The Social Value of Accounting Standards*

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Abstract

We analyze the role of accounting standards as an ex ante commitment device for cost-effectively disseminating public information that serves both an information role (by resolving fundamental uncertainty about the underlying state-of-the-world) and a coordination role (by helping agents predict each other's behavior). We identify the existence of a coordination role of information and uncertainty about information reliability as necessary conditions for reporting with standards to achieve higher ex ante social value than reporting without standards. We show, contrary to the conventional wisdom that faults standards for restricting firms' discretion in communicating information, standards can increase the social value of public information precisely when they credibly constrain firms from engaging in informative but costly discretionary reporting. Our analysis suggests the effectiveness of accounting standards should be evaluated by their enforcement and by how widely they help to disseminate information to intended audiences.

1 INTRODUCTION

We analytically examine the welfare consequences of financial reporting standards as embodied, for example, in US GAAP and in International Financial Reporting Standards (IFRS), specifically focusing on how the publicity and clarity effects of reporting standards affect the social value of public information. In our setting, "publicity" captures how readily the reported information is accessible by financial statement users, and is linked to the enhancing characteristics of decision-useful information, i.e., comparability, consistency, and understandability as described in the conceptual frameworks of the Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB).[1] Accessibility of information does not imply users can fully understand the reliability or precision of that information and correctly incorporate it in decisions. In contrast, the notion of "clarity" captures the extent to which users of the reported information understand the reliability or precision of that information. We adapt and extend a version of the model in Angeletos and Pavan (2004) in which both the publicity and clarity of public information are important inputs to the social value of that information. To provide a role for firms to use reporting discretion to communicate the reliability of information (i.e., achieve clarity), we extend Angeletos and Pavan (2004) by assuming that the reliability of public information is not directly known to users of reported information[2] but is privately observed by firms. In our setting, both higher publicity and better clarity arise endogenously as desirable features to maximize the social value of public information.

Our analysis is motivated by debates over the desirability and consequences of reporting standards as pre-committed rules for the provision of information. On the one hand, report-

[1] Chapter 3 of the FASB's Statement of Financial Accounting Concepts No. 8, (SFAC 8) Conceptual Framework of Financial Reporting (FASB, 2010) is converged with the relevant portions of the IASB's Framework. Both conceptual frameworks describe several enhancing qualitative characteristics of information that is relevant and faithfully represented, including comparability, consistency and understandability. Comparability enables users of financial information to identify and understand similarities and differences among items; consistency, which contributes to the goal of comparability, refers to using the same methods for the same items over time and across entities. Understandability refers to ways of classifying, characterizing and presenting information clearly and concisely, with the goal of making that information comprehensible.

[2] We refer to the recipients of, or the audience for, reported information as agents, or users, subsuming capital market agents, suppliers, customers, and employees.

ing according to prescribed rules that specify, for example, definitions of terms, concepts and presentation formats makes the information more readily accessible to a wider group and improves the decision-usefulness of that information. Reporting that is guided by clearly defined recognition and measurement rules produces information that is consistent and that facilitates cross-firm comparisons (a benefit of standards). On the other hand, reporting standards are viewed by some as, at a minimum, costly and, in the limit, undesirable because they reduce firms' discretion about how to report and thereby reduce both the amount and clarity of information available to users (a cost of standards, for example, Dye and Verrecchia 1995, Sunder 2010). Finally, since the use of specified financial reporting standards is often mandated by regulations, for example, the US SEC's requirement that US registrants apply US GAAP, standards are sometimes viewed as little more than a by-product of mandatory disclosure regulations, the desirability of which remains under debate.[3]

The lack of agreement about whether reporting standards are socially desirable contributes to uncertainty regarding both the desirable properties of standards and the optimal boundaries of standards. With regard to the former, Kothari, Ramanna, and Skinner (2010) and Lambert (2010) express differing views about desirable properties of standards and Holthausen and Watts (2001) and Barth, Beaver, and Landsman (2001) express differing views about how to evaluate accounting standards. With regard to the latter issue, optimal boundaries of standards, the Sustainability Accounting Standards Board (SASB) was established in 2012 to "develop and disseminate sustainability accounting standards" that are part of a "natural evolution in the history of corporate reporting" to include "material environmental, social and governance (ESG) factors" (http://www.sasb.org/sasb/vision-mission/);

[3] On the one hand, Bushman and Landsman (2010) write "the reality [is] that the regulation of corporate reporting is just one piece of a larger regulatory configuration, and that forces at play that would subjugate accounting standards setting to other regulatory demands." The debate on whether mandatory disclosure is optimal has a long history, and remains largely unresolved. See, for example, Grossman (1980), Easterbrook and Fischel (1984), Admati and Pfleiderer (2001), and Leuz and Wysocki (2008). On the other hand, standards sometimes arise from non-regulatory sources. For example, Jamal, Maier, and Sunder (2003) document that US e-Commerce firms voluntarily adopt standards on protecting customer privacy. Boockholdt (1978) describes how accounting standards were developed for the railroad industry during the Industrial Revolution. The first association of public accountants in the U.S., established in 1887, wrote accounting standards and set codes of conducts long before the passage of the Securities Acts of 1933 and 1934. For more details, see http://www.accountingfoundation.org/jsp/Foundation/Page/FAFSectionPage&cid=1351027541272.

that is, the SASB views itself as extending corporate reporting standards, now mostly limited to corporate financial reporting, to encompass specified non-financial items as well.[4] Relatedly, some commentators have called for "generally accepted accounting principles for the environment," specifically, for reporting items such as greenhouse gas emissions and returns on pollution-reducing investments following prescribed standards (The Economist, March 29, 2014, p. 74)

To provide insight into these matters, we analytically examine the welfare consequences of reporting standards. In our model, there are no agency conflicts and therefore no issues linked to the specific content of standards. We are therefore able to focus on how standards of reporting function, without being concerned about, for example, contracting and stewardship uses of reported information. We first analyze a reporting regime with standards that remove the discretion to choose firm-specific publicity; all firms are required to have the same amount of publicity of reporting regardless of the reliability of their information. In this regime, agents do not fully use the reported information, and instead treat all public disclosure as if it has average precision, that is, average reliability. While this restriction compromises the clarity of public information, meaning that users of the reported information misinterpret it, we find that imposing the same level of publicity on all firms is optimal. We then analyze the equilibrium outcome in a regime without standards where firms choose the degree of publicity after observing their reliability of information; that is, they choose a strategy that depends on the quality of their information. While both high-reliability and low-reliability types of firms prefer to maximize publicity, they face incentives not to do so, in order to credibly communicate the reliability of their reported information. As a result, agents form expectations about reliability by observing the firm's choice of disclosure publicity. We find an equilibrium exists where high-reliability firms can credibly communicate information

[4] An early, ambitious and unsuccessful attempt to extend the boundaries of financial reporting standards to encompass business reporting standards was the report of the AICPA Special Committee on Financial Reporting, "Improving Business Reporting—A Customer Focus" (AICPA, 1994). This report recommended that standard setters (in the US, the FASB) set standards for reporting not just on financial position and financial performance but also for reporting other information, for example, non-financial data and certain forward-looking information.

about their reliability by restricting publicity. That is, the need to achieve clarity may entail a compromise on publicity.

Our analyses identify the trade-off between publicity and clarity of public disclosure as a key consideration for evaluating reporting standards. While the discretionary reporting regime allows firms the discretion to communicate the reliability of their information, in order for the communication to be credible (i.e., in order to achieve clarity), firms may find it optimal to incur dead-weight costs by sacrificing publicity. In contrast, while the regime with standards limits firms' discretion in trading off publicity for clarity, it also reduces the dead-weight costs firms incur when they can and do exercise reporting discretion.[5] Our analysis implies, and numerical analysis confirms, that there are settings in which the ex ante social value of public disclosure can be higher in the regime with standards than in the regime without standards. The key feature of those settings is that the reliability of information is privately observed by firms and the information plays a strong coordination role, meaning that there are complementarities among the payoffs of users of reported information.

In contrast to criticisms of financial reporting standards that point to their restrictive nature as a deficiency and a cost, our analysis shows that standards may be socially optimal *because* they are restrictive, in the sense that they limit firms' costly discretionary reporting. This result follows from the fact that the reliability of much financial reporting information is inherently difficult to credibly communicate. For example, while it is easy to verify information about the principal amounts of loans outstanding, it is difficult to verify information about lenders' assessments of credit risk as embodied in loan loss provisions. The difficulty is exacerbated if reliability varies by time, across firms, and by the type of information.[6] While firms may use discretionary reporting choices to communicate such information, any credible actions necessarily entail costs. Since it is always subgame optimal for firms to

[5] The tradeoff between standardized regime and discretionary regime is similar to, but not to be confused with, the well-known choice in monetary policy, "rules vs. discretion." See Kydland and Prescott (1977).

[6] For example, estimates of credit risk may be more precise during economic expansions than during recessions; fair value estimates of financial assets become more difficult and less precise when markets for those assets become illiquid. Since reliability is not a time-invariant firm-specific trait, it is difficult for firms to use reputation-building mechanisms to signal the reliability of their information.

exercise discretion when they can, firms may find it optimal to commit to standards that deprive them of discretion.

In our setting, firms are ex ante identical and, in the absence of agency issues, they aim to maximize the total surplus of their respective constituents, that is, of the intended audience of public information. It follows that when committing to the regime with standards yields higher expected social welfare than does the discretionary regime, standards can arise as optimal contracts agreed upon by firms before they observe the reliability of their information. After reliability is observed, firms with different reliabilities will differ in their preferences for maintaining or breaking the contract. However, there is no gain from renegotiation, and in fact some firms will be strictly worse off if they allow others to abandon standards. Therefore, reporting standards will be maintained as long as the contract to join the standards can be credibly enforced. This finding points to the importance of strong enforcement in regimes with reporting standards.

We believe that our analysis has three types of implications for standards and standard setting. First, the analysis yields both positive and normative implications for the standard setting process. On the positive side, the analysis explains why firms may prefer reporting standards despite their restrictive nature. It also explains why standard setting is often left to private, non-governmental organizations, which usually take great effort to address participants' concerns.[7] In contrast, while securities regulators and other governmental agencies sometimes interfere with the standard setting process, for the most part they focus on enforcement. On the normative side, our analysis highlights the importance of enforcement for standards to achieve social value. The importance of enforcement is consistent with empirical research suggesting that the beneficial effect of adopting IFRS depends on a country's strength of enforcement.[8]

[7]For example, the IASB's constitution, available at www.ifrs.org/the-organisation/governnance-and-accountability/constitution/, specifies an IFRS Advisory Council that provides advice on agenda decisions and standard setting priorities; IASB board meetings are open to the public; and the IASB seeks comment (in the form of comment letters) and consultation (in the form of hearings and roundtable discussions) on its proposals for standards. The FASB has similar arrangements.

[8]For example, mandatory IFRS adoptions represent a commitment to standards. Research on whether mandatory IFRS adoptions reduce the cost of equity (e.g., Li 2010) or increase market responses to earnings

Second, our analysis has implications for what kinds of restrictions standards should impose. Specifically, our results suggest that standards should restrict choices that can enable firms to credibly achieve clarity but are at the same time costly to implement. Since our analysis shows that restricting publicity is a costly but credible tool to convey reliability in the discretionary regime, the social value of standards depends on how well standards improve publicity. This result provides a theoretical justification for the FASB's decision, in Concepts Statement 8, para. OB2-OB5, to focus on general purpose financial reporting to users who cannot require firms to provide information directly to them, and specifies, in para. OB8, that it will "seek to provide the information set that will meet the needs of the maximum number of primary users." The result also provides support for including comparability, consistency, and understandability as enhancing characteristics of decision-useful information reported pursuant to the application of US GAAP and IFRS.[9] To the extent publicity is affected by the choice of how to display the information (e.g., the choice between disclosure and recognition), or the choice of presentation format (e.g., detailed tabular reconciliation of beginning and ending account balances), our model provides a theoretical justification for rules governing these choices.[10]

Third, our analysis sheds light on the boundary of standards with respect to the type of information that standards should be concerned with. Our analysis shows that standards are more likely to be socially optimal when reliability (precision) of information is less uncertain in the sense that cross-sectional variation of reliability is relatively small, and it is the ex ante variation in reliability, not the absolute level of reliability or precision, that matters. We

announcements (e.g., Landsman, Maydew, and Thornock 2012) or increase comparability (e.g., Yip and Young 2012) tends to show that benefits of moving from country-specific reporting to a single set of standards (IFRS) are stronger in the presence of proxies for strong enforcement.

[9] That standards (presumably) achieve higher publicity is also implicit in academic research on the costs and benefits of international accounting convergence (e.g., Barth, Clinch, and Shibano (1999)). Whether existing US GAAP and IFRS indeed enable higher publicity than their alternatives is an empirical question. As will be clear later, while our analysis quantifies the value of publicity, it does not specify how to achieve better publicity. Rather, our analysis reveals that a necessary condition for standards to obtain social value is to achieve higher publicity than the alternative.

[10] Our model is silent on whether, for specific commercial arrangements and transactions, disclosure or recognition achieves higher publicity and why, and whether, for specific accounts, a tabular reconciliation increases publicity.

also find that standards are more desirable for information with a stronger coordination role, consistent with the IASB's and FASB's conceptual framework objective of setting standards whose application results in financial reporting information that is relevant, in the sense of capable of making a difference in the decisions of users of financial reports, including investors and creditors (e.g., SFAC 8, para.OB2; para.QC6-QC10). However, since public information takes on a coordination role only when there are strategic interactions among agents' actions, our analysis points out that being decision-useful for a large number of users is not, in and of itself, sufficient to justify reporting standards; rather, standards become valuable when the actions users take upon receiving the information have significant interactive effects.

In settings characterized by reporting discretion, our analysis reveals an inherent trade-off between the clarity and publicity of public disclosure. This insight can offer an explanation for why firms adopt certain voluntary disclosure practices, as well as for why some disclosure rules specify how information is disclosed, but not whether information must be disclosed (Leuz and Wysocki (2008)). For example, Regulation FD does not require any specific information disclosure but does specify the audience of disclosure, should it be made. Many voluntary disclosure choices made by firms can also influence the extent to which the disclosed information is understood by investors, for example, channels for voluntary disclosure, including conference calls, webcasts, and press releases (Mayew (2008), Bushee and Miller (2012)), or the linguistic complexity and technicality of mandatory disclosure documents (Li (2008)).

Lastly, we distinguish two types of mandatory disclosure rules: those mandating the disclosure of information that otherwise would not be forthcoming (for example, because of agency conflicts), and those mandating how information should be disclosed. Our model has no direct implications for whether and why the first type of disclosure rule is socially optimal; instead, our theory offers an explanation for the latter type of rules. Our analysis suggests that the social value of rules that specify how information should be presented, that is, standards, derives from their role as privately agreed upon contracts. In contrast to viewing standards as a by-product of mandatory disclosure rules, viewing standards as optimal contracts agreed to by willing participants is historically accurate, in that accounting standards existed before they were required by laws and regulations. Viewing standards as contracts also better reconciles with the commonly-held belief that high quality accounting standards play an important role in financial market development, where enforcement is a key determinant for standards' quality (e.g., Levitt (1998), Rajan and Zingales (1998)).

