DELEGATING DISCLOSURE AND STRATEGIC CHOICES*

by

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Abstract: We study how joint delegation of strategic and disclosure choices alters the incentives that firm owners offer to their managers. Our first set of results show how the incentive weights owners place on revenues are affected not only by firm characteristics but also by whether their manager chooses ex ante voluntary disclosure. This arises because the owners choose how sensitive the manager's compensation is to her strategic choice, and since this sensitivity is naturally greater if the manager opts to disclose, owners can and do substitute disclosure for direct contractual incentives. Owners also can and do substitute a rival firm's disclosures for direct incentives. Finally, we show that joint delegation alters the information environment for competing firms by creating incentives to provide more information about the less aggressive competitor and less information about the more aggressive competitor. All of these effects are exacerbated in industries with less product differentiation.

Keywords: delegation, voluntary disclosure, Cournot competition, product differentiation

JEL Classification Codes: D43, L13, M41

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1. Introduction.

A key characteristic of the modern firm is the separation of ownership and control and the associated requirement that decisions be delegated to managers. The benefits and costs of such delegation have received significant attention in the theoretical literature in accounting and economics. A key finding in this literature is that delegation of strategic choices to a manager may result in direct financial benefits accruing to the delegating owners of the firm.[1] Intuitively, these benefits may arise because delegation allows the firm's owners to contractually induce the manager to compete more aggressively on their behalf by selling more units in the product market.[2] However, a potential unintended consequence of providing managers with such incentives, and one that has received little attention in the literature, is that in providing such incentives, the firm's owners may also alter their manager's incentives to voluntarily disclose their private information. In this paper, we provide new insight into this issue by examining the *joint* delegation of strategic and disclosure choices and how it is affected by competition among firms in the same industry.

To accomplish this objective, we develop and analyze a model that synthesizes models of delegation of strategic choices (*e.g.*, Brander and Lewis 1986, Fershtman and Judd 1987) and models of disclosure (*e.g.*, Gal–Or 1985, 1986, Darrough 1993). Specifically, owners of each of two firms hire a manager and delegate two sequential decisions to her: an *ex ante* disclosure decision (whether to adopt a policy of disclosing any private information she subsequently acquires) and a strategic decision (the output choice that determines how successfully the firm will compete with its rival in their product market). As is typical in the literature, these decisions are influenced by the incentives the firm's owners offer their manager. Further, we follow the delegation literature by assuming that the manager's compensation depends on the firm's realized profits and revenues.

Our analysis of joint delegation provides two new, key insights. First, we show how delegation of disclosure in addition to delegation of strategic choices alters the contractual incentives chosen by the firms' owners. Specifically, we show that each firm's owners substitute the decision to disclose by *either* manager for direct contractual incentives to compete more aggressively in the

[1] Most of the rest of the literature on delegation focuses on moral hazard and/or adverse selection issues associated with delegation, *i.e.*, agency costs. The literature on agency costs is too large to cite exhaustively but classic papers in this literature include Holmstrom [1979], Grossman and Hart [1983], and Holmstrom and Milgrom [1987]. See also textbook treatments such as Laffont and Martimort [2001], Bolton and Dewatripont [2004] or Salanie [2005].

[2] Classic papers that show this include Brander and Lewis [1986], Fershtman and Judd [1987], Sklivas [1987], Katz [1991] and Hermalin [1994]. Gal–Or [1997] provides an excellent survey of this part of the delegation literature.

product market (that is, to sell more units of output for any output choice by the rival firm). Intuitively, owners choose how sensitive managerial compensation is to their manager's strategic choice, and because this sensitivity is naturally greater if the manager or her rival opts to disclose, each firm's owners can and do substitute disclosure for direct incentives. We also show that owners of the firm with a larger product market or with lower expected costs are the owners who choose incentive weights that induce their manager to compete relatively more aggressively in the product market. Further, we show that the relative incentive weights chosen by the two firms' owners are less different when a manager is also induced by the incentive contract to adopt a policy of disclosing her private information. Opposite effects of joint delegation hold for firms that have greater cost uncertainty (*i.e.*, younger firms or firms whose input prices are highly variable).

Second, we show that joint delegation alters the competing firms' information environments in important ways. Specifically, owners who choose incentive weights that induce their manager to compete more aggressively simultaneously provide their manager with incentives to tilt her disclosures (relative to the no delegation solution) toward providing information that is more useful in understanding her rival's costs than her own.[3] Conversely, owners of the rival firm give their manager incentives to provide information that is more useful in understanding her own firm's costs. Thus, joint delegation tilts the information environment toward containing more information about the firm with the smaller product market or larger expected marginal costs and away from information about the firm with the larger market or smaller expected marginal costs (relative to the no–delegation disclosure choice). Another effect of joint delegation is that the manager who is given incentives to compete more aggressively is more likely to adopt a policy of disclosure. Thus, joint delegation tilts both the likelihood of disclosure and the content toward disclosure of information about the less aggressive competitor.

Our analysis also reveals a number of cross–sectional empirical implications associated with the type of joint delegation that we study. First, it suggests that firms that seek a competitive advantage through a cost leadership strategy and/or focus on mass markets for their products offer managers contracts that rely more heavily on revenue than profits relative to firms that adopt differentiation strategies and/or focus on niche markets.[4] Further, disclosures of the former set

[3] In our model, a manager's private information provides information about both the firm's and the rival firm's production costs. Our parameterization of how production costs depend on the managers' private information allows us to vary how much information about production costs becomes available to either manager when she learns her private information.

[4] Here we use Porter's [1980] classification of business strategies (cost leadership, differentiation, or niche) to

of firms will differ from disclosures of the latter set in two ways: the latter firms' managers will offer fewer disclosures, and their disclosures will be more focused on their own product costs than on their rival's product costs. Second, regardless of whether a firm employs a cost leadership or differentiation strategy, the owners reduce the incentive weight on revenues when their manager offers more frequent voluntary disclosures (*i.e.*, disclosure substitutes for incentives). Third, our analysis suggests that younger firms or those with greater cost uncertainty are expected to offer managers contracts that rely less heavily on revenue than mature firms or those with relatively stable production costs. However, both types reduce the incentive weight on revenues when the manager is motivated to adopt a policy of providing voluntary disclosures. Fourth, our analysis suggests that there are predictable cross–sectional differences in the information environments of competing firms. Specifically, our model predicts that more information will be disclosed about the cost structure of firms with smaller expected profit margins, smaller expected market shares or more cost uncertainty. Conversely, less information will be provided about firms with greater expected profit margins, greater expected market shares or less cost uncertainty. Finally, our analysis reveals a link between the disclosure policy choices of a firm's rivals and the incentive contract offered to the firm's manager. Specifically, our model predicts that owners place greater incentive weight on revenues when rival managers are not expected to offer voluntary disclosures. Said differently, a firm's owners motivate their manager to compete more aggressively in the product market and increase the likelihood their manager provides voluntary disclosures when their firm's rivals are less likely to offer their own voluntary disclosures.

The remainder of the paper is organized as follows. Section 2 discusses the related literature and Section 3 contains a description of our model. Sections 4, 5 and 6 describe equilibrium in the final, second and first stages of the game, respectively. We describe our results on delegation of operating and disclosure choices in Section 7 and conclude in Section 8.

2. Related Literature.

Because our model synthesizes models of delegated strategic choice and of *ex ante* voluntary disclosure, our work is related to two distinct literatures.[5] The literature on delegated strategic choice is based on an insight in Schelling [1960], and early formal models include Brander and

help link our theoretical constructs to more popular approaches to categorization by business strategy.

[5] In work that complements ours, Yoon [2012] introduces delegation and relative performance evaluation into a model of *ex post* disclosure and finds that delegation combined with RPE offers an alternative solution to the well-known "unraveling" result.

