[\tilde{p} | s, p < P^K] \alpha^K (s) g(s) \, ds}{\int s F(P^K | s) \alpha^K (s) g(s) \, ds},$$

where the set $A^K$:

$$A^K = \{ \{ s, b \} : DP (s) - P^K + b \geq 0 \}$$

represents all $\{ s, b \}$ under which the manager acquires information when disclosure is voluntary. Taken together

$$P^K = \frac{\int s E[\tilde{p} | s] (1 - \alpha^K (s)) g(s) \, ds + \int s F(P^K | s) E[\tilde{p} | s, p < P^K] \alpha^K (s) g(s) \, ds}{\int s (1 - \alpha^K (s)) g(s) \, ds + \int s F(P^K | s) \alpha^K (s) g(s) \, ds},$$

In equilibrium (3.2) and (3.3) hold simultaneously. Equilibrium exists (although not necessarily unique) because $\alpha^K$ is continuous, and for every choice of $P^K$ in (3.2) the RHS of (3.3) is in the range $[p, \tilde{p}]$. Therefore, starting by setting $P^K = p$ in the LHS of (3.3) and increasing it up to $P^K = \tilde{p}$, there must be some $P^K \in [p, \tilde{p}]$ such that (3.2) and (3.3) hold simultaneously.

Next, the equilibrium under a mandatory disclosure regime is characterized.

Equilibrium under mandatory disclosure regime

Since the manager here adopts full disclosure strategy, his expected proceeds if he acquires the signal are $E[\tilde{p} | s] + b$. If instead he chooses not to acquire the information, his certain proceed is $P^K$. Therefore for every $\{ s, b \}$ the manager acquires information if and only if,

$$E[\tilde{p} | s] > P^K + b \geq 0.$$  

The term $E[\tilde{p} | s] - P^K$ represents a deviation from the (ex-ante) efficient acquisition level. When $\tilde{s}$ is informative, in contrast to when disclosure is voluntary, the deviation here can be both positive (when $s$ is high) or negative (when $s$ is low).

Noting that (3.4) implies that the manager acquires information if and only if $\tilde{b} = b$ is greater than $P^{MD} - E[\tilde{p} | s]$, and using the cdf of $\tilde{b}$ one gets

$$\alpha^K (s) = \begin{cases} 
0, & P^K - E[\tilde{p} | s] > \tilde{b} \\
1 - H[P^K - E[\tilde{p} | s]], & P^K - E[\tilde{p} | s] \in [b, \tilde{b}] \\
1, & P^K - E[\tilde{p} | s] < b 
\end{cases}.$$
increasing), therefore, as the manager’s private information about $\tilde{p}$ is more favorable, the manager is more likely to acquire information. An implication of this observation is that absent disclosure entails unfavorable news regarding $\tilde{p}$.

Investors’ expectation for $\tilde{p}$ conditional on the manager not acquiring the signal is

$$P^M_{\phi} = E[\tilde{p} \mid \{s, b\} \notin A^M], \quad (3.6)$$

where the set $A^M$:

$$A^M = \{\{s, b\} : E[\tilde{p} \mid s] - P^M_{\phi} + b \geq 0\}$$

represents all $\{s, b\}$ under which the manager acquires information when disclosure is mandatory.

Using the definition of $\alpha^M$ it follows that

$$P^M_{\phi} = \frac{\int s E[\tilde{p} \mid s] (1 - \alpha^M(s)) g(s) ds}{\int s (1 - \alpha^M(s)) g(s) ds}. \quad (3.7)$$

In contrast, in the standard case in the literature (e.g. Shavell, 1994, Pae, 1999) the manager has no private information about $\tilde{p}$ at the acquisition stage (i.e. $\tilde{s}$ is pure noise) and $P^M_{\phi}$ is equal to the prior expectation of $\tilde{p}$, $E[\tilde{p}]$.

In equilibrium (3.5) and (3.7) hold simultaneously. As under discretionary disclosure regime, equilibrium exists in this case (although not necessarily unique).\(^{13}\)

### 3.1 The case where is $\tilde{s}$ pure noise (benchmark)

The following analysis replicates the results in the literature (Shavell, 1994) as a benchmark case.

**Proposition 2.** Suppose that $\tilde{s}$ is not informative about $\tilde{p}$ then:

1. **Assuming that $b < 0$ on a non-zero measure probability, so that acquisition of information may be a social waste, the manager acquires too much information when disclosure is voluntary.**

2. **When disclosure is mandatory the manager acquires information if and only if it is ex-ante efficient to do so.**\(^{14}\)

\(^{13}\)This can be demonstrated by noting that $\alpha^M$ and $P^M_{\phi}$ are continuous and for every choice of $P^M_{\phi}$ in (3.5) the RHS of (3.7) is in the range $[v, \bar{v}]$. Therefore, starting by setting $P^M_{\phi} = v$ in the LHS of (3.7) and increasing it up to $P^M_{\phi} = \bar{v}$, there must be some $P^M_{\phi} \in [v, \bar{v}]$ such that (3.5) and (3.7) hold.

\(^{14}\)Proposition 2 is somewhat different than the result in Shavell (1994) in that Shavell’s result employs
The intuition for Proposition 2 is that when disclosure is voluntary the manager over-invests in information because of the option to disclose it if it turns out to be favorable (above \( P^D_\phi \)), and consequently enhance the firm’s market price. In contrast, when disclosure is mandatory, and the manager has no superior information about \( \tilde{p} \), acquisition of information has no effect on expected price, because the manager must disclose acquired information irrespectively to its content, and in expectations the potential positive effect of information on firm price (when \( \tilde{p} > P^M_\phi \)) is equal to the potential negative effect on price (when \( \tilde{p} < P^M_\phi \)). Thus, when disclosure is mandatory the manager has no incentive (or disincentive) to acquire information for the sake of influencing firm price. Clearly, this argument lies heavily on the assumption that at the acquisition stage the manager has no private information about how acquisition will affect firm price. As shown next, in the more general case, these results do not hold.