The rest of the paper unfolds in six sections. Section 2 describes our basic model. Sections 3 and 4 characterize the equilibria under the standardized and discretionary disclosure regimes. Section 5 explores the normative question of whether and when the standardized regime is preferred to the discretionary regime. Section 6 summarizes our findings and their implications. Appendix A contains proofs of the formal results presented in the body of the paper.

2 MODEL SET-UP

Our model builds on recent economic literature on the social value of public information (e.g., Morris and Shin (2002), Angeletos and Pavan (2004, 2007)).[11] Prior studies focus on whether more precise public information is socially beneficial, assuming the precision of public information is publicly known to all agents. In contrast, our focus here is on evaluating the cost and benefit of standardization via its impact on how public information is disclosed. As such, we adopt a framework similar to that in Angeletos and Pavan (2007) in which public disclosure is socially beneficial, with an important extension that the precision (reliability) of public disclosure is unknown to agents and only privately observed by the firms. As will become clear soon, this extension allows a role for firms to use discretion to communicate information about reliability. This in turn allows us to compare the social welfare of two regimes: a regime with standards which imposes restrictions on firms' disclosure publicity choices and a regime without standards where firms are free to determine publicity. In what follows, we will describe our basic model setup, and then discuss how this setup is suitable

[11] Morris and Shin (2002) provide the first formal analysis of public information's coordination role, although they do not study its implication for how to disseminate public information. They find public information could reduce social welfare in a beauty contest setting.

for addressing welfare consequences of accounting standards.

2.1 Agents' Utility and Firms' Objective Function

Consider an economy with a large number of firms. Each firm has a continuum of agents indexed by i that are assumed to be distributed on the unit interval $[0,1]$.[12] Agents represent users of firms' financial disclosure, which may include current and potential investors (shareholders and creditors), as well as suppliers, employees, competitors, and regulators. Since all firms are assumed to be ex ante identical and there are no interactions among firms or among agents of different firms, we describe the rest of model for a representative firm.

Let $v \in \mathbb{R}$ be a firm-specific random variable representing the fundamental uncertainty inherent in the firm's business activities. The common prior is that v is uniformly distributed over the real line $\mathbb{R}$. We assume all agents are risk-neutral and have identical preferences given by

$$E_i\left(U_i\right) \equiv \max_{e_i} E\left\{\left[\left(1-\rho\right)v+\rho\bar{e}\right]e_i-\frac{1}{2}e_i^2|\Omega_i\right\}, \tag{1}$$

where $e_i \in \mathbb{R}$ is an action chosen by agent i and E_i denotes the expectation is taken conditional on agent i's information set Ω_i at the time of his decision. The marginal return to action is $\left(1-\rho\right)v+\rho\bar{e}$, with $\rho \in (0,1/2)$ where $\bar{e} \equiv \int_0^1 e_i di$ is the "average" action of all agents.[13]

To better appreciate the economic forces embodied in (1), slightly rewrite agent $i's$ utility as

$$U_i = \left(1-\rho\right)\left(ve_i-\frac{e_i^2}{2}\right)+\rho\left(\bar{e}e_i-\frac{e_i^2}{2}\right),$$

which expresses agent $i's$ utility as a weighted average of two objectives. The first objective, captured by $ve_i-\frac{e_i^2}{2}$, is to choose the best "private action" to match the firm's fundamental, such that e_i is as close to v as possible. For example, if e_i is a creditor's lending decision, then the "private action" term induces i to lend according to the firm's cash flow situation

[12] Assuming a continuum of agents enables each agent to ignore the impact of his own action on other agents, affording tractability to our analysis.

[13] $\rho < 1/2$ ensures that the agent's utility maximization problem is well behaved (i.e. concave).

to maximize payoff safety. The second objective is to choose the best "collective action", captured by $\bar{e}e_i - \frac{e_i^2}{2}$. Given our assumption that $\rho > 0$, the surplus from the "collective action" term is maximized by choosing e_i equal to other agents' average action, $\bar{e}$. That is, agents' actions are strategic complements to each other. For example, creditors are more willing to extend credits if more customers or suppliers continue to do business with the firm. The magnitude of the parameter ρ measures the relative weight that agents put on the "private action" versus "collective action" term.

Our formulation of (1) reflects the key idea that a firm's stakeholders (e.g., shareholders, investors, customers, or suppliers) are often concerned with not only responding to the firm's fundamental but also coordinating with each other.[14] When this is the case, public information serves two potentially conflicting roles: an informative role in helping agents predict the fundamental versus a coordination role in helping agents predict other agents' behavior (Morris and Shin (2002)).

We assume the firm acts as a benevolent actor that maximizes the aggregate utility (AU) of all agents. Formally, the firm's payoff is:

$$AU \equiv E\left(\int_0^1 E\left(U_i\right) di\right). \tag{2}$$

By assuming a perfect interest alignment between the firm and its agents (in aggregate), we abstract away from the stewardship use of public information (e.g., the use of public information to align firm insiders' interests with outsiders), the importance of which varies by firms and by the nature of the conflicts (e.g., conflicts between management and outside shareholders, between current and future shareholders, or between shareholders and creditors). Instead, we focus on the decision-making use of public information. Such a focus is

[14]The importance of strategic complementarities in financial markets has long been recognized in the literature. Strategic complementarities can lead to coordination failure in that agents fail to coordinate their actions to achieve socially optimal outcomes. Coordination failure can have significant macro-level effects by affecting the stability of financial intermediaries in specific and of financial markets in general (e.g., Diamond and Dybvig (1983), Goldstein and Pauzner (2005), Amador and Weill (2010), Goldstein, Ozdenoren, and Yuan (2011)). It can also have micro-, firm-level effects by affecting, for example, firms' liquidity and financial constraints (He and Xiong (2012a, 2012b)) or stock price efficiency (e.g., Allen, Morris, and Shin (2006), Gao (2008), Chen, Huang, and Zhang (2014)).

consistent with the professed goal of accounting standard setters to assist users of financial disclosures to make efficient investment decisions, which encompass but are not restricted to decisions to improve contracting efficiency (FASB Conceptual Framework for Financial Reporting Chapter 1).

2.2 Information Structure

We assume that each agent observes a noisy private signal s_i of v:

$$s_i = v + \varepsilon_i,$$

where the error term ε_i is normally distributed and is independent of v, with mean zero and precision β (i.e., the inverse of the variance, $\beta = 1/\sigma_{\varepsilon_i}^2$).

The firm observes a noisy signal z which may be disclosed to agents (we postpone a detailed discussion of how z can be disclosed to section 2.3):

$$z = v + \eta.$$

We interpret z as the firm's best estimate of v. In the case of banks, for example, z can represent banks' estimates of borrowers' credit-worthiness and likelihood of defaults, or of the fair value of the derivative contracts related to banks' hedging activities. The error term η represents the noise in the firm's estimate, and is assumed to be normally distributed with mean zero and precision $\lambda\beta$. λ reflects the relative precision of the firm's information versus agents' private signals and is therefore referred to as the reliability of public information throughout the paper.

We assume that λ can take one of two values: λ_τ, $\tau \in \{h, l\}$, with $\lambda_h > \lambda_l$. To capture the essential knowledge gap between the public and firms, we assume that it is common knowledge that $\lambda_h > \lambda_l > 1$, that is, all types of signals released by the firm are known to be more accurate than agents' private signal. At date 0, both the firm and agents have a common prior that λ equals to λ_h with probability q, i.e., $\Pr(\lambda = \lambda_h) = q$ and $\Pr(\lambda = \lambda_l) = 1 - q$.

We assume λ_τ is a characteristic of z, and is privately observed by the firm at date 1 when z is realized. Although our model is a one-period model, we have in mind that the reporting decision is recurring periodically whereas λ_τ can change from period to period (that is, it is not a firm-specific constant feature). That said, for the ease of presentation, from now on we will call a firm with reliability λ_h (λ_l) as a type h (l) firm.

As will become clear later, the agents' optimal action choice is independent of their perception of β conditional on that of λ. Therefore, it is without loss of generality that we also assume that the information environments facing the agents are sufficiently complex that they do not have a prior probability assessment on the nominal level of β.[15] It can be justified on the grounds that market participants aren't sufficiently well informed about how information is collected and processed to know how accurate their signals are. Agents do know that their private signal is less accurate than the firm's signal and that the firm is asymmetrically informed about the relative precision of its public disclosure.

2.3 Disclosure Regimes and Timeline

The firm discloses a signal z_i to agent i:

$$z_i = \delta_i z + (1 - \delta_i)\,\emptyset, \tag{3}$$

where δ_i is an indicator variable taking the value of 1 with probability $\bar{\delta} \in [0, 1]$ and δ_i is independent of $\delta_j, \forall i \neq j$. That is, an agent gains access to the firm's signal z with probability $\bar{\delta}$ and a "null signal", $\emptyset$, with probability $1 - \bar{\delta}$. We label $\bar{\delta}$ as the firm's disclosure publicity that determines the measure of agents who are informed of z. $\bar{\delta}$ ranges from 0 (disclosing to no agent) to full publicity of 1 (disclosing to every agent) and is publicly observable. Note that $\bar{\delta}$ is a measure of agents who are informed of z but not necessarily of the reliability of z (i.e., λ). To make this distinction, from now on, we will use the term clarity to describe the extent to which agents are able to infer the reliability of the firm's disclosure.

[15] This technical assumption is to rule out the possibility that an agent can update his belief of λ by comparing his private signal and the disclosed public signal.

Ex ante, prior to the arrival of information about z and λ, the firm commits to either a standard disclosure regime or a discretionary disclosure regime. Under the standard disclosure regime, the firm commits to a publicity level $\bar{\delta}$, by electing to follow established accounting standards that impose restrictions on how the firm discloses its information to agents. Under this regime, the firm cannot ex post adjust its publicity choice as a function of the realized reliability λ.[16]

In contrast, under the discretionary disclosure regime, the firm elects not to follow standards and is free to choose any publicity level after observing λ. As a result, this regime enables the firm to potentially communicate its private information regarding λ via its publicity choice to achieve clarity. This is to say, while agents may not directly observe the reliability of the public disclosure, they may be able to infer it from the firm's publicity.

In both regimes, we focus on disclosure publicity as the key variable of interest because of its direct and indirect effects on agents' aggregate welfare. Agents' welfare is directly affected by publicity: the more agents are informed of z, the better decision they can make even when they may not have clarity on the reliability of the information (λ). Perhaps less apparent is the indirect effect of publicity. As will be shown later, varying publicity with reliability may allow the firm to achieve clarity and improve agents' decision-making. While the firm may control its disclosure with other instruments in richer settings than we have depicted here, to the extent that accounting standards constrain firm's discretion to use these instruments, our main point remains: as long as it is costly to credibly achieve clarity without standards, standards may be optimal precisely because they prevent firms from incurring these costs.

The timeline of the model is:

Date 0: The firm commits to one of the two disclosure regimes. The common prior by both agents and the firm is that v is distributed uniformly across the real line and λ_τ follows

[16] It is true that accounting standards often allow discretions (e.g., LIFO or FIFO). This would translate into admitting multiple levels of publicity in the standard disclosure regime. We note that given the binary nature of λ, it is without of loss of generality to allow only one level of publicity under the standard disclosure regime in our setting. The important assumption here is that the dimension of discretion allowed in standards is smaller than the dimension of firm types. This assumption captures the key idea that the one-size-fit-all nature of standards inevitably involves restricting the firm discretion in communicating firm-specific information.

a binary distribution with $\Pr(\lambda = \lambda_h) = q$ and $\Pr(\lambda = \lambda_l) = 1 - q$.

Date 1: The firm observes z and the associated reliability λ_τ, and makes a disclosure according to the selected disclosure regime. Agents observe their private signal (s_i), and choose actions based on the information available to them, which differs by the disclosure regime.

Date 2: v is realized and agents' utility materializes.

3 EQUILIBRIUM UNDER STANDARD DISCLOSURE REGIME

To fix ideas and to gain some initial insights into the main economic forces, we now illustrate our model by deriving the equilibrium for the standard disclosure regime as a benchmark. Under this regime, the firm commits to a given level of publicity *prior to* observing the reliability λ of its information.

An agent's reaction to the firm's disclosure publicity choice $\bar{\delta}$ is modeled as a best-response equilibrium to disclosure. At the time each agent i makes a decision, his information set

$$\Omega_i \equiv \left\{ s_i, z_i, q, \bar{\delta} \right\}$$

includes his private signal s_i, public signal

$$z_i = \begin{cases} z \text{ with probablity } \bar{\delta} \\ \phi \text{ with probability } 1 - \bar{\delta} \end{cases},$$

the agent's prior probability assessment of a type h firm (q), and the firm's disclosure publicity choice $\bar{\delta}$.

We use $\hat{q}$ to denote $\Pr(\tau = h | \Omega_i)$, i.e., agents' posterior probability assessment of a type h firm conditional on Ω_i. Because both *high and low*-reliability types of firms have committed to choose the same publicity, an agent is not able to update his belief about the firm's type from the observed publicity choice. As such, the agent's ex post probability assessment of a type h firm $\hat{q}$ is equal to q.[17] Agent i selects e_i to solve

$$E_i U_i \equiv \max_{e_i} \; E_i \left[(1-\rho) \left(v e_i - \frac{e_i^2}{2} \right) + \rho \left(\bar{e} e_i - \frac{e_i^2}{2} \right) \right], \tag{4}$$

where E_i is the expectation taken conditional on agent i's information set Ω_i.

Taking a straightforward first order condition with respect to e_i and rearranging, the solution to (4) is

$$e_i^* = (1-\rho) E_i [v] + \rho E_i [\bar{e}] . \tag{5}$$

As expected, e_i^* is increasing in the expected fundamental $E_i [v]$ and in the expected average action $E_i [\bar{e}]$. In principle, finding the agents' equilibrium action from (5) is complicated by the evolution of higher-order beliefs. $i's$ beliefs about other agents' actions determine $i's$ action; in turn, this determines other agents' actions; in turn, this determine $i's$ action;...; and so forth. We are searching for a fixed point to this infinite regress that determines optimal actions. Equation (5) indicates that e_i^* is linear in the updated beliefs of v and $\bar{e}$. Therefore, we conjecture the equilibrium action as a linear function of the private and public signals. This conjecture turns out correct. In fact, it constitutes the unique equilibrium, as demonstrated by the following proposition.

Proposition 1: (Standard Disclosure Regime)

[17] Agents are unable to revise their beliefs about the relative precision of the public disclosure by comparing their public and private signals because such a revision necessitates the use of a prior probability distribution on β, which is ruled out by our assumption.

