5-17-2018

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Li, Jing; Liu, Tingjung; and Zhao, Ran, "Preemption Through Non-disclosure" (2018). Accounting Faculty Articles and Research. 12.  
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Preemption Through Non-disclosure

Comments
Working paper
Preemption Through Non-disclosure

Jing Li, Tingjun Liu, and Ran Zhao*

May 17, 2018

Abstract

An informed bidder can voluntarily disclose his private information on the value of an auctioned asset to rival bidders and the seller. We examine the informed bidder’s optimal disclosure policy and the resulting consequences on the seller’s payoff. We show that the informed bidder strategically withholds information to create a winner’s curse for rival bidders, which has a preemptive effect on the rival’s participation. Taking into account this strategic response, we show that increased competition among bidders may reduce the seller’s payoff—a surprising result that is contrary to the common belief that bidder competition generally increases the seller’s payoff.

Keywords: Asymmetric Auctions, Voluntary Disclosure, Preemption.

JEL Codes: D44, D82

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1 Introduction

Bidders in auctions are often asymmetrically informed about the value of the auctioned asset. Some bidders may gain valuable private information that is unknown to other bidders or the seller. For example, takeover contests often involve inside bidders from the management team or existing large shareholders who obtain private information about the company and contest with other bidders. Similarly, in the IPO market, institutional buyers are perceived to know more about the issuing firm (seller)’s value than other investors and even the firm itself (Rock, 1986). Another example is that in auctions for mining rights of natural resources, some buyers with expert knowledge are in a better position to evaluate and obtain a more accurate estimation regarding the object’s true value than others.

Prior literature on auctions with asymmetric bidders typically takes the information asymmetry among bidders as given. In such a framework, the literature has examined bidders’ bidding strategies for given auction formats, as well as the optimal auction design that maximizes the seller’s revenues (Maskin and Riley, 2000; Campbell and Levin, 2000; Povel and Singh, 2004, 2006; Liu, 2016; etc). Little attention is paid to the information disclosure incentive of the better-informed bidder, which is an important aspect in such auctions. If the informed bidder can publicly release his information to other bidders and the seller, what is his optimal disclosure strategy? How does the level of competition influence the disclosure strategy? Is the seller always better off when competition is stronger, taking such influences into account?

We address these questions in a simple auction model with one informed and one uninformed bidder. For ease of exposition, we pose our analysis in the context of management buyout, which is perhaps the simplest example of
such asymmetric auctions. Management buyout (MBO) is a form of takeover in which a firm’s management initiates an offer to bring the firm private. The manager, who seeks to buy the company for the lowest possible price, typically has access to information on the firm’s future prospects that is not available to shareholders and outsiders. The management is required to provide incremental disclosures about the details of the transaction and the fairness of the price, yet in practice, managers have discretion regarding the amount of information that they disclose to the market before a buyout announcement.

In our model, a firm’s manager has private information on the firm’s fundamental value, and a buyout provides the manager with a private benefit of control, giving rise to gains to trade. There is an outside bidder who would also gain a private benefit of control. We assume that the types (benefits of control) of the manager and outside bidder are common knowledge, and the former exceeds the latter. The nature of the manager’s information is either “hard” or “soft,” wherein only hard information can be credibly disclosed. The timing is as follows. The manager first observes the firm value. When this information is hard in nature, he decides whether to truthfully disclose it to shareholders and outside bidders, or to withhold it. After the manager makes this disclosure decision, he and the outside bidder participate in an ascending price auction. The auction winner then makes a take-it-or-leave-it offer to shareholders in which the offer must be at least as high as the winning price from the auction, and shareholders accept an offer if and only if it is at least as high as the expected firm value given all public information at that time.

The existing literature has focused on settings without the competitive bidder, and there is a standard unraveling result following Grossman (1980) and Milgrom (1981). This result reflects the intuition that a manager has an incentive to reveal bad news to shareholders in order to buy the firm at a
low price when the true value is indeed low. However, shareholders are rational and apply skeptical beliefs upon non-disclosure to require, at the very least, a break-even price. This breaks down any equilibrium that features non-disclosure. In our model, two forces prevent such an unraveling.\textsuperscript{1} The first force is well-understood: because the manager’s information may be soft in nature, and hence cannot be credibly disclosed, a manager who receives hard and favorable information can “pool” through non-disclosure.\textsuperscript{2}

The second force that prevents full unraveling, which is new in our setting, is the competition from the outside bidder. We show that the competition introduces an endogenous cost to disclosure. Indeed, even in the limit that the manager’s information is always hard so that the first force vanishes, the competition effect alone still leads to non-disclosure, breaking down unraveling. This second force is the key insight of our model, yet incorporating the first force helps us to derive further comparative static implications with respect to the nature of information endowment.

Intuitively, the manager’s disclosure influences the outside bidder’s strategy, which affects the manager’s payoff. If the manager discloses his private information, the bidder faces no uncertainty about the firm value and hence bids up to his total valuation— the firm value plus the bidder’s type (benefit of control). This exceeds shareholders’ break-even price, and hence becomes the final price that the manager pays. If, instead, the manager does not disclose his private information, the bidder is uncertain about the true firm value. This

\textsuperscript{1}Prior literature has studied the disclosure decision of an informed seller, and finds that unraveling breaks down for different reasons, such as an explicit disclosure cost (Jovanovic, 1982; Verrecchia, 1983), uncertainty about the seller’s information endowment (Dye, 1985; Jung and Kwon, 1988), or uncertainty about the receiver’s preference (Bond and Zeng, 2018).

\textsuperscript{2}This is similar to disclosure models with uncertainty about the information endowment (Dye, 1985), in that a manager who receives information can pool with a manager who does not.
uncertainty creates a winner’s curse that preempts the bidder: we show that the bidder will not bid above the break-even price, and the bidding outcome is as if the bidder had never participated—an effect similar to Fishman (1988). As a result, the manager pays the shareholders’ break-even price, which is not augmented by the bidder’s type. Therefore, the manager’s incentive to disclose information is reduced when an outside bidder is involved. Furthermore, as the competition intensifies (the outside bidder’s type increases), the threshold of disclosure decreases—hence less disclosure.

Because of the preemptive effect of non-disclosure, shareholders benefit from a bidder’s participation only when the manager possesses and discloses hard information. Perhaps surprisingly, we find that shareholders may be hurt by stronger competition. Although more competitive bidders directly increase payment to shareholders upon disclosure, they also make the manager more likely to withhold information, which attenuates the benefit shareholders receive from competition. We show that when the manager’s type is sufficiently large, the negative effect from increased non-disclosure may dominate. As a result, more competitive bidders may actually reduce shareholder payoffs, as the manager reduces disclosure significantly in response to intense competition from outside bidders.

We then extend our model to consider the possibility that a manager can be of two types—low or high—whose realization is unknown to the bidder or shareholders and the bidder’s type is between these two types. This adds a richer dynamics to the base model: in this scenario the bidder does not necessarily face a winner’s curse because he earns a strictly positive profit if he wins against a low-type manager. Thus the bidder balances the gains from winning against a low-type manager versus the losses from winning against a high-type manager. We show that the bidder’s strategy depends on how his
type compares with a critical cutoff value that is some measure of the ex-ante expected type of the manager. When the bidder’s private value is below the cutoff value, the winner’s curse effect dominates, and the bidder’s participation is again preempted given non-disclosure, as with the base model. In this case, all of our findings vis-à-vis our base model remain qualitatively unchanged. When the outside bidder is relatively strong and his private value exceeds the cutoff, the winner’s curse is of less concern, and the bidder is willing to bid more aggressively to capitalize on the potential gains from winning the low-type manager. In this case, the preemptive effect of non-disclosure is reduced, but importantly, it does not diminish. We show that the manager’s strategic non-disclosure still has a partial preemptive effect, and the outside bidder’s role in improving shareholders’ payoff is restrained.

The “preemptive” effect in our model is closely related to the concept of preemptive bidding in Fishman (1988) that shows how the first mover in a game can strategically preempt subsequent players. In his private value auction model, a high-type bidder makes a high (preemptive) initial bid that discourages a potential rival from learning his own value and participating in the bidding contest. In our model, by contrast, firm valuation has both a common component and a bidder-specific component, and information asymmetry concerns the common component. We show how Fishman’s insights extend to such a setting. The informed bidder strategically withholds information to create a winner’s curse that effectively preempts the uninformed bidder from participating.

