WHY ACCOUNTING REGULATION? AN INTERPLAY BETWEEN INVESTOR EXPERIENCE AND MANAGERIAL MANIPULATION

by

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Abstract

In this paper, I ask the question whether accounting regulation is beneficial or detrimental from the angle of investors' information processing behaviors. It is well established that managers engage in various kinds of reporting manipulations, and the rewards from manipulations are determined by how investors, guided by their experiences, react to reported information. Based on the view that accounting disciplines unmanipulated patterns in financial information, I analyze managers' manipulation incentives in an unregulated economy versus in a regulated economy and examine the efficiency implications of accounting regulation, conditional on different types of investor experience. I find that 1) while accounting regulation generally improves investment efficiency, it can impair investment efficiency and lead to more managerial manipulations; 2) investor sophistication may, but not always, strengthen the effects of accounting regulation; 3) accounting regulation may induce investors to act more conservatively; and 4) optimal accounting regulation varies with investor experience and often features a corner level of stringency. A number of implications are also discussed.

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1. Introduction

In financial reporting, managers refer to the governing accounting standards in the jurisdiction, such as the Generally Accepted Accounting Standards (GAAP) in the U.S., or the International Financial Reporting Standards (IFRS) in Europe. However, voluminous evidence suggests that managers engage in reporting manipulations[1] for private benefits such as monetary or reputational gains even in the presence of accounting standards (e.g., Healy 1985; Guidry, Leone, and Rock 1999; Zhao, Chen, Zhang, and Davis 2012; Ali and Wang 2015). The prevalence of manipulations gives rise to doubts on the true meaning of accounting regulation.

Since manipulations are costly, for manipulations to take place, the expected benefits must exceed the costs. The underlying reason why managers may manipulate financial reporting is that doing so can leave a good impression to investors and thus get a favorable treatment, as opposed to the case without manipulation (e.g., Fields, Lys, and Vincent 2001; Graham, Harvery, and Rajgopal 2005; Das, Kim, and Patro 2011). Ultimately, how many benefits managers can enjoy from manipulations depend on how investors process and react to financial information, which can be influenced by their past experiences. In this paper, I attempt to answer the question why we have accounting regulation from the perspective of investors' information processing behaviors, and examine whether accounting regulation is beneficial in improving investment efficiency and social efficiency which I define as investment efficiency net of the social cost of manipulations.

When investors make their investment decisions, they need to engage in some forms of evaluation. Despite the multiplicity of investment philosophies, one commonality is that investors need to base their decision making on certain forms of financial information and patterns. For

[1] While I use the term "manipulation" in the paper, the literature heavily focuses earnings management because earnings can be viewed as a summary and one of the most important statistics of a firm's financial performance from an accounting perspective. However, earnings is not the only input investors use in making their investment decisions, and manipulations can be done to other aspects of financials, which may or may not eventually flow into the calculation of earnings.

example, surveys suggest that venture capitalists and private equity investors rely on internal rate of return and multiples on invested capital in the evaluation process as a routine, and 23% of venture capitalists stick to the same metrics for all investments (Gompers, Gornall, Kaplan, and Strebulaev 2016; Gompers, Kaplan, and Mukharlyamov 2016).[2] Meanwhile, since accounting standards impose disciplines on how firms record and report transactions, it is expected that with accounting regulation, information conveyed to the external capital market will display similar patterns for firms engaging in economically similar transactions.[3] That is particularly the case for firms in the same industry with similar performances, as firms in the same industry typically operate in the same way and are subject to the same industrial trends and seasonality.[4] Therefore, in the paper, I argue that what accounting regulation really regulates is the similarity in the unmanipulated information patterns among firms. That is, the degree of regulation generated by the governing accounting standards sets up the stage from which managers decide whether to manipulate and how much to manipulate.

When faced with similar information patterns, people are likely to engage in "similarity heuristics" in information processing (Read and Grushka-Cockayne 2011), which is a more refined version of "representative heuristics" (Kahneman and Tversky 1972). That is, people often tend to resort to their past experiences with similar issues when dealing with current is-

[2]For another instance, Peter Lynch, a millionaire fund manager and a pioneer of a hybrid investment model that combines value and growth investment, is famous for his investment philosophy based on a strong sales percentage and a low price to earnings growth ratio (PEG ratio). The school of technical investment, proposed by Charles Dow in the late 1800s and adopted by numerous Chartered Market Technicians (CMT), focuses on identifiable trends and patterns in the time series of financial data in predicting future outcomes with the view that history will repeat itself (Murphy 1999). There is also recent evidence that book-to-market ratio remains a primary indicator for many major funds in selecting investments (Choi, So, and Wang 2020).

[3]That accounting standards may make like things alike is related to the idea of comparability, which is a characteristic distinctive from others. No matter what standards are mandated by GAAP or IFRS and how good GAAP and IFRS are in achieving other qualitative characteristics, the standards apply to all firms. As recognized by both the FASB and the IASB, comparability is a nature consequence of firms' reporting relevant information in a faithful manner (FASB 2010; IASB 2018). Findings by Yip and Young (2012) concur with the boards' concepts, and the idea that the use of common accounting standards may lead to accounting comparability is also expressed in Corona, Huang, and Hwang (2021).

[4]For example, an asset turnover ratio of two or higher is usually considered good for grocery stores, which is indeed the case of Kroger, Walmart, and Costco. For Uber and Lyft which are startups running at a loss, they both have high revenue growth rates, which drive their revenue multiples in valuation.

sues when issues are "similar in essential properties" (Kahneman and Tversky 1972, p.431) which can be viewed as the key indicators investors use in decision making. Indeed, heuristics, which represent a fast and frugal way of decision making, can outperform classical rational approaches such as Bayesian updating, making classical forms of rational inference unnecessary for successes (e.g., Gigerenzer and Goldstein 1996; Gigerenzer, Todd, and the ABC Research Group 1999). Meanwhile, according to the adaptative market hypothesis proposed by Lo (2004), participation in the capital market is a trial-and-error process such that if a certain investment strategy worked in the past, investors would be likely to use it again for the next investment decision (i.e., use the old method) when similar patterns are present. Otherwise, investors will have to use some investment strategies which they may be unfamiliar with (i.e., use a new method). Overall, whether a similar pattern exists can have a profound impact on how investors will go about evaluating a firm.

To capitalize on the idea of similarity, I study a simple game between firm managers seeking to obtain investment and an investor who is endowed with a successful investment experience in the past and able to provide the investment capital. In the game, the managers can decide whether to manipulate to change their firms' information pattern similarity, which will direct the investor's use of the old method versus a new method. In the investment setting, similarity heuristics induced by accounting regulation present both costs and benefits because the preferred strategy, though led to the right investment decision in the past, may not always generate right decisions due to inherent biases. Biases embedded in the old method can lead to overinvestment in bad firms in the case of a positive bias or underinvestment in good firms in the case of a negative bias. Additionally, there can be two types of successful experience–investing in a good firm and not investing in a bad firm. Such different experiences can influence how the investor views firms with a similar versus a different information pattern.

Specifically, I examine the managers' manipulation choices for different states of the firm in a multi-firm setting such that the choice of displaying a similar versus a different information pattern may directly signal the firm type. Based on comparisons between regimes with and without accounting regulation, I demonstrate whether accounting regulation is beneficial or detrimental to investment efficiency and social efficiency. I find that when the investor's past successful experience is with a good firm, if the old method is positively biased, then accounting regulation has limited impact on underinvestment in good firms. In contrast, it may increase, decrease, or have no impact on overinvestment in bad firms, conditional on the magnitude of the positive bias. The reason is that, with a positively biased method, good firms can generally secure investment if the investor keeps using the old method. But bad firms may have an incentive to manipulate to show a similar information pattern and thus take advantage of the positive bias as well. A side effect of accounting regulation is that it may trigger more manipulations by strengthening the manipulation incentives of bad firms, as their unmanipulated information patterns become regulated.

If the old method is negatively biased, then there is generally limited overinvestment in bad firms in the unregulated economy. However, underinvestment in good firms becomes the major concern, especially when the investor has a preference for investing under a similar information pattern, as the successful experience is with a good firm. A regulated economy proves to have the highest efficiency in such case because a negatively biased method minimizes the expected benefits bad firms can obtain from pooling with good firms. Since bad firms won't get much from mimicking good firms, accounting regulation can not only help create a fully separating equilibrium between good and bad firms, but also reduce the need for good firms to manipulate in order to avoid being evaluated by a negatively biased method.

When the investor's past successful experience is with a bad firm, the bias of the old method will become less relevant because a similar information may suggest that the firm is bad. As a result, the managers may prefer to display different information patterns, and the probabilities of obtaining investment will be largely determined by the precision of a new method. Unless the precision of a new method is sufficiently high, accounting regulation does not affect investment efficiency much because firms in general will choose to display a different information pattern with and without regulation. While accounting regulation can help reduce manipulations when the precision of a new method is sufficiently high, it may increase manipulations when the precision of a new method is low.

Moreover, the effects of accounting regulation also vary with investor sophistication. If a sophisticated investor is able to see through manipulations and thus less influenced by similarity heuristics, then overreliance on unwarranted past experiences will decrease, but underreliance on warranted past experiences will increase. So a sophisticated investor can perform worse than a naive one without accounting regulation. In contrast, sophistication will lead to weakly better performance with regulation because firms' unmanipulated information patterns are regulated. Overall, with potentially worse performance without regulation but weakly better performance with regulation, a sophisticated investor will generally benefit more from accounting regulation.

In additional analysis, I first analyze the issue of optimal investor experience. I find that without accounting regulation, while there is no single dominant experience, a combination of a positively biased method and a successful experience with a good firm is likely to be the optimal experience. The intuition is that without accounting regulation, the only way to minimize underinvestment in good firms is to use a positively biased method, whereas both a negatively biased method and signaling can help minimize overinvestment in bad firms. A combination of a positively biased method and a successful experience with a good firm is the only combination that can utilize the tools on both sides. With accounting regulation, however, a combination of a negatively biased method and a successful experience with a good firm is a weakly dominant combination. The reason is that with regulation, the key to maximize efficiency is to minimizes the mimicking incentives of bad firms, which calls for a method that will yield the most unfavorable evaluation outcome on bad firms, as well as the investor's willingness to apply the method.

Finally, I probe into the setting of optimal accounting regulation in maximizing social efficiency. There are couple key observations. First, in costless separations, optimal accounting regulation depends on both the cost function of manipulation and the investor's experience. Second, in costly separations, more stringent accounting regulation is always better because it help reduce the amount of manipulation needed for good firms to separate from bad firms, provided that separations can be achieved. Third, pooling equilibria can be better than separating equilibria if the amount of manipulation needed for bad firms to pool with good firms is low. In pooling equilibria, optimal accounting regulation features a corner level of stringency among the degrees of accounting regulation that will lead to a pooling equilibrium.

My paper makes several contributions to the literature. First, it contributes to the broad literature on accounting regulation. Since my paper examines how imposing accounting regulation may affect managerial incentives to manipulate and consequently investment efficiency, one natural setting to compare my predictions with empirical observations is around IFRS adoptions. For example, Ahmed, Neel, and Wang (2013b) find that accounting manipulations increased after the adoptions of IFRS across 20 countries. The empirical observation is largely consistent with the findings in my study that accounting regulation can motivate more manipulations. However, while the authors argue that the increase in manipulations is indicative of IFRS's low quality, my paper proposes a counter-interpretation of the finding: it is possible that it is exactly because IFRS is of high quality that many of the bad firms are forced to engage in manipulations, as their unmanipulated information patterns are changed from favorable to unfavorable by IFRS. In other words, increases in manipulations can be a natural consequence of an adoption of high-quality standards.

Besides, the results of my paper suggest that despite a potential increase in manipulations, accounting regulation can increase investment efficiency, which is consistent with other empirical findings on IFRS adoption (e.g., Horton and Serafeim 2010; Barth, Landsman, Lang, and Williams 2012; Landsman, Maydew, and Thornock 2012). Future research thus needs to consider the changes in investment efficiency and accounting manipulations concurrently when determining the true quality and implications of new accounting standards. Moreover, my paper extends the possible explanations of the differential effects of IFRS adoption in different countries to differences in investor experience, which is beyond traditional factors such as a country's institutional features (i.e., law, enforcement, culture, etc.). As for policy implications, since accounting regulation may not only create a manipulation incentive for bad firms, but also shift the burden of manipulations from bad firms to good firms as it becomes more stringent, together with Laux and Stocken (2018), I urge regulators to remain vigilant about the social costs of stringent regulation.

A second contribution of my paper is to the literature on investor sophistication. Prior research has studied whether investor sophistication can improve investment efficiency. For example, Bouwman, Frishkoff, and Frishkoff (1987) examine whether sophisticated analysts can better screen prospective investments, and Collins, Gong, and Hribar (2003) examine whether sophisticated investors have a better understanding of accrual mispricing than naïve investors do. By analyzing the role investor sophistication plays with the presence of similarity heuristics, my study provides an opposite view on investor sophistication; that is, investor sophistication may not always result in better outcomes than investor naivety. Specifically, whether investor sophistication has a positive impact on efficiencies and the usefulness of accounting regulation depends on both firm type and the investor's past experience. Such findings not only highlight the importance of incorporating investors' track records into research on investor sophistication, but also call into question many of the previously documented positive outcomes associated with sophistication as to whether they are caused by a more sophisticated information processing process, the degree of regulation, or other factors such as different past experiences.

My paper is also related to the line of theoretical research on comparability. Although similarity and comparability will both arise naturally after firms adopt common standards, they are two different yet related concepts. Most notably, I model information pattern similarity as a one-to-many relationship between firms across time such that it not only drives how the investor views a firm but also serves as a trigger for the choice of evaluation method. In contrast, many prior studies on comparability (e.g., Wu and Xue 2020; Corona et al. 2021; Fang, Iselin, and Zhang 2021) focus on how comparability may enable investors to extract common and idiosyncratic components from firms' financial reporting between two or more firms at a single point of time. To the extent that people tend to use casual reasoning rather than covariations in decision making (Anh, Kalish, Medin, and Gelman 1995), my paper offers a more realistic description of investors' information processing behaviors in practice. Furthermore, the role of a ranking of information pattern similarities in forming the investor's belief and determining the optimal accounting regulation is stressed in the paper. The notion of ranking, nevertheless, resembles the idea of relative performance in Wu and Xue (2020) and Corona et al. (2021).

Last but not least, my paper contributes to the literature on heuristics. The literature has so far identified a number of heuristics that are present in different accounting practices (e.g., Swieringa, Gibbins, Larsson, and Sweeney 1976; Joyce and Biddle 1981; Kadous, Leiby, and Peecher 2013; Messier, Quick, and Vandervelde 2014; Koonce and Lipe 2017). Similarities in information patterns induced by accounting offer a natural context to study similarity heuristics. While my study does not aim to document the presence of similarity heuristics, it is the first to provide a formal theoretical framework on the costs and benefits of similarity heuristics in an investment setting.

A cornerstone of the paper's model is that investors are subject to heuristic behaviors. While I use heuristics to describe human behaviors throughout the paper, heuristics may also exist for other types of decision makers. Notably, algorithmic trading and artificial intelligence have been trending in recent years. When machines make investment decisions, they essentially follow certain pre-programmed algorithms or formulas. Although the algorithms may change over time as machines or programmers learn over time based on past experiences, machines do rely on information patterns for decision making just like human beings. Therefore, the results in the paper also provide regulators with timely and critical policy implications in an era where new technologies are quickly emerging.

The paper proceeds as follows: Section 2 describes the model setup and assumptions; Section 3 and Section 4 analyze the case where the investor's past successful experience is with a good firm and with a bad firm, respectively, and examine the corresponding effects of accounting regulation; Section 5 examines optimal investor experience and optimal accounting regulation; Section 6 presents empirical implications; and Section 7 concludes. In the appendices, Appendix A displays the proofs for the main texts, Appendix B and Appendix C show the results under two alternative assumptions, and Appendix D discusses some extended cases.

2. Model

I consider a stylized game between firm managers seeking investment for their firms and a representative investor who can provide the investment capital. The investor had a successful investment experience with a firm in the past, which I label as Firm X. And the investor is sophisticated with probability u and naïve with probability $1-u$. The managers each manages a firm, and I use "Firm Y" to represent the firms, which can be viewed as potential investment targets. The firms are assumed to be in the same industry as Firm X is to ensure that the investor's experience with Firm X is transferrable to Firm Y. The game has two dates. At date 1, the managers receive a perfect signal about whether his firm is good (G) or bad (B). Before releasing financial information to the investor, the managers can choose to incur a cost of k to form an information pattern that is different from (similar to) Firm X's information pattern if his firm's unmanipulated information pattern is similar to (different from) that of Firm X. I use S (D) to indicate a similar (different) information pattern. Overall, there can be four possible states of Firm Y: GS (good and similar), GD (good and different), BS (bad and similar), and BD (bad and different).[5] The reason why information patterns can be similar or different for the two types of firms is that when accounting regulation is absent, firms can account for transactions and report financial data in divergent ways for exogeneous reasons.[6]

At date 2, the managers deliver potentially manipulated information to the investor. Upon receiving the information, the investor evaluates Firm Y. Depending on whether Firm Y's information pattern is similar to or different from that of Firm X, the investor will choose different evaluation methods. To be specific, if Firm Y's information pattern is different from Firm X's, the investor will apply a new method to evaluate Firm Y. The new method has a fixed success rate of p, which can be thought of as the probability of a matching between Firm Y's true type

[5] I treat GS, GD, BS, and BD as firm groups as opposed to individual firms.

[6] See Appendix B for an analysis where accounting choices without accounting regulation are endogenous.

and the evaluation outcome, or the precision of a new evaluation method. If Firm Y's information pattern is similar to Firm X's, the investor will use the old method which enabled the past success with more details provided below. To differentiate between naive and sophisticated investors, I assume that manipulations can only influence naive investors such that a naive (sophisticated) investor will choose the method based on (un)manipulated information patterns.[7] Using the chosen method, the investor evaluates Firm Y and decides whether to provide the investment capital based on the evaluation outcome. If the evaluation outcome is favorable (unfavorable), the investor will (not) provide the capital (i.e., invest in the firm).

The managers will enjoy a fixed utility of γ if obtaining investment and 0 otherwise. Therefore, the managers will choose to manipulate information pattern similarity only if the product of the marginal increase in the probability of the investor choosing to invest and the reward γ is greater than the cost of manipulation.

I now discuss two more assumptions in the model. One assumption is related to the investor's past experience. As mentioned earlier, I assume that the past experience is a success. The reason is that for the investor to keep using the same method, the investor's past experience must be a success; otherwise, the investor will always try a new method. That said, in principle, there are two kinds of success: 1) investing in a good firm, and 2) not investing in a bad firm. While the former may be more likely to reflect the perception of success in practice, I will consider both possibilities in my analysis.

The other assumption is related to the old method. As argued above, although the investor is assumed to have succeeded in the past investment, the old method may not be perfect because it can be biased. Moreover, the bias can be either a positive bias or a negative bias. In the

[7] The description of investor behaviors is based on empirical evidence. For example, sophisticated investors are found to be less susceptible to earnings management (Balsam, Bartov, and Marquardt 2003) and positive language framing (Tan, Wang, and Zhou 2014) and react less affectively to positive earnings news (Victoravich 2010). In addition, the salient process by which similarities are generated is a key determinant of whether a representative heuristic will emerge (Kahneman and Tversky 1972).

case of a positive bias, I assume that when the old method is positively biased, when applied to Firm Y, it will always generate a favorable outcome if Firm Y is good, but it will generate a favorable outcome with probability $\alpha > 1 - p$ if Firm Y is bad. So Firm Y, regardless of its true type, will always prefer to be evaluated by the old method when it is positively biased, and α can be viewed as the magnitude of the positive bias. In the case of a negative bias, I assume that when the old method is negatively biased, when applied to Firm Y, it will generate a favorable outcome with probability $1 - \beta < p$ if Firm Y is good, but it will always generate an unfavorable outcome if Firm Y is bad. So Firm Y, regardless of its true type, will always prefer to be evaluated by a new method when the old method is negatively biased, and β can be viewed as the magnitude of the negative bias.

Date 1	Date 2
Firm managers observe their firms' true type and decide whether to manipulate their firms' information patterns.	The investor evaluates Firm Y based on information patterns and decides whether to make an investment.

Figure 1: Timeline

3. Analysis–Experience with a Good Firm

In this section, I analyze the case where the investor's past successful experience is with a good firm (i.e., Firm X is good). Specifically, I examine the simultaneous actions taken by all possible states of Firm Y and compare the outcomes in an unregulated economy (i.e., without accounting regulation) versus in a regulated economy (i.e., with accounting regulation), taking into account the potential signaling effect.

I formulate the signaling effect of information patterns as the following: when 1) two or more states of Firm Y choose to display the same information pattern (S or D), and 2) firms taking the same action involve both good and bad types (G and B), the investor will need to rely on an evaluation process and make investment decisions accordingly. Otherwise, the information pattern itself may serve as a signal of the firm type, and the investor will no longer engage in the evaluation process.

3.1 Positively Biased Method

In Section 3.1, I study the case where the old method is positively biased.

3.1.1 Unregulated Economy

In this sub-section, I analyze the possible equilibria in an unregulated economy. I define a stable equilibrium as one where none of the four states of Firm Y will find it optimal to deviate from the equilibrium information pattern choices given the investor's belief, the investor's belief is consistent with firms' information pattern choices, and the investor cannot deviate to a strictly better belief. To limit the number of equilibria and make the outcomes more reasonable, I rule out the belief that a similar information pattern signals the bad type since Firm X is a good firm. When there are multiple equilibria, I also rule out dominated ones in terms of investment efficiency. All possible equilibria are summarized in Lemma 1a.

Lemma 1a: Given a successful experience with a good firm and a positively biased method, without accounting regulation,

1) when the positive bias is large, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {S, S, S, S};

2) when the positive bias is moderate, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, S, S, S} and {S, D, S, D};

3) when the positive bias is small, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, S, S, D} and {S, D, S, D}.

To understand the results, first note that without accounting regulation, all four possible states of Firm Y (i.e., GS, GD, BS, and BD) can co-exist. As a result, neither a similar information pattern nor a different one can signal the good type. The reason is that if a similar (different) information pattern signals the good type, then BS (BD) will remain status quo, and the belief will always turn out to be incorrect. Therefore, without accounting regulation, the only possible signal is that a different information pattern signals the bad type.

For GS and BS, since the old method is positively biased, they will never manipulate and always display a similar information pattern, regardless of whether the investor views a different information pattern as signaling the bad type. Meanwhile, for GD and BD, their information pattern choices depend on both the magnitude of the positive bias and the investor's belief. When the positive bias is large and the investor believes that a different information pattern signals the bad type, both GD and BD will manipulate to display a similar information pattern. The resulting {S, S, S, S} is an equilibrium where the investor always evaluates the firm, as everyone displays a similar information pattern. If investor does not hold any belief related to signaling, BD will still always manipulate since the positive bias is large. For GD, manipulating is better than not manipulating when the cost of manipulation is small, and vice versa; the two possible equilibria are {S, S, S, S} and {S, D, S, S}. However, {S, D, S, S} is dominated by {S, S, S, S} under which there will be less underinvestment in GD, unless a different information pattern signals the good type, which cannot be an equilibrium belief. Hence, {S, S, S, S} is the only equilibrium under a large positive bias.

With a moderate positive bias, the actions of BD and GD depend on the belief the investor holds. On one hand, if the investor believes that a different information pattern signals the bad type, then both BD and GD will choose to manipulate and display a similar information pattern, and the equilibrium is {S, S, S, S}. On the other hand, if the investor chooses to always evaluate the firm, then BD will not manipulate. Depending on whether GD will manipulate, the two possible outcomes {S, S, S, D} and {S, D, S, D}. The investor, however, cannot commit to always evaluating the firm under {S, S, S, D} where a different information pattern indeed signals the bad type. Therefore, the two possible equilibria under a moderate positive bias are {S, S, S, S} and {S, D, S, D}. Compared with {S, D, S, D}, {S, S, S, S} leads to higher investment probabilities in both GD and BD. So neither equilibrium dominates the other.

When the positive bias is small, a possible equilibrium under the belief that a different information pattern signals the bad type is {S, S, S, D} since BD will not manipulate. Meanwhile, possible equilibria without signaling are {S, S, S, D} and {S, D, S, D}. With a low cost of manipulation, {S, S, S, D} without signaling is dominated by {S, S, S, D} with signaling, as the probability of investment in BD would be lower if the investor directly viewed firms with a different information pattern as bad than if the investor evaluated the firms. Similarly, {S, D, S, D} is dominated by {S, S, S, D} with signaling, as the probability of investment in BD is lower and probability of investment in GD is higher in the latter equilibrium. For {S, S, S, D} to be an equilibrium, however, the cost of manipulation cannot be too high because otherwise GD will refrain from manipulation, and the resulting {S, D, S, D} will be inconsistent with the belief that a different information pattern signals the bad type. The equilibrium would become {S, D, S, D} in such case.

To summarize, conditional on the magnitude of the positive bias α, there are three possible equilibria without accounting regulation: {S, S, S, S}, {S, D, S, D}, and {S, S, S, D}. In equilibrium, the investor always evaluates the firm upon a similar information pattern. With respect to a different information pattern, the investor may either evaluate the firm or directly view the firm as bad (i.e., signaling), and the signaling effect will take place only when the positive bias is small.

3.1.2 Regulated Economy

In this sub-section, I analyze the possible equilibria in a regulated economy. With accounting regulation, firms will be required to apply the same set of standards and rules in recording and reporting transactions. As a result, if Firm Y is good (bad), then the unmanipulated information pattern it has will be similar to (different from) that of Firm X after adopting the standards. That is, GD will become GS, and BS will become BD. In other words, accounting regulation changes the unmanipulated information patterns for GD and BS. I summarize the possible equilibria in Lemma 1b in forms parallel to those of Lemma 1a.

Lemma 1b: Given a successful experience with a good firm and a positively biased method, with accounting regulation,

1) when the positive bias is large, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {S, S, S, S};

2) when the positive bias is small, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {S, S, D, D}.