### 3.2 The general case where \( \tilde{s} \) may contain information about \( \tilde{p} \)

When the manager has private information about \( \tilde{p} \) at the acquisition stage, he can better strategize his acquisition activity in order to enhance the ex-post firm price. While it is still the case that when disclosure is voluntary the manager over-invests in information because of the option to conceal unfavorable realizations, when disclosure is mandatory it is no longer the case that the manager’s incentive to acquire information is not affected by his consideration for firm price. In particular, when the manager’s expectations about \( \tilde{p} \) at the acquisition stage are higher (lower) than that of investors, the manager acquires too much (too little) information. This is because, knowing that any acquired information is disclosed, he would have over-incentive (under-incentive) to acquire the information if he has favorable (unfavorable) assessment of it. Hence, in contrast to the case where the manager does not have private information, here mandatory disclosure does not lead to efficient acquisition activity. In fact, without further analysis, it is unclear whether imposition of mandatory disclosure regulations can ever be optimal when the manager’s superior information about \( \tilde{p} \) is sufficiently accurate. To demonstrate this, consider the case where \( \tilde{s} \) perfectly reveals \( \tilde{p} \) (that is, \( s = \tilde{p} \)). It is next shown that imposition of mandatory disclosure requirement cannot strictly improve the firm value unless \( P^M_\phi > P^D_\phi \). When \( s = p \) then \( E[\tilde{p}|s] = p \), and

\[
DP(s) = \begin{cases} 
P^D_\phi, & p \leq P^D_\phi \\
 p, & p > P^D_\phi 
\end{cases}
\]

Employing this on the acquisitions rules (3.4) and (3.1), it is

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A specific benefit function, where the benefit is realized only if the information is disclosed. In contrast, here it is assumed that acquisition of information is sufficient for the firm to realize the real benefit from information.
evident that when disclosure is mandatory the manager acquires information if and only if,

\[ p - P^M_\phi + b \geq 0 \]  

(3.8)

and that when disclosure is voluntary he acquires information if and only if,

\[
\begin{cases}
    b \geq 0, & p \leq P^D_\phi \\
    p - P^D_\phi + b \geq 0, & p > P^D_\phi
\end{cases}
\]  

(3.9)

Comparison of (3.8) and (3.9) reveals why it is not clear whether imposition of mandatory requirement can strictly improve firm value. In particular, when disclosure is mandatory the manager always biases the socially optimal acquisition rule (acquire if and only if, \( b \geq 0 \)) by \( p - P^M_\phi \). When disclosure is voluntary, in contrast, while the manager biases the socially optimal acquisition rule by \( p - P^D_\phi \) if he observes favorable realizations (\( p > P^D_\phi \)), he uses the socially optimal acquisition rule when he observes low realizations (\( p < P^D_\phi \)). Therefore, a necessary condition (but not sufficient) for imposition of disclosure requirement to strictly improve firm value is that the commitment to disclose the signal lowers the manager’s tendency to acquire too much information when he has a favorable assessment of \( \tilde{p} \). From (3.8) and (3.9), this will happen if and only if, \( P^M_\phi > P^D_\phi \).

The fact that the manager possesses private information, and condition the acquisition activity on it, makes it hard to determine the relative magnitude of the prices when no disclosure occurs across the two regimes. While the fact that under voluntary disclosure regime the manager conceals unfavorable information works for \( P^M_\phi > P^D_\phi \), the fact that under mandatory regime the manager is less likely to acquire information if he has an unfavorable assessment of it, works against \( P^M_\phi > P^D_\phi \). However, as the next Lemma establishes for the general case, where the information content of \( \tilde{s} \) is not restricted to be perfect, the first effect dominates the second.

**Lemma.** \( P^M_\phi \geq P^D_\phi \).

The following proposition is a straightforward implication of the lemma.

**Proposition 3.** \( DP(s) - P^D_\phi \geq E[\tilde{p}|s] - P^M_\phi, \forall s \).

Proposition 3 establishes that for every \( s \), the manager acquires more information when disclosure is voluntary than when it is mandatory. This opens the possibility for mandating disclosure to be efficient even when \( \tilde{s} \) is very informative about \( \tilde{p} \), because it indicates that mandating disclosure reduces the managers over-investment in information. However, when \( \tilde{s} \) is informative about \( \tilde{p} \) it is possible that \( E[\tilde{p}|s] - P^M_\phi < 0 \) for some values of \( s \), and
consequently under mandatory disclosure regime the manager may abstain from acquiring valuable information when he has unfavorable assessment of $\tilde{p}$. Whether mandating disclosure enhances firm value or not, is generally determined by the relative magnitudes of these two effects.

The example in Figure 3.2 depicts a case where $\tilde{s}$ contains perfect information about $\tilde{p}$ and net benefit is distributed uniformly over the interval $[-1.25, 1.25]$.

The graphs represent the magnitudes of the over- or under-investment of the manager in information under mandatory regime (red/lower line) and under voluntary regime (blue/upper line). For $p$ values such that the graph is in the positive (negative) quadrant the manager over-invests (under-invests). For example, for $p = 0.6$, there is over-investment under both regimes. In this case, if disclosure is voluntary (mandatory) the manager acquires information when $b \geq -0.24$ ($b \geq -0.17$). The blue line (voluntary disclosure) is never negative, while the red line (mandatory disclosure) is negative for realizations below $P^M_\phi$, and positive for realizations above it. Consistent with the lemma and Proposition 3, $P^M_\phi > P^D_\phi$, and the manager has more motivation to acquire information when disclosure is voluntary (i.e. the blue line lies above the red line).

