Competition among Exchanges and Reputational Concerns

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June, 2016

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Abstract

This paper proposes a theoretical model to analyze the effect of competition on the quality of the certification process offered by stock exchanges. If the stock exchange was to truthfully certify the quality of new issue, then it would list only the good projects, which would alleviate information asymmetries and generate gains from trade. However, it may be more profitable for exchanges to be too lax in its listing requirements. The trade-off between its short-term profits and its reputation induces strategic behavior. The results show that overestimating the quality of a project is an equilibrium despite the presence of the reputation costs. Counter-intuitively, introducing competition leads to more lax behavior than the monopolistic case and reduces welfare as long as the reputation of the competitor is not higher than the incumbent stock exchange.

1 Introduction

Stock exchanges play a key role in financial markets by listing firms in the primary market and organizing trading in the secondary market. Draus (2009) mentions that one important function of exchanges is to certify the quality of listed firms. When a firm applies for a listing, the stock exchange conducts an investigation requiring information. The thoroughness of the investigation depends on the listing standards set by the stock exchange (Chemmanur and Fulghieri, 2006). These listing standards could be quantitative (e.g. minimum market capitalization, profitability record, at least 2 or 3 years of accounting data), or qualitative (e.g. pattern growth, financial integrity, corporate governance standard). However, listing is not automatic even if firms meet the minimum requirements, since exchanges have the discretion to reject applications for listings. The Alternext rule book summarizes this as follows:[1]

> "The Relevant Euronext Market Undertaking may refuse an application for a first admission to trading of Securities if it considers that the first admission to trading of the Securities may be detrimental to the fair, orderly and efficient operation of any Alternext Market or to the reputation of the Alternext Markets."

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[1]Source: Alternext Markets Rule Book, February, 2016.

There seems to be a link between listing standards and the reputation of the exchange (Chemmanur and Fulghieri, 2006). On one hand, a stock exchange that chooses to be more stringent regulator may obtain a competitive advantage by increasing its credibility and reputation, consequently, securing trading volume. On the other hand, stringent enforcement may reduce the exchanges listing revenues if it leads to numerous regulatory delistings, and/or deters companies from seeking to list on that exchange.

This trade-off may be altered by competition between exchanges which has been favored during the last decade. Indeed, regulators often believe that introducing more competition in the stock exchange industry can have a disciplinary effect on improper incentives. At the same time, profit-maximizing exchanges place more and more emphasis on the revenues that customers bring in the form of listing fees, trading fees and by selling market data. This paper aims to develop a theoretical analysis that addresses these two questions in a unified framework: (i) is the reputation sizeable enough to ensure truthful certification of listings? and (ii) does competition impact the certification process offered by the exchanges?.

These questions echo the current debate as to whether profit-maximizing and competing exchanges should continue to regulate listing. In this context, Macey and O'Hara (2005) claim that certification related to listing standards is incompatible with profit maximization. Concerns over such perverse incentives have been raised in Hong Kong, where the government appointed a commission that

pushed for the transfer of the listing function from the exchange to the regulator, arguing that:

> "[a]s a listed company motivated by profitability, the HKEx has a clear interest in listing as many companies as possible since listing fees represent a significant portion of revenues (18 in 2002), and there is a disincentive to allocate resources to enforcement which is costly and produces no revenues.[2]

In fact, despite the decrease of IPO demand, exchanges still scout for companies around the world for potential new listings. This is because public companies' annual listing fees generate steady income that is immune to the ups and downs of trading. In 2015, the exchanges with the biggest share of foreign IPOs (NYSE, Nasdaq, London Stock Exchange and Hong Kong Stock Exchange) earned about 10 to 20 percent of their income from listing fees.[3] Simultaneously, more listings means more transactions and hence more fees as well as more saleable data. As a result, Fama and French (2004) argue that listing requirements have become more lax due to the changing demand and supply of shares. This implies that a profit-maximizing exchange will adapt its listing standards to economic conditions. DeMarzo et al. (2001) lend support to this idea by providing a theoretical framework on regulation enforcement with a self-regulatory stock exchange. They conclude that stock exchanges organized as self-regulatory organizations tend to

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[2]See Baglole (2004).
[3]Source: Stock exchanges are fighting a global war for listings. Bloomberg.

choose a laxer enforcement policy with less frequent investigations and lower penalties.