With accounting regulation, there will only be two possible states of Firm Y: GS and BD, and the unmanipulated information patterns become {S, S, D, D}. For GS, displaying a similar information pattern always dominates displaying a different information pattern, regardless of the investor's belief. Given that GS will never display a different information pattern, a different information pattern will signal the bad type. So bad firms will have an incentive to manipulate. However, the strength of the incentive is conditional on both the magnitude of the positive bias and the investor's belief with respect to a similar information pattern. If the investor viewed firms with a similar information pattern as good directly, then BD would have a strong incentive to manipulate. In such case, unless the manipulation cost were extremely high, the investor would invest in bad firms outright, making the belief incorrect.

Another possible belief is that the investor will simply evaluate the firm upon a similar information pattern. With such belief, BD's manipulation incentive is attenuated. A third possible belief that the investor will evaluate all firms if only one level of similarity is observed, but view more similar firms as good firms if two levels of similarity are observed. With such belief, BD won't have a strong incentive to manipulate either because the investor will never view them as good when all firms are similar.[8] While the two possible beliefs are equivalent with respect to the investment probability in bad firms, the latter one would dominate the former one in maximizing the investment probability in good firms if a positively biased method could not guarantee a favorable evaluation outcome for good firms. Overall, with a large (small) positive bias, BS and BD will (not) manipulate, and possible equilibria include {S, S, S, S} and {S, S, D, D}.[9]

3.1.3 Comparisons

I next examine the investment efficiency and social efficiency implications of accounting regulation by comparing the equilibria with and without accounting regulation. I define social

[8]The belief essentially relies on a ranking of similarity.

[9]It is reasonable to argue that manipulation cost will be higher with accounting regulation than without accounting regulation. However, unless the cost is too high such that the equilibrium with accounting regulation is almost always {S, S, D, D}, all following conclusions will hold.

efficiency as investment efficiency net of the social cost of manipulations.[10] To avoid redundancy, I omit equilibria {S, S, S, S} under a moderate bias and {S, D, S, D} under a small positive bias in the unregulated economy. Note that since unmanipulated information patterns fully separate good and bad firms with accounting regulation and accounting regulation is thus always beneficial to a sophisticated investor, I present the results without investor sophistication and discuss implications in the text if the presence of investor sophistication changes the results.

Proposition 1: Given a successful experience with a good firm and a positively biased method,

1) when the positive bias is large, accounting regulation has no effect on investment efficiency and may increase manipulations;

2) when the positive bias is moderate, accounting regulation decreases underinvestment in good firms, increases overinvestment in bad firms, and increases manipulations;

3) when the positive bias is small, accounting regulation has no effect on investment in good firms, decreases overinvestment in bad firms, and decreases manipulations.

To understand the results, first consider the case of a large positive bias. Given a large positive bias, the equilibrium is {S, S, S, S} under both regimes. As a result, accounting regulation does not change investment efficiency when the investor is naive. However, with the presence of investor sophistication, accounting regulation will be strictly beneficial because a sophisticated investor can fully separate bad from good firms with the help of accounting regulation. For manipulations, accounting regulation triggers more manipulations by BS whose

[10]When the manager decides to manipulate, the manager will internalize the personal costs of manipulations. However, it is possible that manipulations will have some external consequences which will not be internalized by the manager. For example, Cohen and Zarowin (2010) document that earnings management can lead to firm underperformance post SEOs. In addition, real earnings management via R&D cuts may hinder a firm's innovations in future periods (Bereskin, Hsu, and Rotenberg 2018). Firms engaging in earnings management may also deviate from optimal investment levels (Cohen and Zarowin 2008).

unmanipulated information patterns are made different by accounting regulation, but GD will not need to manipulate any more. The net effect depends on whether there are GD or BS in the unregulated economy. Overall, accounting regulation has an ambiguous effect on social efficiency and may decrease social efficiency even when the investor is sophisticated.

When the positive bias is moderate, the comparison is between {S, D, S, D} and {S, S, S, S}. Probabilities of investment in GS are the same across the two regimes. With accounting regulation, it can be seen that the probability of investment in GD will always be higher. Meanwhile, the probability of investment in BS will remain the same (decrease) and the probability of investment in BD will increase (decrease) for a naive (sophisticated) investor. In terms of manipulations, since no one manipulates without accounting regulation, but BS and BD will manipulate with accounting regulation, accounting regulation will always increase manipulations, yielding an ambiguous net effect on social efficiency.

With a small positive bias, the comparison is between {S, S, S, D}and {S, S, D, D}. The effects accounting regulation has on investment efficiency is strictly positive because investment efficiency achieves its maximum under {S, S, D, D} even when the investor is naive. Accounting regulation is also strictly beneficial to social efficiency because GD no longer need to manipulate. Furthermore, accounting regulation proves to be even more beneficial with investor sophistication because, without regulation, underinvestment in GD will occur only when the investor follows unmanipulated information patterns.

To summarize, across all the comparisons, it appears that accounting regulation is weakly beneficial in decreasing underinvestment in good firms. However, it may either increase or decrease overinvestment in bad firms, depending on the magnitude of positive bias. The underlying reason is that accounting regulation helps the investor capitalize more on the positive bias, thus making the downside of accounting regulation mainly concentrate on overinvestment in bad firms and more manipulations by bad firms.

Successful Experience with a Good Firm	Without Regulation	With Regulation
Large Positive Bias	{S, S, S, S}	{S, S, S, S}
Moderate Positive Bias	{S, S, S, S} or {S, D, S, D}	{S, S, S, S}
Small Positive Bias	{S, S, S, D} or {S, D, S, D}	{S, S, D, D}

Figure 2: List of Equilibria (Experience with a Good Firm and a Positively Biased Method)

3.2 Negatively Biased Method

In Section 3.2, I study the case where the old method is negatively biased.

3.2.1 Unregulated Economy

In this sub-section, I analyze the possible equilibria in an unregulated economy, which are summarized in Lemma 2a.

Lemma 2a: Given a successful experience with a good firm a negatively biased method, without accounting regulation,

1) when the negative bias is large, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {D, D, D, D} and {D, D, S, D};

2) when the negative bias is moderate, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {S, D, S, D};

3) when the negative bias is small, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, S, S, D} and {S, D, S, D}.

Without accounting regulation, neither a similar information pattern nor a different information pattern may signal the good type. Since the old method is negatively biased, both good and bad firms prefer to be evaluated by a new method. Hence, for GD and BD, remaining status quo is the dominant strategy, unless the investor believes that a different information pattern signals the bad type. When the negative bias is large and the investor does not hold such belief, GS will manipulate to display a different information pattern. Depending on the cost of manipulation, BS may or may not manipulate, resulting in {D, D, D, D} or {D, D, S, D}. If the investor believes that a different information pattern signals the bad type, GS and BS will not manipulate. BD will also not manipulate because they won't get investment either way. For GD, while the belief puts pressure on GD to display a similar information pattern, since the negative bias is large, the benefit of manipulation is outweighed by the cost. Since GD will display a different information pattern, that a different information pattern signals the bad type cannot be an equilibrium belief.

With a moderate negative bias, GD will still find manipulation not cost-effective even when the investor believes that a different information pattern signals the bad type. So the investor cannot hold a signaling belief in equilibrium. Meanwhile, since the negative bias is not large, GS will prefer to remain status quo. Therefore, depending on BS's action, possible outcomes include {S, D, D, D} and {S, D, S, D}. Under {S, D, D, D}, a better belief for the investor is to view a similar information pattern as signaling the good type. However, if the investor deviates, BS will choose a similar information pattern, making such belief incorrect. Overall, {S, D, S, D} is the only stable equilibrium.

When the negative bias is small, GD will manipulate to display a similar information pattern if the investor believes that a different information pattern signals the bad type. With such belief, GS, BS, and BD will not deviate, and the equilibrium is {S, S, S, D}. In contrast, if the investor does not hold such belief, GD and BD will remain status quo. For GS, because the negative bias is small, it is not cost-effective to manipulate. Since {S, D, D, D} is not stable, the equilibrium can only be {S, D, S, D}. To compare {S, S, S, D} with {S, D, S, D}, the latter one leads to both a higher investment probability in GD and a higher investment probability in

BD. So neither equilibrium dominates the other.

To summarize, conditional on the magnitude of the negative bias β, there are four possible equilibria without accounting regulation: {D, D, D, D}, {D, D, S, D}, {S, D, S, D}, and {S, S, S, D}. In equilibrium, the investor always evaluates the firm upon a similar information pattern. With respect to a different information pattern, the investor may either evaluate the firm or directly view the firm as bad (i.e., signaling), and the signaling effect will occur only when the negative bias is small.

3.2.2 Regulated Economy

In this sub-section, I analyze the possible equilibria in a regulated economy, and the result is summarized in Lemma 2b.

Lemma 2b: Given a successful experience with a good firm and a negatively biased method, with accounting regulation, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {S, S, D, D}.

To understand Lemma 1b, first note that both GS and BD prefer to be evaluated by a new method when the old method is negatively biased. As long as the cost of manipulation is not too high for GD, {D, D, D, D} will emerge. However, a prerequisite for {D, D, D, D} to sustain is that the investor cannot view a different information pattern as signaling the bad type in which case GS will not manipulate. If the investor does believe that a different information pattern signals the bad type, then GS will remain status quo. For BD, they won't get investment if they keep displaying a different information pattern. Whether BD will have an incentive to manipulate depends on the belief the investor holds with respect to a similar information pattern. Specifically, if the investor views firms with a similar information pattern as good directly, then BD will have a strong incentive to manipulate, making the belief incorrect. If the investor will simply evaluate the firm upon a similar information pattern, BD will not manipulate because the old method is negatively biased.

Under {S, S, D, D}, because of the negative bias, an even better belief is that the investor will evaluate all firms if only one level of similarity is observed, but view more similar (different) firms as good (bad) if two levels of similarity are observed. Such belief will not only deter BD from manipulation, but also guarantee investment in GS, and is thus a dominant belief. With the dominant belief, {S, S, D, D} is the single best outcome.

3.2.3 Comparisons

I next examine the investment efficiency and social efficiency implications of accounting regulation. To avoid redundancy, I omit equilibrium {S, D, S, D} under a small negative bias in the unregulated economy. Similar to above, I present the results without investor sophistication in Proposition 2 and discuss implications in the text if the presence of investor sophistication changes the results.

Proposition 2: Given a successful experience with a good firm and a negatively biased method,

1) when the negative bias is large, accounting regulation decreases underinvestment in good firms, overinvestment in bad firms, and manipulations;

2) when the negative bias is moderate, accounting regulation decreases underinvestment in good firms and overinvestment in bad firms and has no effect on manipulations;

3) when the negative bias is small, accounting regulation decreases underinvestment in good firms, has no effect on investment in bad firms, and decreases manipulations.

The conclusions from Proposition 2 are very straightforward. As shown in Lemma 2b, when the old method is negatively biased, accounting regulation will enable a fully separating equilibrium. Since the maximum level of investment efficiency cannot be achieved in the unregulated economy, accounting regulation will always improve investment efficiency. Specifically, since neither a negatively biased method nor a new method can guarantee investment in good firms in the unregulated economy, accounting regulation will always decrease underinvestment in good firms. In addition, unless the equilibrium is {S, S, S, D} without accounting regulation, there will always be less overinvestment in bad firms with regulation.

Note that accounting regulation will also have different implications for naive versus sophisticated investors because of different investment efficiencies without accounting regulation. When the negative bias is large (small) such that good firms choose to display a different (similar) information pattern, the decrease in the underinvestment in good firms will be larger (smaller) if the investor is sophisticated and follows the unmanipulated information patterns. For the decrease in overinvestment in bad firms, the magnitude will the largest when both good and bad firms display a different information pattern and the investor cannot see through it, and the smallest when the investor is naive and believes that a different information pattern signals the bad type.

As for manipulations, since no one manipulates in the regulated economy, accounting regulation will always reduce manipulations with the exception of the equilibrium being {S, D, S, D} without accounting regulation. Overall, accounting regulation is strictly beneficial not only for investment efficiency but also for social efficiency.

Successful Experience with a Good Firm	Without Regulation	With Regulation
Large Negative Bias	{D, D, D, D} or {D, D, S, D}	
Moderate Negative Bias	{S, D, S, D}	{S, S, D, D}
Small Negative Bias	{S, S, S, D} or {S, D, S, D}	

Figure 3: List of Equilibria (Experience with a Good Firm and a Negatively Biased Method)

4. Analysis–Experience with a Bad Firm

In this section, I analyze the case where the investor's past successful experience is with a bad firm (i.e., Firm X is bad). When the investor experienced a success with a bad firm (i.e., not investing in Firm X), it is reasonable for the investor to disfavor firms with a similar information pattern, but remain uncertain about firms with a different information pattern. Given the many possible beliefs that can be held by the investor, I assume away the belief that a different information pattern signals the bad type to limit the number of equilibria and make the outcomes more reasonable. When the investor believes that a similar information pattern signals the bad type, firms will have an incentive to display a different information pattern, in which case the investor will evaluate the firms using a new method. As a result, given a successful experience with a bad firm, the bias embedded in the old method will be less relevant, and what matters more will be the precision of a new method. So instead of analyzing the effects of accounting regulation separately for positive bias and negative bias, I focus on the precision of a new method in the following analysis.

4.1 Unregulated Economy

In this sub-section, I analyze the possible equilibria in an unregulated economy. All possible equilibria are summarized in Lemma 3a.

Lemma 3a: Given a successful experience with a bad firm, without accounting regulation,

1) when the precision of a new method is high, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, D, S, D} (only when the old method has a positive bias) and {D, D, S, D};

2) when the precision of a new method is low, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, S, S, S} (only when the old method has a positive bias) and {D, D, D, D}.

To explain the result, first consider the case where the precision of a new method is high. With a high precision, the probability of getting investment will be high (low) for good (bad) firms. As a result, if the investor views a similar information pattern as signaling the bad type, then manipulating to display a different information pattern will be cost-effective only for GS, but not for BS. Since GD and BD have no incentive to manipulate, the resulting equilibrium is {D, D, S, D}.

If the investor does not hold such belief, then GD and BD will prefer to remain status quo when the old method has a negative bias. Meanwhile, GS (BS) will (not) manipulate because of the high precision. So the equilibrium remains at {D, D, S, D}. When the old method has a positive bias and the investor does not view a similar information pattern as signaling the bad type, GS and BS will prefer to remain status quo; GD will not manipulate either because of the high precision. Depending on the magnitude of the positive bias, BD may or may not manipulate. If BD manipulate, {S, D, S, S} will emerge, which is not stable, as the investor can deviate to a better belief. If BD do not manipulate, {S, D, S, D} will emerge, which is a stable equilibrium. Under a positive bias, compared with {S, D, S, D}, {D, D, S, D} leads to more underinvestment in GS but also less overinvestment in bad firms due to lower investment probabilities in BS. So neither equilibrium dominates the other.

When the precision of a new method is low, both GS and BS will have an incentive to manipulate and display a similar information pattern if the investor believes that a similar information pattern signals the bad type. GD and BD will not manipulate in such case. Hence, the equilibrium is {D, D, D, D}. If the investor does not hold such belief and the old method is negatively biased, GD and BD will again not manipulate. For BS, since the marginal benefit from manipulation is high, it will choose to display a different information pattern. For GS, the decision to manipulate hinges on the magnitude of negative bias, and the two possible outcomes are {S, D, D, D} and {D, D, D, D}. {S, D, D, D} is not a stable equilibrium because the investor can deviate to a better belief. When the old method is positively biased, GS and BS will remain status quo. Meanwhile, both GD and BD will manipulate to capitalize on the positive bias. The resulting equilibrium is {S, S, S, S}. Compared with {S, S, S, S} under a positive bias, {D, D, D, D} leads to more underinvestment in good firms but also less overinvestment in bad firms due to lower investment probabilities in all four possible states of Firm Y. So neither equilibrium dominates the other.

To summarize, conditional on the magnitude of the precision p, there are four possible equilibria without accounting regulation: {D, D, S, D}, {S, D, S, D}, {D, D, D, D}, and {S, S, S, S}. In equilibrium, the investor will always evaluate the firm upon a different information pattern. With respect to a similar information pattern, the investor may either evaluate the firm or directly view the firm as bad (i.e., signaling), and the signaling effect will occur only when the precision of a new method is high.

4.2 Regulated Economy

In this sub-section, I analyze the possible equilibria in a regulated economy. By applying the same set of standards and rules in recording and reporting transactions, if Firm Y is good (bad), the unmanipulated information pattern it has will be different from (similar to) that of Firm X. That is, GS will become GD, and BD will become BS. In other words, accounting regulation changes the unmanipulated information patterns for GS and BD. Possible equilibria with accounting regulation are summarized in Lemma 3b.

Lemma 3b: Given a successful experience with a bad firm, with accounting regulation,

1) when the precision of a new method is high, a stable equilibrium of the information pattern choices made by GS, GD, BS, BD is {D, D, S, S};

2) when the precision of a new method is low, stable equilibria of the information pattern choices made by GS, GD, BS, BD are {S, S, S, S} (only when the old method has a positive bias) and {D, D, D, D}.

In a regulated economy, Firm Y has only two possible states: GD and BS, and the unmanipulated information patterns become {D, D, S, S}. Since bad firms will display a similar information pattern without manipulation, a similar information pattern can never signal the good type. For a different information pattern, the belief that a different information pattern signals the good type only when two levels of information pattern similarity are observed dominates the belief that a different information pattern always signal the good type unconditionally because the latter one would impose a strong manipulation incentive on BS. With conditional belief, BS will manipulate to display a different information pattern only when the precision of a new method is low. Thus, when the precision of a new method is high, a fully separating equilibrium {D, D, S, S} will emerge, whereas when the precision of a new method is low, the equilibrium will be {D, D, D, D}.

Another possible situation is that the investor will simply evaluate the firm all the time. In such case, if the old method is negatively biased, GD will prefer not to manipulate. Meanwhile, BS will (not) manipulate when the precision of a new method is low (high). While the firms' choices in the equilibria are the same as above, the investor would perform better by viewing a similar information pattern as signaling the bad type when the precision is high. If the old method is positively biased, BS will remain status quo. For GD, they will manipulate when the precision is low, resulting in {S, S, S, S}. Under a positive bias, compared with {S, S, S, S}, {D, D, D, D} leads to both more underinvestment in good firms and less overinvestment in bad firms. So neither equilibrium dominates the other.

4.3 Comparisons

I next examine the investment efficiency and social efficiency implications of accounting regulation. To limit the number of comparisons, I hold the bias of the old method and the investor's belief constant for the low precision case. Similar to above, I present the results without investor sophistication in Proposition 3 and discuss implications in the text if the presence of investor sophistication changes the results.

Proposition 3: Given a successful experience with a bad firm,

1) when the precision of a new method is high, accounting regulation decreases underinvestment in good firms, overinvestment in bad firms, and (weakly) manipulations;

2) when the precision of a new method is low, accounting regulation has no effect on investment efficiency and may increase manipulations.

Part 1) of Proposition 3 is not a very surprising result. When the precision of a new method is high, investment efficiency will achieve its maximum with accounting regulation. In contrast, without accounting regulation, underinvestment in good firms and overinvestment in bad firms will always exist. As a result, accounting regulation can help decrease both underinvestment and overinvestment. Note that when the equilibrium without accounting regulation is {D, D, D, D}, the decrease in underinvestment in good firms will be more pronounced for a naive (sophisticated) investor when the old method has a positive (negative) bias because following the unmanipulated information pattern yields a higher (lower) probability in investment in GD than following the manipulated information pattern does. By the same logic, the decrease in overinvestment in bad firms will be more pronounced for a sophisticated investor under a positive bias. As for manipulations, since no manipulation is to occur in the regulated economy, accounting regulation will also reduce manipulations, unless the equilibrium without accounting regulation is {S, D, S, D}.

When the precision of a new method is low, the equilibria are the same with and without accounting regulation. Therefore, only when the investor is sophisticated will accounting regulation have a positive impact on investment efficiency. Moreover, it is possible that accounting regulation will decrease social efficiency by triggering more manipulations. The reason is that under {D, D, D, D}, GS and BS will manipulate without accounting regulation, whereas BS and BD will manipulate with accounting regulation. So which regime will have more manipulations depends on whether there are more GS or BD in the economy. Similarly, under {S, S, S, S}, accounting regulation will increase manipulations if there are more GS than BD in the economy, and vice versa.

Successful Experience with a Bad Firm	Without Regulation	With Regulation
High Precision	{S, D, S, D} (positive bias only) or {D, D, S, D}	{D, D, S, S}
Low Precision	{S, S, S, S} (positive bias only) or {D, D, D, D}	{S, S, S, S} (positive bias only) or {D, D, D, D}

Figure 4: List of Equilibria (Experience with a Bad Firm)

5. Additional Analysis

5.1 Optimal Experience

In this section, I ask the following two questions: 1) what is the optimal bias? and 2) will the investor perform better with a successful experience with a good firm or a bad firm? I answer those two questions by comparing the investment efficiencies across the possible equilibria in different settings under the two regimes. Since a sophisticated investor can always see through manipulations, I adopt the view of a naive investor and focus on investment efficiency in the following analysis.

5.1.1 Regulated Economy

In this sub-section, I compare the equilibria with accounting regulation, and Corollary 1 summarizes a main finding.

Corollary 1: With accounting regulation, a combination of a successful experience with a good firm and a negatively biased method weakly dominates all other possible combinations.

The conclusion from Corollary 1 is an interesting but perhaps not too surprising one. Recall from Lemmas 1b, 2b, and 3b, a fully separating equilibrium is always possible with accounting regulation. For a fully separating equilibrium to emerge, a sufficient condition is that bad firms will have no incentive to mimic good firms. Since the benefits from manipulations are determined by the evaluation method the investor will use, the benefits are the lowest when the investor will use a negatively biased method. Meanwhile, since bad firms have an incentive to mimic good firms, for the investor to apply the old method to bad firms, good firms will need to display a similar information in the first place, which calls for a successful experience with a good firm. Overall, a fully separating equilibrium will span over a wider range of manipulation cost with a negatively biased method and a successful experience with a good firm than when the old method is positively biased or when the successful experience is with a bad firm.

As a practical matter, however, it may be difficult for a combination of a negatively biased method and a successful experience with a good firm to exist because compared with a positively biased method, a negatively biased method is less likely to yield a favorable outcome when applied to good firms. Similarly, if the investor uses a negatively biased method, then it is more likely for the investor to experience a success with a bad firm than with a good firm.

Under pooling equilibria, the equilibrium with a positively biased method and a successful experience with a good firm is {S, S, S, S}, whereas he equilibrium with a successful experience with a bad firm is {D, D, D, D}, unless the old method is positively biased and the investor does not hold a view against a similar information pattern where the equilibrium will be {S, S, S, S}. It is easy to see that there will be weakly less underinvestment in good firms but also weakly more overinvestment in bad firms when the investor succeeded in investing in a good firm in the past with a positively biased method.

A caveat in the above discussion is that I am only comparing the absolute level of investment efficiency with accounting regulation. In other words, Corollary 1 does not address the issue as to when the investor will benefit the most from accounting regulation, which is a more open question. The reason is that the amount of improvement in investment efficiency is jointly determined by the level of investment efficiency without accounting regulation. For example, when the old method is positively (negatively) biased, overinvestment in bad firms (underinvestment in good firms) is the major impediment to investment efficiency. To the extent that overinvestment in bad firms is a more severe problem than underinvestment in good firms, it is not impossible that the investor will benefit more from accounting regulation with a positively biased method than with a negatively biased method.

5.1.2 Unregulated Economy

In this sub-section, I compare the equilibria without accounting regulation. Given there are four possible combinations between bias (i.e., positive versus negative) and experience type (i.e., Firm X is good versus bad), I rule out dominated equilibria within each combination and only make feasible comparisons. Since some equilibria may be the same in form even when the biases are different, I use subscript G (B) to denote experience with a good (bad) firm and P (N) to denote positive (negative) bias. Corollary 2 summarizes the results.

Corollary 2: Without accounting regulation,

1) given a successful experience with a good firm, compared with a negatively biased method, a positively biased method leads to less underinvestment in good firms and may lead to less overinvestment in bad firms and manipulations;

2) given a successful experience with a bad firm, compared with a negatively biased method, a positively biased method leads to weakly less underinvestment in good firms, weakly more overinvestment in bad firms, and weakly fewer manipulations;

3) given a positively biased method, compared with a successful experience with a bad firm, a successful experience with a good firm leads to less underinvestment in good firms and weakly more manipulations and may lead to less overinvestment in bad firms;

4) given a negatively biased method, compared with a successful experience with a bad firm, a successful experience with a good firm leads to weakly more underinvestment in good firms and may lead to more overinvestment in bad firms and manipulations.

To explain part 1) of Corollary 2, first note that with a successful experience with a good firm, $\{S, S, S, D\}_{GP}$ is the dominant equilibrium under a positive bias, whereas $\{S, S, S, D\}_{GN}$ and $\{D, D, S, D\}_{GN}$ are the two undominated equilibria under a negative bias. When the equilibrium is $\{S, S, S, D\}_{G\bullet}$, BD will not get investment, and GS, GD, and BS will be evaluated by the old method. As a result, compared with $\{S, S, S, D\}_{GN}$, $\{S, S, S, D\}_{GP}$ will lead to higher investment probabilities in GS, GD, and BS, which is equivalent to both less underinvestment in good firms and more overinvestment in bad firms.

When the equilibrium is $\{D, D, S, D\}_{GN}$ under a negative bias, $\{S, S, S, D\}_{GP}$ will lead to higher investment probabilities in GS, GD, and BS. Meanwhile, the investment probability in BD is lower under $\{S, S, S, D\}_{GP}$ than under $\{D, D, S, D\}_{GN}$. The underlying reason for the seemingly surprising result is that when the old method has a small positive bias, everyone but BD will choose to display a similar information pattern, which makes a different information pattern a signal of the bad type. In contrast, a different information pattern may not be a signal of the bad type when the old method is negatively biased because GS will choose to display a different information pattern. In such case, BS, rather than BD, will not get investment. To the extent that there are more BD than BS in the economy, overinvestment in bad firms can be less severe under $\{S, S, S, D\}_{GP}$ than under $\{D, D, S, D\}_{GN}$. As for manipulations, more manipulations are expected under $\{D, D, S, D\}_{GN}$ than under $\{S, S, S, D\}_{GP}$ if there are more GS than GD in the economy.