Lewis [1986], Fershtman and Judd [1987], Sklivas [1987] and Hermalin [1994]. All demonstrate that owners can benefit financially from contractually delegating to a manager control of their firm's strategic response to its rivals. Contractual delegation of strategic decision–making serves as a pre–commitment device allowing owners of firms an opportunity to acquire a competitive advantage over their rivals in their product markets. Katz [1991] suggests that these results require that managers' contracts be observable, but recent work by Kockensen and Ok [2004] and Kockensen [2007] clarifies this issue by showing that the benefits from delegation are still basically present even in the absence of observable contracts.[6] In an important extension, Hughes and Williams [2008] examine owners' incentives to *voluntarily* disclose the contractual arrangements with their managers. Their key result is that firms voluntarily disclose contractual arrangements if the costs of disclosure are small enough. They also show that firms disclose if the non–strategic benefits of such commitments are large or if owners have access to enough different commitment mechanisms. Our work contributes to this literature by showing how delegation of disclosure in addition to the delegation of strategic choices alters the contractual incentives chosen by the firm's owners.

The key papers in the literature on *ex ante* disclosure (*e.g.*, Gal–Or 1985, 1986, Darrough 1993, Sankar 1995 and Raith 1996) abstract from the effects of delegation (*i.e.*, they assume that the manager's and owners' incentives are perfectly aligned) and focus on the firm's willingness to disclose private information about its own production costs (referred to as the private or independent values case) or market information that affects the payoffs of both firms equally (referred to as the common values case).[7] The central result in this literature is that the firms' decisions to adopt a policy of disclosing private information depend on on whether the firms strategic choices are quantities or prices when they compete in their product market and whether the information structure examined is the private or common values structure.[8] But the key insight is that the

[6] We should also note that a strand of the literature considers the effects of allowing observable contracts that depend on the profits earned by all of the rivals in the industry. The key result in this literature is that collusive outcomes can be supported with such contracts. See Fershtman, Judd and Kalai [1991], Fershtman and Kalai [1997], Hughes and Kao [1997], Kockesen and Ok [2004], Katz [2006], Kockensen [2007], or Manasakis et al. [2010], among others.

[7] Raith [1996] offers an interesting generalization of Gal–Or and Darrough by introducing imperfect signals. He shows that equilibrium disclosure policies depend on the quality of the signal a firm receives and on how correlated the signals are. See also the nice summary of this literature in Vives [2008].

[8] There is an extensive literature that examines *ex ante* disclosure by firms competing in product markets. Some recent contributions include Maleug and Tsutsui [1996] who focus on disclosure of information about the slope of the market demand curve, Arya and Mittendorf [2007] who examine the impact of third party information on *ex ante* disclosure policy, Currarini and Feri [2007] who focus on disclosure by subsets of rivals, and Bagnoli and Watts [2011] who study the firms' information acquisition decisions and how they are affected by their subsequent disclosure policy adoption decisions.

decision to disclose depends on how disclosure affects the outcome of the firms' rivalry in their product markets. This suggests that delegation of strategic choices and the impact on them will affect the manager's disclosure decision and vice versa. We contribute to the *ex ante* disclosure literature by analyzing the effects of joint delegation of strategic and disclosure choices and the associated contractual incentives the firm's owners offer to managers on the managers' delegated disclosure choices.

Our model is most closely related to Theilen [2007] who considers a homogeneous product market with private information about costs (the private values case). He shows that if the firms' owners delegate *only* the strategic decision to their manager but retain the disclosure decision then delegation may affect the owners' equilibrium disclosure choices. Specifically, if the managers' pay could be reduced when revenues increase, it is possible to reverse the disclosure result in Gal–Or [1985] and Darrough [1993]. If not, then the disclosure policy choice is unaffected by delegation. Our model differs from his in that we examine joint delegation, permit the managers of firms to sell heterogeneous products, and do not restrict attention to the private values case. Our results differ from Theilen's by developing the conditions under which delegation of strategic decisions affects disclosure policy choices and by analyzing how delegation of disclosure choice affects contractual incentives to motivate strategic choices.

Delegation and disclosure have also been studied in a single principal–agent setting. This literature is extensive but key papers that focus on delegated disclosure include Dye [1985], Arya, Glover and Sunder [1998] and Gigler and Hemmer [2001]. Dye shows that managers may not find it optimal to voluntarily disclose information about their performance measure. Arya et al. show that owners may find it useful to restrict disclosure of interim performance measures, and Gigler and Hemmer show that an owner who chooses a more conservative accounting system will induce less timely voluntary disclosures. Our analysis complements these papers by focusing on the joint delegation of disclosure and strategic choices rather than effort choices and on the interactions associated with joint delegation of these choices.

3. The Model.

To develop and analyze a model that synthesizes models of delegation of strategic choices and disclosure we introduce delegation of disclosure and strategic choices into the standard model of *ex ante* disclosure or, equivalently, we introduce delegated disclosure into the standard model of

delegation of strategic choices. Specifically, the firm's owners contractually delegate both disclosure and strategic decisions to a manager who chooses whether or not to commit to disclose her private information prior to learning it. After learning her private information, the manager follows her chosen disclosure strategy, observes any information her rival may have chosen to disclose, and then competes with the rival firm in the product market by choosing output.

The formal description of our model is as follows. In the first stage of the game, owners simultaneously delegate future strategic and disclosure choices to their manager. We follow the analysis in Fershtman and Judd [1987] and Sklivas [1987] and assume the owners of a firm motivate their manager's decisions by offering to pay her based on the firm's realized profits and realized revenues.[9] In particular, we assume that the manager's compensation is proportional to:

$$\mathcal{P}_i = \pi_i + \lambda_i S_i \qquad\qquad i = 1, 2$$

where π_i is firm i's realized profits and S_i is its realized sales and the owners of each firm select $\lambda_i \geq 0$ to maximize their expected profits.

In the second stage of the game, given the incentive weights chosen by the firms' owners, each manager selects her firm's *ex ante* disclosure policy. Let $d_i \in \{D, N\}$ be the disclosure policy chosen where D (N) represents the choice to adopt a policy of disclosure (not adopt a policy of disclosure). As is standard, we assume that each manager makes the disclosure choice without knowing her rival's choice. The managers then learn their private information and follow their chosen disclosure policies. Consequently, each manager potentially has two sources of information: her private information and, if her rival adopts a policy of disclosure, the private information disclosed by her rival manager. As is standard in the disclosure literature, we assume that if a disclosure is made, it is truthful. In the third, and final, stage of the game, after learning all of the available information, the firms compete in their product markets by having their managers choose how much of their product to sell (Cournot competition). We assume that the managers make their *ex ante* disclosure choices and their output decisions to maximize their own expected payoffs (*i.e.*, we assume that managers are risk neutral). Everything else is common knowledge.

The above structure (except for the delegation of the disclosure decision) is the standard one used in the *ex ante* disclosure literature (*e.g.*, Gal–Or 1985, 1986, Darrough 1993, Sankar 1995,

[9] We obtain similar results if the manager is paid based on the firm's realized profits and cost reduction efforts.

Raith 1996). We will, however, alter the information structure to facilitate our study of the impact of a manager's information on the delegation decisions of the owners. To keep things as simple as possible, we will keep what the manager knows fixed but parameterize the firms' cost functions to allow us to alter the importance of that information on the firm's profits and on the rival firm's profits and thereby study the impact of a manager's private information on the delegation decisions.

To formalize the managers' strategic choices, we assume that each firm's demand curve is

$$p_i = \alpha_i - q_i - tq_j \qquad i = 1, 2 \tag{1}$$

with $1 > t > 0$ to ensure that the firms sell substitute products. We assume that both managers know each firm's demand curve but have private information about each firm's cost structure.[10] In particular, we assume that manager i knows c_i and we parameterize each firm's marginal costs of production as

$$k_i = \delta_{ii}c_i + \delta_{ij}c_j$$

and assume that there are no fixed costs of production.

