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ABSTRACT

The Ownership of Ratings*

Standard & Poor's provides corporate governance ratings to firms who can, upon learning those, decide to reveal them or not to the market. This paper identifies the circumstances under which such a simple ownership contract over ratings can emerge as the optimal arrangement. Firms hiding their ratings can only be an equilibrium outcome if they are sufficiently uncertain of their quality at the time of hiring a certification intermediary and if the decision to get a rating is not observable. For some distribution functions of firms' qualities, a competitive market is a necessary condition for this result to obtain. Competition between rating intermediaries will unambiguously lead to less information being revealed in equilibrium.

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1 Introduction

On January 31st, 2003, Standard & Poor's assigned its first Corporate Governance Score (CGS) to a US company, the Federal Mortgage Association, Fannie Mae. Those scores are described by S&P as *independent assessments* resulting from *an interactive process that does not follow a "check the box" approach* and likely, contain information not widely available otherwise. Importantly, the score is made public free of extra charge at the company's discretion and, according to S&P, a "good majority" of firms do not reveal their scores. S&P also commits not to reveal whether a particular company has even approached them for a score: "*assessments can be provided to companies on a confidential basis*".

Although this business model is relevant to academics and practitioners involved in the important debate on corporate governance, and more specifically on the issue of whether a "market" solution will produce the right kind of information to investors, S&P's contractual offer is also of some interest to contract theorists at large. On page 30 of his 1995 book, Oliver Hart argues that "*the owner of an asset has residual control rights over that asset: the right to decide all usages of the asset in any way not inconsistent with a prior contract, custom or law*". For an informational asset like a rating, an important dimension of control over this asset will regard its disclosure. Defining an ownership contract as giving full disclosure rights to its owner, our research question is to identify the circumstances under which such a simple (ownership) contract can emerge as the optimal possible arrangement.

To answer that question, we take a mechanism design approach and consider successively different market structures of the rating market. We show that the transfer of ownership over ratings to firms is one possible way to implement the optimal renegotiation-proof contract between the intermediary and the firm and, furthermore, such transfer of ownership avoids potential hold-up problems. Firms hiding a score can emerge as an equilibrium outcome only if firms are sufficiently uncertain of their quality at the time of hiring the intermediary and a fraction of firms do not ask for a rating. In fact, for some distribution functions of firms' qualities, a competitive market is a necessary condition for this result to obtain. A related result is that competition between rating intermediaries will lead to less information being revealed in equilibrium. This, in the perspective of corporate governance or more generally of the working of certification markets, leads us to conclude that competition may actually be quite harmful if the social value of information is high.

The existing literature does not suggest that ownership contracts of the type documented above could be optimal. In an important paper, Lizzeri (1999) shows two results. First, a monopolist intermediary will commit to never reveal any rating and will optimally make a simple announcement to the effect that a given firm has hired its services. If market participants expect every firm to hire such an intermediary, the absence of this announcement is an out of equilibrium outcome. He shows that the only possible out of equilibrium beliefs must be that market participants (investors, consumers...) then take that firm to be of the lowest possible quality. Firms are then indifferent between going to the intermediary, and being extracted all the surplus created by this decision, or being mistaken for the worst kind. As a second result, competition may lead to full information revelation. In a related set-up but with risk-averse buyers or competitive sellers, Peyrache and Quesada (2004) show that the equilibrium will entail partial disclosure of information. To a large extent, the divergence of our results stems from our emphasis on renegotiation-proof contracts.

The literature on information disclosure is generally not supportive of the view that once the firm has the ownership of its rating, it may actually choose to conceal this information. Grossman and Hart (1980) and Grossman (1981) show that whenever a seller is perfectly informed and can certify at no cost the quality of the good he sells, the only equilibria will involve unravelling and will result in all the information being disclosed. Milgrom (1981) contains an example with a similar result where in addition, revealing information is now costly. The unravelling argument has been the focus of many subsequent articles such as Milgrom and Roberts (1986), Farrell (1986) or Okuno-Fujiwara, Postlewaite and Suzumura (1990). Shavell (1994) offers a different result in a set up where firms can first choose to acquire information regarding their quality and, in a second step, remain silent or disclose it. Like Shavell, we consider endogenous information acquisition but in our model, the cost of getting this information (the price of a rating) is also a strategic variable, dependent on market structure.

Our analysis is a mechanism design exercise that involves both screening and signalling elements and as such is related to Rochet and Stole (2002) to the extent that firms' reservation utilities are endogenous; and it also shares some features of the general set-up analysed by Segal and Whinston (1999, 2003) as ours is a case of contracting with (informational) externalities. Our final section deals with competition in contracts in such a context.

The paper is organized as follows. A brief second section introduces the model. In Section 3 we take the behavior of the intermediaries as given and we look for the conditions under which the option of concealing the rating may be of some value. Knowing those conditions, in Section 4 we investigate whether concealing the rating may be part of an equilibrium. Section 5 discusses the main results and concludes. Additional proofs are provided in the appendix.

2 The model

Consider a firm, a certification intermediary (two in the competitive case) and a number ($n \geq 2$) of competitive, risk neutral, investors.[1] A firm's governance comes in various qualities which result in an incremental value of $v \sim U[0,1]$ for its investors.[2,3] Initially, investors regard any firm as average, and take its value to be $\frac{1}{2}$. Suppose that, at the time of hiring the intermediary, the firm only gets a signal $\mu \in M$ about v. We assume that $\mu \sim U[v-\theta, v+\theta]$ for some $\theta \in [0, \frac{1}{2})$, so $M = [-\theta, 1+\theta]$. This particularly implies that if we consider two different signals $\mu_1 < \mu_2$, the distribution of v conditional on μ_2 first order stochastically dominates the distribution conditional on μ_1.