(a) Given $\bar{\delta}$ and $\hat{q}$, a unique action equilibrium exists:

$$e_i^*\left(\hat{q},\bar{\delta}\right) = \begin{cases} s_i & \text{for} \quad \delta_i = 0 \\ \\ w\left(\hat{q},\bar{\delta}\right) z_i + \left[1 - w\left(\hat{q},\bar{\delta}\right)\right] s_i & \text{for} \quad \delta_i = 1 \end{cases}$$

where

$$w\left(\hat{q},\bar{\delta}\right) \equiv \frac{\frac{\hat{q}\lambda_h}{1+\lambda_h}+\frac{(1-\hat{q})\lambda_l}{1+\lambda_l}}{1-\rho\bar{\delta}\left\{1-\left[\frac{\hat{q}\lambda_h}{1+\lambda_h}+\frac{(1-\hat{q})\lambda_l}{1+\lambda_l}\right]\right\}}.$$

(b) Denote the expected payoff conditional on v for firm type τ given $\bar{\delta}$ and $\hat{q}$ as $EAU_\tau\left(\hat{q},\bar{\delta}\right)$. We have

$$EAU_\tau\left(\hat{q},\bar{\delta}\right) = \frac{v^2}{2} - \frac{1}{2\beta}\left\{\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right) w\left(\hat{q},\bar{\delta}\right)^2}{\lambda_\tau} + \bar{\delta}\left[1 - w\left(\hat{q},\bar{\delta}\right)\right]^2 + 1 - \bar{\delta}\right\}.$$

In equilibrium, $\hat{q} = q$. Denote the equilibrium expected payoff conditional on v for a firm that has yet to observe its type as EAU^{SD}. We have

$$EAU^{SD} = qEAU_h\left(q,\bar{\delta}\right) + (1-q)\, EAU_l\left(q,\bar{\delta}\right). \tag{6}$$

(c) Both $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ and EAU^{SD} are increasing in $\bar{\delta}$.

Proposition 1(a) reveals how the effects of a public disclosure with given characteristics are manifested in the agents' behavior. Recall agents have two goals: one is to choose an action close to the fundamental v, and the other is to match other agents' actions. As a result of the first motive, the agent places a greater weight on the public signal, the more accurate the public information is relative to his private information. This follows because the agent makes a better action when guided by more precise public information. In addition, with agents' actions exhibit strategic complementarities (i.e., $\rho > 0$), public disclosure will have a greater impact on the agent's decision: the more agents rely on public disclosure, the easier it is for agents to forecast and match each other's action. In this case, public disclosure helps coordinating behaviors and fostering positive social interaction.

Previous analyses on the value of publicity show full publicity maximizes social welfare, when the reliability of public signal is known (e.g., Cornand and Heinemann, 2008). Part 1(c) extends this finding to our setting, where agents only know the expected precision of the public information, by showing that full publicity maximizes the value of public disclosure. This result is consistent with the FASB's objective to focus on general purpose financial reporting to users who cannot require firms to provide information directly to them, to issue standards that "seek to provide the information set that will meet the needs of the maximum number of primary users" (SFAC 8, para OB2-OB5; para QC35-QC38; para. OB8).

Proposition 1(a) also identifies the cost of standards. Although the optimal standard requires the firm's signal to be disclosed to all agents, its one-size-fits-all nature prevents the firm from revealing the reliability of the public information. Absent this knowledge, agents choose actions based on the expected, instead of the actual, realized reliability of the public disclosure. As a result, relative to when λ is publicly observed, as Prop. 1(a) shows, agents place too little (too much) weight on the disclosure when λ turns out to be high (low). This misallocation of attention to public disclosure reduces the value of information and renders the standard disclosure regime less valuable for decision makers. More importantly for our purposes, Proposition 1 provides the benchmark for evaluating the costs and benefits of standards relative to discretion, which we turn to next.

4 EQUILIBRIUM UNDER DISCRETIONARY DISCLOSURE REGIME

Under the discretionary disclosure regime, how the firm discloses information can be a function of its privately observed reliability level $\lambda_\tau \in \{\lambda_h, \lambda_l\}$. To proceed, we first analyze whether firms of different types have incentives to truthfully reveal their unverifiable information regarding reliability to agents. We then examine whether disclosure publicity may be used as a credible tool for firms to communicate reliability in equilibrium. Lastly, we establish formal conditions under which a separating equilibrium exists where firms of different types adopt different publicity levels.

4.1 Disclosure Policy in Discretionary Disclosure Regime

While the agents can not observe the firm's reliability type, the firm may reveal its type *directly*, by simply reporting $\hat{\tau} \in \{h, l\}$ and *indirectly*, by choosing publicity $\bar{\delta} \in [0, 1]$. We use $d \equiv \left\{\hat{\tau}, \bar{\delta}\right\}$ to capture these two channels and label d as the firm's *disclosure policy*, i.e., how the firm discloses information to the agents. At the time agent i selects his action, his updated information set now becomes $\Omega_i \equiv \left\{s_i, z_i, \hat{q}(d), \bar{\delta}\right\}$. As before, s_i is the agent's private signal, $\bar{\delta}_\tau$ is the publicity chosen by firm type τ implemented by signals

$$\left\{z_i = z \textit{ with probability } \bar{\delta}_\tau \text{ and } z_i = \emptyset \textit{ with probability } 1 - \bar{\delta}_\tau\right\},$$

and $\hat{q}(d)$ is the agent's updated belief that the firm's type is h given the firms' disclosure policy d. We will refer to $\hat{q}$ as the firm's *influence* over agents' perception of its type via it disclosure policy choice.

We adopt *Perfect Bayesian Equilibrium* as our solution concept. A Perfect Bayesian Equilibrium (PBE) is a strategy profile $\left\{(d), e_i^*\left(\hat{q}(d), \bar{\delta}\right)\right\}$ and a set of agents' beliefs $\{\hat{q}(d)\}$, such that,

(a) *No firm wishes to deviate, given agents' beliefs and the equilibrium strategies of the other type;*

(b) *No agent wishes to deviate, given his beliefs, the equilibrium strategies of the firm and the equilibrium strategies of other agents; and*

(c) *Whenever possible, beliefs are updated by Bayes rule from the equilibrium strategies.*

In addition, we apply Cho and Kreps' (1987) Intuitive Criterion to impose restrictions on off-equilibrium beliefs.

Cho and Kreps' Intuitive Criterion: *Consider an out of equilibrium disclosure policy choice d. If a type τ firm ($\tau \in \{h, l\}$) cannot be strictly better off by choosing d regardless of agents' belief and a type τ' firm with $\tau' \neq \tau$ strictly benefits by choosing d provided it is correctly perceived, then upon observing a firm selecting $\bar{\delta}$ agents must believe such a firm is τ' with probability 1.*

The Intuitive Criterion requires that off-equilibrium disclosure policy choices be supported by "reasonable beliefs" about the type of firm who would have found it profitable to deviate from the expected equilibrium play. Application of the Intuitive Criterion helps to eliminate unreasonable equilibria and strengthen the model's prediction.

Finally, note that, given $\hat{q}$ and publicity $\bar{\delta}$, agents' optimal actions $e_i^*\left(\hat{q}, \bar{\delta}\right)$ are still uniquely characterized by Proposition 1(a). With this in mind, we next analyze the firm's incentives to reveal its type to agents.

4.2 Firm's Incentive to Reveal Public Disclosure Reliability

Our first task is to determine the firm's motives for revealing its type. Consider a hypothetical situation where the firm's type is publicly known. Suppose the firm could choose the weight w^* that all agents place on its public disclosure to maximize the firm's objective (i.e., aggregate utility of all agents). Denote w^{**} as the equilibrium weight that an individual agent choose to maximizes his utility. Then, how would w^* compare with w^{**}? The answer is provided in Lemma 1 below.

Lemma 1*: Given $\bar{\delta}$,*

$$w^* = \frac{\lambda_\tau}{1 + \lambda_\tau - 2\rho\bar{\delta}} > w^{**} = \frac{\lambda_\tau}{1 + \lambda_\tau - \rho\bar{\delta}}.$$

Agents place too little weight on disclosure: $w^{**} < w^*$.

Lemma 1 shows that there exists some discord with how agents process public disclosure. With strategic complementarity, agents pay too little attention to public disclosure. The firm prefers agents to coordinate their behavior based on the information conveyed in the public signal. Agents also benefit by coordinating behavior. However, agents under-coordinate because they fail to account for how other agents benefit from their coordination, resulting in incentive misalignment between the firm and its agents.

On the one hand, Lemma 1 suggests that a firm may have a motive for misrepresenting its type, in order to persuade agents to pay proper attention to its disclosure. This is confirmed by the following lemma,

Lemma 2: *Denote* $\frac{\partial EAU_h(\hat{q},\bar{\delta})}{\partial \hat{q}}|_{\hat{q}=1}$ *as the marginal change in type* h *firm's expected payoff with respect to influence* $\hat{q}$ *when agents believe the firm to be type* h *with probability* 1*. Similarly, denote* $\frac{\partial EAU_l(\hat{q},\bar{\delta})}{\partial \hat{q}}|_{\hat{q}=0}$ *as the marginal change in type* l *firm's expected payoff with respect to influence* $\hat{q}$ *when agents believe the firm to be type* h *with probability* 0*.* $\frac{\partial EAU_h(\hat{q},\bar{\delta})}{\partial \hat{q}}|_{\hat{q}=1} > 0$ *and* $\frac{\partial EAU_l(\hat{q},\bar{\delta})}{\partial \hat{q}}|_{\hat{q}=0} > 0$.

Lemma 2 states that a type l firm, when correctly perceived by the agents (i.e., at $\hat{q} = 0$), strictly benefits if it can induce a higher influence $\hat{q}$ on the margin. This implies that type l may have incentives to pretend to be a type h in order to induce agents to put a higher weight to its public disclosure. In contrast, a type h firm, when it is correctly perceived (i.e. at $\hat{q} = 1$) and thus unable to further enhance its influence, is concerned with being "contaminated" by a mimicing type l and thus receiving a lower influence $\hat{q}$ on the margin. As such, a type h firm has incentives to credibly convey its type to agents in order to avoid such contamination.

On the other hand, Lemma 1 suggests that the degree of incentive misalignment between the firm and its agents varies with ρ (the need for coordinating agent actions). Specifically, the difference between w^{**} and w^{*} vanishes as ρ approaches 0, implying that when ρ is small firms may not wish to be perceived as the other type. This reasoning is confirmed by Proposition 2.

Proposition 2: (Costless Signaling Equilibrium) *There exists a* $\bar{\rho}$ *such that with* $\rho \in [0, \bar{\rho}]$ *firms truthfully announcing their types directly and selecting full publicity* ($\bar{\delta} = 1$) *constitute a unique equilibrium that satisfies the Intuitive Criterion. That is, in such* *a costless signaling equilibrium, a type h firm chooses $d_h = \left\{h, \bar{\delta}_h = 1\right\}$, a type l firm chooses $d_l = \left\{l, \bar{\delta}_l = 1\right\}$ and agents updated posteriors are $\hat{q}\left(d_h\right) = 1$ and $\hat{q}\left(d_l\right) = 0$. $\bar{\rho}$ is weakly increasing in λ_h.*

Proposition 2 pertains to settings where conflicts between the firm and its agents are insignificant. The source of disagreement stems from different preferences for coordinating actions, as reflected by the size of ρ relative to variation in signal precision $\lambda_h - \lambda_l$. When ρ is small relative to $\lambda_h - \lambda_l$, in spite of the fact that a type l firm wishes to increase its influence *on the margin*, going all the way and pretending to a type h comes at too large a cost of deceiving agents to pay too much attention to public information than is warranted. As a result, in this case, agents' reaction to the disclosure is aligned with the firm's preferences; the firm has no incentive to pervert information by misreporting its type.

4.3 Publicity as a Credible Channel to Convey Disclosure Reliability

When $\rho > \bar{\rho}$, discretionary disclosure can no longer implement costless signaling as the misalignment between the firm and agents are so severe that at full publicity type l firm strictly prefers to be perceived as type h. In this case, the direct disclosure channel $\hat{\tau}$ becomes cheap talk and would not be believed by agents by itself. Knowing that type l may try to imitate the other type, our next task is to explore other communication channel through which different types use. Proposition 1(c) shows that a firm's expected payoff is reduced by a decrease in publicity $(\bar{\delta})$. However, we note that for the same marginal change in publicity, the magnitude of the corresponding change in the firm's payoff depends on the firm's type, thus making publicity choice a possible communication channel.

To elaborate, with strategic complementarities in agents' actions, both types of firms benefit from making agents' actions close to each other. Reduced publicity is costly as it adds heterogeneity to agents' information set which in turn induces less coordinated behaviors. This occurs because agents who only observe the null public signal (i.e., $\delta_i = 0$) rely exclusively on their private information s_i to determine their actions; whereas agents who observe the firm's signal (i.e. $\delta_i = 1$) choose actions based on both their private information and the firm's signal z. The cost of heterogeneity is lower when the correlation is greater between the information sets of the two groups of agents. Agents' information sets are correlated via their correlation to the underlying state. The correlation is higher when the public information is more precise. This in turn implies that reduced publicity is less costly for a type h firm than for a type l, enabling the former to use publicity as a credible tool to reveal its type.

Formally, we have

Lemma 3: *Let* $MRS_\tau\left(\hat{q}, \bar{\delta}\right) = -\frac{\frac{\partial EAU_\tau(\hat{q},\bar{\delta})}{\partial \hat{q}}}{\frac{\partial EAU_\tau(\hat{q},\bar{\delta})}{\partial \bar{\delta}}}$ *denote the marginal rate of substitution between publicity* $\bar{\delta}$ *and influence* $\hat{q}$ *for a firm of type* τ.

(a)

$$\frac{dMRS_\tau\left(\hat{q}, \bar{\delta}\right)}{d\lambda_\tau} < 0;$$

(b) consider influence-publicity combinations $\left(\hat{q}_1, \bar{\delta}_1\right)$ *and* $\left(\hat{q}_2, \bar{\delta}_2\right)$*, with* $\hat{q}_2 > \hat{q}_1$*. If type* l *is indifferent between choosing* $\left(\hat{q}_1, \bar{\delta}_1\right)$ *and* $\left(\hat{q}_2, \bar{\delta}_2\right)$*, then type* h *strictly prefers* $\left(\hat{q}_2, \bar{\delta}_2\right)$ *to* $\left(\hat{q}_1, \bar{\delta}_1\right)$.

Lemma 3(a) formalizes the above intuition and demonstrates that the type h firm is willing to substitute publicity for clarity at a lower rate than the type l firm. It documents the usual "single-crossing property" by showing that the marginal substitution of publicity for influence is a decreasing function of the reliability of public information.