For part 2) of Corollary 2, the comparisons are between $\{S, D, S, D\}_{BP}$ or $\{D, D, S, D\}_{BP}$ and $\{D, D, S, D\}_{BN}$. When the equilibrium is $\{D, D, S, D\}_{B\bullet}$, investment probabilities across the two biases are the same for GD, GS, and BD. For BS, since the investor views a similar information pattern as signaling the bad type under $\{D, D, S, D\}_{BP}$, BD will not get investment even when the old method is positively biased. As a result, under $\{D, D, S, D\}_{B\bullet}$, investment efficiencies are the same across different biases.

To compare $\{S, D, S, D\}_{BP}$ with $\{D, D, S, D\}_{BN}$, it can be seen that investment probabilities are the same for both GD and BD across the two regimes. Meanwhile, GS are more likely to get investment when evaluated by a positively biased method than by a new method, and BS is also more likely to get investment when evaluated by a positively biased method than by a negatively biased method or being signaled. So $\{S, D, S, D\}_{BP}$ leads to both less underinvestment in good firms and more overinvestment in bad firms. In terms of manipulations, GS will always manipulate under a negative bias, whereas GS may or may not manipulate under a positive bias. So a negative bias will lead to weakly more manipulations.

The comparisons for part 3) of Corollary 2 are between $\{S, S, S, D\}_{GP}$ and $\{S, D, S, D\}_{BP}$ or $\{D, D, S, D\}_{BP}$. It can be seen that under a positive bias, a successful experience with a good firm will always lead to less underinvestment in good firms. The driving force for the result lies in the misalignment between the positive bias and experience with a bad firm. When the old method is positively biased, to minimize underinvestment, the investor will need to keep using the old method. However, when the successful experience is with a bad firm, the investor will naturally disfavor firms with a similar information pattern, thus limiting the use of the old method. At the same time, a successful experience with a good firm may also lead to less overinvestment in bad firms. Similar to that of part 1) of Corollary 1, the reason is that a different (similar) information pattern may signal the bad type when the successful experience is with a good (bad) firm. So if there are more BD than BS in the economy,[11] it is likely that overinvestment will be less severe when the successful experience is with a good firm. Notwithstanding its superiority in investment efficiency, $\{S, S, S, D\}_{GP}$ will lead to more manipulations when compared with $\{S, D, S, D\}_{BP}$.

Finally, for part 4) of Corollary 2, one comparison is between $\{S, S, S, D\}_{GN}$ and $\{D, D, S, D\}_{BN}$, both of which involve a signaling belief. When the successful experience is with a good (bad) firm, a different (similar) information pattern signals the bad type, and GS and GD will be evaluated by the old (a new) method. Due to the negative bias embedded in the old method, underinvestment in good firms will be less severe when the successful experience is with a bad firm than when the successful experience is with a good firm.

While a successful experience with a good firm may lead to more underinvestment in good

[11] This is from the view of an investor with a successful experience with a good firm.

firms, it may lead to less overinvestment in bad firms. Given a successful experience with a good firm, the investor will have two tools in reducing overinvestment: the negatively biased method and a belief that a different information pattern signals the bad type. In contrast, when the successful experience is with a bad firm, the two tools coincide, and overinvestment in bad firms will necessarily occur when bad firms display a different information pattern. Overall, under a negative bias, for the investor to avoid overinvestment in bad firms, the investor will need to view a different information pattern as signaling the bad type, which will inevitably lead good firms to display a similar information pattern and thus result in more underinvestment.

Another comparison is between $\{D, D, S, D\}_{GN}$ and $\{D, D, S, D\}_{BN}$. While they are the same in form, a key difference is that the numbers of bad firms displaying a similar information are different due to different past experiences. If there are more BD than BS in the economy,[12] the former will lead to more overinvestment in bad firms, and vice versa. In terms of manipulations, whether a successful experience with a good firm or a successful experience with a bad firm will lead to more manipulations depends on the numbers of GS and GD in the economy.

In summary, it appears that without accounting regulation, the investor will perform the best with a successful experience with a good firm and a positively biased method. The reason is twofold. First, in an unregulated economy, neither a similar information pattern nor a different one may signal the good type. Hence, underinvestment in good firms will be the lowest when the investor uses a positively biased method, which requires that the investor has a successful experience with a good firm and thus does not hold a view against similar information patterns.

Second, for investment in bad firms, one way to achieve a low level of overinvestment is to use a negatively biased method. Meanwhile, since either a similar information pattern or a different information pattern may serve as a signal of the bad type, signaling can replicate the effect of a negatively biased method in lowering overinvestment. However, a major difference

[12] Again, this is from the view of an investor with a successful experience with a good firm.

between signaling by a similar information pattern and signaling by a different information pattern is that while the former is a substitute to a negatively biased method, the latter is a complement. In other words, unless the investor uses a negatively biased method and has a successful experience with a good firm (in which case there will be a large amount of underinvestment in good firms), the levels of overinvestment are comparable when the investor uses a positively biased method or has a successful experience with a bad firm. Taken together, a positively biased method, together with a successful experience with a good firm, is likely to yield the highest level of investment efficiency, given the large benefits and limited costs.

Undominated Equilibria	Positive Bias	Negative Bias
Successful Experience with a Good Firm	{S, S, S, D}	{S, S, S, D} or {D, D, S, D}
Successful Experience with a Bad Firm	{S, D, S, D} or {D, D, S, D}	{D, D, S, D}

Figure 5: List of Undominated Equilibria for Four Types of Experiences without Accounting Regulation

5.2 Optimal Regulation

In previous sections, I examine the case where accounting regulation leads to a corner level of similarity in firms' information patterns using a binary model. In this sub-section, I extend the main analysis by analyzing a continuous model where accounting regulation can mandate an intermediate level of information pattern similarity in order to provide more policy implications. Specifically, let the stringency of accounting regulation be $\lambda \in [0, \overline{\lambda}]$ such that $\lambda = 0$ denotes the loosest regulation and $\lambda = \overline{\lambda}$ denotes the most stringent regulation. I define the optimal λ as the one that maximizes social efficiency, which is investment efficiency net of the social cost of manipulations.

For space consideration, I mainly discuss the case where the past successful experience is with a good firm; the case where the past successful experience is with a bad firm will be briefly mentioned in the end. Since accounting regulation exists, there will only be two states of Firm Y: good (GT) and bad (BT). Without loss of generality, I assume there is one GT and one BT in the economy. Let $\tau_{G(B)}$ denote the similarity in the unmanipulated information pattern for GT (BT) such that $\tau_G = \tau_{G0}$ and $\tau_B = \tau_{B0}$ with $\tau_{G0} > \tau_{B0}$ under $\lambda = 0$. When $\lambda > 0$, $\tau_G = \tau_{G0} + g\lambda$ and $\tau_B = \tau_{B0} - b\lambda$ with $g > 0$ and $b > 0$ capturing the differential effects of accounting regulation on GT and BT, respectively. Let $w_{G(B)}$ denote the information pattern choice made by GT (BT). I allow a full action space for both firms such that $0 \leqslant w_G, w_B \leqslant 1$.

To facilitate the analysis, I abstract away from investor sophistication, and make two more assumptions. First, the investor is able to discern an interior level of similarity in information patterns such that the probability that the investor uses the old (a new) method is given by w $(1-w)$. Second, when firms are indifferent, I assume that they will always choose to separate. In Proposition 4, I summarize the key findings.

Proposition 4: For separation:

1) When i) the successful experience is with a good firm and the old method is positively biased, or ii) the successful experience is with a bad firm and the old method is negatively biased, if separation can be achieved in a costless manner, optimal accounting regulation is i) any degree of regulation, or ii) sufficiently stringent regulation, or iii) sufficiently loose regulation. If separation needs to be achieved in a costly manner, either the most stringent or an intermediate degree of accounting regulation is optimal.

2) When i) the successful experience is with a good firm and the old method is negatively biased, or ii) the successful experience is with a bad firm and the old method is positively biased, if separation can be achieved in a costless manner, optimal accounting regulation is either any degree of regulation or sufficiently stringent regulation. If separation needs to be achieved in a costly manner, the most stringent accounting regulation is optimal.

3) Provided that separation can be achieved, the more stringent accounting regulation, the higher the social efficiency.

4) In costly separations, a negatively biased method yields a higher level of social efficiency than a positively biased method does.

If social efficiency under a pooling equilibrium is higher than that under the least costly separation:

5) When i) the successful experience is with a good firm and the old method is positively biased, or ii) the successful experience is with a bad firm and the old method is negatively biased, optimal accounting regulation is i) the loosest regulation, or ii) the most stringent regulation, or iii) an intermediate degree of accounting regulation.

6) When i) the successful experience is with a good firm and the old method is negatively biased, or ii) the successful experience is with a bad firm and the old method is positively biased, optimal accounting regulation is either the loosest regulation or an intermediate degree of accounting regulation.

7) In separating equilibria, the good firm may or may not manipulate and the bad firm never manipulates. In pooling equilibria, the good firm may or may not manipulate and the bad firm always manipulates.

To explain Proposition 4, first consider the case where the past successful experience is with a good firm. To induce separation, the investor will set a separation point that is at least as high as τ_G in terms of similarity. Following the logic above, since viewing a firm as good for achieving a certain level of similarity (i.e., separation point) conditionally is always better than an unconditional view, BT's probability of getting investment is either zero or determined by evaluation in equilibrium. Suppose the separation point is set at τ_G, there are several possible situations when the old method is positively biased.

First, BT has no incentive to mimic GT under the loosest regulation. When accounting regulation becomes more stringent, τ_G becomes higher. Under the conditional belief, since the old method is positively biased, BT's benefit from achieving τ_G will increase, as the investor will be more likely to use the old method. Meanwhile, BT's cost of manipulation will also increase because the gap between GT's and BT's unmanipulated information pattern similarity will widen. Therefore, one possibility is that BT will never mimic GT, regardless of accounting regulation. In such case, the stringency of accounting regulation does not matter, as a costless separation can always be achieved. Another possibility is that BT will mimic GT for some intermediate degrees of accounting regulation. In such case, to achieve costless separation, accounting regulation needs to be either sufficiently loose or sufficiently stringent.

Second, BT has an incentive to mimic GT under the loosest regulation. Since manipulation cost is convex in the amount of manipulation, there will always exist a separation point above which BT will not manipulate. If BT has no incentive to mimic GT when accounting regulation is the most stringent, then a costless separation can be achieved for sufficiently stringent regulation. Note that a costless separation represents the most ideal situation for social efficiency because the maximum level of investment efficiency is achieved without any cost.

However, it is likely that BT will have an incentive to mimic GT even under the most stringent regulation. If that's the case, then separation can be achieved only if GT manipulates to $\tau_S > \tau_G$ such that it is irrational for BT to mimic at $w_B = \tau_S$. For τ_S, it decreases as accounting regulation becomes more stringent. The reason is that with more stringent regulation, BT's unmanipulated level of information pattern similarity will be lower, and it will thus be more costly for BT to reach a specific level of information pattern similarity. Meanwhile, since GT will have a more similar information pattern with more stringent regulation, the cost of manipulation for separation will be lower for GT when accounting regulation is more stringent.

Nevertheless, whether GT will choose to manipulate to the separation point depends on the investor's belief. If the investor holds a view against any information pattern similarity lower than τ_S, then GT will always choose to manipulate, resulting in a separating equilibrium.[13] The most stringent regulation is optimal because it minimizes the amount of manipulation for GT.

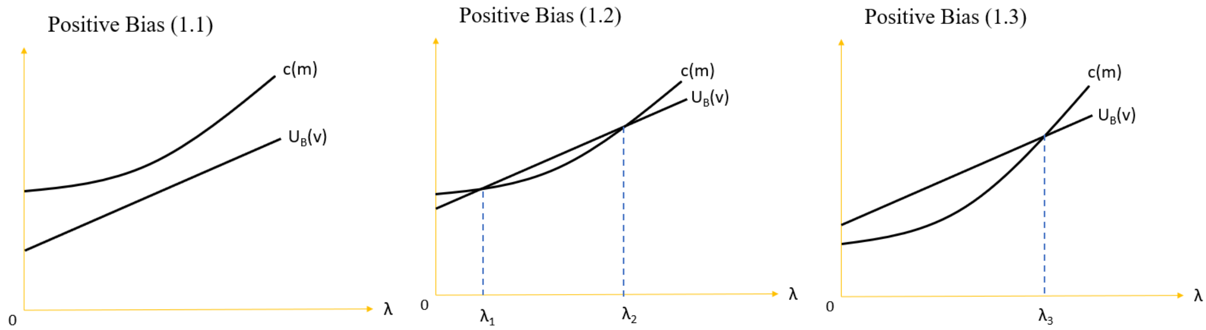
Alternatively, if the investor allows pooling at similarity levels lower than τ_S, then the issue becomes whether it is incentive compatible for GT to separate relative to pooling with BT. With more stringent accounting regulation, GT's unmanipulated information pattern similarity will be higher, and the benefit from separation for GT will be lower. At the same time, however, it will be less costly for GT to separate, as the separation point τ_S will be lower. With a convex cost function, GT will find it incentive compatible to separate under 1) all degrees of regulation, or 2) sufficiently stringent regulation, or 3) an intermediate range of regulation, or 4) sufficiently loose regulation, or it is never incentive compatible for GT to do so. Under a separating equilibrium, since the amount of manipulation needed to separate decreases in the stringency of accounting regulation, the more stringent regulation, the higher social efficiency.

In other cases, GT will prefer being mimicked by BT. Under a pooling equilibrium, more stringent accounting regulation will increase the investment probability in GT, but will also increase the investment probability in BT and the amount of manipulations. As a result, optimal accounting regulation features a corner level of stringency among the degrees of stringency which will lead to a pooling equilibrium. In pooling equilibria, since GT prefers a higher level of similarity, it may either manipulate upwards or not, depending on the cost of manipulation relative to the benefits. GT's potential manipulation will weakly increase the amount of manipulation that will be needed for BT to pool with GT.

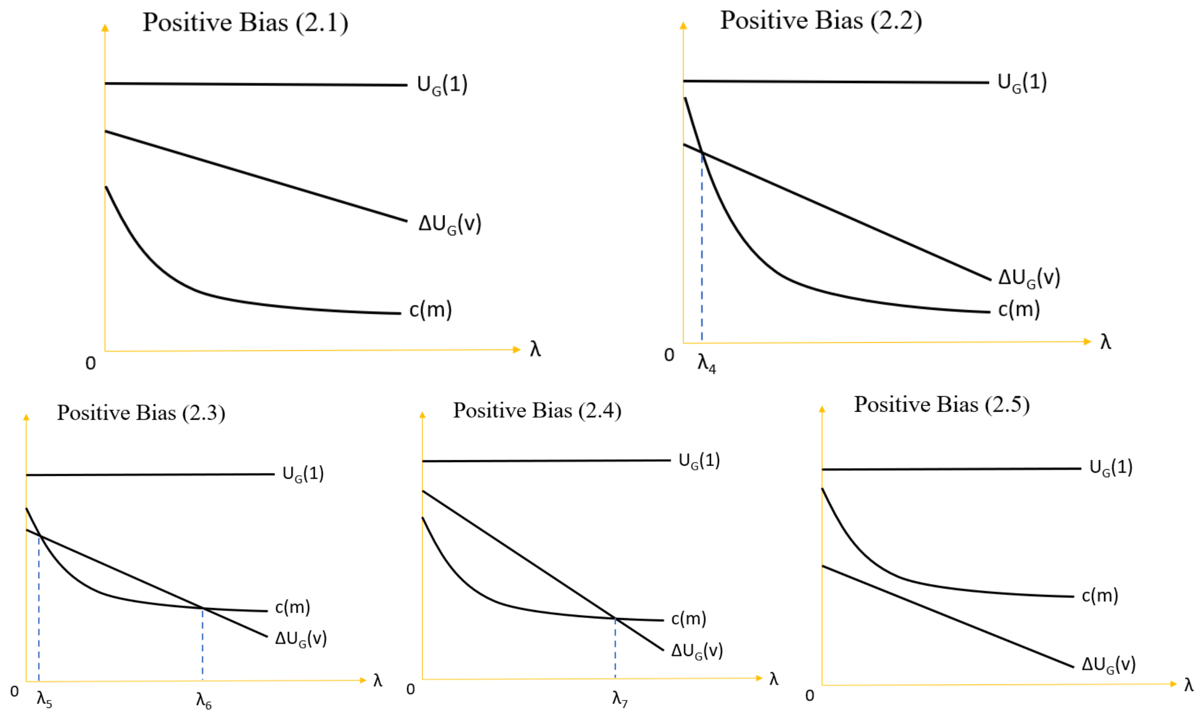
Note that allowing pooling at lower levels of information pattern similarity opens up more possibilities for pooling. While a pooling equilibrium is always worse than a separating equi-

[13] An assumption here is that there always exists a $\tau_S \leqslant 1$ at which BT will have no incentive to pool with GT.

librium in terms of investment efficiency, it nevertheless may lead to higher social efficiency if the amount of manipulation that is needed for BT to pool with GT is less than that is needed for GT to separate from BT.[14] To the extent that 1) the social loss from manipulation is sufficiently high, and 2) the amount of manipulation needed for BT to pool is low relative to the manipulation needed for GT to separate, the society will be better off with the investor allowing pooling at lower levels of information pattern similarity.



Figures 6a, 6b 6c: Relation Between Regulation Stringency and BT's Cost and Benefit of Manipulation (Experience with a Good Firm and a Positively Biased Method)



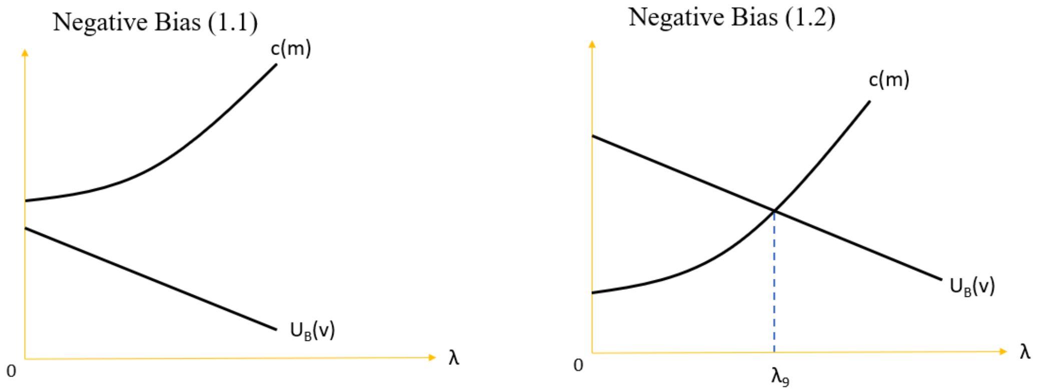
Figures 7a, 7b, 7c, 7d, 7e: Relation Between Regulation Stringency and GT's Cost and Relative Benefit of Manipulation (Experience with a Good Firm and a Positively Biased Method)

[14]This statement is based on a neutral assumption that the social costs of manipulations are the same for good and bad firms. In cases where good firms' manipulations will entail greater social loss than bad firms' manipulations, pooling equilibria will have an additional advantage over separating equilibria.

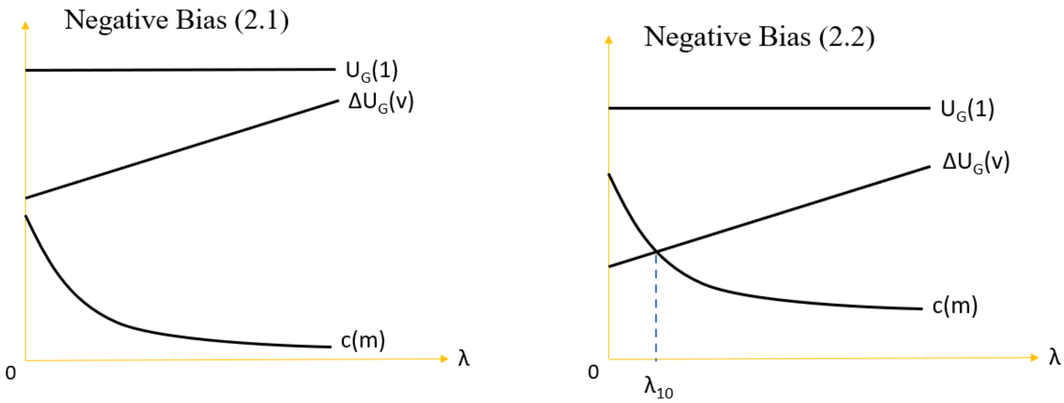
When the old method is negatively biased, there a few differences. First, since the old method is negatively biased, BT's benefit from pooling will decrease when the similarity level is higher. Therefore, if BT has no incentive to mimic GT under the loosest regulation, then BT will never mimic GT for any degree of accounting regulation. If BT has an incentive to mimic GT under the loosest regulation, then there will always exist a separation point above which BT will not manipulate. As long as BT has no incentive to mimic GT under the most stringent regulation, then a costless separation can be achieved with sufficiently stringent regulation.

Second, if BT has an incentive to mimic GT even under the most stringent regulation, then the most stringent accounting regulation is always optimal for separation, regardless of the investor's belief. The reason is that even if the investor allows pooling, since more stringent regulation leads to a higher level of information pattern similarity for GT, the investment probability in GT will decrease as regulation tightens because the old method is negatively biased. As a result, the benefit from separation will be higher for GT when regulation is more stringent. Meanwhile, as the separation point will decrease with more stringent regulation, the cost of manipulation to achieve separation will decrease. With an increase in benefit and a decrease in cost, GT will have the largest incentive (i.e., net benefit) to separate from BT under the most stringent regulation. Given that a separation point always exists under a negatively biased method because BT will never manipulate to $w_B = 1$, the most stringent accounting regulation is always optimal for separation.

That said, under sufficiently loose regulation, it is possible that GT will prefer pooling over separation. In such case, the optimal accounting regulation again features a corner degree of stringency, which is either the loosest regulation or the most stringent regulation which does not induce separation. In pooling equilibria, since GT prefers to be evaluated by a new method, it may manipulate to become less similar or not, which will weakly reduce the amount of manipulation that will be needed for BT to pool with GT.



Figures 8a, 8b: Relation Between Regulation Stringency and BT's Cost and Benefit of Manipulation (Experience with a Good Firm and a Negatively Biased Method)



Figures 9a, 9b: Relation Between Regulation Stringency and GT's Cost and Relative Benefit of Manipulation (Experience with a Good Firm and a Negatively Biased Method)

All the discussions above concern the case where the past successful experience is with a good firm. When the past successful experience is with a bad firm, the implications are generally the same with a few exceptions. Specifically, since GT will by default be less similar than BT and more stringent regulation will make GT more different and BT more similar, the separation point will be set to $\tau_S \leqslant \tau_G$. Moreover, when manipulating to become more different, the benefit from pooling will decrease (increase) when the old method is positively (negatively) biased. Hence, the implication are flipped in a systematic way in the sense that the combination of a successful experience with a bad firm and a negatively biased method is in line with the combination of a successful experience with a bad firm and a positively biased method, and vice versa.

As a final note, conditional on the past successful experience, social efficiency is higher when the old method is negatively biased than when the old method is positively biased under the least costly separation. The reason is that when BT's benefit from pooling comes from evaluation, BT is always less likely to get investment when the investor uses a negatively biased method as opposed to a positively biased one. As a result, the separation point is always lower (higher) when the old method is negatively (positively) biased. Therefore, the amount of manipulation needed for separation is always lower for GT under a negatively biased method.

6. Empirical Implications

In this section, I summarize the empirical implications that can be drawn from the model and discuss the potential ways to interpret and test the relevant predictions.

One of the biggest implications of the paper is related to the consequences of accounting regulation in terms of both investment efficiency and managerial manipulations which are summarized in Propositions 1, 2, and 3. Since the comparisons are between regimes with and without accounting regulation, private firms which are not subject to accounting regulation are good candidates for testing the predictions if data are available. A caveat when studying private firms is that self-selection can be a concerning issue that good firms are more likely to adopt the prevailing standards and get audited. In the public firm realm, while it is impossible to find an economy which has data but no accounting regulation, empirical researchers can examine the effects of accounting regulation in an indirect way. For example, one can identify a sample of non-U.S. firms which were first listed in a domestic market and then (cross-)listed in the U.S. and reported under U.S. GAAP. Since U.S. GAAP is usually viewed as of high quality, the changes in firms' reporting and investors' investment behaviors can be viewed as the effects of accounting regulation. Ideally, those firms would be headquartered in countries with loose standards or poor implementations.

Moreover, for the predictions in Propositions 1 through 3, there can actually be two ways of testing, depending on researchers' priors. Take IFRS adoption for example. On one hand, if one has a firm belief about IFRS being better or worse than the local GAAP, then one may use empirical findings around IFRS adoption to check if my predictions are correct. On the other hand, since standard setting can be a very political process (e.g., Zeff 2002, Johnston and Jones 2006, Gipper, Lombardi, Skinner 2013), it is not necessary that new standards are always better than old ones. Hence, a perhaps more ambitious way of using the predictions is to address the question of how IFRS is compared with the local GAAP by looking at the changes in manipulations and investment efficiencies concurrently.[15] That is, the predictions in the paper may help researchers figure out which set of standards is actually of higher quality through reverse engineering.

In conducting reverse engineering, one should be cautious that my predictions are conditional on the different types of investor experience. While a positively biased method is more likely to capture the competitiveness of market participation than a negative bias is,[16] there exist many proxies for the magnitude of market bias such as the high-low index, bullish percentage index, etc. Or empirical researchers also enjoy the luxury of using ex-post outcomes to measure whether the market was positively or negatively biased ex ante.

As for experiences with a good firm versus with a bad firm, they might be relatively harder to capture directly. However, one potential proxy is the overall economic environment. To the extent that those who stay in the market are likely to be winners in the past, a booming (shrinking) economy is more likely to be associated with experiences with good (bad) firms. Alternatively, normal sense suggests that a successful experience with a good (bad) firm is more (less) likely to be present in the market. The reason is that for investment to be successful with a bad firm, the investor must have not invested in the firm. Without investment, it is possible that the firm will cease to operate, making its true type unknown. Furthermore, while I am not aware of any empirical evidence, it is likely to be the case that a negatively biased method is associated more with a successful experience with a bad firm than with a good firm, and vice versa.

