Disclosure interactions: accounting policy choice and voluntary disclosure effects on the cost of raising outside capital

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Abstract—In this research we consider how disclosure of accounting policy interacts with subsequent choice over voluntary disclosure of a non-financial performance metric. We compare and contrast regimes. In the first, firms are free to choose between a conservative or an aggressive accounting policy before they decide whether to make additional voluntary disclosures. In the other regime, all firms either voluntarily or via mandation use the same accounting policy. We then investigate the cost of raising capital for firms under the two regimes. We show that communication via voluntary disclosure need not be a simple substitute for communication via accounting policy choice.

1. Introduction

'Increasingly, more sophisticated companies have recognised the shortcomings of the historic financial reporting model as an effective communications tool, and are seeking ways to measure and report on newer and more progressive drivers of value.' PricewaterhouseCoopers, 1999:11

In a financial world in which timely corporate communication is taking place via a host of channels such as analyst meetings, press and internet reports, the above quotation suggests that traditional historic financial reports are of increasingly marginal value. Indeed, in the limit, one may take the extreme position that historic financial reports are simply a legal requirement after the event and that the primary timely means by which investor perceptions can be influenced is via on going voluntary disclosures of financial and non-financial performance metrics. Our research argues that such a view omits at least one very important feature of corporate communication. We show, in a stylised setting, that in equilibrium the choice of historic accounting policy can be used to communicate private information about the firm because the choice interacts with the optimal firm strategy for voluntary disclosure.

To illustrate the importance of such interactive effects, we are able to show formally that the optimal disclosure policy for some firms is simply to disclose choice of a conservative accounting policy. In contrast, other types of firms find it too costly to adopt conservative accounting and instead communicate via voluntary disclosure. Thus, when a firm’s cost of raising outside capital is dependent upon the extent of information that potential investors receive, then ceteris paribus, if the firm increases (credible) voluntary disclosures this will put downward pressure upon the cost of raising capital. This has led to a number of empirical studies testing the link between voluntary disclosure and the costs of raising capital. With such studies in mind, it is important to note that the above potential benefit of making voluntary disclosures does not necessarily imply that investors will reward firms that make the most voluntary disclosures with the lowest costs for raising capital. This may arise empirically because the ceteris paribus condition that we assumed above does not hold. That is, firms may simultaneously choose to communicate in other ways. Specifically, given interaction between the two communication channels, accounting policy choice and voluntary disclosures, one cannot conclude that firms which make more voluntary disclosures will face a lower cost.

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The final version of this paper was accepted in February 2003.

We will make precise what this cost is shortly. For the moment this cost can be interpreted as being dependent upon the extent to which investors have credible information concerning the prospects of the firm. The less information provided to potential investors, the higher the cost.
of raising outside capital than firms that disclose less. Indeed, we show in our paper how an equilibrium can exist in which the firms that make the least voluntary disclosures face the lowest cost of raising capital. This arises because in some well defined settings, potential investors rationally form an expectation that those firms that choose a conservative accounting policy and simultaneously decide not make voluntary disclosures are more likely to be successful, than firms which adopt an aggressive accounting policy and simultaneously make voluntary disclosures. Thus, the main theme of this paper will be to model the interactions between the two communication channels and how these give rise to firms adopting different communication strategies.

To understand intuitively the richness of the empirical setting we model, we note that given two communication channels, one's first impression may be to believe that if one channel is restricted (for instance by voluntary choice or via mandation of accounting policy), the optimal response may be simply to increase communication via the other channel (voluntary disclosure). For those who take the view that more voluntary disclosure should be promoted, such a result (if it were true) would be desirable. Expressed informally, the above logic could be used to support an argument that ‘who cares about accounting choice’ since firms will simply adjust voluntary disclosures to keep the market informed, with the two channels of communication being viewed as substitutes. However, we show that even where restricting accounting policy leads unequivocally to an increase in voluntary disclosures, all firms may be worse off because investors (rationally responding to available information) set a higher cost of capital for all firms. That is, where substitution is feasible it may be excessively costly; in which case accounting policy choice does matter.

The underlying rationale for our above derived results is that some freedom to choose accounting policies may provide firms with an effective means to communicate privately held information about their expected prospects to investors. This is an often overlooked informational perspective by those arguing for uniformity in accounting policy choice. The importance of this specific form of (soft) privately held information differentiates our approach from the complete contracts literature because we assume that it is not possible to write a contract on a perception or a view of the future, since this is soft information which is non-verifiable. While agreeing that there are many sources of hard information revelation that can be effectively analysed within a complete contracting setting, we take the view that indirect hard information which further helps an investor refine her view on what soft information management actually holds, is also of significant importance to the investment community. Hence, in part we consider how an accounting system (producing hard information) can be used to signal the privately held perceptions (soft information) of management.

Summarising the above argument more formally, in our model the case that accounting policy choice influences voluntary disclosure will be dependent upon a complex mix of firm and environmental factors. The central contribution of this research is to make precise a formal setting in which accounting policy choice has significant signalling value and, moreover, where the signalling value dominates the value of increased voluntary disclosure when accounting policies are chosen or mandated to be uniform. The key to this result is to capture the interaction between the signalling effect of a conservative accounting policy on the cost of raising capital from investors relative to the (voluntary) disclosure effect on the cost of raising capital. Note that since both signalling and disclosure give rise to costs, for a wide range of settings firms may decide to use only one of these methods to influence the cost of raising capital. This illustrates clearly the fundamental paradigm in which we wish to appraise the comparative efficacy of an accounting system. We suggest it is only when one recognises and allows for communication with investors by other independent means, that we can address fundamental questions concerning the value of accounting. Too often accounting research has been based upon the premise that accounting numbers are the only information upon which to communicate or contract. We believe that at this time when the fundamental accounting model is increasingly being called into question, an alternative approach in which we allow for competing information sources is necessary.

The paper is organised as follows. In the next subsection we review the existing literature on voluntary disclosure and signalling through accounting policy choice. In Section 2 we will present our optimal financial reporting model in which firms are free to choose between two accounting policies and whether or not to make a voluntary disclosure. We conclude the section by characterising various candidate equilibria. In Section 3 we analyse one of these equilibria in detail. The equilibrium is called the interaction equilibrium because firms vary their voluntary disclosure strategy depending upon which accounting policy they adopt. In Section 4 we consider equilibria in which firms choose either voluntarily or are forced via regulation to adopt the same accounting policy. We then compare the firms’ cost of capital under these uniform accounting policy regimes to the case were firms differ in their choice of accounting policy.
The comparative results are presented formally in Section 5 and help us to understand why freedom to choose accounting policy has information value that can not simply be replicated via additional voluntary disclosure. We briefly discuss the implications of our research for empirical work in Section 6 and present concluding comments in Section 7.

2. Related literature

Commencing from the well known full disclosure result of, for example, Milgrom (1981), various authors have provided different theoretical explanations for why only partial disclosure may result, where for instance only favourable information is disclosed and unfavourable information is not. Various causal factors for only partial disclosure include cost of disclosure (Verrecchia, 1983); random information (Dye, 1985; Dye and Shridar, 1995; Jung and Kwon, 1988 and Verrecchia, 1990); competitive reaction in the product market (Wagenhofer, 1990); litigation risk (Hughes and Sankar, 1998); different degrees of investor sophistication (Fishman and Hagerty, 1997; Dye, 1998); prices playing a dual disclosure and efficiency role (Rajan and Sarath, 1996). All these papers deal with the voluntary decision to credibly and directly disclose (or not disclose) information about the liquidating dividend of the firm. In addition, the choice of an accounting policy is either not directly considered or it is embedded in the disclosure decision in that the disclosure decision is effectively one that establishes the precision of an accounting report. In part motivated by our opening quotation, we consider accounting reports and credible voluntary disclosures as two distinct, but interrelated means of communicating information about the liquidating value of the firm.

