# Security versus bank finance : the importance of a proper enforcement of legal rules

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# Dominant Investors and Strategic Transparency[*]

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Abstract

This paper studies product market competition under a strategic transparency decision. Dominant investors can influence information collection in the financial market, and thereby corporate transparency, by affecting market liquidity or the cost of information collection. More transparency on a firm's competitive position has both strategic advantages and disadvantages: in general, transparency results in higher variability of profits and output. Thus lenders prefer less information revelation through stock market trading, since this protects firms when in a weak competitive position, while equityholders prefer more to make full use of the strategic advantage of a strong firm. We show that bank-controlled firms will tend to discourage trading to reduce price informativeness, while shareholder-run firms prefer more transparency. Our comparative statics show that bank control may fail to keep firms less transparent as global trading volumes rise.

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# 1 Introduction

The recent literature on the comparative advantages of di¤erent corporate governance models has been a exciting area for competing ideas. Much attention has been dedicated to the comparison between the e¤ectiveness of shareholder control over delegated monitoring by lenders.

The debate over the comparative information e¢ ciency of the two governance structures is particularly interesting. On one hand, Diamond (1984) has argued that information gathering may be best delegated to intermediaries to avoid duplicating e¤orts.[1] On the other hand, the market microstructure literature has emphasized the importance of decentralized market trading to support information collection (see, e.g., Holmström and Tirole (1993)). In fact, in Röell's (1995) review (see also Ransley (1984)), enhanced visibility is cited as the …rst or second most important motivation for the decision to go public. Mirroring this, somewhat ironically, the most important costs of going public are "increased pressure on senior management due to closer public scrutiny", disclosure requirements, and external investor scrutiny.

This paper does not take a view on the quality of information-gathering by banks versus markets; rather it focuses on their comparative e¤ect on the di¤usion of information. Our starting point is the widely accepted perception that bank-dominated …rms are more opaque. As in Bhattacharya and Chiesa (1995), we argue that bank-dominated …nancing relationships are less transparent to external observers, while market …nancing results in more corporate information becoming known to both investors and competitors.

There are many intuitive reasons for this argument. A main bank may be able to fund or arrange directly the entire investment requirement by its creditor …rm, thus limiting information leakage to the market. Bank monitoring may further reduce the need for tight public transparency, and reduces the need to maintain dispersed investors constantly updated on the

[1] A considerable literature has explored the long term corporate performance in countries with active capital markets and those economies such as Japan and Germany where markets have less in‡uence and strong direct ties exist between companies and …nancial intermediaries. See Mayer (1988) for an interesting descriptive approach, and, e.g., Rajan (1992) and von Thadden (1995) for theoretical work.

firm performance. Bank financing may lead to a low level of trading liquidity and this in turn may discourage information-gathering by investors. For recent evidence of greater opaqueness of banks' assets, see Flannery et al (1997).

This paper adds to this list a new explanation, recognizing that when information may be disclosed to more than one audience, it will have strategic effects in a context of imperfect competition (Bhattacharya and Ritter, 1982; Gertner, Gibbons and Scharfstein, 1988). Most of this literature has focused on the incentive to disclose once a firm has acquired some private information. Firms with good news prefer more or less disclosure depending on the nature of their private information. When it concerns their own strength, better firms may want to enhance visibility (e.g. by an IPO as a mean to commit to more disclosure, as in Stoughton, Wong and Zechner, 1996).When good information concerns the profitability of the market, and competitors may choose to enter, firms with better information prefer less disclosure, and thus private, bilateral financing (Yosha, 1995; Gertner, Gibbons and Scharfstein, 1988).

In our model we do not consider any ex ante information asymmetry; rather we focus on the preference of the dominant investors on the ex post dissemination of information which result from endogenous market prices of their shares. In other words, companies become transparent not via direct disclosure (which may be unreliable) but indirectly via market prices. Product market competition takes place under endogenous information revelation via a simple market microstructure model, which allows us to study the interplay between market trading and strategic behavior, and their dependance on corporate transparency policy. The model builds on the general result that under imperfect competition more opaque firms will exhibit less variability in profits and output relative to more transparent competitors (for an excellent survey, see Kühn and Vives, 1994).

The economic intuition for the impact of transparency on profits is as follows. Less transparent firms reveal less to competitors on their competitive strength, which creates strategic advantages and disadvantages. When firms act on the basis of less information, their expectation over competitors' output is either too high or too low. This hurts firms which are strong, as it leads competitors to be more aggressive, forcing the firm to restrain its output; but it protects weak firms, which face less aggressive competition and can better protect their market share and profitability. As a result, under lack of transparency expected profits are lower, but the volatility of profits and output are lower as well. These results are quite robust and hold for the case of Cournot as well as Bertrand competition regardless of whether products are strategic complements or substitutes.

A reduced volatility (and in particular the higher profitability in the lower states) has the effect of increasing the return to all claimholders with a fixed claim on the firm. This implies that there is a natural preference by lenders for less ex post information dissemination, as they do not gain from higher profits but suffer from higher risk (Jensen and Meckling, 1976). We are able to show that lender-dominated firms will not encourage transparency via informative prices, as this would endogenously undermine the value of lenders' claims.[2] In contrast, firms dominated by shareholders prefer greater informativeness of prices, as information dissemination on average increases profitability as well as risk.

In this paper, we take the allocation of investors' influence on the firm as exogenously determined.[3] We define a firm as debt- or equity-dominated on the basis of the supplier of capital which is dominant in terms of governance and influence, not in terms of the amount of capital supplied.

Our main result is that competition among firms dominated by the same type of investors tends to produce symmetric equilibria in corporate transparency. Competition among equity-dominated firms generates more dissemination of information, while competition among lender-dominated firms tend to result in uninformative prices. Competition among firms with different types of dominant investors does not alter their transparency choice, although a lender's claim enjoys less protection from less public information if its firm faces a transparent competitor. Interestingly, lack of transparency relative to one's competitor does not constitute necessarily a strategic advantage. Finally, there may be interactive effects of information acquisition, leading to multiple equilibria. There are cases of strategic information com-

[2] The well-known listing of Daimler-Benz on the NYSE, which shed light on a traditionally opaque company, is a possible example. While Deutsche Bank was the dominant investor in Daimler-Benz, it held at the time more than a quarter of the firm's equity and was thus more a shareholder than a lender.

[3] We do not allow for transferability of control rights, nor we assume that their allocation is contingent on the level or seniority of leverage (see e.g. Berglöf and von Thadden (1994), Hart (1995)). In fact, dominance may arise not from a contractual assignment of control rights but from legal characteristics of the financial system or the organizational structure of the firm. The German Depotstimmrecht is an example of a nontrasferrable source of voting rights, as banks do not own the shares themselves but are de facto able to vote them.

plementarity where investors have an incentive to acquire information on one …rm only if other investors choose to acquire information on its competitors; viceversa there are cases of strategic information substitutability when in equilibrium only one price is informative.

There are several empirical implications arising from our modelling. The main prediction is that lender-dominated …rms (and …rms in bank-dominated …nancial systems) are less transparent than equity-dominated …rms (and …rms in shareholder-oriented …nancial systems). Moreover, corporate profitability should be lower on average in bank-dominated …rms, but less volatile than those in equity-dominated …rms. As further equilibria exist if the level of debt is low, these predictions should be stronger, the higher the level of debt in the system.[4]

While there have been little empirical analysis of these issues, there is some evidence that Japanese companies with in‡uential main banks tend to be less pro…table than more independent companies (Caves and Uesaka, 1976; Weinstein and Yafeh, 1994). They also tend to be less liquidity constrained (Hoshi, Kashyap and Scharfstein, 1991), which is consistent with the model's suggestion that production is more supported in less pro…table states under bank funding. Overall, these …rms appear to have less variability in pro…tability and grow comparatively less than independent companies (Nakatani, 1984). All these facts are consistent with our results that less transparent …rms competing with more transparent rivals ought to have lower average output and pro…ts and less volatility of economic results.