My paper also offers several empirical implications on the relation between accounting

[15]The idea can broadly generalize to the implementations of any new standard.

[16]For investors to keep using a specific method, they must have experienced a success with such method. Compared with investors who use a positively biased method, investors who use a negatively biased method may have much fewer opportunities to invest, test their investment philosophies, and experience a success. As a result, it may not be possible for investors to keep using a negatively biased method, let alone a commitment to do so.

regulation and evaluation biases. One example is that the equilibrium is predicted to be {S, S, S, S} when the positive bias is large. Again, there are two ways to interpret the result. First, to the extent that a large bias in the evaluation process is the most likely to persist in practice, the equilibrium features an outcome where all the firms will want to display a rosy picture of firm performance, which may indeed reflect the reality. Conversely, if the real economy is characterized as both good and bad firms choosing to manipulate, then the results indicate that the market tends to use a fairly positively biased method in the evaluation of investment opportunities. Depending on one's understanding of the world, the results in the paper can be used in multiple ways.

Another prediction related to evaluation biases is based on Corollaries 1 and 2. To be more specific, my result suggests that without accounting regulation, investors in the market are likely to perform the best by being aggressive (i.e., use a positively biased method), whereas with accounting regulation, they will be better off being less aggressive (i.e., use a negatively biased method). Therefore, empirical researchers can test whether a negative relation exists between market sentiment and accounting regulation, which may highlight the stabilizing role of accounting regulation. An additional empirical implication is that if investors do adjust their evaluation methods according to regulation, then the effect of accounting regulation will mainly concentrate on reducing overinvestment in bad firms. Moreover, if a negatively (positively) biased method is more likely to foster a successful experience with a bad (good) firm, then accounting regulation could curb investment in good firms.[17]

Furthermore, my paper provides new insights on the interplay between investor sophistication and accounting regulation. While in many cases accounting regulation is more beneficial with the presence of investor sophistication, one needs to be cautious that the result is not equiv-

[17] This statement is based on a comparison between {D, D, S, D} and {S, S, S, S} or {S, D, S, D} or {S, S, S, D}.

alent to sophisticated investors necessarily faring better than naive investors. Rather, in many cases it is because sophisticated investors will perform worse than naive investors without accounting regulation so that they will benefit more from accounting regulation. On the empirical side, the results attribute the differential effects of IFRS adoption in different countries to a new determinant—the level of market sophistication.

Last but not least, a general observation from Proposition 4 is that while stringent regulation is more likely to lead to a separating equilibrium, loose regulation is more likely to lead to a pooling equilibrium. In pooling equilibria, bad firms will manipulate, whereas good firms may manipulate in separating equilibria. To the extent that the social cost of manipulations represents discounted future losses such as lower levels of innovation, empirical researchers may conduct tests to see whether a negative relation exists between regulation stringency and the number of patents in the economy for example, provided that manipulations by good firms have a stronger effect on innovation than those by bad firms.

7. Conclusion

In this paper, I treat accounting regulation as regulating unmanipulated patterns in the financial information managers can supply to the market and compare managerial manipulation decisions in an unregulated economy versus in a regulated economy. Depending on how biased the evaluation method the investor will use is upon a similar information pattern and whether the investor's past experience is with a good or a bad firm, accounting regulation may either increase or decrease investment efficiency and social efficiency. The effects also vary with whether the investor is sophisticated or naive. Optimal accounting regulation needs to condition on different types of investor experience and take into account potential side effects. It is hoped that the results in the paper can offer useful policy and empirical implications en route to creating a better world via accounting.

Appendix A: Proofs

Proof of Lemma 1a:

Let $r_i \in \{S, D\}$ denote the information pattern similarity choice made by Firm Y in state $i \in \{GS, GD, BS, BD\}$.

When the investor is sophisticated and thus able to see through manipulations, the information patterns used by a sophisticated investor are always {S, D, S, D}. It is apparent that neither S nor D can signal the good or the bad type. So in the following, beliefs on signaling apply only when the investor is naive.

First consider the belief such that S signals the good type. For BS, $E_{BS}(r_{BS} = S) = (u\alpha + 1 - u)\gamma$, and $E_{BS}(r_{BS} = D) = [u\alpha + (1-u)(1-p)]\gamma - k < (u\alpha + 1 - u)\gamma$. So S is the dominant strategy for BS, which contradicts the belief that S signals the good type.

Suppose D signals the good type. For BD, $E_{BD}(r_{BD} = D) = [u(1-p) + 1 - u]\gamma$, and $E_{BD}(r_{BD} = S) = [u(1-p) + (1-u)\alpha]\gamma - k < [u(1-p) + 1 - u]\gamma$. So D is the dominant strategy for BD, which contradicts the belief that D signals the good type.

Suppose D signals the bad type. For GS, $E_{GS}(r_{GS} = S) = \gamma$, and $E_{GS}(r_{GS} = D) = u\gamma - k < \gamma$. So S is the dominant strategy for GS.

For BS, $E_{BS}(r_{BS} = S) = \alpha\gamma$, and $E_{BS}(r_{BS} = D) = [u\alpha + (1-u)(1-p)\gamma - k < \alpha\gamma$ since $\alpha > 1 - p$. So S is also the dominant strategy for BS.

For GD, $E_{GD}(r_{GD} = D) = up\gamma$, and $E_{GD}(r_{GD} = S) = (up + 1 - u)\gamma - k > up\gamma$ if $\kappa < 1 - u$.

For BD, $E_{BD}(r_{BD} = D) = u(1-p)\gamma$, and $E_{BD}(r_{BD} = S) = [u(1-p) + (1-u)\alpha]\gamma - k > u(1-p)\gamma$ if $\alpha > \frac{\kappa}{1-u} \Leftrightarrow \kappa < (1-u)\alpha$.

When $\kappa < (1-u)\alpha$, $r_{BD} = r_{GD} = S$. The strategy profile{S, S, S, S} agrees with the belief.

When $(1-u)\alpha < \kappa < 1 - u$, $r_{BD} = D$ and $r_{GD} = S$. The strategy profile {S, S, S, D} agrees with the belief.

When $\kappa > 1 - u$, $r_{BD} = r_{GD} = D$. The strategy profile {S, D, S, D} contradicts the belief.

Suppose there is no signaling that the investor always evaluates the firm. S remains the dominant strategy for GS and BS. For GD, $E_{GD}(r_{GD} = D) = p\gamma$, and $E_{GD}(r_{GD} = S) = (up + 1 - u)\gamma - k > p\gamma$ if $\kappa < (1-u)(1-p)$. For BD, $E_{BD}(r_{BD} = D) = (1-p)\gamma$, and $E_{BD}(r_{BD} =$

$S) = [u(1-p)+(1-u)\alpha]\gamma - k > (1-p)\gamma$ if $\alpha < 1-p+\frac{\kappa}{1-u}$. Depending on the parameter values, {S, S, S, S}, {S, D, S, S}, {S, D, S, D}, and {S, S, S, D} are all possible. With {S, D, S, S}, since $p < 1$ for GD, the investor can deviate by viewing D as signaling the good type. But with such belief, BD will also deviate, leading to {S, D, S, D}. So I rule out {S, D, S, S} without signaling.

With {S, S, S, D}, since $\alpha > 0$ for BD, the investor can deviate by viewing D as signaling the bad type. But with such belief, BD will deviate if $\frac{\kappa}{1-u} < \alpha < 1-p+\frac{\kappa}{1-u}$, so I rule out {S, S, S, D} without signaling.

Taken together, when $\alpha > 1-p+\frac{\kappa}{1-u}$, $\alpha > \frac{\kappa}{1-u}$. The possible equilibria are {S, S, S, S} (no signal) and {S, S, S, S} (D is bad). The two equilibria are equivalent.

When $\alpha < \frac{\kappa}{1-u}$, $\alpha < 1-p+\frac{\kappa}{1-u}$. If $\kappa < (1-u)(1-p)$, the only possible equilibrium is {S, S, S, D} (D is bad).

If $(1-u)(1-p) < \kappa < 1-u$, the possible equilibria are {S, S, S, D} (D is bad) and {S, D, S, D} (no signal). Since $1 > p$ for GD, I rule out {S, D, S, D} which is dominated by {S, S, S, D}.

If $\kappa > 1-u$, the only possible equilibrium is {S, D, S, D} (no signal).

When $\frac{\kappa}{1-u} < \alpha < 1-p+\frac{\kappa}{1-u}$, if $\kappa < (1-u)(1-p)$, the only equilibrium is {S, S, S, S} (D is bad).

If $\kappa > (1-u)(1-p)$, the possible equilibria are {S, S, S, S} (D is bad) and {S, D, S, D} (no signal). Since $1 > p$ for GD but $\alpha > 1-p$ for BD, neither equilibrium dominates the other.

Proof of Lemma 1b:

Let k_r be the cost of manipulation under accounting regulation such that $k_r > k$, and $\kappa_r = \frac{k_r}{\gamma}$.

With accounting regulation, GD become GS and BS become BD. When the investor is sophisticated and thus able to see through manipulations, the information patterns used by a sophisticated investor are always {S, S, D, D}. It is always the case that S signals the good type and D signals the bad type. So in the following, I focus on the beliefs of a naive investor.

For GS, S is the dominant strategy because unless S signals the bad type, $E_{GS}(r_{GS} = S) = \gamma$. Therefore, D is always a signal of the bad type. For BD, $E_{BD}(r_{BD} = D) = 0$.

If S signals the good type, $E_{BD}(r_{BD} = S) = (1-u)\gamma - k_r > 0$ if $\kappa_r < 1-u$. (Belief 1)

If there is no signaling belief related to S, $E_{BD}(r_{BD} = S) = (1-u)\alpha\gamma - k_r > 0$ if $\kappa_r < (1-u)\alpha$. (Belief 2)

If S signals the good type only when both S and D are observed, $E_{BD}(r_{BD} = S) = (1-u)\alpha\gamma - k_r > 0$ if $\kappa_r < (1-u)\alpha$. (Belief 3)

When $(1-u)\alpha < \kappa_r < 1-u$, BD will manipulate with Belief 1 but not with Belief 2 or 3, so Belief 2 and 3 weakly dominate Belief 1.

Taken together, when $\alpha > \frac{\kappa_r}{1-u}$, with either Belief 2 or 3, the equilibrium is {S, S, S, S} where the investor always evaluates the firm.

When $\alpha < \frac{\kappa_r}{1-u}$, with either Belief 2 or 3, the equilibrium is {S, S, D, D} where the investor never invests upon D. Upon S, Belief 3 guarantees investment in GS, whereas with Belief 2, GS will get investment for sure only because the old method is positively biased.

Proof of Proposition 1:

Recall from Lemma 1b, if $\alpha < \frac{\kappa_r}{1-u}$, then the equilibrium with accounting regulation is {S, S, D, D} where investment efficiency is maximized. In such case, accounting regulation is at least weakly beneficial. To focus on more general cases, I assume $\frac{\kappa_r}{1-u} < 1-p+\frac{\kappa}{1-u}$.

In comparisons, I use $\Delta_\bullet$ to represent how implementing accounting regulation will affect investment and social efficiencies compared with not implementing accounting regulation. The surplus from investment in a good firm is $S > 0$, the loss from investment in a bad firm is $L > 0$, and the social cost of manipulations is K. In addition, I use Δ_G to denote the change in the aggregate change in surplus from investment in good firms (i.e., accounting regulation is more beneficial when the value is larger), Δ_B to denote the aggregate change in loss from investment in bad firms (i.e., accounting regulation is more beneficial when the value is smaller or more negative), and Δ_W to denote the change in the social costs of manipulations (i.e., accounting regulation is more detrimental when the value is larger). I also use subscripts J and NJ to denote investor sophistication and no investor sophistication, respectively.

Let the numbers of GS, GD, BS, and BD in the unregulated economy be q_1, q_2, q_3, and q_4, respectively.

When $\alpha > 1-p+\frac{\kappa}{1-u}$, compare {S, S, S, S} (with regulation) with {S, S, S, S} (without regulation): $\Delta_{G,J} = u(1-p)q_2S > 0$, $\Delta_{B,J} = [-u\alpha q_3 - u(1-p)q_4]L < 0$, and $\Delta_W = (q_3 - q_2)K > (<) 0$ if $q_3 > (<) q_2$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

When $\frac{\kappa_r}{1-u} < \alpha < 1-p+\frac{\kappa}{1-u}$, compare {S, S, S, S} (with regulation) with {S, D, S, D}(without regulation): $\Delta_{G,J} = (1-p)q_2S > 0$, $\Delta_{B,J} = [-u\alpha q_3 - u(1-p)q_4 + (1-u)(\alpha - 1+p)q_4]L \gtreqless 0$, and $\Delta_W = (q_3+q_4)K > 0$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = (\alpha - 1 + p)q_4 > 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

When $\frac{\kappa}{1-u} < \alpha < \frac{\kappa_r}{1-u}$, compare {S, S, D, D} (with regulation) with {S, D, S, D} (without regulation): $\Delta_{G,J} = (1-p)q_2S > 0$, $\Delta_{B,J} = [-\alpha q_3 - (1-p)q_4]L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

When $\alpha < \frac{\kappa}{1-u}$, compare {S, S, D, D} (with regulation) with {S, S, S, D} (without regulation): $\Delta_{G,J} = u(1-p)q_2S > 0$, $\Delta_{B,J} = \{u[-\alpha q_3 - (1-p)q_4] + (1-u)(-\alpha q_3)\}L = [-\alpha q_3 - u(1-p)q_4]L < 0$ and $\Delta_W = -q_2K < 0$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = -\alpha q_3 < 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Proof of Lemma 2a:

As shown above, without accounting regulation, neither S nor D can signal the good type.

Suppose D signals the bad type. Then S is the dominant strategy for GS and BS.

For GD, $E_{GD}(r_{GD} = D) = up\gamma$, and $E_{GD}(r_{GD} = S) = [up + (1-u)(1-\beta)]\gamma - k > up\gamma$ if $\kappa < (1-u)(1-\beta)$.

For BD, $E_{BD}(r_{BD} = D) = u(1-p)\gamma$, and $E_{BD}(r_{BD} = S) = u(1-p)\gamma - k < u(1-p)\gamma$. So D is the dominant strategy for BD.

When $\kappa < (1-u)(1-\beta)$, $r_{GD} = S$. The strategy profile{S, S, S, D} agrees with the belief.

When $\kappa > (1-u)(1-\beta)$, $r_{GD} = D$. The strategy profile{S, D, S, D} contradicts the belief.

Suppose there is no signaling that the investor always evaluates the firm. Since $1-\beta < p$ and $0 < 1-p$, D is the dominant strategy for GD and BD.

For GS, $r_{GS} = D$ if $\kappa < (1-u)(p-1+\beta) \Leftrightarrow \beta > 1-p+\frac{\kappa}{1-u}$, and $r_{GS} = S$ if $\kappa > (1-$

$u)(p-1+\beta) \Leftrightarrow \beta < 1-p+\frac{\kappa}{1-u}$.

For BS, $r_{BS} = D$ if $\kappa < (1-u)(1-p)$, and $r_{BS} = S$ if $\kappa > (1-u)(1-p)$.

Depending on the parameter values, {D, D, D, D}, {D, D, S, D}, {S, D, D, D}, and {S, D, S, D} are all possible outcomes. With {S, D, D, D}, since $1-\beta < 1$ for GS, the investor can deviate by viewing S as signaling the good type. But with such belief, BS will also deviate, leading to {S, D, S, D}. So I rule out {S, D, D, D} without signaling.

To limit the number of cases, I assume $\kappa > (1-u)\frac{p}{2}$ so that $1-\frac{\kappa}{1-u} < 1-p+\frac{\kappa}{1-u}$. Taken together, when $\beta > 1-p+\frac{\kappa}{1-u}$, if $\kappa < (1-u)(1-p)$, the only possible equilibrium is {D, D, D, D} (no signal).

When $\beta > 1-p+\frac{\kappa}{1-u}$, if $(1-u)(1-p) < \kappa < (1-u)p$, the only possible equilibrium is {D, D, S, D} (no signal).

When $1-\frac{\kappa}{1-u} < \beta < 1-p+\frac{\kappa}{1-u}$, $\kappa > (1-u)(1-p)$, and the only possible equilibrium is {S, D, S, D} (no signal).

When $\beta < 1-\frac{\kappa}{1-u}$, if $\kappa < (1-u)(1-p)$, the only possible equilibrium is {S, S, S, D} (D is bad).

When $\beta < 1-\frac{\kappa}{1-u}$, if $(1-u)(1-p) < \kappa < (1-u)p$, the possible equilibria are {S, D, S, D} (no signal) and {S, S, S, D} (D is bad). Since $p > 1-\beta$ for GD but $1-p > 0$ for BD, neither equilibrium dominates the other.

Proof of Lemma 2b:

Recall from Proof of Lemma 1b, the belief that S signals the good type only when both S and D are observed may dominate the belief that S signals the good type unconditionally or no signaling belief.

Suppose the investor holds the conditional belief and GS choose S. For BD, $E_{BD}(r_{BD} = D \mid r_{GS} = S) = 0$, and $E_{BD}(r_{BD} = S \mid r_{GS} = S) = -k_r < 0$. So D is the dominant strategy for BD.

For GS, $E_{GS}(r_{GS} = S \mid r_{BD} = D) = \gamma$, and $E_{GS}(r_{GS} = D \mid r_{BD} = D) = [u+(1-u)p]\gamma - k_r < \gamma$. So S is the dominant strategy for GS, and the equilibrium is {S, S, D, D}.

If S signals the good type unconditionally and D does not signal the bad type, for BD, $E_{BD}(r_{BD} = D) = (1-u)(1-p)\gamma$, and $E_{BD}(r_{BD} = S) = (1-u)\gamma - k_r > (1-u)(1-p)\gamma$ if $\kappa_r <$

$(1-u)p$.

If S signals the good type unconditionally and D signals the bad type, $r_{BD} = S$ if $\kappa_r < 1-u$. So for some moderate κ_r, BD will manipulate, making the belief incorrect. If S does not signal the good type, underinvestment in GS will always exist.

Overall, the maximum investment efficiency can be achieved only when the investor holds Belief 3.

Proof of Proposition 2:

When $\beta > 1-p+\frac{\kappa}{1-u}$, compare {S, S, D, D} (with regulation) with {D, D, D, D} (without regulation): $\Delta_{G,J} = \{[u\beta+(1-u)(1-p)]q_1+(1-p)q_2\}S > 0$, $\Delta_{B,J} = [-(1-u)(1-p)q_3-(1-p)q_4]L < 0$, and $\Delta_W = -(q_1+q_3)K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = -(1-p)(q_3+q_4)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

Or compare {S, S, D, D} (with regulation) with {D, D, S, D} (without regulation): $\Delta_{G,J} = \{[u\beta+(1-u)(1-p)]q_1+(1-p)q_2\}S > 0$, $\Delta_{B,J} = -(1-p)q_4L < 0$, and $\Delta_W = -q_1K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = \Delta_{B,J}$.

When $1-\frac{\kappa}{1-u} < \beta < 1-p+\frac{\kappa}{1-u}$, compare {S, S, D, D} (with regulation) with {S, D, S, D}(without regulation): $\Delta_{G,J} = [\beta q_1+(1-p)q_2]S > 0$, $\Delta_{B,J} = -(1-p)q_4L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

When $\beta < 1-\frac{\kappa}{1-u}$, compare {S, S, D, D} (with regulation) with {S, S, S, D} (without regulation): $\Delta_{G,J} = \{\beta q_1+[u(1-p)+(1-u)\beta]q_2\}S > 0$, $\Delta_{B,J} = 0$, and $\Delta_W = -q_2K < 0$.

Without sophistication, $\Delta_{G,NJ} = \beta(q_1+q_2)S$, and $\Delta_{G,NJ} > \Delta_{G,J}$. $\Delta_{B,NJ} = \Delta_{B,J}$.

Proof of Lemma 3a:

First consider the case when the old method is positively biased.

As shown in Proof of Lemma 1, neither S nor D can signal the bad type without accounting regulation.

Suppose S signals the bad type. For GS, $E_{GS}(r_{GS} = S) = u\gamma$, and $E_{GS}(r_{GS} = D) = [u+(1-$

$u)p]\gamma - k > u\gamma$ if $\kappa < (1-u)p$.

For BS, $E_{BS}(r_{BS} = S) = u\alpha\gamma$, and $E_{BS}(r_{BS} = D) = [u\alpha + (1-u)(1-p)]\gamma - k > u\alpha\gamma$ if $\kappa < (1-u)(1-p)$.

For GD, $E_{GD}(r_{GD} = D) = p\gamma$, and $E_{GD}(r_{GD} = S) = up\gamma - k < p\gamma$.

For BD, $E_{BD}(r_{BD} = D) = (1-p)\gamma$, and $E_{BD}(r_{BD} = S) = u(1-p)\gamma - k < (1-p)\gamma$. So D is the dominant strategy for GD and BD.

When $\kappa < (1-u)(1-p)$, $r_{GS} = r_{BS} = D$. The strategy profile{D, D, D, D} agrees with the belief.

When $(1-u)(1-p) < \kappa < (1-u)p$, $r_{GS} = D$ and $r_{BS} = S$. The strategy profile {D, D, S, D} agrees with the belief.

When $\kappa > (1-u)p$, $r_{GS} = r_{BS} = D$. The strategy profile {S, D, S, D} contradicts the belief.

Equilibria under no signaling are the same as those in Lemma 1a. To limit the number of cases, I assume the precision of a new method is not too low so that $\kappa < (1-u)p$.

When $\kappa < (1-u)(1-p)$, $\alpha > \frac{\kappa}{1-u}$. If $\alpha > 1 - p + \frac{\kappa}{1-u}$, the possible equilibria are {S, S, S, S} (no signal) and {D, D, D, D} (S is bad). Since $1 > p$ for GS and GD but $\alpha > 1-p$ for BS and BD, neither equilibrium dominates the other.

If $\frac{\kappa}{1-u} < \alpha < 1 - p + \frac{\kappa}{1-u}$, the only possible equilibrium is {D, D, D, D} (S is bad).

When $(1-u)(1-p) < \kappa < (1-u)p$, if $\alpha > \frac{\kappa}{1-u}$, the only possible equilibrium is {D, D, S, D} (S is bad).

If $\alpha < \frac{\kappa}{1-u}$, the possible equilibria are {S, D, S, D} (no signal) and {D, D, S, D} (S is bad). Since $1 > p$ for GS but $\alpha > 0$ for BS, neither equilibrium dominates the other.

Next consider the case when the old method is negatively biased.

Suppose S signals the bad type. Then D is the dominant strategy for GD and BD.

For GS, $E_{GS}(r_{GS} = S) = u\gamma$, and $E_{GS}(r_{GS} = D) = [u + (1-u)p]\gamma - k > u\gamma$ if $\kappa < (1-u)p$.

For BS, $E_{BS}(r_{BS} = S) = 0$, and $E_{BS}(r_{BS} = D) = (1-u)(1-p)\gamma - k > 0$ if $\kappa < (1-u)(1-p)$.

When $\kappa < (1-u)(1-p)$, $r_{GS} = r_{BS} = D$. The strategy profile{D, D, D, D} agrees with the belief.

When $(1-u)(1-p) < \kappa < (1-u)p$, $r_{GS} = D$ and $r_{BS} = S$. The strategy profile {D, D, S, D} agrees with the belief.

When $\kappa > (1-u)p$, $r_{GS} = r_{BS} = D$. The strategy profile {S, D, S, D} contradicts the belief.

Equilibria under no signaling are the same as those in Lemma 2a. To limit the number of cases, I assume the precision of a new method is not too low so that $\kappa < (1-u)p$.

When $\kappa < (1-u)(1-p)$, the only possible equilibrium is {D, D, D, D} (no signal or S is bad).

When $(1-u)(1-p) < \kappa < (1-u)p$, the possible equilibria are {D, D, S, D} (S is bad), {D, D, S, D} (no signal) and {S, D, S, D} (no signal). The first two are equivalent. Since $p > 1-\beta$ for GS, I rule out {S, D, S, D} which is dominated by {D, D, S, D}.

Taken together, when $\kappa < (1-u)(1-p)$, the possible equilibria are {D, D, D, D} and {S, S, S, S} (only for positively biased method).

When $\kappa > (1-u)(1-p)$, the possible equilibria are {D, D, S, D} and {S, D, S, D} (only for positively biased method).

Proof of Lemma 3b:

With accounting regulation, GS become GD, BD become BS, and the unmanipulated information patterns are {D, D, S, S}.

Follow the logic in Proof of Lemma 2b, the belief that D signals the good type only when both D and S are observed may dominate the belief that D signals the good type unconditionally or no signaling belief.

Suppose the investor holds the conditional belief and GD choose D. For BS, $E_{BS}(r_{BS} = S \mid r_{GD} = D) = 0$, and $E_{BS}(r_{BS} = D \mid r_{GD} = D) = (1-u)(1-p)\gamma - k_r$. So when $\kappa_r > (1-u)(1-p)$ and $r_{GD} = D$, $r_{BS} = S$.

For GD, $E_{GD}(r_{GD} = D \mid r_{BS} = S) = \gamma > E_{GD}(r_{GD} = S \mid r_{BS} = S)$. So D is the dominant strategy for GD, and the equilibrium is {D, D, S, S}.

If D signals the good type unconditionally and S does not signal the bad type, for BS, $E_{BS}(r_{BS} = S) = (1-u)(1-p)\gamma$ with a positively biased method or 0 with a negatively biased method, and $E_{BS}(r_{BS} = S) = (1-u)\gamma - k_r$. So $r_{BS} = D$ if $\kappa_r < (1-u)p$ or $\kappa_r < 1-u$, the RHS of which are both greater than $(1-u)(1-p)$.

If D signals the good type unconditionally and S signals the bad type, $r_{BS} = D$ if $\kappa_r < 1-u$.