Another stream of research has focused specifically upon the issues we highlighted in the initial introduction, that of whether accounting information has lost relevance as a source of information for potential investors, because it is neither timely nor sufficiently accurate. Gigler and Hemmer, (1998, 2001) and Lundholm (1999), show that the criticism of traditional accounting based upon a so called lack of timeliness is questionable. They establish that subsequent accounting reports have a confirmatory role in relation to earlier voluntary disclosures. We adopt a complementary approach in which the choice by a firm of an accounting policy can signal a crucial piece of value relevant information concerning the firm’s expected prospects which can not be credibly revealed ex ante and can not be verified ex-post. Thus, what differentiates our research from the existing literature is that we start by assuming that when firms are considering which accounting policy to adopt, they should do so with a recognition that accounting policy choice and credible voluntary disclosures are competing sources of information that can help investors in forming beliefs about the original value relevant information.

We shall now briefly review the signalling theory literature as it relates to our work. Following Leland and Pyle (1977), Bhattacharaya (1979), Ross (1979), Myers and Majluf (1984) in the finance literature, it is well established that when direct revelation is not possible, firms may use corporate financial decisions such as dividend and capital structure policy to signal there type. In turn, several researchers have argued that a firm’s choice of accounting policy can also act as an effective signalling instrument. Commencing with the work of Holthausen (1981). Leftwich (1981) and Holthausen and Leftwich (1983) and most recently by Hand and Skantz (1998), researchers have produced empirical support for the hypothesis that firms discretionary accounting choices are made in part to signal firm type. In addition, Hughes and Schwartz (1988) and Frantz (1997) have modelled these issues within a formal equilibrium setting. We extend this literature by adding a disclosure stage to the basic signalling model, so firms have a choice between signalling and disclosure. This differentiates our model from the Dye and Verrecchia (1995) and Gigler and Hemmer (1998) class of models, which takes a moral hazard setting and adds a disclosure stage. In those models there is no interaction between accounting policy choice and voluntary disclosure, because either accounting policy is exogenously determined (Gigler and Hemmer, 1998); or there is no disclosure over and above accounting policy choice (Dye and Verrecchia, 1995); or the level of disclosure is the precision of the accounting report (Baiman and Verrecchia, 1996; Stocken and Verrecchia, 1999). In contrast, in our model accounting policy choice and disclosure are separate communication activities. Hence to summarise,

2 For an extended discussion of this point see, for instance, Lev (1997).
3 Because it is not credible for instance, see Healy and Palepu (1995).
4 For an overview of this research, see Ball and Smith (1992).
5 Since our focus is primarily to model how investors react to the competing role of the two sources of information (signalling versus disclosure) we abstract away internal firm incentive issues that can arise when disclosed information becomes contractible. That is, we assume that internal agents are rewarded on the basis of accounting profit and additionally disclosed information does not enter the compensation function of the agent in our production model. In this version of the model we are assuming that the productive agent’s effort does not affect the firm’s type nor the realisation of the piece of information object of the disclosure decision. Clearly, linking the two models is an important topic for future research and at present we assume that knowledge generation (strategic prospects) within the firm are directly managed by the original owner of the firm.
we study a simpler organisational structure in a richer financial communication model.

One of the central objectives of disclosure research is to develop an understanding of how by varying disclosure, a firm can influence the cost of capital that it faces in the market place. Easley and O'Hara (2001) make the point that in their view, paradoxically, traditional asset pricing models do not include disclosure levels as determining the required return for a company's stock and hence those models do not provide a theoretical link between disclosure levels and the cost of capital. They review some alternative models such as Diamond and Verrechia (1991) in which differing levels of disclosure affects the markets willingness to provide liquidity for a stock. However, rather than be driven by dealer liquidity concerns, Easley and O'Hara introduce a two-period rational expectations model in which there are informed and uninformed traders and both public and private information. They show how the standard separation theorem that typically characterises asset-pricing models does not hold since the two classes of investors perceive different risks and returns, and thus hold different portfolios. They then show how in equilibrium the quantity and quality of information affects asset prices, resulting in cross-sectional differences in firms required returns. Botosan (1997) provides empirical support for this hypothesis and Botosan and Plumlee (2001) go one step further by empirically estimating firm's cost of capital.

In this later paper the model specification is derived from reformulations of the classic dividend discount model. Based upon the above work a fully descriptive model of cost of capital determination requires asymmetry of access to information by at least two classes of investors and multiple periods of dividend distribution. However, a limitation of the Easley and O'Hara approach is that there is no strategic model of how firms determine what information to communicate to investors. We attempt to address this issue directly by assuming that firms choose their disclosure policy in a strategic fashion, balancing the gains from increased disclosure which lead to increased investor confidence against the undesirable proprietary cost of providing competitors with better information. Thus, we introduce a more complex information generation process to capture these strategic linkages. However, given this greater complexity we find it necessary to make a simplifying assumption elsewhere. In particular we model the investment fund raising problem as a one-shot problem. That is, the model we introduce is more akin to a venture capital funding situation in which the owner sells a share of the business to raise capital. We adopt this approach since if we allowed for multi-period dividend streams this would also necessitate solving a multi-period strategic disclosure problem. In principle such an extension is possible; but at this stage we first clarify the single period strategic problem. We follow Verrechia (1999) in describing this as a cost of raising capital problem on the clear understanding that this is more akin to a cost of venture capital problem. Clearly, an important topic for subsequent research will be to extend the analysis to multi-periods so that the model can be mapped into the more general cost of capital setting in which firms are distributing dividends through time.

3. The model

In this section we analyse how firms choose an equilibrium accounting policy and voluntary disclosure strategy. Each of these two channels of communication could be used by investors to revise their expectations about a firm's prospects. However, if there are costs associated with transmitting information via each channel, firms may decide to use only one method if the benefits of communication via an additional channel are outweighed by the costs. For instance, if adoption of a conservative accounting policy is not too costly and is a clear signal of a firm's enhanced prospects, firms may adopt conservative accounting and save the costs associated with voluntary disclosures. On the other hand, adoption of aggressive accounting policies may look suspicious to investors and induce more voluntary disclosure by firms wanting to assure the market of good prospects. Our model is designed to capture these sorts of interactions between these two means of corporate communication.

Let us now consider how to formally model these issues. The first issue we need to address is why choosing a particular accounting policy may have signalling value, in particular we need to establish why all firms do not simply pool on a accounting policy choice. Broadly speaking, there are two main classes of model that establish why this may not happen. The first class of formal models, which we shall call the incentive income smoothing class typified by Wagenhofer (1999), establishes that if firms are forced to fully expense all expenditure on durable items such as fixed assets (under a conservative accounting policy), this restricts the firm's ability to optimally manage inter-temporal incentives. That is, adopting a conservative accounting policy imposes an incremental cost upon firms, which we shall denote as $AV$ since they can not induce the same agent behaviour that is possible with (income smoothing) aggressive accounting. The second class of models,  

\[\text{See also Fudenberg and Tirole (1995).}\]
which we shall call the firm continuance class of models typified by Hughes and Schwartz (1988) and Franz (1997), establish that if firms adopt conservative accounting policies this increases the probability of violating binding constraints such as debt covenants. Following Holthausen (1981), we note that firms may change depreciation policies in order to relax binding accounting-based constraints found in bond indentures. Binding covenants can be costly to a firm, since they constrain behaviour and or increase the cost of repayment or renegotiation of debt. To capture this cost under a conservative accounting policy we shall denote the expected cost of a binding bond covenant using the generic cost term $AV$ again.

