Laboratoire d'Economie d'Orléans

Document de Recherche

n° 2004-06

" *Accounting Transparency and the Cost of Capital* "

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Accounting transparency and the cost of capital

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This version‡: 15th March 2004

Abstract

This paper identifies a negative effect of corporate transparency, and shows that more precise accounting standards can lead to a higher cost of capital. We build a model of a firm raising funds through an IPO to finance a positive NPV project. Due the presence of an informed speculator, increased disclosure through accounting data can increase informational asymmetries in the secondary market, thereby reducing market liquidity. Our uninformed traders are rational liquidity traders that anticipate that they loose because of informed trading. Reduction in market liquidity therefore leads to higher cost of external capital. The "agency cost" comes from asymmetries among investors.

JEL classification: D82, G10, M41

Keywords: financial market, cost of capital, accounting standards, transparency, lemon premium.

Résumé

Un effet négatif de la transparence des firmes est formalisé, montrant que des standards comptables plus précis *peuvent augmenter* le coût du capital. Une firme émet des titres échangeables pour financer un projet de VAN positive. De par la présence d'un spéculateur informé, la divulgation d'information via les annonces comptables peut augmenter les asymétries d'information dans le marché secondaire, et réduire la liquidité. Les investisseurs non informés sont rationnels et valorisent la liquidité des titres. La moindre liquidité du marché induit alors un coût du financement externe plus élevé. Ce "coût d'agence" est expliqué par les asymétries entre investisseurs.

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‡We acknowledge comments by participants at seminar at the University of Paris 10. We thank Bertrand Gobillard for pointing some mistakes in the previous manuscript. Remaining errors are our own.

1 Introduction

One of the key principles underlying current evolutions in accounting regulation – e.g. adoption of *IASB* standards by European Community – is the objective to provide financial investors with more accurate and precise information about firms' activity. This stated objective has been reinforced by recent corporate scandals (Enron, Parmalat), that illustrated how actual accounting practices and standards were not able to prevent public misperception of a corporate financial position. In the view of regulation makers, more precise, "transparent" accounting standards allow investors to better control managers' actions, which will "enhance the comparability and transparency of financial information, thereby increasing the efficiency of the markets and reducing the cost of capital for companies[1]" (EU Directive on consolidated accounts, 2002).

The line of argument sustaining this typical statement runs as follows. Well-designed accounting standards increase the precision of information extracted from accounting release. In turn, more precise information reduces information asymmetries between firms and investors, thereby contributing to lower the cost of capital (Leuz and Verrecchia, 2000). We think this argument narrowly focuses on informational asymmetries between managers and investors, and understates important effects on the distribution of information among investors. Intuitive as it may be, the presumption that information disclosure reduces all informational asymmetries is false. When investors are heterogenous – because they differ in their ability to process accounting information, or have access to different private information – more public information can increase informational asymmetries among market participants. This can adversely affect the liquidity of the firm's stock and finally raise the cost of external finance. Although we build on existing ideas in the microstructure literature, to our knowledge the effect we stress has not appeared in the accounting regulation debate.

Despite the widespread perception that transparency is beneficial[2], the literature has identified situations where more public information may be socially undesirable[3]. First it is well known since Hirshleifer (1971) that public information can destroy risk-sharing opportunities. Dye (2001) applies this very general effect to discuss the desirability of information disclosure by firms. Another strand of literature

[1]US Security and Exchange Commission former Chairman Arthur Levitt delivered quite the same message, see Admati and Pfleiderer (2000).

[2]The benefits of information disclosure are well documented. See, inter alia, Diamond (1985) and Fishman and Hagerty (1989, 1990). For a survey on the literature on disclosure, see Verrecchia (2001). We highly recommend the discussion by Dye (2001) on the use of linear rational pricing models in the accounting literature.

[3]Even in settings were more information is better, more stringent disclosure legislation need not be optimal. For instance, Dye (1985) shows that when substitutions effect with other sources of public information (voluntary disclosure by firms) are present, this can paradoxically lower publicly available information. Similarly, the effects on private acquisition of information are ambiguous (Bushman, 1991). We term those effects as "indirect", in contrast to "direct" costs of more information.

points to the notion of proprietary information, the disclosure of which can benefit the firm's competitor, thereby lowering the firm's position and associated cash-flow (Dye, 1985)[4]. In a pure agency setting, Crémer (1995) and Prat (2003) show that more information about the agent's type can be detrimental to welfare through diminished incentives. Negative effects of corporate transparency in Almazan, Suarez and Titman (2003) hinges on another instance of unintended disclosure to a third party. In their model, lower public information about the firm's type induces the worker force to exert higher effort. Finally, Kanodia and Singh (2001) argue that when a firm's investment decision is influenced by how its decisions are priced in the market, imprecision in accounting reports may be necessary to induce outside investors to incorporate ongoing information.

We point to a distinct potential cost of transparency. The key idea is that more public information and less private information are not synonymous. The intuition builds on two assumptions. (i) When some investors have access to private information, more precise accounting information can increase the informational advantage of informed speculators vis-à-vis uninformed liquidity traders. As in Boot and Thakor (2001), this occurs when the information disclosed by firm is complementary to the private information of informed traders. (ii) Informational asymmetries among market participants hinder the liquidity of the secondary market (Glosten and Milgrom, 1985; Gorton and Pennachi, 1990). When investors value liquidity, this represents a cost which is ultimately borne by the firm.

More precisely, we consider a firm raising external finance for a risky project. The capital market is populated by one potential speculator and many small investors who value liquidity. The environment is designed such that more precise accounting raises the speculator's informational advantage. As an example, consider a firm developing a product designed for one of two competing technological standards. Some investors in the market may have private information about which standard will finally prevail. However this information is only valuable when there is public information about the firm's choice of standard. When such information is disclosed (through, e.g. accounting release), the informed trader enters the market, because accounting information raises the value of his private information. Anticipating that they may suffer from speculation when selling their shares for liquidity reasons, small investors require a higher return to initially buy the firm's shares. The firm's cost of capital is higher under transparency. Disclosure raises the incentives to acquire socially harmful information. This result contrasts those in Diamond (1985) and Boot and Thakor (2001) who study incentives to acquire socially usefull information.