Figure 3.2: Over- and under- investment in information as a function of $p$, under discretionary disclosure regime and under mandatory disclosure regime. $s = p$, $p \sim U(0, 1)$, $b \sim U(-1.25, +1.25)$.
Whether mandating disclosure is optimal is determined by the expectation for the costs and benefits that falls between the red line and the blue line. When the expectation of the net costs ($\tilde{b} < 0$) that fall between the red line and the blue line in the positive quadrant (the area that is marked by “+”) are greater than the expectation of the net benefits that fall between the red line and the blue line in the negative quadrant (the area that is marked by “-”), then the over-investment of information when disclosure is voluntary is more costly than the under-investment in information when disclosure is mandatory. Consequently, mandating disclosure is optimal. When the reverse is true, allowing the manager discretion is optimal. This implies that, ceteris paribus, the efficiency of mandating disclosure is determined by the distribution of the real benefit $\tilde{b}$ of acquiring the information.\footnote{It should be noted that the distribution of net benefit not only determines the expected costs/benefits that fall into a certain area in the graph, but also the magnitude of the areas. This is because $P_\phi$ is a function of the probability of acquisition, which is a function of the distribution of $\tilde{b}$.}

It can be shown that when it is known that information is social waste (i.e. $\tilde{b} \leq 0$), or when it is known that information is socially beneficial (i.e. $\tilde{b} \geq 0$), imposing a disclosure requirement is optimal no matter how much private information the manager has. While this is not surprising when it is known that $\tilde{b} \leq 0$, this is somewhat surprising when it is known that $\tilde{b} \geq 0$. The reason for this result is that when $\tilde{b} \geq 0$, a force, similar to the force that leads to the unraveling result, causes firms to always acquire the information, even when disclosure is required and the firms have unfavorable assessment about the impact of the information on their market prices.

In sum, the analysis here shows that when there is uncertainty about the real value of the information to firms and at the acquisition stage managers have private information about how the information reflects on the value of the firm, the optimality of mandating disclosure depends on the distribution of the real benefits from the information. This suggests that it is not likely that the main purpose of disclosure regulations is to induce higher efficiency in firms’ real activities. Instead, the effect of disclosure regulations on real decisions may be a (possibly undesired) by-product, while the main purpose lies elsewhere. We next explore the extent to which disclosure regulations are efficient, in a robust way, in reducing the cost of the information asymmetry between the firm and the capital market.

4 Mandating Disclosure of Information that Reduces the Information Asymmetry in the Capital Markets

This section analyzes the role of regulation in a pure exchange economy where information is valuable in reducing the liquidity premium that arises due to the asymmetry of information.
between the manager and investors. We will make use of the model in the previous section, with slight changes, and provide a different interpretation to the model.

Figure 4.1: Timeline for Section 4

At date 1 the manager learns the firms’ cash flows, but the only way for him to credibly communicate it to investors is by producing a noisy accounting signal $\tilde{y}$ about the firms’ cash flows. In contrast to the previous section, the signal here has value in reducing asymmetry of information but has no productive value. We maintain the assumption that the signal is costly to collect and thus replace $\tilde{b}$, from the previous section, with $\tilde{c}$ to represent the stochastic cost of producing the signal. Specifically, it is assumed that before deciding whether to acquire the signal the manager privately observes the set $\{v, s, c\}$. Under the interpretation in this section, $\tilde{s}$ represents the manager superior information about the realization of $\tilde{y}$, through his knowledge of $\tilde{v}$ and, possibly, more information that he observes about $\tilde{y}$ before deciding whether to acquire the signal. As before $p = E[\tilde{v} | y]$.

It is assumed that while the manager is interested in selling the firm (e.g. in order to release his capital), he is willing to do so only if the market price of the firm is not too low. In particular, at the end of the period the manager can liquidate the firm and receive $v - k$, where $k > 0$, and thus he sells the firm in the market if and only if the market price is $v - k$ or higher. This motivation for the cost of asymmetry of information is in the spirit of Meyers and Mujluf (1984). Alternative interpretation for the model is that $k$ represents the cost of locking up the manager’s capital for a certain period before he can unlock it, or that $k$ represents a positive net present value that the firm forgoes when raising capital in the market is too expensive (Meyers and Mujluf, 1984).

Rational investors, realizing that trade would not occur unless the price is high enough, price protect themselves so that, given that trade occurs, the price is equal to the expected
cash flows. This means that, from an ex-ante perspective, the total proceeds generated from the firm is $E[\tilde{v}]$ if trades occur, and $E[\tilde{v}] - k$ if trade does not occur. Therefore the ex-ante cost of asymmetry of information is $k$ multiplied by the probability that trade does not occur. The accounting system can reduce this cost by credibly communicating to investors the real value of the firm, and by that increasing the probability that efficient trade occurs. It is assumed that the signal $\tilde{y}$ is accurate enough such that given disclosure of it, trade occurs. This means that for every firm type $v$, $E[\tilde{v} | y] \geq v - k$ for all $y$ values that are possible for that firm. Firm value here is equal to the ex-ante expected proceeds (the higher of market price and $v - k$) less the cost expanded in producing the accounting signal.

Previous research show that commitment to higher disclosure level is beneficial in reducing asymmetry of information problems (e.g. Mahoney, 1995; Rock, 2002, Guay and Verrecchia, 2007; Göx and Wagenhofer, 2009), however, it is not clear whether regulation (and what kind of regulation) is welfare-enhancing in this context. The reason is that regulation does not affect only the disclosure strategy of the manager but also his information acquisition activity. As was shown before, reporting requirement of $\tilde{y}$ cannot enhance welfare in this context because this imposes collection of information that might be too costly. The question we ask here is whether mandating disclosure in this case is optimal despite the discouraging effect that this regulation has on the manager’s incentive to collect information.

In this context, it is useful to distinguish between high value firms, such that $v > P_\phi + k$, which prefer liquidating over trading at $P_\phi$, and low value firm, such that $v - k \leq P_\phi$, which prefer trading at $P_\phi$ over liquidating.