There are two advantages of adopting this information structure. First, the parameters δ_{ii} and δ_{ij} create a flexible information structure for the managers' private information that results in the private and common values structures previously analyzed in the *ex ante* disclosure literature becoming special cases.[11] Second, it offers a parsimonious way to represent information structures in which a manager's private information is differentially important/useful to the two firms. For example, large values of δ_{ii} and δ_{ji} represent a situation in which manager i's private information (c_i) is very important/useful to both firms because both firms' marginal costs are very sensitive to the realization of c_i.[12] Alternatively, large values of δ_{ii} and δ_{ij} represent a situation in which both managers' private information is much more useful to firm i than firm j because firm i's costs are particularly sensitive to the realizations of c_i and c_j.[13] Thus, this structure allows us

[10] In a previous version of this paper, we analyzed the effects of assuming that managers have private information about product demands. We showed that, in that case, that managers choose disclosure strategies that are similar to those in Theorem 1 with one key difference. The linearity of the demand structure, cost structure and compensation structure implies that the delegated disclosure decision is independent of the chosen incentives to compete in the product market. Results are available from the authors.

[11] In particular, the private values information structure is represented by $\delta_{11} = \delta_{22} = 1$ and $\delta_{12} = \delta_{21} = 0$; and the common values information structure by $\delta_{11} = \delta_{22} = \delta_{12} = \delta_{21} = 1$.

[12] This type of situation can arise if both firms are heavily dependent on a particular input to their production processes and c_i represents manager i having private information about the input's price.

[13] This type of situation can arise if the firms sell differentiated products and there is more uncertainty about the costs of making one version of the product.

to examine how contractually delegating joint disclosure and strategic decisions depends on the relative importance of the manager's private information, *i.e.*, on what the manager "knows" about the two firms' cost functions.

To complete the description of the information structure, we assume that the firm's owners and managers have common priors: all variables are drawn from known distributions with finite means and variances. We also assume that c_1 and c_2 are independent so that the distribution of c_j given c_i is independent of c_i for $i = 1, 2$. To ensure interior solutions in the final stage of the game, we assume that the smallest value of the intercept parameter for each firm exceeds the largest value that firm's marginal costs can take on. We seek a Bayes–Nash equilibrium of the model and begin by solving the final stage of the game, when the firms compete in the product market.

Before turning to solving for the equilibrium in our model, there are two features that deserve additional discussion. The first is our assumption that the incentive contracts chosen by the firm's owners are observed by all parties. As mentioned previously, at one time, this assumption was controversial. Specifically, Katz [1991] suggested that the main results in the delegated strategic choice literature were the result of this observability assumption but subsequent work (Kockensen and Ok 2004 and Kockensen 2007) has clarified the issue by showing that the benefits from delegation remain even in the absence of observable contracts. We choose to assume observability of the contracts for two reasons. First, the assumption simplifies the analysis without changing the qualitative nature of the results as shown by Kockensen and Ok [2004] and Kockensen [2007]. Second, observability is consistent with the current regulatory environment (see Larcker and Tayan 2012 for an excellent survey). Specifically, disclosure is required as part of the SEC's 2006 decision to require "plain English" discussion of the key components of CEO compensation, a required section of a firm's 10–K filing.[14] This requirement has been reiterated in SEC Staff 2007 review compliance and the 2009 update provided in a speech by Shelley Parratt, Deputy Director, Division of Corporation Finance, SEC.[15] In addition, the 2010 Dodd–Frank legislation enhances disclosure requirements for pay–for–performance compensation (http://www.sec.gov/spotlight/dodd-frank/corporategovernance.shtml). Together, these regulatory requirements suggest that contract observability is a reasonable approximation.

[14] Details of the requirements associated with the "plain English" discussion of compensation are available at http://www.sec.gov/news/press/2006/2006-123.htm.

[15] See the SEC Staff review at http://www.sec.gov/divisions/corpfin/guidance/execcompdisclosure.htm; and the 2009 update at http://www.sec.gov/news/speech/2009/spch110909sp.htm.

The second feature that deserves additional discussion is our focus on *ex ante* disclosure (precommitment to disclose or not). There are two concerns with *ex ante* disclosure. First, does the decision–maker prefer to commit to the disclosure decision? Second, what forces keep the decision–maker from reneging on the commitment? Turning to the first concern, it is straightforward to show that the decision–maker's payoff is greater if he/she chooses *ex ante* rather than *ex post* disclosure. To see why, we begin by observing that both the firm's profits and the manager's payoff are convex in the amount the firm sells in its product market.[16] Since the decision to choose an *ex ante* or an *ex post* disclosure strategy must logically be made prior to the decision–maker learning his/her private information, the optimal choice is the one that maximizes expected profits which is equivalent to the choice that produces the greater variance in the subsequent output decision. If the *ex ante* disclosure decision is to commit to disclose (commit to not disclose), then the variance of output given disclosure exceeds (is smaller than) the variance given no disclosure. Since *ex post* disclosure results in disclosure for some realizations of the private information and no disclosure for the remaining realizations, *ex ante* the variance of output is a weighted average of the variance with disclosure of all realizations and the variance for disclosure of none. Thus, the decision–maker prefers to adopt an *ex ante* rather than an *ex post* disclosure strategy. The other concern with *ex ante* disclosure noted above is the possibility of reneging on the commitment. In our setting this is less of a concern because the disclosure choice is delegated by the owners to the manager. Thus, owners, who prefer *ex ante* disclosure, can achieve this outcome by imposing sufficient penalties on the manager to ensure that the benefits from reneging never exceed this penalty.[17]

4. Final Stage: Delegated Product Market Competition.

To solve for all equilibrium decisions, we begin by determining each manager's equilibrium output choice for every possible choice of incentive weights by the firm's owners and every possible disclosure choice by each of the managers. When firms compete in their product markets, each manager's strategic choice is the output that maximizes her expected payoff conditional on all information available to her and all prior decisions. Thus, her decision depends on her own private information (c_i), the disclosure strategy chosen by her rival, d_j, the information the rival's strategy requires disclosing, and her own disclosure strategy, d_i.

[16] This feature of their payoff functions is derived below.

[17] There are always benefits to reneging for some realizations of the manager's private information, but our assumptions of finite supports for the random variables ensures that these benefits are bounded.

Turning to the manager's choice of output, the manager of firm i solves $\max_{q_i} \mathrm{E}[\pi_i + \lambda_i S_i \mid \phi_i]$ where ϕ_i represents the information manager i has about c_i and c_j at the time of her strategic choice. Rewriting,

$$\max_{q_i} \quad \mathrm{E}[(1+\lambda_i)(\alpha_i - q_i - tq_j)q_i - (\delta_{ii}c_i + \delta_{ij}c_j)q_i \mid \phi_i].$$

The first order condition is

$$q_i = \mathrm{E}\big[\frac{1}{2}(\alpha_i - tq_j) - \frac{1}{2(1+\lambda_i)}(\delta_{ii}c_i + \delta_{ij}c_j) \mid \phi_i\big].$$

The usual calculations yield equilibrium quantity choices and payoffs to the managers.

Proposition 1: *When both managers have private information about costs, Cournot equilibrium quantities for each disclosure combination are*

$$\begin{aligned}
q_i(D,D) &= \frac{1}{(4-t^2)}\left(2\alpha_i - t\alpha_j - \frac{2k_i}{1+\lambda_i} + \frac{tk_j}{1+\lambda_j}\right)\\
q_i(D,N) &= \frac{1}{(4-t^2)}\left(2\alpha_i - t\alpha_j - \frac{2\mathrm{E}[k_i \mid c_i]}{1+\lambda_i} + \frac{t\mathrm{E}[k_j \mid c_i]}{1+\lambda_j}\right)\\
q_i(N,D) &= \frac{1}{(4-t^2)}\left(2\alpha_i - t\alpha_j + \frac{t^2\mathrm{E}[k_i \mid c_j]}{1+\lambda_i} - \frac{t\mathrm{E}[k_j \mid c_i]}{1+\lambda_j}\right) - \frac{k_i}{1+\lambda_i}\\
q_i(N,N) &= \frac{1}{2(4-t^2)}\left(4\alpha_i - 2t\alpha_j - \frac{(4-t^2)\mathrm{E}[k_i \mid c_i]}{1+\lambda_i} - \frac{t^2\mathrm{E}[k_i]}{1+\lambda_i} + \frac{2t\mathrm{E}[k_j]}{1+\lambda_j}\right).
\end{aligned}$$

Equilibrium payoffs to the managers in this stage of the game are proportional to $\mathcal{P}_i(d_i,d_j) = (1+\lambda_i)[q_i(d_i,d_j)]^2$ *for* $i = 1,2; j \neq i$.[18]

The differences in equilibrium quantity choices arise from the managers' prior disclosure choices and the owners' prior contracting choices. When both managers chose to disclose their private information, both are fully informed about each firm's production costs leading to the standard full–information Cournot solution. When one manager chose to disclose and the other chose not to, the latter is fully informed but the former must use her priors concerning her rival's private information when estimating both firms' costs of production. If neither manager chose to disclose, then each knows only their private information about costs as well as both firms' customer demands.