It is important to note that whereas we commence by assuming that the non-pooling conditions in the above models are satisfied (so that signalling can take place), we do not conclude that firms necessarily subsequently do choose to signal. This arises because we allow the other channel of communication (voluntary disclosures). Thus, firms that in the pure signalling model of Franz (1997) separate on accounting policy, may not separate within our framework, since they will first consider whether increased voluntary disclosure would be more (cost) effective than adopting a conservative accounting policy. That is our signalling – disclosure communication space is far richer than the simple signalling space assumed in the above firm continuance models.

The importance of this adoption cost $\Delta V$, associated with conservative accounting in each setting is that if it is sufficiently large, firms will not pool on choice of accounting policy because only firms with good prospects can afford to incur the (signalling) cost. That is adoption of conservative accounting can act as an effective signalling instrument, if only those firms that believe they will be successful in the future are prepared to incur the cost. Holthausen (1981:101) has argued: ‘One hypothesis consistent with the observed results is that firms switch depreciation methods because the covenants of bond indenture agreements are expected to become binding. This change in turn, conveys information to the market concerning managers’ expectations of future investment opportunities and earnings.’

Thus let us now formalise how (market) expectations are determined. We shall assume that the probability of the firm being successful in the market place, which we shall call its type, is known by the principal but not the investor. Specifically, the type variable relates to the value of the business, in that, if the principal is successful in a business venture:

$$J = \text{value of business opportunity},$$

and the principal believes that:

$$q = \text{ex-ante probability of success in } J.$$

That is, the firm’s type is the value of $q$ known to the principal of the firm but not known by investors. Since perceptions are a form of soft information they are non-verifiable and complete contracts cannot be written to insure truthful revelation. Instead, the focus of our research will be to see how risk neutral investors can use various sources of hard information such as choice of accounting policy and voluntary disclosure of a test result to refine their inferences concerning $q$. To simplify our subsequent discussion we will perform our analysis assuming that $q$ is uniformly distributed on $[0, 1]$.

Next, we formalise the costliness of adopting a conservative accounting policy, for instance interpreted here as consistent with Holthausen’s distinction between accelerated and straight-line depreciation. We assume that the expected period payoff to the firm (independent of the realisation of $J$) is $V$ assuming straight line depreciation is adopted, which we shall describe as the aggressive accounting policy. Alternatively, if the firm adopts accelerated depreciation the expected period payoff is:

$$V(\text{con}) = V - \Delta V,$$

that is, the expected bond indenture cost is incurred when the accelerated method ($\delta = \text{con}$) is adopted, which we shall describe as the conservative accounting policy.

In addition to the information held by the firm on type, a test is conducted during the first period, which provides additional information on the underlying probability of success as illustrated by the following time order diagram.

The simplest interpretation for this test is that it is a firm performance statistic such as a test by an independent agency or quarterly sales or new customer accounts, which are not subject to mandatory disclosure regulation. To be more precise, we assume that the dichotomous test either produces

\footnotesize{\textsuperscript{7}For a formal derivation of this cost within a bond indenture setting see Franz (1997). For a review of empirical support see Ball and Smith (1992).}  
\footnotesize{\textsuperscript{8}We formally make precise what we mean by ‘good prospects’ after introducing all the notation.}  
\footnotesize{\textsuperscript{9}The analysis could be extended to allow the test result to be a continuous variable, however, this considerably complicated the analysis without changing the results significantly. Another alternative extension suggested to us by one of the anonymous referees would be to allow firms the choice of whether to conduct the test or not. If the test result was monthly sales volume such a choice does not seem to be institutionally relevant. However, in contrast if the test was the assurance services of an auditor over some non-financial performance metric, investors would condition their beliefs upon whether the firm employed the auditor or not and the result of the test. Another interesting area for future research concerns which firms would benefit most from exercising such a presumably expensive choice.}
the result $G$ (good) or $B$ (bad) for a project that may either be successful earning $J > 0$ or not successful and earning $J = 0$. The test is used to make inferences concerning the success of the project with:

$$m = \Pr(G \mid J > 0) = \Pr(B \mid J = 0),$$
denoting the reliability of the test, i.e., $m$ is the probability of the test reporting good (bad) when the project is successful (unsuccessful).

Given a prior $q$, if the principal (firm owner) receives $G$ news Bayesian updating by the principal gives:

$$\Pr(J > 0 \mid G) = \frac{mq}{mq + (1-m)(1-q)} = s(q),$$
that is, $s(q)$ is the probability of success given the good test result and

$$\Pr(J = 0 \mid G) = 1 - s(q),$$
is the probability of failure given the good test result. Analogously we have:

$$\Pr(J > 0 \mid B) = \frac{(1-m)q}{(1-m)q + m(1-q)} = u(q),$$
with being the probability of success when a bad test result occurs and

$$\Pr(J = 0 \mid B) = 1 - u(q).$$

We shall also assume that firms need not always communicate the result of such tests to investors because there is a fixed cost associated with disclosure\footnote{The nature of this cost may arise from competitors being able to refocus their business strategy given a disclosure. Our model could subsequently be extended by specifying how strategic interaction between the firms endogenously drives the determination of disclosure costs (Wagenhofer, 1990). In addition, an alternative version of the model with a non-linear cost of disclosure varying in type value is available from the authors. The qualitative results are similar to the results reported here.} denoted $C$. We assume that these costs arise because competitors benefit from disclosure for instance because it encourages them to mimic successful products.

We will use the following notation to model the equilibrium strategies of the firms defined over:

(i) Choice of accounting policy $\delta \in \{agg,con\}$ where $\delta = agg$ indicates the adoption of an aggressive policy and $\delta = con$ a conservative policy.

(ii) Choice of disclosure policy $\eta \in \{G,B,N\}$ where $N$ is no disclosure and as above $G$ is disclosure of a good test result and $B$ is disclosure of a bad test result.

Given we will show that the disclosure of $B$ (bad news) can never be optimal in our model (at most it is equivalent to no disclosure $N$) we focus on the following four strategies:

$$\Theta = \{(agg,G); (agg,N), (con,G), (con,N)\}$$

The next critical element of our model is to link the firm's choice of disclosure strategy to some measure of the market cost of raising capital that becomes conditioned upon disclosure in a meaningful way. We follow Verrechia (1999) in that capital is raised through some sort of venture capital channel rather than directly through the stock market. We assume the firms need to raise $K$ capital to continue operations and they do this by asking risk neutral investors to buy a share of the firm.\footnote{We are considering the simplest case where the firm is not yet publicly traded. In addition, by direct implication the larger the share that has to be given to investors, the higher the effective cost of capital to the firm.}  

**Remark:** In our model we describe a firm as having a higher cost of raising capital when the entrepreneur has to give up a larger share of the business $\alpha$, to venture capitalists providing funding of $K$. Thus a higher cost of raising capital is synonymous with a larger value for, and hence a lower residual ownership share by, the entrepreneur.

The venture capitalists/investors provide $K$ after determining the required share according to the realised value of $\Theta$ that is after the firm's choice...
of accounting policy and the test disclosure strategy. This means that the share $\alpha$ of the firm that, in equilibrium, must be sold to raise $K$ has to assume one of the following four values:

\[
\alpha = \{ \alpha_{aggG}, \alpha_{aggN}, \alpha_{conG}, \alpha_{conN} \}
\]

with the test result conditioned payoff of the firm being:

\[
\pi(\delta, \eta | G) = (1 - \alpha_{agg})[V - I_1(\delta)AV + s(q)J - I_2(\eta)C],
\]

or

\[
\pi(\delta, \eta | B) = (1 - \alpha_{agg})[V - I_1(\delta)AV + u(q)J - I_2(\eta)C],
\]

where $I_1$ and $I_2$ are the following indicator functions

\[
I_1(\delta) = \begin{cases} 
1 & \text{if } \delta = \text{con} \\
0 & \text{if } \delta = \text{agg} 
\end{cases}
\]

\[
I_2(\eta) = \begin{cases} 
1 & \text{if } \eta = G \\
0 & \text{if } \eta = N .
\end{cases}
\]

This share $\alpha$ will be our metric in comparing the possible equilibria of the model. Given the inverse relationship existing between firm valuation and $\alpha$, we will call $\alpha$ the 'cost of raising outside capital', interpreting the increased share of firm ownership to be sold to outside investors as the 'cost' of raising capital $K$. As discussed earlier, we alert the reader to the fact that in our one shot setting it is best interpreted as the cost of venture capital. For it to apply more generally, development of a multi-period version of the model with dividend distributing firms is required.