Specifically, Lemma 3(b) implies that type h is more eager to credibly communicate its type than type l. Figure 1 illustrates the rationale behind Lemma 3(b). It shows in a publicity-influence space that type l's indifference curve (denoted by I^l) intersects type h's indifference curve (denoted by I^h) once from above at point B (where $\hat{q} = 0$ and $\bar{\delta} = 1$). This implies type h has a smaller marginal rate of substitution of publicity for influence than type l. Consequently, as the figure confirms, if type l is indifferent to points A and B that lie on its indifference curve I^l, then type h strictly prefers point A to B, since A lies in type h's "preferred-to" set. Notice, point A consists of lower publicity and higher influence than profile B, implying that type h is more eager to credibly communicate its type by reducing publicity than type l.

The aforementioned preference orderings in Lemma 3 are all we require to characterize "reasonable equilibria" for our game, by which we mean equilibria supported by Cho and Kreps' (1987) Intuitive Criterion.

Proposition 3: (Costly Signaling Equilibrium) *For $\rho > \bar{\rho}$, there exists a separating equilibrium that satisfies the Intuitive Criterion where type h selects publicity $\bar{\delta}^h < 1$ and agents update beliefs $\hat{q}\left(\bar{\delta}^h\right) = 1$, and type l selects publicity $\bar{\delta}^l = 1$ and agents update beliefs to $\hat{q}(1) = 0$.*[18] *Type l is indifferent between selecting publicities equal to $\bar{\delta}^h$ and to 1. Denote the equilibrium expected payoff conditional on v for a firm before observing its type as EAU^{DD}. We have*

$$EAU^{DD} = qEAU_h\left(1, \bar{\delta}^h\right) + (1-q)\, EAU_l(0,1)\,. \tag{7}$$

The rationale for the separation pattern is quite clear. The type h firm is more eager to credibly reveal that the reliability of public information is high when it is concerned with being imitated by the type l firm. More important, though, is the reason for which the firm restricts its disclosure publicity. In contrast to Morris and Shin (2002), public information is rationed to clarify its reliability rather than to prevent agents from (mis)using it.

While our analysis so far views publicity as a key feature of public disclosure, it does not address the issue of how type h firm achieves partial publicity. We note that what matters for our insight is not necessarily the number of agents who can in principle observe the disclosure; rather it is the number of agents who understand the reliability of disclosure and can correctly incorporate public disclosure in their decisions.[19] Viewed in this perspec-

[18] The proof to Proposition 3 shows that for a given ρ when costless signaling is not feasible there exists a $\hat{\lambda}$ such that $\forall \lambda_h < \hat{\lambda}$ the equilibrium characterized in Proposition 3 is unique. In addition, $\forall \lambda_h \geq \hat{\lambda}$, this equilibrium generate the highest payoff for firm type h among all separating equilibria that satisfy the Intuitive Criterion. Our subsequent numerical analyses in section 5 are not qualitatively changed if we use any other equilibrium when $\lambda \geq \hat{\lambda}$.

[19] Recent empirical research on the consequences of firms' 10K readability is consistent with the idea while

tive, reduced publicity may be achieved by the way public information is communicated and explained (e.g., technical lingo or plain and simple language), by the medium used to deliver the information (such as official briefings, press releases, or word of mouth), and by the frequency of disclosures to different audiences.[20] To the extent that various voluntary disclosure practices and strategies can achieve the de facto degree of publicity, the results from the discretionary disclosure regime can potentially provide a theoretical underpinning for these practices, including, for example, conference calls, webcasts, or press releases, or the linguistic complexity of the disclosure.[21] We leave it to future research to evaluate the effects of different disclosure practices (say, conference calls or press releases) on publicity.

5 EX ANTE WELFARE COMPARISONS OF REGIMES

Having characterized the equilibrium outcomes under the two regimes in the previous sections, we now compare the firm's payoff (i.e., the expected aggregate utility of all agents) between two disclosure regimes (EAU^{SD} versus EAU^{DD}). The discretionary disclosure regime permits the firm to tailor its disclosure policy to communicate reliability of the disclosure, the equilibrium of which is characterized by Propositions 2 and 3. In particular, when $\rho > \bar{\rho}$, type h firm conveys the reliability of public information to agents by restricting the publicity of its disclosure. In a separating equilibrium, agents are able to perfectly infer the firm's type by its choice of publicity. Here, clarity may be achieved at the cost of publicity.

The alternative is the standard disclosure regime which commits firms of all types to a pre-determined publicity level stipulated by the standards and bars firms from making their disclosure policies as a function of their observed reliabilty. Proposition 1(c) shows that the aggregate utility is increasing in $\bar{\delta}$ for both types, implying that welfare is maximized at full

all agents in principle can observe these disclosures, they do not incorporate all information in 10K in their decisions (e.g., Li (2008)).

[20] See the discussons in Cornand and Heinemann (2008), Geraats (2006, 2007, 2009), Hirshleifer and Teoh (2003), Morris and Shin (2007) and Walsh (2006) for further elaboration on how partial disclosures of information can be implemented.

[21] A disclosure of derivative-based hedging activities can be made close to incomprehensible to all but a few who are well versed in both the economics of derivatives and the complexity of hedge accounting.

publicity. We therefore will evaluate EAU^{SD} at $\bar{\delta} = 1$ for the purpose of welfare comparisons in this section.[22] While all agents receive public information, they do not know its reliability because they are not able to update their prior beliefs through the observed publicity choice. Here, full publicity is achieved at the cost of clarity. The tradeoff between publicity and clarity is the key to understand the benefits and costs of the two regimes.

Proposition 4 summarizes some preliminary findings.

Proposition 4: *A necessary condition for the standard disclosure regime to achieve higher payoff than the discretionary disclosure regime (i.e., $EAU^{SD} > EAU^{DD}$) is when the information has a strong coordination role, i.e., $\rho > \bar{\rho}$, and when the reliability of public disclosure is privately observed by firms.*

When action complementarity is weak ($\rho \leq \bar{\rho}$), the misalignment between the firm's and agents' interests is sufficiently small so that firms resort to the costless signaling channel without restricting publicity. When this is the case, because discretionary disclosure credibly conveys precision of the disclosure with full publicity, it is preferred to the standard disclosure which is inefficient, as it does not inform agents' of public information reliability, causing them to weight the public signal inappropriately.[23] Likewise, when the firm type is publicly known, firms no longer need to resort to reduced publicity to signal their types, thus making standards redundant. For the standard regime to dominate the discretionary regime, it is thus necessary to have both $\rho > \bar{\rho}$ and information asymmetry (between firms and agents) about the reliability of public disclosure.

Unfortunately, EAU^{DD} and EAU^{SD} are complicated functions of ρ, $\lambda's$ and q. They do not lend themselves to a simple analytical comparison. We can, however, provide some

[22] We do not take a stand on whether the current financial reporting standards achieve full publicity or not.

[23] One might question whether this comparison is fair as we do not allow the firm to directly announce its type to agents under the standard disclosure regime. The purpose of the paper is to shed light on the pros and cons of allowing firm discretion in how to disclose information. Allowing firms to directly announce their types in the standard regime in fact constitutes a form of discretion by enabling firms to adjust their behavior ex post. As such, in order to highlight the effect of discretion, we intentionally define the standard regime as an extreme void of any discretion: firms are not able to finetune their disclosure policies at all after privately observing their types.

indications of their respective superiority by calculating and comparing EAU^{DD} and EAU^{SD} for a representative set of parameter values. A conceptual representation of the preferred disclosure regimes is illustrated in Figure 3, which depicts the (ρ, q) plane for a specified set of relative precision (λ_h, λ_l). Region D in Figure 3a and 3b are environments where the discretionary disclosure regime implements the costless signaling equilibrium with full publicity. As Proposition 2 and 4 indicate, when ρ is small relative to $\lambda_h - \lambda_l$ such that $\rho \leq \bar{\rho}$, misalignment of the firm's and agents' interests disappear. Both parties prefer full publicity and perfect clarity, with the result that discretionary disclosure regime admits a costless signaling equilibrium in which the ex-ante, as well as, ex-post efficiencies are maximized.

Figures 3a and 3b imply, and Proposition 2 confirms, that when $\rho > \bar{\rho}$, a large misalignment between the firm's and agents' interests develops, so as to preclude the possibility of a costless signaling equilibrium. Now the preference for the discretionary versus standard disclosure regime depends on the cost incurred by firms to clarify their types for the benefit of the agents. The cost of signaling is relatively small for Region D' in Figures 3a and 3b, indicating that firms are willing to sacrifice publicity to enhance clarity and therefore prefer the discretionary to standard disclosure regime. In contrast, Region S represents settings where the cost of signaling is high such that the firm prefers the standard disclosure regime where clarity is sacrificed to ensure there is full publicity.

Summarizing, these observations provide us with some predictions about the settings in which the discretionary disclosure regime is likely to be preferred to the standard disclosure regime:

- *Discretion in reporting is preferred for settings where preferences for coordination are relatively weak compared to the firm's preferences for clarity.*

  Interest misalignment impairs firms' ability to disclose with clarity. The misalignment in preferences between different firm types and their affiliated agents disappears as the coordination role of public information becomes small relative to the firm's preferences for clarity, as Figure 3b implies. When differences in clarity are large between types, firms will not wish to mislead their agents regarding the reliability of their information to induce more collective action. Hence potential conflicts are reduced and the self-interests of different firm types are aligned. Consequently, moderate (or no) reduction in disclosure publicity is required to communicate reliability, which in turn implies the benefits from clarity of disclosure outweigh the costs of separation among types. In this case, allowing firms the discretion to disclose their types directly or indirectly by reducing publicity yields higher expected payoff than the standard disclosure regime.

- *Standard reporting is preferred for settings where there is a relatively strong collective action preference and a large q (prior probability that the firm is of type h).*

  Figures 3a and 3b indicate that the standard disclosure regime is preferred when ρ or q is sufficiently large. This may seem surprising. After all, clarity is most important when there are strong collective action externalities and discretion seems beneficial when more firms are eager to demonstrate their types. However, in these settings, to credibly communicate reliability, firm h separates from firm l by reducing its publicity; the larger ρ is the greater the reduction in publicity and the larger q is the higher the probability that high type firm is called on to prove its type. As a result, the cost of signaling exceeds its benefit. Ex ante, the firm is better off committing itself to report under standards, thereby relieving itself of the discretion and duty to demonstrate its type is high.

6 Summary and implications

6.1 Summary

In this paper we propose an analytical explanation for the existence of financial reporting standards. Our aim is to shed light on the optimal boundary of accounting standards, i.e., what type of information should be governed by financial reporting standards. We address this question in a setting where public information can serve both an information role, by reducing agents' uncertainty about firm fundamentals, and a coordination role, by reducing agents' uncertainty about other agents' actions. The coordination role of public information arises in the presence of strategic interactions among the actions agents take upon receiving the public information. Actions exhibit strategic interactions when the marginal payoff to an agent's action depends on what other agents do.

We analyze the role of accounting standards in disseminating public information assuming that firms wish to maximize the aggregate utility of all users of public information; such a setting abstracts from issues of agency conflicts. Specifically, we evaluate the efficiency of accounting standards by comparing the ex ante aggregage utility in a regime with standards with that in a regime without standards. In our analysis, accounting standards provide rules that firms must commit to use in disclosing future information *before* they observe the reliability of their future public information. We take the perspective that because it is impossible to anticipate and prescribe rules for all future contingencies for all firms, committing to standards invariably restricts firms' ability to convey reliability information. The specific restriction we study is the publicity of public disclosure.

In our model, when the reliability of public disclosure is publicly known to all agents, firms prefer accessible public information for all agents (full publicity). However, when firms privately observe the reliability of public disclosure, they have incentives to restrict publicity in order to communicate information about reliability (i.e., achieve clarity, in the sense of communicating the precision or reliabilty of reported information). We find that while the regime without standards allows firms to choose disclosure publicity to communicate information about reliability, for the disclosure to be credible, firms may find it optimal to incur dead-weight costs by sacrificing publicity. In contrast, while the regime with standards limits firms' discretion in trading off publicity for clarity, it also reduces the dead-weight costs firms *have to* incur when they do exercise the discretion. We find that for accounting standards to achieve higher ex ante aggregate utility, the necessary conditions are that public information plays a coordination role and agents are uncertain about the reliability of public dislcosure.

6.2 Implications

In this subsection we discuss several implications of our analysis and findings for financial reporting standard setting and for consideration of the standards themselves. We acknowledge that some implications can be viewed as positive or explanatory, and some as normative or prescriptive, but we do not focus on this distinction.

First, and most broadly, our analysis pertains to the issue of how to evaluate financial reporting standards, including the desirability of their existence. In this context, we first note the existence of longstanding debates about, for example, whether financial reporting standards should serve mostly a contracting function or mostly a valuation function, or should yield more conservative reported outcomes. One implicit assumption seems to be that the purpose of standards is to facilitate efficient capital allocation. However, a more fundamental question seems to be: are financial reporting standards the best way to implement this objective or could the objective be readily achieved without standards? Lambert (2010, p. 288-289) expresses this idea clearly: "....suppose we started from scratch with the objective of raising money via debt on the most favorable terms. What information would we provide when debt was being issued, what performance measures would we develop to use over the life of the debt, and how would we measure them? It doesn't seem likely that our current financial statements would be the result."

Put another way, the debate over what standards should look like *assumes* the existence of standards and then goes on to consider desirable properties. But the debate does not consider that those desirable properties can just as well be included in firm-specific information systems and do not necessarily have to be implemented by standards. Furthermore, debates over what standards should look like, and what they should require, for example, more fair value measurment or less, do not start with a theory or framework that explains why standards exist to begin with, and why the existing standards are the way they are. This idea is also expressed by Lambert (2010, p. 289), who suggests that those who believe that certain standards are misguided should consider why these apparent standard setting errors occurred.

We believe that our model generates predictions that offer reasonable explanations for some observed characteristics and properties of existing financial reporting standards. More specifically, our model asks a central and basic question, what makes standards a better reporting regime than the alternative of no standards, instead of taking the existence of standards as exogenously determined and proposing desirable characteristics of standards. Our analyses imply that firms may wish to commit to accounting standards that can credibly prohibit them from later incurring costs in attempts to credibly convey disclosure reliablity. Thus, it shows that the restrictive nature of standards is one important condition that makes standards socially valuable. In contrast to the conventional view that faults standards for their restrictive nature, our analysis suggests that firms may voluntarily commit to standards, therefore offering a positive explanation for the fact that accounting standards existed before disclosure regulation was introduced.

Since it is always subgame optimal for some firms to deviate from standards, our analysis also suggests that strong enforcement is another important condition for standards to achieve its maximum social value. In our model, standards can be implemented by a contract that prohibits contracting parties from deviating from reporting rules as specified by standards, and that can only be dissolved by consensus from all contracting parties. In this view, the value of standards can be maximized by measures that improve their enforcement. To the extent that mandatory rules are such measures, our analysis thus offers an explanation for why standards are often mandated, especially for firms whose securities are publicly traded (and therefore whose users' actions are more likely to exhibit strategic interactions). To the extent that private standard setting bodies (such as the FASB) are more sensitive to the concerns of their constituents than to the concerns of government agencies, our results could explain why standard setting responsibilities often do not rest with governmental bodies.