Our paper also contributes to the literature on information disclosure in auction settings. Prior studies have focused on the disclosure problem of the seller who possesses or controls the access to private signals that affect the
valuation of the buyers. To our best knowledge, our study is the first to examine the voluntary disclosure decision by an informed bidder in a setting where other bidders are relatively less informed. Such disclosure enables the informed bidder to alter the degree of information asymmetry among bidders. Our findings reveal that in such a setting where the bidder makes the disclosure decision, withholding of information has a preemptive effect on rival bidders, and that such preemptive effect is stronger when competition increases so that greater competition can reduce the seller’s profit in equilibrium.

Our findings provide policy implications for the governance of the buyout process, highlighting the necessity for the board to account for managers’ disclosure incentives when making decisions with regard to intensity with which to seek outside bidders. A “market check,” which seeks potential competitive bidders to contest with management or puts the firm on auction, is often viewed as an important safeguard for shareholders receiving fair value. We show that the board must carefully consider the consequences of conducting such a bidding contest in evaluating its merits for maximizing shareholders’ welfare. The board should take into account the endogenous response of the manager’s disclosure policy when seeking outside bidders to contest with the manager. It is not always in shareholders’ best interest for the board to seek the strongest bidder in the market, as a strong bidder may discourage a manager from disclosing information, which reduces shareholders’ payoffs. Our findings show

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3Milgrom and Weber (1982) show that the seller prefers to fully disclose his information to buyers, which maximizes his expected revenue. Eso and Szentes (2007) also find that a monopolist seller maximizes the expected value by making available all or part of the information “new” to the buyers. Li and Shi (2017) show that a seller’s optimal disclosure is discriminatory, which maximizes the seller’s revenue by releasing different amounts of additional information to different types of buyers.

4It is common for management buyout transactions to involve competition from outside bidders. Easterwood, et al. (1994) find that 39 percent of buyout proposals faced explicit competition and involved multiple bidders, and 16 percent experienced other forms of competitive takeover activity but did not receive a formal outside offer.
that the “optimal” level of competition may decrease with the manager’s type.

Our paper proceeds as follows. Section 2 presents the base model and analyzes the equilibrium. Section 3 extends the analysis to a setting in which the manager’s type is his private information. Section 4 concludes.

2 Base model

2.1 Model setup

A firm is a potential buyout target with a fundamental value of \( v \), where \( v \) is drawn from a uniform distribution over \([0, \bar{v}]\). The firm manager (the informed bidder) observes \( v \) perfectly, but outsiders (shareholders and an outside bidder) only know its distribution. By acquiring the company via a buyout, the manager gains a private benefit of control of \( m > 0 \); thus the manager values the firm at \( v + m \). We refer to \( m \) as the manager’s type. An outside bidder would also gain a private benefit of control of \( t > 0 \) if he acquires the company. We refer to \( t \) as the bidder’s type. For simplicity, in our base model we assume both \( t \) and \( m \) are publicly known and that \( 0 < t < m \). We also assume that \( m \leq \frac{\bar{v}}{2} \), which simplifies the analysis and guarantees the uniqueness of equilibrium. In Section 3 we introduce asymmetric information on types and show that our basic insights carry through.

While the manager is informed about the value of \( v \), the nature of the manager’s information can be either “soft” or “hard.” “Hard” information refers to information that can be verified and quantified, for example, a firm’s earnings or sales. “Soft” information refers to information that cannot be verified, for example, information about human capital or customer satisfaction, and so

\[5\] If, instead, the bidder’s type exceeds the manager’s, the game becomes trivial: that is, the manager always loses, and hence the disclosure policy is irrelevant.
forth. With probability $\gamma \in (0, 1)$, the manager’s information is soft. With probability $1 - \gamma$, the manager’s information is hard. Soft information cannot be credibly disclosed, nor can the manager credibly convey to the market that his information is soft. Only when the manager receives hard information could he choose to disclose his information. We assume that disclosure must be truthful. We label the manager’s disclosure choice by $\omega \in \{D, ND\}$, representing disclosure and non-disclosure, respectively. A manager with soft information can only choose $ND$, whereas a manager with hard information can make either choice. The manager’s disclosure choice is publicly observed, which conveys information about firm value to both shareholders and the outside bidder, thereby affecting the buyout outcome.

After the manager makes the disclosure choice, he and the outside bidder participate in an ascending-price auction in which the price rises continuously from zero until one bidder (either the manager or the outside bidder) exits. The winner then makes a take-it-or-leave-it offer to shareholders that must be at least as high as the winning price from the auction. Shareholders are rational and update their beliefs about the fundamental value $v$ given all public information available. The public information includes the manager’s disclosure choice $\omega$, the identity of the winner, and the fact that the winner is willing to pay his final offer. Shareholders accept the offer if they at least break even, or the buyout fails.

Figure 1 shows the timing of events.

2.2 Equilibrium analysis

In this section we characterize a manager’s disclosure policy and derive equilibrium consequences. The presence of the competitive bidder introduces rich dy-
namic interactions: the manager’s disclosure policy not only influences shareholder beliefs about the firm value, but more importantly, it affects the bidder’s strategy and hence the bidding outcome, which in turn feeds back to shareholders’ information set in determining the break-even price.

We assume that no weakly dominated strategies are played in equilibrium—a standard assumption for robustness against trembling hands. As a result, the bidder will participate in the bidding even though he will not win in equilibrium given the common knowledge that his type is less than that of the manager. Our assumption of common knowledge about types is made only for simplicity, which allows us to convey the key insights in the most transparent way. In Section 3 we relax this assumption to incorporate asymmetric information about the manager’s types, and we show that our insights carry through.\footnote{If we instead incorporate private information over $t$, our main insights also go through. The analysis is simpler (and not as interesting) in this case.}

2.2.1 Equilibrium characterization

**Bidding strategies.** We first solve the bidding game between the manager and the bidder, given the manager’s disclosure choice. Our assumption that no weakly dominated strategies are played in equilibrium pins down the manager’s strategy: because he observes the true firm value $v$, he has a weakly
The bidder’s strategy, on the other hand, depends critically on the manager’s disclosure choice.

**Definition 1** The bidder’s strategy, denoted by $\beta_t^\omega$, is the price at which type-$t$ bidder exits the ascending price auction given the manager’s disclosure choice $\omega$.

When the firm value $v$ is disclosed ($\omega = D$), the bidder knows precisely the value of the firm to him, and hence he has a weakly dominant strategy, $\beta_t^D = v + t$. Because $m > t$, the manager wins the auction at $\beta_t^D$.

When the manager chooses non-disclosure ($\omega = ND$), the bidder is uncertain about the firm value. This uncertainty creates a winner’s curse for the bidder (because winning against the manager implies suffering a loss) that significantly affects the bidder’s strategy as we will show. Technically, complications arise because a weakly dominant strategy does not exist and multiple equilibria may arise;\(^8\) nonetheless, we show that $\beta_t^{ND}$, the bidder’s strategy given non-disclosure, is bounded. The following summarizes the bidder’s strategies.

**Lemma 1** When the manager discloses firm value, the bidder’s strategy is $\beta_t^D = v + t$. When the manager does not disclose, the bidder’s strategy $\beta_t^{ND}$ is bounded, $t \leq \beta_t^{ND} \leq \min \{m, \bar{v} + t\} \leq m$.

The result $t \leq \beta_t^{ND}$ reflects that the firm’s fundamental value $v$ is at least zero, and hence the bidder values the firm at least $t$. The other result, $\beta_t^{ND} \leq \min \{m, \bar{v} + t\}$, is a key component of our analysis. To understand

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\(^8\)Multiple equilibria arise due to freedom in specifying out-of-equilibrium beliefs about the expected firm value if the manager exits prior to his equilibrium strategy.
it, first note that $\beta^N_D \leq \bar{v} + t$ because $v \leq \bar{v}$. Next, suppose the bidder wins at some price $p_e \in (m, \bar{v} + t]$. It then must be the case that $v = p_e - m$ such that the manager drops out at $p_e$,\footnote{This occurs in equilibrium with a positive probability: if $v = p_e - m$, and the manager has soft information and hence cannot disclose $v$, he exits at $p_e$.} implying that the bidder would suffer an immediate loss of $m - t$ upon winning. This is the source of the winner’s curse that we previously mentioned. As a result, the bidder would never bid past $m$.