For low value firms trade always occurs in the capital market. In addition, the market sets $P_\phi$ as the expected value of low value firms because only these firms trade at $P_\phi$. For low value firms the analysis in the previous section applies without any change (except, of course, that $\tilde{b}$ is now restricted to represent net cost). It follows that $P_\phi^M \geq P_\phi^D$ (Lemma), and that low value firms produce more accounting information when disclosure is voluntary than when disclosure is mandatory (Proposition 3). Production of accounting information for low value firms is a social waste because for these firms trade would occur even without disclosure of information to the capital market.

In contrast, for high value firms the price absent disclosure $P_\phi$ reflects too high of mispricing, and consequently, trade occurs if and only if the firm produces accounting signal. If a high value firm produces an accounting signal it will disclose it with certainty in order to avoid the mispricing. Since, for these firms full disclosure occur whether disclosure is mandatory or voluntary, the acquisition strategy of high value firms is the same whether disclosure is mandatory or voluntary. Specifically, under both regimes high value firms acquire
information if and only if

\[ E[\hat{p}|s] - (v - k) - c \geq 0 \] (4.1)

where \( E[\hat{p}|s] \) is the expected price if the firm acquires information, and \( v - k \) is the proceeds if the firm does not acquire the accounting signal.

Now, let \( \alpha(v) \) denote the ex-ante probability that (4.1) holds for a firm of type \( v \), conditional on the firm being a high value firm (i.e. \( v > P_\phi + k \)), and zero otherwise; and let \( j \) denotes the pdf of \( v \). The ex-ante cost of asymmetry of information, denoted by \( L \), can be expressed as follows:

\[
L^i = k \int_{P_\phi + k}^{\hat{v}} [1 - \hat{\alpha}(v)] j(v) \, dv. \quad \forall i = M, D
\] (4.2)

The ex-ante cost of asymmetry of information is a multiplication of \( k \) by the ex-ante probability that a firm becomes of high value and would not produce an accounting signal. BIn particular, at the end of the period the manager can liquidate the firm and receive because, as discussed earlier, \( P_M^\phi \geq P_D^\phi \), then \( L_D \geq L_M \). The intuition is that, as the price when no disclosure occurs \( P_\phi \) is lower, it is less likely that efficient trade occurs because less firms are willing to execute a trade at that price.

Therefore, when disclosure is mandatory, trade occurs with higher probability, and moreover, firms for which trade occurs even without collection of information (low value firms) produce less accounting information. As a result, imposing requirement to disclose information enhance firm value. The following proposition summarizes this result.

**Proposition 4.** It is efficient to mandate disclosure of information that reduces the costliness of the information asymmetry between firms and the market capital, despite the fact that the manager has less incentive to collect information when disclosure of it is required. This is true no matter how much private knowledge the manager has, at the acquisition stage, about how disclosure of the information is going to affect the market price of the firm.

The reason that mandating disclosure is efficient, despite the disincentive to collect information, is that when disclosure is voluntary higher level of information collection exacerbates the asymmetry of information in the market. This is because the manager can be more strategic when he possesses information than when he does not. An implication of this is that mandating disclosure is optimal even when the cost of collecting the information is low enough, so that under voluntary disclosure firms acquire information with probability one and adopt full disclosure strategy (the unraveling result).\(^{16}\)

\(^{16}\)The following demonstrates this. Suppose that the cost of acquisition is low, so that \( 0 < \bar{c} \leq \)
This result suggests that a potential purpose of imposition of disclosure regulations is the asymmetry of information in the capital markets.\footnote{17}

We next move to explore the role of disclosure regulations and reporting requirement in the context of performance information.

5 The Disciplinary Role of Disclosure Regulations and Reporting Requirements

Consider a reduced form of the model in section 3 where the cash flows of the firm is endogenously determined by the investment \( a \) that the manager makes. Specifically,

\[
\tilde{v} = ma + \tilde{\theta}.
\]

The profitability parameter \( m, m > 0 \) is common knowledge. The investment \( a \) is not observed by investors, and the noise term \( \tilde{\theta} \) is a random variable that is uniformly distributed around zero. That is, \( \tilde{\theta} \sim U(-\Delta, +\Delta) \), where \( \Delta > 0 \). At a cost \( \tilde{c}, \tilde{c} \in \{c, \bar{c}\} \), \( 0 < c < \bar{c} \) the manager can obtain a verifiable signal that reveals \( \tilde{v} \). \( \tilde{c} = c \) occurs with probability \( \beta \), and \( \tilde{c} = \bar{c} \) occurs with the complementary probability, where \( \beta \in (0, 1) \). The cost for the manager of investing \( a \) is \( \frac{1}{2}qa^2 \), where \( q, q > 0 \) is common knowledge. The cost of investment and the cost of collecting the information are privately borne by the manager. It is assumed that the manager has no private information about \( \tilde{\theta} \) before observing the signal. We discuss in the analysis how the results change when the manager has perfect information about \( \tilde{\theta} \) at the acquisition stage. We start by solving for the first best case where the investment \( a \) is publically observed. In this case verifiable information about \( \tilde{v} \) has no value, and the signal is not acquired. The manager chooses \( a \) to solve

\[
\max_a E[\tilde{v}|a] - \frac{1}{2}qa^2, \quad (5.1)
\]

where \( E[\tilde{v}|a] = ma \). The solution is

\( E[\max(E[\tilde{v}|y], \bar{v})|s] = \bar{v} \), \( \forall s \), then under discretionary regime all firms in the interval \([\bar{v}, \bar{v} + k]\) acquires information with probability one, and disclose it. Consequently, by the unraveling result, investors set \( P^D_\phi = \bar{v} \). The range of firm at risk of no trade (incurring cost of \( k \)) without information, \([\bar{v} + k, \bar{v}]\), is the largest possible. Under mandatory regime this range will be smaller since \( P^M_\phi \geq P^D_\phi \) and firms in the range \([\bar{v}, P^M_\phi + k]\) acquire less information. Thus, although we get full disclosure under discretionary regime, mandatory regime is optimal because when disclosure is required more trade occurs and less accounting information is produced.