Having as a first step identified the sources of the standards regime's advantages, as compared to the alternative regime of no standards, the second step, how to evaluate standards, follows in a straight-forward manner. Specifically, our findings imply that effective standards will aim to maximize publicity and will be strictly enforced (i.e., deviations from established standards need to be punished as a deterrence). Because our perspective is one of general "decision-making usefulness," the framework of our model can accommodate both the "valuation usefulness" and "contracting usefulness" functions.

Our model shows that consideration of interactions among users of financial reporting information is fundamental to understanding how standards should function (a normative question) and how they do function (a positive question). This perspective enriches and extends the conceptual frameworks of the FASB and IASB, which focus on improving the decision usefulness of financial reports without explicit consideration and analysis of how users make decisions. Our model highlights that users often consider what other users may do in reaching their own decisions, and this characteristic has implications for financial reporting standard setting. In what follows, we discuss how our analysis can offer insights to some specific standard setting issues.

First, our analysis sheds light on the question: should there be only one set of financial reporting standards, applicable to all entities? If not, what should be the basis for differences in standards across types of entities? Answers to these questions are relevant to understanding two related observations: the first is the movement toward a single set of global accounting standards that would be applicable to firms regardless of where they are domiciled; and the second is the development of specified differences in standards based on ownership structure or size or some combination of the two.

With regard to the former – cross-country convergence of global financial reporting standards – our model shows that using the same standards is more important when the standards govern the reporting of information that serves a coordinating role. This would occur, for example, when there are many disparate user groups dispersed across multiple jurisdictions, suggesting that a single set of global standards matters more for firms that operate globally (for example, banking, insurance) or whose securities are traded globally. The existence of global standards would be less important, because the coordinating role is less important, for smaller, more localized entities such as not-for-profits, smaller unlisted firms and firms with few or no non-domestic financial statement users. In drawing this implication, we recognize that capital, goods and services increasingly flow across borders even for smaller unlisted firms. But we also emphasize that the increasing demand for a single set of global standards coincided with an increase in cross-border capital raising in the latter parts of the twentieth century. That is, as global integration increased so too did the demand for converged accounting standards applicable across jurisdictions.

With regard to the latter question, if there are to be differences in standards for certain firms, what should be the basis for those differences, we note that our model emphasizes the value of financial reporting standards from the perspective of user decisions. One key condition for standards to have social value is the existence of complementarities among users, in the sense that users' payoffs are to some extent mutually interdependent. While there is no reason to believe that a standard setter would be able to discern the presence or absence of complementarities, there is every reason to believe that a standard setter would be able to identify relatively stable firm features that are indicators of the degree of interaction among user payoffs. One such indicator, used by both the FASB and the IASB, is ownership structure, for example, a not-for-profit entity with no owners versus a profit seeking entity with no traded securities versus a profit seeking entity with traded securities. Both standard setters interpret differences in ownership structure as indicating differences, across entities, in both the types of financial report users and the types of decisions they make. These differences in user types, and user decisions, form the basis for decisions about exempting certain entities from requirements imposed on other entities. For example, the IASB has created *IFRS for SMEs,* a special simplified and condensed set of reporting standards usable by specified unlisted firms (but excluding financial institutions). The FASB sometimes exempts private (unlisted) firms from certain reporting requirements, for example, the requirement to disclosure fair values of financial instruments.

Second, our focus on publicity (the ease with which users access the reported information) and clarity (users' understanding of the reliability or precision of the reported numbers) speaks to the use of aggregation and disaggregation in financial reporting. On the one hand, grouping like items in a single category reduces the number of categories of financial statement items to be analyzed by users, and thereby makes the information more accessible (that is, publicity). On the other hand, some reporting standards require explicit disaggregations specifically linked to providing information about the reliability of reported numbers, for example, the requirement that firms disclose three levels of inputs to fair value measures, in decreasing order of verifiability.

Finally, our approach highlights both a special characteristic of public information that contrasts with private information that is observed only by a countable number of agents, and the implication of strategic uncertainty (meaning that users are uncertain about what other users will do). In addition to having practical implications for the task of standard setting, we speculate that this perspective, which explicitly considers the coordination role of public information and its implication for optimal standards, may also provide a direction for future research that extends recent work by, for example, Plantin, et al. (2008), and Gigler et al. (2013).

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7 APPENDIX

Let $E_i(*)$ and e_i^* denote, respectively, agent i's expectation of $*$ and his optimal action to maximize the expected utility, conditional on his information set Ω_i. Define $\bar{E}(*) \equiv \int_0^1 E_i(*)\,di$ and $\bar{E}^k(*) \equiv \underbrace{\overline{E}\overline{E}...\overline{E}}_{k \text{ layers}}(*)$. Let I denote the set of agents who observe signal z (i.e. $\delta_i = 1$) and J denote the set of agents who observe the null signal $\emptyset$ (i.e. $\delta_j = 0$).

Lemma A1

$$\begin{aligned} \bar{E}^k(v) &= \left[1 - \bar{\delta}\bar{\gamma}A(k)\right] v + \bar{\delta}\bar{\gamma}A(k)\, z \\ \text{where } A(k) &\equiv \frac{1 - \bar{\delta}^k (1-\bar{\gamma})^k}{1 - \bar{\delta}(1-\bar{\gamma})}, k = 1, 2, ..., \\ \text{and } \bar{\gamma} &\equiv \hat{q}\frac{\lambda_h}{\lambda_h + 1} + (1-\hat{q})\frac{\lambda_l}{\lambda_l + 1}; \end{aligned} \tag{A1}$$

Further,

$$\begin{aligned} E_j\left(\bar{E}^k(v)\right) &= s_j \\ \text{and } E_i\left(\bar{E}^k(v)\right) &= \left[1 - \bar{\gamma}A(k+1)\right] s_i + A(k+1)\,\bar{\gamma} z. \end{aligned} \tag{A2}$$

Proof for Lemma A1: For $\forall k$, given $(A1)$, $(A2)$ are obtained by the standard normal updating, as shown below:

$$E_j\left(\bar{E}^k(v)\right) = \left[1 - \bar{\delta}\bar{\gamma}A(k)\right] E_j(v) + \bar{\delta}\bar{\gamma}A(k)\, E_j(z) = s_j$$

and

$$\begin{aligned}
E_i\left(\bar{E}^k(v)\right) &= \left[1-\bar{\delta}\bar{\gamma}A(k)\right]\left[(1-\bar{\gamma})s_i+\bar{\gamma}z\right]+\bar{\delta}\bar{\gamma}A(k)z \\
&= \left[1-\bar{\delta}\bar{\gamma}A(k)\right](1-\bar{\gamma})s_i+\left[1-\bar{\delta}\bar{\gamma}A(k)+\bar{\delta}A(k)\right]\bar{\gamma}z \\
&= \left\{1-\bar{\gamma}\left[1+\bar{\delta}(1-\bar{\gamma})A(k)\right]\right\}s_i+\left[1+\bar{\delta}A(k)(1-\bar{\gamma})\right]\bar{\gamma}z \\
&= \left[1-\bar{\gamma}A(k+1)\right]s_i+A(k+1)\bar{\gamma}z.
\end{aligned}$$

The last equality was obtained by noting that

$$\begin{aligned}
1+\bar{\delta}(1-\bar{\gamma})A(k) &= \frac{1-\bar{\delta}(1-\bar{\gamma})+\bar{\delta}(1-\bar{\gamma})\left[1-\bar{\delta}^k(1-\bar{\gamma})^k\right]}{1-\bar{\delta}(1-\bar{\gamma})} \\
= \frac{1-\bar{\delta}(1-\bar{\gamma})+\bar{\delta}(1-\bar{\gamma})-\bar{\delta}(1-\bar{\gamma})\bar{\delta}^k(1-\bar{\gamma})^k}{1-\bar{\delta}(1-\bar{\gamma})} &= A(k+1).
\end{aligned}$$

To prove $(A1)$, we use the method of induction. First for $k=1$, normal updating and a diffuse prior on v imply

$$\begin{aligned}
E_j(v) &= s_j; \\
E_i(v) &= \left[\hat{q}\frac{1}{\lambda_h+1}+(1-\hat{q})\frac{1}{\lambda_l+1}\right]s_i+\left[\hat{q}\frac{\lambda_h}{\lambda_h+1}+(1-\hat{q})\frac{\lambda_l}{\lambda_l+1}\right]z; \\
&= (1-\bar{\gamma})s_i+\bar{\gamma}z
\end{aligned}$$

Thus,

$$\begin{aligned}
\bar{E}(v) &\equiv \int_I E_i(v)\,di+\int_J E_j(v)\,dj \\
&= \int_I\left[(1-\bar{\gamma})s_i+\bar{\gamma}z\right]di+\int_J s_j dj=\bar{\delta}(1-\bar{\gamma})v+\bar{\delta}\bar{\gamma}z+\left(1-\bar{\delta}\right)v \\
&= \left(1-\bar{\delta}\bar{\gamma}\right)v+\bar{\delta}\bar{\gamma}z.
\end{aligned}$$

Note that $A(1)\equiv 1$, thus $(A1)$ is true for $k=1$.

Suppose $(A1)$ hold for $k = n$. Then substitute in $(A2)$, we have

$$\bar{E}^{n+1}(v) \equiv \int_I E_i\left(\bar{E}^k(v)\right) di + \int_J E_j\left(\bar{E}^k(v)\right) dj$$
$$= \bar{\delta}\left[1 - \bar{\gamma}A(k+1)\right] v + \bar{\delta}A(k+1)\bar{\gamma}z + \left(1 - \bar{\delta}\right) v$$
$$= \left[1 - \bar{\delta}\bar{\gamma}A(k+1)\right] v + \bar{\delta}\bar{\gamma}A(k+1) z.$$

■

Proof for Proposition 1(a)

Equation (5) shows the optimal action for agents receiving public signal is

$$\begin{aligned} e_i^* &= (1-\rho)E_i(v) + rE_i(\bar{e}) \\ &= (1-\rho)E_i(v) + \rho(1-\rho)E_i(\bar{E}(v)) + \rho^2(1-\rho)E_i(\bar{E}^2(v)) + ... \\ &= (1-\rho)\sum_{k=0}^{\infty}\rho^k E_i(\bar{E}^k(v)). \end{aligned} \tag{A3}$$

Substitute $E_i\left(\bar{E}^k(v)\right)$ from Lemma A1 into $(A3)$ yields the weight on the public signal z as

$$\begin{aligned} w\left(\hat{q}, \bar{\delta}\right) &= (1-\rho)\bar{\gamma}\sum_{k=0}^{\infty}\rho^k A(k+1) \\ &= \frac{\bar{\gamma}(1-\rho)}{1-\bar{\delta}(1-\bar{\gamma})}\left(\sum_{k=0}^{\infty}\rho^k - \sum_{k=0}^{\infty}\rho^k\bar{\delta}^{k+1}(1-\bar{\gamma})^{k+1}\right) \\ &= \frac{\bar{\gamma}}{1-\bar{\delta}(1-\bar{\gamma})}\left(1 - \frac{\bar{\delta}(1-\bar{\gamma})(1-\rho)}{1-\bar{\delta}\rho(1-\bar{\gamma})}\right) \\ &= \frac{\bar{\gamma}}{1-\bar{\delta}\rho(1-\bar{\gamma})}, \end{aligned}$$

and the weight on private signal s_i as

$$\begin{aligned} &(1-\rho)\sum_{k=0}^{\infty}\rho^k - (1-\rho)\bar{\gamma}\sum_{k=0}^{\infty}\rho^k A(k+1) \\ =\ & 1 - w\left(\hat{q}, \bar{\delta}\right), \end{aligned}$$

where $\bar{\gamma}$ is defined in Lemma A1**.** Similarly, the optimal action for agent A_j in J (receiving no public signal) is

$$e_j^* = (1-\rho)\sum_{k=0}^{\infty}\rho^k E_j\left(\bar{E}^k(v)\right) = (1-\rho)\sum_{k=0}^{\infty}\rho^k s_j = s_j.$$

■

Proof of Proposition 1(b)

Substitute U_i into $EAU_\tau\left(\hat{q},\bar{\delta}\right) \equiv E\left[\int_0^1 U_i d_i \mid v,\tau\right]$, we have

$$EAU_\tau\left(\hat{q},\bar{\delta}\right) = (1-\rho)\,E\left(\int_0^1\left(ve_i^* - \frac{e_i^{*2}}{2}\right)di \mid v,\tau\right) + \rho E\left(\int_0^1\left(\bar{e}e_i^* - \frac{e_i^{*2}}{2}\right)di \mid v,\tau\right).$$

Substitute e_i^* and e_j^* from Proposition 1(a), and straightforward algebra leads to the expression for $EAU_\tau\left(\hat{q},\bar{\delta}\right)$. In equilibrium, because agents are not able to update their belief regarding the firm type from the observed publicity $\bar{\delta}$ under the standard disclosure regime, their equilibrium conjecture $\hat{q}$ is the same as the prior q, which implies

$$EAU^{SD} = qEAU_h\left(q,\bar{\delta}\right) + (1-q)\,EAU_l\left(q,\bar{\delta}\right).$$

■

Proof of Proposition 1(c) To simplify notation, we drop the argument $\left(\hat{q},\bar{\delta}\right)$ in $w\left(\hat{q},\bar{\delta}\right)$ when it doesn't cause confusion. Proposition 1(a) implies

$$\frac{\partial w}{\partial\bar{\delta}} = \frac{\rho\,(1-\bar{\gamma})\,\bar{\gamma}}{\left[1-\rho\bar{\delta}\,(1-\bar{\gamma})\right]^2} = \frac{\rho\,(1-\bar{\gamma})\,w}{1-\rho\bar{\delta}\,(1-\bar{\gamma})}$$

where $\bar{\gamma}$ is defined in Lemma A1. Algebra shows that the partial derivative of $EAU_\tau\left(\hat{q},\bar{\delta}\right)$

with respect to $\bar{\delta}$ can be simplified to

$$\begin{aligned}\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}} &= \frac{\partial\left\{\frac{v^2}{2}-\frac{1}{2\beta}\left[\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right)w^2}{\lambda_\tau}+\bar{\delta}(1-w)^2+1-\bar{\delta}\right]\right\}}{\partial\bar{\delta}} \\ &= \frac{w}{\beta\lambda_\tau}\left\{\frac{\lambda_\tau\left(2-w\right)-w}{2}+\left[w\left(1+\bar{\gamma}\right)+\left(1-w\right)\left(1-\bar{\gamma}\right)\lambda_\tau\right]\frac{\rho\bar{\delta}}{1-\rho\bar{\delta}\left(1-\bar{\gamma}\right)}\right\}.\end{aligned}$$