Before discussing a key implication of Proposition 1, we observe that if we specialize our information structure to the private ($\delta_{ii} = \delta_{jj} = 1; \delta_{ji} = \delta_{ij} = 0$) or common ($\delta_{ii} = \delta_{ji} = \delta_{ij} = \delta_{jj} = 1$) values cases and eliminate the impact of delegation ($\lambda_i = \lambda_j = 0$), the equilibrium

[18] Note that $\mathrm{E}[k_i \mid c_i] \equiv \delta_{ii}c_i + \delta_{ij}\mathrm{E}[c_j]$ and $\mathrm{E}[k_i] \equiv \delta_{ii}\mathrm{E}[c_i] + \delta_{ij}\mathrm{E}[c_j]$.

strategies simplify to those obtained in Gal–Or [1985, 1986] or Darrough [1993] showing that our information structure is an appropriate generalization of the prior literature.

The main result in Proposition 1 is that, in equilibrium, managerial payoffs are convex in the manager's output choice. The reason this is important is that when we examine equilibrium disclosure choices, these choices will be made prior to the manager learning her private information. As a result, managers will seek to maximize their expected payoffs and, because of our convexity result, this will mean that they seek to maximize the variance of their output decisions. In other words, the managers will seek the option that makes their subsequent output choices most sensitive to the realization of their private information.

Proposition 1 also offers two insights regarding a manager's equilibrium quantity choice. First, the equilibrium quantities illustrate the effect of strategic delegation as originally described in Fershtman and Judd [1987] and Sklivas [1987]. In equilibrium, firm i's output is increasing in λ_i and decreasing in λ_j. To see why, assume that only the owners of firm i motivate their manager by placing incentive weight on sales ($\lambda_i > 0$). These incentives cause the manager to sell more than a profit–maximizing manager for every level of output by the rival. The rival manager, anticipating the effect of the incentives, finds it optimal to "accommodate" them by reducing the output she chooses. As a result, firm i's sales are larger and firm j's sales are smaller than they would be absent delegation. And, even though total output is greater than if both managers were simply maximizing profits, sufficient sales are shifted to firm i so that its profits actually increase. Intuitively, delegation is a means of precommitting the firm to produce greater output which shifts profits toward the firm. In equilibrium, rivalry causes both firms' owners to provide incentives that emphasize revenues as well as profits in order to motivate each manager to choose a larger output.

Second, the equilibrium quantities reveal the importance of parameterizing the usefulness of a manager's private information. Recall that how useful knowing c_i is to the manager and her rival depends on the values of δ_{ii} and δ_{ji}. Holding all else constant, in equilibrium for a given realization of c_i, larger values of δ_{ii} increase the firm's marginal costs of production, k_i, and cause the manager to choose a smaller output for any realization of her private information. Similarly, holding all else constant, larger values of δ_{ji} increase k_j and cause firm i's manager to choose a larger output for any realization of her private information.[19] Below, we show that these features

[19] This effect is the result of the firms being Cournot competitors. Under Cournot competition, the managers' output choices are strategic substitutes and that feature generates the δ_{ii} and δ_{ji} terms having opposite signs

of the equilibrium quantity choices will have important effects on the managers' disclosure choices and therefore highlight the importance of analyzing our more general information structure.

Finally, we observe that the effects of delegation described above appear to work by implicitly lowering the manager's perceived cost of selling additional units of output even though the owners are using revenue–based incentives. This feature is due to the linearity of both the incentive contract and the firm's demand, which allow revenue incentives to operate "as if" the manager faces reduced marginal costs of additional output.

Having determined equilibrium quantities chosen in the final stage of the game, we turn to the second stage and examine under what conditions the managers choose to commit to disclose.

5. Stage 2: Delegated Disclosure Choices.

The equilibrium quantities and payoffs described in Proposition 1 are conditional on each possible specification of both the managers' private information and their disclosure policy adoption decisions. To determine the managers' equilibrium disclosure policy adoption decisions for all possible choices of incentive weights by the firms' owners, we turn to an analysis of their *ex ante* disclosure incentives. Proposition 1 provides the information needed to describe the Bayes–Nash equilibrium of the second stage of our game as the equilibrium of the associated normal form game whose payoffs are the expected profits computed for each decision.

		Firm 2	
		D	N
Firm 1	D	$\mathrm{E}[\mathcal{P}_1(D,D)], \mathrm{E}[\mathcal{P}_2(D,D)]$	$\mathrm{E}[\mathcal{P}_1(D,N)], \mathrm{E}[\mathcal{P}_2(N,D)]$
	N	$\mathrm{E}[\mathcal{P}_1(N,D)], \mathrm{E}[\mathcal{P}_2(D,N)]$	$\mathrm{E}[\mathcal{P}_1(N,N)], \mathrm{E}[\mathcal{P}_2(N,N)]$

Given this, the main result of our analysis on delegated disclosure is presented in Theorem 1 and illustrated in Figure 1.

Theorem 1: *When the firms are Cournot competitors, disclosure of cost information is a dominant strategy for manager i $(i = 1, 2\ i \neq j)$ if*

$$\text{(C1)} \qquad \left(\frac{1+\lambda_i}{1+\lambda_j}\right)\left(\frac{2}{t}\right)\delta_{ji} < \delta_{ii} \qquad \text{or} \qquad \left(\frac{1+\lambda_i}{1+\lambda_j}\right)\left(\frac{2t}{8-t^2}\right)\delta_{ji} > \delta_{ii}.$$

in Proposition 1. Had the firms been Bertrand competitors, their price choices would be strategic complements and the terms would have the same signs.

Theorem 1 offers insight into when a manager chooses to adopt a policy of disclosing her private information and when she chooses to adopt a policy of not disclosing her private information when she learns it. (C1) indicates that the manager chooses to disclose if her private information (c_i) is sufficiently differentially useful/informative about her firm's marginal costs relative to her rival's marginal costs.[20]

Intuitively, the manager benefits from increases in the variability of the equilibrium outputs chosen by either manager as a function of their private information.[21] Thus the manager's benefits from choosing not to disclose her private information arise only from her ability to tailor her output decision to her private information. If instead she chooses to disclose her private information then the rival manager can also tailor her output to the information revealed by the disclosure (the information effect) and strategically adjust her output more effectively to the disclosing firm's output choice (the strategic effect). Since the firms' output choices are strategic substitutes, increases in the sensitivity of the rival's output to the disclosing manager's private information dampens the variability of the disclosing manager's output choice. This is the disadvantage to disclosure. As a result, with Cournot competition in the product market, the manager only chooses to disclose when her private information is sufficiently asymmetrically useful to her and her rival. If the information is predominantly useful to the disclosing manager, the information effect is small and disclosure is preferred. Similarly if the information is predominantly useful to the rival manager, the information effect is large, increasing the benefits of disclosure, while the benefits from not disclosing are, in this case, small.[22]

Theorem 1 highlights some important effects of delegating both disclosure and strategic choices to a manager. Specifically, the disclosure decisions made by the firms' managers are almost surely different from the profit–maximizing disclosure choices. Thus, as we conjectured, delegating both strategic and disclosure decisions leads to changes in the firms' disclosure choices. In particular,

[20] A large value of δ_{ii} (δ_{ji}) means that firm i's marginal costs (firm j's marginal costs) are more sensitive to the realization of the manager's private information, c_i, and so variations in its realized value translate into larger variations in firm i's marginal costs (firm j's marginal costs), thus making the manager's private information more useful/informative about her firm's (her rival's) marginal costs.