The intermediary possesses a certification technology which provides an informative signal, σ, about the true value of v at a cost $c > 0$. We suppose that $\sigma \sim U[v-\omega, v+\omega]$. Except in one occasion, we will concentrate on the case where the signal is perfectly revealing, i.e. $\omega = 0$. We consider this signal to be hard information. That is, it can either be concealed or truthfully revealed.

The intermediary and the firm can enter into a transaction by which in exchange of a fee, the intermediary performs an audit that results in a rating of its corporate governance. We do not put any restriction on the class of contracts that can be offered to the firm. Based on the information they obtain, investors update their beliefs regarding the quality of the corporate governance and, given that they are risk neutral, pay the expected quality.

The timing of the game can be summarized as follows. Nature chooses v and firms get an informative signal μ on their true value v. Not observing any of these variables, intermediaries post (simultaneously in the competitive case) contracts $\{p_0, p(v), d(v)\}_\mu$ that can stipulate both an up-front fee p_0, a fee contingent on what rating is ultimately obtained $p(v)$ and a disclosure rule $d(v) \in [0,1]$ where $d(v)$ is the probability that a score of v is revealed. This contract offer can in principle be contingent (in an incentive compatible way) on any report of the firm on the signal it received, μ. The contract also specifies whether the hiring decision is to be made public or kept secret. Observing the intermediaries' offers, firms can approach an intermediary to obtain a rating. Once a firm hires an intermediary, the score is then revealed or not to the market. Finally, market participants

[1] The risk neutrality assumption implies that there is no social value of information. One may then wonder why it is of any interest to study what information will be revealed in equilibrium in such a setting. It is easy to incorporate in our model a loss function that would justify the need to provide accurate information to investors. We take the short cut that ultimately the more information is revealed by the rating intermediary, the better it is for society.

[2] A number of recent studies support the simple proposition that greater shareholder governance translates into greater shareholder value. See for example Gompers, Ishii and Metrick (2003)

[3] None of the results contained in Section 3 depend on the uniform distribution assumption. Some of those in Section 4 do, but we discuss there and in Section 5 the extent to which this may be so.

update their beliefs on v, using Bayes' rule whenever possible. The firm's value is then equal to the updated expected value of v, given all the information provided.

3 The Value of the No Disclosure Option

We aim at understanding both the circumstances under which a simple ownership contract emerges as the optimal arrangement and the reasons why a non-negligible proportion of firms, once given the option, prefers to hide the score. We answer these two questions sequentially. In this section, we start by identifying some necessary conditions for the option to be valuable.

We first derive the willingness to pay of a firm for any contract offered by the intermediary. Denote by ϕ the information that market participants have when no rating is revealed. The absence of a rating does not imply that market participants keep their prior beliefs, since they may learn something from the fact that no rating is revealed. For instance, if the decision to hire the intermediary is kept secret, market participants may infer from the absence of a rating that either the firm belongs to the set of values v for which $d(v) = 0$ or to the set of firms that do not hire the intermediary. In general, denote by $E_v[v/\phi]$ the updated value that market participants place on a firm without a rating. Given an offer $\{p_0, p(v), d(v)\}_\mu$, a firm of type μ will go to the intermediary if and only if:

$$E_v \left[\left(d(v)v + (1 - d(v))E_v[v/\phi_1] - p(v) - p_0 \right) /\mu \right] \geq E_v[v/\phi_0] \tag{1}$$

where ϕ_1 is the market participants information if $d(v) = 0$ while ϕ_0 is their information when they observe that a firm did not hire the intermediary. In the case of secret contracting, $\phi_1 = \phi_0$ as market participants cannot tell whether the absence of a rating (the only thing they see) is due to the firm not hiring the intermediary or the intermediary hiding the rating of a rated firm.

In the sequel, we will take the view that the firm and the intermediary(ies) will be able to fully realize gains from trade available to them under symmetric information. That is:

Assumption 1 *Parties cannot commit not to renegotiate.*

Whatever the contract signed initially, we require that there is no deviation at any stage of the game that would be preferred by both the intermediary and the firms. In particular, this assumption implies that the decision to reveal the rating or not must be *ex post efficient.* For any firm with true value v that has hired the intermediary it is immediate to prove the following result.

Lemma 1 *A contract is renegotiation-proof if and only if it satisfies the following:*

$$d(v) = \begin{cases} 1 & \text{if} \quad v > E_v[v/\phi_1] \\ 0 & \text{if} \quad v < E_v[v/\phi_1]. \end{cases} \tag{2}$$

Proof. The firm is considered to be worth $E_v[v/\phi_1]$ when the rating is not revealed, while v if it is revealed. ■

A direct implication of Lemma 1 and first order stochastic dominance is that the willingness to pay for a rating increases in the signal μ in any renegotiation-proof equilibrium.

We now define a particular class of equilibria:

Definition 1 *A threshold equilibrium is defined as an equilibrium in which all types μ above a certain threshold $\hat{\mu}$ hire one intermediary, while all those below do not.*

We will show later that an implication of Lemma 1 - and the fact that firms with more positive signals have a higher willingness to get a rating - is that whatever the market structure the only possible equilibria have to be threshold equilibria. In this section, we assume that this is so and derive a few implications of the threshold structure. But before, we can narrow down our search for the circumstances under which hiding a rating may be part of an equilibrium by noticing that:

Proposition 1 *If intermediary i reveals that a given firm has hired its services (public contracting), then whatever the outcome of the rating, it is revealed: $\forall\, i$, $\forall\, v$, $d_i(v) = 1$.*

Proof. Call $M_i \subset M$ the set of types who hire intermediary i and $V_i = \{v \in [0,1] : \exists \mu \in M_i : f(v|\mu) > 0\}$, the set of ratings that intermediary i can encounter in equilibrium. Suppose that there exists some subset $\bar{V}_i \subset V_i$ of ratings that are not revealed ($d_i(v) < 1$ for $v \in \bar{V}_i$). Under public contracting, $E_v[v/\phi_1] = E_v[v/\mu \in M_i \text{ and } v \in \bar{V}_i]$. Now, define $\bar{v}_i := \sup \bar{V}_i$. It is optimal to renegotiate the disclosure policy and set $d(\bar{v}_i) = 1$, since, by definition, $\bar{v}_i > E_v[v/\phi_1]$. This argument unravels and all types are revealed. ■