**The buyout offer.** Recall that the manager’s buyout offer after winning the auction must be at least as high as the winning price from the auction. Thus

$$p^\omega \geq \beta^\omega_t \text{ for } \omega \in \{D, ND\},$$

where $p^\omega$ denotes the manager’s buyout offer.

Shareholders are rational and set their break-even price as the expected firm value conditional on all public information available. We denote by $v^\omega_{BE}$ this break-even price for a given disclosure strategy $\omega$. When the manager discloses $v$, we simply have

$$v^D_{BE} = v.$$  \hfill (2)

Because under disclosure the outside bidder bids up to $v + t$, which exceeds $v^D_{BE}$, the manager’s buyout offer is

$$p^D = \beta^D_t = v + t.$$  \hfill (3)

When the manager does not disclose, shareholders update their beliefs about firm value accordingly, given their belief about types of managers who do not disclose and taking into account that the manager’s offer $p^N_D$ is profitable to the manager—namely, $v + m \geq p^N_D$. Thus

$$v^N_D_{BE} = E[v|ND, v \geq p^N_D - m],$$  \hfill (4)
and shareholders accept the offer if and only if

\[ p^{ND} \geq v^{ND}_{BE}. \]  \hspace{1cm} (5)

Because the manager makes a take-it-or-leave-it offer, the offer is the lowest price that satisfies (5) and (1). Otherwise, the manager could lower the offer and still have it accepted. Thus, in equilibrium, we have

\[ p^{ND} = \max\{\beta^{ND}_t, v^{ND}_{BE}\}. \]  \hspace{1cm} (6)

Given \( \beta^{ND}_t \) and shareholders’ belief about the manager’s disclosure strategy, Eq. (6)—where \( p^{ND} \) is the unknown—has at least one solution over \( p^{ND} \in [0, \bar{v}] \). This follows from the intermediate value theorem and Lemma 1.\(^{10}\) If multiple solutions exist to (6), \( p^{ND} \) is the smallest of them.

By Lemma 1, the right-hand side of (6) is no less than \( t \), thus

\[ p^{ND} \geq t. \]  \hspace{1cm} (7)

**Manager’s disclosure strategy.** When the manager has hard information, he makes the disclosure choice based on the respective payoffs, disclosing if and only if the buyout payment upon disclosure is less than that upon non-disclosure; i.e., \( p^D < p^{ND} \). Thus, substituting (3) for \( p^D \), we obtain the manager’s disclosure strategy as follows.

\[ \text{Lemma 2 } A \text{ manager with hard information discloses if and only if } v < \mu, \]

where

\[ \mu = p^{ND} - t. \]  \hspace{1cm} (8)
Lemma 2 shows that the manager’s disclosure strategy is characterized by a threshold $\mu$, which is the value of $v$ when the manager is indifferent between disclosing and non-disclosing. By (7), $\mu \geq 0$. Furthermore, the lemma implies that a manager who receives hard information and chooses not to disclose is always willing to make an offer at $p^{ND}$, because his expected payoff from the buyout is positive, $v + m - p^{ND} > 0$ (by $v \geq \mu$ and $m > t$). However, a manager who receives soft information and cannot credibly disclose it may not always find it profitable to make an offer that is acceptable to shareholders. Specifically, when the firm value is so low that the expected payoff for the manager becomes negative (i.e., when $v + m < p^{ND}$), the manager chooses not to make an offer, foregoing the buyout opportunity even though it is socially optimal.

These implications facilitate the computation of shareholders’ break-even price given non-disclosure, $v_{BE}^{ND}$, in (4). Concretely, shareholders’ updating of beliefs about the firm value is based on the probabilities of two events: (1) a manager with hard information chooses to withhold the information, implying $v \geq \mu$; and (2) a manager with soft information cannot disclose, but chooses to make a buyout offer at $p^{ND}$, implying $v \geq \max\{p^{ND} - m, 0\}$. We denote the probabilities of these events by $\tau_1$ and $\tau_2$, respectively, where

$$
\tau_1 = (1 - \gamma) \frac{\bar{v} - \mu}{\bar{v}},
$$

$$
\tau_2 = \gamma \frac{\bar{v} - \max\{p^{ND} - m, 0\}}{\bar{v}}.
$$

Substituting the event probabilities $\tau_1$ and $\tau_2$ into the conditional expectation in (4), yields

$$
v_{BE}^{ND} = \frac{\tau_1}{\tau_1 + \tau_2} \mathbb{E}[v|v \geq \mu] + \frac{\tau_2}{\tau_1 + \tau_2} \mathbb{E}[v|v \geq \max\{p^{ND} - m, 0\}]
$$

$$
= \frac{1}{\tau_1 + \tau_2} (\tau_1 \frac{\bar{v} + \mu}{2} + \tau_2 \frac{\bar{v} + \max\{p^{ND} - m, 0\}}{2}).
$$

(9)
Lemma 3 Under non-disclosure, the bidder’s exit price is below shareholders’ break-even price: \( \beta_t^{ND} \leq v_{BE}^{ND} \).

To understand the lemma, observe that (9) yields \( v_{BE}^{ND} \geq \bar{v}/2 \). Intuitively, this reflects that the manager’s non-disclosure and willingness to make an offer both convey positive news about firm value. The reason is that the non-disclosure either implies \( v \geq \mu \) if the manager has hard information or conveys no information about firm value if the manager has soft information, and that the willingness to make an offer \( p^{ND} \) implies \( v \geq p^{ND} - m \). Hence shareholders’ updated belief about firm value is no less than the prior. By Lemma 1 and \( m \leq \bar{v}/2 \), Lemma 3 follows.

Lemma 3 has the critical implication that when the manager withholds information, the bidder’s exit price is even below the break-even price of shareholders, although the bidder values the firm more than the shareholders. This is in sharp contrast to what happens when the manager discloses firm value, in which case, as (3) shows, the bidder will bid beyond shareholders’ break-even price, rendering shareholders with a profit of \( t \). Such a contrast reflects our insight that non-disclosure creates a winner’s curse for the bidder that deters the bidder from competition. Lemma 3 shows that this deterrence is so strong that it fully preempts the bidder. The bidding outcome is as if the bidder had never participated: shareholders do not receive any benefit from the bidder’s participation, which in turn benefits the manager. This effect, as we will show, creates incentives for the manager to withhold information in equilibrium.\(^{11}\)

\(^{11}\)If we relax our assumption \( m \leq \bar{v}/2 \) to allow for \( m > \bar{v}/2 \), in some of the (multiple) equilibria, it is then possible that \( \beta_t^{ND} > v_{BE}^{ND} \) such that shareholders do receive some benefit from the bidder’s participation. Nonetheless, our basic insights remain in that upon non-disclosure, shareholders do not receive the full benefit of the bidder’s participation, and this creates incentives for the manager to withhold information. Concretely, Lemma 1 implies \( \beta_t^{ND} \leq \bar{v} + t \); as long as the strict inequality holds (which would be the case in all equilibria if \( m < \bar{v} + t \)), when firm value is sufficiently high, the manager makes a strictly higher profit if he withholds than if he discloses information.
By Lemma 3, (6) simplifies to

\[ p^{ND} = v^{ND}. \]  \hspace{1cm} (10)

Because \( v^{ND}_{BE} \geq \frac{\bar{v}}{2} > m \), by (10), \( \max \{ p^{ND} - m, 0 \} = p^{ND} - m \). Thus (9) simplifies to

\[ v^{ND}_{BE} = \frac{1}{\tau_1 + \tau_2} \left( \tau_1 \frac{\bar{v} + \mu}{2} + \tau_2 \frac{\bar{v} + p^{ND} - m}{2} \right). \]  \hspace{1cm} (11)

Combining the indifference condition in (8), the buyout offer in (10), and the break-even price in (11), we obtain a unique solution over \( \mu \in [0, \bar{v}] \):

\[ \mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2}. \]  \hspace{1cm} (12)

Plugging (12) into (8) yields

\[ p^{ND} = \bar{v} - \sqrt{\gamma m^2 + (1 - \gamma) t^2}. \]  \hspace{1cm} (13)

**Proposition 1** In equilibrium, the non-disclosure threshold \( \mu \) for a manager with hard information is given by (12). Upon non-disclosure, the bidder exits before the shareholders’ break-even price, and the manager buys out the firm at a price given by (13).