# 2 The Model

## 2.1 Timing and product market interaction

The model is a dynamic game with …ve stages. In stage 1, the dominant investors in each …rm determine the degree of ex ante transparency of the …rm. In stage 2, …rms receive some private information about their own quality (which we often refer to as its type). In stage 3, some agents in the stock market can choose to become informed about …rm quality at some cost. In stage 4, there is trading in the …rms' stocks, which may or may not

[4] In a companion paper (Perotti and von Thadden, 1998) we look at the question of what determines the overall degree of bank in‡uence versus a regulatory regime favorable to equity investment and shareholder dominance.

reveal information. Finally, in stage 5, the two firms, after observing stock market prices, compete in the product market. Then, customers make their purchase, profits are realized and distributed to investors.

We consider two firms who compete on the product market. The firms produce differentiated products and act as Cournot competitors. Firms have either a high quality or a lower quality product, which has an effect on the relative attractiveness of their own product vis-a-vis their competitor's. Quality (or "type") is described by a parameter $\theta_i$ which can take two values. When the product is of high quality, $\theta_i = \theta_H$, while $\theta_i = \theta_L$ otherwise, with $\theta_H > \theta_L$. Product quality is uncertain; ex ante either firm has a prior probability $q$ of having a high quality product. The probability of high quality is common to both firms and commonly known.[5] Once output is realized, customers base their purchase on actual quality.

The inverse demand function faced by firm $i$ is given by

$$P_i = \theta_i - Q_i - \gamma Q_j; \tag{1}$$

where $i = 1; 2;\ j \neq i;$ and $-1 \le \gamma \le 1$. $\gamma$ can be interpreted as the degree of substitutability between the firms' products, and describes the intensity of competition in the market. If $\gamma > 0$ the two goods are strategic substitutes under Cournot competition; if $\gamma < 0$, the goods are strategic complements. By inverting the demand system (1) one sees that Bertrand competition has the same structure, with strategic complements becoming strategic substitutes and vice versa. Hence, although our discussion is in terms of quantity choices, the above specification covers the Bertrand case as well.[6] To simplify the exposition we will concentrate here on the case $\gamma \ge 0$; all our main results hold, with minor changes to some formulas, for arbitrary $\gamma$.

In order to focus on the impact of transparency on competition, we assume that productivity is constant across firms and that marginal costs for each firm are constant and normalized to zero.

Finally, we assume throughout that the production decision of the firm is taken by managers who maximize profits, $\pi_i = P_i Q_i$, i.e. that investors do not influence $Q_i$ directly. This is in contrast to an important strand of the literature inspired by Brander and Lewis (1986), that analyses product

[5] Given our linear demand specification, the difference in product quality can as well be interpreted as a difference in marginal costs. The two formulatons are equivalent.

[6] This specification of demand is standard and can be derived from quadratic preferences of a representative consumer (see, e.g., Singh and Vives (1984)).

market competition under the impact of capital structure. In particular, in Brander and Lewis (1986), if the …rm has risky debt equity investors have an incentive to distort $Q_i$ away from the pro…t-maximizing level in order to take advantage of limited liability. Since this e¤ect is empirically not well documented and theoretically ambiguous (the result is not renegotiation-proof), we choose to work with the simple assumption of pro…t maximization.[7]

## 2.2 Capital structure, in‡uence, and information dissemination

Each …rm has a capital structure consisting of debt and equity. The level of debt …nancing, given by $D_i$, and the allocation of governance rights (or in‡uence) are taken to be exogenous.[8] We assume that either shareholders or lenders have a dominant in‡uence. Thus we interpret the dominant form of …nance in terms of its governance role, or capacity to in‡uence, rather than in terms of its explicit ownership rights or the quantity of …nancial capital supplied.

While investor in‡uence certainly has several di¤erent implications, we de…ne in‡uence here as the capacity to determine the ex ante transparency policy of a …rm. This is a long term choice which takes place before …rms receive private information, and a¤ects the cost and incentive for ex post information acquisition by market investors. A …rm may choose a policy of transparency either by maintaining a broad ex ante disclosure policy, facilitating access to management and company resources for analysts and researchers, encouraging secondary trading in the …rm's stock, list on stock exchanges with stringent disclosure requirements, etc.[9]

We assume that the governance rights enjoyed by the dominant investor are neither contractible nor transferrable. This is realistic whenever because

[7] We have investigate such incentives in an earlier version. The treatment is much more complex and does not add much to our results. For theoretical work on the general problem see, e.g., Maksimovic (1988), Bolton and Scharfstein (1990) and Showalter (1995); for contrary empirical evidence see Chevalier (1995).

[8] While a higher level of debt may be more typical for a creditor dominated …rm (and may justify the creditor's in‡uence), for the sake of generality we do not make such an assumption.

[9] This applies, e.g., to European …rms deciding to list on the NYSE. An other example is the decision to switch from the British Unlisted Securities Market to the O¢cial List of the LSE.

of other contractual or legal provisions the dominant investor always retains some discretion over long-term decisions, so that there cannot be reliable recontracting. Thus …nancial claims cannot be rearranged contingent on the information cost decision.[10]

The degree of ex ante transparency a¤ects the cost of becoming informed about the …rm ex post. For simplicity, we assume that a …rm can be either transparent (T) or opaque (O) with no di¤erential cost. As a result, the …xed cost for market investors of learning the …rm's type is either K (for an opaque …rm) or 0 (for a transparent …rm). The revelation mechanism cannot be changed after private information is obtained.[11]

In the third period the stock market opens. We assume that both …rms have traded equity. In order to simplify the information aggregation in the market, we assume that each …rm has one (representative) potentially informed investor, who compares the cost of information acquisition with the expected gain from informed trading. If this investor chooses to become informed, she becomes perfectly informed about the …rm's µ¡.

For the stock market interaction in stage 4, we employ the simplest possible market microstructure model in which gains on informed trading are possible.[12] We assume that in each market, in addition to the informed investor, there is a set of liquidity traders who, as an aggregate, trade a random amount + ¸ or ¡ ¸ with equal probability $\frac{1}{2}$. Prices are set by a competitive market-maker at the expected future realization of the stock value, which equals …nal period equity return, conditional on the total order ‡ow. When setting the price in one market, the market maker observes the price realized in the other market.[13]

[10] Transparency may require disclosing 'proprietary information', such as product speci…cations which increases competitors' technological or market information and thus reduce potential pro…ts. Such costs may eliminate any shareholder incentive in buying out control over transparency from lenders.

[11] There will be in general an ex post incentive to reveal more if the information is good, or less if the information is bad. In the model there is no credible way to selectively communicate this information ex post, unless a reliable market-based mechanism has been established in advance to allow information to be easily observable to investors.

[12] See, e.g., Biais, Foucault and Hillion (1997, ch. 3) for a discussion of this type of model.

[13] This seems to be the more realistic assumption. One can also assume that stock prices do not re‡ect new information from the competing …rm's stock, with no impact on our results.

## 2.3 Summary: the game

To wrap up the description of the model, we summarize here the …ve stages of the game, together with the relevant decision variables.

- Stage 1: in each …rm, the dominant investors choose the degree of transparency, $T$ or $O$.
- Stage 2: $\mu_1; \mu_2$ realized, private information of the …rm.
- Stage 3: in each stock, one investor chooses to become informed ($I$) or to remained not informed ($N$).
- Stage 4: in each stock, a market price is realized based on liquidity trading and informed trading.
- Stage 5: …rms observes stock prices and compete by choosing quantities $Q_i$.

After the last stage, demand is realized and each individual …rm's gross pro…ts, $¼_i$, are distributed among lenders, who hold a …xed claim $D_i$, and equityholders, who receive the residual.

# 3 Product Market Competition

We analyse the game by solving for subgame perfect equilibria using backwards induction. Therefore, in order to understand the incentives to choose di¤erent degrees of transparency under any form of governance and to acquire and use information in the capital market, we …rst, in this section, examine the impact of more or less public information on product market interaction. Throughout this paper we will assume that the production decisions of the …rm are taken by managers who maximize pro…ts, $¼_i = P_i Q_i$:[14]

From the way we have modelled capital market trading there can be only two outcomes concerning the public availability of information about a …rm's $\mu$: either an informed investor is present and her trading reveals $\mu$ completely, or there is no informed investor, in which case no information

[14] In particular, we are not interested here in the issue of managerial self-interest (see, e.g., Hart, 1995). If one wants to, one can interpret pro…ts as net of private managerial bene…ts.

about $\theta$ is revealed. Equivalently, there is an informed investor who hides her trading motives perfectly behind liquidity trading, in which case again no information at all about $\theta$ is revealed to the market.[15] Therefore, we have two possible informational states for each firm, R (if its type $\theta$ has been revealed) or P (if its $\theta$ is still private information). In total, this yields four informational structures for market interaction, which we shall discuss now in turn.