The proof of Proposition 1 does not assume any particular form for the contract offered by intermediary i, nor does it depend on the exact market structure. It only uses the simple intuition that once a firm is seen to have hired an intermediary but that no rating is revealed, it must be bad news. An important implication is then that there cannot be an equilibrium where firms hire intermediaries but do not reveal ratings unless those hiring contracts are kept secret. We explore this possibility in the next subsection, successively considering settings where the firm is perfectly and imperfectly informed of its own type. Before, note that a setting where all firms ask for a rating can easily be reinterpreted as a particular form of public contracting, since in equilibrium investors know that the firm has hired an intermediary. Closely related is then the following result.

Corollary 1 *In an equilibrium where all types of firms hire an intermediary, then all ratings are disclosed.*

For completeness, such an equilibrium could only be supported by the out-of-equilibrium beliefs that a firm without a rating must be of the worst possible type (i.e. $\mu = -\theta$).
We specialize our analysis in the remainder of this section to the case of a fully informed firm: $\theta = 0$. We establish that in any threshold equilibrium the value of the no disclosure option in this case is zero. To do so, we need to focus on the case of secret contracting as we have already shown that if the hiring decision is public, the option has no value.
As the firm knows exactly its value v, the willingness to pay of any type hiring intermediary i is :

$$d_i(v)v + (1 - d_i(v))E_v[v/\phi] - E_v[v/\phi] = d_i(v)(v - E_v[v/\phi])$$

where $\phi_0 = \phi_1 = \phi$ as the hiring decision is secret. Moreover, we know from Lemma 1 how $d_i(v)$ must be designed in any renegotiation-proof equilibrium. As firms are informed about v they know exactly their maximum willingness to pay. In particular, a firm for which $v < E_v[v/\phi]$ in a given putative equilibrium is willing to pay 0 to hire the intermediary. From this, it follows that

Proposition 2 *Assume the equilibrium has a threshold structure. The option to hide the rating has no value if the firm is perfectly informed about its type, $\theta = 0$.*

Proof. As firms are fully informed of their type, they know at the time of hiring an intermediary if $d(v)$ will be 0 or 1. If they know that their rating will not be disclosed, their willingness to pay is 0. Therefore, all firms with $v < E_v[v/\phi]$ in any putative equilibrium are pooled with the same willingness to pay of 0. Note that no intermediary can be made better off by contracting with those types. If they do so, their score will be hidden. The same outcome would be achieved by not producing any rating for those types. That would save c, more that their willingness to pay of 0. So, only firms with types $v \geq E_v[v/\phi]$ and for which $d_i(v) = 1$ hire the intermediary and no rating is ever hidden. ■

Whenever the firm is fully informed of its type at the time of hiring the intermediary, there is no difference between public and secret contracting. In both cases, a firm without a rating can only be a firm that has not hired the intermediary.
Proposition 2 amounts to showing that in the absence of any uncertainty, an option contract is of no value. This is no surprise from a finance point of view (the price of a call increases with the volatility of the underlying asset) but it is important to highlight the role of the threshold structure in our analysis. Indeed, consider alternative equilibrium candidates where only low types hire some intermediary. Then, hiding information could be of some value, because the firm could be pooled with those high types that do not get rated. In Section 4, we show that such candidates cannot be

part of an equilibrium and that threshold structures are uniquely optimal. Moreover it is interesting to notice that not any type of uncertainty can confer value to this option in our set-up. Suppose that the firm still perfectly informed on v (i.e. $\theta = 0$) is uncertain about the rating it will get because the intermediary's technology is imprecise, i.e. $\omega > 0$. We have:

Proposition 3 *Assume the equilibrium has a threshold structure. The option to hide the rating has no value if the firm is perfectly informed about its type, $\theta = 0$ even if $\omega > 0$.*

Proof. Previous proofs have to be amended to account for the fact that ratings are noisy. First, notice that Lemma 1 still holds if we replace v by $E_v[v/\sigma]$: $d(\sigma) = 1$ if and only if $E_v[v/\sigma] > E_v[v/\phi]$. This implies that the firm's willingness to pay is $E_v[\max\{E_v[v/\sigma] - E_v[v/\phi], 0\}/\mu$, increasing in μ.

Consider the case of secret contracting and $\theta = 0$. Importantly, the threshold structure implies that a firm with a rating must have a value $v \geq \hat{v}$. This is true even if $\sigma < \hat{v}$ so that the revelation of a rating cannot result in an updated value less than $\hat{v}$. Not revealing a rating results in being valued at $E_v[v/v \leq \hat{v}]$ always less than $\hat{v}$. Therefore all ratings are revealed. ■

This result runs somehow against the intuition that this option may be valuable when ratings can be wrong: firms would get some protection against low ratings. But it ignores an important point: under fully informed firms and threshold equilibrium, a low rating cannot be bad news for the threshold firm. Market participants know that the firm's true value must be above a certain threshold. Any rating that suggests otherwise is disregarded, on the account that the rating technology is noisy (while the firm's information is perfect): such a rating must be a "mistake".

4 Hiding the Rating as an Equilibrium Outcome

Whether or not giving the option to conceal the score emerges as an equilibrium outcome depends on the set of types who hire an intermediary and therefore on the prices offered by those. Therefore, it is important to distinguish between different market structures. We look at two possible cases: a monopoly intermediary and two Bertrand competitors.