### 2.2.2 Equilibrium implications

To understand the implications of the equilibrium in Proposition 1, we first compare with a benchmark case in which the competitive bidder is not present. Observe that (10) and (11) hold in this case, and that (8) holds with zero replacing \( t \). Hence, the disclosure strategy and the winning price are the same as in Proposition 1 upon setting \( t = 0 \). Thus we have the following corollary.

**Corollary 1** Without the competitive bidder, the non-disclosure threshold for a manager with hard information and the shareholders’ break-even price are:
\[ \mu_0 = p_0^{ND} = \bar{v} - m\sqrt{\gamma}. \] when the manager’s information is always hard \((\gamma \to 0)\), information fully unravels \((\mu_0 \to \bar{v})\).

The result that \(\mu_0 < \bar{v}\) in Corollary 1 reflects the incentive to withhold information in the presence of soft information. The intuition has been explained in the existing literature on voluntary disclosure (typically by the seller) with uncertainty about the information endowment in the absence of competition (Dye, 1985; Jung and Kwon, 1988): An informed seller benefits from withholding unfavorable information and pooling with a seller who does not receive information, which increases the price he can sell. In our setting, the informed buyer (the manager) who receives hard information about firm value above a certain threshold optimally withholds information, this allows him to pool with those managers with soft information that cannot be credibly disclosed, thereby lowering the payment he has to make.

However, this effect weakens when the ex-ante probability that the manager’s information is hard increases \((\gamma \downarrow)\); that is, when the market expects the manager is likely to have hard information, the disclosure threshold rises—the manager discloses more. In the limit that the manager’s information is always hard, the manager always discloses. This is the standard unraveling result in Grossman (1981) and Milgrom (1981). If shareholders are certain that the manager’s information is hard, they apply the skeptical belief: when the manager withholds information, shareholders infer that the manager is concealing favorable information which, if disclosed, would increase his payment. In response to this, the manager always discloses his information in equilibrium.

When a competitive bidder is present, the manager’s incentives to disclose information change. Intuitively, in the benchmark case without the bidder, the manager makes a profit of \(m\) when he discloses firm value. With the bidder,
when firm value is disclosed, the manager’s payment for the buyout is \( v + t \), which is the exit price of the bidder in the bidding contest, and the manager’s profit is only \( m - t \). By contrast, if the manager withholds information, he is able to effectively preempt the bidder from participating, thus still making an expected profit of \( m \). Thus, the manager’s incentives to withhold information are stronger when an outside bidder is present due to the wedge between the manager’s payoffs (\( m \) versus \( m - t \)). This breaks down the unraveling result without competition when \( \gamma \) approaches zero, and lowers the disclosure threshold at all \( \gamma \).

**Proposition 2** For all \( \gamma > 0 \), the non-disclosure threshold is lower with the outside bidder than without, \( \mu_0 > \mu \). In particular, when \( \gamma \) approaches zero, non-disclosure persists (\( \mu|_{\gamma=0} = \bar{v} - 2t < \bar{v} \)) with the bidder.

### 2.3 Comparative statics

We now examine the comparative statics of the disclosure threshold \( \mu \) and shareholders’ payoffs with respect to the following: (1) the manager’s information nature as measured by \( \gamma \), (2) the competitiveness of the bidder as measured by \( t \), and (3) the manager’s benefit of control as measured by his type \( m \).

#### 2.3.1 Disclosure thresholds

The manager’s information nature affects the equilibrium disclosure threshold through its impact on shareholders’ belief given non-disclosure. When the manager’s information is more likely to be soft (\( \gamma \) increases), shareholders believe that any non-disclosure is more likely due to the manager’s inability to credibly communicate information even though he may have observed a low value. Hence, the expected firm value conditional on non-disclosure is lower.
As a result, a manager who receives hard information can benefit by withholding information and paying a lower break-even price, which leads to less disclosure.

**Corollary 2** For any \( t \), the equilibrium non-disclosure threshold \( \mu \) decreases with \( \gamma \).

We now analyze the impact of the intensity of competition (as captured by \( t \)) on the manager’s disclosure policy. We show this impact is strong because competition induces two compounding effects that mutually reinforce and feedback. First, recall that the manager’s profit is \( m - t \) when he discloses the true value to the bidder. The stronger the competition (larger \( t \)), the lower the manager’s profit given disclosure. Therefore, the manager’s incentive to create the winner’s curse through non-disclosure is stronger when competition increases, taking shareholders’ break-even price as given. Second, the increased incentives to withhold information—which leads to lower \( \mu \)—decrease shareholders’ expectation of the firm value upon non-disclosure and further increases the incentives to withhold information.\(^{12}\)

**Corollary 3** Stronger competition leads to less disclosure: for any \( \gamma \), the equilibrium non-disclosure threshold \( \mu \) decreases with the bidder’s type \( t \).

Finally, we examine the effects of the manager’s own type \( m \).

**Corollary 4** A stronger manager discloses less: for any \( \gamma \), the equilibrium non-disclosure threshold \( \mu \) decreases with the manager’s type \( m \).

\(^{12}\)Intuitively, (11) shows how \( v_{BE}^{ND} \) decreases as \( \mu \) decreases; more precisely, (13) shows how \( p^{ND} \) decreases as \( t \) increases.
Corollary 4 shows that the manager’s benefit of control $m$ has a similar effect on the disclosure threshold as the bidder’s type $t$. However, the intuition is different. When $m$ increases, a manager with soft information (who is unable to disclose firm value) can afford the shareholders’ break-even price even if the actual firm value is low. Therefore, given non-disclosure, shareholders’ expected firm value is lower. This in turn incentivizes a manager with hard information to withhold his information (in which case he pays the shareholders a lower break-even price, thus driving down the disclosure threshold.

### 2.3.2 Shareholders’ expected profit

In this section we examine shareholders’ expected profit in equilibrium. Upon non-disclosure, shareholders receive zero expected profit because the manager pays the break-even price; upon disclosure, shareholders receive a premium of $t$ above the firm value because the bidder bids up to $v+t$. Therefore, the overall expected profit takes a simple form, which is the probability that the manager discloses, multiplied by $t$. As the manager discloses only when he has hard information (with probability $1-\gamma$) and $v < \mu$ (with probability $\frac{\mu}{\bar{v}}$), we have:

**Corollary 5** In equilibrium, shareholders’ expected profit is

$$\Pi_s = \frac{(1-\gamma)\mu}{\bar{v}}t. \quad (14)$$

By (12), $\mu$ is a function of the manager’s information nature $\gamma$, the manager’s type $m$, and the bidder’s type $t$, and thus (14) expresses shareholders’ expected profit $\Pi_s$ as a function of $\gamma$, $m$, and $t$ (either explicitly or implicitly). We now use (14) to analyze how $\Pi_s$ varies with $\gamma$, $m$, and $t$.

**Corollary 6** Shareholders’ expected profit in equilibrium decreases with both $\gamma$ and $m$. 

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Intuitively, when $\gamma$ increases, the manager’s information is more likely to be soft, which directly reduces the likelihood of disclosure. Furthermore, in the event that the manager has hard information, the equilibrium non-disclosure threshold $\mu$ decreases with $\gamma$ as (12) shows, which further (indirectly) reduces the likelihood of disclosure. Taken together, increasing $\gamma$ leads to an overall reduction in disclosure, lowering shareholders’ expected profit from buyout. Similarly, by (12), an increase in the manager’s type $m$ leads to a reduction in $\mu$, which reduces the likelihood of disclosure and hence lowering shareholders’ expected profit.