In response to these accusations, the exchanges themselves claim that their credibility is more important than their profits and that, in a competitive environment, their reputation is even more important to protect their commercial viability. Some exchanges, including the London Stock Exchange, already cite strong reputation and brand name as key competitive strengths.[4]

In this paper, I adapt the framework of Mathis et al. (2009) to the stock exchange industry and extend it to analyze whether a profit-maximizing exchange in a competitive context, will certify listings truthfully. Under incomplete information about the project type, a good project may be suspected of being a bad one, resulting in reduced welfare. This is in line with Tirole (2010) who argues that issuers may raise less funds or raise funds less often when the capital market has limited access to information about the firm. I develop an intuition about the effect of competition but I also discuss the case of a monopolistic stock exchange which I use as a benchmark model.

The model runs over two-periods. At each period a new issuer comes to the market with a new project requiring listing. The project could be good or bad. I assume that good projects should be financed but without prior knowledge about the quality of the project, no financing will take place. A stock exchange has a technology for evaluating projects and decides on this basis whether or not to list

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[4]Annual report, 2009: Experts in responsible investment solutions.

the project. The stock exchange could be of two types: either it is committed to always telling the truth (ensuring future profits) and listing only the good projects or it adopts a strategy that maximizes current profits at the expense of long-term profits (reputation). The reputation of the stock exchange is the probability that investors will asses the stock exchange as truthful.[5]

The results show that the strategic behavior tends to dominate the disciplinary effect when reputation costs are low. Moreover, the probability that a strategic stock exchange is lying tends to increase with reputation. This is because when reputation increases, the marginal cost of lying decreases because failure is attributed to the failure of a good project rather than to a strategic behavior.

In reality, there is competition among exchanges. Besides, stock exchanges argue that it disciplines their behavior. I thus extend the model where two stock exchanges compete for listing. Surprisingly, when an incumbent stock exchange faces competition, lax behavior tends to increase as compared to the monopolistic case, in particular, when the reputation of the stock exchange in question exceeds that of the competitor'. In the latter case, competition delivers lower welfare than monopoly.

Consequently, the self-discipline argument used by exchanges in practice does not hold and reputation fails to discipline strategic behavior. Counter-intuitively,

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[5]I also model a cashless issuer who needs outside financing but who plays no role, except in the competitive case, in which he chooses where to list his project.

competition only reinforces this mechanism, which is the outcome of a trade-off between short-term and long-term profits.

My findings suggest a greater regulatory intervention regarding stock exchanges that are self-regulated, profit-maximizing and that set the listing standards. In addition, there is a crucial need to increase resources devoted to monitoring activity, charging penalties in case of misconduct and dissuading such institutions from deceiving investors.

Related literature

This paper contributes to the literature on information revelation and competition for financial intermediaries by addressing the importance of reputation. It addresses the situation of stock exchanges that while they may alleviate investors' information asymmetry, incur a fixed reputational cost every time their listing is misleading. This paper deals with reputation, endogenously updates using Bayesian rule. A closely related paper is Mathis et al. (2009) which examines how reputation can have a disciplinary effect on credit rating agencies (e.g. Crawford and Sobel, 1982; Sobel, 1985; Benabou and Laroque, 1992; Morris, 2001). The authors find that in equilibrium, CRAs are likely to behave laxly and are prone to reputation cycles. They conclude that reputation concerns are not enough to discipline CRAs or solve the conflict of interest problem. Camanho et al. (2009) build up-on this paper to model the competitive case. They demonstrate that

strategic behavior tends to dominate when the competitor's reputation is high, and this may reduce overall welfare. My model combines and extends these two papers. I introduce competition with Bayesian update of reputation and explore its welfare implications. Moreover, in these papers, the income of the the financial intermediary is assumed to be fixed. In contrast, I study a model in which the fee vary with the project quality, the stock exchange strategy and reputation and model it. Even though both institutional setting act as financial intermediaries, providing investors information, they are quite different. The main difference is that the credit rating agency is based on the issuer-pay model which according to Mathis et al. (2009) is the source of the conflict of interest. While the stock exchange derives profits from both issuers and investors that in my model and for simplicity, are described as listing fees paid by the issuer conditionally on the investors financing.