This will introduce additional complexity since we need to model signalling possibilities with strategic dynamic issuance of dividends, and so concentrate first upon establishing new results within our one-shot venture capital setting. To summarise, within our setting $\alpha$ is a convenient measure of the opportunity cost of venture capital, since it formally considers the diminished final payoff that a firm receives when raising capital $K$ units of venture capital.

Let us now turn to our original question and present a taxonomy of the simplest set of equilibria which formalise the form of interaction (or non-interaction) that can take place between accounting policy choice and voluntary disclosure.

We organise the rest of our study as follows. Our principle concern is in studying how choice of an accounting policy can affect (interact with) the voluntary disclosure strategy of a firm and whether such voluntary disclosure can be used as a substitute for accounting policy choice. In the above taxonomy, the three equilibria in which separation in accounting policy choice is freely chosen by firms are the interaction, no interaction I and no interaction II equilibria. We note that in both no interaction equilibria the choice whether or not to make a voluntary disclosure does not depend upon the accounting policy chosen. Hence, we exclude the two no interaction equilibria from further analysis and our principle focus becomes first establishing the existence of the interaction equilibrium. Then the idea is that starting with this equilibrium we analyse the effect of a uniform choice of accounting policy on disclosure strategy, either arising voluntarily as in the pure disclosure equilibrium or via fiat in the regulation equilibrium.

At this point, we note that one of the properties of the interaction equilibrium is that there need not exist a simple inverse relationship between voluntary disclosure and the cost of raising capital. That is, having established existence of the interaction equilibrium we can explain why firms that make no voluntary disclosures could have the lowest cost of raising capital. Intuitively this arises because accounting policy may be a more effective means by which to signal type than through voluntary disclosure.

### 4. The interaction equilibrium

In this equilibrium, high type firms separate from lower types by adopting conservative accounting policies (a first separation) and moreover choose

<table>
<thead>
<tr>
<th>Accounting policy</th>
<th>Disclosure</th>
<th>Equilibrium</th>
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<tbody>
<tr>
<td>Pool on aggressive</td>
<td>All disclose $G$ news</td>
<td>Pure disclosure</td>
</tr>
<tr>
<td>Pool on conservative</td>
<td>All disclose $G$ news</td>
<td>Regulated</td>
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<tr>
<td>Separate</td>
<td>Disclose if adopt one a. policy</td>
<td>Interaction</td>
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<td>Separate</td>
<td>Not disclose otherwise</td>
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<td>Separate</td>
<td>All disclose $G$ news</td>
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<td>Separate</td>
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12 It is common in standard game-theoretic settings, for multiple equilibria to exist. A topic of interest for future research concerns how (disclosure) game players coordinate their strategies so they arrive at one particular equilibrium or alternatively how they may choose to move from one equilibrium to another.
not to disclose the test result unlike the lower type firms which always disclose good test results (a second separation). That is, a firm's disclosure strategy depends upon choice of accounting policy. The intuition for the existence of this equilibrium is as follows. If accounting policy choice is an effective signalling device to investors, then firms that manage to signal their superior type need not necessarily also incur disclosure cost in order to further influence investors' beliefs about their type. We proceed with our analysis recursively by commencing from the final strategic choice of the firm.

4.1 Choice whether to disclose the test result

Given the prior choice of an accounting policy, at the disclosure stage a conservative firm (i.e. \( \delta = \text{con} \)) with good news \( G \) will not disclose the result of the test if the payoff from non disclosure dominates that from disclosure, that is if:

\[
(1 - \alpha^{\text{con}})(V - \Delta V + s(q)J) - C \leq (1 - \alpha^{\text{agg}})(V - \Delta V + s(q)J)
\]

or equivalently if:

\[
(\alpha^{\text{con}} - \alpha^{\text{agg}})[V - \Delta V + s(q)J] \leq (1 - \alpha^{\text{agg}})C.
\]  

Conversely, an aggressive firm (i.e. \( \delta = \text{agg} \)) with good news will disclose if:

\[
(\alpha^{\text{agg}} - \alpha^{\text{con}})[V - \Delta V + s(q)J] \geq (1 - \alpha^{\text{agg}})C.
\]  

Intuitively (3) and (4) simply compare the incremental benefit of disclosure (left hand side) with the direct cost of disclosure (right hand side). Thus if (3) and (4) both hold, we have aggressive firms disclosing good information and conservative firms choosing not to disclose no matter what the test result. Also notice that in this equilibrium investors correctly infer that aggressive firms that do not disclose have bad news. Having looked at the final stage, we now analyse the prior stage of the game.

4.2 Accounting policy choice stage

If 'conservative' firms do not disclose, the expected final payoff\(^{14}\) for conservative accounting policy choice is:

\[
\pi^{\text{con}N} = (1 - \alpha^{\text{conN}})(V - \Delta V + qJ)
\]  

On the other hand if 'aggressive' firms disclose when they have good information, then the expected final payoff is (noting the \( G \) and \( B \) superscripts in following):

\[
\pi^{\text{aggG}} = \Pr(G|q)(1 - \alpha^{\text{aggG}})(V + s(q)J - C)
\]

\[
+ \Pr(B|q)(1 - \alpha^{\text{aggG}})(V + u(q)J)
\]

\[
= (1 - \alpha^{\text{aggG}})(V + qJ - \Pr(G|q)(1 - \alpha^{\text{aggG}})C
\]

\[
- \Pr(B|q)(\alpha^{\text{aggN}} - \alpha^{\text{aggG}})(V + u(q)J)
\]

Assume now that there exist a \( q^* (0 < q^* < 1) \) such that:

\[
\pi^{\text{conN}} > \pi^{\text{aggG}} \iff q > q^*
\]

in which case firms with high \( q(q > q^*) \) will choose a conservative accounting policy and will not disclose a \( G \) good test result. On the other hand, firms with \( q(q \leq q^*) \) will choose the aggressive accounting policy and disclose good test results when they receive them.

Having modelled firm's strategic payoffs, we now consider how the investors form their beliefs in order to determine the cost of raising capital charges conditioned on the various informational possibilities.

In equilibrium, the cost of raising capital charges are defined as:

\[
\alpha^{\text{con}}(q^*) = \frac{K}{V - \Delta V + \Pr(J > 0|\delta = \text{con}, \eta = N)J}
\]

\[
\alpha^{\text{agg}}(q^*) = \frac{K}{V + \Pr(J > 0|\delta = \text{agg}, \eta = G)J - C}
\]

\[
\alpha^{\text{agg}}(q^*) = \frac{K}{V + \Pr(J > 0|\delta = \text{agg}, \eta = N)J}
\]

Given our uniform distributional assumption we show in Appendix A that if the \( q^* \) defined by (7) exists, then we will have:\(^{15}\)

\[
\Pr(J > 0|\delta = \text{con}, \eta = N) = E(q|\delta = \text{con}, \eta = N) = \frac{1}{2}(q^* + 1)
\]

\[
\Pr(J > 0|\delta = \text{agg}, \eta = G) = \frac{mq^*}{(2m - 1)q^* + 2(1 - m)}
\]

and

\[
\Pr(J > 0|\delta = \text{agg}, \eta = N) = \frac{(1 - m)q^*}{(1 - 2m)q^* + 2m}
\]