\footnote{17}If the manager has perfect information about \( \tilde{p} \) at the acquisition stage, he shifts all his strategic behavior from the disclosure stage to the acquisition stage, and mandating disclosure cannot affect his behavior. Consequently, in this extreme case, mandating disclosure is efficient only in the weak sense.
\[ a^{FB} = \frac{m}{q}, \]

where the superscript \( FB \) signifies first best. The value of the firm (net of costs of investment) is

\[ \pi^{FB} = \frac{m^2}{2q}. \]

In the second best case, where the investment is unobserved by investors, this outcome is not feasible. If the regulator imposes reporting requirement of the signal \( \tilde{v} \), then the manager chooses the first best investment level (because he chooses \( a \) to solve (5.1)); however welfare is reduced by the expected cost of acquiring the signal, \( E[\tilde{c}] = \beta\bar{c} + (1 - \beta)\bar{c} \). It is assumed that under reporting regime the value of the firm is positive. That is, that

\[ \frac{m^2}{2q} - E[\tilde{c}] > 0. \]  \hspace{1cm} (5.2)

It is also assumed that \( \bar{c} \) is low enough so that in the limit case where \( \beta \to 1 \), it is optimal that the manager acquires the signal with probability one. Since \( \bar{c} \) is bounded from below by \( \underline{c} \), this assumption allows for the possibility that when \( \bar{c} \) is low enough (e.g., when \( \bar{c} \to \underline{c} \)), it is desirable that the manager collects the information with probability one.

The condition in (5.2) imposes an upper bound on \( \bar{c} \)

\[ \bar{c} < \frac{m^2}{2q} - \beta\underline{c} \]

\hspace{1cm} (5.3)

The focus of the analysis in this section is in comparison of reporting regime to discretionary regime and mandatory regime, where in the latter two regimes the equilibrium is such that there is partial collection of information (i.e., the manager acquires information only when \( c = \underline{c} \)). This is because in other cases the analysis is trivial and reporting regime is always optimal (at least in a weak sense).\(^\text{18}\) In addition, since it is clear that reporting regime cannot be optimal if \( \bar{c} \) is too high, and is weakly optimal if \( \bar{c} \) is low enough, we will be focused on understanding when there is a range of \( \bar{c} \) under which reporting regime strictly enhances firm value. Lastly, consistent with the approach taken in previous sections, we are interested in examining the extent to which the efficiency of regulations is sensitive to assumptions.

\(^{18}\)If no equilibrium exists under discretionary regime, or the equilibrium is such that the manager never acquires information (and consequently chooses \( a = 0 \)), reporting requirement strictly enhance firm value (by (5.2)). If the equilibrium is such that the manager always acquires information, and by the unraveling result discloses it, requiring firms to report the information does not change anything. A similar argument holds when comparing reporting regime to mandatory regime.
about the private information that the manager possesses at the acquisition stage. It can be shown that when the manager knows \( \tilde{\theta} \) at the acquisition stage, reporting regime is strictly optimal as long as \( \tilde{\tau} \) is not too high. The reason is that if the manager observes low \( \tilde{\theta} \) he prefers not to acquire the information even if \( c = c_\ast \). Therefore, when the accounting is not too costly, it is optimal to impose reporting requirement. Justifying reporting requirement is more challenging when the manager has no private information, because he is then less strategic at the acquisition stage. We next investigate this case.

The need for regulation in this setting arises because after the investment is made, the manager does not consider the disciplinary benefit of the information in his acquisition and disclosure decisions. However, if the investment decision is made after the acquisition stage, the manager internalizes the disciplinary benefit in his acquisition decision. Consider this case first. In this case it is optimal to mandate disclosure. Given the obligation to disclose information, if the manager decides to acquire the information, anticipating full disclosure he will choose the first best investment and receive \( m^2/2q \) less the acquisition costs. If, instead, the manager decides not to acquire information, he will choose \( a = 0 \). Investors realize that no disclosure implies \( a = 0 \) and set the firm price to be zero. Consequently the manager will acquire the information if and only if \( m^2/2q - \tilde{c} \geq 0 \). Therefore, under mandatory regime the firm value is

\[
\beta \max\left( \frac{m^2}{2q} - \tilde{c}, 0 \right) + (1 - \beta) \max\left( \frac{m^2}{2q} - \tau, 0 \right).
\]

The firm value under mandatory regime is the highest possible under the constraint that the manager needs to be motivated to make efficient investment. This is possible because at the acquisition stage the manager fully internalize the cost and benefit of information, and at the disclosure stage he is required to make full disclosure. Regulating the manager’s acquisition activity is inefficient in this case. This can be seen by comparing the firm value under mandatory regime with the LHS of (5.2).\textsuperscript{19} Moreover, allowing the manager discretion over disclosure is not efficient, because then the manager will choose less than full disclosure, which is not optimal ex-ante (because the disciplinary role of information is maximized when full disclosure occurs). However, as was discussed earlier, the optimality of mandating disclosure is sensitive to the assumption that the manager has no private information about \( \tilde{\theta} \). We conclude that when the investment is made after the acquisition stage the efficiency of reporting regime and of mandatory regime is not robust.