The possibility of a noisy signal may induce firms to make two sorts of mistakes when deciding to hire a rating intermediary. First, they may decide on the basis of their signal μ to hire an intermediary, but once learning their exact value v, they wished they had not applied for a rating. It is for this set of excessively "optimistic" firms that the option to hide a rating may be attractive. This will be all the more so, if there is a second type of mistake taking place in this market: firms who on the basis of their signal decide not to hire a rating intermediary, while if they knew their true value they would have been better off getting a rating and revealing it. The larger the number of those excessively "pessimistic" firms, the less bad it is not to have a rating. The rest of the paper will show that the interplay of these two forces will be key in determining the value of the option. As the objective of this section is to identify when ratings can be profitably hidden, we focus now on the case of secret contracting, with firms imperfectly informed of their true quality at the time of hiring an intermediary ($\theta > 0$).

4.1 Monopoly Intermediary

Let us first show that we can place ourself in the framework of Section 3, namely that the equilibrium is of threshold type.

Lemma 2 *All equilibria belong to the class of threshold equilibria.*

Proof. If the monopolist could extract all the rents (the case of symmetric information), then equation (1) implies that if the monopolist finds it profitable to take on type $\hat{\mu}$, it will also find it profitable to take all types above $\hat{\mu}$ since they are willing to pay more.

We show that even when the monopolist does not know μ, it can extract all the rents from all types above $\hat{\mu}$. Consider the following pricing structure: $p_0 = \epsilon$, with $\epsilon > 0$, very small, and $p(v) = 0$ if $v \leq E_v[v/\phi]$ and $p(v) = v - E_v[v/\phi] - \frac{\epsilon}{\Pr(v > E_v[v/\phi]/\hat{\mu})}$. With this offer, the utility of a type μ who accepts the contract is

$$E_v[v/\phi] + \epsilon \left(\frac{\Pr(v > E_v[v/\phi]/\mu)}{\Pr(v > E_v[v/\phi]/\hat{\mu})} - 1 \right).$$

First order stochastic dominance implies that $\Pr(v > E_v[v/\phi]/\mu)$ increases with μ, so types below $\hat{\mu}$ stay out of the market and types above accept the offer. The rent of any type μ can be made arbitrarily close to 0 by approaching ϵ to 0. Thus, the monopolist extracts all the rents and the equilibrium must be threshold.[4] ■

The profit of the intermediary is then

$$\Pi = \max_{\hat{\mu}} \Pr(\mu \geq \hat{\mu}) \left(E_\mu \left[E_v[\max\{v - E_v[v/\phi], 0\}/\mu]/\mu \geq \hat{\mu} \right] - c \right).$$

We now proceed to show that for the case where firms' values v and signals μ are uniformly distributed, there is no circumstances under which the option to hide a score is of some value when the intermediary is a monopolist.

Proposition 4 *For all $\theta \geq 0$, the unique renegotiation-proof contract is for the monopolistic intermediary to offer a price structure so that* $p_0 + p(v) = v$ *and* $d(v) = 1$, $\forall v$. *Such equilibrium is*

[4] Whenever $\omega > 0$, replace v by $E_v[v/\sigma]$ in the analysis above and the spirit of the proof is similar (with a slightly modified value of ϵ).

supported by the out of equilibrium beliefs that a firm without rating is worth zero. All types of firms accept this contract, resulting in an equilibrium profit level of $1/2 - c$ *for the intermediary.*

Since the intermediary takes on all types, it is irrelevant whether contracts are secret or public. It is worth emphasizing that there is some cross-subsidization between types. Indeed, whenever $v \leq c$, the intermediary loses money on those types. It still pays for the intermediary to take them on, as not doing so will admittedly save $v - c$ but will reduce the willingness to pay for its services of all firms with higher values as it would increase $E_v[v/\phi]$. The situation is in fact quite similar to a discriminating monopolist who starts contracting with the consumers with the highest valuation and who is surely willing to do so with all consumers with a valuation exceeding the cost of delivering the good or service (as again, the monopolist extracts all the surplus). But there is an extra effect in our set-up: as the monopolist walks down the demand curve, the demand curve is shifted upwards. This second effect explains that the monopolist is willing to contract with types with a valuation lower than c. Finally, contracting with all types also has the impact of destroying the value of the no disclosure option, as explained in Corollary 1. The fact that the monopolist prefers taking all types is specific to the uniform assumption but this arbitrage between making a loss on low types, increasing the willingness to pay of all types above and reducing the no disclosure option value remains general. The following simple mechanism implements the previous outcome:

Proposition 5 *The optimal contract is implementable with a simple ownership contract where the intermediary owns the rating and where the firm and the intermediary renegotiate over its revelation.*

Indeed, the ownership of the rating confers to the intermediary the right to use this informational asset in any way it wants. In particular, the intermediary has the right to hide the rating. This would result in the firm being valued at $E_v[v/\phi]$ and therefore the intermediary can bargain to extract $v - E_v[v/\phi]$. In our case where the intermediary takes on all types, the previous out of equilibrium beliefs imply $E_v[v/\phi] = 0$. It follows then that $p_0 = 0$ and $p(v) = v$. As we see, the fact that μ is private information plays no role and the equilibrium in this situation remains the one described in Proposition 5.

This result is in sharp contrast with the result of Lizzeri (1999) where all companies ask for a rating and the intermediary only publicly reveals whether the firm has hired the intermediary or not.[5] The difference comes from our emphasis on renegotiation-proofness. Indeed, in equilibrium, a firm who hires the intermediary is worth $1/2$ if no information is revealed. Therefore, a firm of type

[5]Following our notation, the optimal contract is $p_0 = 1/2$ and, $d(v) = 0 \ \forall v$. It is noticeable that the monopolist's profit is still $1/2 - c$. In other words, this contract is still optimal once contingent mechanisms are allowed.