So for some moderate κ_r, BS will manipulate, making the belief incorrect. If D does not signal the good type, there will be underinvestment in GD unless the old method is positively biased and $r_{GD} = S$. When $r_{GD} = S$, $E_{BS}(r_{BS} = S \mid r_{GD} = S) = (1-u)\alpha\gamma$, and $E_{BS}(r_{BS} = D \mid r_{GD} = S) \leqslant (1-u)(1-p)\gamma - k_r < (1-u)\alpha\gamma$. So S is the dominant strategy for BS, and overinvestment in BS will always exist.

Overall, when $\kappa_r > (1-u)(1-p)$, the maximum investment efficiency can be achieved only when the investor holds Belief 3.

When $\kappa_r < (1-u)(1-p)$, even with Belief 3, BS will manipulate regardless of the belief on S, resulting in {D, D, D, D}. So D cannot signal the good type.

First consider the case when the old method is positively biased.

Suppose S signals the bad type. Then D is the dominant strategy for GD.

For BS, $E_{BS}(r_{BS} = S) = 0$, and $E_{BS}(r_{BS} = D) = (1-u)(1-p)\gamma - k_r > 0$ since $\kappa_r < (1-u)(1-p)$. So D is the dominant strategy for BS, and the equilibrium is {D, D, D, D}.

Suppose there is no signaling that the investor always evaluates the firm. Then S is the dominant strategy for BS.

For GD, $E_{GD}(r_{GD} = D) = [u + (1-u)p]\gamma$, and $E_{GD}(r_{GD} = S) = \gamma - k_r > 0$ since $\kappa_r < (1-u)(1-p)$. So S is the dominant strategy for GD, and the equilibrium is {S, S, S, S}.

Next consider the case when the old method is negatively biased.

Suppose S signals the bad type, then the equilibrium is {D, D, D, D}.

Suppose there is no signaling that the investor always evaluates the firm. Then D is the dominant strategy for GD.

For BS, $E_{BS}(r_{BS} = S) = 0$, and $E_{BS}(r_{BS} = D) = (1-u)(1-p)\gamma - k_r > 0$ since $\kappa_r < (1-u)(1-p)$. So D is the dominant strategy for BS, and the equilibrium is {D, D, D, D}.

Taken together, when $\kappa_r > (1-u)(1-p)$, the dominant equilibrium is {D, D, S, S}.

When $\kappa_r < (1-u)(1-p)$, the possible equilibria are {D, D, D, D} and {S, S, S, S} (only for positively biased method).

Proof of Proposition 3:

With a successful experience with a bad firm, the numbers of GS, GD, BS, and BD in the unregulated economy are q_2, q_1, q_4, and q_3, respectively.

First consider the case when the old method is positively biased.

When $\kappa > (1-u)(1-p)$, $\kappa_r > (1-u)(1-p)$. Compare {D, D, S, S} (with regulation) with {D, D, S, D} (without regulation): $\Delta_{G,J} = [(1-p)q_1 + (1-u)(1-p)q_2]S > 0$, $\Delta_{B,J} = [-\alpha q_4 - (1-p)q_3]L < 0$, and $\Delta_W = -q_2 K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S > 0$, and $\Delta_{G,NJ} > \Delta_{G,J}$. $\Delta_{B,NJ} = \Delta_{B,J}$.

Or compare {D, D, S, S} (with regulation) with {S, D, S, D} (without regulation): $\Delta_{G,J} = (1-p)q_1 S > 0$, $\Delta_{B,J} = [-\alpha q_4 - (1-p)q_3]L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

When $\kappa < (1-u)(1-p) < \kappa_r$, compare {D, D, S, S} (with regulation) with {S, S, S, S} (without regulation): $\Delta_{G,J} = u(1-p)q_1 S > 0$, $\Delta_{B,J} = \{u[-\alpha q_4 - (1-p)q_3] - (1-u)\alpha(q_3 + q_4)\}L < 0$, and $\Delta_W = -(q_2+q_4)K < 0$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,J} = -\alpha(q_3+q_4)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

Or compare {D, D, S, S} (with regulation) with {D, D, D, D} (without regulation): $\Delta_{G,J} = [(1-u)(1-p)q_2 + (1-p)q_1]S > 0$, $\Delta_{B,J} = [-u\alpha q_4 - (1-u)(1-p)q_4 - (1-p)q_3]L < 0$, and $\Delta_W = -(q_2+q_4)K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S$, and $\Delta_{G,NJ} > \Delta_{G,J}$. $\Delta_{B,NJ} = -(1-p)(q_3+q_4)L < 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

When $\kappa_r < (1-u)(1-p)$, $\kappa < (1-u)(1-p)$. Compare {D, D, D, D} (with regulation) with {D, D, D, D} (without regulation): $\Delta_{G,J} = u(1-p)q_1 S > 0$, $\Delta_{B,J} = u[-\alpha q_4 - (1-p)q_3]L < 0$, and $\Delta_W = (q_3 - q_2)K > (<)0$ if $q_3 > (<) q_2$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Or compare {S, S, S, S} (with regulation) with {S, S, S, S} (without regulation): $\Delta_{G,J} = u(1-p)q_1 S > 0$, $\Delta_{B,J} = u[-\alpha q_4 - (1-p)q_3]L < 0$, and $\Delta_W = (q_2 - q_3)K > (<)0$ if $q_2 > (<) q_3$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Next consider the case when the old method is negatively biased.

When $\kappa > (1-u)(1-p)$, $\kappa_r > (1-u)(1-p)$. Compare {D, D, S, S} (with regulation) with {D, D, S, D} (without regulation): $\Delta_{G,J} = [(1-p)q_1 + u\beta q_2 + (1-u)(1-p)q_2]S > 0$,

$\Delta_{B,J} = -(1-p)q_3L < 0$, and $\Delta_W = -q_2K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S > 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = \Delta_{B,J}$.

When $\kappa < (1-u)(1-p) < \kappa_r$, compare {D, D, S, S} (with regulation) with {D, D, D, D} (without regulation): $\Delta_{G,J} = [u\beta q_2 + (1-u)(1-p)q_2 + (1-p)q_1]S > 0$, $\Delta_{B,J} = [-(1-u)(1-p)q_4 - (1-p)q_3]L < 0$, and $\Delta_W = -(q_2+q_4)K < 0$.

Without sophistication, $\Delta_{G,NJ} = (1-p)(q_1+q_2)S$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = -(1-p)(q_3+q_4)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

When $\kappa_r < (1-u)(1-p)$, $\kappa < (1-u)(1-p)$. Compare {D, D, D, D} (with regulation) with {D, D, D, D} (without regulation): $\Delta_{G,J} = u[\beta q_2 + (1-p)q_1]S > 0$, $\Delta_{B,J} = -u(1-p)q_3L < 0$, and $\Delta_W = (q_3 - q_2)K > (<) 0$ if $q_3 > (<) q_2$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Proof of Corollary 1:

Recall from Lemmas 1b, 2b, and 3b, with a successful experience with a good firm and a negatively biased method, a fully separating equilibrium {S, S, D, D} can always be achieved, and there is no manipulation.

With a successful experience with a bad firm, {D, D, S, S} can always be achieved only for when $\kappa_r > (1-u)(1-p)$.

With a successful experience with a good firm and a positively biased method, {S, S, D, D} can always be achieved only when $\kappa_r > (1-u)\alpha > (1-u)(1-p)$.

While the three types of experience will all lead to a pooling equilibrium when $\kappa_r > (1-u)\alpha$, a combination of a successful experience with a good firm and a negatively biased method weakly dominates other types of experience when $\kappa_r < (1-u)\alpha$.

When $(1-u)(1-p) < \kappa_r < (1-u)\alpha$, a successful experience with a bad firm dominates a combination of a successful experience with a good firm and a positively biased method.

When $\kappa_r < (1-u)(1-p)$, compare $\{S, S, S, S\}_{GP}$ with $\{D, D, D, D\}_{BN}$: $\Delta_{G,NJ} = (1-p)(q_1+q_2)S > 0$, $\Delta_{B,NJ} = (\alpha - 1 + p)(q_3+q_4)L > 0$, and $\Delta_W = (q_3+q_4-q_1-q_2)K > (<) 0$ if $q_3+q_4 > (<) q_1+q_2$.

Proof of Corollary 2:

With a successful experience with a good firm and a positively biased method, the equilibria are {S, S, S, S}, {S, D, S, D}, and {S, S, S, D}. To compare {S, D, S, D} with {S, S, S, D}, since $1 > p$ for GD and $0 < 1-p$ for BD, {S, D, S, D} is dominated by {S, S, S, D}. To compare {S, S, S, S} with {S, S, S, D}, since $0 < \alpha$ for BD, {S, S, S, S} is dominated by {S, S, S, D}. Overall, {S, S, S, D} is the dominant equilibrium.

With a successful experience with a good firm and a negatively biased method, the equilibria are {S, S, S, D}, {S, D, S, D}, {D, D, D, D}, and {D, D, S, D}. To compare {S, D, S, D} with {D, D, S, D}, since $1-\beta < p$ for GS, {S, D, S, D} is dominated by {D, D, S, D}. To compare {D, D, D, D} with {D, D, S, D}, since $1-p > 0$ for BS, {D, D, D, D} is dominated by {D, D, S, D}. To compare {S, S, S, D} with {D, D, S, D}, since $1-\beta < p$ for GS and GD but $0 < 1-p$ for BD, neither equilibrium dominates the other. To compare {S, S, S, D} with {S, D, S, D}, since $1-\beta < p$ for GD but $0 < 1-p$ for BD, neither equilibrium dominates the other. To compare {S, S, S, D} with {D, D, D, D}, since $1-\beta < p$ for GS and GD but $0 < 1-p$ for BS and BD, neither equilibrium dominates the other. Overall, {S, S, S, D} and {D, D, S, D} are the two undominated equilibria.

With a successful experience with a bad firm and a positively biased method, the equilibria are {S, S, S, S}, {S, D, S, D}, {D, D, D, D}, and {D, D, S, D}. To compare {D, D, D, D} with {D, D, S, D}, since $1-p >0$ for BS, {D, D, D, D} is dominated by {D, D, S, D}. To compare {S, S, S, S} with {D, D, S, D}, since$1 > p$ for GS and GD but $\alpha > 0$ for BS and $\alpha > 1-p$ for BD, neither equilibrium dominates the other. To compare {S, S, S, S} with {S, D, S, D}, since $1 > p$ for GS but $\alpha > 1-p$ for BD, neither equilibrium dominates the other. To compare {S, D, S, D} with {D, D, S, D}, since $1 > p$ for GS but $\alpha > 0$ for BD, neither equilibrium dominates the other. Overall, {S, S, S, S}, {S, D, S, D}, and {D, D, S, D} are the three undominated equilibria.

With a successful experience with a bad firm and a negatively biased method, the equilibria are {D, D, D, D} and {D, D, S, D}. Since $1-p > 0$ for BS, {D, D, D, D} is dominated by {D, D, S, D}. Overall, {D, D, S, D} is the dominant equilibrium.

Note that for both $\{S, S, S, D\}_{GP}$ and $\{D, D, S, D\}_{BN}$, it is necessary that $\kappa > (1-u)(1-$

p). With $\kappa > (1-u)(1-p)$, {S, S, S, S}$_{BP}$ is impossible. So I focus on the comparisons under $\kappa > (1-u)(1-p)$ and rule out {S, S, S, S}$_{BP}$. Since the information patterns used by a sophisticated investor are always {S, D, S, D}, I take the view of a naive investor in the following comparisons.

With a successful experience with a good firm, first compare {S, S, S, D}$_{GP}$ with {S, S, S, D}$_{GN}$: $\Delta_{G,NJ} = \beta(q_1+q_2)S > 0$, $\Delta_{B,NJ} = \alpha q_3 L > 0$, and $\Delta_W = 0$.

Next compare {S, S, S, D}$_{GP}$ with {D, D, S, D}$_{GN}$: $\Delta_{G,NJ} = (1-p)(q_1+q_2)S > 0$, $\Delta_{B,NJ} = [\alpha q_3 - (1-p)q_4]L > (<) 0$ if $q_3 > (<) \frac{1-p}{\alpha} q_4$, and $\Delta_W = (q_2 - q_1)K > (<) 0$ if $q_2 > (<) q_1$.

With a successful experience with a bad firm, first compare {S, D, S, D}$_{BP}$ with {D, D, S, D}$_{BN}$: $\Delta_{G,NJ} = \beta q_2 S > 0$, $\Delta_{B,NJ} = \alpha q_4 L > 0$, and $\Delta_W = -q_2 K < 0$.

Next compare {D, D, S, D}$_{BP}$ with {D, D, S, D}$_{BN}$: $\Delta_{G,NJ} = 0$, $\Delta_{B,NJ} = 0$, and $\Delta_W = 0$.

With a positively biased method, first compare {S, S, S, D}$_{GP}$ with {S, D, S, D}$_{BP}$: $\Delta_{G,NJ} = (1-p)q_1 S > 0$, $\Delta_{B,NJ} = [\alpha q_3 - \alpha q_4 - (1-p)q_3]L > (<) 0$ if $q_3 > (<) \frac{\alpha}{\alpha-1+p} q_4$, and $\Delta_W = q_2 K > 0$.

Next compare {S, S, S, D}$_{GP}$ with {D, D, S, D}$_{BP}$: $\Delta_{G,NJ} = (1-p)(q_1+q_2)S > 0$, $\Delta_{B,NJ} = (\alpha - 1 + p)q_3 L > 0$, and $\Delta_W = 0$.

With a negatively biased method, first compare {S, S, S, D}$_{GN}$ with {D, D, S, D}$_{BN}$: $\Delta_{G,NJ} = (1-\beta-p)(q_1+q_2)S < 0$, $\Delta_{B,NJ} = -(1-p)q_3 L < 0$, and $\Delta_W = 0$.

Next compare {D, D, S, D}$_{GN}$ with {D, D, S, D}$_{BN}$: $\Delta_{G,NJ} = 0$, $\Delta_{B,NJ} = (1-p)(q_4 - q_3)L > (<) 0$ if $q_4 > (<) q_3$, and $\Delta_W = (q_1 - q_2)K > (<) 0$ if $q_1 > (<) q_2$.

Proof of Proposition 4:

Let $\lambda \in [0, \overline{\lambda}]$ denote the degree of accounting regulation.

Let τ_G (τ_B) denote the unmanipulated information pattern similarity for GT (BT) such that $\tau_G = \tau_{G0}$ and $\tau_B = \tau_{B0}$ when $\lambda = 0$ and $0 < \tau_{B0} < \tau_{G0} < 1$.

When $\lambda > 0$, let g (b) denote the effect of accounting regulation on the information pattern similarity of GT (BT) such that $\tau_G = \tau_{G0} + g\lambda$ and $\tau_B = \tau_{B0} - b\lambda$ when the successful experience is with a good firm.

Let $\tau_{Gmax} \equiv \tau_{G0} + g\overline{\lambda} < 1$ and $\tau_{Bmin} \equiv \tau_{B0} - b\overline{\lambda} > 0$. By design, $0 < \tau_{Bmin} < \tau_{B0} < \tau_{G0} <$

$\tau_{Gmax} < 1$.

Let w_G (w_B) denote the choice of information pattern similarity of GT (BT).

Let m denote the amount of manipulation, and the cost of manipulation is given by $c(m)$ with $c^{'}(m) > 0$ and $c^{''}(m) > 0$.

Let $U_G(v_G)$ and $U_B(v_B)$ the manager's utility from getting investment for GT and BT, respectively, and that $U_G(v) \geqslant U_B(v)$ for any specific level of v.

In the game, since the manager's gain comes from getting investment, $U_\bullet(v_\bullet)$ is linear in v.

I assume that when indifferent, both GT and BT will choose to separate.

In the analysis, I first compare two possible beliefs, and then apply the beliefs to different scenarios.

I. The Case of a Positively Biased Method

Since GT has a higher level of similarity than BT without manipulation, first consider a traditional framework for separation such that a firms is viewed as good if choosing $w \geqslant \tau_F \geqslant \tau_G$ and bad if choosing $w < \tau_F$ (standard belief).

For BT to not choose $w_B = \tau_F$, it must be the case that $U_B(1) - c(\tau_F - \tau_B) \leqslant 0$.

Let τ_{F0} be such that $U_B(1) - c(\tau_{F0} - \tau_B) = 0$.

For GT, for any λ, since $\tau_G > \tau_B$ and $\frac{dc(m)}{dm} > 0$, it must be true that $c(\tau_{F0} - \tau_G) < c(\tau_{F0} - \tau_B)$. Therefore, $U_G(1) - c(\tau_{F0} - \tau_B) > 0$.

Under separation, investment efficiency is maximized. So to maximize social efficiency is to minimize $\tau_{F0} - \tau_G$.

Since $\frac{dc(m)}{dm} > 0$ and $\frac{d\tau_B}{d\lambda} < 0$, $\frac{d\tau_{F0}}{d\lambda} < 0$. Since $\frac{d\tau_G}{d\lambda} > 0$, $\frac{d(\tau_{F0} - \tau_G)}{d\lambda} < 0$. So $\lambda^* = \overline{\lambda}$ if $\tau_{F0} \geqslant \tau_{Gmax}$.

In the traditional framework, τ_{F0} is determined by $U_B(1) - c(\tau_{F0} - \tau_B) = 0$, and BT will be viewed as good unconditionally if $w_B = \tau_{F0}$. Also, if $U_B(1) - c(1 - \tau_{Bmin}) > 0$, then separation cannot be achieved under such belief.

To see if there can be any improvement, let w_i and w_j be the two observed levels of similarity. Consider the belief that if one chooses $w = \tau_F \geqslant \tau_G$ and the other chooses $w \neq \tau_F$, then $w = \tau_F$ indicates that the firm is good, and any $w \neq \tau_F$ indicates that the firm is bad. If both firms choose $w = \tau_F$, then both firms will be evaluated using a weighted combination of the old method and a new method (revised belief).

Under such belief, provided that $w_G = \tau_F$, BT will not choose $w_B = \tau_F$ if $U_B[v_B(\tau_F)] - c(\tau_F - \tau_B) \leqslant 0$, and $U_B[v_B(\tau_F)] < U_B(1)$ since $Max[v_B(\tau_F)] = \alpha < 1$.

Let τ_S be such that $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$. Since $U_B[v_B(\tau_S)] < U_B(1)$ and $\frac{dc(m)}{dm} > 0$, it follows that $\tau_S < \tau_{F0}$ for any given λ.

For GT, suppose $w_G = \tau_S$. If $w_B = \tau_S$, then utility is $U_G[v_G(\tau_S)] - c(\tau_S - \tau_G) > 0$. The reason is that since $1 > \alpha$ and $p > 1-p$, it is always the case that $v_G(\tau_S) > v_B(\tau_S)$. Also, since $\tau_G > \tau_B$, $c(\tau_S - \tau_G) < c(\tau_S - \tau_B)$.

If $w_B = \tau_B$, then utility is $U_G[1] - c(\tau_S - \tau_G) > U_G[v_G(\tau_S)] - c(\tau_S - \tau_G) > 0$. So τ_S is a dominant strategy for GT, and $w_G^* = \tau_S$.

Given $w_G^* = \tau_S$, $w_B^* = \tau_B$ since $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$.

I next show that $\frac{d\tau_S}{d\lambda} < 0$.

When $\lambda = 0$, let τ_{S0} be such that $U_B[v_B(\tau_{S0})] - c(\tau_{S0} - \tau_{B0}) = 0$.

Then for $\lambda > 0$, since $\frac{dc(\tau_{S0} - \tau_B)}{d\lambda} > 0$, it must be true that $U_B[v_B(\tau_{S0})] - c(\tau_{S0} - \tau_B) < 0$.

Since U_B is linear and c is convex, there must exist a $\tau_S < \tau_{S0}$ such that $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$.

Since $\frac{d\tau_S}{d\lambda} < 0$ and $\frac{d\tau_G}{d\lambda} > 0$, $\frac{d(\tau_S - \tau_G)}{d\lambda} < 0$. So $\lambda^* = \overline{\lambda}$ if $\tau_{F0} \geqslant \tau_{Gmax}$.

At $\lambda = \overline{\lambda}$, since $\tau_S < \tau_{F0}$, $\tau_S - \tau_{Gmax} < \tau_{F0} - \tau_{Gmax}$. Given the same investment efficiency and lower manipulation, the revised belief dominates the standard belief.

In the following, I build my analysis based on the revised belief and examine several possible scenarios.

Scenario 1.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) < 0$.

Given evaluation, when the old method is positively biased, $v_B = \alpha w_B + (1-p)(1-w_B)$ for BT. So $\frac{dU(v_B)}{dw_B} \propto \alpha - 1 + p > 0$. Similarly, for GT, $\frac{dU(v_G)}{dw_G} \propto 1 - p > 0$.

Since U_B is increasing and linear and c is increasing and convex, there may be zero, one, or two intersections between U_B and c as λ increases.

i) If U_B and c never intersect, then BT will never mimic GT. Since a fully separating equilibrium can always be achieved, $\lambda^* \in [0, \overline{\lambda}]$.

ii) If U_B and c intersect once, as long as BT takes the more socially desirable action when indifferent, a fully separating equilibrium can always be achieved. So $\lambda^* \in [0,\ \overline{\lambda}]$.

iii) If U_B and c intersect twice, let λ_1 and λ_2 be the two intersections. Since $U_B(\tau_G) - c(\tau_G - \tau_B) > 0$ when $\lambda_1 < \lambda < \lambda_2$, $\lambda^* \in [0,\ \lambda_1]$ if $\overline{\lambda} < \lambda_2$, and $\lambda^* \in [0,\ \lambda_1] \cup [\lambda_2,\ \overline{\lambda}]$ if $\overline{\lambda} \geqslant \lambda_2$.

Scenario 2.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) > 0$.

Since U_B is increasing and linear and c is increasing and convex, there always exists one intersection between U_B and c as λ increases. Let λ_3 be the intersection.

If $\overline{\lambda} \geqslant \lambda_3$, as long as accounting regulation is sufficiently stringent, BT will not mimic, so $\lambda^* \in [\lambda_3,\ \overline{\lambda}]$.

In Scenarios 1 and 2, based on the revised belief, a fully separating equilibrium can emerge without manipulation with $\tau_S = \tau_G(\lambda^*)$. In equilibrium, $w_G^* = \tau_G(\lambda^*)$ and $w_B^* = \tau_B(\lambda^*)$. Social efficiency $SE = S \equiv SE_0$.

Scenario 3.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) > 0$ and $\overline{\lambda} < \lambda_3$.

In Scenario 3, BT will always mimic GT, unless GT manipulates.

Given accounting regulation λ, GT will have to manipulate to τ_S such that $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$ to separate from BT.

As shown above, in such case, for GT, $U_G(1) - c(\tau_S - \tau_G)$ >0 and $\lambda^* = \overline{\lambda}$.

Let $\tau_{Smin} \equiv \tau_S(\overline{\lambda})$. Socially efficiency $SE = S - (\tau_{Smin} - \tau_{Gmax})K \equiv SE_1$.

Note that in such case, GT is forced to separate from BT because not doing so will yield an expected utility equal to zero.

Now consider a more benign belief such that the investor does not view a firm as bad if $w \neq \tau_S$ but will rather evaluate it. In case $w_i \neq w_j$, I assume that the investor can always tell whether the firm is good or bad so that the best BT can do is to mimic GT (benign belief). In the following, I examine whether there are situations where the benign belief may outperform the revised belief.

Provided that BT mimics GT, for GT to voluntarily separate from BT, the incentive compatibility condition is $U_G(1) - U_G[v_G(\tau_G)] \geqslant c(\tau_S - \tau_G)$. (1)

Recall that the IC under the revised belief under $\lambda = \overline{\lambda}$ is $U_G(1) - 0 \geqslant c(\tau_{Smin} - \tau_{Gmax})$. (2)

Since $0 < U_G[v_G(\tau_G)]$ and $Min[c(\tau_S - \tau_G)] = c(\tau_{Smin} - \tau_{Gmax})$, satisfying inequality (1) is a sufficient condition for satisfying inequality (2).

That is, if separation cannot be achieved under the revised belief, then separation can never be achieved under the benign belief.

If inequality (2) cannot be satisfied, then there will always be a pooling equilibrium, and the benign belief is the only correct belief that can be held in equilibrium.

In the following, I assume that inequality (2) can always be satisfied.

Note that under separation, $Min(m) = \tau_{Smin} - \tau_{Gmax}$ with $\lambda = \overline{\lambda}$, and SE_1 is the social efficiency under the least costly separation.

Now with the benign belief, focus on inequality (1).

Since $\frac{dU_G[v_G(\tau_G)]}{d\lambda} > 0$ and $\frac{dU_G^2[v_G(\tau_G)]}{d\lambda^2} = 0$, the LHS of (1) is decreasing and linear in λ.

Since $\frac{dc(m)}{dm} > 0$, $\frac{dc^2(m)}{dm^2} > 0$, $\frac{d\tau_S}{d\lambda} < 0$, $\frac{d\tau_G}{d\lambda} > 0$, it follows that $\frac{dc(\tau_S - \tau_G)}{d\lambda} < 0$ and $\frac{dc^2(\tau_S - \tau_G)}{d\lambda^2} < 0$. So the RHS of (1) is decreasing and convex in λ.

There are several possibilities.

i) Inequality (1) is satisfied $\forall\ \lambda \in [0,\ \overline{\lambda}]$. In such case, GT will always manipulate to τ_S to separate from BT. Given that investment efficiency is fixed, to minimize manipulations, $\lambda^* = \overline{\lambda}$. Here, the revised belief and the benign belief yield the same outcome.

ii) There exists a λ_4 such that inequality (1) is (not) satisfied when $\lambda \geqslant (<) \lambda_4$. In such case, to achieve separation, $\lambda \geqslant \lambda_4$, and $\lambda^* = \overline{\lambda}$ minimizes manipulations under separation. And social efficiency is SE_1.

If $\lambda < \lambda_4$, there is always a pooling equilibrium. Given pooling, for GT, $w_G = \tau_G + \mu$. Let μ_G be the solution to $\frac{dU(v_G)}{dw_G} = \frac{dc(\mu)}{d\mu}$. So $\mu^* = Max[0,\ \mu_G]$. Note that $\frac{d\mu_G}{d\lambda} = 0$ because $\frac{d^2U_G(v_G)}{dw_G^2} = 0$.