Hence an equilibrium value of \( q^* \) exists if there exists a \( 0 < q^* < 1 \) such that:

\[
(1 - \alpha^{\text{con}}(q^*))(V - \Delta V + q^*J)
\]

\(^{14}\) This follows because

\[
\pi^{\text{con}} = (1 - \alpha^{\text{con}})[\Pr(G|q)(V - \Delta V + s(q)J) + \Pr(B|q)(V - \Delta V + u(q)J)]
\]

and using the definition of \( s(q) \), \( u(q) \) and the fact that:

\[
\Pr(G|q) = mq + (1 - m)(1 - q)
\]

\[
\Pr(B|q) = (1 - m)q + m(1 - q)
\]

\(^{15}\) We are grateful to one of the referees for comments on the computation of these posterior probabilities.
and for $q > q^*$ we have:

$$\left(1 - \alpha_{\text{agg}}^N(q^*)\right)\left(V + q^*J\right) - \Pr(G|q^*)\left(1 - \alpha_{\text{agg}}^G(q^*)\right)C$$

and for $q < q^*$ we have:

$$\left(1 - \alpha_{\text{agg}}^N(q^*)\right)\left(V - \Delta V + qJ\right)$$

We need to make sure that the equilibrium at the accounting policy stage is consistent with the disclosure strategies assumed to define the equilibrium. In order to do this we need to substitute in the equilibrium values for the cost of raising capital $\{\alpha_{\text{agg}}^N(q^*), \alpha_{\text{agg}}^G(q^*), \alpha_{\text{agg}}^G(q^*)\}$ in (3) and (4) and check that they still hold.

**Proposition 1: Existence conditions for the interaction equilibrium**

If there exists a $q^*$ such that (11), (12), (13), (3) and (4) hold, then there exists an equilibrium where relatively high type firms ($q > q^*$) choose conservative accounting policy and never disclose test results, whereas relatively low type firms ($q < q^*$) choose aggressive accounting policy and disclose $G$. 

**Proof:** From above QED.

The following parameter values can be used to establish existence of the interaction equilibrium by using the algorithm presented below:

$$J = 85, \ \ V = 10, \ \ \Delta V = 3.3, K = 3.9, m = 0.77, \ \ C = 0.65$$

Step 1. Solving (11) for $q^* = q^*(J, V, \Delta V, K, m, C)$ gives $q^* = 0.929897$

Step 2. Substitute $q^*$ in (12) and (13) and check that they hold.

Step 3. Substitute $q^*$ in (3) and (4) and check that they hold.

Step 4. Compute the cost of raising capital. For these parameter values we have

$$\alpha_{\text{agg}}^N(q^*) = 4.4\%; \ \ \alpha_{\text{agg}}^G(q^*) = 5.4\%; \ \ \alpha_{\text{agg}}^G(q^*) = 14.2\%$$

The existence of such an equilibrium establishes an interaction between accounting policy choice and disclosure strategy in that the voluntary disclosure strategy varies directly with the choice of accounting policy. The importance of this result is that it calls into question the assumption that firms that make voluntary disclosure necessarily face a lower cost of raising capital. For instance, in the above example, (15) shows that the non-disclosing conservative firms have the lowest equilibrium cost of raising capital. We will discuss the significance of this result in the later section on empirical implications of our analysis.

5. Additional voluntary disclosure as a replacement for accounting policy choice

In this section we consider two regimes in which firms choose the same accounting policy. Relative to our former analysis our comparative exercise will be structured around differential costs of raising capital effects for firms of all types. The rationale for analysing these two regimes is quite different. In the first regime (pure disclosure), the choice of a uniform accounting policy is an equilibrium strategy with all communication taking place via disclosure. At issue here is whether additional voluntary disclosure can act as a perfect substitute for signalling via accounting policy choice. That is, would all firms freely choose the pure disclosure equilibrium over the interaction equilibrium? In contrast in the second regime (regulated), firms choice of accounting policy is exogenously restricted. Here the issue is whether there can be both winners and losers or whether all firms may be worse off once this restriction is in place.

5.1. The pure disclosure equilibrium

We start by characterising the pure disclosure equilibrium where all firms choose an aggressive accounting policy and all those with $G$ news disclose it. Given the uniform distribution assumption, we will have that:

$$\Pr(G) = \frac{1}{2} = \int_0^1 \Pr(G|q) dq = \frac{1}{2}$$

Hence investors updated beliefs are given by:

$$\Pr(J > 0|\beta)$$

$$\Pr(J > 0|\beta) = \int_0^1 u(q) \Pr(q|\beta) dq$$

$$= 2 \int_0^1 \frac{(1-m)q}{(1-m)q + m(1-q)}[u(q) + u(1-q)] dq$$
were $\alpha^{C\omega}$ and $\alpha^{N\omega}$ are the out of equilibrium beliefs concerning the cost of raising capital if firms fully disclosed while all adopting the conservative accounting policy.\(^\text{18}\)

**Proposition 2: Existence conditions for the pure disclosure equilibrium**

If (21) and (22) both hold the pure disclosure equilibrium exists.

**Proof:** From above QED.

It is interesting to note that for the same parameters that established existence for the interaction equilibrium, i.e. (14), the pure disclosure equilibrium also exists resulting in costs of raising capital:

$$\alpha^{C\omega} = 5.2\%;\; \alpha^{N\omega} = 13.2\%$$

Having characterised the pure disclosure equilibrium, we now characterise the regulatory equilibrium before considering the cost of raising capital effects in the following section.

### 5.2. The regulated equilibrium

Let us now consider a regime in which all firms are required to use conservative accounting policy and they all disclose $G$ news when observed. The history of accounting regulation is full of examples where accounting regulatory bodies, when faced with the choice between two alternative accounting methods, have imposed the conservative one rather than continue to allow choice to be exercised. In the US a classical example is provided by the requirement to expense R&D costs (SFAS 2), whereas in the UK an example is given by the prohibition to capitalise reorganization costs following an acquisition (FRS 7).

The inference made by investors after observing disclosure or no disclosure is identical to the pure disclosure equilibrium and so it is still described by (17) and (18). However, in setting the cost of raising capital, investors will take into account the cost of using conservative accounting. Thus we have

$$K = V + \Pr(J > 0(G)J - C$$

and

$$\alpha^{N\omega} = \frac{K}{V + \Pr(J > 0(B)J}$$

For full disclosure to be optimal we require that:

$$(1 - \alpha^{C\omega})(V + \ell(q)J - C) > (1 - \alpha^{N\omega})(V + \ell(q)J)$$

(21)

for $0 \leq q \leq 1$.

In addition, we need to insure that adoption of an aggressive accounting policy always dominates use of a conservative policy, that is for $0 \leq q \leq 1$ we require:

$$\Pr(G|q)(1 - \alpha^{C\omega})(V + \ell(q)J - C)$$

(22)

$$+ \Pr(B|q)(1 - \alpha^{N\omega})(V + \ell(q)J)$$

$$> \Pr(G|q)(1 - \alpha^{C\omega})(V - \Delta V + \ell(q)J - C)$$

$$+ \Pr(B|q)(1 - \alpha^{N\omega})(V - \Delta V + \ell(q)J)$$

Proposition 3: Existence of regulated equilibrium

Condition (25) determines the existence of a regulated equilibrium.
Proof: Follows from above, QED.

Again the set of parameters (14), used to prove existence of the interaction equilibrium, can be used to prove existence of the regulated equilibrium with cost of raising capital

\[ \alpha^{RC} = 5.5\%; \alpha^{RN} = 14.9\% \]  

(26)

6. Some remarks about equilibrium existence

Given the complexity of the model, it has not been possible to formally identify the full existence parameter space. However, we have been able to numerically simulate the various equilibria for certain parameter ranges. This analysis allows us to say the following.