$v > 1/2$ that has hired the intermediary is willing to pay an extra fee (at most $v - 1/2$) for the intermediary to reveal its type instead of remaining valued as an average firm in the absence of such an announcement. If the firm and the intermediary can renegotiate the initial contract, they will find a way to certify this information to the market as doing so creates an additional surplus.
The rating market could not work better from the viewpoint of information revelation, taking as given the distribution of firms' quality. Thus, if one is sufficiently confident that market forces will lead to intermediary's ownership of the rating and to renegotiation taking place, then one should see no need for regulatory intervention. This conclusion should however be toned down: firms have no incentives to improve their governance, as their equilibrium payoff is independent of v.

4.2 Competing Intermediaries

We now turn our attention to the opposite case of Bertrand competition: two intermediaries who can produce a perfectly revealing score at a cost c compete on the rating market. It is enough, for our purpose of exhibiting cases where ratings are hidden in equilibrium, to focus on the case of uniform distributions and $c \leq \frac{1}{6}$.[6]
Unsurprisingly, an equilibrium where the intermediary keeps full ownership of the rating and captures all the surplus as described in Propositions 4 and 5 cannot survive in a competing framework. Indeed, the standard Bertrand-like reasoning applies and one of the intermediaries will always lower his price to attract all firms willing to obtain a score. This is summarized in the following lemma:

Lemma 3 *When two identical intermediaries compete in contracts, they price such that they make zero profit on each type μ asking for a rating. That is, $E[p^i/\mu] = c$ for all μ and for $i = 1, 2$.*

Proof. First observe that any firm asking for a rating but withholding it will get $E_v[v|\phi]$ whatever the identity of the intermediary who provided the rating since, by definition, the market is not aware of such identity. Then, from Lemma 1, the expected information that will be revealed after asking for a rating is again the same whatever the identity of the intermediary and the contract initially offered. Namely, the rating will be disclosed whenever $v > E_v[v|\phi]$. Therefore, firms get valued in the same way whether they go to intermediary i or j, and whether they disclose a rating or not. Given this homogeneity in the service provided by intermediaries, intermediary i cannot make a strictly positive profit on any subset of types, without intermediary j having an incentive to undercut it. Therefore the only equilibrium involves $E[p^i/\mu] = c$, $\forall \mu, i$. ■

Being aware of the pricing strategy that emerges in equilibrium, we get

[6] Considering cases where $\frac{1}{6} < c < \frac{1}{2}$ would add cumbersome computations without changing our message.

Lemma 4 *Any equilibrium is a threshold equilibrium.*

Proof. Any type μ expects to pay c in equilibrium. Since the willingness to pay is increasing in μ, if type $\hat{\mu}$ accepts one offer, so do all types $\mu \geq \hat{\mu}$. ∎

Following the analysis of Section 3, let us solely consider the case of secret contracting and $\theta > 0$. For the option of hiding the score to be truly valuable, we need to exhibit an equilibrium where there exists some $\mu \geq \hat{\mu}$ for which the set of attainable values of v contains some range for which $v < E_v[v/\phi]$. This last condition is itself endogenous.

Consider a putative symmetric equilibrium where both intermediaries offer the same contract. Suppose that firms with $\mu \geq \hat{\mu}$ ask for certification while others do not. A firm that asks and obtains a rating v can either reveal it and get v, or withhold it and get:

$$E_v[v/\phi] = E_v[v/\mu \leq \hat{\mu} \textit{ or } \mu \geq \hat{\mu} \text{ and } v \leq v_\phi]$$

where v_ϕ is the type which ex post is just indifferent between revealing v_ϕ or nothing, $v_\phi = E_v[v/\phi]$. We are now equipped to provide the following result.

Proposition 6 *The option of hiding the score has value if and only if $\theta > c$. That is, when $\theta \leq c$, the only equilibrium entails full revelation for all types who ask for a score to any intermediary. On the contrary, when $\theta > c$, some ratings are hidden in equilibrium. A firm hires any one of the intermediaries if and only if $\mu \geq \hat{\mu}$ where $\hat{\mu}$ is such that*

$$\Pr(v \geq v_\phi/\hat{\mu})\,(E_v[v/v \geq v_\phi,\, \hat{\mu}] - v_\phi) = c. \tag{3}$$

We have shown that if the quality of the firms' information is relatively high (θ small) the option of hiding the score has no value and therefore, in equilibrium all scores are revealed. However, this equilibrium does not exist anymore when the firm is poorly informed about its type (θ large). In such a case, a firm is no longer guaranteed that the lowest possible score it can get is necessarily higher than the market participants expectation in the absence of a rating. An intermediary now wants to deviate to offering secret contracts that include the option of no disclosure. By doing this, the firm is insured against bad scores. The unravelling result breaks down when we introduce secret contracting and firms have noisy information about their types. Note that this happens when the rating industry is more valuable: it is not very costly (c is low) and it considerably improves the information available (θ is large). We now turn to the implementation of the optimal contract.

Proposition 7 *Transferring the ownership of the rating to the intermediary cannot implement the optimal contract. In contrast, the optimal contract can be implemented when the firm has ownership over the rating.*

There are some important differences with the monopolistic market structure. First, allocating the ownership to the rating intermediary can no longer be achieved as it would expose firms to a hold-up problem ex post whereby the intermediary would extract more than c by threatening to either withhold the score (if $v > E_v[v/\phi]$) or to disclose it (in the opposite case). Once the price is paid, the intermediary is a monopolist at the information disclosure stage. Transferring ownership over the rating to firms instead is one way of implementing the optimal contract. Other possibilities would require contingent contracts that would fully specify $d^*(v)$. Interestingly, whenever the market has concerns regarding the verifiability of the contract or, as developed in Battigalli and Maggi (2004) the cost of writing contract is proportional to the amount of contingencies it entails, then transferring ownership becomes an efficient way of implementing the optimal contract.
A final noticeable difference between a monopolistic market structure for the rating market and a competitive one is that for the same parameter values, competition between intermediaries reduces the amount of information that is revealed to market participants in equilibrium. Fewer firms get a rating and amongst those some may withhold their scores.