Suppose instead that the investment decision is made prior to the acquisition decision (and the manager has no private information about \( \tilde{\theta} \) at the acquisition stage). In this case

\textsuperscript{19}If \( \tilde{c} > m^2/2q \), mandating regime strictly dominates reporting regime.
mandating disclosure cannot be optimal because it leads to no acquisition of information. The reason is that at the acquisition stage the investment decision is already made, therefore, given that on average the signal’s realization is equal to investors’ expectations, the manager has no incentive to acquire the signal. Here, despite the fact that full disclosure is optimal, mandating disclosure is not efficient because of the disincentive to collect the signal. In contrast, if disclosure is voluntary, the manager has incentive to collect the signal due to the option to enhance the firm price. We employ the results from section 3 in order to solve for the equilibrium when disclosure is voluntary and the investment decision is made prior to the acquisition stage. Specifically, given certain investment level, the equilibrium under voluntary disclosure is a special case of the equilibrium in section 3. The equilibrium is derived in three steps. First, using (3.3) the threshold disclosure is determined for a conjectured level of investment $\hat{a}$ in equilibrium. Second, given the disclosure threshold and the conjectured investment level, the investment level $a$ is determined to maximize the net proceeds for the manager. Third, using the equilibrium condition $a = \hat{a}$, the equilibrium investment level is characterized in terms of the other variables in the model. We provide a detailed description of these steps in the appendix, and summarize the results below. The second order condition for assuring interior solution for the investment level is $\Delta > \frac{m^2 \beta}{2q}$. It is assumed that this condition holds. In equilibrium, the investment level is given by

$$a^D = \frac{m}{q} (1 - \sqrt{1 - \beta}),$$

and firm value (net of costs of investment and cost of acquisition of information) is given by $\pi^D = \beta (\frac{m^2}{2q} - c)$.

As can be expected, the investment level under voluntary regime is lower than the first best investment. Comparison of firm value (net of all costs) under reporting regime and under voluntary disclosure regime yields $\pi^R - \pi^D = (1 - \beta) (\frac{m^2}{2q} - c)$.

Therefore, assuming that under voluntary regime the manager acquires information only when $c = c$, firm value under reporting regime is higher than under voluntary regime if and only if

$$c < \frac{m^2}{2q}.$$  \hspace{1cm} (5.4)

We now turn to show that there is a range of $c$ such that (5.4) holds and under voluntary regime the manager acquires information only when the cost of acquisition is low. To

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\textsuperscript{20}In fact this condition not only guarantees an interior solution, but also assures that equilibrium exists. When $\Delta$ is small an equilibrium may not exist. This can be seen by considering the case where $\Delta = 0$. In this case investors have no uncertainty about $\tilde{v}$ in equilibrium (if such exists), and therefore they set the price to be equal to $ma$, whether disclosure (that confirms their conjecture) occurs or not. Since, absent disclosure does not affect negatively the price, the manager is better off not acquiring information and hence he chooses $a = 0$. However, if investors conjecture $\hat{a} = 0$ the manager is better off increasing the firm value above zero by choosing the first best investment and acquiring information with probability one. By the assumption (5.2) this yields a positive firm value (net proceeds for the manager). Therefore, equilibrium does not exist in this case.
show this it is necessary to show that the value of the option to disclose the information, \( E \left[ \max \left( \tilde{p}, P^D \phi \right) \right] - P^D \phi \), is lower than \( m^2/2q \), so that if \( E \left[ \max \left( \tilde{p}, P^D \phi \right) \right] - P^D \phi < \bar{c} < m^2/2q \) the manager does not acquire the information when \( c = \bar{c} \), despite the fact that such acquisition is efficient. Using the fact that \( \bar{p} = \bar{v} \), together with the assumed distribution of \( \tilde{v} \), and the solution for \( P^D \phi \), which is given in the appendix, we have

\[
E \left[ \max \left( \tilde{p}, P^D \phi \right) \right] - P^D \phi = P^D \phi \int_{p^D}^{\bar{v}} f(p|a)dv + \int_{p^D}^{\bar{v}} pf(p|a)dv - P^D \phi = \Delta \left( \frac{1 - \sqrt{1 - \beta}}{\beta^2} \right). \tag{5.5}
\]

When disclosure is voluntary, the signal is an option to make disclosure. Therefore the value of the signal is increasing in \( \Delta \), which is a measure of the signal’s volatility. The value of acquiring the signal is also increasing in the probability of acquisition \( \beta \), because the alternative of not acquiring the signal is less attractive when \( \beta \) is high. This is because when \( \beta \) is high investors assess that no disclosure is more likely to be a result of the manager concealing unfavorable information, and consequently set the price when no disclosure occur to be lower.

The next proposition summarizes the results

**Proposition 5.** For parameter values such that \( \frac{m^2}{2q} - \Delta \left( \frac{1 - \sqrt{1 - \beta}}{\beta^2} \right)^2 > 0 \), there exist a range of \( \bar{c} \) such that requiring firms to report \( \tilde{v} \) strictly improves their values.

In the proof for the proposition it is shown that there are parameter values such that

\[
\frac{m^2}{2q} - \Delta \left( \frac{1 - \sqrt{1 - \beta}}{\beta^2} \right)^2 > 0 \tag{5.6}
\]

under the restriction that the second order condition imposes.

We interpret \( m^2/2q \) as a measure for the firm’s productivity, and conclude that all else equal, requiring the firm to report their output is more likely to be efficient the higher their productivity is.\(^{21}\)

In sum, the analysis in this section shows that when the investment decision is \underline{made after} the firm sets the information acquisition level, the contribution of mandating disclosure or requiring reporting to firm value is sensitive to what information the manager observes at the acquisition stage. In contrast, when the investment is made \underline{prior} to the acquisition stage, if the firm productivity is high enough it is optimal to impose reporting requirement as long as the cost of collecting information is not too high. This

\(^{21}\)In particular, the characteristics of the information system \( \{\beta, \Delta\} \) are held constant.
is true irrespectively of whether the manager knows how the disclosure of the information affects the market price for the firm.