Let $\lambda_{4s} \equiv \lambda_4 - \varepsilon$ where ε is positive and infinitesimal. When $\mu_G > 0$, it must be the case that $\tau_{G0} + g\lambda_{4s} + \mu_G < \tau_S(\lambda_{4s})$. The reason is $U_G(1) > U_G[v_G(\tau_{G0} + g\lambda_{4s} + \mu_G)]$. Since $U_G(1) - U_G[v_G(\tau_{G0} + g\lambda_{4s})] < c[\tau_S(\lambda_{4s}) - \tau_{G0} - g\lambda_{4s}]$ and $U_G[v_G(\tau_{G0} + g\lambda_{4s} + \mu_G)] - U_G[v_G(\tau_{G0} + g\lambda_{4s})] > c(\mu_G)$, it follows that $c[\tau_S(\lambda_{4s}) - \tau_{G0} - g\lambda_{4s}] > c(\mu_G)$. Since $c^{'}(m) > 0$, it must be true that $\mu_G < \tau_S(\lambda_{4s}) - \tau_{G0} - g\lambda_{4s} \Rightarrow \tau_{G0} + g\lambda_{4s} + \mu_G < \tau_{G0} + g\lambda_{4s} + [\tau_S(\lambda_{4s}) - \tau_{G0} - g\lambda_{4s}] =$

$\tau_S(\lambda_{4s})$.

Since $w_B = w_G$ in a pooling equilibrium, $SE = [\tau_G + \mu^* + (1-\tau_G-\mu^*)p]S - [(\tau_G+\mu^*)\alpha + (1-\tau_G-\mu^*)(1-p)]L - (\tau_G - \tau_B + 2\mu^*)K$. $\frac{dSE}{d\lambda} = g(1-p)S - g(\alpha-1+p)L - (g+b)K$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda = \lambda_{4s}$ is optimal under pooling, and $SE = [\tau_{G0} + g\lambda_{4s} + \mu^* + (1-\tau_{G0} - g\lambda_{4s} - \mu^*)p]S - [(\tau_{G0} + g\lambda_{4s} + \mu^*)\alpha + (1-\tau_{G0} - g\lambda_{4s} - \mu^*)(1-p)]L - (\tau_{G0} - \tau_{B0} + g\lambda_{4s} + b\lambda_{4s} + 2\mu^*)K \equiv SE_2$.

If $SE_1 > SE_2$, $\lambda^* = \overline{\lambda}$. If $SE_1 < SE_2$, $\lambda^* = \lambda_{4s}$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K < 0$, $\lambda = 0$ is optimal under pooling, and $SE = [\tau_{G0} + \mu^* + (1-\tau_{G0} - \mu^*)p]S - [(\tau_{G0} + \mu^*)\alpha + (1-\tau_{G0} - \mu^*)(1-p)]L - (\tau_{G0} - \tau_{B0} + 2\mu^*)K \equiv SE_3$.

If $SE_1 > SE_3$, $\lambda^* = \overline{\lambda}$. If $SE_1 < SE_3$, $\lambda^* = 0$.

So the benign belief will outperform the revised belief if $Max(SE_2,\ SE_3) > SE_1$.

iii) There exist λ_5 and λ_6 with $0 < \lambda_5 < \lambda_6 < \overline{\lambda}$ such that inequality (1) is satisfied only when $\lambda_5 \leqslant \lambda \leqslant \lambda_6$ if $\lambda_5 > 0$. In such case, to achieve separation, $\lambda_5 \leqslant \lambda \leqslant \lambda_6$, and $\lambda^* = \lambda_6$ minimizes manipulations under separation. And social efficiency $SE = S - [\tau_S(\lambda_6) - \tau_G(\lambda_6)]K \equiv SE_4 < SE_1$.

Following part ii), under a pooling equilibrium, when $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda = \overline{\lambda}$ is optimal, and $SE = [\tau_{G0} + g\overline{\lambda} + \mu^* + (1-\tau_{G0} - g\overline{\lambda} - \mu^*)p]S - [(\tau_{G0} + g\overline{\lambda} + \mu^*)\alpha + (1-\tau_{G0} - g\overline{\lambda} - \mu^*)(1-p)]L - (\tau_{G0} - \tau_{B0} + g\overline{\lambda} + b\overline{\lambda} + 2\mu^*)K \equiv SE_5$.

If $SE_4 > SE_5$, $\lambda^* = \lambda_6$. If $SE_4 < SE_5$, $\lambda^* = \overline{\lambda}$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K < 0$, $\lambda = 0$ is optimal under pooling, and $SE = SE_3$.

If $SE_4 > SE_3$, $\lambda^* = \lambda_6$. If $SE_4 < SE_3$, $\lambda^* = 0$.

So the benign belief will outperform the revised belief if $Max(SE_3,\ SE_5) > SE_1$.

If $\lambda_5 < 0$, then $\lambda^* = \lambda_6$ minimizes manipulations under separation. And social efficiency is SE_4.

Following part ii), under a pooling equilibrium, when $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda = \overline{\lambda}$ is optimal, and social efficiency is SE_5.

If $SE_4 > SE_5$, $\lambda^* = \lambda_6$. If $SE_4 < SE_5$, $\lambda^* = \overline{\lambda}$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K < 0$, $\lambda_{6l} \equiv \lambda_6 + \varepsilon$ is optimal under pooling, and $SE = [\tau_{G0} + g\lambda_{6l} + \mu^* + (1-\tau_{G0} - g\lambda_{6l} - \mu^*)p]S - [(\tau_{G0} + g\lambda_{6l} + \mu^*)\alpha + (1-\tau_{G0} - g\lambda_{6l} - \mu^*)(1-p)]L - (\tau_{G0} - \tau_{B0} + g\lambda_{6l} + b\lambda_{6l} + 2\mu^*)K \equiv SE_6$.

If $SE_4 > SE_6$, $\lambda^* = \lambda_6$. If $SE_4 < SE_6$, $\lambda^* = \lambda_{6l}$.

So the benign belief will outperform the revised belief if $Max(SE_5,\ SE_6) > SE_1$.

iv) There exists a λ_4 such that inequality (1) is (not) satisfied when $\lambda \leqslant (>)\lambda_7$. In such case, to achieve separation, $\lambda \leqslant \lambda_7$, and $\lambda^* = \lambda_7$ minimizes manipulations under separation. And social efficiency $SE = S - [\tau_S(\lambda_7) - \tau_G(\lambda_7)]K \equiv SE_7 < SE_1$.

If $\lambda > \lambda_7$, there is always a pooling equilibrium. Following above, under a pooling equilibrium, when $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda = \overline{\lambda}$ is optimal, and $SE = SE_5$.

If $SE_7 > SE_5$, $\lambda^* = \lambda_7$. If $SE_7 < SE_5$, $\lambda^* = \overline{\lambda}$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K < 0$, $\lambda_{7l} \equiv \lambda_7 + \varepsilon$ is optimal under pooling, and $SE = [\tau_{G0} + g\lambda_{7l} + \mu^* + (1-\tau_{G0} - g\lambda_{7l} - \mu^*)p]S - [(\tau_{G0} + g\lambda_{7l} + \mu^*)\alpha + (1-\tau_{G0} - g\lambda_{7l} - \mu^*)(1-p)]L - (\tau_{G0} - \tau_{B0} + g\lambda_{7l} + b\lambda_{7l} + 2\mu^*)K \equiv SE_8$.

If $SE_7 > SE_8$, $\lambda^* = \lambda_7$. If $SE_7 < SE_8$, $\lambda^* = \lambda_{7l}$.

So the benign belief will outperform the revised belief if $Max(SE_8,\ SE_5) > SE_1$.

v) There exists a λ_8 such that inequality (1) is satisfied in the form of equality only when $\lambda = \lambda_8$ and not satisfied when $\lambda \neq \lambda_8$. In such case, to achieve separation, $\lambda = \lambda_8$, and social efficiency $SE = S - [\tau_S(\lambda_8) - \tau_G(\lambda_8)]K \equiv SE_9 < SE_1$.

Following above, under a pooling equilibrium, when $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda = \overline{\lambda}$ is optimal, and social efficiency is SE_5.

If $SE_9 > SE_5$, $\lambda^* = \lambda_7$. If $SE_9 < SE_5$, $\lambda^* = \overline{\lambda}$.

When $g(1-p)S - g(\alpha-1+p)L - (g+b)K < 0$, $\lambda = 0$ is optimal under pooling, and social efficiency is SE_3.

If $SE_9 > SE_3$, $\lambda^* = \lambda_7$. If $SE_9 < SE_3$, $\lambda^* = 0$.

So the benign belief will outperform the revised belief if $Max(SE_3,\ SE_5) > SE_1$.

vi) Inequality (1) is never satisfied $\forall\ \lambda \in [0,\ \overline{\lambda}]$. In such case, there is always a pooling equilibrium.

Following above, when $g(1-p)S - g(\alpha-1+p)L - (g+b)K > 0$, $\lambda^* = \overline{\lambda}$, and social efficiency is SE_5.

When $g(1-p)S - g(\alpha-1+p)L-(g+b)K < 0$, $\lambda^* = 0$, and social efficiency is SE_3.

So the benign belief will outperform the revised belief if $Max(SE_3,\ SE_5) > SE_1$.

In Scenario 3, under a separating equilibrium, $w_G^* = \tau_S(\lambda^*)$ and $w_B^* = \tau_B(\lambda^*)$. Under a pooling equilibrium, $w_G^* = w_B^* = \tau_G(\lambda^*) + \mu^*$.

II. The Case of a Negatively Biased Method

The analysis when the old method is negatively biased is similar to that of the case where the old method is positively biased. So in the following, I mainly highlight areas where the conclusions may be different.

Under the standard belief, a firm is viewed as good if choosing $w \geqslant \tau_{F0}$ and bad if choosing $w < \tau_{F0}$ since the benefit from reaching τ_{F0}, $U_B(1)$ is independent of the old method. And $\lambda^* = \overline{\lambda}$ if $\tau_{F0} \geqslant \tau_{Gmax}$.

Under the revised belief, provided that $w_G = \tau_F$, BT will not choose $w_B = \tau_F$ if $U_B[v_B(\tau_F)] - c(\tau_F - \tau_B) \leqslant 0$, and $U_B[v_B(\tau_F)] < U_B(1)$.

Let τ_{S2} be such that $U_B[v_B(\tau_{S2})] - c(\tau_{S2} - \tau_B) = 0$. Since $U_B[v_B(\tau_{S2})] < U_B(1)$ and $\frac{dc(m)}{dm} > 0$, it follows that $\tau_{S2} < \tau_{F0}$ for any given λ.

For GT, since $1-\beta > 0$ and $p > 1-p$, it is always the case that $v_G(\tau_{S2}) > v_B(\tau_{S2})$. So τ_{S2} is a dominant strategy for GT. Since $\frac{d\tau_{S2}}{d\lambda} < 0$ and $\frac{d\tau_G}{d\lambda} > 0$, $\lambda^* = \overline{\lambda}$.

At $\lambda = \overline{\lambda}$, the revised belief dominates the standard belief.

Under the benign belief, there are three possible scenarios.

Scenario 1.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) < 0$.

Given evaluation, when the old method is negatively biased, $v_B = (1-p)(1-w_B)$ for BT. So $\frac{dU(v_B)}{dw_B} \propto -1+p < 0$. Similarly, for GT, $\frac{dU(v_G)}{dw_G} \propto 1-\beta-p < 0$.

Since U_B is decreasing and linear and c is increasing and convex, U_B and c will never intersect as λ increases.

As BT will never mimic GT, accounting regulation does not matter, and $\lambda^* \in [0,\ \overline{\lambda}]$.

Scenario 2.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) > 0$.

Since U_B is decreasing and linear and c is increasing and convex, there always exists one intersection between U_B and c as λ increases. Let λ_9 be the intersection.

If $\overline{\lambda} \geqslant \lambda_9$, as long as accounting regulation is sufficiently stringent, BT will not mimic, so $\lambda^* \in [\lambda_9,\ \overline{\lambda}]$.

In Scenarios 1 and 2, based on the revised belief, a fully separating equilibrium can emerge without manipulation with $\tau_{S2} = \tau_G(\lambda^*)$. In equilibrium, $w_G^* = \tau_G(\lambda^*)$ and $w_B^* = \tau_B(\lambda^*)$.

Scenario 3.

$U_B[v_B(\tau_{G0})] - c(\tau_{G0} - \tau_{B0}) > 0$ amd $\overline{\lambda} < \lambda_9$.

In Scenario 3, BT will always mimic GT, unless GT manipulates.

Given accounting regulation λ, GT will have to manipulate to τ_{S2} such that $U_B[v_B(\tau_{S2})] - c(\tau_{S2} - \tau_B) = 0$ to separate from BT.

τ_{S2} always exists because at $\tau_{S2} U_B[v_B(\tau_{S2})] = 0$ and $U_B[v_B(\tau_{S2})] - c(\tau_{S2} - \tau_B) < 0$.

Under the benign belief, the incentive compatibility condition for GT is $U_G(1) - U_G[v_G(\tau_G)] \geqslant c(\tau_{S2} - \tau_G)$. (3)

Let $\tau_{S2min} \equiv \tau_{S2}(\overline{\lambda})$. Under separation, $Min(m) = \tau_{S2min} - \tau_{Gmax}$ with $\lambda = \overline{\lambda}$, and $SE = S - (\tau_{S2min} - \tau_{Gmax})K \equiv SE_{10}$ is the social efficiency under the least costly separation.

Since $\frac{dU_G[v_G(\tau_G)]}{d\lambda} < 0$ and $\frac{dU_G^2[v_G(\tau_G)]}{d\lambda^2} = 0$, the LHS of (3) is increasing and linear in λ.

Since $\frac{dc(\tau_{S2}-\tau_G)}{d\lambda} < 0$ and $\frac{dc^2(\tau_{S2}-\tau_G)}{d\lambda^2} < 0$, the RHS of (3) is decreasing and convex in λ.

There are two possibilities.

i) Inequality (1) is satisfied $\forall\ \lambda \in [0,\ \overline{\lambda}]$. In such case, GT will always manipulate to τ_{S2} to separate from BT. Given that investment efficiency is fixed, to minimize manipulations, $\lambda^* = \overline{\lambda}$. Here, the revised belief and the benign belief yield the same outcome.

ii) There exists a λ_{10} such that inequality (1) is (not) satisfied when $\lambda \geqslant (<)\lambda_{10}$. In such case, to achieve separation, $\lambda \geqslant \lambda_{10}$, and $\lambda^* = \overline{\lambda}$ minimizes manipulations under separation. And social efficiency is SE_{10}.

If $\lambda < \lambda_{10}$, there is always a pooling equilibrium. Given pooling, for GT, $w_G = \tau_G + \mu_2$. Let μ_{G2} be the solution to $\frac{dU(v_G)}{dw_G} = \frac{dc(\mu)}{d\mu}$. So $\mu_2^* = Min[0,\ \mu_{G2}]$. Note that $\frac{d\mu_{G2}}{d\lambda} = 0$ because $\frac{d^2U_G(v_G)}{dw_G^2} = 0$. It is easy to see that $\tau_G - \mu_2^* < \tau_{S2}$ since $\mu_2^* \leqslant 0$.

Let $\lambda_{10s} \equiv \lambda_{10} - \varepsilon$ where ε is positive and infinitesimal.

Since $w_B = w_G$ in a pooling equilibrium, $SE = [(\tau_G + \mu_2^*)(1-\beta) + (1-\tau_G-\mu_2^*)p]S - (1-\tau_G-\mu_2^*)(1-p)L - (\tau_G-\tau_B-\mu_2^*)K$. $\frac{dSE}{d\lambda} = g(1-\beta-p)S + g(1-p)L - (g+b)K$.

When $g(1-\beta-p)S + g(1-p)L - (g+b)K > 0$, $\lambda = \lambda_{10s}$ is optimal under pooling, and $SE = [(\tau_{G0} + g\lambda_{9s} + \mu_2^*)(1-\beta) + (1-\tau_{G0} - g\lambda_{9s} - \mu_2^*)p]S - (1-\tau_{G0} - g\lambda_{9s} - \mu_2^*)(1-p)L - (\tau_{G0} - \tau_{B0} + g\lambda_{9s} + b\lambda_{9s} - \mu_2^*)K \equiv SE_{11}$.

If $SE_{10} > SE_{11}$, $\lambda^* = \overline{\lambda}$. If $SE_8 < SE_9$, $\lambda^* = \lambda_{9s}$.

When $g(1-\beta-p)S + g(1-p)L - (g+b)K < 0$, $\lambda = 0$ is optimal under pooling, and $SE = [(\tau_{G0} + \mu_2^*)(1-\beta) + (1-\tau_{G0} - \mu_2^*)p]S - (1-\tau_{G0} - \mu_2^*)(1-p)L - (\tau_{G0} - \tau_{B0} - \mu_2^*)K \equiv SE_{12}$.

If $SE_{10} > SE_{12}$, $\lambda^* = \overline{\lambda}$. If $SE_{10} < SE_{12}$, $\lambda^* = 0$.

So the benign belief will outperform the revised belief if $Max(SE_{11},\ SE_{12}) > SE_{10}$.

In Scenario 3, under a separating equilibrium, $w_G^* = \tau_{S2}(\lambda^*)$ and $w_B^* = \tau_B(\lambda^*)$. Under a pooling equilibrium, $w_G^* = w_B^* = \tau_G(\lambda^*) + \mu_2^*$.

To compared SE_1 with SE_{10}, note that the only difference is the cost of manipulation. To show $SE_{10} > SE_1$, it is sufficient to show that $\tau_{S2min} < \tau_{Smin}$.

With a negatively biased method, τ_{S2min} is determined by $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$ under $\lambda = \overline{\lambda}$. Here, $v_B(\tau_{S2min}) = (1-\tau_{S2min})(1-p)$.

Given a positively biased method and $\lambda = \overline{\lambda}$, at τ_{S2min}, $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) > 0$ since $v_B(\tau_{S2min}) = \tau_{S2min}\alpha + (1-\tau_{S2min})(1-p) > (1-\tau_{S2min})(1-p)$, unless $\tau_{S2min} = 0$.

With a positively biased method, since U_B is increasing and linear and c is increasing and convex, for $U_B[v_B(\tau_S)] - c(\tau_S - \tau_B) = 0$ under $\lambda = \overline{\lambda}$, it must be the case that $\tau_S > \tau_{S2min}$. So $\tau_{Smin} > \tau_{S2min}$.

Everything so far concerns with the case where the past successful experience is with a good firm. If the past successful experience is with a bad firm, then $\tau_{G0} < \tau_{B0}$, $\tau_G = \tau_{G0} - g\lambda > 0$, and $\tau_B = \tau_{B0} + b\lambda < 1$. For the investor, the point of separation becomes $\tau_Z \leqslant \tau_G$. The analysis for the case where the old method is positively biased and the experience is with a bad firm is analogous to the case where old method is negatively biased and the experience is with a good firm. The reason is that for BT, as it manipulates towards the separation point, its expected benefit from being evaluated will decrease. Meanwhile, for GT, as λ increases, its benefit from separation will increase. In a similar vein, the analysis for the case where the old method is negatively biased and the experience is with a bad firm is analogous to the case where old method is positively biased and the experience is with a good firm. Applying the above logic, under $\lambda = \overline{\lambda}$ and separation, it is less costly to separate when the old method is negatively biased than when the old method is positively biased.

Appendix B: Endogenous Accounting Choice

An underlying assumption in the main analysis is that in an unregulated economy, Firm Y's unmanipulated information pattern similarity is exogeneous so that Firm Y can have four different states: GS, GD, BS, and BD. In this section, I apply an alternative assumption such that Firm Y's information pattern is an endogenous choice. That is, firm managers can choose any accounting and reporting system in an unregulated economy. The analysis in this section is as follows: I first examine the equilibria in an unregulated economy and then discuss the implications of accounting regulation by comparing equilibria under different regimes.

I.1 Unregulated economy

I.1.1 Experience with a good firm

In this sub-section, I analyze the case where the past successful experience is with a good firm (i.e., Firm X is good). Without accounting regulation, firms may be able to freely choose the accounting methods used for financial reporting. However, the freedom may not have equal effects on good versus bad firms. To be more specific, if Firm Y is good, its manager can choose whether to display a similar or different information pattern costlessly because of the firm's good nature. I label good firms as GS/D. In contrast, for bad firms, only a portion can display an information pattern similar to Firm X in a costless manner (BS/D); the rest will have a different information pattern without manipulation (BD). The possible equilibria are summarized in the following lemma.

Lemma A1: Under endogenous accounting systems and given a successful experience with a good firm, without accounting regulation,

1) when the old method has a large positive bias, a stable equilibrium of the information pattern choices made by GS/D, BS/D, BD is {S, S, S};

2) when the old method has a small positive bias, a stable equilibrium of the information pattern choices made by GS/D, BS/D, BD is {S, S, D};

3) when the old method has a negative bias, stable equilibria of the information pattern choices made by GS/D, BS/D, BD are {S, S, D}, {S, D, D}, and {D, D, D}.

To explain Lemma A1, first consider the case where the old method is positively biased. Given the positive bias, both GS/D and BS/D will prefer to display a similar information pattern, unless a similar pattern signals the bad type, which is unreasonable, or a different information pattern signals the good type, which is impossible in equilibrium given the existence of BD. Since displaying a similar information pattern is the dominant strategy for both GS/D and BS/D, a different information pattern can signal the bad type, and the choice of BD hinges on how large the positive bias is. When the positive bias is large (small), BD will (not) manipulate and display a similar (different) information pattern. The resulting equilibrium is {S, S, S} or {S, S, D}.

When the old method is negatively biased, everyone will prefer to display a different information pattern, unless a different information pattern signals the bad type. As a result, the belief of the investor dictates firms' choices. When the investor remains agnostic about a different information pattern, {D, D, D} will emerge and the investor will always evaluate the firm. In contrast, if the investor believes that a different information pattern signals the bad type, then GS/D will choose to display a similar information pattern. For BS/D and BD, since neither a similar information pattern nor a different information pattern will give them some hope of getting investment, BS/D will be indifferent and BD will remain status quo, and the equilibrium is {S, S, D} or {S, D, D}, the efficiencies of which are the same.

I.1.2 Experience with a bad firm

In this sub-section, I analyze the case where the past successful experience is with a bad firm (i.e., Firm X is bad). Similar to above, I assume that if Firm Y is good, its manager can choose whether to display a similar or different information pattern costlessly (GS/D). However, only a portion of bad firms can display an information pattern different from that of Firm X in a costless manner (BS/D); the rest will have a similar information pattern without manipulation (BS). I summarize possible equilibria in the following lemma.

Lemma A2: Under endogenous accounting systems and given a successful experience with a bad firm, without accounting regulation,

1) when the precision of a new method is high, stable equilibria of the information pattern choices made by GS/D, BS/D, BS are {S, S, S} (only when the old method has a positive bias) and {D, D, S};

2) when the precision of a new method is low, stable equilibria of the information pattern choices made by GS/D, BS/D, BS are {S, S, S} (only when the old method has a positive bias) and {D, D, D}.

Results in Lemma A2 are similar to those in Lemma 3a. When the investor has a successful experience with a bad firm, the investor may believe that a similar information pattern signals the bad type. With such belief, both GS/D and BS/D will choose to display a similar information pattern. For BS, the decision to manipulate depends on how precise a new method is. When the precision is low (high), BS will (not) manipulate and display a different (similar) information pattern, leading to {D, D, D} ({D, D, S}).

Without a signaling belief, the choices of GS/D, BS/D, and BD will condition on the bias of the old method. When the old method is negatively biased, a different information pattern is the dominant strategy for everyone, and the equilibrium is {D, D, D}. In contrast, when the old method is positively biased, a similar information pattern is the dominant strategy for everyone, and the equilibrium is {S, S, S}.

I.2 Comparisons

I.2.1 Effects of Accounting Regulation

In this sub-section, I analyze the effects of accounting regulation relative to no regulation. Note that equilibria with accounting regulation are insensitive to whether accounting choices are exogenous or endogenous without regulation. Following the main analysis, I adopt the view of a naive investor in presenting the results.

Proposition A1: Under endogenous accounting systems and given a successful experience with a good firm,

1) when the old method has a large positive bias, accounting regulation has no effect on investment efficiency and increases manipulations;

2) when the old method has a small positive bias, accounting regulation has no effect on investment in good firms and manipulations and decreases overinvestment in bad firms;

3) when the old method has a negative bias, accounting regulation decreases underinvestment in good firms, may decrease overinvestment in bad firms, and has no effect on manipulations.

The results of the first two parts of Proposition A1 are similar to those in Proposition 1. With accounting regulation, GS/D become GS and BS/D become BD without manipulation. Given a large positive bias, the equilibrium is {S, S, S} under both regimes. As a result, accounting regulation does not change investment efficiency when the investor is naive. Nevertheless, accounting regulation may be detrimental to social welfare because there will be more manipulations. The reason is that BS/D's ability to display a similar information pattern through accounting choices is deprived by accounting regulation. In order to display a similar information pattern, BS/D can only resort to manipulations.

When the positive bias is small, the equilibrium with accounting regulation is a fully-separating one. Since good firms can always guarantee investment without accounting regulation because the old method is positively biased and accounting choices without accounting regulation are endogenous, accounting regulation, however, does not affect investment in good firms. Meanwhile, accounting regulation will always decrease overinvestment in bad firms because of the presence of BS/D in the unregulated economy. Finally, since BD never manipulate under a small positive bias, accounting regulation does not affect manipulations.

When the old method is negatively biased, accounting regulation can always lead to the maximum level of investment efficiency. In contrast, underinvestment in good firms always exists without accounting regulation. Therefore, accounting regulation can always help decrease underinvestment. As for overinvestment in bad firms, it will decrease only when the equilibrium without accounting regulation is {D, D, D}. In terms of manipulations, since GS/D and BS/D's accounting choices are endogenous and BD will never manipulate, no manipulation is expected whether there is accounting regulation or not.