## 3.1 Competition under symmetric information

We first consider competition under symmetric information, defined as a situation in which the information on each firm's $\theta$ is public, because it has been revealed through financial market activity.

In order to keep the notation as simple as possible, we shall assume throughout the paper that firms produce a positive level of output whatever the constellation of $(\theta_1; \theta_2)$; i.e. that there is no exit. This requires assuming that demand even for a low quality product is sufficiently strong. The following assumption, which will be maintained throughout the paper, is sufficient to guarantee this in the different settings we consider later on:

$$\theta_L \geq \theta_H - \theta_L. \tag{2}$$

Both firms simultaneously choose their quantities $Q_i$ to maximize profits, taking the other's choice as given. Hence, firm i chooses Q as to $\max_Q (\theta_i - Q - \gamma Q_j)Q$.

Firm i's behaviour will depend on its own $\theta$ and that of its competitor. We therefore have four different possible states, $ij = HH; HL; LH; LL$, for the interaction. It is straightforward to verify that the firm's actions in Nash equilibrium are given by

$$\begin{aligned} Q^{RR}_{HL} &= \frac{1}{2+\gamma}\left(\theta_H + \frac{\gamma}{2-\gamma}(\theta_H - \theta_L)\right); \\ Q^{RR}_{HH} &= \frac{\theta_H}{2+\gamma}; \end{aligned}$$

[15] This last feature is due to the assumption that liquidity traders buy and sell with the same probability. If those probabilities differed, information would be revealed partially in the case of a zero aggregate order flow.

$$
\begin{aligned}
Q^{RR}_{LL} &= \frac{\theta_L}{2+\gamma}; \\
Q^{RR}_{LH} &= \frac{1}{2+\gamma}\left(\theta_L - \frac{\gamma}{2-\gamma}(\theta_H - \theta_L)\right);
\end{aligned}
$$

where the superscript $RR$ denotes the fact that both firms' $\theta$ have been revealed. $Q^{RR}_{ij}$ denotes a firm's equilibrium action if itself is of type $i$ and its competitor of type $j$. The ordering of the four different output levels is intuitive. In fact, We have

$$Q^{RR}_{HL} > Q^{RR}_{HH} > Q^{RR}_{LL} > Q^{RR}_{LH};$$

where $LH$ is the worst possible state for firm $i$; and the firm produces less than in state $LL$, the second worst state, etc.[16] The corresponding profits are

$$\pi^{RR}_{ij} = (Q^{RR}_{ij})^2; \tag{4}$$

and the ordering of equilibrium profits is the same as for equilibrium outputs.

The analysis of this standard form of market interaction is quite simple. The effect of complete information is in general to produce some implicit coordination in output decisions, as each firm conditions its production on the actual strength of its competitor's demand and thus on the competitor's ability to expand beyond its own market.

## 3.2 Competition under symmetrically incomplete information

We now consider the case of competition when there is no public information about any firm's quality available. We shall index all variables by $PP$, as all the $\theta$'s are private information.

Now each firm makes its output decision at a time when there is imperfect information about the level of its competitor's product-specific demand $\theta_j$. In this case each firm will choose output as a function only of its own $\theta_i$; maximizes expected profits, and therefore produce as to $\max_Q(\theta_i - Q - \gamma E Q_j(\theta_j))Q$:

[16] If $\gamma < 0$; i.e. if the goods are strategic complements, we have $Q^{TT}_{HH} > Q^{TT}_{HL} > Q^{TT}_{LH} > Q^{TT}_{LL}$ : in $LL$; the worst possible state for firm $i$; it produces less than in state $LH$, the second worst state, etc.

It is readily verified that the game again has a unique (Bayesian) Nash equilibrium,

$$
\begin{aligned}
Q_H^{PP} &= \frac{1}{2+\gamma}\left(\theta_H + \frac{\gamma}{2}(1-q)(\theta_H-\theta_L)\right);\\
Q_L^{PP} &= \frac{1}{2+\gamma}\left(\theta_L - \frac{\gamma}{2}q(\theta_H-\theta_L)\right);
\end{aligned}
$$

where $Q_i^{PP}$ denotes a firm's equilibrium action when it has quality $\theta_i$. The corresponding profit levels in the four possible states, $\pi_{HL}^{PP}; \pi_{HH}^{PP}; \pi_{LL}^{PP}; \pi_{LH}^{PP}$, are obtained by straightforward computations reported in the appendix.

As in the case of symmetric information, it is straightforward to show that these state-contingent profits are ordered as intuition suggests:

$$\pi_{HL}^{PP} > \pi_{HH}^{PP} > \pi_{LL}^{PP} > \pi_{LH}^{PP}.$$

We state here without proof a general result from the industrial organization literature (see Kühn and Vives, 1994).

**Remark 1** Average output is the same in the symmetrically informed and uninformed case, while profits are both higher on average and more variable in the first case.

In brief, the main differences in strategic interaction vis-a-vis the symmetrically informed case is less aggressive output choice by the stronger firm in the most favorable state $HL$: thus the weaker firm is "protected" by the lack of accurate information. In contrast, there is more output in the $HH$ state, as both firms, attaching some probability the event of the competitor being weak, produce more aggressively than in a transparent system. This can be interpreted as a result of "poor coordination" due to less information, and leads to lower profitability. Thus output in $LL$ is lower, as both firms are too cautious due to the perceived risk of a strong competitor. Similarly, firms under uninformed competition tend to be more protected when in their weakest competitive position $LH$.

While profits are higher on average for weaker firms, the lack of common information leads to less coordination on output and, in the case of a very low $\gamma$, to lower profitability in state LH. In this case the competitive advantage is less than the coordination loss. From an ex ante perspective, however, the reduced profitability due to poor coordination in high quality states, when marginal profitability is highest, is greater than the profit gain in low quality states.

## 3.3 Competition under asymmetric information

The last case to consider is the asymmetric case, in which the type of one firm, say firm 1, is unknown to the market [17], whereas the other's type is has been revealed. Now firm 1, when making its output decision, knows the state of firm 2, but firm 2 does not know $\theta_1$. In this case, firm 1 will choose output as a function of $\theta_1$ and $\theta_2$ and therefore produce as to $\max_Q(\theta_1 - Q - \gamma Q_2(\theta_2))Q$, where $Q$ depends on $\theta_1$ and $\theta_2$. Firm 2, on the other hand, seeks to $\max_Q(\theta_2 - Q - \gamma E_{\theta_1} Q_1(\theta_1, \theta_2))Q$, where $Q$ depends on $\theta_2$ only.

It is straightforward (if lengthy) to show that the game has a unique (Bayesian) Nash equilibrium $(Q_H^{RP}, Q_L^{RP}, Q_{HL}^{PR}, Q_{HH}^{PR}, Q_{LL}^{PR}, Q_{LH}^{PR})$, which we spell out in the appendix. Here, $Q_i^{RP}$ is the equilibrium quantity produced by the firm whose $\theta$ has been revealed, if it has type $i \in \{L, H\}$, and $Q_{ij}^{RP}$ the quantity produced by the firm with private information about its type (who faces a transparent competitor) when its own quality is $i$ and that of its competitor $j$. The corresponding eight profit levels (for each state and each firm) are given in the appendix.

Again, it can easily be verified that equilibrium quantities and profits are ordered as in the two equilibria under symmetric information. For example, the profits of a transparent firm facing a non-transparent firm are highest when the firm has high quality and the competitor low quality, second highest when both have high quality, third highest when both have low quality, and lowest when the firm has low and its competitor high quality.

In order to understand the costs and benefits of disclosure in this context, it is useful to compare the profit levels of firm $i$ in the case where both firms are transparent ($\pi^{RR}$) with those where firm $j$ is transparent but firm $i$ not ($\pi^{PR}$). It turns out that profits are more variable under fully transparent competition than under competition with asymmetric information. The reason is that by disclosing more, the firm allows its competitor to react more precisely to the situation on the product market, which makes the intercept of its residual demand more volatile (see Fried (1984), Li (1985), Shapiro (1986)).