[21] This follows from the fact that each manager's payoff is convex in output choices.

[22] This is the key difference between our results when firms are Cournot instead of Bertrand competitors. When firms compete in their product markets by choosing prices, prices are strategic complements rather than strategic substitutes (Bulow et. al. 1985) and so increased variability in one firm's price amplifies the variability in the rival's price. With Cournot competition increased variability in one firm's output dampens the variability in the rival's output. As a result, with Bertrand competition, the managers choose to disclose information that is useful to both firms and to not disclose information that is sufficiently asymmetrically useful to the two firms.

(C1) shows that the impact of delegating strategic choices on the disclosure decision depends on whether the ratio $(1+\lambda_i)/(1+\lambda_j)$ exceeds one or not.[23] If it exceeds one, the owners of firm i have chosen to motivate their manager to compete more aggressively, relative to their rival's manager, in the product market by selling more units that the profit–maximizing quantity, and these incentives also tilt their manager's disclosure away from disclosing private information that is more informative about her own firm's costs and toward disclosing information that is more informative about the rival's costs.[24] Conversely, if the ratio is less than one, owners of firm i have chosen to motivate their manager to compete less aggressively in the product market, and these incentives tilt their manager's disclosure toward disclosing private information that is more informative about her own firm's costs and away from disclosing information that is more informative about the rival's costs. Thus joint delegation tilts the information environment toward having more information about the cost structure of the less aggressive firm and less information about the cost structure of the more aggressive firm.[25] Interestingly, the net effect of joint delegation is to increase the likelihood of disclosure by the manager of the more aggressive competitor and decreases the likelihood of disclosure by the manager of the less aggressive competitor.[26]

The tilt in the information environment introduced by joint delegation relative to the no–delegation outcome (*i.e.*, having more information about the less aggressive firm in equilibrium) arises because owners who motivate their manager to be the more aggressive competitor increase the benefits to that manager of tailoring her output choice to her private information. As a result, the benefits to the manager and owners of the firm from not disclosing information that is particularly useful to the disclosing manager increase relative to the benefits from disclosing the information. This reduces the manager's incentive to disclose information about her firm's costs and increases her incentives to disclose information predominantly useful to her rival. Said succinctly, joint

[23] In the next section, when we analyze the choices of incentive weights by firms' owners, we will cast those results in terms of this same ratio so that it is straightforward to make the link back to the impact of endogenous incentive weights on the disclosure choices of the firms' managers.

[24] We use the term tilt in this context to indicate that the manager's disclosure choice has been altered relative to her choice if $\lambda = 0$, when the manager is not offered incentives to increase output relative to the profit–maximizing quantity.

[25] To simplify the discussion in this section, we will refer to the firm whose owners have chosen a larger incentive weight on revenues as the more aggressive firm because such incentive weights motivate the manager to choose to sell more units in the product market for any output choice of her rival.

[26] To make this precise, let $(\delta_{ii}, \delta_{ji}) \in [0,1]\text{x}[0,1]$, and assume a uniform distribution with full support on the unit square. In this case, the probability of disclosure is greater when the area associated with disclosure is greater. Theorem 1 indicates that the area of the unit square representing pairs of δ_{ii}, δ_{ji} that lead the manager to adopt a policy of disclosure is greater than when the disclosure choice is made by the owners directly.

delegation induces the manager who is motivated to be the more aggressive competitor toward disclosing information useful to her rival and induces the manager who is motivated to be the less aggressive competitor toward disclosing information that is useful to herself. Thus, joint delegation alters the information environment by reducing the information available about the more aggressive firm's costs and increasing the information available to the less aggressive firm's costs.

Unlike the prior *ex ante* disclosure literature (*e.g.*, Gal–Or 1985, 1986 and Darrough 1993), in our model, Theorem 1 shows that disclosure choices also depend on how differentiated the firm's products are. With joint delegation, the manager motivated to be the more aggressive competitor is more likely to choose to disclose her private information and the manager motivated to be the less aggressive competitor is less likely to disclose her private information, and (C1) tells us that both effects increase as the firms' products become more homogeneous.

Finally, we can focus on the special cases analyzed originally by Gal–Or [1985,1986] and Darrough [1993], the private and common value cases. In our model, the private values information structure has $\delta_{ii} = \delta_{jj} = 1$, $\delta_{ij} = \delta_{ji} = 0$ and the common values information structure has $\delta_{ii} = \delta_{ji} = \delta_{ij} = \delta_{jj} = 1$. The proof of Corollary 1 follows immediately from (C1) after substituting the restrictions just mentioned.

Corollary 1: (Private and Common Values Information Structures):

(a) *For the common values information structure, the unique equilibrium has both managers adopting a policy of not disclosing their private information unless the incentive weights chosen by the owners of the two firms are sufficiently different. If so, then the owners placing greater emphasis on revenues induce their manager to adopt a policy of disclosure while their rival's owners do not.*

(b) *For the private values information structure, the unique equilibrium has both managers adopting a policy of disclosing their private information about production costs with or without delegation.*

We also note that it is straightforward to extend our analysis to the case when managers are uncertain as to whether their information is, in fact, private. As long as there is a positive probability that the information is private, disclosure choices are the same as they would be if the managers were certain that their information is private. Intuitively, if the manager's information is not private, her disclosure choice is payoff–irrelevant and so the disclosure choice is made based only on the possibility that her information is, in fact, private.

6. Stage 1: The Owners' Delegation Decisions.

Working from the results in Proposition 1 and Theorem 1, we now turn to the owners' equilibrium delegation decisions: how much emphasis to place on revenues in the manager's employment contract. Each firm's owners choose the incentive weight that maximizes expected profits taking into account both whether the manager will subsequently find it optimal to adopt a policy of disclosure and the impact on how she competes in the firm's product market. Recall that the owners choose incentive weights simultaneously and that these choices are known by both managers.[27]

To characterize equilibrium contractual incentives, we use the result in Proposition 1 that each firm's expected profits are $\mathrm{E}[q_i^2(d_i, d_j)]$ and the results in Theorem 1 describing equilibrium disclosure choices (d_i and d_j). In particular, condition (C1) in Theorem 1 shows that the effect of delegating strategic choices on delegated disclosure choices depends on the relation between the ratio $(1+\lambda_i)/(1+\lambda_j)$ and 1. If this ratio is larger than one, the owners of firm i are choosing incentives to induce their manager to be more aggressive when competing in the product market relative to firm j and if it is less than one, the roles are reversed. Further, the equilibrium disclosure choices are tilted (relative to the no-delegation solution) toward providing the market with more information about the firm whose owners provide fewer incentives to compete aggressively in the product market firm and away from the firm whose owners provide more aggressive incentives.

Theorem 2: *When the manager has private information about costs, the ratio of the owners' equilibrium incentive weights is:*

$$\frac{1+\lambda_i^*(d_i, d_j)}{1+\lambda_j^*(d_i, d_j)} = \frac{B_i(d_i, d_j)}{B_j(d_j, d_i)}, \qquad \text{for } d_i \in \{D, N\}; \quad i = 1, 2; \; j \neq i$$

where:

[27] We also remind the reader that Kockesen [2007] shows that benefits similar to the type arising with observable contracts arise in settings such as ours when the act of delegation is observable even when the contract itself is not observable. Also, recall that SEC requirements on CEO compensation disclosure suggest that the appropriate modeling choice is to assume that the contracts are observable. Thus, we simplify the analysis by directly assuming that the contracts themselves are observable rather than just the fact that the decisions have been delegated.