Proposition A2: Under endogenous accounting systems and given a successful experience with a bad firm,

1) when the precision of a new method is high, accounting regulation decreases (weakly) underinvestment in good firms, overinvestment in bad firms, and (weakly) manipulations;

2) when the precision of a new method is low, accounting regulation has no effect on investment efficiency and increases manipulations.

Recall from Proposition 3 that when the precision of a new method is high, investment efficiency will achieve its maximum with accounting regulation. In contrast, without accounting regulation, there always exists underinvestment in good firms (unless when the old method is positively biased) and overinvestment in bad firms. As a result, accounting regulation can help decrease both underinvestment and overinvestment. Moreover, if BS choose to display a different information pattern without accounting regulation, then accounting regulation can also deter manipulations.

When the precision of a new method is low, the equilibria are the same with and without accounting regulation. As a result, accounting regulation does not affect investment efficiency. However, since GS/D become GD and BS/D become BS with accounting regulation, more manipulations are expected from GS/D (BS/D) when the equilibrium is {S, S, S} ({D, D, D}).

I.2.2 Compare Different Experiences

Corollary A1: Under endogenous accounting systems and without accounting regulation,

1) given a successful experience with a good firm, compared with a negatively biased method, a positively biased method leads to less underinvestment in good firms and may lead to less overinvestment in bad firms;

2) given a successful experience with a bad firm, compared with a negatively biased method, a positively biased method leads to weakly less underinvestment in good firms and weakly more overinvestment in bad firms;

3) given a positively biased method, compared with a successful experience with a bad firm, a successful experience with a good firm leads to weakly less underinvestment in good firms and may lead to less overinvestment in bad firms;

4) given a negatively biased method, compared with a successful experience with a bad firm, a successful experience with a good firm leads to weakly more underinvestment in good firms and may lead to more overinvestment in bad firms.

The results of Corollary A1 are in line with those in Corollary 2. With a successful experience with a good firm, $\{S, S, D\}_{GP}$ is the dominant equilibrium under a positive bias. Regardless of the equilibria under a negative bias, $\{S, S, D\}_{GP}$ will always lead to more investment in GS/D and BS/D. When the equilibrium under a negative bias is $\{S, S, D\}_{GN}$, investment probabilities are the same for BD regardless of the bias because a different information pattern signals the bad type. When the equilibrium under a negative bias is $\{D, D, D\}_{GN}$, since there will be less investment in BD under a positive bias due to signaling effect, it is possible that there will be less overinvestment in bad firms.

When the successful experience is with a bad firm, undominated equilibria are $\{S, S, S\}_{BP}$ or $\{D, D, S\}_{BP}$ and $\{D, D, S\}_{BN}$. When the equilibrium is $\{D, D, S\}_{B\bullet}$, investment efficiencies are the same because a similar information pattern signals the bad type. However, compared with $\{D, D, S\}_{BN}$, $\{S, S, S\}_{BP}$ leads to more investment in all firms due to the positive bias. Overall, a positive bias will result in weakly less underinvestment in good firms but more overinvestment in bad firms.

For part 3) of Corollary A1, a successful experience with a good firm will lead to more (the same) investment in GS/D and BS/D when the equilibrium under a successful experience with a bad firm is $\{D, D, S\}_{BP}$ ($\{S, S, S\}_{BP}$). Meanwhile, the probability of investment in BD[18] will be weakly lower. Hence, it is possible that a successful experience with a good firm will not only decrease underinvestment in good firms, but also decrease overinvestment in bad firms relative to a successful experience with a bad firm.

When the old method is negatively biased, a successful experience with a good firm will be dominated by a successful experience with a bad firm if the equilibria are $\{D, D, D\}_{GN}$ and $\{D, D, S\}_{BN}$, respectively, owing to the different investment probabilities in BD. If the comparison is between $\{S, S, D\}_{GN}$ and $\{D, D, S\}_{BN}$, then BD will not get investment anyway. However, a successful experience with a good firm will lead to lower investment probabilities in both GS/D and BS/D.

As a final note, in all undominated equilibria, BD do not manipulate because manipulation

[18]This is from the view of an investor with a successful experience with a good firm. All following discussions adopt the same view.

will either signal BD's bad type or make the resulting equilibria dominated ones. Since the accounting choices for GS/D and BS/D are endogenous, no manipulation is expected in all undominated equilibria. Different types of investor experience, therefore, do not have implications for manipulations.

Proof of Lemma A1:

First consider the case where the old method is positively biased.

Since BS/D can costlessly choose between S and D, neither S or D may signal the good type in equilibrium.

Suppose D signals the bad type. For GS/D, $E_{GS/D}(r_{GS/D} = S) = \gamma$, and $E_{GS/D}(r_{GS/D} = D) = 0 < \gamma$.

For BS/D, $E_{BS/D}(r_{BS/D} = S) = \alpha\gamma$, and $E_{BS/D}(r_{BS/D} = D) = 0 < \alpha\gamma$. So S is the dominant strategy for GS/D and BS/D.

For BD, $E_{BD}(r_{BD} = D) = 0$, and $E_{BD}(r_{BD} = S) = (1-u)\alpha\gamma - k > 0$ if $\alpha > \frac{\kappa}{1-u}$.

When $\alpha > \frac{\kappa}{1-u}$, $r_{BD} = S$. The strategy profile{S, S, S} agrees with the belief.

When $\alpha < \frac{\kappa}{1-u}$, $r_{BD} = D$. The strategy profile{S, S, D} agrees with the belief.

Suppose there is no signaling. Using the same approach, the equilibria are {S, S, S} if $\alpha > 1 - p + \frac{\kappa}{1-u}$, and {S, S, D} if $\alpha < 1 - p + \frac{\kappa}{1-u}$.

Under {S, S, D}, since $0 < 1 - p$ for BD, the investor can deviate by viewing D as signaling the bad type. But with such belief, BD will deviate if $\frac{\kappa}{1-u} < \alpha < 1 - p + \frac{\kappa}{1-u}$. And {S, S, D} is stable only when $\alpha < \frac{\kappa}{1-u}$.

Taken together, when $\alpha < \frac{\kappa}{1-u}$, the equilibrium is {S, S, D} (D is bad). When $\alpha > \frac{\kappa}{1-u}$, the equilibrium is {S, S, S} (no signal or D is bad).

Next consider the case where the old method is negatively biased.

Suppose D signals the bad type. For GS/D, $E_{GS/D}(r_{GS/D} = S) = (1-\beta)\gamma$, and $E_{GS/D}(r_{GS/D} = D) = 0 < (1-\beta)\gamma$.

For BS/D, $E_{BS/D}(r_{BS/D} = S) = 0$, and $E_{BS/D}(r_{BS/D} = D) = (1-p)\gamma > 0$. So D is the dominant strategy for GS/D and BS/D.

For BD, $E_{BD}(r_{BD} = D) = (1-p)\gamma$, and $E_{BD}(r_{BD} = S) = -k < (1-p)\gamma$.

Strategy profiles{S, S, D} and {S, D, D} both agree with the belief.

Suppose there is no signaling. For GS/D, $E_{GS/D}(r_{GS/D} = S) = (1-\beta)\gamma$, and $E_{GS/D}(r_{GS/D} = D) = p\gamma > (1-\beta)\gamma$.

For BS/D, $E_{BS/D}(r_{BS/D} = S) = 0$, and $E_{BS/D}(r_{BS/D} = D) = 0$. So BS/D are indifferent between S and D.

For BD, $E_{BD}(r_{BD} = D) = 0$, and $E_{BD}(r_{BD} = S) = -k < 0$.

The strategy profile{D, D, D} agrees with the belief.

Taken together, the equilibria are {S, S, D} (D is bad), {S, D, D} (D is bad), and {D, D, D} (no signal).

Proof of Proposition A1:

Let the numbers of GS/D, BS/D, and BD be q_5, q_6, and q_7, respectively.

First consider the case where the old method is positively biased.

When $\alpha > \frac{\kappa_r}{1-u}$, compare {S, S, S} (with regulation) with {S, S, S}(without regulation): $\Delta_{G,J} = 0$, $\Delta_{B,J} = -u\alpha q_6 L < 0$, and $\Delta_W = q_6 K > 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

When $\frac{\kappa}{1-u} < \alpha < \frac{\kappa_r}{1-u}$, compare {S, D, D} (with regulation) with {S, S, S} (without regulation): $\Delta_{G,J} = 0$, $\Delta_{B,J} = [-\alpha q_6 - (1-u)\alpha q_7]L < 0$, and $\Delta_W = -q_7 K < 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$. $\Delta_{B,NJ} = -\alpha(q_6 + q_7)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

When $\alpha < \frac{\kappa}{1-u}$, compare {S, D, D} (with regulation) with {S, S, D} (without regulation): $\Delta_{G,J} = 0$, $\Delta_{B,J} = -\alpha q_6 L < 0$ and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

Next consider the case where the old method is negatively biased.

When the investor believes that D signals the bad type, compare {S, D, D} (with regulation) with {S, S, D} or {S, D, D} (without regulation): $\Delta_{G,J} = \beta q_5 S > 0$, $\Delta_{B,J} = 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

When the investor does not believe that D signals the bad type, compare {S, D, D} (with regulation) with {D, D, D} (without regulation): $\Delta_{G,J} = \beta q_5 S > 0$, $\Delta_{B,J} = -(1-p)(q_6 + q_7)L < 0$, and $\Delta_W = -q_5 K < 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

Proof of Lemma A2:

Since BS/D can costlessly choose between S and D, neither S or D may signal the good type in equilibrium.

Suppose S signals the bad type. For GS/D, $E_{GS/D}(r_{GS/D} = S) = 0$, and $E_{GS/D}(r_{GS/D} = D) = p\gamma > 0$.

For BS/D, $E_{BS/D}(r_{BS/D} = S) = 0$, and $E_{BS/D}(r_{BS/D} = D) = (1-p)\gamma > 0$. So D is the dominant strategy for GS/D and BS/D.

For BS, $E_{BS}(r_{BS} = S) = 0$, and $E_{BS}(r_{BS} = D) = (1-u)(1-p)\gamma - k > 0$ if $\kappa < (1-u)(1-p)$.

When $\kappa < (1-u)(1-p)$, $r_{BS} = D$. The strategy profile{D, D, D} agrees with the belief.

When $\kappa > (1-u)(1-p)$, $r_{BS} = S$. The strategy profile{D, D, S} agrees with the belief.

When there is no signaling, another possible equilibrium under a positive bias is {S, S, S}, and another possible equilibrium under a negative bias is {D, D, D}.

For {D, D, D} and {S, S, S}, since $1 > p$ for GS/D but $\alpha > 1-p$ for BS/D and BS, neither equilibrium dominates the other.

For {D, D, S} and {S, S, S}, since $1 > p$ for GS/D but $\alpha > 1-p$ for BS/D and $\alpha > 0$ for BS, neither equilibrium dominates the other.

For {D, D, S} and {D, D, D}, since $0 < 1-p$ for BS, I rule out {D, D, D} when $\kappa > (1-u)(1-p)$.

Proof of Proposition A2:

With a successful experience with a bad firm, the numbers of GS/D, BS/D, and BS in the unregulated economy are q_5, q_6, and q_7, respectively.

First consider the case where the old method is positively biased.

When $\kappa > (1-u)(1-p)$, compare {D, S, S} (with regulation) with {D, D, S} (without regulation): $\Delta_{G,J} = (1-p)q_5 S > 0$, $\Delta_{B,J} = -(1-p)q_6 L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

Or compare {D, S, S} (with regulation) with {S, S, S} (without regulation): $\Delta_{G,J} = 0$, $\Delta_{B,J} = [-\alpha q_6 - (1-p)q_7]L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

When $\kappa < (1-u)(1-p) < \kappa_r$, compare {D, S, S} (with regulation) with {D, D, D} (without regulation): $\Delta_{G,J} = (1-p)q_5 S > 0$, $\Delta_{B,J} = [-(1-p)q_6 - (1-u)(1-p)q_7]L < 0$, and $\Delta_W =$

$-q_7K < 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$. $\Delta_{B,NJ} = -(1-p)(q_6+q_7)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

Or compare {D, S, S} (with regulation) with {S, S, S} (without regulation), and the results are the same as above.

When $\kappa_r < (1-u)(1-p)$, compare {D, D, D} (with regulation) with {D, D, D} (without regulation): $\Delta_{G,J} = u(1-p)q_5S > 0$, $\Delta_{B,J} = -u(1-p)q_6L < 0$, and $\Delta_W = q_6K > 0$.

Without sophistication, $\Delta_{G,NJ} = 0$, and $\Delta_{G,NJ} < \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Or compare {S, S, S} (with regulation) with {S, S, S} (without regulation): $\Delta_{G,J} = 0$, $\Delta_{B,J} = -u\alpha(q_6+q_7)L < 0$, and $\Delta_W = q_5K > 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$. $\Delta_{B,NJ} = 0$, and $\Delta_{B,NJ} > \Delta_{B,J}$.

Next consider the case where the old method is negatively biased.

When $\kappa > (1-u)(1-p)$, compare {D, S, S} (with regulation) with {D, D, S} (without regulation): $\Delta_{G,J} = (1-p)q_5S > 0$, $\Delta_{B,J} = -(1-p)q_6L < 0$, and $\Delta_W = 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$, and $\Delta_{B,NJ} = \Delta_{B,J}$.

Or compare {D, S, S} (with regulation) with {D, D, D} (without regulation): $\Delta_{G,J} = (1-p)q_5S > 0$, $\Delta_{B,J} = [-(1-p)q_6 - (1-u)(1-p)q_7]L < 0$, and $\Delta_W = -q_7K < 0$.

Without sophistication, $\Delta_{G,NJ} = \Delta_{G,J}$. $\Delta_{B,NJ} = -(1-p)(q_6+q_7)L < 0$, and $\Delta_{B,NJ} < \Delta_{B,J}$.

When $\kappa < (1-u)(1-p) < \kappa_r$, compare {D, S, S} (with regulation) with {D, D, D} (without regulation), and the results are the same as above.

When $\kappa_r < (1-u)(1-p)$, compare {D, D, D} (with regulation) with {D, D, D} (without regulation), and the results are the same as above.

Proof of Corollary A1:

Following the main analysis, I focus on the case where $\kappa > (1-u)(1-p)$. Undominated equilibria include $\{S, S, D\}_{GP}$, $\{S, S, D\}_{GN}$, $\{D, D, D\}_{GN}$, $\{S, S, S\}_{BP}$, $\{D, D, S\}_{BP}$, and $\{D, D, S\}_{BN}$.

With a successful experience with a good firm, first compare $\{S, S, D\}_{GP}$ with $\{S, S, D\}_{GN}$: $\Delta_{G,NJ} = \beta q_5S > 0$, $\Delta_{B,NJ} = \alpha q_3L > 0$, and $\Delta_W = 0$.

Next compare $\{S, S, D\}_{GP}$ with $\{D, D, D\}_{GN}$: $\Delta_{G,NJ} = (1-p)q_5S > 0$, $\Delta_{B,NJ} = [(\alpha - 1 +$

$p)q_3 - (1-p)q_4]L > (<)0$ if $q_3 > (<)\frac{1-p}{\alpha-1+p}q_4$, and $\Delta_W = 0$.

With a successful experience with a bad firm, first compare $\{$D, D, S$\}_{BP}$ with $\{$D, D, S$\}_{BN}$: $\Delta_{G,NJ} = 0$, $\Delta_{B,NJ} = 0$, and $\Delta_W = 0$.

Next compare $\{$S, S, S$\}_{BP}$ with $\{$D, D, S$\}_{BN}$: $\Delta_{G,NJ} = (1-p)q_5 S > 0$, $\Delta_{B,NJ} = [(\alpha - 1 + p)q_6 + \alpha q_7]L > 0$, and $\Delta_W = 0$.

With a positively biased method, first compare $\{$S, S, D$\}_{GP}$ with $\{$S, S, S$\}_{BP}$: $\Delta_{G,NJ} = 0$, $\Delta_{B,NJ} = -\alpha q_7 L < 0$, and $\Delta_W = 0$.

Next compare $\{$S, S, D$\}_{GP}$ with $\{$D, D, S$\}_{BP}$: $\Delta_{G,NJ} = (1-p)q_5 S > 0$, $\Delta_{B,NJ} = (\alpha - 1 + p)q_6 L > 0$, and $\Delta_W = 0$.

With a negatively biased method, first compare $\{$S, S, D$\}_{GN}$ with $\{$D, D, S$\}_{BN}$: $\Delta_{G,NJ} = (1-\beta-p)q_5 S < 0$, $\Delta_{B,NJ} = -(1-p)q_6 L < 0$, and $\Delta_W = 0$.

Next compare $\{$D, D, D$\}_{GN}$ with $\{$D, D, S$\}_{BN}$: $\Delta_{G,NJ} = 0$, $\Delta_{B,NJ} = (1-p)q_7 L > 0$, and $\Delta_W = 0$.

Appendix C: An Alternative Belief

In the main text, I analyzed optimal accounting regulation based on some theoretically sound beliefs. In the analysis, it is assumed that BT will not get investment if choosing a similarity level different from that of GT. One perhaps not so realistic part about the assumption is that from a more behavioral and evolutionary perspective, when the investor has a successful experience with a good (bad) firm, then the investor will naturally prefer the more similar (different) firm if two levels of information pattern similarity are observed. In such case, both GT and BT will have an incentive to be more similar (different) than the other, and there will be a race to similarity (difference). So in the following, I analyze a game between GT and BT such that if one is more similar (different) than the other under a successful experience with a good (bad) firm, then the more similar (different) firm will be viewed as good with the other being viewed as bad. If GT and BT display the same level of information pattern similarity, then both will be evaluated. For tractability, I assume that GT and BT can either choose to remain status quo or manipulate fully to being perfectly similar or different. In Proposition A3, I summarize the optimal accounting regulation in maximizing social efficiency.

Proposition A3: 1) When the successful experience is with a good firm and the old method is positively biased, optimal accounting regulation is i) any degree of regulation, or ii) the loosest or the most stringent regulation, or iii) sufficiently stringent regulation.

2) When the successful experience is with a good firm and the old method is negatively biased, optimal accounting regulation is sufficiently stringent regulation.

3) When the successful experience is with a bad firm, optimal accounting regulation is i) sufficiently stringent regulation, or ii) the loosest or the most stringent regulation, or iii) an intermediate degree of regulation.

To explain Proposition A3, first note that GT will always prefer not to manipulate if BT does not manipulate because by default, GT is more similar (different) than BT is when the past successful experience is with a good (bad) firm. As long as BT does not manipulate, GT can always separate from BT costlessly.

When the successful experience is with a good firm and the old method is positively biased, there are several possibilities. First, if GT prefers being viewed as bad over pooling with BT at $\tau = 1$ under the most stringent regulation, then remaining status quo will be a dominant strategy for GT. Given that it is too costly for GT to manipulate to $\tau = 1$ and get investment with certainty (since the old method is positively biased), then it will never be rational for BT to manipulate because manipulating to $\tau = 1$ is always more costly for BT, even if doing so may secure investment. As a result, neither GT nor BT will manipulate. Moreover, since GT will not manipulate even under the most preferrable condition (manipulating to $\tau = 1$ is the least costly under the most stringent regulation) and it is always more costly for BT to manipulate regardless of regulation, neither GT nor BT will manipulate even when the regulation is the loosest. In such case, accounting regulation does not matter.

Second, if GT prefers pooling with BT over being viewed as bad, then GT does not have a dominant strategy. Meanwhile, the choice of BT depends on its net benefit from pooling with GT. If BT has an incentive to pool with GT even under the most stringent regulation, then both GT and BT will choose to manipulate regardless of accounting regulation. Since accounting regulation cannot affect investment efficiency in such case, optimal accounting regulation will need to minimize total manipulations. As more stringent regulation decreases the amount of manipulation for GT but increases the amount of manipulation for BT, optimal accounting regulation hinges on its effect on GT relative to that on BT. To the extent that accounting regulation is better (worse) at making GT more similar than making BT more different, the most stringent (loosest) regulation is optimal.

If BT has an incentive to pool with GT only when accounting regulation is not very stringent, then BT's action will be dependent on whether BT has an incentive to manipulate provided that GT remains status quo. If BT has no incentive to separate from GT under sufficiently stringent regulation, then it will not have an incentive to pool with GT as well. With stringent regulation, BT will not manipulate, and GT can separate from BT costlessly. So optimal accounting regulation is sufficiently stringent regulation. However, if BT has an incentive to separate from GT even under the most stringent regulation, then GT will always want to choose an action that is the same as that of BT, whereas BT will always want to choose an action that is different from that of GT. A pure strategy equilibrium is impossible in such case.

When the successful experience is with a good firm and the old method is negatively biased, BT will always choose to remain status quo if GT manipulates because of the negative bias. Meanwhile, if it is too costly for BT to separate from GT provided that GT does not manipulate, then BT's dominant strategy is to remain status quo. And the best response of GT is to remain status quo as well. To achieve such costless separation, it is necessary that BT will not separate from GT. Since it is more costly for BT to separate when accounting regulation is more stringent, optimal accounting regulation features sufficiently stringent regulation, as long as BT will not separate at least under the most stringent regulation.

If BT finds it rational to separate from GT if GT does not manipulate even under the most stringent regulation, then BT does not have dominant strategy. For GT, if the benefit from pooling with BT at $\tau = 1$ is low which will be case when the negative bias is large, then GT's dominant strategy will be to remain status quo. Anticipating that, BT will always manipulate. In the end, BT will get investment but GT will not, and the investor's belief will be incorrect. Similarly, if GT's dominant strategy is to remain status quo when accounting regulation is sufficiently loose, then under sufficiently loose regulation, the investor will always be wrong, whereas under sufficiently stringent regulation, a mixed strategy will be played.

When the successful experience is with a bad firm, since there will be a flight to being different, the bias associated with the old method becomes irrelevant. For BT, if it prefers to not manipulate to separate when GT does not manipulate under the most stringent regulation, then it will also prefer not to pool with GT when GT manipulates. In such case, remaining status quo is the dominant strategy for BT. Hence, GT will remain status quo and separate from BT costlessly. To hold costless separation in equilibrium, accounting regulation needs to be sufficiently stringent to make separation sufficiently costly for BT.

If BT prefers to pool with GT even under the most stringent regulation, then BT's dominant strategy is to manipulate. At the same time, since GT's benefit from pooling is higher than that of BT and the cost of manipulation is lower, GT will always manipulate when BT manipulates. Similar to above, optimal accounting regulation will be either the loosest or the most stringent regulation to minimize total manipulations.

If, under the most stringent regulation, BT prefers to manipulate when GT does not but prefers not to manipulate when GT does, then there are two possibilities. First, if BT prefers pooling with GT over being viewed as bad under sufficiently loose regulation, then BT's dominant strategy is to manipulate when regulation is sufficiently loose. Given that BT will always manipulate, the best response of GT is to manipulate as well. So optimal accounting regulation is either the loosest regulation or the most stringent regulation (i.e., an intermediate degree of regulation) such that BT will have a dominant strategy to manipulate.

When regulation becomes more stringent, however, BT will not have a dominant strategy. For GT, if pooling with BT via manipulation is too costly which will be the case when the precision of a new method is low, then GT will have a dominant strategy to remain status quo. Given that GT will never manipulate, BT will always manipulate. Again, the investor will be wrong in such case because BT will get investment but GT will not. In contrast, if it is not too costly for GT to pool with BT at $\lambda = 0$, then neither GT nor BT has a dominant strategy. The outcome will be either 1) a mixed strategy for any degree of sufficiently stringent regulation, or 2) a mixed strategy for highly stringent regulation and BT being more different than GT for moderately stringent regulation so that the investor is always wrong.

The second possibility is that BT prefers being viewed as bad over pooling even under the loosest regulation. In such case, BT will not have a dominant strategy for any degree of regulation. Depending on whether GT has a dominant strategy to remain status quo, a mixed strategy will be played for either sufficiently stringent regulation or any degree of regulation. In the former case, when regulation is sufficiently loose, the investor will always be wrong.

Note that in Proposition A3, I focus on the optimal accounting regulation under pure strategy equilibria where the investor's belief is correct. As shown above, there are also several situations where the alternative belief can be incorrect. If the belief is used to only formulate the payoffs to GT and BT but not as an equilibrium condition, then for accounting regulation under which the investor is always wrong, the loosest regulation is optimal. The reason is that if only BT manipulates, then optimal accounting regulation needs to minimize the amount of manipulation for BT, which calls for the loosest regulation.

Moreover, there are also many situations where GT and BT will play a mixed strategy. Under a mixed strategy, except when BT manipulates and GT does not, the investor's belief will be correct. In other words, the investor can be either right or wrong with some probabilities. Again, if the equilibrium condition is loosely set, then mixed strategy equilibria can sustain. A perhaps interesting finding is that in mixed strategy equilibria, while optimal accounting regulation may either be a corner level of regulation or an intermediate one, it features a corner level of stringency more often than not.

Proof of Proposition A3:

Let $I_\bullet = 1$ indicate that the firm manipulates, and $I_\bullet = 0$ indicate that the firm does not manipulate.

I. Successful Experience with a Good Firm and Positively Biased Method

Here $\tau_{G0} > \tau_{B0}$, $\tau_{Gmax} \equiv \tau_{G0} + g\overline{\lambda}$, and $\tau_{Bmin} \equiv \tau_{B0} - b\overline{\lambda}$. Firms can choose to manipulate to $\tau = 1$.

The payoffs to GT and BT are as follows:

		Good Firm (GT)	
		$I_G = 1$	$I_G = 0$
Bad Firm (BT)	$I_B = 1$	$\alpha\gamma - (1-\tau_B)k, \gamma - (1-\tau_G)k$	$\gamma - (1-\tau_B)k, 0$
	$I_B = 0$	$0, \gamma - (1-\tau_G)k$	$0, \gamma$

For GT, $I_G^* = 0$ when $I_B = 0$.

There are several possible cases.

Case 1.

For GT, if $\gamma - (1-\tau_{Gmax})k < 0$, $I_G^* = 0$ when $I_B = 1$. So $I_G = 0$ is the dominant strategy for GT.

Since $\tau_{Bmin} < \tau_{Gmax}$, $\gamma - (1-\tau_{Bmin})k < \gamma - (1-\tau_{Gmax})k < 0$. With $\alpha < 1$, $I_B^* = 0$ when $I_G^* = 0$, and the equilibrium is $I_G = I_B = 0$ when $\lambda = \overline{\lambda}$.