Our argument can be given the following alternative interpretation. Accounting release is raw data, that must generally be processed or combined with other sources to yield valuable information. Hence, in real world settings, disclosure *per se* does not imply more public information. Indeed, some investors may lack the ability to fully

[4] The idea that confidentiality has value for firms appeared in Campbell (1979). Bhattacharya and Chiesa (1995) and Yosha (1995) use this idea to explain firm's choice of financing source.

process increasingly technical financial reports, while other have a comparative advantage in this respect[5]. In that case, increasing the technicity of financial statement, through a more detailed account of, e.g. firm's derivative position can help to mitigate the informational asymmetry between manager and some investors (the more sophisticated). But at the same time, this would deepen the informational asymmetry between investors, thereby creating an opportunity for the sophisticated to make profit at the expense of the less sophisticated as the former can used their knowledge of the true firm position to sell their share to the less informed, before this information is incorporated into the price. So this work is also related to some extant research that emphasise investors' differing sophistication (Indjejikian, 1991; Hirschleifer and Teoh, 2004).

The rest of the paper is organised as follows. Section 2 presents the economic environment, in term of agents, information structure and trading mechanism. Section 3 solves for the equilibrium on the secondary market. Section 4 analyses the initial public offreing stage for a given accounting structure. Effect of accounting structure is analysed in section 5. Section 6 concludes. Computations are in the appendix.

2 Environment

This is a three-date economy. Time is indexed by $t = 0, 1, 2$. The situation is that of an entrepreneur raising cash through an initial public offering (IPO) in order to undertake an investment project.

Firm. A risk neutral entrepreneur with no cash (henceforth E) is endowed with a project requiring a fixed investment $I = 1$ at $t = 0$. He goes to the capital market in order to raise I through an IPO. The project yields a risky cash flow $\tilde{V}$ at $t = 2$: it can succeed and yield V^H with probability π, or fail and yield $V^L = 0$ with probability $1 - \pi$. The project has positive net present value:

$$\pi V^H > 1 \tag{1}$$

We assume limited liability, so that E issue securities that pay R in case of success. At the time of the IPO, the entrepreneur does not have any private information about the project. The outcome does not depend on any (unobservable) action of the entrepreneur. Thus there is no adverse selection nor moral hazard problem between the firm and outside investors. Furthermore, π is common knowledge and the date 2 realisation V is publicly observed. Just after the project has started, the entrepreneur privately observes a signal $S^i \in \left\{S^0, S^1\right\}$ on the date 2 cash flow.

[5]There is some support to the idea that a research on the effect of more transparent accounting disclosure on firm's cost of capital have to take into account the existence of various types of traders on the financial market. The existence of various type of investors on the capital market have, e.g., been stressed by the FASB in July, 1995 in a report worrying about an "information overload" problem that at least one group of traders can experienced.

Investors. At date 0, there are two types of risk neutral investors that can participate in the IPO: one speculator with wealth $W^0 > 1$ and an infinity of small investors with individual wealth $W << 1$. Investors' type are unobservable. The riskless interest rate is normalised to $r = 0$.

Small investors are rational liquidity traders, as in Gorton and Pennachi (1990). They are subject to a preference shock *à la* Diamond and Dybvig (1983): a small investor can turn out to be impatient and value only date 1 consumption, or patient and value only date 2 consumption. The fraction of impatient investors is uncertain. Formally, a small investor has utility

$$u(c_1, c_2) = \begin{cases} c_1 & \text{with probability } \lambda \\ c_2 & \text{with probability } 1 - \lambda \end{cases} \tag{2}$$

The aggregate shock $\tilde{\lambda}$ is drawn from a uniform distribution distributed over $[0, 1]$.

The speculator (henceforth S) is potentially an informed investor. S is risk neutral and maximizes $\mathrm{E}_{t=0}[c_1 + c_2]$. After the project has been undertaken, he observes a private signal $s^i \in \{s^0, s^1\}$. However, S participates if an only if his expected profit is higher than an outside option c. This can be given two interpretations. One can think of it as a date 0 cost that S incurs if he wants to have private information about the firm at date 1 (cost of information or attention). Alternatively, c can represent S's opportunity cost of participation, that is to say the profit he could make on unmodelled alternative firms[6].

Finally, there is a competitive risk neutral market marker who supplies liquidity for the secondary market at date 1. The market maker observes the aggregate order of the market, Q. As usual in the literature since Kyle (1985), this simple microstructure yields a price equal to the expected value conditional on the information observed by the (competitive) market maker (see section 3).

Information. The main ingredient of the analysis is the specification of information structures. Assumptions about information are contained in the statistical relationship between (S^i, s^j) and the firm's date 2 cash flow V. For a given information X, denote $\pi(X) \equiv \Pr[V = V^H | X]$ the probability of success conditional on X. This notation will be adhered to throughout the paper. The unconditional probability is $\pi = \Pr[V = V^H]$. Then, information structures are completely described by the implied probabilities $\pi(S^i)$, $\pi(s^j)$ and $\pi(S^i, s^j)$.

We share with most of the literature the premise that accounting is an information structure on the firm's activity. Accounting standards can be thought of as determining the precision of this information. In our simple setting, the only piece of private information that E possesses is S^i. This gives the straightforward definition of transparent accounting rules, which is equivalent in our simple setting to Dye's (1985) definition based on the "fineness" of the associated information structure:

[6]So S must decide ex ante to be attentive or not to a given firm in the future. Indeed, c can stand for diverse effects, e.g. learning cost, organisational cost for the sophisticated trader, specialisation on a given industry. Note that c cannot be interpreted as the speculator's opportunity cost of funds.

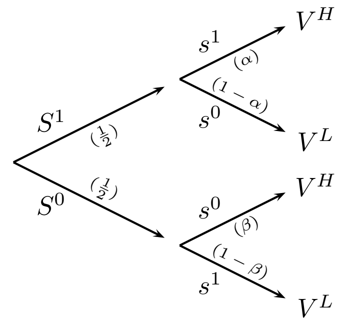

Figure 1: Information structure

Definition 1. *Accounting standards are "transparent" if accounting disclosure reveals the entrepreneur's private information S^i.*

In the sequel, we will contrast two extreme situations : transparent accounting standards and opaque accounting standards. With opaque standards, accounting release is uninformative, and the speculator's information is given by his private signal $\left(s^i\right)$. The shift to transparent standards shifts public information to $\left(S^i\right)$, and S information to $\left(S^i, s^j\right)$. We assume that even though no investor knows what information will be disclosed by the firm, any investor can look at the firm's announced disclosure policy and determine how the nature of the information of various investors will change when the disclosure actually occurs.

All results from sections 3 to 5 are derived for a general information structure, the only restriction being that s^i takes on two values. However, for the sake of illustration we will consider two cases of information structure of the form depicted in figure 1.