6 Concluding Remark

This paper investigates the unique role of each of two regulatory tools, disclosure regulations and reporting requirements, in enhancing the ex-ante value of the disclosing firm. The results suggest that an important determinant of what regulation, if at all, is beneficial for firms is the nature of the information that is subject to regulation. When the sole purpose of the obtaining the information is to allow the capital market to make more accurate assessment of the firm’s future cash flows, requiring firms to make full disclosure is efficient. However, when the information has real effect on the firm’s cash flows, the analysis points out that the efficiency of mandating disclosure is crucially depends on whether the manager has superior knowledge of the price effect of disclosure. In contrast, requiring a firm to report information for the sole reduction in asymmetry of information in the market is not efficient, while it is potentially welfare enhancing if reporting the information disciplines the firm’s investment decision made prior to when the firm sets the level of information acquisition. This is consistent with the observation that a main source of obligation to provide periodic financial reports is IPO’s, where firms commit to provide future reports on the performance of their uses of the capital raised. The empirical implications are straightforward. The analysis suggests that disclosure regulations are more likely to be imposed on information that is value relevant but has no operational value, while reporting requirement are more likely to be imposed in the context of information about the ex-post performance of the firm. Of course, the performance information has a disciplinary value only to the extent investors’ use it to value the firm. This suggests that, while not the main purpose, reported information can reduce the firm’s cost of capital (e.g. Botosan and Plumlee, 2002).

The analysis in this paper is conducted in the context of an isolated firm, in an economy where investors break even. This setting abstracts from economy wide benefits of disclosure. For example, firm’s disclosure can be informative about the financial situation of other firms (e.g., Dye 1990; Easterbrook and Fischel, 1991; Admati and Pfleiderer, 2000). In addition, Lambert, Leuz and Verrecchia (2007) show that in a CAPM economy disclosure can affect the firm’s cost of capital through the effect of disclosure on the firm’s real decision. This may suggest that in a CAPM economy, reporting requirements can be an efficient way for reducing firm’s cost of capital. Examination of this issue is left for future research.
Appendix

Proof. Proposition 2

Part 1:
When \( \tilde{s} \) is pure noise, (3.3) becomes

\[
P^D_\phi = \frac{(1 - \alpha^D) E[\tilde{p}] + \alpha^D \int_{v<t} v f(v) dv}{(1 - \alpha^D) + \alpha^D \int_{v<t} f(v) dv}.
\] (6.1)

This is the standard case in the literature (e.g. Jung and Kwon, 1988), and it is a standard exercise to show that \( P^D_\phi \leq E[\tilde{p}] \). The manager’s acquisition rule in (3.1) becomes

\[
E[\max(\tilde{p}, P^D_\phi)] - P^D_\phi + b \geq 0.
\] (6.2)

Now, \( E[\max(\tilde{p}, P^D_\phi)] - P^D_\phi > 0 \) (because \( \tilde{p} > E[\tilde{p}] \) on a positive probability measure), and therefore the manager over-invests in information. In addition, (6.2) holds for negative values of \( \tilde{b} \) that are close enough to zero. Hence, with positive probability the manager acquires information that has net cost.

Part 2:
When \( \tilde{s} \) is pure noise, \( E[\tilde{p} | s] = E[\tilde{p}] \), and consequently \( P^M_\phi = E[\tilde{p}] \int s \frac{(1-\alpha^M(s))g(s)}{(1-\alpha^M(s))g(s)ds} ds = E[\tilde{p}] \). Employing these facts on the acquisition rule under mandatory regime, given in (3.4), it is evident that the manager acquires information if and only if, \( b \geq 0 \), which is the social efficient acquisition rule.

Proof. Lemma

For the purpose of this proof we will use the superscript \( \{Aq,t\} \), where \( Aq = A^M, A^D \), to signify that the calculations are made under the assumption that the acquisition activity is represented by the set \( Aq \) (firms that belong to the set \( Aq \) acquire information) and the disclosure threshold is \( t \). \( Aq'' \geq Aq' \) means that under \( Aq'' \), \( \alpha(s) \) is greater than under \( Aq' \) for every \( s \).

\[
A^D = \{ \{s, b\} : DP(s) - P^D_\phi + b \geq 0 \}
\]

By the law of iterated expectations

\[
P_\phi = E^{\{Aq,t\}}[E[\tilde{p} | s] | ND],
\]

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where $ND$ signifies that the expectation is taken conditionally on no disclosure. Under mandatory regime disclosure always occurs and $t = -\infty$, and under voluntary regime $t = P^D_{\phi}$. It can be verified (using the acquisition rules in the two regimes) that $P^M_{\phi} \geq P^D_{\phi}$ implies $A^M \leq \alpha A^D$. Therefore, it is sufficient to prove that $P^M_{\phi} \geq P^D_{\phi}$ under the assumption that $A^M \leq \alpha A^D$. This is done by showing that

$$P^M_{\phi} = E\{A^M, -\infty\} [E [\bar{p} | s] | ND] \geq E\{A^M, t\} [E [\bar{p} | s] | ND] \geq E\{A^M, t\} [E [\bar{p} | s] | ND] \geq P^D_{\phi}$$

(6.3)

where $t = E\{A^M, t\} [E [\bar{p} | s] | ND]$. We proceed by proving each of the inequalities in (6.3). We will use the equality

$$E\{A^M, t\} [E [\bar{p} | s] | ND] = \int_s (1 - a(s)) \left( \int_p f(p | s) dp h(s) ds + \int_s a(s) \left( \int_p f(p | s) dp h(s) ds \right) \right) \right) \right] ds$$

(6.4)

First inequality:

$$E\{A^M, -\infty\} [E [\bar{p} | s] | ND] \geq E\{A^M, t\} [E [\bar{p} | s] | ND].$$

(6.5)

The first inequality follows from the fact that the first derivative of $E\{A^M, t\} [E [\bar{p} | s] | ND]$ with respect to $t$ is negative for every $d < E\{A^M, t\} [E [\bar{p} | s] | ND]$.