What is more, one can show that profits are ordered state by state. Profits under full transparency, $\pi^{RR}$, are a "median-preserving spread" of profits under unilateral non-transparency, $\pi^{PR}$, in the sense that $\pi^{RR}$ is statewise

[17] In equilibrium, this will occur either because no investor has become informed or because trading has not revealed any private information.

lower than $¼^{PR}$ in the two unfavorable states $(LL; LH)$ and statewise higher in the two favorable states $(HH; HL)$. Thus expected pro…tability is always higher for the R …rm than for the P …rm in the strong quality state, and viceversa in the weaker quality state. The economic intuition can be expressed as follows. When in the state of high demand, a …rm whose quality is revealed (R) can produce more aggressively than if it were opaque: the …rm knows that its competitor is aware of its strength, and will thus restrain its output. In addition, in this case the R …rm does not restrain its output when its competitor is strong, since it does not know it. On average its output turns out to be higher than under complete information. The opposite is true when the …rm is weak.

In contrast, a P …rm loses some market share when strong, but as in the symmetrically uninformed case, it has a higher average output when weak relative to the output of a visibly weak …rm.[18]

On average, competition under asymmetric information provides less protection of downside pro…ts for an opaque …rm than the symmetrically uninformed case.

# 4 Informed Trading in the Stock Market

## 4.1 Trading

In the last but one stage of the game, one investor is either informed or uninformed about a …rm's $µ_i$, depending on her choice to acquire information made beforehand, and interacts with uninformed liquidity traders through competitive market makers. As mentioned earlier, we assume that the agents on the market for the stock of …rm i observe the equilibrium stock price of …rm j and vice versa.

Suppose …rst that there is an informed investor in the market of, say, …rm 1's stock. Given that liquidity trading is either $+¸$ or $¡¸$, any trading by the informed investor which is di¤erent from $§¸$ leads to her information being revealed and her trading pro…ts being zero. Hence, if she trades, she trades $+¸$ or $¡¸$ units. It is easy to see that she maximises trading pro…ts by trading $¡¸$ (shortselling) if $µ_1 = µ_L$ and $+¸$ (buying) if $µ_1 = µ_H$.

[18] More speci…cally, the P …rm's output in the lowest state LH is higher, and lower in the LL state, than under full disclosure.

Whatever information is publicly available about firm 2, there are three possible trading outcomes for firm 1's stock. The first is that liquidity traders buy and that $\theta_1 = \theta_H$, which occurs with probability $\frac{1}{2}q$. In this case the aggregate order flow is $+2\lambda$ and $\theta_1$ is fully revealed. We will denote the outcome that firm quality is fully revealed through trading by $P$. The second outcome, which happens with probability $\frac{1}{2}(1-q)$, is that liquidity traders and the informed investor sell, so that aggregate order flow is $-2\lambda$ and $\theta_1$ again is fully revealed. In the last case, informed trading just offsets liquidity trading and the aggregate order flow is 0. This case happens with probability $\frac{1}{2}$, and here no information about $\theta_1$ is revealed (denoted by $P$: quality remains private information).

In each case, competitive market makers set prices such that they make expected zero profits. In doing so, they take into account the available information about each firm's quality ($\theta_i$) and the competitive structure on the product market generated by this information. Define the value of equity in the different contingencies as

$$e_{ij}^{xy} = \max\,(\pi_{ij}^{xy} - D; 0); \qquad x; y \in \{P; R\}; \quad i; j \in \{L; H\}; \tag{6}$$

where $D$ is the firm's debt level and $\pi_{ij}^{xy}$ are the firm's profits before debt, as derived in the last section, if the firm is of quality $\theta_i$, its competitor of quality $\theta_j$, and the availability of information about both firms' quality at the competition stage is described by $x \in \{P; R\}$ for the firm and by $y \in \{P; R\}$ for its competitor. Using this notation, the valuation of equity is straightforward.

Suppose first that the competitor's stock price is noninformative. Then the market value of the firm under consideration is equal to

$$v(2\lambda) = qe_{HH}^{RP} + (1-q)e_{HL}^{RP}$$

if the aggregate order flow received by the market maker is $2\lambda$, and, therefore, reveals the firm's quality to be $\theta_H$. For an aggregate order flow of $-2\lambda$, the market value is

$$v(-2\lambda) = qe_{LH}^{RP} + (1-q)e_{LL}^{RP};$$

and if the aggregate order flow is 0, hence uninformative, the value is

$$v(0) = q^2e_{HH}^{PP} + q(1-q)e_{HL}^{PP} + q(1-q)e_{LH}^{PP} + (1-q)^2e_{LL}^{PP}:$$

In the first two cases, the informed investor makes zero profits on her trades, because her information is revealed fully in the aggregate order flow. In the last case, she makes positive profits at the expense of the liquidity traders.

**Remark 2** An informed trader makes positive profits only in states in which the true type of the firm she trades in is not revealed.

If she has good information, her profits are

$$\begin{aligned} G_H(0) &= \left(qe^{PP}_{HH} + (1-q)e^{PP}_{HL} - v(0)\right)\lambda \\ &= (1-q)\left(q(e^{PP}_{HH} - e^{PP}_{LH}) + (1-q)(e^{PP}_{HL} - e^{PP}_{LL})\right)\lambda; \end{aligned} \tag{7}$$

and

$$G_L(0) = q\left(q(e^{PP}_{HH} - e^{PP}_{LH}) + (1-q)(e^{PP}_{HL} - e^{PP}_{LL})\right)\lambda \tag{8}$$

if her information is negative.

The reasoning is analogous in the case where the competitor's stock price is informative. If aggregate order flows are $2\lambda$ or $-2\lambda$, the price is fully informative and an informed trader makes no profits, whereas she makes

$$G_{Hj}(0) = (1-q)(e^{PR}_{Hj} - e^{PR}_{Lj})\lambda \tag{9}$$

if the aggregate order flow is uninformative, her information is good, and the competitor is revealed to be of type $\theta_j; j \in \{L; H\}$. Correspondingly, if her information is bad, she makes profits of

$$G_{Lj}(0) = q(e^{PR}_{Hj} - e^{PR}_{Lj})\lambda. \tag{10}$$

**Remark 3** The return from informed trading is highest when the true state is the least likely state, as this produces a larger price correction; if $q = 1/2$, the investor is indifferent between receiving good or bad news.

We can now compute the investor's expected profit from information acquisition. Consider first the case where there is no informed investor in the other market, so that the other firm's stock price will not be revealing. With probability $\frac{1}{2}$ the investor in firm 1's stock will be able to profit from her information, and expected profits are, by using (7) and (8),

$$
\begin{aligned}
G^N &= \frac{1}{2}\left(qG_H^P(0) + (1-q)G_L^P(0)\right) \qquad (11)\\
&= q(1-q)\left(q(e_{HH}^{PP} - e_{LH}^{PP}) + (1-q)(e_{HL}^{PP} - e_{LL}^{PP})\right)\lambda;
\end{aligned}
$$

where the superscript $N$ ("no informed investor") denotes the fact that there are no informed investors in the other market.

If there is an informed investor in the other market, the other firm's stock price will be informative with probability $\frac{1}{2}$, so expected profits for the informed investor in the first market are obtained by averaging over (7), (8), (9), and (10):

$$
\begin{aligned}
G^I = \frac{1}{2}q(1-q)\Big(&q(e_{HH}^{PP} - e_{LH}^{PP}) + (1-q)(e_{HL}^{PP} - e_{LL}^{PP}) + q(e_{HH}^{PR} - e_{LH}^{PR})\\
&+(1-q)(e_{HL}^{PR} - e_{LL}^{PR})\Big)\lambda. \qquad (12)
\end{aligned}
$$

where the superscript $I$ ("informed investor") denotes the fact that there is an informed investor in the other market.

**Remark 4** *The expected return from informed trading is increasing in the volume of liquidity trading* $\lambda$.

This is a standard result from the literature on market microstructure. However, it acquires some interesting meaning in the context of the model, in which dominant investors may have differential preferences about the informativeness of prices. We return to this issue in the final discussion.