First, for all the equilibria to exist, the cost of disclosure has to be fairly low. This is intuitive given that we have looked for 'full disclosure' equilibria. Both the pure disclosure and the regulated equilibrium are full disclosure equilibria in the classical sense, i.e. disclosure is an optimal strategy for all types. The interaction equilibrium is a 'full disclosure' equilibrium for aggressive firms. One of the consolidated results in the disclosure literature is that, when disclosure is costly, the equilibrium is one of partial disclosure, i.e. disclosure is optimal only for types above a certain threshold. Given the discrete nature of the payoff function in our model we are able to obtain 'full disclosure' equilibria even with a positive disclosure cost. However, this disclosure cost can not be too high.

Second, the interaction equilibrium does not seem to exist if signalling and disclosure cost are the same, i.e. \( \Delta V = C \). Again, this is fairly intuitive. If low type firms decide not to signal, they save the signalling cost but they have to sell a bigger share of the company. This effect is partially mitigated by the possibility to disclose the test result later on. However, if this disclosure costs exactly the same as signalling, then this strategy cannot be an equilibrium. What low type firms save in the first stage, they have to pay in the second stage. However, they will never be able to obtain the same benefit because if they don't signal they reveal that their type is below a certain threshold and this loss can not be recovered. So for the interaction equilibrium to exist, \( C \) has to be sufficiently lower than \( \Delta V \).

Finally, it has been impossible to find a set of parameter values satisfying the restriction \( -\psi \geq m \) for which the interaction equilibrium exists. Again, this finding seems logical. The ratio \( -\psi \) measures the magnitude of the signalling cost with respect to the possible gain \( J \). If this ratio is higher than the test reliability, then it is difficult to think that it can be optimal for a firm to prefer signalling to disclosure, which is exactly what happens for high type firms in the interaction equilibrium.

7. Comparisons between equilibria

Let us now consider the equilibrium values of in situations were signalling via accounting policy does not occur, either voluntarily (pure disclosure equilibrium) or by fiat (regulated equilibrium). The reason for considering this is because this comparison provides us with the clearest way in which to appraise the value of accounting policy choice, that is an understanding of what firms' cost of raising capital would be if accounting policy was uniform. In other words, this type of comparison allows us to address the question concerning whether disclosure can act as a perfect substitute for signalling via accounting policy choice. There are three possible outcomes: the cost of raising capital could be uniformly lower for all firm types, alternatively uniformly higher for all types or alternatively there could be winners and losers. We will perform the comparisons under the assumption that the test is reliable, i.e. \( m > 0.5 \).

In the comparison between the interaction and pure disclosure equilibrium we are able to exclude the possibility that all firms could face a higher cost of raising capital with pure disclosure. We find either that all firms will be better off or there will be winners and losers. The first situation only happens if the cost of signalling is above a certain threshold.\(^{19}\) In all other cases we find that the winners in the pure disclosure case are the firms with higher cost of raising capital in the regulatory equilibrium. We find that all firms will be better off or there will be winners and losers. The first situation only happens if the cost of signalling is above a certain threshold.\(^{19}\) In all other cases we find that the winners in the pure disclosure case are the firms with higher cost of raising capital in the regulatory equilibrium.

Next, we turn to consider identification of winners and losers if a regulatory equilibrium is imposed. Significantly in this case, we are able to identify conditions under which all firms face a higher cost of raising capital in the regulatory equilibrium.

To summarise we show that increased voluntary disclosure does not always act as a perfect substitute for signalling through adoption of differential accounting policies. Hence we see that adoption of uniform accounting policy (whether it be voluntary or via regulation) can impose costs upon firms that can not be removed by simply increasing communication via the voluntary disclosure channel.

7.1. Relative costs of raising capital in the interaction versus the pure disclosure equilibria

In the following analysis we show that there is a differential effect depending upon whether a firm's type is greater or weakly less than the critical type

\(^{19}\) We will specify this in Proposition 4 below.
Lemma 1: Firms that adopt aggressive accounting policy choice in the interaction equilibrium \((q \leq q^*)\) will always face a lower cost of raising capital in the pure disclosure equilibrium no matter whether they receive \(G\) or \(B\) news.

That is:
\[
\alpha_{AD}^{G} < \alpha_{DISC}^{G} \text{ and } \alpha_{AD}^{B} < \alpha_{DISC}^{B}
\]

Proof: In Appendix B. QED

Next, comparing firms (types) that adopt a conservative accounting policy in the interaction equilibrium, we see that such a simple domination result does not hold. This situation is of clear interest because it pits signalling versus disclosure directly. Here in one case a firm communicates via signalling with choice of conservative accounting policy, and in the other case communicates via disclosure of a \(G\) test result (if seen). We summarise our findings via the following proposition.

Proposition 4: Signalling dominates disclosure for high types with \(G\) news; \(\alpha_{DISC}^{G} < \alpha_{AD}^{G}\)

If
\[
q^* > \frac{2(\Delta V - C)}{J} + (2m - 1)
\]

high type firms \((q > q^*)\) with \(G\) news face a lower cost of raising capital in the interaction equilibrium than in the pure disclosure equilibrium, that is:

\[
\alpha_{DISC}^{G} < \alpha_{AD}^{G}
\]

7.2. Relative costs of raising capital in the interaction versus the regulated equilibria

In the previous section we showed that in relation to the interaction equilibrium, the alternative equilibrium in which firms freely choose to pool on accounting policy gives rise to benefits to some firms and imposes costs on others. Thus, it is natural to ask if a conservative accounting policy was imposed exogenously, would this also give rise to winners and losers? In fact we are able to provide a definitive response. In this section we identify a condition which guarantees that all firms will face a higher cost of raising capital.

Given Lemma 1 and satisfaction of Proposition 4 we know \(\alpha_{DISC}^{G} < \alpha_{AD}^{G}\) i.e. conservative non-disclosing firms face a lower cost of raising capital than aggressive disclosing firms. Within this setting the most interesting comparison is between the cost of raising capital for aggressive and disclosing firms in the interaction equilibrium \((\alpha_{DISC}^{G})\) and the cost of raising capital of disclosing firms in the regulated equilibrium \((\alpha_{AD}^{G})\). If we had that \(\alpha_{DISC}^{G} < \alpha_{AD}^{G}\), then regulation raises the cost of raising capital for relative low types \(q\) with good news.
Proposition 5: Cost of raising capital increases for all types in the regulated equilibrium

If
\[ \frac{\Delta V}{J} \geq m \]
or
\[ 0 \leq \frac{\Delta V}{J} < m \]
and
\[ q^* > \frac{2(1-m)(m-\frac{\Delta V}{J})}{2m(1-m)-(1-2m)\frac{\Delta V}{J}} = \Gamma \left( m, \frac{\Delta V}{J} \right) \]
then:
\[ \alpha^{regN} < \alpha^{regG} < \alpha^{RG} \]

Proof: See Appendix D. QED

The intuition for the result is as follows. The fact that you pool with better types (in regulatory case) rather than being part of an upper truncated distribution (under signalling) does not compensate for the need to incur the cost \( \Delta V \). Thus the above Proposition establishes that contrary to the pure disclosure case, all firms can face a higher cost of raising capital when a unified conservative accounting policy is in place.\(^{21}\)

8. Implications for empirical research

Even though our measure of the cost of raising capital directly applies strictly only within a venture capital financing setting, our analysis may provide some general methodological suggestions for empirical tests of increased disclosure on the cost of equity capital. If the economy is described by interaction equilibrium and Proposition 4 holds, then the relationship between disclosure and cost of raising capital need not be a monotonic non-decreasing relationship. This is because we have shown logically how settings can arise in which firms adopting a conservative accounting policy have a low level of disclosure, and also obtain the lowest cost of raising capital. Thus, our research suggests that empirical tests of an inverse relationship between disclosure level and the cost of capital may use accounting policy choice as a control variable, and this may improve the power of existing tests for the relationship. For instance, Botosan (1997) finds no statistically significant relationship between cost of equity capital and disclosure on her full sample, but she finds a significant negative relationship for firms with a low analyst following. It would be interesting to re-run the empirical tests using an index of significant differences (if any) in accounting policy choices as the control variable.