By contrast, the impact of $t$ (intensity of competition) on shareholders’ payoff is not as straightforward because two opposing forces exist. On one hand, increased competition directly raises the winning price from bidding upon disclosure, hence benefiting shareholders. On the other hand, the disclosure threshold $\mu$ decreases in $t$ as (12) shows. This reflects that the manager is more likely to withhold information in response to stronger competition, which reduces shareholders’ expected profit. Taking the derivative of (14) with respect to $t$ illustrates this tradeoff:

$$\frac{d\Pi_s}{dt} = \frac{\partial \Pi_s}{\partial t} + \frac{\partial \Pi_s}{\partial \mu} \frac{\partial \mu}{\partial t}$$

$$= \frac{1 - \gamma}{\bar{v}} \mu + \frac{1 - \gamma}{\bar{v}} t \frac{\partial \mu}{\partial t}$$

Direct effect \hspace{2cm} Indirect effect

$$= \frac{1 - \gamma}{\bar{v}} \left( \mu - t \left( 1 + \frac{(1 - \gamma) t}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}} \right) \right), \quad (15)$$

where the direct effect is positive, $\frac{\partial \Pi_s}{\partial t} > 0$, and the indirect effect is negative, $\frac{\partial \Pi_s}{\partial \mu} \frac{\partial \mu}{\partial t} < 0$.

To determine the net effect, we first establish a desirable property of $\Pi_s$ that simplifies the analysis.
Lemma 4  Shareholders’ expected profit $\Pi_s$ is concave in $t$: $\frac{d^2\Pi_s}{dt^2} < 0$ at all $t \in [0, m)$.

Because $\frac{d\Pi_s}{dt}|_{t=0} > 0$ by (15) and (12), Lemma 4 implies that $\Pi_s$ can only take one of two forms over $t \in [0, m)$: strictly increasing or single-peaked. The following proposition identifies the conditions for these two cases.

Proposition 3  (i) When $m < \frac{\bar{v}}{4-\gamma}$, shareholders’ expected profit, $\Pi_s$, strictly increases over $t \in [0, m)$; (ii) when $m > \frac{\bar{v}}{4-\gamma}$, $\Pi_s$ is maximized at $t = t_s$, where $t_s < m$ is the unique solution to the first-order condition $\mu + t \frac{\partial \mu}{\partial t} = 0$, where $\mu$ is a function of $t$ given by (12).

To understand Proposition 3, observe that in light of Lemma 4, whether $\Pi_s$ is strictly increasing or single-peaked over $t \in [0, m)$ depends only on the sign of $\frac{d\Pi_s}{dt}$ as $t$ approaches $m$ from below. By (12) and (15) we have

\[ \left. \frac{d\Pi_s}{dt} \right|_{t \to m} = \frac{1 - \gamma}{\bar{v}} (\bar{v} - (4 - \gamma) m). \tag{16} \]

It follows that $\left. \frac{d\Pi_s}{dt} \right|_{t \to m} < 0$ if $m < \frac{\bar{v}}{4-\gamma}$ and $\left. \frac{d\Pi_s}{dt} \right|_{t \to m} > 0$ if $m > \frac{\bar{v}}{4-\gamma}$, thus establishing the proposition.

The results in Proposition 3 are somewhat surprising. Observe that casual intuition might suggest that (1) a stronger bidder would always benefit shareholders, and (2) when the firm has a strong manager, intensified competition would be particularly helpful for shareholders to extract surplus from the manager. However, Proposition 3 shows that such intuition is incomplete on both accounts: shareholders’ payoffs may decrease when a bidder is more competitive and this non-monotonicity occurs precisely when the manager is strong.

Proposition 3 highlights the insight that a stronger competitor creates more incentives for the manager to preempt the bidder by withholding information,
which deprives shareholders from the benefit of the bidder’s participation. The negative impact on the shareholders’ profit is particularly high for a stronger manager who benefits more from preempting the bidder. Concretely, recall that a manager with hard information makes a profit of $m - t$ when he discloses, whereas his expected profit is $m$ upon non-disclosure. The wedge between $m$ and $m - t$ creates incentives for the manager to withhold information. For given $m$, when $t$ is close to $m$, the wedge is widest—hence the incentive to withhold information is the strongest as the manager’s profit approaches zero when he discloses. When $m$ increases, this (maximum) wedge widens, which increases the manager’s incentive to withhold information, thereby increasing the negative (indirect) effect of competition on shareholders’ profit, causing the latter to be non-monotonic in $t$.

Figure 2 illustrates the monotonicity of shareholders’ profit over the level of competition when $m$ is small, and the non-monotonicity of the relationship when $m$ is large. We set $\bar{v} = 2, \gamma = 0.5$. We choose $m = 0.2$ in the left panel and $m = 0.9$ in the right panel, and let the level of competition $t$ vary over $(0, m)$. The left graph shows how shareholders’ profit strictly increases over $t$. By contrast, shareholders’ profit in the right graph is non-monotone in $t$: shareholders’ profit first increases until some maximum point, after which it starts to decrease with $t$.

Further underscoring the intuition for Proposition 3, the following corollary shows the optimal degree of competition decreases with manager type.

**Corollary 7** When $m > \frac{\bar{v}}{4 - \gamma}$, the maximum point $t_s$ decreases with $m$.

To see this, we write down $\frac{\partial}{\partial m} (\frac{\partial \Pi_s}{\partial t})$, the marginal effect of increasing $m$ on the first-order derivative of $\Pi_s$ with respect to $t$ as in (15):
A stronger manager \((m \uparrow)\) has two consequences: (1) from Corollary 4, 
\(\frac{\partial \mu}{\partial m} < 0\), the non-disclosure threshold is lower, which reduces the positive (direct) effect of increased competition (on the disclosure threshold); (2) the cross-partial derivative is positive, 
\(\frac{\partial}{\partial m} \left( \frac{\partial \mu}{\partial t} \right) > 0\), which reduces the negative (indirect) effect of increased competition (on the disclosure threshold). We show (in the Appendix) that the direct effect in (1) exceeds the indirect effect in (2), hence \(\frac{\partial}{\partial m} \left( \frac{\partial \Pi_s}{\partial t} \right) < 0\), establishing the corollary. Therefore, the level of competition that maximizes shareholders payoffs decreases with \(m\).

3 Disclosure policy when the manager’s type is private information

In the base model, the manager’s type \(m\) is publicly known and larger than the outside bidder’s; hence, the manager always wins the bidding contest. In this section we extend the model to a setting in which the manager’s type
is his private information, and we incorporate a positive probability that the manager’s type is less than that of the bidder so that the bidder has a chance to win in equilibrium. Specifically, we assume the bidder’s type $t$ is still publicly known, but the manager can be of either low-type $m_l$ or high-type $m_h$, with $m_l < t < m_h \leq \frac{\bar{v}}{2}$. The probability that the manager is of low-type is $q \in (0, 1)$, which is common knowledge, but the realization of the manager’s type is the manager’s private information.

As with the base model, the manager observes the firm’s fundamental value $v$. A manager with hard information chooses his disclosure policy based on $v$ and his type. In the current setting, however, we may not have a unique equilibrium as in the base model, because some low-type managers may be indifferent between disclosure and non-disclosure. To see this, suppose a low-type manager with hard information discloses $v$. The bidder will then outbid the manager because $t > m_l$, leaving the manager with zero profit. Thus the low-type manager always weakly prefers withholding information. However, on the other hand, if a low-type manager withholds information when $v$ is low, shareholders’ break-even price may exceed the manager’s value for the firm (which is $v + m_l$), rendering the manager with zero profit. Consequently, a low-type manager with hard information will be indifferent between disclosing and withholding information when $v$ is low, which leads to multiplicity of equilibria that is not present in the base model. In this section, we focus on equilibria in which the manager chooses to withhold information whenever he is indifferent between disclosing and withholding—hence the low-type manager always withholds information. This restores the uniqueness of the equilibrium as we will show and eases the analysis.

\begin{footnote}
13In the base model, by contrast, the manager is indifferent between disclosing and non-disclosing only at single point $v = \mu$.
\end{footnote}

\begin{footnote}
14The qualitative results are unchanged in other types of equilibria when we do not
\end{footnote}
3.1 The bidding strategies and the buyout offer

Before we solve the equilibrium, we first characterize the manager and bidder’s strategies in the bidding contest.