Case 1: $\alpha = \beta = \pi$. With this symmetric structure, any single signal contains no information:

$$\pi\left(S^1\right) = \pi\left(S^0\right) = \pi\left(s^1\right) = \pi\left(s^0\right) = \pi$$

whereas (S, s) is fully informative.

Case 2: $\alpha = \frac{1+\varepsilon}{2}$ and $\beta = \frac{1-\varepsilon}{2}$, with $0 < \varepsilon < 1$. In this case, (s) is uninformative while (S) is partially informative, so that transparent standards will lower the information asymmetries between the firm and any investor.

Timing. The game unfolds as follows (see figure 2). *Before* $t = 0$, the entrepreneur announces his information disclosure policy (accounting standards). We assume that accounting standards are implementable or, equivalently, that any accounting information is truthfull[7]. *Date 0* is the IPO stage : E announces a payment R to holders of the securities in case of success. He seeks to minimize his cost of capital, subject to the constraint that enough funds are raised. Small investors and

[7] This amount to assuming that S^i is verifiable. In other words, fraud is verifiable, and sanctions against fraud are high. Issues related to the verifiability of accounting information are beyond the scope of the paper.

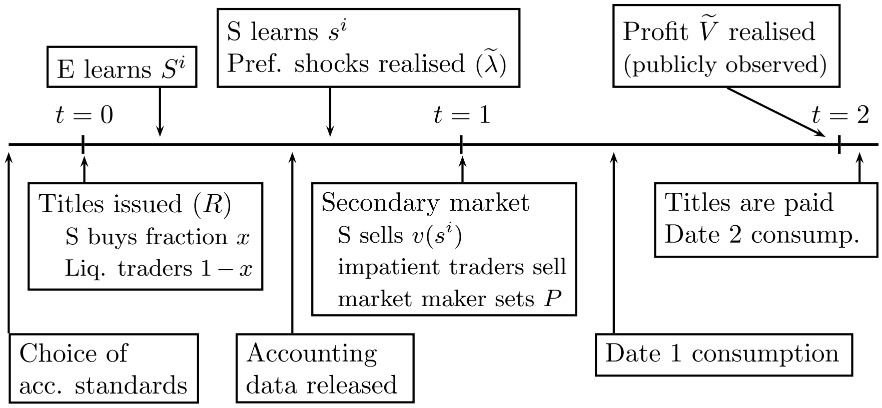

Figure 2: Timing of events

S then decide how much stocks to buy. S buys a fraction x of issued securities. Small investors will not choose to invest in the entrepreneur's project (buying the remaining $1 - x$) if they expect that this will yield them a negative payoff (Gorton and Pennachi, 1990). The firm's cost of capital is the required return on the firm's securities. If enough funds have been raised, the project is initiated. After the project has started, signals S^i and s^j are received by relevant parties; small investors learn whether they are impatient or patient. The entrepreneur then disclose an accounting statement according to the accounting standards. At *date* 1, trade occurs in the secondary market. Traders address orders to the market maker who only observes the aggregate amount of orders and sets price accordingly. Using this information and the inference he can make regarding other's actions, he sets a price such that he gets a zero expected payoff. Date 1 consumption takes place. At *date* 2, the liquidation value V is realised, payments are made if the project is successful, and final consumption takes place. Sections 3 to 5 solve this by backward induction.

3 Secondary market equilibrium

In this section, we solve for the equilibrium on the secondary market, for given accounting standards and a given payment R. This stage is essentially a game between the liquidity supplier and the informed speculator. Indeed, patient liquidity traders do not trade because they do not have any (private) information. Impatient traders sell their stocks and introduce noise between the market maker and the informed trader.

Accounting information defines a public prior $\pi(\mathcal{I})$, with $\mathcal{I}$ information contained in accounting disclosures. If S's signal is not informative, then $\pi\left(\mathcal{I}, s^i\right) = \pi(\mathcal{I})$ and it is obvious that the market trader stands ready to buy/sell at the price $\pi(\mathcal{I})\, R$. The interesting case is when S has some informational advantage over public information. In this case, one must have that $\pi\left(\mathcal{I}, s^i\right) > \pi(\mathcal{I}) > \pi\left(\mathcal{I}, s^j\right)$ for $i = 0$ or 1, and

$i \neq j$. For the remaining of this section, we will denote s^i the state for which $\pi\left(\mathcal{I}, s^i\right) > \pi\left(\mathcal{I}\right)$, and s^{-i} the state for which $\pi\left(\mathcal{I}\right) > \pi\left(\mathcal{I}, s^{-i}\right)$.

The risk neutral market maker observes the aggregate order Q. As usual in the literature since Kyle (1985), competitive liquidity supply yields a price equal to the expected value conditional on the market maker information:

$$P\left(Q\right) = \mathbb{E}\left[\tilde{R}|\mathcal{I},Q\right] \tag{3}$$

As a monopolist, the speculator anticipates the effect his order v has on the price set by the market maker. As $\pi\left(\mathcal{I}, s^i\right) > \pi\left(\mathcal{I}\right)$, S buys the stock when his signal is s^i, betting on a low realisation of λ to full the market maker. Conversely, he is willing to sell when $s = s^{-i}$; he can hide his trade when λ is high. Formally, upon observing s, S maximises his date 2 earnings:

$$\max_{v} \left\{x\pi\left(\mathcal{I}\right)R + v \cdot \left[\pi\left(\mathcal{I}, s\right) - \mathbb{E}\left[P\left(Q\right)|\mathcal{I}, s\right]\right]\right\} \tag{4}$$

subject to the no short sell constraint $v\left(s\right) \leq x$.

Denote by v^e the anticipated speculator's strategy. For a given realisation λ of the aggregate liquidity shock, $\lambda \cdot (1 - x)$ stocks are sold for liquidity reasons. The market maker sets the price equal to the expectation of the value of the firm for claim-holders, given the aggregate selling $Q = \lambda \cdot (1 - x) + v^e\left(s\right)$.

$$P = \mathbb{E}\left[\tilde{R}|\mathcal{I},Q\right] = \Pr\left[V^H|\mathcal{I},Q\right]R = \pi\left(\mathcal{I},Q\right)R \tag{5}$$

with

$$\pi\left(\mathcal{I}, Q\right) = \Pr\left[s^i|\mathcal{I}, Q\right]\pi\left(\mathcal{I}, s^i\right) + \Pr\left[s^{-i}|\mathcal{I}, Q\right]\pi\left(\mathcal{I}, s^{-i}\right) \tag{6}$$

This yields the following pricing rule, the intuition of which is straightforward from figure 3. (Proof in appendix A)