5 Discussion

Alternative distribution functions. A fair question to ask is whether our results are general properties or do they depend on the assumed distribution function. In the competitive case, the equilibrium price is equal to the marginal cost, c, and, consequently there are always some types who prefer to stay out of the rating market. Under secret contracting and poor information held by the firms, some rated firms will then prefer to be pooled with those types who stayed out rather than reveal their low true values.
In the monopoly setting, things are less clear. Our result that the option has no value relies on the fact that the monopoly intermediary does not want to leave some types out of the rating market. This certainly depends on the shape of the distribution. Under alternative distribution functions, the intermediary may decide to leave some types out and the option of hiding the score could become valuable.[7] It is actually possible to find examples in which the option is less often exerted under

[7]For instance, suppose that the signal μ is such that it induces first order stochastic dominance, but the distribution of v conditional on μ has full support on $[0, 1]$ whatever the value of μ. In this case, as soon as some types do not ask

Bertrand competition. However, for any distribution of values and signals that satisfies the first order stochastic dominance assumption we can show the following result.

Proposition 8 *Under Bertrand competition there is less information revealed in equilibrium, i.e.* $v_\phi^B > v_\phi^M$.

Even though we cannot rank the two market structures in terms of the value of the option, it is always true that the monopoly attracts more types than two Bertrand competitors, which in turn implies that the ex ante probability that a rating is not revealed is greater in a competitive setting.

Welfare analysis. Our modelling approach based on risk neutral agents did not confer any social value to information. We implicitly assumed in our discussions that more information revealed was a good thing. Given the cost c of performing a rating, unless the value of information is very large, there should be in fact an optimal level of rating disclosures. The comparison of the two market structures in such a model would not be trivial as two effects can be distinguished. First, we have seen that a monopolistic structure will be conducive to a larger set of firms applying for a rating than under Bertrand competition. In fact the monopolistic structure will involve a welfare loss by generating too many ratings. But second, Bertrand competition will generate a larger set of ratings unrevealed. This is also inefficient as the cost of producing the rating is paid but the option of hiding the score is exercised so that still market participants do not get the information.

Lack of information about the rating agency. Suppose there is a proportion of firms who are unaware of the existence of intermediaries who evaluate corporate governance. Those "ignorant" firms will not ask for a rating, no matter how good their signal is. If this is the case, the value of v_ϕ is less responsive to the strategic decisions made by firms informed about the workings of the rating market. This possibility will reduce (but not eliminate) the forces behind the unravelling effect and is likely to increase the value of the no disclosure option. Still, the probability that a score will not be revealed is higher under competition.

6 Appendix

Proof of Proposition 4

First, suppose that $\theta = 0$. Call $\hat{v}$ the type who is just indifferent between asking for a rating or not. Since $\theta = 0$ the option has no value and therefore $v_\phi = E_v[v/v < \hat{v}] = \frac{\hat{v}}{2}$. Then, the profit of the monopolist is

$$\Pi(\hat{v}) = \max_{\hat{v}} \int_{\hat{v}}^{1} \left(v - \frac{\hat{v}}{2} - c \right) dv.$$

for a rating, there is a strictly positive probability that the rating will not be revealed whatever the market structure.

Deriving with respect to $\hat{v}$ we obtain

$$\frac{d\Pi}{d\hat{v}} = -\left(\frac{1}{2} - c\right) \leq 0$$

for any $\hat{v}$ because $c \leq 1/2$. Hence, the monopolist chooses the lowest possible $\hat{v} = 0$.

Suppose now that $\theta > 0$. We then have $v_\phi = E_v[v/\phi] \equiv E_v[v/\mu \leq \hat{\mu} \cup \mu \geq \hat{\mu} \text{ and } v \leq v_\phi]$. The profit of a monopolist who takes all types above $\hat{\mu}$ writes as

$$\Pi(\hat{\mu}) = \int_{\hat{\mu}}^{1+\theta} \Pr(v \geq v_\phi(\hat{\mu})/\mu)[E(v/v \geq v_\phi(\hat{\mu}), \mu) - v_\phi(\hat{\mu})]f(\mu)d\mu - (1 - F(\hat{\mu}))c.$$

It is equal to $\frac{1}{2} - c$ whenever $\hat{\mu} = -\theta$ and to 0 whenever $\hat{\mu} = 1 + \theta$. Let us define the condition under which, at any interior point, the profit is lower than $\frac{1}{2} - c$. That is, for any $\hat{\mu} \in [-\theta, 1 + \theta]$,

$$\Pi(\hat{\mu}) = \int_{\hat{\mu}}^{\mu_{\max}} \Pr(v \geq v_\phi(\hat{\mu})/\mu)[E_v[v/v \geq v_\phi(\hat{\mu}), \mu] - v_\phi(\hat{\mu})]f(\mu)d\mu - (1 - F(\hat{\mu}))c \leq \frac{1}{2} - c. \tag{4}$$

Denoting by $\Pr(\phi) = \Pr(\mu < \hat{\mu} \bigcup (\mu > \hat{\mu} \bigcap v < v_\phi))$ and using the fact that

$$\Pr(\phi)v_\phi + (1 - \Pr(\phi))E_v[v/v \geq v_\phi \text{ and } \mu \geq \hat{\mu}] = E[v] = \frac{1}{2},$$

and

$$\int_{\hat{\mu}}^{\mu_{\max}} \Pr(v \geq v_\phi(\hat{\mu})/\mu)[E_v[v/v \geq v_\phi(\hat{\mu}), \mu] - v_\phi(\hat{\mu})]f(\mu)d\mu = -(1-\Pr(\phi))v_\phi + (1-\Pr(\phi))E_v[v/v \geq v_\phi \text{ and } \mu \geq \hat{\mu}],$$

then equation (4) can be written as

$$-v_\phi(\hat{\mu}) + F(\hat{\mu})c \leq 0, \tag{5}$$

which has to be true for any $c \leq 1/2$ and for any $\hat{\mu} \in [-\theta, 1 + \theta]$.