**The bidding strategies.** The manager’s strategy is straightforward, which is to bid up to $\beta_{m_j} = v + m_j$, where $j \in \{h, l\}$ is his type. For the bidder’s strategy, we again denote it by $\beta^\omega$, where $\omega \in \{D, ND\}$ is the manager’s disclosure choice. The bidder’s strategy given disclosure is still $\beta^D_t = v + t$, as in the base model. We now examine the bidder’s strategy upon non-disclosure, $\beta^{ND}_t$, which will differ from the base model because the bidder now faces asymmetric information concerning not only firm value $v$, but also the manager’s type. We first establish some useful bounds on $\beta^{ND}_t$.

1. $\beta^{ND}_t \geq m_h$: First, because $v \geq 0$, the bidder will at least bid up to $t$; i.e., $\beta^{ND}_t \geq t$. Second, it is not optimal to exit at any point $p \in [t, m_h)$, because if the bidder wins at such a price, it must be the case that the manager is of low-type $m_l$ and the firm value $v = p - m_l$ (so that the manager exits at $p$). In such a case, the bidder would make a positive profit of $v + t - p = t - m_l$.

2. $\beta^{ND}_t \leq \bar{v} + m_l$: If the manager stays past $\bar{v} + m_l$, he must be of high-type $m_h$, thus the bidder will withdraw from the competition for fear of the winner’s curse.

Summarizing these two cases, we have

$$\beta^{ND}_t \in [m_h, \bar{v} + m_l].$$

restrict the manager’s disclosure decision when he is indifferent. The corresponding analysis is omitted in the paper.
We next show that in equilibrium, $\beta_{t}^{ND}$ will be either at the upper or lower bound of (18), depending on whether $t$ is large or small.

**Lemma 5**  The bidder’s bidding strategy upon non-disclosure is uniquely given by

$$
\beta_{t}^{ND} = \begin{cases} 
\bar{v} + m_l & \text{if } t > \bar{t} \\
ml & \text{if } t < \bar{t}
\end{cases} \quad (i)
$$

where

$$
\bar{t} = \frac{qm_l + (1-q)\gamma m_h}{q + (1-q)\gamma}.
$$

To understand the lemma, suppose the manager does not disclose firm value, the bidder stays in the auctions and wins at a price between $[p, p + dp]$, where $p \in (m_h, \bar{v} + m_l)$ is the running price and $dp$ is infinitesimally small. Because the low-type manager never discloses in equilibrium, the probability that the manager is of low-type, chooses non-disclosure, and exits between $[p, p + dp]$ is $q_{dp}$. On the other hand, the probability that the manager is of high-type, chooses non-disclosure, and exits between $[p, p + dp]$ is at least $(1-q)\gamma_{dp}$, where $\gamma$ is the probability that the manager has soft information—hence, he does not disclose—and the inequality reflects that the manager may possibly withhold information even when he has hard information. Thus by Bayes’ rule, conditional on the manager withholding information and exiting between $[p, p + dp]$, the probability that the manager is of high-type is at least $\frac{(1-q)\gamma}{(1-q)\gamma + q}$. The bidder’s winning payoff is $t - m_h$ and $t - m_l$, respectively, when he wins against a high-type and low-type manager. Thus the bidder’s overall expected payoff, $\kappa$, satisfies

$$
\kappa \leq \left( \frac{q}{(1-q)\gamma + q} \right) (t - m_l) + \frac{(1-q)\gamma}{(1-q)\gamma + q} (t - m_h) \quad (19)
$$

$$
\kappa = t - \bar{t}. \quad (20)
$$

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By (20), when \( t < t_{\ast} \), the bidder’s expected profit will be negative if he wins at a price above \( m_h \). This establishes part (ii) of Lemma 5 by (18). In the proof of the lemma we show that when \( t > t_{\ast} \), (19) holds as an equality, establishing part (i) of the lemma.

Lemma 5 shows that the bidder’s strategy depends critically on how his type \( t \) compares with \( t_{\ast} \), which is some measure of the ex-ante expected type of the manager (it is not the simple ex-ante expected value). If \( t < t_{\ast} \), the bidder expects to earn negative profit if he wins against the manager at a price above \( m_h \), thus the bidder bids up only to \( m_h \), the lower bound of (18). Conversely, when \( t > t_{\ast} \), the bidder expects to earn positive profit by bidding past \( m_h \). As a result, he optimally bids up to the upper-bound \( \bar{v} + m_l \).

**The buyout offer.** The winner from the first-stage bidding contest makes a take-it-or-leave-it offer to the shareholders. Similar to the base model, the winner’s buyout offer needs to be at least as high as both the winning price and the shareholders’ break-even price conditional on all public information. The winner’s offer is the minimum price that satisfies both conditions. Different from the base model, however, because now the bidder has a positive probability of winning, both the winning price and the winner’s identity are taken into account when shareholders determine the break-even price.

When the high-type manager with hard information chooses to disclose \( v \)— i.e., when \( \omega = D \)— the shareholders’ break-even price is simply \( v^D = v \). The bidding outcome is the same as in the base model for the high-type manager: He wins at the bidder’s exit price \( \beta^D_t \), which is greater than the break-even price. Therefore, the buyout offer made by the high-type manager given dis-

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\(^{15}\)If \( t = t_{\ast} \), the bidder is indifferent between winning and losing at \( p \in (m_h, \bar{v} + m_l) \). This leads to multiple equilibria, which is an uninteresting case that we do not examine.
closure is simply the winning price,

\[ p^D = \beta_t^D. \]  

(21)

When the firm value is not disclosed— i.e., when \( \omega = ND \)— the shareholders’ break-even price depends on who wins the bidding contest and the corresponding winning price. Specifically, if the bidder wins, then the winning price must be the low-type manager’s exit price \( \beta_{m_l} = v + m_l \), which is always above the firm’s true value. The buyout offer made by the bidder is then simply the winning price, \( \beta_{m_l} \).

If, instead, the manager wins the bidding contest, shareholders set the break-even price based on the fact that the manager chooses non-disclosure, and the offer \( p \) is profitable to the manager. Denoting by \( v_{BE}^{ND} \) (same as in the base model) this break-even price given non-disclosure and the manager’s winning the auction, we have

\[ v_{BE}^{ND} = E[v|ND, v + m_j \geq p^{ND}]. \]  

(22)

Then the manager’s buyout offer given non-disclosure and winning the auction is

\[ p^{ND} = \max\{\beta_t^{ND}, v_{BE}^{ND}\}. \]  

(23)

To determine \( p^{ND} \), we first compare \( \beta_t^{ND} \) in Lemma 5 and the shareholders’ break-even price in (22).

**Lemma 6** Given non-disclosure, the following result holds,

\[ \begin{cases} \beta_t^{ND} < v_{BE}^{ND} & \text{if } t < t, \\ \beta_t^{ND} > v_{BE}^{ND} & \text{if } t > t. \end{cases} \]

Intuitively, by Lemma 5, when the bidder is relatively weak such that \( t < t \), the bidder’s strategy is to bid up to \( \beta_t^{ND} = m_h \). By a similar argument as
in the base model, \( v_{BE}^{ND} \geq \frac{\bar{v}}{2} > m_h \), shareholders’ break-even price is always higher than the bidder’s exit price. Thus, when the bidder is weak, non-disclosure preempts the bidder, as in the base model, because the bidder is concerned about the winner’s curse that non-disclosure creates and hence bids conservatively. On the other hand, when the bidder is strong, \( t > T \), he bids up to \( \beta_t^{ND} = \bar{v} + m_t \), which exceeds shareholders’ break-even price because \( \beta_t^{ND} > \bar{v} > v_{BE}^{ND} \). Intuitively, when the bidder is highly competitive, he is less concerned about the winner’s curse and bids more aggressively.