$$
\begin{aligned}
B_i(D,D) &= \mathrm{E}[k_i](2\alpha_i - t\alpha_j - 2\mathrm{E}[k_i]) - 2{\delta_{ii}}^2\mathrm{Var}[k_i] - 2{\delta_{ij}}^2\mathrm{Var}[k_j] \\
B_i(D,N) &= \Big[\mathrm{E}[k_i](2\alpha_i - t\alpha_j - 2\mathrm{E}[k_i]) - 2{\delta_{ii}}^2\mathrm{Var}[k_i]\Big] \\
&\qquad \Big[\mathrm{E}[k_i]\mathrm{E}[k_j] + \delta_{ii}\delta_{ji}\mathrm{Var}[k_i] + \delta_{ij}\delta_{jj}\mathrm{Var}[k_j]\Big] \\
B_i(N,D) &= \Big[\mathrm{E}[k_i](2\alpha_i - t\alpha_j - 2\mathrm{E}[k_i]) - 2{\delta_{ii}}^2\mathrm{Var}[k_i] - 2{\delta_{ij}}^2\mathrm{Var}[k_j]\Big] \\
&\qquad \Big[\mathrm{E}[k_i]\mathrm{E}[k_j] + \delta_{ji}\delta_{jj}\mathrm{Var}[k_j]\Big] \\
B_i(N,N) &= 8\mathrm{E}[k_i](2\alpha_i - t\alpha_j - 2\mathrm{E}[k_i]) - (4-t^2){\delta_{ii}}^2\mathrm{Var}[k_i].
\end{aligned}
$$

Theorem 2 explains how equilibrium incentive weights are affected by the joint delegation of strategic and disclosure choices.[28] As expected, the exact conditions depend on subsequent disclosure choices but there are three common conditions that lead the owners of a firm to place greater incentive weight on revenues than its rival firm's owners do. However, it is easy to show that $B_i(D,\cdot) < B_i(N,\cdot)$ which implies that the owners of firm i choose a smaller incentive weight when their manager is expected to choose a policy of disclosure than if the manager is expected to choose a policy of non–disclosure, for any incentive weight chosen by the rival. In other words, disclosure substitutes for direct contractual incentives. Theorem 2 also provides a number of useful comparative static results all of which are derived by examining whether $B_i(d_i,d_j)/B_j(d_j,d_i)$ exceeds 1 or, equivalently, whether $B_i(d_i,d_j) - B_j(d_j,d_i) > 1$.

First, all else equal, the owners of the firm with the larger market size (firm i if $\alpha_i > \alpha_j$) offer incentives that induce their manager to compete more aggressively in the product market for all possible subsequent equilibrium disclosure choices. That is, $\alpha_i > \alpha_j$ implies that $(1+\lambda_i)/(1+\lambda_j) > 1$ in equilibrium for all disclosure regimes. Intuitively, the firm with the large market gains more from providing its manager with incentives to sell additional units by increasing the incentive weight on revenues relative to its rival. And, as a result, the information environment is tilted toward cost information about the firm with the smaller market share and away from the firm with the larger market share.

Second, in all but one case, an increase in firm i's expected marginal costs, keeping prior

[28] Theorem 2 offers the equilibrium ratio of incentive weights for each of the four possible disclosure regimes because each regime (managers of both firms commit to disclose, the manager of one firm commits and manager of the other does not, neither commits to disclose) is feasible in equilibrium. To see why, note that Corollary 1 ensures that in the private values case, disclosure is the unique choice. Similarly, there are values for market intercept and variance that ensure that the manager chooses to not disclose.

uncertainty unchanged, reduces the incentive weight the firm's owners put on revenues relative to the weight chosen by the rival firm's owners.[29] As a result, the manager is motivated to compete less aggressively in the firm's product market and, all else equal, leads to an increased inclination to disclose information that is predominantly useful in understanding the firm's marginal costs. That is, $(1 + \lambda_i)/(1 + \lambda_j) < 1$ when firm i is the high–cost producer, tilting the information environment toward cost information about the high–cost firm and away from cost information about the low–cost firm. Things are slightly different if the manager of firm i is induced to disclose her private information but the manager of the rival firm is not. In this case, firm i's rival will be fully informed while firm i will not learn its rival manager's private information. As a result, there is an additional strategic effect that impacts the owners' choice of incentive weight. So long as firm i is not at an extreme cost disadvantage, the results just described remain. Only when firm i's cost disadvantage is extreme do its owners respond by choosing a larger incentive weight on revenues than the rival's owners.

Third, Theorem 2 allows us to analyze the impact of differences in *a priori* uncertainty on equilibrium incentive weights and delegated disclosure. Uncertainty is usually measured as the variance of a random variable. However, because the variance depends on both the mean and dispersion and the mean has direct effects as described above, for clarity, we will instead focus on dispersion as measured by a mean preserving spread as our proxy for increased uncertainty. In all but one case, when uncertainty about firm i's marginal costs increases, the ratio of incentive weights declines and any induced disclosures by firm i's manager are tilted toward disclosing more information about her own costs and less information about her rival's. Things are slightly different if the manager of firm i is induced to disclose but the manager of firm j is not (when δ_{ii} and δ_{ji} are sufficiently different while δ_{ij} and δ_{jj} are sufficiently similar). Again, because manager i's rival is fully informed while she does not learn her rival manager's private information, an additional strategic effect arises that can alter the owners' choice of equilibrium incentive weights. Specifically, if manager i's private information is predominantly useful in understanding her own firm's marginal costs (δ_{ii} is sufficiently bigger than δ_{ji}), then an increase in uncertainty about firm i's marginal costs has the same effects as just described. However, if manager i's private information is predominantly useful to understanding her rival's marginal costs (δ_{ji} is sufficiently bigger than δ_{ii}), then the reverse occurs—an increase in uncertainty about firm i's marginal costs tilts toward

[29] Again, the results are obtained by examining the conditions under which $B_i(d_i, d_j) - B_j(d_j, d_i) > 1$.

manager i disclosing more information about firm j's costs and less information about her firm's costs. In all but this last possibility, a firm's owners benefit from the inherent uncertainty in costs and are therefore able to reduce the incentive weight on revenues. In the last possibility, when manager i discloses her private information while manager j does not, the information advantage provided to the rival is sufficient to cause the firm's owners to increase the incentive weight on revenues.

Finally, Theorem 2 offers insight into how the degree of product differentiation affects the joint delegation of strategic and disclosure choices. In particular, for fixed market sizes, if firm i has smaller expected marginal costs, the ratio of incentive weights increases—the owners of the firm with smaller expected marginal costs provide incentives that induce their manager to compete more aggressively in the product market and to be more willing to disclose information she has about her rival's marginal costs when the firms sell more differentiated products. Thus, in markets with less differentiated products, disclosure is inclined toward information about the high–cost firm and away from information about the low–cost firm.

Our analysis of joint delegation also offers insights into the impact of the firm's owners anticipating the rival manager's disclosure choice on equilibrium incentive weights.

Theorem 3: *If the firms differ only in how useful their private information about costs is to their rival, then the owners choose a larger incentive weight on revenues when the rival does not disclose its private information about costs when compared to the weight chosen when the rival does disclose* $(\lambda_i(\cdot, N) > \lambda_i(\cdot, D))$.

Intuitively, because profits are a convex function of the firm's production choice, the value of the firm is greater when the output chosen by the manager is more sensitive to the available information. The sensitivity to the available information is greater if the rival manager discloses her private information because the firm's manager can tailor her output choice to the rival's private information as well as her own. However, the sensitivity is also greater if the owners choose a larger incentive weight on revenues. Thus, Theorem 3 tells us that these two sources of sensitivity are substitutes in that the firm's owners opt to cut back on contractual incentives when the *rival's* disclosure will substitute for the "lost" sensitivity.

Before turning to empirical implications of joint delegation, we should summarize the information Theorem 2 provides about the impact of joint delegation on firm disclosures. Specifically,

incentives chosen by the firm's owners do not ensure that either disclosure or non–disclosure is always the induced choice by the manager. Rather, equilibrium incentives result in all four disclosure adoption choices (neither firm disclosing, one firm disclosing, the other firm disclosing, or both disclosing) arising for different parameterizations. Further, joint delegation alters both the likelihood of disclosure and what will be disclosed. For owners who choose to be the more aggressive competitor, joint delegation increases the likelihood of disclosure and tilts disclosure away from information that is predominantly about the disclosing firm and toward information that is predominantly useful to the rival. Conversely, for owners who choose to be the less aggressive competitor, delegation reduces the likelihood of disclosure, but if the manager does adopt a policy of disclosure, the incentives provided by the owners lead the manager to tilt the information she discloses toward information about her own firm. Thus, delegation shifts the information publicly available so that more is learned about less aggressive competitors and less is learned about more aggressive competitors.