Clearly, the value of information about one stock depends on the trading activity in the other stock, as information on the competitor's strength affect the value of the stock. It turns out that $G^I$ and $G^N$ cannot be ordered in general; thus the incentives to acquire information are not quite straightforward to analyse.

## 4.2 Information collection

Solving backwards, we now determine the outcomes of the information acquisition subgame on the stock market as a function of the firms' ex ante transparency policy.

As described earlier, we denote the choices by the dominant investors in stage 1 by $T$ ("transparent") and $O$ ("opaque"). Remember that information acquisition in a $T$ …rm is costless, and in a $O$ …rm $K > 0$. As before, we denote the decision to acquire information about a …rm by $I$ ("become informed") or $N$ ("no information acquisition").

**Proposition 1** If $K < G^I; G^N$, then $(I; I)$ is the only equilibrium in the information collection subgame for all possible $T$ ¡ $O$ combinations.

This case is somewhat trivial: the transparency decision has no economic e¤ect, because information collection is cheap in any case. In the sequel, we shall not elaborate further on this case.

**Proposition 2** If $G^I; G^N < K$, then, for all possible $T$ ¡ $O$ combinations, the unique equilibrium of the information collection subgame has $I$ if the …rm is $T$ and $N$ if $O$.

This is an economically more interesting case. A …rm which chooses $T$ can be sure that there will be an informed investor, and a …rm choosing $O$ can be sure that there will be no informed investor.

A third possibility is that the cost of information gathering falls in the intermediate range. In this case each …rm's share price will re‡ect any information revealed on the competitor's share price, so there is strategic interaction between the information gathering decisions of investors in the two stocks. This gives rise to multiple equilibria.

**Proposition 3** a) If $G^N < K < G^I$, then $(I; I)$ is an equilibrium of the information collection subgame for all possible $T$ ¡ $O$ combinations. In addition, if both …rms are opaque $(O; O)$, then $(N; N)$ is also an equilibrium. As a result, in this case there is also an equilibrium in mixed strategies, where the probability of choosing $I$ equals $x = \frac{K \text{ ¡ } G^N}{G^I \text{ ¡ } G^N}$.

b) If $G^I < K < G^N$, then $(I; I)$ is the unique equilibrium of the information collection subgame if both …rms are transparent $(T; T)$. $(I; N)$ is the unique equilibrium in the asymmetric case $(T; O)$, and $(I; N)$ and $(N; I)$ are the equilibria for $(O; O)$. In the case $(O; O)$ there is also an equilibrium in mixed strategies, in which both investors choose to become informed with mixing probability $x = \frac{G^N \text{ ¡ } K}{G^N \text{ ¡ } G^I}$.

The proofs of all the above three propositions follow immediately from elementary comparisons of costs and benefits in the four possible transparency combinations at stage 3.

While in the case of Proposition 2 the transparency decision in stage 1 determines the incentives for information acquisition unambiguously, Proposition 3 reflects the interesting intermediate case where the transparency decision by the dominant investor has some impact on information acquisition but is not completely decisive.

In general, $I$ is a dominant strategy if the firm is transparent ($T$), whatever the information structure realized in the other market. The intuition is simply that transparency makes information acquisition inexpensive, and liquidity traders ensure that it is profitable.

What is noteworthy is the possibility of multiple equilibria in information gathering when the firm is opaque.The nature of these equilibria depends on the ordering of $G^I$ and $G^N$, and thus on the complementary or exclusionary nature of information acquisition in the two markets.

In case a ($G^N < G^I$), information acquisition is complementary across markets: investing in information about an opaque firm is profitable if and only if information is also acquired in the other market. In this case, investors may coordinate on information gathering, leading potentially to complete revelation, even when firms attempted to remain opaque. In case b ($G^N > G^I$), information acquisition in the two markets is exclusionary: investing in information about an opaque firm is profitable if and only if no information is acquired in the other market.

Comparing (11) and (12), we see that $G^I > G^N$ if and only if

$$q(e^{PR}_{HH} - e^{PR}_{LH}) + (1 - q)(e^{PR}_{HL} - e^{PR}_{LL}) > q(e^{PP}_{HH} - e^{PP}_{LH}) + (1 - q)(e^{PP}_{HL} - e^{PP}_{LL}) \quad (13)$$

The left hand side of (13) reflects the value of information acquisition if an informed investor trades in the other market, and the right hand side the value of information if there is no such investor in the other market.[19]

The difference in the attractiveness of information gathering can be reinterpreted as the expected difference in the variation of the stock price under PR competition relative to PP competition. Intuitively, informed trading profits depend on the expected price "surprise".

[19] Remember that information acquisition is ex post profitable only when the firm type is not revealed, i.e. if the superscript of $e^{xy}_{ij}$ has $x = P$.

The relative attractivess of information gathering in the two cases depends more generally on the level of debt. We consider first the extreme case, when debt is riskless.

**Proposition 4** If debt is completely riskless in all contingencies, i.e. if $e_{ij}^{Py} = \pi_{ij}^{Py} - D$ for all $y \in \{P; R\}$ and $i; j \in \{L; H\}$, then $G^I = G^N$, i.e. the value of information in one market is completely independent of information in the other.

The proof follows from straightforward computations using the formulae for $\pi_{ij}^{Py}$ in the Appendix. Its intuition is simple: in the case of riskless debt, the average price change is the same whether the information structure in the product market is PP or PR.

**Proposition 5** When the debt level is such that it can be repaid whenever the firm has high quality, but never when it has low quality, then $G^I > G^N$.

Proof: In this case $e_{Hj}^{Py} = \pi_{Hj}^{Py} - D$ and $e_{Lj}^{Py} = 0$ for all $y \in \{P; R\}$ and $j \in \{L; H\}$. In this case explicit calculation yields that

$$q(\pi_{HH}^{PR} - \pi_{HH}^{PP}) + (1 - q)(\pi_{HL}^{PR} - \pi_{HL}^{PP}) > 0: \tag{14}$$

from which the result immediately follows.

■

For intermediate debt levels, however, the ordering of $G^I$ and $G^N$ is ambiguous. For most parameter values, $G^I > G^N$. But the difference can be negative at moderate levels of debt, when the degree of competition, as expressed by the value of $\gamma$, is large. In that case the variability of the stock price around its uninformative (i.e. expected) value is greater under PR competition, as a weak firm suffers much more from facing an opponent which is known to be stronger than what it gains from better coordination.

**Remark 5** When the debt level is such that it can be always repaid except in the worst state LH, then $G^I > G^N$ as long as $\gamma$ is small enough.

Proof: In this case $e_{ij}^{Py} = \pi_{ij}^{Py} - D$ for all $y \in \{P; R\}$ and $ij \neq LH$, while $e_{LH}^{Py} = 0$ for all $y \in \{P; R\}$. In this case we obtain that

$$G^I - G^N = \frac{q(1-q)}{2}\Big[\frac{q(1-q)\gamma^2(\theta_H-\theta_L)^2}{(2-\gamma)^2} - \tag{15}$$

$$- (1-q)\frac{q\gamma^2(\theta_H-\theta_L)}{4(2+\gamma)^2(2-\gamma)^2}[2\gamma(2-\gamma)\theta_L + q(4-2\gamma^2+\gamma^3)(\theta_H-\theta_L)]\Big] \tag{16}$$

This term is positive, unless $\theta_H - \theta_L$ is very small and $\gamma$ is large. Figure 1 illustrates the two possible cases.

Figure 1 about here

The interpretation is as follows. Payoffs to informed trading depend on the difference in firm profits when the firm quality is not revealed; thus the relative payoff $G^I - G^N$ compares the price surprise under a PR versus a PP outcome. An opaque firm facing a strong opponent usually has lower profits when its competitor is revealed, which implies a much lower profit in the lower state under PR. This decrease in profitability due to more aggressive competition is increasing in $\gamma$; as well as in the difference $\theta_H - \theta_L$: In other words, under a large $\gamma$ the expected price change increases under PR relative to PP in the range $\pi_{LH}^{PP}; \pi_{LH}^{PR}$: As debt rises further, the net gain $G^I - G^N$ increases monotonically and it becomes unambiguously positive in the interval $(e_{LL}^{PP}; e_{LL}^{PR})$. On the other hand, when $\gamma$ is small, the reduced profits due to this competitive effect are small relative to the reduced profits due to coordination loss: this results in less variability of price changes in the low states under PR. In this case the difference $G^I - G^N$ is always positive.