Lemma 1. *The inference problem of the market maker leads to the pricing rule*

$$P\left(Q\right) = \begin{cases} \pi\left(\mathcal{I}, s^i\right)R & \forall Q < v^e\left(s^i\right) \\ \pi\left(\mathcal{I}\right)R & \forall v^e\left(s^i\right) < Q < 1 - x + v^e\left(s^{-i}\right) + v^e\left(s^i\right) \\ \pi\left(\mathcal{I}, s^{-i}\right)R & \forall 1 - x + v^e\left(s^{-i}\right) + v^e\left(s^i\right) < Q \end{cases} \tag{7}$$

In equilibrium, the market maker correctly anticipates the speculator's strategy, so that $v^e = v^*$. An equilibrium for the secondary market game thus consists of a trading strategy for S, v^*, and a pricing rule for the market maker, P^*, such that (i) S's strategy maximizes its profit taking as given the pricing rule P^*,

$$v^*\left(s\right) = \arg\max_{v \leq x} v \cdot \left[\mathbb{E}\left[P^*\left(Q\right)|\mathcal{I}, s\right] - \pi\left(\mathcal{I}, s\right)\right] \tag{8}$$

and (ii) the pricing rule is consistent with v^* and Bayes' rule,

$$P^*\left(Q\right) = \mathbb{E}\left[\tilde{R}|Q, v^*\right] \tag{9}$$

The following proposition characterises the unique equilibrium (Proof in the appendix).

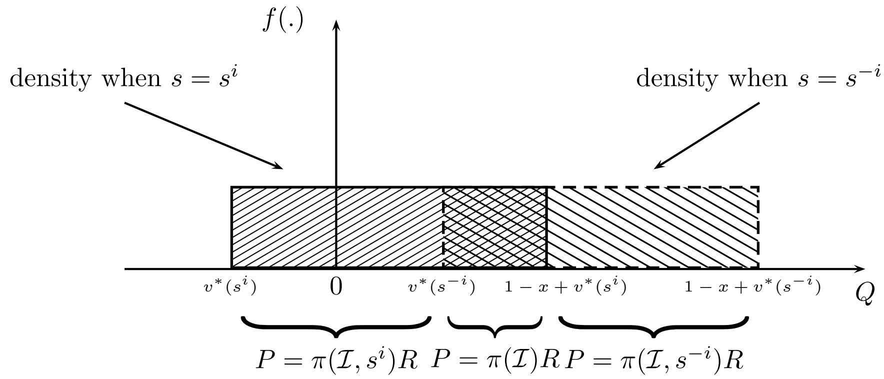

Figure 3: The market maker inference problem

Proposition 2. *There is a unique equilibrium on the secondary market. If the speculator's initial position $x \leq \frac{1}{4}$, then S is constrained by his initial holding, and his equilibrium strategy is*

$$v^*\left(s^i\right) = -\left(\frac{1}{2} - x\right) \qquad v^*\left(s^{-i}\right) = x \tag{10}$$

If $\frac{1}{4} \leq x \leq 1$, then the no-short selling contraint is not binding, and S's equilibrium strategy is

$$v^*\left(s^i\right) = -\frac{1-x}{3} \qquad v^*\left(s^{-i}\right) = \frac{1-x}{3} \tag{11}$$

4 IPO Stage

The previous section analysed the secondary market outcome, for a given level of x. Hence, in the first place, the speculator should be willing to contribute to a fraction x of the investment, and uninformed liquidity traders should be ready to contribute for the remaining fraction $1-x$, even though they know that the speculator could participate.

4.1 Speculator position

At $t = 0$, the speculator decides the fraction x of total issued stocks to buy. His $t = 0$ expected profit (gross of the initial cost c) is

$$\Pi^S(x) = x(\pi R - 1) + \sum_{\mathcal{I}} \Pr[\mathcal{I}] \sum_s \left[\Pr(s|\mathcal{I}) \max_{v \leq x} v \cdot [\pi(\mathcal{I}, s) - \mathbb{E}[P^*(Q)|\mathcal{I}, s]]\right] \tag{12}$$

Expression (12) for the speculator's profit can be pined down to a measure of his informational advantage. More precisely, define

$$T = \sum_{\mathcal{I}} \Pr[\mathcal{I}] \sum_{s} \Pr[s|\mathcal{I}] \cdot |\pi(\mathcal{I}, s) - \pi(S)| \tag{13}$$

With some computations Π^S can be written as a function $\Pi^S(x, R, T)$, increasing with R and with the informational advantage T (see appendix C).

Conditional on participating, S buys at the IPO stage the fraction $x^*(R,T) \equiv \arg\max_{[0,1]} \Pi^S(x,R,T)$ of issued stocks. Define $\Pi^*(R,T) = \max_x \Pi^S(x,R,T)$ the associated expected profit of S if he participates. The speculator's optimal holding is characterised as follows:

Proposition 3. *Let* $x^* = \arg\max_{[0,1]} \Pi^S(x,R,T)$. *Define*

$$\bar{R} = \frac{1}{\pi}\left(1 + \frac{1}{8}T\right) \tag{14}$$

Then (i) if $R < \bar{R}$ *then* $x^* = 0$ *and* $\Pi^*(R,T) = \frac{1}{8}T$. *(ii) if* $R > \bar{R}$ *then* $x^* = 1$ *and* $\Pi^*(R,T) = \pi R - 1$.

One comment is in order about maximisation of expression (12) by our informed trader. One consequence is that S chooses the amount of noise in the secondary market by choosing his initial holding x. So, although S's position is unobservable at the time of the IPO, we assume that the market maker somehow get to learn x before there is trading on the secondary market.