Proposition 4 suggests one would find a significant negative relationship for firms with an aggressive accounting policy mix and no relationship (and less disclosure) for firms with a conservative accounting policy mix. This approach may also provide some theoretical underpinning for the results in Botosan and Plumlee (2002) in which they find that firms that make more timely disclosures face an increased cost of capital. Again, our model provides the insight that high type firms in the interaction equilibrium that have adopted a conservative accounting policy find little additional benefit from making timely voluntary disclosures. The market then penalises firms that adopt an aggressive accounting policy by charging them a higher cost of capital. When such firms with good news try to separate themselves from those with bad news by voluntarily disclosing, the market rewards them for this, but it may still leave them with a cost of raising capital above that of the firms adopting conservative accounting.

Another interesting implication of this theoretical research is in the area of accounting standard-setting. In particular, our research makes a not very often clearly articulated argument against harmonisation or mandation of accounting policies. Our research also makes the point that mandating all firms to adopt one accounting policy may actually be detrimental to firms since there are then less communication channels by which firms can signal their prospects.\(^{22}\) As we suggested in the introductory section, our model shows that moving from a situation in which firms are free to choose an accounting policy to mandation does not necessarily lead to a simple substitution effect in which firms then all subsequently make more voluntary disclosures. This lack of a 'simple' effect arises because signalling via accounting policy choice is essentially a statistical censoring process in which all conservative firms are indicating that the q they face is above \( q^* \). In contrast, disclosure of a \( G \) test result could be made by a firm of any \( q \) subject to

\(^{21}\) Again, we have to remember what we have been able to say about equilibrium existence. Given the impossibility of reaching general conclusions we had to state Proposition 5 in its most general form. However it seems very unlikely that the interaction equilibrium exists for the case \( \frac{\Delta V}{J} \geq m \).

\(^{22}\) At this point it is important to note that care must be taken in interpreting our results too literally. In particular, two reasons often claimed for harmonisation is to increase comparability across firms and to insure that unsophisticated users of financial statements are not disadvantaged. To the extent that either of these two arguments are true, our initial model does not incorporate these two features and so would need to be further developed to incorporate such issues if it was to be directly applied in policy settings. Such an extension is clearly an interesting area for future research.
the fact that the higher the $q$ a firm faces the more likely they see a $G$ test result. An interesting topic for future research would be to try and make proxy estimates or comparisons for $AV$ and $C$ so that one could make empirical predictions when ‘shutting down’ freedom of accounting policy choice is most costly and who would be disadvantaged. For instance, if $AV$ was large this would suggest that given existence of the interaction equilibrium, mandation of accounting policy choice by standard setters would be most costly to high $q$ firms that have not received a good test result.

9. Conclusion
We have established in this paper that no simple substitution may exist between various communication channels that firms can use. When firms either voluntarily or by regulation switch from using accounting policy choice as a signal of future prospects to using a uniform policy they should not expect that they can always adjust voluntary disclosure in such a way as either to improve or maintain the perceptions that investors form about their expected performance. That is, the decision whether or not to make voluntary disclosures will depend critically upon the prior or simultaneously chosen accounting policy. Moreover, the interaction between these communication channels can lead to a situation where the ‘best’ firms choose to communicate only via one channel. For instance, firms with good prospects may adopt conservative accounting policy and make no voluntary disclosure. Rationally anticipating this, investors may then charge a (cost of capital) premium to firms that adopt aggressive accounting even though they voluntarily (and credibly) disclose good news unlike those adopting a conservative policy.

The implications of this research are that the value relevance of either accounting policy adoption or voluntary disclosures can not be meaningfully studied in isolation. Any study of the value relevance of accounting needs to control for the voluntary disclosure strategy of firms. Similarly, any study of the link between cost of capital and voluntary disclosure should control for differences in accounting policy adoption. Our research is an initial attempt to develop a multi-dimensional characterisation of disclosure in which accounting is only one possible channel of communication. Given the opening quotation, we suggest that it is only within such a multi-dimensional setting that the future relevance of accounting can meaningfully be appraised.

Appendix A

Derivation of $(J > 0 \mid \delta = \text{agg}, \eta = G)$, $Pr(J > 0 \mid \delta = \text{agg}, \eta = N)$ and $Pr(J > 0 \mid \delta = \text{con}, \eta = N)$

Recall we are considering an interaction equilibrium where:

$$0 < q < q^* \Rightarrow \delta = \text{agg}, \eta = D \text{ if } G, \text{ N otherwise}$$

$$q^* \leq q \leq 1 \Rightarrow \delta = \text{con}, \text{ N}$$

We now need to establish what (Bayesian) inferences an investor makes with respect to the type value $q$ when looking at firms that use an aggressive accounting policy and either disclose good test results or nothing.

**Case I: $\delta = \text{agg}$ and $G$.**

In this case investors observe aggressive accounting policy and disclosure of good news. We have:

$$Pr(D|\delta = \text{agg}) = Pr(G|\delta = \text{agg}) = \frac{Pr(G|0 \leq q \leq q^*)}{Pr(\text{agg})}$$

$$= \int_0^{q^*} \frac{mq + (1-m)(1-q)}{q} dq = (2m-1)\frac{q^*}{2} + (1-m)$$

Using Bayes theorem\(^{23}\) we have

$$Pr(q|\delta = \text{agg}, \eta = G) = \frac{Pr(G|q, \text{agg})Pr(q|\text{agg})}{Pr(G|\text{agg})} = \frac{[mq + (1-m)(1-q)](1/q^*)}{Pr(G|\text{agg})}$$

\(^{23}\) In the standard Bayesian inference updating problem, an investor updates beliefs on the basis of an observed test result $G(\text{ood})$ or $B(\text{ad})$. However, in our model setting the investor has more information, which it would not be rational to ignore. In particular, given firms with $q < q^*$ choose an aggressive accounting policy, before updating on the basis of the test result the investor knows that a firm choosing aggressive accounting must have a $q$ less than $q^*$ and so the updating only occurs on this low $q$ interval.
and we can conclude that:

$$\Pr(J > 0 | \delta = \text{agg}, \eta = G) = \int_0^\infty s(q) \Pr(q | \delta = \text{agg}, \eta = G) dq$$

$$= \int_0^\infty s(q) \frac{mq + (1-m)(1-q)}{\Pr(G | \text{agg}) q^*} dq$$

$$= \frac{1}{(2m-1)q^* + 2(1-m)} \int_0^\infty mq dq$$

(A.4)

**Case II:** $\delta = \text{agg}$ and $B$.  
In this case, investors observe No Disclosure (Bad News) and aggressive policy. We have:

$$\Pr(B | \delta = \text{agg}) = \int_0^\infty \Pr(B | q; \text{agg}) dq$$

$$= \int_0^\infty \frac{[(1-m)q + m(1-q)]}{q^*} dq = (1-2m)q^* + m$$

Using Bayes theorem we have:

$$\Pr(q | \delta = \text{agg}, \eta = N) = \frac{\Pr(B | q; \text{agg}) \Pr(q; \text{agg})}{\Pr(B | \text{agg})} = \frac{[(1-m)q + m(1-q)](1/q^*)}{\Pr(B | \text{agg})}$$

(A.5)

and we can conclude that:

$$\Pr(J > 0 | \delta = \text{agg}, \eta = N) = \int_0^\infty u(q) \Pr(q | \delta = \text{agg}, \eta = N) dq$$

$$= \int_0^\infty u(q) \frac{[(1-m)q + m(1-q)]}{\Pr(G | \text{agg}) q^*} dq$$

$$= \frac{1}{(1-2m)q^* + 2m} \int_0^\infty (1-m)q dq$$

$$= \frac{(1-m)q^*}{(1-2m)q^* + 2m}$$

(A.6)