Note that when the debt level D is above $\pi_{HH}$, the difference $G^I - G^N$ is always positive: To see this recall that the difference is positive for debt between $\pi_{LL}^{PR}$ and the minimum $\pi_{HH}$; it may then decrease or increase, but it is always decreasing ($\pi_{HL}$ are unambiguously higher under PR) until zero in the range $\pi_{HL}^{PP}$ and $\pi_{HL}^{PR}$.

# 5 Transparency Choice

In this section we investigate the choice of transparency at the first stage of the game. The two dominant investors choose simultaneously, with the objective of maximising the expected future value of their financial claim.

We consider first the case $G^I, G^N < K$ presented in Proposition 2, which offers the key insights also for the case of intermediate information costs, which we consider in subsection 5.4.

For the analysis we have to distinguish between three different possible allocations of power in the two firms: the case where both firms are controlled by equity interests, where they are both controlled by debt interests, and the mixed case.

It is clear that any theory in which debt and equity have different incentives can only apply to debt levels which are not excessive. Otherwise debt would become the residual claimant in all states and act like equity. We shall, therefore, assume from now on that in product market equilibrium equity always receives a positive payoff if the firm is of high quality, i.e. in the states $HH$ and $HL$:

**Assumption A:** $D_1, D_2 \leq \pi^{ij}_{HH}$ for all four possible information structures $ij = \{RR, RP, PR, PP\}$.

This assumption is (much) stronger than needed for any of our results, but it shortens and unifies the presentation and, last but not least, is plausible in a wide range of situations.

## 5.1 All equity control

We begin by considering the case in which equity holders exert the dominant influence in both firms. Hence, in both firms, the choice of transparency is made such as to maximise

$$E \max\left(\pi_i^*(\theta_1, \theta_2) - D_i, 0\right); \tag{17}$$

where $E$ denotes the expectation over $(\theta_1, \theta_2)$ and the revelation of information in the financial market (which is, of course, influenced by the choice of transparency), and $\pi_i^*(\theta_1, \theta_2)$ are equilibrium profits in the product market, given product quality and the information available after financial market activity. In order to understand the costs and benefits of transparency in this context, it is useful to compare the profit levels before debt payments of firm $i$ in the case where both firms' types are revealed ($\pi^{RR}$; given by (4)) with those where firm $j$'s type is revealed but firm $i$'s not ($\pi^{PR}$; given by (26) in the appendix). As discussed in Section 3, the comparison shows that profits are more variable under fully revealed competition than under competition with asymmetric information, with $\pi^{RR}$ being a "median-preserving spread" of $\pi^{PR}$, in the sense that $\pi^{RR}$ is statewise lower than $\pi^{PR}$ in the two unfavorable states $(LL, LH)$ and statewise higher in the two favorable states $(HH, HL)$. Figure 2 summarizes the discussion given in Section 3.

Figure 2 about here

This observation leads to the following proposition.

**Proposition 6** *If both firms are controlled by equity interests and if $G^I, G^N < K$, then for all levels of debt $D_1, D_2$ satisfying Assumption A, in the unique subgame perfect equilibrium of the game, both firms are transparent.*

**Proof.** Given the reasoning in the last section, a transparent firm will have its quality revealed in the financial markets with probability $\frac{1}{2}$, whereas an opaque firm will keep its quality secret with probability 1. Therefore, if firm $j$ is transparent, an equity controlled firm $i$ prefers to be transparent if

$$\delta(D_i) := E\max\left(\pi_i^{RR}(\theta_1, \theta_2) - D_i, 0\right) - E\max\left(\pi_i^{PR}(\theta_1, \theta_2) - D_i, 0\right) \geq 0. \tag{18}$$

The state-by-state comparison of profit levels given in Figure 2 implies that $\delta(D_i) > 0$ for all $D_i$ if $\delta(0) > 0$. This is because the graph of $\delta$ is (weakly) single-peaked, which becomes clear when walking backwards from $\pi_{HL}^{RR}$ (where $\delta = 0$) in Figure 3.

Figure 3 about here

In other words, $\delta$ is positive for all $D_i$ if only $E\pi_i^{RR} > E\pi_i^{PR}$. A lengthy calculation indeed establishes that

$$\delta(0) = q(1-q)\frac{\gamma^2}{(2-\gamma)^2}(\theta_H - \theta_L)^2\left(2 - \frac{\gamma^2}{4}\right) > 0 \tag{19}$$

for all $\gamma$. This also proves that $OT$ and $TO$ cannot be equilibrium transparency structures. To prove uniqueness we have to compare the transparency structure $OO$ with $TO$. As in the case of Figure 2, it is straightforward to compare $\pi^{PP}$ and $\pi^{RP}$ state by state. Again, profits under transparency are a spread of profits under non-disclosure, as shown in Figure 4.

Figure 4 about here

An equity controlled firm wants to deviate from OO to TO if

$$\beta(D_i) := E\max\left(\pi_i^{RP}(\theta_1;\theta_2) - D_i; 0\right) - E\max\left(\pi_i^{PP}(\theta_1;\theta_2) - D_i; 0\right) > 0. \tag{20}$$

By the same argument as above, (20) holds for all $D_i$ if it holds for $D_i = 0$. Another calculation establishes that

$$\begin{aligned} \beta(0) &= E\pi_i^{TN} - E\pi_i^{NN} \\ &= q(1-q)\frac{\gamma^2}{(2+\gamma)^2(2-\gamma)^2}(\theta_H - \theta_L)^2\left(3 - \frac{\gamma^2}{4}\right) > 0 \end{aligned} \tag{21}$$

which concludes the proof.
■

As the proof shows, transparency is, in fact, a dominant strategy in the game between equity holders at the first stage. The effect of complete information is in general to produce some implicit coordination in output decisions, as each firm conditions its production on the actual strength of its competitor's demand and thus on the competitor's ability to expand beyond its own market. This implicit coordination is so valuable that an equity-controlled firm unilaterally prefers to become transparent. Hence, the case of all equity control is a direct generalization of the results on endogenous information sharing cited in Section 3 to the case of a capital structure with debt and equity.

## 5.2 All Debt Control

We now turn to the case in which lenders exert the dominant influence in both firms. Hence, in both firms, the choice of transparency is made such as to maximise

$$E\min\left(\pi_i^{?}(\theta_1;\theta_2); D_i\right). \tag{22}$$

Figures 2 and 4 also provide the intuition about costs and benefits of information revelation in this case. Take the situation described in Figure 4. A lender controlled firm which faces a non-transparent competitor has the choice between the random profits $\pi^{PP}$ and $\frac{1}{2}(\pi^{PP} + \pi^{RP})$. Since the dominant interest now is to protect the downside of profits, lenders will prefer $\pi^{PP}$ (if debt levels are not much higher than $\pi_{HH}^{RP}$, i.e. if equity gets the upside of profits, which has been assumed in Assumption A). If their debt is above the smallest possible profit level under information structure RP, which is $\pi_{LH}^{RP}$, they will even strictly prefer $\pi^{PP}$.

This argument shows that the lowest possible profit level, $\pi_{LH}$, is an important threshold for the debt levels $D_i$, above which best responses are unique and below which best responses are arbitrary. Using this threshold, we can determine the best responses of dominant lenders:

**Lemma 7** Suppose that $G^I, G^N < K$ and Assumption A holds.

1. If $D_i > \pi_{LH}^{RR}$, then O is the lenders' unique best response to T.
2. If $D_i \le \pi_{LH}^{RR}$, then O and T are the lenders' best responses to T.
3. If $D_i > \pi_{LH}^{RP}$, then O is the lenders' unique best response to O.
4. If $D_i \le \pi_{LH}^{RP}$, then O and T are the lenders' best responses to O.