$\rho > 0$, $w, \bar{\gamma} \in [0,1]$ and $\lambda_\tau > 1$ imply that $w\left(1+\bar{\gamma}\right)+\left(1-w\right)\left(1-\bar{\gamma}\right)\lambda_\tau > 0$ and $\lambda_\tau\left(2-w\right)-w > 0$. Hence, $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}} > 0$, which also implies $\frac{\partial EAU^{SD}}{\partial\bar{\delta}} > 0$. ■

Proof of Lemma 1

Taking derivative on $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ with respect to w and setting it to zero yields w^*.

$$\begin{aligned}\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w} &= \frac{\partial\left\{\frac{v^2}{2}-\frac{1}{2\beta}\left[\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right)w^2}{\lambda_\tau}+\bar{\delta}\left(1-w\right)^2+1-\bar{\delta}\right]\right\}}{\partial w} \\ &= -\frac{1}{\beta}\left[\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right)w}{\lambda_\tau}-\bar{\delta}\left(1-w\right)\right]=0 \\ \Longrightarrow\ & w^*=\frac{\lambda_\tau}{1+\lambda_\tau-2\rho\bar{\delta}}.\end{aligned}$$

The first order condition is both necessary and sufficient for a unique maximum as $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ is strictly concave in w. To see this, note $\frac{\partial^2 EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w^2} = -\frac{\bar{\delta}}{\beta}\left(\frac{1-2\rho\bar{\delta}}{\lambda_\tau}+1\right)$, which is negative for $\rho < 0$. When $\rho \in [0,1/2]$, $\frac{\partial^2 EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w^2} < 0$ for $\forall\bar{\delta} \in [0,1]$. $w^{**} = \frac{\lambda_\tau}{1+\lambda_\tau-\rho\bar{\delta}}$ is obtained by setting $\hat{q}$ to either 0 or 1 in the w's expression in Proposition 1(a). Since $w^* > w^{**}$ if and only if $\rho > 0$, the rest of Lemma 1 is then immediate. ■

Proof of Lemma 2

The derivative on $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ with respect to $\hat{q}$,

$$\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}} = \frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w}\frac{\partial w}{\partial\hat{q}},$$

where

$$\frac{\partial w}{\partial \hat{q}} = \frac{\left(\frac{\lambda_h}{1+\lambda_h} - \frac{\lambda_l}{1+\lambda_l}\right)\left(1-\rho\bar{\delta}\right)}{\left\{1-\rho\bar{\delta}\left\{1-\left[\frac{\hat{q}\lambda_h}{1+\lambda_h}+\frac{(1-\hat{q})\lambda_l}{1+\lambda_l}\right]\right\}\right\}^2} > 0.$$

From Lemma 1, when the firm's type is correctly perceived, agents place the weight $w^{**} = \frac{\lambda_\tau}{1+\lambda_\tau-\rho\bar{\delta}}$ to the public disclosure. Evaluate $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w}$ at w^{**},

$$\begin{aligned}
\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w}|_{w=w^{**}} &= -\frac{1}{\beta}\left[\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right)w^{**}}{\lambda_\tau} - \bar{\delta}\left(1-w^{**}\right)\right] \\
&= \frac{\rho\bar{\delta}}{\beta\left(1+\lambda_\tau-\rho\bar{\delta}\right)}.
\end{aligned}$$

The lemma is thus obtained by noting that $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial w}|_{w=w^{**}} > 0$ if and only if $\rho > 0$. ■

Proof of Proposition 2 Lemma 2 establishes that type h does not wish to be perceived as type l. This implies that the costless signaling equilibrium is guaranteed if we can obtain a condition under which type l does not find in its own interest to be perceived as type h at full publicity ($\bar{\delta} = 1$). Note that $EAU_l\left(\dot{\lambda},\bar{\delta}\right)$ is a quadratic function in w (agents' weight on the public disclosure) and that Lemma 1 shows type l's expected payoff achieves its maximum at $w^* = \frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}}$. Thus, type l does not wish to mimic type h if and only if

$$\frac{\lambda_l}{1+\lambda_l-2\rho} - \frac{\lambda_l}{1+\lambda_l-\rho} < \frac{\lambda_h}{1+\lambda_h-\rho} - \frac{\lambda_l}{1+\lambda_l-2\rho}, \tag{8}$$

which is equivalent to

$$-2\lambda_h\rho^2 + \left(3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2\right)\rho + \lambda_l^2 + \lambda_l - \lambda_h - \lambda_h\lambda_l < 0. \tag{9}$$

It is easy to see that the LHS of the above expression is a quadratic function in ρ and peaks at

$$\rho = \frac{3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2}{4\lambda_h} > 1.$$

As such, the solution to (8) that can possibly be smaller than 1/2 is

$$\begin{aligned} & \frac{3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2 - \sqrt{\left(3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2\right)^2 + 8\lambda_h\left(\lambda_l^2 + \lambda_l - \lambda_h - \lambda_h\lambda_l\right)}}{4\lambda_h} \\ = & \frac{3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2 - \sqrt{1+\lambda_l}\sqrt{\lambda_h^2 + 2\lambda_h\lambda_l + 9\lambda_h^2\lambda_l + \lambda_l^2 - 6\lambda_h\lambda_l^2 + \lambda_l^3}}{4\lambda_h} \end{aligned}$$

We also note that the terms in the square root are strictly positive and the above expression is positive (as at $\rho = 0$, the LHS of (9) < 0). Thus,

$$\bar{\rho}\left(\lambda_h\right) = \min\left\{\frac{3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2 - \sqrt{1+\lambda_l}\sqrt{\lambda_h^2 + 2\lambda_h\lambda_l + 9\lambda_h^2\lambda_l + \lambda_l^2 - 6\lambda_h\lambda_l^2 + \lambda_l^3}}{4\lambda_h}, 1/2\right\}.$$

We now establish this costless signaling equilibrium as the unique quilibrium that satisfies the Intuitive Criterion. To see this, suppose there exists another equilibrium in which type h selects a different disclosure policy where $\bar{\delta} \neq 1$. Then by the above analysis, if type h deviates to $\left\{h, \bar{\delta}_h = 1\right\}$, the Intuitive Criterion require the agents to believe such a deviation must be made by type h with probability 1. Thus, by Proposition 1(c) and Lemma 2, type h strictly benefits from deviating to $\left\{h, \bar{\delta}_h = 1\right\}$, a contradiction. Finally, that $\bar{\rho}$ is weakly increasing in λ_h can be easily established by noting $\frac{3\lambda_h - \lambda_l + 3\lambda_h\lambda_l - \lambda_l^2 - \sqrt{1+\lambda_l}\sqrt{\lambda_h^2 + 2\lambda_h\lambda_l + 9\lambda_h^2\lambda_l + \lambda_l^2 - 6\lambda_h\lambda_l^2 + \lambda_l^3}}{4\lambda_h}$ is strictly increasing in λ_h. Q.E.D.

Proof of Lemma 3

- Lemma 3(a): we use $=_s$to represent "equal in sign":

$$\begin{aligned}
\frac{d}{d\lambda_\tau}\left[-\frac{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}\right] &=_s \frac{d}{d\lambda_\tau}\left[\frac{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}\right] \\
&= \frac{d}{d\lambda_\tau}\left\{\frac{\frac{\partial w}{\partial\bar{\delta}}}{\frac{\partial w}{\partial\hat{q}}}+\frac{\lambda_\tau-\lambda_\tau\left(1-w\right)^2+\left(4\rho\bar{\delta}-1\right)w^2}{2\left[\left(2\rho\bar{\delta}-1\right)w+\lambda_\tau(1-w)\right]\frac{\partial w}{\partial q}}\right\} \\
&=_s \left[1-(1-w)^2\right]\left[\left(2\rho\bar{\delta}-1\right)w+\lambda_\tau(1-w)\right] \\
&\quad -(1-w)\left[\lambda_\tau-\lambda_\tau\left(1-w\right)^2+\left(4\rho\bar{\delta}-1\right)w^2\right] \\
&=_s 2\rho\bar{\delta}w-1<0.
\end{aligned}$$

- Lemma 3(b): Since $\left(\hat{q}_1,\bar{\delta}_1\right)$ and $\left(\hat{q}_2,\bar{\delta}_2\right)$ are on type l's indifference curve, we can define $\bar{\delta}\left(\hat{q}\right)$ as a implicit function of $\hat{q}$ as we move from $\left(\hat{q}_1,\bar{\delta}_1\right)$ to $\left(\hat{q}_2,\bar{\delta}_2\right)$ along type l's indifference curve, with $\frac{d\bar{\delta}(\hat{q})}{d\hat{q}}=-\frac{\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}$. Thus, for the type h firm,

$$\begin{aligned}
& EAU_h\left(\hat{q}_2,\bar{\delta}_2\right)-EAU_h\left(\hat{q}_1,\bar{\delta}_1\right) \\
= & \int_{\hat{q}_1}^{\hat{q}_2}\frac{dEAU_h\left(\hat{q},\bar{\delta}\right)}{d\hat{q}}d\hat{q}=\int_{\hat{q}_1}^{\hat{q}_2}\left[\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}+\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}\frac{d\bar{\delta}\left(\hat{q}\right)}{d\hat{q}}\right]d\hat{q} \\
= & \int_{\hat{q}_1}^{\hat{q}_2}\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}\left[\frac{\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}+\frac{d\bar{\delta}\left(\hat{q}\right)}{d\hat{q}}\right]d\hat{q} \\
= & \int_{\hat{q}_1}^{\hat{q}_2}\frac{\partial EAU_h\left(\hat{q},\bar{\delta}|v\right)}{\partial\bar{\delta}}\left[\frac{\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}-\frac{\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}\right]d\hat{q}>0.
\end{aligned}$$

The last inequality obtains because $\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}>0$ from Proposition 1(c) and $\frac{d}{d\lambda_\tau}\left[-\frac{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}\right]<0$ from Lemma 3(a).■

A key component in proving Proposition 3 is to characterize the shape of the firm's indifference curve in the $\hat{q}-\bar{\delta}$ space. To streamline the presentation of the results, we first establish a set of lemmas that shows the indifference curve is monotonic only when λ_h and

λ_l are not too far apart. When the indifference curve is non-monotone, multiple equilibria exist that survive the Intuitive Criterion.

Lemma A2 *Define* $\dot{\lambda}$ *as*

$$\frac{\dot{\lambda}}{1+\dot{\lambda}} = \frac{\hat{q}\lambda_h}{1+\lambda_h} + \frac{(1-\hat{q})\,\lambda_l}{1+\lambda_l}.$$

$\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial \hat{q}} > 0$ *if and only* $\frac{\lambda_l}{\dot{\lambda}} > \frac{1-2\rho\bar{\delta}}{1-\rho\bar{\delta}}$*; and* $\frac{\partial EAU_h\left(\hat{q},\bar{\delta}\right)}{\partial \hat{q}} > 0$.

Proof of Lemma A2

- Since $\hat{q}$ influences $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ only through the term $\frac{\hat{q}\lambda_h}{1+\lambda_h} + \frac{(1-\hat{q})\lambda_l}{1+\lambda_l}$, by a change of variable from $\hat{q}$ to $\dot{\lambda}$, we can rewrite $EAU_\tau\left(\hat{q},\bar{\delta}\right)$ as

$$EAU_\tau\left(\dot{\lambda},\bar{\delta}\right) = \frac{v^2}{2} - \frac{1}{2\beta}\left\{\frac{\bar{\delta}\left(1-2\rho\bar{\delta}\right)w\left(\dot{\lambda}\right)^2}{\lambda_\tau} + \bar{\delta}\left[1-w\left(\dot{\lambda}\right)\right]^2 + 1 - \bar{\delta}\right\},$$

where

$$w\left(\dot{\lambda}\right) = \frac{\frac{\dot{\lambda}}{1+\dot{\lambda}}}{1-\rho\bar{\delta}\left(1-\frac{\dot{\lambda}}{1+\dot{\lambda}}\right)} = \frac{\dot{\lambda}}{1+\dot{\lambda}-\rho\bar{\delta}}.$$

Intuitively, this change of variable implies that the firm's expected payoff is the same whether agents believe it is type h with probability $\hat{q}$ or agents believe it has a relative precision of $\dot{\lambda}$. As such, like $\hat{q}$, $\dot{\lambda}$ can also be equivalently viewed as the firm's influence over the agents.

- By the Chain Rule,

$$\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial \hat{q}} = \frac{\partial EAU_\tau\left(\dot{\lambda},\bar{\delta}\right)}{\partial \dot{\lambda}}\frac{\partial \dot{\lambda}}{\partial \hat{q}}.$$

By the definition of $\dot{\lambda}$, $\dot{\lambda}$ monotonically increases with $\hat{q}$, i.e., $\frac{\partial \dot{\lambda}}{\partial \hat{q}} > 0$. Thus, $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial \hat{q}}$ has the same sign as $\frac{\partial EAU_\tau\left(\dot{\lambda},\bar{\delta}\right)}{\partial \dot{\lambda}}$.

- Note that $EAU_l\left(\dot{\lambda},\bar{\delta}\right)$ is a quadratic function in w, agents' weight on the public disclosure. Lemma 1 shows that type l's expected payoff achieves its maximum at

$w^* = \frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}}$. Thus, $\frac{\partial EAU_l(\dot{\lambda},\bar{\delta})}{\partial\dot{\lambda}} > 0$ if and only if $\frac{\dot{\lambda}}{1+\dot{\lambda}-\rho\bar{\delta}} < w^* = \frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}}$ which in turn is equivalent to $\frac{\lambda_l}{\dot{\lambda}} \geq \frac{1-2\rho\bar{\delta}}{1-\rho\bar{\delta}}$. Similarly, $\frac{\partial EAU_h(\hat{q},\bar{\delta})}{\partial\hat{q}} > 0$. ■

Lemma A3 *There exists a $\hat{\lambda}$ such that the* type *l's indifference curve that passes influence-publicity combination $(\hat{q},\bar{\delta}) = (0,1)$ is downward sloping if and only if $\lambda_h < \hat{\lambda}$.*

Proof of Lemma A3

- As discussed in the first two bullet points in the proof for Lemma A2, $EAU_l(\hat{q},\bar{\delta})$ can be equivalently expressed in terms of $EAU_l(\dot{\lambda},\bar{\delta})$. In the $\dot{\lambda}-\bar{\delta}$ space with the vertical axis $\dot{\lambda} \in [\lambda_l,\lambda_h]$ and horizontal axis $\bar{\delta} \in [0,1]$, firm type l's indifference curve that passes through $(\dot{\lambda},\bar{\delta}) = (\lambda_l,1)$ can be described by I^l, such that

$$I^l = \left\{ \left(\dot{\lambda},\bar{\delta}\right) | EAU_l(\lambda_l,1) = EAU_l\left(\dot{\lambda},\bar{\delta}\right) \right\}. \tag{A4}$$

- Let the influence-publicity combination $\left(\ddot{\lambda},\bar{\delta}^*\right)$ be the solution to the following equations:

$$EAU_l(\lambda_l,1) = \frac{v^2}{2} - \frac{1}{2\beta}\left[\begin{array}{c} \frac{\bar{\delta}^*\left(1-2\rho\bar{\delta}^*\right)\left(\frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}^*}\right)^2}{\lambda_l} \\ +\bar{\delta}^*\left(1-\frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}^*}\right)^2 + 1 - \bar{\delta}^* \end{array}\right] \tag{A5a}$$

$$\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\bar{\delta}^*} = \frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}^*}. \tag{A5b}$$

Note that $\left(\ddot{\lambda},\bar{\delta}^*\right)$ is unique determined. To see this, note that the right-hand-side (RHS) of $(A5a)$ is type l's expected payoff when it is correctly perceived and agents apply the socially optimal weight $\frac{\lambda_l}{1+\lambda_l-2\rho\bar{\delta}^*}$ (as opposed to the equilibrium weight, $\frac{\lambda_l}{1+\lambda_l-\rho\bar{\delta}^*}$) on the public signal. Thus, by design, the RHS of $(A5a)$ evaluated at $\bar{\delta}^* = 1 > EAU_l(\lambda_l,1)$ and the RHS of $(A5a)$ evaluated at $\bar{\delta} = 0$ is equal to $EAU_l\left(\lambda_l,\bar{\delta}=0\right) < EAU_l(\lambda_l,1)$. Further, it is easy to show that the RHS of $(A5a)$ is increasing in $\bar{\delta}^*$. Therefore, $\bar{\delta}^* \in (0,1)$ and is unique. $(A5b)$ shows that $\ddot{\lambda}$ is also uniquely determined at $\ddot{\lambda} = \frac{1-\rho\bar{\delta}^*}{1-2\rho\bar{\delta}^*}\lambda_l > \lambda_l$ for a given $\bar{\delta}^*$.