S participates if and only if the profit from his private information covers the initial participation cost:

$$\Pi^*(R,T) > c \tag{15}$$

4.2 Liquidity traders participation

Rational liquidity traders know they can suffer from informed speculation. A small liquidity trader investing his wealth W in the riskless technology would get utility $E_{\tilde{\lambda}}[\lambda W + (1-\lambda) W] = W$. Conversely, investing all his wealth[8] W in the firm's stock would give him an expected utility

$$\mathbb{E}_{t=0}[u(c_1, c_2)] = W \mathbb{E}\left[\lambda P^* + (1-\lambda)\tilde{R}\right] \tag{16}$$

where the expectation operator taken w.r.t all uncertainty at date 0, aggregate shock λ, future public information $\mathcal{I}$ and the speculator's private information s^i if he participates. In that case, let $U^e \equiv \mathbb{E}\left[\lambda P^* + (1-\lambda)\tilde{R}\right]$. Computing U^e directly is a bit tricky. For the sake of interpretation, it is better to relate uninformed investors

[8]One can easily check that with preferences represented by (2), small investors' portfolio choice is of the all–or–nothing type.

expected utility to S's profit the analysis of date 2 payments by E and date 1 trading in the secondary market. At date 2, total payments by the firm are distributed among securities holders, according to their final holding of the firm's stock:

$$\underbrace{(1-x)\ (1-\lambda)\,\tilde{R}}_{\text{patient liq. traders}}+\underbrace{(x-v)\,\tilde{R}}_{\text{S}}+\underbrace{\Big((1-x)\,\lambda+v\Big)\,\tilde{R}}_{\text{market maker}}=\tilde{R} \tag{17}$$

Trading in the secondary market at date 1 is a zero sum game between small investors, S, and the market maker. A similar decomposition among traders then yields:

$$\underbrace{(1-x)\,\lambda P^*}_{\text{impatient liq. traders}}\quad+\underbrace{vP^*}_{\text{S}}-\underbrace{\Big((1-x)\,\lambda+v\Big)\,P^*}_{\text{market maker}}=0 \tag{18}$$

Adding (17) and (18) and summing over all realisations of random variables, we get the gains of all traders' expected gains (gross of date 0 investment):

$$(1-x)\,U^e+\left[\Pi^S+x\right]+\Pi^M=\pi R \tag{19}$$

with Π^M the expected profit of the market maker. In equilibrium, the (competitive) market maker makes zero expected profit. Equation (19) thus simplifies to

$$(1-x)\,U^e+\left[\Pi^S+x\right]=\pi R \tag{20}$$

The market maker is merely providing liquidity, and disapears from the aggregate relation (20). Expression (20) formalises the intuition that the speculator's gain from trade is made at the expense of the uninformed liquidity traders. As investors are risk neutral, the problem is not the uncertainty of the market price P^* but the correlation between λ and P^* induces by informed trading. Indeed, one can writes

$$U^e=\mathbb{E}\left[\lambda P^*+(1-\lambda)\,\tilde{R}\right]=\mathbb{E}\left[\lambda P^*\right]+\mathbb{E}\left[1-\lambda\right]\pi R$$

From the pricing rule (7), it is clear that the expected price $\mathbb{E}\left[P^*|\lambda\right]$ is decreasing with λ, so that $\mathbb{E}\left[\lambda P^*\right]<\mathbb{E}\left[\lambda\right]\mathbb{E}\left[P^*\right]$. The interpretation is as follows. When λ is high – when liquidity traders would benefit from a high price – the price is more likely to be low, because the market maker sets a price to shield himself from informed selling. Conversely, the price is more likely to be high when liquidity traders do not need it – when λ is low.

As a consequence, when S participates, $\mathbb{E}\left[\lambda P^*+(1-\lambda)\,\tilde{R}\right]<\pi R$. The entrepreneur has to compensate liquidity traders the loss induced by speculative trading[9]. Finally, small investors buy the fraction $(1-x)$ if and only if $U^e\geq 1$, that is

$$\pi R-\left[\Pi^S+x\right]\geq 1-x \tag{21}$$

If there is no informed trading, liquidity traders participation constraint writes

$$\pi R\geq 1 \tag{22}$$

[9]This result is reminiscent of Spiegel and Subrahmanyan's (1992) analysis. In their model, noisy trading is motivated on risk-sharing grounds. Informed trading makes risk-averse uninformed traders worse-off. See also Glosten (1989).

4.3 The entrepreneur's problem

For a given accounting structure, the entrepreneur's problem is to minimise his cost of capital, πR, subject to the constraint that enough funds are raised, $I = 1$. The choice of accounting standards is analysed in the next section.

The first best payment is $R^* \equiv \frac{1}{\pi}$ (alternative investments give the riskless return $r = 0$). For any $R < R^*$, investors would not participate. Now assume that E promises the payment R^*. This is an equilibrium if and only if the speculator does not enter. This is the case when $\Pi^* (R^*, T) < c$. Using proposition 3, we get that S's optimal profit is $\Pi^S (R^*, T) = \frac{1}{8}T$ which yields

$$\frac{1}{8}T < c \tag{23}$$

Condition (23) is a necessary and sufficient condition to get the first best payment. As S makes expected losses, he does not acquire his information. Anticipating that S does not participate, liquidity traders are willing to buy the firm's stocks at date 0, as $\mathbb{E}\left[\lambda P^* + (1-\lambda)\tilde{R}\right] = \pi R^* \geq 1$.

When the converse of (23) holds, S enters the market. Payment R^* is not sufficient to induce liquidity traders to participate, because informed trading hinders liquidity supply by the market maker. Liquidity traders require higher return πR in compensation. Therefore if the investment is to be financed, one must have $R > R^*$ and a cost of capital higher than the first best. Formally, liquidity traders participate if and only if

$$\pi R - (\Pi^* (R, T) + x^* (R)) \geq 1 - x^* (R) \tag{24}$$

Using proposition 3, it is easily checked that condition (24) does not hold for any payment $R < \bar{R} \equiv R^* + \frac{1}{\pi}\frac{1}{8}T$ whereas setting $\bar{R}$ is sufficient. The main result of this section is therefore:

Proposition 4. *If $\frac{1}{8}T < c$ then $R = R^*$ and there is no wedge between the internal return of investment and the external cost of capital. Otherwise, $R = R^* + \frac{1}{\pi}\frac{1}{8}T$.*

When $\frac{1}{8}T > c$ there is a wedge between the internal return on investment and the external cost of capital: the capital market is imperfect (Hubbard, 1998). As is well known, this can lead to inefficient investment decisions. Efficient investment – those whith positive expected value $\pi V^H > 1$ – could be rejected. Only projects with expected payoff $\pi V^H > 1 + \frac{1}{8}T$ can be financed by the market. However, the implied "agency cost" is not rooted in the entrepreneur having more knowledge than the market, as is generally the case, but in informational asymmetries within the capital market[10].

[10] In the context of a borrower-lender relationship, Inderst and Müller (2003) show that agency cost can arise because of the *lender*, not the borrower, having private information.

5 Choice of accounting standards

It is now straightforward to determine the consequences of accounting standards. Proposition 4 shows how the external cost of capital can be affected by public information through accounting disclosure. The entrepreneur will choose the accounting standards that minimize his cost of capital. In this setting where price informativeness *per se* does not have value, this amounts to choosing the accounting standards that minimize S's informational advantage.