Theorem 2 and Corollary 1 also highlight a stark difference between disclosure choices without delegation and disclosure with joint delegation. Specifically, absent delegation in the private values Cournot competition case, neither firm adopts a policy of disclosing private information (Gal–Or 1985, 1986, Darrough 1993 and our Corollary 1). In contrast, with joint delegation, Corollary 1 combines with Theorem 2 to show that owners of one firm may offer their manager sufficient incentives to compete aggressively in the product market which *also* induces their manager to choose to disclose her private information. Thus, with joint delegation, the more aggressive competitor may, in fact, choose a different disclosure policy than would have been chosen absent joint delegation.

7. Empirical Implications of Joint Delegation.

In this section, we combine our results from the prior two sections to develop empirical implications associated with joint delegation of disclosure and strategic choices. Focusing first on the implications for contractual incentive weights, we have shown that owners of the firm with a larger market or lower costs, in expectation, place greater weight on the firm's revenues so as to motivate their manager to be a more aggressive competitor in the product market. Further, for all firms, the incentive weight is smaller when owners anticipate that their manager will provide a voluntary disclosure. Thus, our model can be interpreted to predict that firms with larger market shares or who employ cost leadership strategies will offer incentive contracts that depend more heavily on realized revenues than firms that have smaller market shares or who employ differentiation strate-

gies. Further, for both groups, the contracts will place smaller weight on revenue performance for those firms whose managers offer more voluntary disclosures. Our analysis also shows that these same differences arise when comparing young versus mature firms and firms in industries with highly variable production costs versus firms in industries with more stable input prices.

Turning to the empirical implications of joint delegation on disclosure choices, we emphasize at the outset that none of these implications follow without delegation. That is, absent delegation, firm disclosure choices are not affected by expected market sizes, production costs or *ex ante* cost uncertainty. Specifically, our analysis implies that firms with larger expected profit margins are more likely to provide voluntary disclosures and less likely to provide voluntary disclosures that are predominantly related to their own costs. In contrast, firms with smaller expected profit margins are less likely to provide voluntary disclosures but more likely to provide voluntary disclosures that are predominantly related to their own costs. As a result, our model predicts that more information about the cost structure of firms with smaller expected profit margins and less information about the cost structures of firms with larger expected profit margins will be provided. Since our results on expected profit margins and larger product markets are similar, our analysis also suggests that firms with greater market shares are also more likely to provide voluntary disclosures but less likely to provide voluntary disclosures that are predominantly related to their own costs and so, again, there will be more information available about the cost structure of firms with small market shares and less information about the cost structures of firms with large market shares. Said differently, our model suggests that a main result of joint delegation is that more information about the "weaker" competitor and less information about the "stronger" competitor will be disclosed.

Our analysis also suggests that joint delegation is affected by the degree of product differentiation. Specifically, in markets with less differentiated products, joint delegation implies that disclosure is inclined toward information about the high–cost firm and away from information about the low–cost firm. Further, the degree of production differentiation also moderates the impact of different expected profit margins. The effects of different profit margins will be smaller in industries with high levels of product differentiation and will be larger in industries with less differentiation. Since these conditions are often associated with the firms' chosen business strategies, we expect that the magnitude of the effects will be greater for firms choosing cost leadership strategies and smaller for firms choosing differentiation strategies.

Finally, Theorem 3 offers new empirical predictions that relate managerial compensation to

rival firms' disclosures. First, it suggests that managerial compensation will be more sensitive to the firm's revenues in industries where voluntary corporate disclosures are less common and less sensitive in industries where they are more common. Second, it suggests that the difference should be greater in industries with short histories (those with greater prior cost uncertainty). Third, it suggests that the difference should be larger in industries with greater product heterogeneity.

While none of these predictions have been directly tested in the empirical literature, there is some work that relates disclosure and empirical measures of product market competition. Verrecchia and Weber [2006] focus on redacted disclosures as their measure of voluntary disclosure (redaction decisions are interpreted as reductions in voluntary disclosures) and find that more competitive industries redact less than less competitive industries. Dedman and Lennox [2009] also focus on redactions, but this time by private companies in the U.K.[30] Their measure of industry competition is from a survey of managers' perceptions of their firm's competitive environment. They find that managers who perceive competition to be greater more often choose to redact revenue and cost of sales information from their public filing. Li [2010] focus on management forecasts of earnings (or capital expenditures) as her measure of voluntary disclosure and uses a factor analysis–based measures of industry competition. She finds that the fraction of firms in an industry providing disclosures is smaller in industries where the first factor (which she interprets as a measure of industry competition) is greater and smaller where the second factor (which she interprets as a measure of the threat of entry) is greater. Karuna [2011] suggests that Li's factors are difficult to interpret and instead uses price–cost margin and market size as measures of competitiveness.[31] He focuses on voluntary disclosures of research and development costs, the number of employees and order backlog and finds that more competitive industries exhibit greater disclosure of both R& D costs and the number of employees.

8. Conclusions.

We study the joint delegation of strategic and disclosure choices in a model that synthesizes the delegation of strategic choices literature (*e.g.*, Brander and Lewis 1986, Fershtman and Judd 1987) and the *ex ante* voluntary disclosure literature (*e.g.*, Gal–Or 1985, 1986, Darrough 1993).

[30] Private companies in the U.K. are required to provide financial statements to their shareholders and banks. They are also required to provide them to a central depository but are permitted to redact revenue and cost of sales from this filing.

[31] Karuna [2007] provides evidence suggesting that the Herfindahl index does not perform well as a measure of product market competition.

We do this by assuming that each manager's compensation depends on the firm's realized revenues and profits and that both the decision to adopt a disclosure policy and the strategic decision of how much to sell in the product market are delegated to the firm's manager. Our first set of results describe firm characteristics that lead owners to place relatively greater incentive weight on revenues. Further, these incentive weights differ for managers who choose *ex ante* voluntary disclosure. Specifically, the owners of firms with larger expected markets, lower expected costs or less uncertainty about production costs choose to place greater incentive weight on revenues, thereby encouraging their manager to compete more aggressively in the product market relative to the rival. Further, the delegation of disclosure in addition to the delegation of strategic choices allows the firm's owners to reduce the incentive weight on revenues for managers who disclose their private information. Intuitively, the firm's owners choose how sensitive managerial compensation is to the manager's strategic choice and since this sensitivity is naturally greater if the manager opts to disclose, the firm's owners can and do substitute disclosure for direct incentives. The firm's owners can also substitute disclosures by their firm's rivals for direct incentives. That is, disclosure substitutes for direct contractual incentives.

Our second set of results relate to the impact of joint delegation on the decision to disclose. We find that owners of the firm who provide incentives for their manager to compete more aggressively in the product market also increase the likelihood that their manager opts to disclose and, perhaps more importantly, tilt (relative to the no–delegation solution) their manager's disclosure away from disclosing information that is predominantly informative about the firm's production costs and toward information that is predominantly informative about the rival's production costs. That is, joint delegation alters the information environment for competing firms by creating incentives to provide more information about production costs of less aggressive competitors and less information about production costs of more aggressive competitors.

Our analysis of joint delegation also produces a number of testable cross–sectional empirical implications. First, our results suggest that firms that adopt cost leadership strategies or that focus on serving mass markets use incentive contracts that rely more heavily on revenue metrics than do firms that employ differentiation strategies or focus on serving niche markets. Second, as mentioned above, joint delegation alters the information environment for the firms in a given industry: it reduces the information available about the larger, more aggressive competitors and increases the information about the smaller, less aggressive competitors. Third, our analysis suggests that firms

whose managers offer more (less) voluntary disclosures will have compensation contracts that rely less (more) heavily on revenue metrics. Fourth, our analysis suggests that these same relationships hold for firms that have less cost uncertainty either because key input prices are relatively stable or because the firms compete in mature markets when compared to firms whose key input prices are very uncertain or that are younger or in rapidly changing industries. Finally, our analysis offers an interesting linkage between the disclosure policy of a firm's rivals and the incentive contract chosen by the firm's owners. Specifically, the owners of a firm place greater incentive weight on revenues when *rival firm's* managers are not expected to offer voluntary disclosures. That is, in industries where disclosure by rivals is limited, owners induce their manager to compete more aggressively and increase the likelihood that their manager offers voluntary disclosures.