By Lemma 6, the manager’s take-it-or-leave-it offer upon non-disclosure in (23) becomes
\[
P_{ND} = \begin{cases} v_{BE}^{ND} & \text{if } t < T, \\ \beta_t^{ND} & \text{if } t > T. \end{cases}
\] (24)

### 3.2 Equilibrium

Given the bidder’s strategies and the buyout offer as previously determined, we solve the disclosure policy of the high-type manager with hard information. The manager decides whether to disclose by comparing the respective prices that he has to pay upon disclosing and non-disclosing. If he discloses, the buyout payment is \( p^D = v + t \) by (21). If he does not disclose, he pays \( p^{ND} \) in (24). Therefore, the high-type manager discloses if and only if \( v \leq \mu_h \), where \( \mu_h \) is the critical value that the manager is indifferent between disclosing and non-disclosing:

\[
\mu_h + t = p^{ND}.
\] (25)

We now solve the disclosure threshold \( \mu_h \) for the two cases in (24).

**Case 1 (\( t < T \)):** In this case, the buyout offer is shareholders’ break-even price,
\[
p^{ND} = v_{BE}^{ND}.
\] (26)
Now we solve for the shareholders’ break-even price in (22). Given non-disclosure and that the manager’s winning price does not exceed \( v_{BE}^{ND} \) (Lemma 6), shareholders infer that the manager is of the following three scenarios: (1) a high-type with hard information but chooses ND (following the previous logic, such a manager is always willing to make an offer \( v_{BE}^{ND} \)); (2) a high-type with soft information and \( v \geq p^{ND} - m_h \); or (3) a low-type with \( v \geq p^{ND} - m_l \).

Denote the probability of each scenario by \( \delta_1 \), \( \delta_2 \), and \( \delta_3 \), respectively, we have:

\[
\begin{align*}
\delta_1 &= (1 - q) (1 - \gamma) \frac{\bar{v} - \mu_h}{\bar{v}}, \\
\delta_2 &= (1 - q) \gamma \frac{\bar{v} - p^{ND} + m_h}{\bar{v}}, \\
\delta_3 &= q \frac{\bar{v} - p^{ND} + m_l}{\bar{v}}.
\end{align*}
\]

Given these probabilities, by Bayes’ law, shareholders’ conditional expectation of the firm value in (22) becomes

\[
v^{ND} = \frac{1}{\delta_1 + \delta_2 + \delta_3} \left[ \delta_1 \frac{\bar{v} + \mu_h}{2} + \delta_2 \frac{\bar{v} + p^{ND} - m_h}{2} + \delta_3 \frac{\bar{v} + p^{ND} - m_l}{2} \right]. \tag{27}
\]

Combining (25), (26) and (27), we have a unique solution over \( \mu_h \in [0, \bar{v}] \).

Using an underscore to denote the corresponding quantities for Case 1, we have\(^{16}\)

\[
\begin{align*}
\mu_h &\equiv \bar{v} - t - \sqrt{t^2 + q (m_l^2 - t^2) + (1 - q) \gamma (m_h^2 - t^2)}, \\
p^{ND} &\equiv \bar{v} - \sqrt{t^2 + q (m_l^2 - t^2) + (1 - q) \gamma (m_h^2 - t^2)}. \tag{28}
\end{align*}
\]

**Proposition 3a** When \( t < t_c \), in equilibrium the high-type manager discloses if and only if \( v \leq \mu_h \), where \( \mu_h \) is given by (28).

\(^{16}\)The base model solution corresponds to the special case of the current one in which \( q \) approaches 0.
Case 2 \((t > t)\): In this case, the manager’s buyout offer is the bidder’s exit strategy,

\[ p^{ND} = \beta_t^{ND} \]  

(29)

The critical value of the indifference point for the manager then becomes:

\[ \bar{\mu}_h = \beta_t^{ND} - t. \]  

(30)

Substituting the bidder’s strategy from Lemma 5 when \( t > t \) — i.e., \( \beta_t^{ND} = \bar{v} + m_t \) — we get

\[ \bar{\mu}_h \equiv \bar{v} + m_t - t. \]  

(31)

**Proposition 3b** When \( t > t \), in equilibrium the high-type manager with hard information discloses if and only if \( v \leq \bar{\mu}_h \equiv \bar{v} + m_t - t \).

In both Cases 1 and 2, the strategy of the high-type manager is to withhold good news, disclosing only if the firm value is below a certain threshold. The threshold in Case 1 is lower than that in Case 2; i.e., \( \mu_h < \bar{\mu}_h \). Intuitively, if the bidder expects to be stronger than the manager, his fear of winner’s curse is less, and hence non-disclosure is less useful as a means of preemption.

The comparative statistics results in the base model all go through in Case 1: (1) for any given \( t \), the equilibrium disclosure threshold decreases with \( \gamma \); (2) for any given \( \gamma \), the equilibrium disclosure threshold decreases with \( t \); and (3) for any given \( t \) and \( \gamma \), the equilibrium disclosure threshold decreases with \( m_h \) and \( m_l \). In Case 2, the equilibrium disclosure threshold decreases with \( t \), but is independent of information softness \( \gamma \).

**Non-disclosure and the preemptive effect:** The preemptive effects of non-disclosure, as identified in Section 2, extend to the current setting. In Case 1, the preemptive effect is essentially identical to that in the base model: shareholders do not receive more than the expected firm value when the manager
withholds information, and non-disclosure preempts the bidder’s participation. In fact, the implication of this preemption is more dramatic than in the base model: even when the manager is of low-type, who would have no chance of winning if he disclosed firm value, now, when firm value is high \((v > p^{ND} - m_l)\), he will win and receive a positive profit when he withholds information.

Even in Case 2 in which the bidder’s type is strong and hence he is less concerned about the winner’s curse, partial preemptive effect still exists when the manager withholds information. Consider the high-type manager with hard information who chooses not to disclose—and hence \(v > \bar{v} + m_t - t\)—the buyout price is the bidder’s exit price \(\bar{v} + m_t\) when the manager withholds information, whereas it would be \(v + t > \bar{v} + m_t\) if the manager disclosed his information. Thus, shareholders do not receive the full benefit of the bidder’s participation upon non-disclosure.

4 Conclusion

This paper examines the disclosure strategy of an informed bidder and the resulting consequences on seller’s payoff in a setting in which the informed bidder can voluntarily disclose his private information about the value of the auctioned asset. The informed bidder has a publicly known benefit of control so that there are gains to trade. He competes with an outside bidder who also has a publicly-known benefit of control, and the winner’s offer needs to leave the seller with a non-negative expected profit.

We show that the presence of the outside bidder creates incentives for the informed bidder to withhold information. Our insight is that the non-disclosure creates a winner’s curse for the outside bidder, which has a preemptive effect such that the outside bidder will exit at a low price. Taking into
account this endogenous response by the informed bidder, we obtain a counter-intuitive result that increased competition may reduce the seller’s payoff. A stronger outside bidder makes the informed bidder more likely to withhold information, the cost of which (to the seller) can outweigh the benefit.

We extend our model to a setting in which the informed bidder’s type (benefit of control) is his private information. Thus the informed bidder is privately informed about both the asset value and his own type. We show that as long as there is a positive probability that the informed bidder is of a higher type than the outside bidder, non-disclosure and preemption will still occur in equilibrium such that the seller does not receive the full benefit of competition. In this regard, our findings regarding non-disclosure and the unexpected effects of competition on the seller’s payoff are general.
References


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Proofs

Proof. Proposition 1

Substituting \( \tau_1 = (1 - \gamma) \frac{\bar{v} - \mu}{\bar{v}} \) and \( \tau_2 = \gamma \frac{\bar{v} - (p^{ND} - m)}{\bar{v}} \) into the right hand-side of (11) and combining with (8) and (10), we obtain that
\[
p^{ND} = \frac{p^{ND2} - 2p^{ND}t + t^2 - \bar{v}^2 + (m - t)(m - 2p^{ND} + t)\gamma}{2(p^{ND} - t - \bar{v} - m\gamma + t\gamma)}.
\] (32)

We then solve the above equation for \( p^{ND} \). We obtain two solutions of \( p^{ND} \):
\[
p^{ND} = \bar{v} \pm \sqrt{\gamma m^2 + (1 - \gamma) \frac{t^2}{\gamma m^2 + (1 - \gamma) t^2}}.
\] (33)

Combining the above equation with the indifference condition in (8), we can solve for \( \mu \) as
\[
\mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2}.
\] (34)

Proof. Proof of Proposition 2

As derived in Corollary 1 and Proposition 1, \( \mu_0 = \bar{v} - m\sqrt{\gamma} \) and \( \mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2} \). It can be easily proved that \( \mu_0 > \mu \) for any \( t > 0 \).