If accounting standards are opaque, accounting data do not give any public information about the realised S^i. The speculator's advantage is given by

$$T_0 = \sum_s \Pr[s] \cdot |\pi(s) - \pi| \tag{25}$$

Conversely, if E chooses a transparent accounting structure, then S^i becomes public information at the time of accounting announcement. In this case, S's informational advantage is

$$T_1 = \sum_S \Pr[S] \sum_s \Pr[s|S] \cdot |\pi(S,s) - \pi(S)| \tag{26}$$

Example 1. Take the case where $\alpha = \beta = \pi$. We will show that in this case more transparent accounting standards can raise the cost of capital. It is easy to see that any single signal S or s is uninformative while (S,s) is fully informative:

$$\pi\left(S^1\right) = \pi\left(S^0\right) = \pi\left(s^1\right) = \pi\left(s^0\right) = \pi$$
$$\pi\left(S^i, s^j\right) = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$$

so that $T_0 = 0 < T_1 = 2\pi(1-\pi)$. From proposition 4 it follows that with an opaque accounting structure, $R_0 = R^*$. If $2\pi(1-\pi) > c$ then switching to a transparent accounting structure would raise the cost of capital to $R_1 = R^* + \frac{1}{\pi}\frac{1}{8}T_1 = R^* + \frac{1-\pi}{4}$. The difference $R_1 - R^*$ comes from information asymmetries among investors.

The intuition for this result is straightforward. The speculator's profit comes from his information structure (about the firm's prospects) being finer than public information ($T > 0$). While it is true that transparent accounting information gives finer information to both S and the public, the effect on the difference $T_1 - T_0$ is mixed. Here, accounting information is complementary to S's private information.

Example 2. Of course, the general wisdom that information disclosure can lower the cost of capital can be true in our setting. To see this, consider a slightly different information structure than figure 1: take $\Pr\left[s^1|S^1\right] = \alpha = 1$ and $\Pr\left[s^0|S^0\right] = \beta = 1$, but assume that when $S^i = S^0$, s^0 is associated with V^L (instead of V^H in figure 1). This is a case where S^i and s^i are perfect substitutes (indeed $S^i \sim s^i$). Any single signal is perfectly informative:

$$\pi\left(S^1\right) = \pi\left(s^1\right) = 1$$
$$\pi\left(S^0\right) = \pi\left(s^0\right) = 0$$

In this case, one has $T_0 = \frac{1}{2} > T_1 = 0$. When S^i is disclosed, S's informational advantage vanishes to 0. Release of public information does lead to a reduction of informational asymmetries between investors and to a reduction in the cost of capital.

That it is important to distinguish between cases where information released is complementary or substitute to investor's private information is emphasized by Boot and Thakor (2001). However, they conclude that the firm should release any kind of information. They focus on the informational content of prices and how it helps mitigating the agency cost between E and investors. Taking into account the effect that asymmetries of information *in the market* have on market liquidity can yield to different conclusions.

EXAMPLE 3. Finally, to illustrate how accounting rules can implement a more precise information structure, consider the opposition between *fair value* and *book value* principles. Consider the case $\alpha = \frac{1+\varepsilon}{2}$ and $\beta = \frac{1-\varepsilon}{2}$ with $\varepsilon > 0$. It is straightforward to see that (S) is partially informative while (s) is uninformative

$$\pi\left(S^1\right) = \frac{1+\varepsilon}{2} \geq \pi\left(S^0\right) = \frac{1-\varepsilon}{2}$$
$$\pi\left(s^1\right) = \pi\left(s^0\right) = \frac{1}{2}$$

S's private signal being of no value on its own, one has $T_0 = 0$. *Fair value* would require that any event leading to an updated expected value for the firm's asset be incorporated in the accounting disclosure. In our simple information structure, the fact that the entrepreneur observes either a realisation S^0 or a realisation S^1, should lead to a raise (respectively a fall) in the accounting value of the asset. However, this means that S can use the updating from accounting value $\frac{1}{2}V^H$ to αV^H or βV^H to infer S^i and hence raises his informational advantage to $T_1 > 0$. Depending on S's outside option, this can have the effect of raising the external cost of capital.

6 Conclusion

The main insight of the paper is that increased corporate transparency can *increase* information asymmetries among traders, and that this potentially raises the cost of external finance. When the risk of informed trading increases, rational liquidity traders require a higher expected return to buy the firm's securities. Reduction in market liquidity therefore leads to higher cost of external capital and the "agency cost" comes from asymmetries among investors.

We have obtained this result under a set of specific assumptions. Indeed, our description of the secondary market is highly primitive. However, the result should hold in any setting where informational asymmetries among financial investors adversely affect market performance (as in recent contributions by Easley and O'Hara (2002) or Biais and Mariotti (2003)[11]). This issue is central to contemporary mar-

[11] Biais and Mariotti (2003) analyse the interaction between security design and liquidity supply when the issuer has private information.

ket microstructure theory (Biais, Glosten and Spatt, 2002). However, research in accounting have focussed mainly on the twin issue of the informational content of market prices (see, e.g., Verrecchia (2001)) to study the effect of accounting rules on firms' cost of capital.

Our speculator can be interpreted as an investor making profit out of his private information. In our setting, this information only have individual value. Arguably, information possessed by sophisticated traders can have public value. Prices that (partially) reveal this information can then be used to mitigate the agency problem between managers and shareholders (Diamond and Verrecchia, 1982; Holmström and Tirole, 1993). However, this is an assumption about the nature of information that traders possess, and should not be a premise of *all models.* Sophisticated traders seek information they can profit from; the nature of this information will be highly dependent on economic environment. More research should be done to analyse environments in which agents have individual incentives to acquire socially harmful information. We believe new insights could be gained concerning the economic consequences of accounting rules. Anyhow, intuitive arguments should not be taken at face value when evaluating the consequences of real-world changes in regulation.