**Proof.** If the competitor is transparent, firm i (strictly) prefers to be opaque if and only if

$$\eta(D_i) := E\min\left(D_i, \pi_i^{PR}(\theta_1, \theta_2)\right) - E\min\left(D_i, \pi_i^{RR}(\theta_1, \theta_2)\right) > 0.$$

As in the proof of Proposition 6, it is straightforward to draw the graph of $\eta$: Noting that $\eta(\pi_{LH}^{RR}) = 0$, $\eta(\pi_{HL}^{RR}) = -\delta(0)$, and $\delta(0) > 0$ by (19), this graph has the following form:

Figure 5 here

An inspection of Figure 5 proves 1 and 2. A similar argument for the case of the competitor's being opaque, establishes 3 and 4.

■

Lemma 7 states that dominant lenders are indifferent with respect to the choice of transparency if and only if their debt is riskless under both information structures; otherwise, they strictly prefer opaqueness. Therefore, there can exist multiple equilibria caused by indifference. The Lemma also shows that the multiplicity of equilibria at the stage of transparency choice will depend on the relative sizes of $\pi_{LH}^{RR}$ and $\pi_{LH}^{RP}$. However, these two values cannot be ranked in general:

**Lemma 8** We have

$$\pi^{RP}_{LH} > \pi^{RR}_{LH} \Leftrightarrow \gamma(2-\gamma)\theta_L > (2 - q(2-\gamma^2))(\theta_H - \theta_L).$$

Ceteris paribus, this inequality tends to hold for $\gamma$ close to 1 (strong interaction in the product market), and does not hold for $\gamma$ close to 0 and $\theta_L$ large relative to $(\theta_H - \theta_L)$. In this case the loss to a weak firm due to the stronger competition induced by disclosure is less then the resulting coordination gain. Hence, both possibilities can arise.

Lemma 7 and 8 show that the game of transparency choice between two dominant lenders has different equilibria for different parameter constellations. To simplify the presentation, we focus on the case of symmetric debt levels, in which the number of different parameter constellations to consider reduces to four.

**Proposition 9** Suppose both firms are lender controlled, that $G^I, G^N < K$, that $D_1 = D_2 = D$, and that $D$ satisfies Assumption A.

If $D > \max(\pi^{RP}_{LH}, \pi^{RR}_{LH})$, the game has a unique subgame-perfect Nash equilibrium; in this equilibrium, both firms are opaque.

If $\pi^{RR}_{LH} \geq D > \pi^{RP}_{LH}$, there is also a second subgame-perfect equilibrium, in which both firms are transparent.

If $\pi^{RP}_{LH} \geq D > \pi^{RR}_{LH}$, the game has three subgame-perfect equilibria; in the first, both firms are non-transparent, in the second and third, one firm is transparent and the other is not.

Proposition 9 follows immediately from Lemma 7. It states, most importantly, that general opaqueness is a subgame-perfect equilibrium outcome under lender control in all possible circumstances. If debt levels are so low that the dominant lenders become indifferent about their choice, additional equilibria will arise. In other words, opaqueness is unique unless switching to transparency makes the debt riskless. If debt levels are such that $\pi^{RR}_{LH} \geq D > \pi^{RP}_{LH}$ (the second case of Proposition 9), then the best response to opaqueness is still opaqueness, but the best response to transparency is indeterminate. Hence, $(T, T)$ is an equilibrium choice. The situation for $\pi^{RP}_{LH} \geq D > \pi^{RR}_{LH}$ is analogous.Finally, if debt levels are so low that debt is riskless under any information structure, lenders are completely indifferent.[20] All equilibria but $(O, O)$ are the result of indifference.

Proposition 9 provides a converse to Proposition 6: whereas in the case of all equity control firms in equilibrium will be transparent, dominant lenders when competing with each other necessarily choose to be opaque, if debt is risky.

### 5.3 The mixed case

To complete the analysis for the case $G^I, G^N < K$, we consider the case of competition between two different modes of control. For this, assume that firm 1, say, is dominated by equity interests, whereas firm 2 by lender interests. Hence, when determining its degree of transparency, firm 1's objectives are given by (17) and firm 2's objectives by (22).

Given the results of the last two subsections, the analysis is straightforward. By Proposition 6 firm 1's dominant strategy is $T$, to be transparent. By Lemma 7 the only threshold to consider for the choice of firm 2 therefore is $\pi^{RR}_{LH}$.

**Proposition 10** Suppose that firm 1 is equity controlled and firm 2 lender controlled, that $G^I, G^N < K$, and that debt levels satisfy Assumption A. Then the unique subgame-perfect equilibrium has firm 1 being transparent and firm 2 opaque.

The situation in Proposition 10 is a combination of those in the preceding two subsections. Due to the increase in expected profits, equity will always prefer transparency, while the lenders' best response is opaqueness as long as debt is risky.[21]

Hence, competition across firms under two different regimes of corporate control will tend to not change their chosen degree of transparency, as long as the dominant investors do not change.

---

[20] Note that the cases ignored by assuming $D_1 = D_2$, are straightforward extensions of those described in Proposition 9. If, e.g., the debt level of firm 1 is high and that of firm 2 very low, non-transparency is the dominant choice for firm 1, while firm 2 is indifferent. In such cases $(O, O)$ and $(O, T)$ are both possible equilibrium outcomes.

[21] If $D_2 \le \pi^{RR}_{LH}$ so that debt is riskless, we have again the possibility of an indeterminate response: firm 1 in subgame-perfect equilibrium is transparent, and firm 2 is either transparent or opaque.

## 5.4 Equilibrium in the case of intermediate information costs

To complete the analysis we must determine the transparency choice at stage 1 for the parameter constellation considered in Proposition 3, that is where either $G^I < K < G^N$ or $G^N < K < G^I$. As we know from Proposition 3, the equilibrium continuation at stage 3 of the game need not be unique in these cases.

We first consider the case $G^N < K < G^I$. By Proposition 3, $(I; I)$ is the unique equilibrium continuation given stage 1 choices $(T; T)$, $(T; O)$, and $(O; T)$. Following $(O; O)$, on the other hand, also $(N; N)$ can arise in equilibrium, as well as a mixed strategy equilibrium.

We know from the proof of Proposition 6 that equity prefers information revelation (R), regardless of the situation of the competitor. Therefore, as long as there is the slightest doubt about whether $(I; I)$ will be played in stage 3, equity will choose transparency at stage 1 regardless of the choice of its competitor. In fact, by doing so it guarantees that investors will collect information about both firms, thereby making it likely that information will be revealed for product market competition. Therefore, for the cases of equity - equity control and the mixed case (subsections 5.1 and 5.3 above) equity can be expected to behave as indicated in Propositions 6 and 10. In the latter case, debt holders will be indifferent, because their choice has no impact on financial markets if the competitor is transparent: the complementary nature of information acquisition in the case $G^N < K < G^I$ will make information acquisition profitable even in an opaque firm.[22] In the case of bilateral debtor control (subsection 5.2 above), the transparency choice depends on anticipated investor behavior in the financial market, too. If the equilibrium continuation for opaque firms $(O; O)$ will be $(N; N)$, i.e. no information collection in the markets, then only $(O; O)$ is an equilibrium choice. If the continuation will be $(I; I)$, the transparency choice does not matter.

The case $G^I < K < G^N$ is treated analogously. What is important in these cases of intermediate information acquisition costs is that debtors have less control over the informativeness of stock prices even if they attempt to hold the firm opaque. It is therefore possible in equilibrium to have mar-

[22] Formally, of course, there are many subgame-perfect equilibria. Under equity - equity control, $(T; T)$, $(T; O)$, and $(O; T)$ are all stage 1 equilibrium outcomes (with $(I; I)$ as the unique continuation in stage 3). Also $(O; O)$ is a stage 1 equilibrium outcome, if the stage 3 equilibrium continuation is $(I; I)$. Similarly for the case of equity - debt control.

ket investors pro…tably collecting information about opaque …rms, and even more, dominant debtors anticipating this and making their …rms transparent.

# 6 Conclusions

In this paper we have highlighted the impact of the dominant investors on the di¤usion of information. We provide an incentive-based explanation for the casual observation that lender-dominated …rms are more opaque, and suggest that besides the lower degree of transparency accompanying debt …nancing, the informativeness of traded security prices may be deliberately discouraged.