In addition, when \( \gamma \) becomes 0, we have \( \mu_0|_{\gamma=0} = \bar{v} \) and \( \mu|_{\gamma=0} = \bar{v} - 2t < \bar{v} \).

Proof. Proof of Corollary 2, 3, and 4

We have derived in Proposition 1 that \( \mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2} \) and \( p^{ND} = \bar{v} - \sqrt{\gamma m^2 + (1 - \gamma) t^2} \).

We can therefore prove that
\[
\frac{d\mu}{d\gamma} = \frac{dp^{ND}}{d\gamma} = -\frac{m^2 - t^2}{2\sqrt{\gamma m^2 + (1 - \gamma) t^2}} < 0; \tag{35}
\]
\[
\frac{d\mu}{dt} = -1 - \frac{t(1 - \gamma)}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}} < 0; \tag{36}
\]

36
\[
\frac{dp^{ND}}{dt} = -\frac{t(1 - \gamma)}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}} < 0; \quad (37)
\]
\[
\frac{d\mu}{dm} = \frac{dp^{ND}}{dm} = -\frac{m\gamma}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}} < 0. \quad (38)
\]

Therefore, \(\mu\) and \(p^{ND}\) decreases with \(\gamma\), \(t\) and \(m\). \(\blacksquare\)

Proof. Proof of Corollary 6

We have derived in Corollary 5 that \(\Pi_s = \frac{(1 - \gamma)\mu}{\bar{v}}t\). Recalling that \(\mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2}\) as shown in Proposition 1, we can obtain
\[
\frac{d\Pi_s}{d\gamma} = \frac{\partial \Pi_s}{\partial \gamma} + \frac{\partial \Pi_s}{\partial \mu} \frac{d\mu}{d\gamma} = -\frac{t\mu}{\bar{v}} + \frac{t(1 - \gamma)}{\bar{v}} \left(-\frac{m^2 - t^2}{2\sqrt{\gamma m^2 + (1 - \gamma) t^2}}\right) < 0;
\]
\[
\frac{d\Pi_s}{dm} = \frac{\partial \Pi_s}{\partial m} + \frac{\partial \Pi_s}{\partial \mu} \frac{d\mu}{dm} = \frac{t(1 - \gamma)}{\bar{v}} \left(-\frac{m\gamma}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}}\right) < 0.
\]

As a result, \(\Pi_s\) decreases with \(\gamma\) and \(m\). \(\blacksquare\)

Proof. Proof of Lemma 4

We have derived in Corollary 5 that \(\Pi_s = \frac{(1 - \gamma)\mu}{\bar{v}}t\). Substituting \(\mu = \bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2}\) as derived in Proposition 1 into \(\Pi_s\), we obtain that
\[
\Pi_s = \frac{(1 - \gamma)}{\bar{v}} t(\bar{v} - t - \sqrt{\gamma m^2 + (1 - \gamma) t^2}). \quad (39)
\]

As a result, we have the second-order condition as
\[
\frac{d^2\Pi_s}{dt^2} = -\frac{(1 - \gamma)}{\bar{v}} \left\{2 + \frac{t(1 - \gamma)[2t^2(1 - \gamma) + 3\gamma m^2]}{\sqrt{\gamma m^2 + (1 - \gamma) t^2}^3}\right\} \quad (40)
\]

We can prove that \(\frac{d^2\Pi_s}{dt^2} < 0\) for \(t \in [0, m]\). \(\blacksquare\)

Proof. Proof of Proposition 3

Substituting \(t = 0\) and \(m\) respectively into the first-order condition (15)
and Eq (12), we have

\[
\frac{d\Pi_s}{dt} \bigg|_{t=0} = \frac{\mu_0(1-\gamma)}{\bar{v}} > 0; \tag{41}
\]

\[
\frac{d\Pi_s}{dt} \bigg|_{t=m} = \frac{(1-\gamma)}{\bar{v}}(\bar{v} - (4-\gamma)m) \tag{42}
\]

Because \(\Pi_s\) is concave in \(t\), we have the following results:

(i) when \(m < \frac{\bar{v}}{4-\gamma}\), \(\Pi_s\) increases with \(t\) for all \(t \in [0, m)\);

(ii) when \(m > \frac{\bar{v}}{4-\gamma}\), there is a unique \(t_s \in [0, m)\) satisfying the first-order condition \(\mu(t_s) + t_s \frac{d\mu}{dt_s} = 0\), maximizes \(\Pi_s\). ■

**Proof. Proof of Corollary 7**

We have derived the marginal effect of increasing \(m\) on the first-order derivative of \(\Pi_s\) with respect to \(t\) as

\[
\frac{\partial}{\partial m} \left( \frac{\partial \Pi_s}{\partial t} \right) = \frac{1-\gamma}{\bar{v}} \left( \frac{\partial \mu}{\partial m} + t \frac{\partial}{\partial m} \left( \frac{\partial \mu}{\partial t} \right) \right) \tag{43}
\]

Recalling \(\mu = \bar{v} - t - \sqrt{\gamma m^2 + (1-\gamma)t^2}\), we can obtain that \(\frac{\partial \mu}{\partial t} = -1 - \frac{t(1-\gamma)}{\sqrt{\gamma m^2 + (1-\gamma)t^2}}\) and \(\frac{\partial \mu}{\partial m} = -\frac{m\gamma}{\sqrt{\gamma m^2 + (1-\gamma)t^2}}\).

Therefore, we can prove that

\[
\frac{\partial}{\partial m} \left( \frac{\partial \Pi_s}{\partial t} \right) = \frac{1-\gamma}{\bar{v}} \frac{m^3 \gamma^2}{\sqrt{(\gamma m^2 + (1-\gamma)t^2)^3}} < 0. \tag{44}
\]

As the first-order derivative of \(\Pi_s\) with respect to \(t\) decreases with \(m\), we can prove that \(t_s\) decreases with \(m\). ■

**Proof. Proof of Lemma 5**

Part (ii) of the lemma is proved in the text. Here we prove part (i). We first show that in equilibrium the high-type manager with hard information follows a threshold disclosure strategy. To see this, suppose the manager withholds information when firm value is \(v\), and hence pays shareholders’ break-even
price $v_{BE}^{ND}$. Because his payment would be $v + t$ if he disclosed firm value, we have $v_{BE}^{ND} \leq v + t$. Because $v_{BE}^{ND}$ is independent of $v$, it follows that the manager strictly prefers to withhold information rather than disclosing it at any higher firm value. Thus the manager withholds information if and only if firm value is above a threshold $\mu_h$.

Next, we assume $t > \frac{4}{3}$ and show that (19) holds as an equality for all $p \in (m_h, \bar{v} + m_l)$. Consider two cases.

Case 1: $\mu_h + m_h \geq ml + \bar{v}$. Then, referring to the discussions in the text, the probability that the manager is of high-type, withholds information, and exits between $p$ and $p + dp$ is exactly $(1 - q) \gamma dp$: the fact that the manager exits at $p < ml + \bar{v} \leq \mu_h + m_h$ implies that he must be of low-type or high-type with soft information because, if instead he were of high-type with hard information, then the corresponding firm value at which he exits would satisfy $v + m_h = p$ and hence $v < \mu_h$, which contradicts his disclosure strategy. Thus (20) holds as an equality. Therefore the bidder would receive a strictly positive profit if he wins at $p \in (m_h, \bar{v} + m_l)$, establishing part (i).

Case 2: $\mu_h + m_h < ml + \bar{v}$. When $p \in (m_h, \mu_h + m_h)$, the same logic as above shows (20) holds as an equality. Hence the bidder would make a strictly positive profit, thus he will bid at least to $\mu_h + m_h$. However, this would mean that when $v = \mu_h$, a high-type manager with hard information would receive a non-positive profit if he withholds information, whereas he would receive a positive profit of $m_h - t$ if he discloses firm value. This contradicts the premise that $\mu_h$ is the point at which the manager is indifferent between withholding and disclosing information. Thus Case 2 does not exist. ■