A Proof of lemma 1

For any interval $[a,b] \subset \mathbb{R}$, let $f_{[a,b]} : \mathbb{R} \rightarrow \mathbb{R}$ denote the uniform density over $[a,b]$. The aggregate liquidity $\tilde{\lambda}$ shock has density $f_{[0,1]}$. Consider a market maker anticipating that S's strategy is given by $v^e(s)$. The aggregate buying of the market is given by $Q = \lambda(1-x) + v^e$, and has density $f_{[v^e, v^e+1-x]}$. Facing a speculator with private signal s^i or s^{-i}, the market maker can infer (using Bayes' rule)

$$\pi(\mathcal{I}, Q) = \Pr\left[s = s^i | \mathcal{I}, Q\right] \pi\left(\mathcal{I}, s^i\right) + \Pr\left[s = s^{-i} | \mathcal{I}, Q\right] \pi\left(\mathcal{I}, s^{-i}\right)$$

define $\Omega^i = \left[v^e\left(s^i\right), v^e\left(s^i\right) + 1 - x\right]$ and $\Omega^{-i} = \left[v^e\left(s^{-i}\right), v^e\left(s^{-i}\right) + 1 - x\right]$. Further define $D(Q) = \Pr\left[s^i | \mathcal{I}, Q\right] f_{\Omega^i}(Q) + \Pr\left[s^{-i} | \mathcal{I}, Q\right] f_{\Omega^{-i}}(Q)$. Whenever $D(Q) \neq 0$, one has

$$\Pr\left[s^i | \mathcal{I}, Q\right] = \frac{\Pr\left[s^i | \mathcal{I}, Q\right] f_{\Omega^i}(Q)}{D(Q)}$$
$$\Pr\left[s^{-i} | \mathcal{I}, Q\right] = \frac{\Pr\left[s^{-i} | \mathcal{I}, Q\right] f_{\Omega^{-i}}(Q)}{D(Q)}$$

It is straightforward to see that (figure 3) that $\Pr\left[s^i | \mathcal{I}, Q\right] = \Pr\left[s^{-i} | \mathcal{I}, Q\right] = \Pr\left[s^{-i} | \mathcal{I}\right]$ whenever $Q \in \Omega^i \cap \Omega^{-i}$, $\Pr\left[s^i | \mathcal{I}, Q\right] = 1$ and $\Pr\left[s^{-i} | \mathcal{I}, Q\right] = 0$ whenever $Q \in \Omega^i$ and $Q \notin \Omega^{-i}$, and $\Pr\left[s^i | \mathcal{I}, Q\right] = 0$ and $\Pr\left[s^{-i} | \mathcal{I}, Q\right] = 1$ whenever $Q \notin \Omega^i$ and $Q \in \Omega^{-i}$. Finally,

$$\pi(\mathcal{I}, Q) = \begin{cases} \pi\left(\mathcal{I}, s^i\right) & \forall Q < v^e\left(s^i\right) \\ \pi(\mathcal{I}) & \forall v^e\left(s^i\right) < Q < 1 - x + v^e\left(s^{-i}\right) + v^e\left(s^i\right) \\ \pi\left(\mathcal{I}, s^{-i}\right) & \forall 1 - x + v^e\left(s^{-i}\right) + v^e\left(s^i\right) < Q \end{cases}$$

which yields the price schedule (7).

B Proof of proposition 2

Taking as given the market maker expectation $v^e(.)$ and the resulting pricing rule, S seeks to use his private information to abuse the market maker. When his signal is s^i, he trades

$$v\left(s^i\right) = \arg\max_{v \leq x} v \cdot \left[\mathbb{E}\left[P\left(Q\right)|\mathcal{I}, s\right] - \pi\left(\mathcal{I}, s\right)\right]$$

As a monopolist, S anticipates the effect his order v has on the price set by the market maker. Formally, if he submits an order v, then the aggregate quantity is $Q = (1-x)\lambda + v$, and the expected price conditional on s is

$$\mathbb{E}\left[P\left(Q\right)|\mathcal{I}, s\right] = \mathbb{E}\left[P\left((1-x)\lambda + v\right)|\mathcal{I}, s\right]$$

When $s = s^i$, $\pi\left(\mathcal{I}, s^i\right) > \pi\left(\mathcal{I}\right)$ so S is willing to buy, and is betting for a high realisation of $\tilde{\lambda}$ to fool the market maker. Conditional on $s = s^i$,

$$P\left((1-x)\lambda + v\right) = \begin{cases} \pi\left(\mathcal{I}, s^i\right) & \text{if } (1-x)\lambda + v > v^e\left(s^{-i}\right) \\ \pi\left(\mathcal{I}\right) & \text{if } (1-x)\lambda + v > v^e\left(s^{-i}\right) \end{cases}$$

which yields

$$\begin{aligned} \pi\left(\mathcal{I}, s\right) - \mathbb{E}\left[P\left(Q\right)|\mathcal{I}, s\right] &= \left(\pi\left(\mathcal{I}, s^i\right) - \pi\left(\mathcal{I}\right)\right)\Pr\left[(1-x)\lambda + v > v^e\left(s^{-i}\right)\right] \\ &= \left(\pi\left(\mathcal{I}, s^i\right) - \pi\left(\mathcal{I}\right)\right)\Pr\left[\lambda > \frac{v^e\left(s^{-i}\right) - v}{1-x}\right] \end{aligned}$$

Conversely, for $s = s^{-i}$, $\pi\left(\mathcal{I}, s^i\right) > \pi\left(\mathcal{I}\right)$ and S is willing to sell the stock and is betting for a low aggregate liquidity shock to hide his trade. Conditional on $s = s^{-i}$,

$$P\left((1-x)\lambda + v\right) = \begin{cases} \pi\left(\mathcal{I}, s^\iota\right) & \text{if } (1-x)\lambda + v > v^e\left(s^{-i}\right) \\ \pi\left(\mathcal{I}\right) & \text{if } (1-x)\lambda + v > v^e\left(s^{-i}\right) \end{cases}$$

which yields

$$\begin{aligned} \mathbb{E}\left[P\left(Q\right)|\mathcal{I}, s\right] - \pi\left(\mathcal{I}, s\right) &= \left(\pi\left(\mathcal{I}\right) - \pi\left(\mathcal{I}, s^{-i}\right)\right)\Pr\left[(1-x)\lambda + v < 1 - x + v^e\left(s^i\right)\right] \\ &= \left(\pi\left(\mathcal{I}\right) - \pi\left(\mathcal{I}, s^{-i}\right)\right)\Pr\left[\lambda < 1 - \frac{v - v^e\left(s^i\right)}{1-x}\right] \end{aligned}$$