- Replacing $\frac{\lambda_l}{1+\lambda_l-2\rho\overline{\delta}^*}$ in $(A5a)$ with $\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\overline{\delta}^*}$, the RHS of $(A5a)$ can be written as $EAU_l\left(\ddot{\lambda},\overline{\delta}^*\right)$: type l's expected utility when it chooses $\overline{\delta}^*$ and agents perceive its influence to be $\ddot{\lambda}$ and apply the corresponding equilibrium weight ($\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\overline{\delta}^*}$). $(A5a)$ implies $EAU_l\left(\ddot{\lambda},\overline{\delta}^*\right) = EAU_l\left(\lambda_l,1\right)$, therefore $\left(\ddot{\lambda},\overline{\delta}^*\right)\in I^l$.

- Consider any influence-publicity combination $\left(\dot{\lambda}',\overline{\delta}'\right)\in I^l$ with $\dot{\lambda}'>\ddot{\lambda}$. We claim that $\overline{\delta}'>\overline{\delta}^*$. To see this, observe that $\left(\dot{\lambda}',\overline{\delta}^*\right)\notin I^l$ as $EAU_l\left(\dot{\lambda}',\overline{\delta}^*\right) < EAU_l\left(\ddot{\lambda},\overline{\delta}^*\right) = EAU_l\left(\lambda_l,1\right)$. This follows because type l's expected payoff is quadratic in w and maximizes at $w^*=\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\overline{\delta}^*}$. However, in equilibrium agents apply a higher weight $w=\frac{\dot{\lambda}'}{1+\dot{\lambda}'-\rho\overline{\delta}^*}>w^*$. Since $EAU_l\left(\dot{\lambda},\overline{\delta}\right)$ is increasing in $\overline{\delta}$ (Proposition 1(c)), in order for $EAU_l\left(\dot{\lambda}',\overline{\delta}'\right)$ to equal $EAU_l\left(\lambda_l,1\right)$, $\overline{\delta}'$ needs to be larger than $\overline{\delta}^*$.

- Next, consider another influence-publicity combination $\left(\dot{\lambda}'',\overline{\delta}''\right)\in I^l$ with $\dot{\lambda}''>\dot{\lambda}'$. We claim that $\overline{\delta}''>\overline{\delta}'$. To see this, first observe that $\left(\dot{\lambda}'',\overline{\delta}'\right)\notin I^l$. This is because

$$\frac{\dot{\lambda}''}{1+\dot{\lambda}''-\rho\overline{\delta}'}>\frac{\dot{\lambda}'}{1+\dot{\lambda}'-\rho\overline{\delta}'}>\frac{\dot{\lambda}'}{1+\dot{\lambda}'-\rho\overline{\delta}^*}>\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\overline{\delta}^*}.$$

  The first and last inequality obtains as $\frac{\dot{\lambda}}{1+\dot{\lambda}-\rho\overline{\delta}}$ is increasing in $\dot{\lambda}$, while the second inequality obtains as $\frac{\dot{\lambda}}{1+\dot{\lambda}-\rho\overline{\delta}}$ is increasing in $\overline{\delta}$ and $\overline{\delta}'>\overline{\delta}^*$. Therefore, $EAU_l\left(\dot{\lambda}'',\overline{\delta}'\right) < EAU_l\left(\dot{\lambda}',\overline{\delta}'\right)$. Since $EAU_l\left(\dot{\lambda}'',\overline{\delta}\right)$ is increasing in $\overline{\delta}$ (by Proposition 1(c)), for $\left(\dot{\lambda}'',\overline{\delta}''\right)$ to be on the indifference curve, $\overline{\delta}''$ needs to be larger than $\overline{\delta}'$. We thus have established that, for any $\dot{\lambda}''$ and $\dot{\lambda}'$ such that $\dot{\lambda}''>\dot{\lambda}'>\ddot{\lambda}$, $\overline{\delta}''>\overline{\delta}'>\overline{\delta}^*$. This implies that type l's indifference curve that passes influence-publicity combination $\left(\lambda_l,1\right)$ is positively sloped at any $\dot{\lambda}>\ddot{\lambda}$.

- We now consider an influence-publicity combination $\left(\dot{\lambda}',\overline{\delta}'\right)\in I^l$ with $\dot{\lambda}'<\ddot{\lambda}$. We claim that $\overline{\delta}'>\overline{\delta}^*$. To see this, observe that $EAU_l\left(\dot{\lambda}',\overline{\delta}^*\right) < EAU_l\left(\ddot{\lambda},\overline{\delta}^*\right) = EAU_l\left(\lambda_l,1\right)$, as

$$\frac{\dot{\lambda}'}{1+\dot{\lambda}'-\rho\overline{\delta}^*}<\frac{\ddot{\lambda}}{1+\ddot{\lambda}-\rho\overline{\delta}^*}.$$

Since $EAU^l\left(\dot{\lambda}',\bar{\delta}\right)$ is increasing in $\bar{\delta}$, for $EAU_l\left(\dot{\lambda}',\bar{\delta}'\right)=EAU_l\left(\ddot{\lambda},\bar{\delta}^*\right)=EAU_l\left(\lambda_l,1\right)$, $\bar{\delta}'$ needs to be larger than $\bar{\delta}^*$.

The proof of Lemma A2 shows $\frac{\partial EAU_\tau}{\partial\dot{\lambda}}$ has the same sign as $\frac{\partial EAU_\tau}{\partial\hat{q}}$. Further, Lemma A2 shows $\frac{\partial EAU_l}{\partial\dot{\lambda}}>0$ if and only if $\frac{\lambda_l}{\dot{\lambda}}>\frac{1-2\rho\bar{\delta}}{1-\rho\bar{\delta}}$. Note that at $\left(\ddot{\lambda},\bar{\delta}^*\right)$, $\frac{\lambda_l}{\ddot{\lambda}}=\frac{1-2\rho\bar{\delta}^*}{1-\rho\bar{\delta}^*}$. Observe that $\frac{\lambda_l}{\dot{\lambda}}$ is strictly decreasing in $\dot{\lambda}$ and $\frac{1-2\rho\bar{\delta}}{1-\rho\bar{\delta}}$ strictly decreasing in $\bar{\delta}$. Hence, we have

$$\frac{\lambda_l}{\dot{\lambda}'}>\frac{\lambda_l}{\ddot{\lambda}}=\frac{1-2\rho\bar{\delta}^*}{1-\rho\bar{\delta}^*}>\frac{1-2\rho\bar{\delta}'}{1-\rho\bar{\delta}'}.$$

Lemma A2 then implies $\frac{\partial EAU_l}{\partial\dot{\lambda}}>0$, $\forall\dot{\lambda}<\ddot{\lambda}$. Further, Proposition 1(c) implies that $\frac{\partial EAU_\tau\left(\dot{\lambda},\bar{\delta}\right)}{\partial\bar{\delta}}>0$. By the Implicit Function Theorem, the slope for P^τ's indifference curve in the $\dot{\lambda}-\bar{\delta}$ space is $-\frac{\frac{\partial EAU_\tau\left(\dot{\lambda},\bar{\delta}\right)}{\partial\bar{\delta}}}{\frac{\partial EAU_\tau\left(\dot{\lambda},\bar{\delta}\right)}{\partial\dot{\lambda}}}$. Thus, the slope of the indifference curve is negative $\forall\dot{\lambda}<\ddot{\lambda}$.

- Lemma A3 is thus immediate by noticing that $\dot{\lambda}$ monotonically increases with $\hat{q}$. And $\hat{\lambda}$ described in the lemma can be then established as the unique value satisfying $\frac{\ddot{\lambda}}{1+\ddot{\lambda}}\equiv\frac{\hat{q}\hat{\lambda}}{1+\hat{\lambda}}+\frac{(1-\hat{q})\lambda_l}{1+\lambda_l}$. ■

Lemma A4 Let I^l be the indifference curve in the $\hat{q}-\bar{\delta}$ space such that

$$I^l=\left\{\left(\hat{q},\bar{\delta}\right)|EAU_l\left(0,1\right)=EAU_l\left(\hat{q},\bar{\delta}\right)\right\}. \tag{A6}$$

When $\lambda_h<\hat{\lambda}$, $\frac{\partial EAU_l\left(\hat{q}',\bar{\delta}'\right)}{\partial\hat{q}'}>0$ for any influence-publicity combination $\left(\hat{q}',\bar{\delta}'\right)$ that lies to the right of I^l (i.e. $\exists\left(\hat{q}',\bar{\delta}''\right)\in I^l$ s.t. $\bar{\delta}''<\bar{\delta}'$).

Proof for Lemma A4

Figure 1 plots I^l for the case of $\lambda_h<\hat{\lambda}$. For any combination $\left(\hat{q}',\bar{\delta}'\right)$ that lies to the right of I^l, consider a unique combination $\left(\hat{q}',\bar{\delta}''\right)$ with the same influence $\hat{q}'$ but lies on I^l with $\bar{\delta}''<\bar{\delta}'$. Since $\left(\hat{q}',\bar{\delta}''\right)\in I^l$ and $\lambda_h<\hat{\lambda}$, by Lemma A3, $\frac{\partial EAU_l\left(\hat{q}',\bar{\delta}''\right)}{\partial\hat{q}}>0$.[24] By the "only

[24]To see this, note $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}>0$ and the slope for type τ's indifference curve in the $\hat{q}-\bar{\delta}$ space is

if" part of Lemma A2, this suggests that $\frac{\lambda_l}{\dot{\lambda}} > \frac{1-2\rho\bar{\delta}''}{1-\rho\bar{\delta}''}$, where $\frac{\dot{\lambda}}{1+\dot{\lambda}} = \frac{\hat{q}'\lambda_h}{1+\lambda_h} + \frac{(1-\hat{q}')\lambda_l}{1+\lambda_l}$. Since $\frac{1-2\rho\bar{\delta}}{1-\rho\bar{\delta}}$ is strictly decreasing in $\bar{\delta}$ and $\bar{\delta}'' < \bar{\delta}'$, we must have $\frac{\lambda_l}{\dot{\lambda}} > \frac{1-2\rho\bar{\delta}''}{1-\rho\bar{\delta}''} > \frac{1-2\rho\bar{\delta}'}{1-\rho\bar{\delta}'}$, which, by the "if" part of Lemma A2, implies that $\frac{\partial EAU_l\left(\hat{q}',\bar{\delta}'\right)}{\partial\hat{q}} > 0$. ■

Proof of Proposition 3

- Lemma A3 implies that when costless signaling is not feasible type l's indifference curve takes only two shapes as depicted in Figure 1 and Figure 2, respectively. Specifically, let $\hat{\lambda}$ be as identified in Lemma A3 such that type l's indifference curve as defined by I^l in $(A6)$ is downward sloping if and only if $\lambda_h < \hat{\lambda}$. Figure 1 plots the I^l curve for $\lambda_h < \hat{\lambda}$ and Figure 2 plots the I^l curve for $\lambda_h > \hat{\lambda}$. First consider the case when $\lambda_h < \hat{\lambda}$.

- Claim: any separating equilibrium must have type l choosing full publicity. Otherwise, it would be strictly better off by deviating to full publicity. This is because $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}} > 0$ for any $\hat{q}$. If such a move leads to an increase in $\hat{q}$ from 0, type l would benefit even more. This is because the downward sloping indifference curve implies that $(\hat{q}, 1)$ is to the right of I^l $\forall\hat{q} > 0$, which in turns implies $\frac{\partial EAU_l(\hat{q},1)}{\partial\hat{q}} > 0$, $\forall\hat{q}$.

- From Figure 1, it is easy to obtain that in any separating equilibrium type h selects a combination $\left(\hat{q} = 1, \bar{\delta} \in \left[\bar{\delta}^{A\prime}, \bar{\delta}^{A}\right] < 1\right)$ (i.e. any point between A and A' on Figure 1) and type l selects $\left(\hat{q} = 0, \bar{\delta} = 1\right)$ (i.e. point B on Figure 1). However, in the next three subpoints, we show that the equilibria with $\bar{\delta} < \bar{\delta}^{A}$ do not survive the Intuitive Criterion as firm type h would have incentive to deviate to $\bar{\delta}^{A}$.

  - Claim: when type l deviates from full to partial publicity at $\bar{\delta}^{A}$, the most favorable influence for it is $\hat{q} = 1$. To see this, note Lemma A3 implies $\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}} > 0$ at $\left(1, \bar{\delta}^{A}\right)$ as $\left(1, \bar{\delta}^{A}\right)$ lies on I^l. By the "only if" part of Lemma A2, it must be $\frac{\lambda_l}{\dot{\lambda}(\hat{q}=1)} > \frac{1-2\rho\bar{\delta}^{A}}{1-\rho\bar{\delta}^{A}}$. Since by definition $\dot{\lambda}$ strictly increases with $\hat{q}$, $\frac{\lambda_l}{\dot{\lambda}(\hat{q}<1)} > \frac{\lambda_l}{\dot{\lambda}(\hat{q}=1)} >$

$-\frac{\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\bar{\delta}}}{\frac{\partial EAU\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}}$, which has the opposite sign to $\frac{\partial EAU_\tau\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}}$. Lemma A3 shows for $\lambda_h < \hat{\lambda}$, I^l is downward sloping. Therefore, $\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial\hat{q}} > 0$, $\forall\left(\hat{q}, \bar{\delta}\right)$ on I^l.