For completeness we also derive:

**Case III:** $\delta = \text{con}$ and $N$  
In this case, investors only observe conservative accounting policy. Given observation of a firm using conservative accounting policy the investors infers that the firm's type is above $q^*$. We have:

$$\Pr(N | \delta = \text{con}) = \Pr(q^* \leq q \leq 1) = \int_{q^*}^1 dq = 1 - q^*$$

Hence

$$\Pr(q | \delta = \text{con}, \eta = N) = \frac{\Pr(N | q; \text{con}) \Pr(q; \text{con})}{\Pr(N | \text{con})} = \frac{1}{(1-q^*)}$$
Finally
\[
\Pr(J > 0 | \delta = con, \eta = N) = E(q | \delta = con, \eta = N) = \int_0^1 \frac{1}{(1 - q)} q dq = \frac{1}{2} (\frac{q^*}{2}) = \frac{1}{2} (q^* + 1)
\]

**Appendix B**

**Proof of Lemma 1**
It is easy to check that
\[
\alpha^{G \omega} < \alpha^{agg} \iff \Pr(J > 0 | G) > \Pr(J > 0 | \delta = agg, \eta = G) \iff m > \frac{mq^*}{(2m - 1)q^* + 2(1 - m)} \tag{A.9}
\]
and
\[
\alpha^{N \omega} < \alpha^{agg} \iff \Pr(J > 0 | N) > \Pr(J > 0 | \delta = agg, \eta = N) \iff (1 - m) > \frac{(1 - m)q^*}{(1 - 2m)q^* + 2m} \tag{A.10}
\]

It is easy to check that (A.10) and (A.11) always hold for any \(m > 0.5\) and \(0 < q^* < 1\).

**Appendix C**

**Proof of Proposition 4**
We have that
\[
\alpha^{con} < \alpha^{G \omega} \iff \left[ \Pr(J > 0 | \delta = con, \eta = N) - \Pr(J > 0 | G) \right] J > \Delta V - C \tag{A.12}
\]
or
\[
\frac{(q^* + 1)}{2} - m > \frac{2(\Delta V - C)}{J}
\]
Rearranging we have
\[
\alpha^{con} < \alpha^{G \omega} \iff q^* > \frac{2(\Delta V - C)}{J} + (2m - 1) \tag{A.13}
\]
Finally, Lemma 1 guarantees that \(\alpha^{G \omega} < \alpha^{aggG}\) and so
\[
\alpha^{con} < \alpha^{G \omega} < \alpha^{aggG} \tag{A.14}
\]

**Appendix D**

**Proof of Proposition 5**
We need to find the condition that guarantees \(\alpha^{aggG} < \alpha^{RG}\) and \(\alpha^{aggN} < \alpha^{RN}\). It is easy to check that
\[
\alpha^{aggG} < \alpha^{R G} \iff \left[ \Pr(J > 0 | \delta = agg, \eta = G) - \Pr(J > 0 | G) \right] J + \Delta V > 0 \tag{A.15}
\]
After some algebraic manipulations we get
\[
\alpha^{aggG} < \alpha^{R G} \iff q^* > \frac{2(1 - m) \left( m - \frac{\Delta V}{J} \right)}{2m(1 - m) - (1 - 2m) \Delta V} = \Gamma \left( m, \frac{\Delta V}{J} \right) \tag{A.16}
\]
Note that if \(\frac{\Delta V}{J} \geq m\), then \(\Gamma \left( m, \frac{\Delta V}{J} \right) < 0\) and so \(\alpha^{aggG} < \alpha^{RG}\) always.
Again, it is easy to check that

\[ \alpha^{gg} < \alpha^{pp} \iff \text{Pr}(J > 0|\delta = \text{agg}, \eta = N) - \text{Pr}(J > 0|N) + \Delta V > 0 \]  

(A.17)

After some algebraic manipulations we get to the following condition:

\[ \alpha^{gg} < \alpha^{pp} \iff \left[ 2m(m-1) - (1-2m) \frac{\Delta V}{J} \right] q^* < 2m(m-1) + 2m \frac{\Delta V}{J} \]  

(A.18)

If

\[ \frac{\Delta V}{J} \geq \frac{2m(m-1)}{(1-2m)} \]  

then condition (A.18) reduces to

\[ q^* < \frac{2m(m-1) + 2m \Delta V}{2m(m-1) + 2m - \frac{\Delta V}{J}} \]  

(A.20)

and so \( \alpha^{ggN} < \alpha^{RN} \) always.

If

\[ \frac{\Delta V}{J} < \frac{2m(m-1)}{(1-2m)} \]  

then condition A.18 reduces to

\[ q^* > \frac{2m(m-1) + 2m \Delta V}{2m(m-1) + 2m - \frac{\Delta V}{J}} = \Psi \left( m, \frac{\Delta V}{J} \right) \]  

(A.22)

which is negative (positive) if \( \Delta V > (1-m) \) (\( \Delta V < (1-m) \)).

In order to summarise our results we first need to order \( \Psi \left( m, \frac{\Delta V}{J} \right) \), \( \Gamma \left( m, \frac{\Delta V}{J} \right) \). We have the following:

\[ \Psi \left( m, \frac{\Delta V}{J} \right) \leq \Gamma \left( m, \frac{\Delta V}{J} \right) \iff 0 \leq \frac{\Delta V}{J} \leq \frac{2m(m-1)m}{(1-2m)} \]  

(A.23)

Moreover we have that

\[ \text{if } m > \frac{3}{4} \Rightarrow (1-m) < \frac{2(m-1)m}{(1-2m)} < m \]  

(A.24)

whereas

\[ \text{if } m \leq \frac{3}{4} \Rightarrow (1-m) < m \leq \frac{2(m-1)m}{(1-2m)} \]  

(A.25)

Let us consider the case of \( m > \frac{3}{4} \).

We have the following.

If

\[ \frac{\Delta V}{J} \geq m > (1-m) \]  

(A.26)

then

\[ \alpha^{eg} < \alpha^{pp} \text{ because } \frac{\Delta V}{J} > m \Rightarrow q^* > \Gamma \left( m, \frac{\Delta V}{J} \right) \text{ always} \]  

(A.27)

\[ \alpha^{eg} < \alpha^{NN} \text{ because } \frac{\Delta V}{J} > (1-m) \Rightarrow q^* > \Psi \left( m, \frac{\Delta V}{J} \right) \text{ always} \]  

(A.28)
If
\[
\frac{2(m-1)m}{(1-2m)} \leq \Delta V < m
\]  
(A.29)
then
\[
\alpha^{\text{agg}} < \alpha^{\text{ng}} \Rightarrow \varphi > \Gamma\left(m, \frac{\Delta V}{j}\right)
\]  
(A.30)

\[
\alpha^{\text{gen}} < \alpha^{\text{ng}} \text{ because } \frac{\Delta V}{J} > \frac{2(m-1)m}{(1-2m)} \Rightarrow \varphi > \Psi\left(m, \frac{\Delta V}{j}\right) \text{ always}
\]  
(A.31)

If
\[
0 \leq \frac{\Delta V}{J} < \frac{2(m-1)m}{(1-2m)}
\]  
(A.32)
then
\[
\alpha^{\text{agg}} < \alpha^{\text{ng}} \text{ and } \alpha^{\text{gen}} < \alpha^{\text{ng}} \Rightarrow \varphi > \Gamma\left(m, \frac{\Delta V}{j}\right) > \Psi\left(m, \frac{\Delta V}{j}\right)
\]  
(A.33)

This proves Proposition 5 for the case \(m > \frac{1}{3}\). The case \(m \leq \frac{1}{3}\) is easily proven with a similar argument and it is omitted here.

References