For the ease of notation, for the remainder of this proof we posit $z = v\left(s^{-i}\right)$, $z^e = v^e\left(s^{-i}\right)$, $-y = v\left(s^i\right)$ and $-y^e = v^e\left(s^i\right)$. Then we seek a solution

$$y^* = \arg\max y\left(1 - \frac{z^a + y}{1-x}\right)^+ \left(\pi\left(\mathcal{I}, s^i\right) - \pi\left(\mathcal{I}\right)\right) \tag{27}$$

$$z^* = \arg\max_{z \leq x} z\left(1 - \frac{z + y^a}{1-x}\right)^+ \left(\pi\left(\mathcal{I}\right) - \pi\left(\mathcal{I}, s^{-i}\right)\right) \tag{28}$$

where $f^+(.) = \min(0, f(.))$. Criteria in (27) and (28) are concave, and have one unique, interior, unconstrained maximum for resp. $y \in [0, 1-x-z^a]$ and $z \in [0, 1-x-y^a]$. The F.O.C for (27) and (28) give

$$1 - x - z^a - 2y = 0$$
$$\left| \begin{array}{lll} 1 - x - y^a - 2z = 0 & \text{and} & z < x \\ 1 - x - y^a - 2z < 0 & \text{and} & z = x \end{array} \right.$$

In equilibrium, one must have $y^a = y$ and $z^a = z$. If the constraint $z \leq x$ is not binding, then we get

$$y = z = \frac{1-x}{3} \tag{29}$$

while if it is binding

$$z = x \qquad y = \frac{1}{2} - x \tag{30}$$

The constraint is not binding when $\frac{1-x}{3} < x$, which gives $x < \frac{1}{4}$.

C Proof of proposition 3

We stick with the notations of previous proof. First, define

$$T = \sum_{\mathcal{I}} \Pr[\mathcal{I}] \left[\Pr\left(s^0|\mathcal{I}\right) \left|\pi\left(\mathcal{I}, s^0\right) - \pi(\mathcal{I})\right| + \Pr\left(s^1|\mathcal{I}\right) \left|\pi(\mathcal{I}) - \pi\left(\mathcal{I}, s^1\right)\right| \right] \tag{31}$$

noting that by Bayes' rule

$$\left(\Pr\left(s^i|\mathcal{I}\right) + \Pr\left(s^{-i}|\mathcal{I}\right)\right) \pi(\mathcal{I}) = \pi(\mathcal{I}) = \Pr\left(s^i|\mathcal{I}\right) \pi\left(\mathcal{I}, s^i\right) + \Pr\left(s^{-i}|\mathcal{I}\right) \pi\left(\mathcal{I}, s^{-i}\right) \tag{32}$$

we get

$$\Pr\left(s^{-i}|\mathcal{I}\right) \left(\pi(\mathcal{I}) - \pi\left(\mathcal{I}, s^{-i}\right)\right) = \Pr\left(s^i|\mathcal{I}\right) \left(\pi\left(\mathcal{I}, s^i\right) - \pi(\mathcal{I})\right) \tag{33}$$

so that

$$T = 2 \sum_{\mathcal{I}} \Pr[\mathcal{I}] \Pr\left(s^i|\mathcal{I}\right) \left(\pi\left(\mathcal{I}, s^i\right) - \pi(\mathcal{I})\right) \tag{34}$$

$$= 2 \sum_{\mathcal{I}} \Pr[\mathcal{I}] \Pr\left(s^{-i}|\mathcal{I}\right) \left(\pi(\mathcal{I}) - \pi\left(\mathcal{I}, s^{-i}\right)\right) \tag{35}$$

As $v^*\left(s^i\right)$ and $v^*\left(s^{-i}\right)$ do not depend on public information $\mathcal{I}$, the speculator's profit can be written as

$$\Pi^S(x) = x(\pi R - 1) + \sum_{\mathcal{I}} \Pr[\mathcal{I}] \left[\begin{array}{c} \Pr\left(s^i|\mathcal{I}\right) \left(\pi\left(\mathcal{I}, s^i\right) - \pi(\mathcal{I})\right) y + \\ \Pr\left(s^{-i}|\mathcal{I}\right) \left(\pi(\mathcal{I}) - \pi\left(\mathcal{I}, s^{-i}\right)\right) z \end{array} \right] \left[1 - \frac{z+y}{1-x}\right]$$

Using (34) and (35) this reduces to

$$\Pi^S(x) = x(\pi R - 1) + \frac{1}{2} T (y + z) \left[1 - \frac{z+y}{1-x}\right]$$

Using expressions (29) and (30) to substitute for y and z, one gets

$$\Pi^S|_{x\leq\frac{1}{4}} = x(\pi R - 1) + \frac{1}{4}T\left[1 - \frac{1}{2}\frac{1}{1-x}\right]$$
$$\Pi^S|_{x\geq\frac{1}{4}} = x(\pi R - 1) + \frac{1}{9}T(1-x)$$

Π^S is continuous. We need to characterise $\Pi^* = \max\left(\max \Pi^S|_{x\leq\frac{1}{4}}, \max \Pi^S|_{x\geq\frac{1}{4}}\right)$. Π^S is concave on $x \leq \frac{1}{4}$, and linear on $x \geq \frac{1}{4}$. Straightforward computations shows $\Pi^S|_{x\leq\frac{1}{4}}(x) > \Pi^S|_{x\geq\frac{1}{4}}(x) \iff x < \frac{1}{4}$. Furthermore, $\Pi^S(0) = \frac{1}{8}T$ and $\Pi^S(1) = \pi R - 1$. Let $\bar{R} = \frac{1}{\pi}\left(1 + \frac{1}{8}T\right)$. Further define $x_1 = \arg\max_{x\leq\frac{1}{4}} \Pi^S|_{x\leq\frac{1}{4}}$ and $x_2 = \arg\max_{x\geq\frac{1}{4}} \Pi^S|_{x\geq\frac{1}{4}}$.

Now consider two cases. First, $R < \bar{R}$. Then one has $\frac{\partial \Pi^S}{\partial x}|_{x=0} < 0$ so that $x_1 = 0$. Furthermore, $\Pi^S(1) < \Pi^S(0)$, and $\Pi^S(1) > \Pi^S\left(\frac{1}{4}\right)$. Thus $x^* = 0$. Second, $R > \bar{R}$. Then $\frac{\partial \Pi^S}{\partial x}|_{x=0} > 0$. However, $\Pi^S|_{x\leq\frac{1}{4}}$ being concave, it is always below his tangency. The tangency at $x = 0$ is $\Pi^S(0) + x\frac{\partial \Pi^S}{\partial x}|_{x=0}$. As $\frac{\partial \Pi^S}{\partial x}|_{x=0} = \pi R - 1 - \frac{1}{8}T = \Pi^S(1) - \Pi^S(0)$, one gets that $\Pi^S|_{x\leq\frac{1}{4}}(x) < \Pi^S(0) + x\left(\Pi^S(1) - \Pi^S(0)\right)\ \forall x$, which implies $\Pi^S(0) < \Pi^S(1)$. Thus, $x^* = 1$. This terminates the proof.

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