$\frac{1-2\rho\bar{\delta}^A}{1-\rho\bar{\delta}^A}$. Thus by the "if" part of Lemma A2, it must be that $\frac{\partial EAU_l\left(\hat{q},\bar{\delta}\right)}{\partial \hat{q}} > 0$ at $\left(\hat{q},\bar{\delta}^A\right)$ for all $\hat{q} < 1$. This implies that at publicity $\bar{\delta}^A$, the most favorable influence that generates the highest payoff for type l is $\hat{q} = 1$.

- Since $\left(1,\bar{\delta}^A\right)$ lies on type l's the indifference curve of I^l, the previous bullet point implies that in any separating equilibrium type l cannot strictly benefit from deviating to $\bar{\delta}^A$ regardless of what agents' beliefs. By the Intuitive Criterion, agents must believe it is type h who chooses an off-equilibrium publicity $\bar{\delta}^A$.
- Given the above belief, consider any separating equilibrium where type h selects a combination $\left(\hat{q} = 1, \bar{\delta} \in [\bar{\delta}^{A\prime}, \bar{\delta}^A)\right)$. Clearly, it doesn't survive the Intuitive Criterion, as type h would strictly be better off by deviating to $\bar{\delta}^A$ as $\frac{\partial EAU_h\left(1,\bar{\delta}\right)}{\partial \bar{\delta}} > 0$ for any $\bar{\delta}$. This implies that the only remaining separating equilibrium with $\left(\hat{q} = 1, \bar{\delta} = \bar{\delta}^A\right)$ for type h and $\left(\hat{q} = 0, \bar{\delta} = 1\right)$ for type l survives the Intuitive Criterion.

- Next, consider an arbitrary pooling (or partial pooling) equilibrium at an influence-publicity combination $\left(\hat{q}^{pool},\bar{\delta}^{pool}\right)$. Clearly, such a combination must lie on or to the right of I^l. Otherwise, type l would be strictly better off by deviating to full publicity. Further, let $I^{l,pool}$ denote type $l's$ indifference curve that passes through $\left(\hat{q}^{pool},\bar{\delta}^{pool}\right)$. By definition, $I^{l,pool}$ must also lie to the right of I^l. As a result, by Lemma A4, at any point on this indifference curve, we must have $\frac{\partial EAU_l}{\partial \hat{q}} > 0$.
- Let $\left(1,\bar{\delta}'\right)$ be the intersection between $I^{l,pool}$ and $\hat{q} = 1$. Following the same logic as in bullet point #3, the Intuitive Criterion requires that agents believe a firm who chooses an off-equilibrium publicity $\bar{\delta}'$ must be type h for sure, i.e. $\hat{q} = 1$. Under this belief, by Lemma 3(b), type h would strictly benefit from deviating to $\bar{\delta}'$, thus guaranteeing the influence $\hat{q} = 1$ and breaking the pooling equilibrium. Hence, any pooling (or partial pooling) equilibrium does not survive the Intuitive Criterion.
- Next we show that multiple equilibria survive the Intuitive Criterion when $\lambda_h > \hat{\lambda}$. $I^{l\prime}$ in Figure 2 represents type l's indifference curve that passes influence-publicity

combination $\left(\hat{q}, \bar{\delta}\right) = (0, 1)$ when $\lambda_h > \hat{\lambda}$. Consider any separating equilibrium where type l chooses full publicity. The Intuitive Criterion is not able to pin down a unique belief for an off-equilibrium publicity $\bar{\delta}^{A\prime}$ in Figure 2. This is because type l is strictly better off by deviating to $\bar{\delta}^{A\prime}$ if agents believe such a deviation is made by type h with any probability $\hat{q} \in (\hat{q}', 1)$ as the vertical segment $A' - C$ lies to the right of $I^{l\prime}$ (shown in Figure 2). Applying the same logic, the Intuitive Criterion cannot pin down a unique off-equilibrium belief for any publicity between $\bar{\delta}^{A\prime}$ and $\bar{\delta}^{A\prime\prime}$. Consequently, any publicity between $\bar{\delta}^{A\prime}$ and $\bar{\delta}^{A\prime\prime}$ could constitute a separating equilibrium for type h. Particularly, type h selecting a combination $\left(\hat{q} = 1, \bar{\delta} = \bar{\delta}^{A\prime}\right)$ and type l selecting $\left(\hat{q} = 0, \bar{\delta} = 1\right)$ is a separating equilibrium that survives the Intuitive Criterion. Clearly, in this equilibrium, type l is indifferent between selecting full publicity (hence revealing it type) and choosing $\bar{\delta}^{A\prime}$ (hence mimicking type h). From an inspection of Figure 2, it is obvious that this equilibrium has the highest publicity level and thus generates the highest payoff for type h firm among all separting equilibria that survive the Intuitive Criterion.

- The expression for EAU^{DD} is immediate. ■

Proof of Proposition 4 Proved in paragraph that immediately follows the proposition in the text, hence omitted.

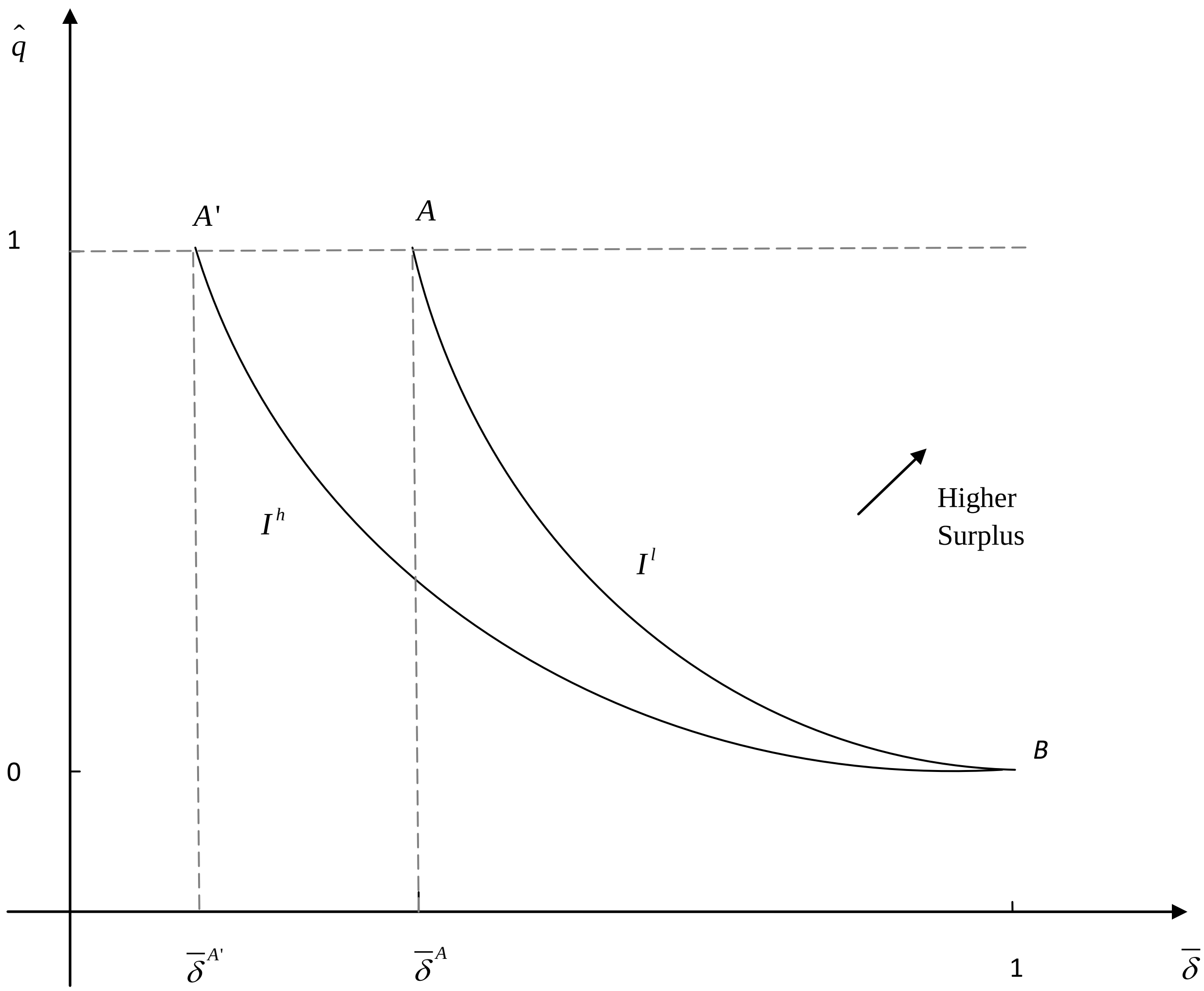

Figure 1

Indifference Curve for High versus Low Type when $\lambda_h \leq \hat{\lambda}$.

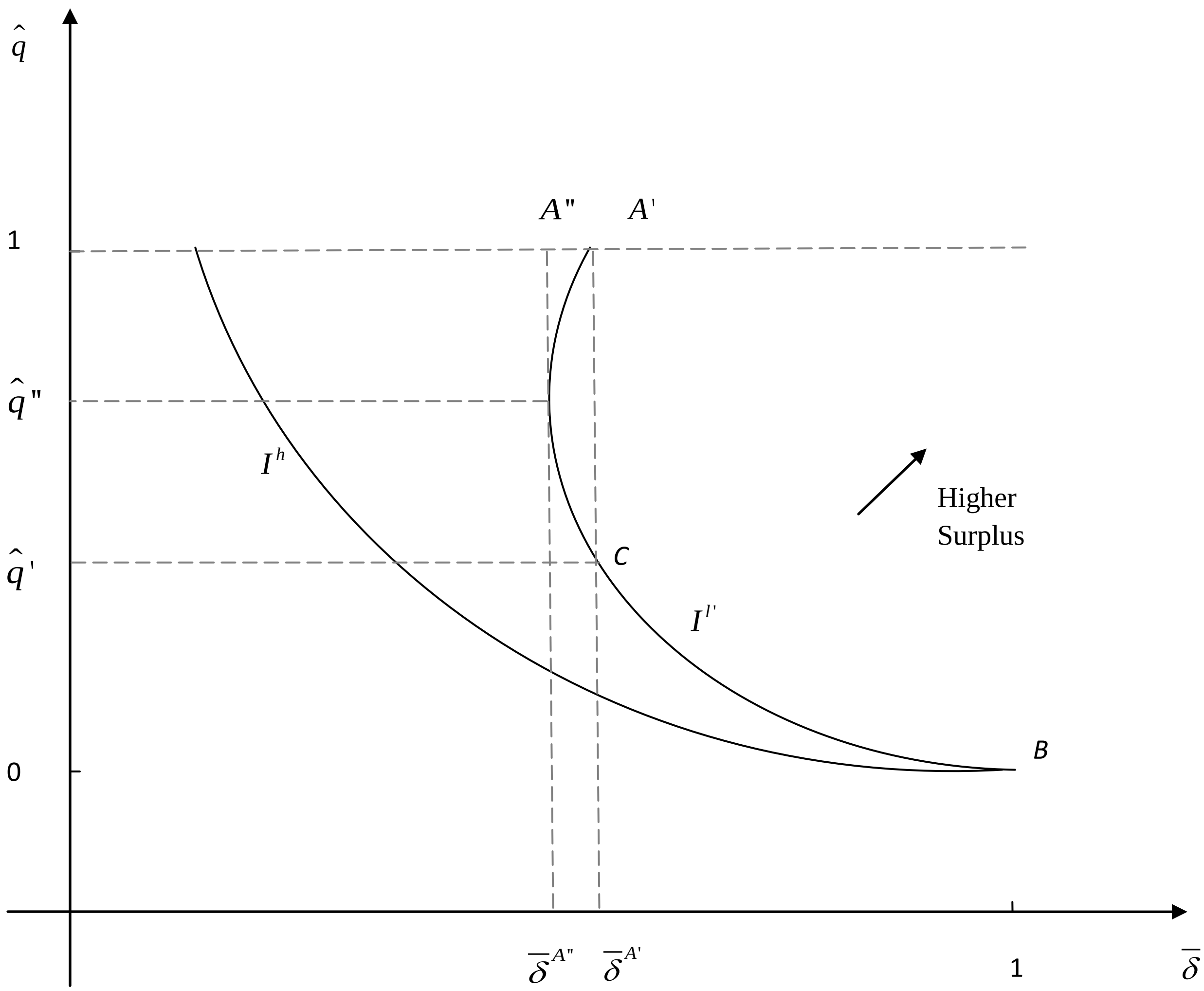

Figure 2

Indifference Curve for High versus Low Type when $\lambda_h > \hat{\lambda}$.

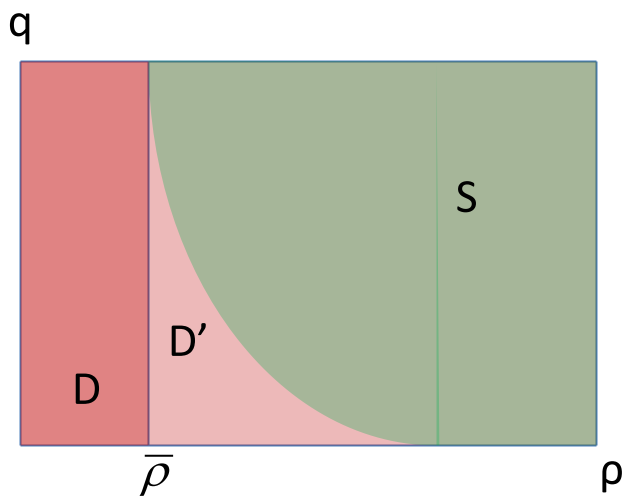

Figure 3a: Small $\Delta\lambda$

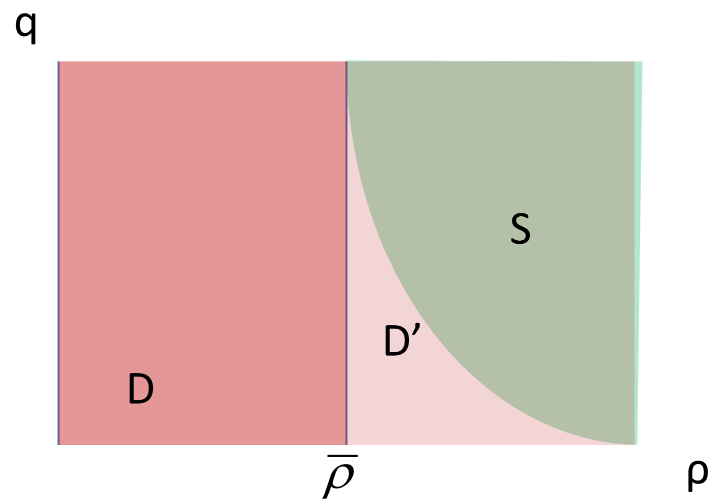

Figure 3b: Large $\Delta\lambda$