Since $\tau_{B0} < \tau_{G0} < \tau_{Gmax}$, $\gamma - (1-\tau_{B0})k < \gamma - (1-\tau_{G0})k < \gamma - (1-\tau_{Gmax})k < 0$. So the equilibrium remains at $I_G = I_B = 0$ when $\lambda = 0$.

Since the equilibrium is always $I_G = I_B = 0$ and no firm will manipulate, accounting regulation does not matter, and $\lambda^* \in [0, \overline{\lambda}]$.

Case 2.

For GT, if $\gamma - (1-\tau_{Gmax})k > 0$, $I_G^* = 1$ when $I_B = 1$. So GT does not have a dominant strategy.

For BT, if $\alpha\gamma - (1-\tau_{Bmin})k > 0$, then $\gamma - (1-\tau_{Bmin})k > 0$ and $\alpha\gamma - (1-\tau_{B0})k > 0$. So $I_B = 1$ is the dominant strategy for BT.

For GT, since $\gamma - (1-\tau_{Gmax})k > \alpha\gamma - (1-\tau_{Bmin})k > 0$, $I_G^* = 1$ when $I_B^* = 1$. So the equilibrium is always $I_G = I_B = 1$.

Since accounting regulation does not affect investment efficiency, optimal accounting regulation is the one that minimizes expected manipulations.

To avoid confusion between k and K, I substitute K with M in representing the social cost of manipulations. In equilibrium, $E(M) = (1-\tau_G)M + (1-\tau_B)M$. $\frac{dE(M)}{d\lambda} \propto -g + b > (<) 0$ if $b > (<) g$.

So when $b > g$, $\lambda^* = 0$, and when $b < g$, $\lambda^* = \overline{\lambda}$.

Case 3.

For BT, if $\gamma - (1-\tau_{Bmin})k < 0$, then $\alpha\gamma - (1-\tau_{Bmin})k < 0$. So when $\lambda = \overline{\lambda}$, $I_B = 0$ is the dominant strategy for BT, and the equilibrium is $I_G = I_B = 0$.

Since both investment efficiency and social efficiency are maximized when $I_G = I_B = 0$, $\overline{\lambda}$ is an optimal choice.

To hold $I_G = I_B = 0$ in equilibrium, it must true that $\gamma - (1-\tau_B)k < 0$ so that $\alpha\gamma - (1-\tau_B)k < 0$. $\gamma - (1-\tau_B)k < 0 \Leftrightarrow \lambda > \frac{\gamma/k + \tau_{B0} - 1}{b}$.

So $\lambda^* \in [\frac{\tau_{B0} + \gamma/k - 1}{b}, \overline{\lambda}]$ if $\frac{\tau_{B0} + \gamma/k - 1}{b} > 0$,and $\lambda^* \in [0, \overline{\lambda}]$ if $\frac{\tau_{B0} + \gamma/k - 1}{b} < 0$.

Case 4.

For BT, if $\gamma - (1-\tau_{Bmin})k > 0$ and $\alpha\gamma - (1-\tau_{Bmin})k < 0$, then BT does not have a dominant strategy when $\lambda = \overline{\lambda}$.

When $\lambda < \overline{\lambda}$, there are two possibilities. First, if $\alpha\gamma - (1-\tau_{B0})k > 0$, then there exists $\lambda^c \equiv \frac{\alpha\gamma/k + \tau_{B0} - 1}{b}$ such that $\alpha\gamma - (1-\tau_B)k = 0$ by the intermediate value theorem.

When $\lambda \leqslant \lambda^c$, $I_B = 1$ is the (weakly) dominant strategy for BT. And the equilibrium is $I_G = I_B = 1$. Within the range of $[0, \lambda^c]$, $\lambda^* = 0$ if $b > g$ and $\lambda^* = \lambda^c$ if $b < g$.

When $\lambda > \lambda^c$, BT does not have a dominant strategy. And the equilibrium will be a mixed strategy equilibrium.

Let $x = Pr(I_B = 1)$ and $y = Pr(I_G = 1)$. The indifference conditions are 1) $\gamma - (1-\tau_G)k = (1-x)\gamma$, and 2) $y\alpha\gamma + (1-y)\gamma - (1-\tau_B)k = 0$.

Solving the two indifference conditions, I obtain $x = \frac{(1-\tau_G)k}{\gamma}$ and $y = \frac{\gamma-(1-\tau_B)k}{(1-\alpha)\gamma}$. And the equilibrium is $I_G = 1$ with probability y, $I_G = 0$ with probability $1-y$, $I_B = 1$ with probability

x, and $I_B = 0$ with probability $1-x$.

In equilibrium, expected social welfare $E(W) = xy(S-\alpha L) - x(1-y)L + (1-x)S - xy[(1-\tau_G) + (1-\tau_B)]M - x(1-y)(1-\tau_B)M - y(1-x)(1-\tau_G)M$.

Before finding the optimal accounting regulation, first note that $\lambda = \frac{\tau_G - \tau_{G0}}{g} \Rightarrow \tau_B = \tau_{B0} - \frac{b}{g}(\tau_G - \tau_{G0})$. And $\frac{d(1-\tau_G)(1-\tau_B)}{d\tau_G} = -\frac{2b}{g}\tau_G + \frac{b}{g} - 1 + \tau_{B0} + \frac{b}{g}\tau_{G0} \equiv \theta$.

$\frac{dE(W)}{d\tau_G} = -\frac{\alpha\gamma k + k^2\theta}{(1-\alpha)\gamma^2}S + \frac{k}{\gamma}L + \frac{-\gamma k - k^2\theta}{\gamma^2}L - \frac{k}{\gamma}\theta M + \frac{M}{1-\alpha} + \frac{k\theta}{(1-\alpha)\gamma}M$.

$sign[\frac{d^2E(W)}{d\tau_G^2}] = sign\{-\frac{2b}{g}[-k^2S - (1-\alpha)k^2L - (1-\alpha)\gamma kM + \gamma kM]\} = sign[kS + (1-\alpha)kL - \alpha\gamma M]$. Since $\alpha\gamma - (1-\tau_{Bmin})k < 0$, $\alpha\gamma < k$. As long as $S > M$, the sign of the second derivative is positive.

Since a corner level of τ_G is optimal and $\frac{d\tau_G}{d\lambda} > 0$, a corner level of λ is optimal. Within the range of $(\lambda^c, \overline{\lambda}\}$, $\lambda^* = \lambda^c + \varepsilon$ or $\overline{\lambda}$ where ε is positive and infinitesimal. Together, $\lambda^* = 0$ or λ^cor $\lambda^c + \varepsilon$ or $\overline{\lambda}$.

Second, if $\alpha\gamma - (1-\tau_{B0})k < 0$, then the equilibrium will always be a mixed strategy equilibrium. In equilibrium, $I_G = 1$ with probability y, $I_G = 0$ with probability $1-y$, $I_B = 1$ with probability x, and $I_B = 0$ with probability $1-x$.

By the same logic, $\lambda^* = 0$ or $\overline{\lambda}$.

Note that the investor's belief here only serves as a determinant of the payoffs to GT and BT. If I impose an additional criterion such that the investor's belief must always be correct, then a mixed strategy equilibrium cannot sustain because with probability $x(1-y)$, the investor's belief will be incorrect. Therefore, the belief that a more (less) similar information pattern signals the good (bad) type is correct only when $\gamma - (1-\tau_{Bmin})k < 0$ or $\alpha\gamma - (1-\tau_{B0})k > 0$.

II. Successful Experience with a Good Firm and Negatively Biased Method

The payoffs to GT and BT are as follows:

		Good Firm (GT)	
		$I_G = 1$	$I_G = 0$
Bad Firm (BT)	$I_B = 1$	$-(1-\tau_B)k, (1-\beta)\gamma - (1-\tau_G)k$	$\gamma - (1-\tau_B)k, 0$
	$I_B = 0$	$0, \gamma - (1-\tau_G)k$	$0, \gamma$

For GT, $I_G^* = 0$ when $I_B = 0$.

For BT, $I_B^* = 0$ when $I_G = 1$.

There are several possible cases.

Case 1.

For BT, if $\gamma - (1 - \tau_{Bmin})k < 0$, then $I_B = 0$ is the dominant strategy for BT.

For GT, $I_G^* = 0$ when $I_B = 0$. So the equilibrium is $I_G = I_B = 0$ when $\lambda = \overline{\lambda}$.

Note that it is a costless separation. To keep $I_G = I_B = 0$, it must be true that $\gamma - (1 - \tau_B)k < 0$.

Since $\frac{d\tau_B}{d\lambda} < 0$, $\lambda^* \in [\frac{\tau_{B0}+\gamma/k-1}{b}, \overline{\lambda}]$ if $\frac{\tau_{B0}+\gamma/k-1}{b} \geqslant 0$ or $\lambda^* \in [0, \overline{\lambda}]$ if $\frac{\tau_{B0}+\gamma/k-1}{b} < 0$.

Case 2.

For BT, if $\gamma - (1 - \tau_{Bmin})k > 0$, then $I_B^* = 1$ when $I_G = 0$.

For GT, if $(1 - \beta)\gamma - (1 - \tau_{Gmax})k < 0$, then $I_G^* = 0$ when $I_B = 1$,

The equilibrium is $I_G = 0$ and $I_B = 1$ when $\lambda = \overline{\lambda}$.

Since $\tau_{Gmax} > \tau_{G0} > \tau_{B0} > \tau_{Bmin}$,, the equilibrium remains at $I_G = 0$ and $I_B = 1$ for $\forall\ \lambda \in [0, \overline{\lambda}]$. The investor's belief is always incorrect. Since only BT manipulates, to minimize BT's manipulation, $\lambda^* = 0$.

Case 3.

For GT, if $(1-\beta)\gamma - (1 - \tau_{Gmax})k > 0$, then GT does not have a dominant strategy at $\lambda = \overline{\lambda}$.

For BT, if $\gamma - (1 - \tau_{Bmin})k > 0$, then BT does not have a dominant strategy at $\lambda = \overline{\lambda}$.

At $\lambda = \overline{\lambda}$, when $I_G = 1$, $I_B^* = 0$. When $I_B = 0$, $I_G^* = 0$.

When $I_G = 0$, $I_B^* = 1$. When $I_B = 1$, $I_G^* = 1$. So there can only be a mixed strategy equilibrium.

Since $\tau_{Bmin} < \tau_{B0}$, $\gamma - (1 - \tau_B)k > 0$ is always true for BT.

For GT, if $(1 - \beta)\gamma - (1 - \tau_{G0})k > 0$, then there is always a mixed strategy equilibrium.

If $(1 - \beta)\gamma - (1 - \tau_{G0})k < 0$, then there exists $\lambda^{c2} \equiv \frac{1-\tau_{G0}-(1-\beta)\gamma/k}{g}$ such that $(1 - \beta)\gamma - (1 - \tau_G)k = 0$ by the intermediate value theorem.

So when $\lambda \leqslant \lambda^{c2}$, the equilibrium is $I_G = 0$ and $I_B = 1$ where the investor is always wrong, and $\lambda^* = 0$.

When $\lambda > \lambda^{c2}$, there is a mixed strategy equilibrium.

The indifference conditions are 1)$[x(1 - \beta) + 1 - x]\gamma - (1 - \tau_G)k = (1 - x)\gamma$, and 2) (1 −

$y)\gamma - (1-\tau_B)k = 0$.

Solving the two indifference conditions yields $x = \frac{(1-\tau_G)k}{(1-\beta)\gamma}$ and $y = 1 - \frac{(1-\tau_B)k}{\gamma}$.

$\frac{dE(W)}{d\tau_G} = \frac{\beta\gamma k-(1-\beta)k^2\theta}{(1-\beta)\gamma^2}S - \frac{k^2\theta}{(1-\beta)\gamma^2}L - \frac{k}{(1-\beta)\gamma}\theta M + M + \frac{k\theta}{\gamma}M.$

$sign[\frac{d^2E(W)}{d\tau_G^2}] = sign\{-\frac{2b}{g}[-(1-\beta)k^2S - k^2L + (1-\beta)\gamma kM - \gamma kM]\} = sign[(1-\beta)kS + kL - \beta\gamma M]$. As long as $(1-\beta)kS + kL - \beta\gamma M > 0$, $\lambda^* = \lambda^{c2} + \varepsilon$ or 0 or $\overline{\lambda}$.

In a mixed strategy equilibrium, with probability $x(1-y)$, the investor will be wrong. Overall, the belief that a more (less) similar information pattern signals the good (bad) type is correct only when $\gamma - (1-\tau_{Bmin})k < 0$.

III. Successful Experience with a Bad Firm

Here $\tau_{G0} < \tau_{B0}$, $\tau_{Gmin} = \tau_{G0} - g\overline{\lambda}$, and $\tau_{Bmax} = \tau_{B0} + b\overline{\lambda}$. Firms can choose to manipulate to $\tau = 0$.

The payoffs to GT and BT are as follows:

		Good Firm (GT)	
		$I_G = 1$	$I_G = 0$
Bad Firm (BT)	$I_B = 1$	$(1-p)\gamma - \tau_B k, p\gamma - \tau_G k$	$\gamma - \tau_B k, 0$
	$I_B = 0$	$0, \gamma - \tau_G k$	$0, \gamma$

For GT, $I_G^* = 0$ when $I_B = 0$.

There are several possible cases.

Case 1.

For BT, if $\gamma - \tau_{Bmax}k < 0$, then $(1-p)\gamma - \tau_{Bmax}k < 0$. So $I_B = 0$ is the dominant strategy for BT.

For GT, $I_G^* = 0$ when $I_B = 0$. So the equilibrium is $I_G = I_B = 0$ when $\lambda = \overline{\lambda}$.

Note that it is a costless separation. To keep $I_G = I_B = 0$, it must be true that $\gamma - \tau_B k < 0$. Since $\frac{d\tau_B}{d\lambda} > 0$, $\lambda^* \in [\frac{\gamma/k-\tau_{B0}}{b}, \overline{\lambda}]$ if $\frac{\gamma/k-\tau_{B0}}{b} > 0$,and $\lambda^* \in [0, \overline{\lambda}]$ if $\frac{\gamma/k-\tau_{B0}}{b} < 0$.

Case 2.

For BT, if $(1-p)\gamma - \tau_{Bmax}k > 0$, then $\gamma - \tau_{Bmax}k > 0$. So $I_B = 1$ is the dominant strategy for BT.

For GT, since $p\gamma - \tau_{Gmin}k > (1-p)\gamma - \tau_{Bmax}k > 0$, $I_G^* = 1$ when $I_B = 1$. So the equilibrium is $I_G = I_B = 1$ when $\lambda = \overline{\lambda}$.

Since $\tau_{Gmin} < \tau_{G0} < \tau_{B0} < \tau_{Bmax}$, the equilibrium remains at $I_G = I_B = 1$ for $\forall\ \lambda \in [0,\ \overline{\lambda}]$.

Since accounting regulation does not affect investment efficiency, optimal accounting regulation minimizes expected manipulations $E(M) = \tau_G M + \tau_B M$. $\frac{dE(M)}{d\lambda} \propto -g + b > (<)0$ if $b > (<)g$.

So when $b > g$, $\lambda^* = 0$, and when $b < g$, $\lambda^* = \overline{\lambda}$.

Case 3.

For GT, if $p\gamma - \tau_{Gmin}k > 0$, then GT does not have a dominant strategy at $\lambda = \overline{\lambda}$.

For BT, if $\gamma - \tau_{Bmax}k > 0$ and $(1-p)\gamma - \tau_{Bmax}k < 0$, then BT does not have a dominant strategy at $\lambda = \overline{\lambda}$.

At $\lambda = \overline{\lambda}$, when $I_G = 1$, $I_B^* = 0$. When $I_B = 0$, $I_G^* = 0$.

When $I_G = 0$, $I_B^* = 1$. When $I_B = 1$, $I_G^* = 1$. So there can only be a mixed strategy equilibrium.

Since $\tau_{Bmax} > \tau_{B0}$, $\gamma - \tau_B k > 0$ is always true for BT.

i) If there exists $\lambda^{c3} \equiv \frac{(1-p)\gamma/k - \tau_{B0}}{b} > 0$ such that $(1-p)\gamma - \tau_B k = 0$, then for $0 \leqslant \lambda \leqslant \lambda^{c3}$, $I_B = 1$ is the dominant strategy for BT.

For GT, since $p\gamma - \tau_G k > (1-p)\gamma - \tau_B k > 0$, $I_G^* = 1$ when $I_B = 1$. So the equilibrium is $I_G = I_B = 1$ when $0 \leqslant \lambda \leqslant \lambda^{c3}$.

Based on the above logic, when $b > g$, $\lambda^* = 0$, and when $b < g$, $\lambda^* = \lambda^{c3}$.

When $\lambda > \lambda^{c3}$, BT does not have a dominant strategy.

For GT, if $p\gamma - \tau_{G0}k > 0$, then there is always a mixed strategy equilibrium.

If $p\gamma - \tau_{G0}k < 0$, then there exists $\lambda^{c4} \equiv \frac{\tau_{G0} - p\gamma/k}{g}$ such that $p\gamma - \tau_G k = 0$ by the intermediate value theorem.

If $\lambda^{c3} < \lambda^{c4}$, then when $\lambda \leqslant \lambda^{c4}$, the equilibrium is $I_G = 0$ and $I_B = 1$ where the investor is always wrong, and $\lambda^* = \lambda^{c3} + \varepsilon$ minimizes BT's manipulation.

When $\lambda > \lambda^{c4}$, there is a mixed strategy equilibrium.

The indifference conditions are 1)$(xp + 1 - x)\gamma - \tau_G k = (1-x)\gamma$, and 2) $[y(1-p) + 1 - y]\gamma - \tau_B k = 0$.

Solving the two indifference conditions yields $x = \frac{\tau_G k}{p\gamma}$ and $y = \frac{\gamma - \tau_B k}{p\gamma}$.

$\frac{dE(W)}{d\tau_G} = -\frac{k^2\theta_2}{p\gamma^2}S - \frac{k^2\theta_2}{p\gamma^2}L - \frac{1}{p}M$, where $\theta_2 \equiv \frac{d\tau_G\tau_B}{\tau_G} = -\frac{2b}{g}\tau_G + \tau_{B0} + \frac{b}{g}\tau_{G0}$.

$sign[\frac{d^2E(W)}{d\tau_G^2}] = sign[-\frac{2b}{g}(-k^2S - k^2L)] = sign(S+L) > 0$. So $\lambda^* = \lambda^{c4} + \varepsilon$ or $\overline{\lambda}$.

Again, with probability $x(1-y)$, the investor will be wrong.

If $\lambda^{c3} > \lambda^{c4}$, then $\lambda > \lambda^{c3}$, there is a mixed strategy equilibrium, and $\lambda^* = \lambda^{c3} + \varepsilon$ or $\overline{\lambda}$.

ii) If $\lambda^{c3} < 0$, then BT never has a dominant strategy.

If $\lambda^{c4} > 0$, then when $\lambda \leqslant \lambda^{c4}$, the equilibrium is $I_G = 0$ and $I_B = 1$ where the investor is always wrong, and $\lambda^* = 0$ minimizes BT's manipulation.

When $\lambda > \lambda^{c4}$, there is a mixed strategy equilibrium, and $\lambda^* = \lambda^{c4} + \varepsilon$ or $\overline{\lambda}$.

If $\lambda^{c4} < 0$, then a mixed strategy will always be played, and $\lambda^* = 0$ or $\overline{\lambda}$.

Taken together, $\lambda^* = 0$ or λ^{c3} or $\lambda^{c3} + \varepsilon$ or $\lambda^{c4} + \varepsilon$ or $\overline{\lambda}$.

Overall, the belief that a more (less) different information pattern signals the good (bad) type is correct only when $\gamma - \tau_{Bmax}k < 0$ or $(1-p)\gamma - \tau_{B0}k > 0$.

Appendix D: More on Experiences

II.1 Unsuccessful Experience

The main text of the paper focuses on the case where the investor's past investment experience is a success such that the investor may keep using the old method. Here I study a special case where the investor's past investment experience is a failure. When the investor failed in the past, then according to the adaptive market hypothesis, the investor will try a new method even when seeing a similar information pattern. Therefore, regardless of the firm's information pattern, the investor will always use a new method in the evaluation process. Although information patterns no longer direct the investor's evaluation method choice, they can still influence the investor's belief.

Take the case of an unsuccessful experience with a good firm for example. Without accounting regulation, the investor will encounter GS, GD, BS, and BD in the economy. If the investor does not hold any signaling belief, then the investor will use a new method to evaluate the firms all the time. Although the equilibrium is {S, D, S, D}, investment efficiency in such case is equivalent to that of {D, D, D, D} since a new method will be used regardless of information pattern. However, given the experience with a good firm, a different information pattern may signal the bad type, as in the case of a successful experience in the past.[19] With such belief, GD and BD will have an incentive to manipulate, and GD will always have a relatively stronger incentive to manipulate as long as $p > 1 - p$. Unless the cost of manipulation is too high that the signaling belief becomes incorrect, such belief will lead to weakly higher investment efficiency. The reason is that when the cost of manipulation is low, the equilibrium is {S, D, S, D}, which has the same investment efficiency as {D, D, D, D}. But when the cost of manipulation is moderate, the equilibrium is {S, S, S, D}, which has higher investment

[19]This assumes that Firm X's true state becomes known ex-post.

efficiency than {D, D, D, D} because a different information pattern signals the bad type of BD in such case.

With regulation, there will be only GS and BD. Again, a different information pattern will signal the bad type. Since the investor will use a new method upon a similar information pattern, BD's manipulation incentive is determined by the precision of a new method. The equilibrium is either {S, S, S, S} or {S, S, D, D}.

The case where the unsuccessful experience with a bad firm is analogous. Without regulation, the investor may view a similar information pattern as signaling the bad type, resulting in {D, D, D, D} or {D, D, S, D}. With regulation, under the same belief, the equilibrium is either {D, D, D, D} or {D, D, S, S}.

Regardless of whether the unsuccessful experience is with a good firm or a bad firm, investment efficiency is weakly higher with accounting regulation. Specifically, when BD (or BS when the experience is with a bad firm) have an incentive to manipulate, the equilibria will be the same with or without regulation. Whether there will be more manipulations with regulation depends on whether there are more GD or BS in the economy.[20] When BD (or BS) do not have an incentive to manipulate, the equilibrium with accounting regulation is always a fully separating one, whereas the one without regulation is only a partially separating one. So accounting regulation always improves both investment efficiency and social efficiency.

In terms of optimal accounting regulation, since a new method will be used by the investor, both GT and BT's expected benefit from pooling is insensitive to the level of information pattern similarity. For BT, given a convex cost function and a fixed benefit, there always exists a separation point beyond which BT will not manipulate. Hence, as long as GT's unmanipulated information can reach the separation point with the most stringent regulation, a costless separation can be achieved for sufficiently stringent regulation. If not, then the issue becomes

[20]Again, this is from the view of an investor with a successful experience with a good firm.

whether GT will have an incentive to separate from BT. For GT, the incremental benefit from separation is fixed because its benefit from pooling is fixed regardless of the investor's belief. While the most stringent regulation is again optimal in cases of costly separation, a pooling equilibrium may emerge when the regulation is sufficiently loose under a benign belief. To the extent that a pooling equilibrium is associated with higher social efficiency than is the least costly separation, optimal regulation will be either the loosest regulation or an intermediate degree of regulation.

II.2 Multiple Experiences

Everything up to here assumes that the investor has only one past experience. In the end of the appendix, I briefly discuss the possibility of multiple past experiences. Since each past experience can be a success or a failure and it can be associated with a good firm or a bad firm, there are four possibilities. In the main text, I studied the case of a successful experience in the past. While it is implicitly assumed that the investor has no experience with a bad (good) firm when the successful experience is with a good (bad) firm, the analysis in the main text can generalize to the case where the investor's past experience with a bad (good) firm is a failure. The reason is that from the perspective of evolution, decision makers will choose to use a new method when they either encounter unfamiliar issues (i.e., no experience) or their strategies failed in the past (i.e., unsuccessful experience). By the same logic, part II.1 of Appendix D can be viewed as the case where the investor has two unsuccessful experiences in the past, one with a good firm and the other with a bad firm.

So the only unexamined possibility is that the investor has successful experiences with both a good firm and a bad firm. There are two more cases within the possibility. First, the investor applied the same method to both firms, which is essentially a flipped case of part II.1 of Appendix D. Since the investor has seen both information patterns, the investor will always use the old method with the potential help of a signaling belief. The equilibrium will be either {S, S, S, S} or {S, S, S, D} without accounting regulation,[21] and {S, S, S, S} or {S, S, D, D} with regulation. Note that since {S, S, S, D} without regulation will emerge only when the corresponding equilibrium with regulation is {S, S, D, D}, accounting regulation weakly decreases overinvestment in bad firms under a positive bias and underinvestment in good firms under a negative bias. Again, accounting regulation may trigger more manipulations under a positive bias if there are more BS than GD in the economy.

Second, the investor applied one method to the good firm but a different one to the bad firm. Without accounting regulation, if the investor holds a belief against the information pattern of a bad firm, then the equilibria are the same as if the investor only used one method in the past, since everyone will have an incentive to display an information pattern similar to that of a good firm. Given that equilibria are also the same with accounting regulation, the effects of accounting regulation are the same as those in the first case.

If the investor does not hold a signaling belief in the unregulated economy, provided that no one manipulates, underinvestment in GD and overinvestment in BS will exist if the investor applied a positively (negatively) biased method to a good (bad) firm in the past. Since the method applied to the good firm dictates the equilibria in the regulated economy, accounting regulation will always decrease underinvestment in good firms but may increase both overinvestment in bad firms and manipulations. If the investor applied a negatively (positively) biased method to a good (bad) firm in the past, then underinvestment in GS and overinvestment in BD will exist in the unregulated economy. With a fully separating equilibrium in the regulated economy, accounting regulation will always decrease both underinvestment in good firms and overinvestment in bad firms.

[21] Another possible equilibrium is {S, D, S, D}, which has the same investment efficiency as that of {S, S, S, S}.

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