9. Appendix

Proof of Proposition 1: Manager i solves $\max_{q_i} \quad \mathrm{E}[(1+\lambda_i)(\alpha_i - q_i - tq_j)q_i - (\delta_{ii}c_i + \delta_{ij}c_j)q_i \mid \phi_i]$ which yields the first order condition $q_i = \mathrm{E}\big[\frac{1}{2}(\alpha_i - tq_j) - \frac{1}{2(1+\lambda_i)}k_i \mid \phi_i\big]$. Each of the cases differ in that the managers' information sets are different. For example, if both have committed to disclose, then both know c_i and c_j and thus both know k_i and k_j. In other words, the managers play a game of complete information and we obtain the standard result for $q_i(D,D)$. If manager i has committed to disclose but manager j has not, then manager i does not learn c_j. As a result, manager i's first order condition becomes $q_i = \frac{1}{2}(\alpha_i - t\mathrm{E}[q_j \mid c_i]) - \frac{1}{2(1+\lambda_i)}\mathrm{E}[k_i \mid c_i]$ and manager j's is the same as in the full information case. Solving produces $q_i(D,N)$ and, by symmetry $q_i(N,D)$. The final case, when both managers commit not to disclose, the first order conditions are again $q_i = \frac{1}{2}(\alpha_i - t\mathrm{E}[q_j \mid c_i]) - \frac{1}{2(1+\lambda_i)}\mathrm{E}[k_i \mid c_i]$ (where the difference in this case comes from using the fact that the manager of firm i knows that the manager of firm j does not know c_i while she does in the D,N case). Solving this pair of equations yields $q_i(N,N)$. In each case, substituting the equilibrium quantities into the manager's objective function produces the expression for her payoffs given in the Proposition. ∎

Proof of Theorem 1: Our proof strategy is to show that $\mathrm{E}[\pi_i^C(D,N)] > \mathrm{E}[\pi_i^C(N,N)]$ and then that $\mathrm{E}[\pi_i^C(D,D)] > \mathrm{E}[\pi_i^C(N,D)]$ which are the conditions required for disclosure to be the dominant strategy. Similarly, reversing the inequalities yields the conditions required for non–disclosure to be the dominant strategy. Direct computations show that

$$\begin{aligned}
&\mathrm{E}[\pi_i^C(D,N)] - \mathrm{E}[\pi_i^C(N,N)] = \mathrm{E}[\pi_i^C(D,D)] - \mathrm{E}[\pi_i^C(N,D)] \\
&\quad = \left(\frac{-t}{4(1+\lambda_i)^2(1+\lambda_j)^2(4-t^2)^2}\right) \\
&\qquad\qquad + (-4t(1+\lambda_i)^2{\delta_{ji}}^2 + 16(1+\lambda_i)(1+\lambda_j)\delta_{ii}\delta_{ji} + t(1+\lambda_j)^2(-8+t^2){\delta_{ii}}^2)\mathrm{Var}[c_i]\Big].
\end{aligned}$$

Thus, if (C1) holds, disclosure of private information about production costs is manager 1's dominant strategy. If (C1) fails, non–disclosure is her dominant strategy. ∎

Proof of Theorem 2: Each firm's owners choose the incentive weight to offer their manager simultaneously and so we determine their equilibrium choices in the usual way. First, the owners of firm i solve $\max_{\lambda_i(d_i,d_j)} \mathrm{E}[q_i(d_i,d_j)^2]$ which yields the first order condition $0 = \mathrm{E}[2q_i(d_i,d_j)\frac{\partial q_i(d_i,d_j)}{\partial \lambda_i}]$. These equations are then solved simultaneously for the equilibrium incentive weights. The expressions are most easily simplified by computing the ratio $(1+\lambda_j)/(1+\lambda_i)$ to obtain the expressions in the text. ∎

Proof of Theorem 3: Tedious calculations using the results on incentive weights from Theorem 2 show that

$$\lambda_i(\cdot,N) - \lambda_i(\cdot,D) = \mathrm{E}[a_i]\mathrm{E}[c_i]^5(8-t^2)(4-t^2) + 2t^3\mathrm{E}[c_i]^3\mathrm{E}[a_i](16-8t-2t^2-t^3)\mathrm{Var}[c_i].$$

Because $t<1$, both the first and second terms are positive. Thus, the incentive weight when the firm's rival manager does not disclose exceeds the incentive weight when the rival manager does disclose. ∎

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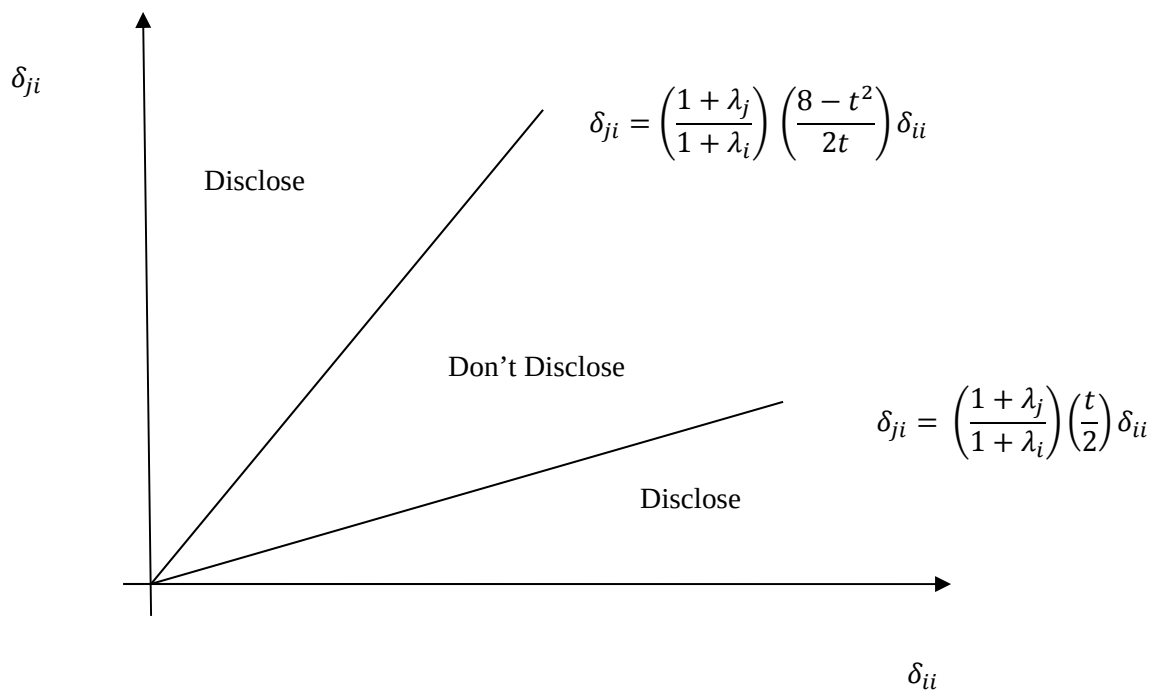
Figure 1
Equilibrium Disclosure Choice



This figure provides a graphical representation of condition (C2) from Theorem 1. Specifically, $\delta_{ji} = \left(\frac{1+\lambda_j}{1+\lambda_i}\right)\left(\frac{t}{2}\right)\delta_{ii}$ represents the first part of (C2) and $\delta_{ji} = \left(\frac{1+\lambda_j}{1+\lambda_i}\right)\left(\frac{8-t^2}{2t}\right)\delta_{ii}$ represents the second part.