For the uniform case we have that simple Bayesian updating gives the density of μ,

$$f(\mu) = \int_0^1 f(\mu|v)f(v)dv = \begin{cases} \frac{\mu+\theta}{2\theta} & if \quad \mu \in [-\theta, \theta) \\ 1 & if \quad \mu \in [\theta, 1 - \theta] \\ \frac{1+\theta-\mu}{2\theta} & if \quad \mu \in (1 - \theta, 1 + \theta] \end{cases}$$

and

$$f(v|\mu) = \frac{f(\mu|v)f(v)}{f(\mu)} = \begin{cases} \frac{1}{1+\theta-\mu} & if \quad \mu > 1 - \theta, & v \in [\mu - \theta, 1], \\ \frac{1}{2\theta} & if \quad \mu \in [\theta, 1 - \theta], & v \in [\mu - \theta, \mu + \theta], \\ \frac{1}{\mu+\theta} & if \quad \mu < \theta, & v \in [0, \mu + \theta]. \end{cases}$$

a) Suppose that the option has no value for a particular value of $\hat{\mu}$. That is,

$$v_\phi(\hat{\mu}) = E_v[v/\mu \leq \hat{\mu}] = \frac{F(\hat{\mu})}{4\theta}.$$

Condition (5) then is equivalent to

$$4c\theta - 1 \leq 0,$$

which is true because $c \leq 1/2$ and $\theta \leq 1/2$.

b) Now, consider a $\hat{\mu} \leq 1-\theta$ for which the option would have value, so $v_{\phi}(\hat{\mu}) > \max\{\hat{\mu}-\theta, 0\}$. It is easy to verify that

$$v_{\phi}(\hat{\mu}) = E_v[v|\phi] \Leftrightarrow \hat{\mu} = v_{\phi} - \theta + (6\theta)^{\frac{1}{3}}\, v_{\phi}^{\frac{2}{3}}. \tag{6}$$

b.1) $\hat{\mu} < \theta$ which using (6) implies

$$v_{\phi} + (6\theta)^{\frac{1}{3}} v_{\phi}^{\frac{2}{3}} < 2\theta \tag{7}$$

Then $F(\hat{\mu}) = \frac{(\hat{\mu}+\theta)^2}{4\theta}$ and, using (6), condition (5) rewrites as

$$-v_{\phi} + \frac{\left(v_{\phi} + (6\theta)^{\frac{1}{3}} v_{\phi}^{\frac{2}{3}}\right)^2}{4\theta} c \leq 0$$

which is true given condition (7), $c \leq 1/2$ and $v_{\phi} \leq 1$.
b.2) $1-\theta > \hat{\mu} > \theta$. Again, we have $\hat{\mu} = v_{\phi} - \theta + (6\theta)^{\frac{1}{3}}\, v_{\phi}^{\frac{2}{3}}$. The necessary condition for the option to have value is given by

$$v_{\phi} > \hat{\mu} - \theta \Leftrightarrow v_{\phi} < \left(\frac{4}{3}\right)^{\frac{1}{2}} \theta \tag{8}$$

It is enough to show that the profit at any point in which the first order condition for profit maximization is satisfied is lower than $1/2 - c$ to guarantee that it is optimal for the monopolist to attract all types. The first order condition can be written as

$$\int_{v_{\phi}}^{1} (v - v_{\phi}) f(v/\hat{\mu}^*) dv = \Pr(\phi) c.$$

Using this, condition (5) can be rewritten

$$-v_{\phi}(\hat{\mu}^*) + \frac{F(\hat{\mu}^*)}{\Pr(\phi^*)} \int_{v_{\phi}(\hat{\mu}^*)}^{1} (v - v_{\phi}(\hat{\mu}^*)) f(v/\hat{\mu}^*) dv \leq 0. \tag{9}$$

Given that $\frac{F(\hat{\mu}^*)}{\Pr(\phi)} < 1$, a sufficient condition for equation (9) to be satisfied is that

$$-v_{\phi}(\hat{\mu}^*) + \int_{v_{\phi}(\hat{\mu}^*)}^{1} (v - v_{\phi}(\hat{\mu}^*)) f(v/\hat{\mu}^*) dv \leq 0. \tag{10}$$

Using (6), condition (10) rewrites

$$v_{\phi}(\mu^*) \geq \int_{v_{\phi}(\hat{\mu}^*)}^{\hat{\mu}^*+\theta} (v - v_{\phi}(\mu^*) f(v/\hat{\mu}^*) dv \quad \Leftrightarrow \quad 4\theta \geq (6\theta)^{\frac{2}{3}}\, v_{\phi}^{\frac{1}{3}} + 2v_{\phi}.$$

Given that the (RHS) of the last inequality is increasing in v_{ϕ}, one easily gets that $v_{\phi} \leq \frac{16}{9}\theta$ which is trivially satisfied whenever condition (8) is satisfied.

Finally the case where $1-\theta < \hat{\mu}$ is irrelevant in the monopoly case.[8]

Proof of Proposition 6

[8] This case is explicitly shown to be irrelevant in the competition setting. Given that, as shown in Proposition 8, a monopolist intermediary provides more ratings than any intermediary under competition, the results directly follows.