Our notion of debtor control captures a limited, but probably important part in some institutional settings of the corporate governance problem. One quali…cation, however, is that in order to exert control, debt holders must act in a concerted manner, which is usually impossible if debt is widely held. As a consequence, our analysis of lender control only applies to debt held by concentrated in‡uential investors, in particular banks. Thus it is presumably more relevant to Japanese or European than to US companies, where equity control seems to be the norm (out of Chapter 7 bankruptcy). Thus our model predicts higher corporate transparency in the US (and perhaps UK) relative to other countries.An interesting side result is that the informational advantage of an opaque …rm facing a transparent competitor does not translate in an outright competitive advantage. While lack of transparency ensures that it is shielded when in a weak competitive position, when the …rm is in a strong position it cannot take full advantage of common knowledge of its strength to restrain output by competitors, losing market share precisely when its product is relatively pro…table. Hence, the value of transparency depends on whether investors are interested in the upside or the downside of pro…ts.

In related work we analyse in greater detail the allocation of nontransferable control rights as politically determined (Perotti and von Thadden, 1997). We show there that bank dominance may emerge as a result of political support for a less competitive marketplace, which results in lower average asset values but also reduces the risks associated with employed individuals' stakeholder rents, which are in general undiversi…able.

In future work the model can also be extended to analyzing some indirect cost of lack of transparency. It is possible that limited price informativeness may result, for instance, in reduced innovation or as a discouragement of entry by new …rms. We also wish to study the role of information in traded securities in informing a …rm's own corporate strategy, and the impact of the growing trend towards equity market development.

A particularly challenging question which we have begun to address is the question of the evolution of disclosure in …nancial systems historically dominated by banks. It is possible that the increasing pressure for shareholder value in countries such as Japan and Germany re‡ects changing conditions on the riskiness of loans and the impact of foreign competition.

Moreover, opaqueness may be increasingly hard to sustain as trading liquidity rises due to rising global investment ‡ows. An increase in stock market trading due to more uninformed foreign investment may increase the pro…ts to informed trading even if the dominant investors attempt to increase the cost of becoming informed. This would lead to greater informativeness of prices, thus stronger competition and a greater average pro…tability and riskiness. We intend to return to these themes in the future.

# 7 Appendix

In this appendix, we provide the equilibrium quantities and profits for the three different possible informational structures in the product market. They are obtained by standard calculations. For the case of competition under symmetric information $(R; R)$ we have

$$Q^{RR}_{HL} = \frac{1}{2+\gamma}\left(\theta_H + \frac{\gamma}{2-\gamma}(\theta_H - \theta_L)\right); \tag{23a}$$

$$Q^{RR}_{HH} = \frac{\theta_H}{2+\gamma}; \tag{23b}$$

$$Q^{RR}_{LL} = \frac{\theta_L}{2+\gamma}; \tag{23c}$$

$$Q^{RR}_{LH} = \frac{1}{2+\gamma}\left(\theta_L - \frac{\gamma}{2-\gamma}(\theta_H - \theta_L)\right); \tag{23d}$$

with equilibrium profits given by $\pi^{RR}_{ij} = (Q^{RR}_{ij})^2$. In the case where both firms' quality is private information, $(P; P)$, we have

$$Q^{PP}_{H} = \frac{1}{2+\gamma}\left(\theta_H + \frac{\gamma}{2}(1-q)(\theta_H - \theta_L)\right); \tag{24a}$$

$$Q^{PP}_{L} = \frac{1}{2+\gamma}\left(\theta_L - \frac{\gamma}{2}q(\theta_H - \theta_L)\right); \tag{24b}$$

and equilibrium profits

$$\pi^{PP}_{HL} = \frac{1}{(2+\gamma)^2}\left(\theta_H^2 + \frac{\gamma}{2}(2+\gamma q)\theta_H(\theta_H - \theta_L) + \frac{\gamma^2}{4}(1-q)(1+(1+\gamma)q)(\theta_H - \theta_L)^2\right); \tag{24c}$$

$$\pi^{PP}_{HH} = \frac{1}{(2+\gamma)^2}\left(\theta_H^2 - \frac{\gamma^2}{2}(1-q)\theta_H(\theta_H - \theta_L) - \frac{\gamma^2}{4}(1-q)^2(1+\gamma)(\theta_H - \theta_L)^2\right); \tag{24d}$$

$$\pi^{PP}_{LL} = \frac{1}{(2+\gamma)^2}\left(\theta_L^2 + \frac{\gamma^2}{2}q\theta_L(\theta_H - \theta_L) - \frac{\gamma^2}{4}q^2(1+\gamma)(\theta_H - \theta_L)^2\right) \tag{24e}$$

$$\pi^{PP}_{LH} = \frac{1}{(2+\gamma)^2}\left(\theta_L^2 - \frac{\gamma}{2}(2+\gamma-\gamma q)\theta_L(\theta_H-\theta_L) + \frac{\gamma^2}{4}q(1+(1+\gamma)(1-q))(\theta_H-\theta_L)^2\right). \tag{24f}$$

In the asymmetric case, where one firm's type is publicly revealed and the other's only privately known, the equilibrium is given by

$$Q^{RP}_{H} = \frac{1}{2+\gamma}\left(\theta_H + \frac{\gamma(1-q)}{2-\gamma}(\theta_H-\theta_L)\right), \tag{25a}$$

$$Q^{RP}_{L} = \frac{1}{2+\gamma}\left(\theta_L - \frac{\gamma q}{2-\gamma}(\theta_H-\theta_L)\right), \tag{25b}$$

$$Q^{PR}_{HH} = \frac{1}{2+\gamma}\left(\theta_H - \frac{\gamma^2(1-q)}{2(2-\gamma)}(\theta_H-\theta_L)\right), \tag{25c}$$

$$Q^{PR}_{HL} = \frac{1}{2+\gamma}\left(\theta_H + \gamma\frac{2-\gamma(1-q)}{2(2-\gamma)}(\theta_H-\theta_L)\right), \tag{25d}$$

$$Q^{PR}_{LL} = \frac{1}{2+\gamma}\left(\theta_L + \frac{\gamma^2 q}{2(2-\gamma)}(\theta_H-\theta_L)\right), \tag{25e}$$

$$Q^{PR}_{LH} = \frac{1}{2+\gamma}\left(\theta_L - \gamma\frac{2-\gamma q}{2(2-\gamma)}(\theta_H-\theta_L)\right), \tag{25f}$$

with profits

$$\pi^{PR}_{ij} = (Q^{PR}_{ij})^2 \tag{26}$$

for $ij = HH, HL, LH, LL$, and

$$\pi^{RP}_{HH} = \frac{1}{(2+\gamma)^2}\left(\theta_H^2 + \frac{\gamma^3(1-q)}{2(2-\gamma)}\theta_H(\theta_H-\theta_L) - \frac{\gamma^2(1-q)^2(2-\gamma^2)}{2(2-\gamma)^2}(\theta_H-\theta_L)^2\right), \tag{27a}$$

$$\pi^{RP}_{HL} = \frac{1}{(2+\gamma)^2}\left(\theta_H^2 + \frac{\gamma(4-\gamma^2 q)}{2(2-\gamma)}\theta_H(\theta_H-\theta_L) + \frac{\gamma^2(1-q)}{2(2-\gamma)^2}(2+2q-\gamma^2 q)(\theta_H-\theta_L)^2\right), \tag{27b}$$

$$\pi^{RP}_{LL} = \frac{1}{(2+\gamma)^2}\left(\theta_L^2 - \frac{\gamma^3 q}{2(2-\gamma)}\theta_L(\theta_H - \theta_L) - \frac{\gamma^2 q^2 (2-\gamma^2)}{2(2-\gamma)^2}(\theta_H - \theta_L)^2\right); \quad (27c)$$

$$\begin{aligned}\pi^{RP}_{LH} = \frac{1}{(2+\gamma)^2}\Bigg(\theta_L^2 &- \frac{\gamma(4-\gamma^2(1-q))}{2(2-\gamma)}\theta_L(\theta_H - \theta_L) \\ &+ \frac{\gamma^2 q}{2(2-\gamma)^2}(2(2-q) - \gamma^2(1-q))(\theta_H - \theta_L)^2\Bigg).\end{aligned} \quad (27d)$$

Note that all quantities described here are positive by assumption (2).

# 8 References


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