Second inequality:

$$E\{A^M, t\} [E [\bar{p} | s] | ND] \geq E\{A^D, t\} [E [\bar{p} | s] | ND].$$

(6.6)

Denote

$$\Delta (s) \equiv a^D (s) - a^M (s), \quad \Delta (s) \geq 0, \forall s.$$  

(6.7)

Using (6.4) and (6.7) it is evident that (6.6) is equivalent to

$$\int_s \frac{\Delta (s) f (p | s) g (s) ds}{\int_p p \frac{\bar{p}}{s} \int_s \Delta (s) f (p | s) g (s) ds dp \geq t.}$$

(6.8)
The term \( \frac{\int \Delta(s)f(p|s)g(s)ds}{\int (\int \Delta(s)f(p|s)g(s)ds)dp} \) can be viewed as a pdf over the support \([t, \bar{p}]\), because it is positive and it integrates to one over this support. It follows that the LHS of (6.8) is in the range \([t, \bar{p}]\) and therefore (6.8) holds.

Third inequality:

\[
E \{ A^D, t \} \left[ E [\tilde{p} | s] | ND \right] \geq P^D.
\] (6.9)

The second inequality (6.6) implies that

\[
t \geq E \{ A^D, t \} \left[ E [\tilde{p} | s] | ND \right].
\] (6.10)

Therefore, we need to show that under voluntary disclosure regime the equilibrium condition \( t^D = E \{ A^D, t^D \} \left[ E [\tilde{p} | s] | ND \right] \) is achieved with \( t^D \leq t \).

Manipulation of (6.4) shows that in equilibrium the following condition holds

\[
t^D = \frac{\int E [\tilde{p} | s] (1 - a^D(s)) g(s) ds - \int (\int F (t | s) dt)a^D(s) g(s) ds}{\int (1 - a^D(s)) g(s) ds}.
\]

Define the function \( R() \) such that

\[
R(k) = k - \frac{\int E [\tilde{p} | s] (1 - a^D(s)) g(s) ds - \int (\int F (p | s) dp)a^D(s) g(s) ds}{\int (1 - a^D(s)) g(s) ds}.
\]

\( R() \) is an increasing function because

\[
R'(k) = 1 + \frac{\int F (k | s) a^D(s) g(s) ds}{\int (1 - a^D(s)) g(s) ds} > 0.
\]

Therefore, starting with \( R(t) \geq 0, R(t^D) = 0 \) is achieved with \( t^D \leq t \).

Derivation of the equilibrium when investment is made prior to the acquisition stage and disclosure is voluntary

Step 1:
Given that the manager acquires information he discloses it if and only if \( \tilde{v} \geq P^D_\phi \). Employing \( \alpha^D(s) = \beta \), and \( p = v \), on (3.3), and acknowledging that \( \tilde{s} \) is pure noise and that the distribution of \( \tilde{v} \) is now conditioned on investors conjecture about the investment \( \hat{a} \) we have

\[
(1 - \beta) E[\tilde{v} | \hat{a}] + \beta \int^{P^D_\phi} \tilde{v} f(v | \hat{a}) dv
\]

\[
P^D_\phi = \frac{1 - \beta \int^{P^D_\phi} f(v | \hat{a}) dv}{1 - \beta \int^{P^D_\phi} f(v | \hat{a}) dv}.
\]

Using the distribution of \( \tilde{\theta} \) we have \( \tilde{v} \sim U(m\hat{a} - \Delta, m\hat{a} + \Delta) \) and \( f(v | \hat{a}) = \frac{1}{2\Delta}, E[\tilde{v} | \hat{a}] = m\hat{a} \). Solving for \( P^D_\phi \) we have

\[
P^D_\phi = m\hat{a} - \Delta \frac{(1 - \sqrt{1 - \beta})^2}{\beta}.
\] (6.11)

**Step 2:**

At the investment date the expected net proceeds for the manager (expected firm price net of costs of investment and costs of acquisition of information) are equal to the firm value \( \pi^D \). Thus the manager chooses investment \( a \) to solve

\[
\max_a \pi^D,
\] (6.12)

where

\[
\pi^D = \beta \int^{P^D_\phi} v f(v | a) dv + (1 - \beta) \int^{P^D_\phi} f(v | a) dv P^D_\phi - \beta c - \frac{1}{2} qa^2.
\] (6.13)

Using the assumed distribution for \( \tilde{\nu} \), the first order condition yields

\[
a^D = \frac{m(\Delta - P^D_\phi) \beta}{2q \Delta - m^2 \beta},
\]

for

\[
2q \Delta - m^2 \beta \neq 0,
\]

where \( P^D_\phi \) is given by (6.11).

The second order condition is
\[ \Delta > \frac{m^2 \beta}{2q}. \]

Step 3:

Employing the equilibrium condition that investors’ conjecture is fulfilled (i.e. \(a^D = \hat{a}\)), solving for the optimal investment yields

\[ a^D = \frac{m}{q} \left( 1 - \sqrt{1 - \beta} \right). \] (6.14)

Employing (6.14) on (6.13) yields

\[ \pi^D = \beta \left( \frac{m^2}{2q} - c \right). \]

**Proof. Proposition 5**

The only way that the statement in the proposition is not true is that there are no parameter values that comply with the second order condition and with 5.6 simultaneously. If that was the case then the LHS of 5.6 would be negative if \(\Delta\) is the lowest possible under the second order condition (i.e. if \(\Delta = \frac{m^2 \beta}{2q}\)). However, this is not the case as the following shows \(\frac{m^2}{2q} - \frac{m^2 \beta (1 - \sqrt{1 - \beta})^2}{\beta^2} = \frac{m^2}{2q} \left[ 1 - \left( \frac{1 - \sqrt{1 - \beta}^2}{\beta} \right) \right] > 0, \forall 0 < \beta < 1, m > 0, 0 < q < \infty. \) \(\square\)
References