We know that the firm that is indifferent between asking for a rating or staying out of the certification market is given by

$$\Pr(v \geq v_\phi)E_v[v/v \geq v_\phi,\, \hat{\mu}] + (1 - \Pr(v \geq v_\phi))\, v_\phi - c = E_v[v|\phi] = v_\phi.$$

Rearranging terms, this gives equation (3). In particular, this implies that $\hat{\mu} > -\theta$ in any equilibrium if $c > 0$. Thus, the mass of types who stay out is strictly positive, which means that $v_\phi > 0$.
Now, the worst rating that could be obtained by a firm endowed with a signal $\hat{\mu}$ is $\hat{\mu} - \theta$. Therefore, the option will have some value if and only if

$$v_\phi > \max\{\hat{\mu} - \theta, 0\}. \tag{11}$$

We start by showing that if the option has value, it must be that $\theta > c$.
Consider first the case in which $\hat{\mu} \geq \theta$, so condition (11) becomes $v_\phi > \hat{\mu} - \theta$. Using the uniform distribution and under the assumption that (11) holds, equation (3) can be written as

$$\left(1 - \frac{v_\phi - (\hat{\mu} - \theta)}{2\theta}\right)\left(\frac{v_\phi + (\hat{\mu} + \theta)}{2} - v_\phi\right) = c,$$

or equivalently

$$\hat{\mu} + \theta - 2\sqrt{\theta c} = v_\phi.$$

Using this, we can check that condition (11) holds as long as $\theta > c$.
Take now the case in which $\hat{\mu} < \theta$. Then, condition (11) becomes $v_\phi > 0$, which is always true as long as $c > 0$. So, the only thing we need to prove here is that this case can never occur when $\theta \leq c$. So, suppose that $\hat{\mu} < \theta \leq c$. Equation (3) when $\hat{\mu} < \theta$ and $v_\phi > 0$ becomes

$$\frac{\hat{\mu} + \theta - v_\phi}{\hat{\mu} + \theta}\left(\frac{\hat{\mu} + \theta + v_\phi}{2} - v_\phi\right) = c,$$

or equivalently,

$$\hat{\mu} + \theta - \sqrt{2c(\hat{\mu} + \theta)} = v_\phi.$$

Now, $\hat{\mu} < \theta \leq c$ implies that $\hat{\mu} + \theta - \sqrt{2c(\hat{\mu} + \theta)} < 0$, a contradiction.[9]
Finally, we need to show that if $\theta \leq c$, there is an equilibrium with full revelation for all types. From the previous analysis we can see that the only relevant case here is $\hat{\mu} \geq \theta$. Now, when the option has no value, equation (3) can be written as

$$E_v[v/\hat{\mu}] - c = E_v[v/\mu \leq \hat{\mu}] \tag{12}$$

because the absence of a score is identified with the types who do not ask for it. Moreover, $E_v[v/\hat{\mu}] = \hat{\mu}$ because $\hat{\mu} \geq \theta$. Now, since the option has no value, the opposite of condition (11) must hold, which together with (12) and the fact that $\theta \leq c$ gives

$$\hat{\mu} - \theta \geq E_v[v/\mu \leq \hat{\mu}] = \hat{\mu} - c,$$

[9] It can be shown that the case $\hat{\mu} > 1 - \theta$ can never be an equilibrium when $c \leq 1/6$. A proof is available from the authors upon request.

Proof of Proposition 7

By definition we can express $v_\phi(\hat{\mu})$ as follows,

$$\Pr(\phi)v_\phi(\hat{\mu}) = \int_{\mu_{\min}}^{\hat{\mu}} \int_0^1 vf(v/\mu)f(\mu)dvd\mu + \int_{\hat{\mu}}^{\mu_{\max}} \int_0^{v_\phi} vf(v/\mu)f(\mu)dvd\mu,$$

where

$$\Pr(\phi) = \int_{\mu_{\min}}^{\hat{\mu}} \int_0^1 f(v/\mu)f(\mu)dvd\mu + \int_{\hat{\mu}}^{\mu_{\max}} \int_0^{v_\phi} f(v/\mu)f(\mu)dvd\mu.$$

This implies, in particular that

$$\frac{dv_\phi}{d\hat{\mu}} = \frac{f(\hat{\mu})}{\Pr(\phi)} \int_{v_\phi}^1 (v - v_\phi)f(v/\hat{\mu})dv \geq 0.$$

Therefore, it is enough to show that $\hat{\mu}^B > \hat{\mu}^M$. The profit of the monopolist is given by:

$$\Pi(\hat{\mu}) = \int_{\hat{\mu}}^{\mu_{\max}} [p(\mu, \hat{\mu}) - c]f(\mu)d\mu,$$

with

$$p(\mu, \hat{\mu}) = \int_{v_\phi(\hat{\mu})}^1 (v - v_\phi(\hat{\mu}))f(v/\mu)dv.$$

Deriving this function with respect to $\hat{\mu}$ we get

$$\frac{\partial \Pi}{\partial \hat{\mu}} = -[p(\hat{\mu}, \hat{\mu}) - c]f(\hat{\mu}) + \int_{\hat{\mu}}^{\mu_{\max}} \frac{\partial p(\mu, \hat{\mu})}{\partial \hat{\mu}} f(\mu)d\mu.$$

Under Bertrand competition, the lowest type who asks for a rating is $\hat{\mu}^B$ such that $p(\hat{\mu}^B, \hat{\mu}^B) = c$. Evaluating the monopolist's first order condition at $\hat{\mu}^B$, we get

$$\frac{\partial \Pi}{\partial \hat{\mu}}(\hat{\mu}^B) = \int_{\hat{\mu}^B}^{\mu_{\max}} \frac{\partial p(\mu, \hat{\mu}^B)}{\partial \hat{\mu}} f(\mu)d\mu = -\int_{\hat{\mu}^B}^{\mu_{\max}} \int_{v_\phi(\hat{\mu}^B)}^1 f(v/\mu)dvd\mu \frac{dv_\phi}{d\hat{\mu}}(\hat{\mu}^B) < 0$$

since v_ϕ increases with $\hat{\mu}$. A monopolist intermediary attracts more firms seeking for a rating and, therefore, lowers the lowest score that is revealed. More information is then revealed in the monopoly case.

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