This paper is also related to the literature on the certification role of listing and the listing standards of exchanges. Draus (2009) proposes a model to analyze how a stock exchange adapts its listing requirements conditional on the incentives of a firm to list. Chemmanur and Fulghieri (2006) analyze the choice of a cross-listing location and the choice of exchanges' listing standards. They show that the firms listing choice is driven by the presence (or absence) of skilled analysts and investors in various markets and the extent of information about the firm available to these investors. While these papers share some important features with mine, I do not study the firms' listing decisions and their effect on the choice

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of listing standards'. My paper's primary focus analyzes whether reputation concerns would induce exchanges to certify listings truthfully and hence maintain high listing standards despite profit maximization and competition.

This paper also borrows from the literature on competition between exchanges. Easley and O'hara (2010) claim that the new landscape for stock exchanges has forced them to compete for issuers and investors alike. The competitive role concerns features such as listing standards, trading halts, market rules and procedures (e.g. Macey and O'Hara, 2002; Macey et al., 2008; Parlour and Seppi, 2003; Chemmanur and Fulghieri, 2006; Dewenter et al., 2007, 2010; Ramos and von Thadden, 2008). In this context, Foucault and Parlour (2004) develop a model in which two profit maximizing exchanges compete for IPO listings and can choose both trading rules and listing requirements. They find that competition does not guarantee that exchanges choose welfare maximizing trading rules. Pescatori and Caglio (2013) explore how competition among stock exchanges operated as self-regulatory organizations, affects the design of their members' surveillance. They show that when investors do not have perfect information, competition among exchanges induces to a race to bottom in enforcement policy and a reduction in total welfare compared to the monopolist self-regulatory organization's case.

The rest of the paper is organized as follows. Section 2 describes the basic characteristics of the monopolistic model and Section 3 contains the equilibrium analysis. Section 4 develops a more realistic scenario in which there is competition

in the stock exchanges industry and Section 5 compares monopoly vs competition in term of manipulation and welfare. Finally, Section 6 discusses some policy implications and concludes the paper. The proofs are presented in the Appendix.

2 The benchmark model: a monopoly

2.1 The model

Consider an economy populated by three types of *risk-neutral* agents: issuer (he), a stock exchange (it) and investors with a measure of one. The model is a finite horizon which lasts for two periods t, with $t = \{1, 2\}$.

At each period, a cashless issuer needs to raise capital from outside investors to finance a project of a size $I < 1$.[6] The project could be good or bad. The type of the project is unknown ex-ante, but general conditions of the economy determine a common prior belief about it. A project is good with probability α and bad with probability $(1 - \alpha)$, with $\alpha \in (0, 1)$. A good project succeeds with probability p and fails with probability $(1 - p)$. A bad project always fails. Either type of project yields the same cash flow R normalized to 1 (the payoff is normalized so there is no discounting within periods) when not in default and zero in default. The interest rate in the economy is normalized to 0.

Assumption 1. *I assume that $p > I$. Under this assumption, a good project*

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[6]For simplicity, I do not model the issuer's financing decision and I assume that the issuer is restricted to use equity.

should be financed. A bad project yields a negative net project value and should

not be financed.

The stock exchange intermediates trades between the issuer and investors. It uses its technology to evaluate the project and convince investors to provide financing.[7] I assume that it perfectly observes the project type, good or bad (at a cost normalized to zero) and decides whether to list it or not in its venue.[8]

The stock exchange derives profits from listing fees f_t paid by the issuer at period t which, coupled with the investment, correspond to the project cost I. The fee is paid only if a listing occurs. The stock exchange is a long-run player with discount factor $\delta \in (0, 1)$. Its value function at period t, V_t, corresponds to the discounted sum of payoffs. It writes:

$$V_t = \mathbb{1}_L . f_t + \delta V_{t+1}, \tag{1}$$

where $\mathbb{1}_L$ is a dummy variable that takes value 1 if the listing is realized and 0 otherwise.

There are two types of stock exchanges, truthful and strategic. A truthful stock exchange only lists a good project. A strategic stock exchange acts strate-

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[7]In reality, stock exchanges investigate firms on the basis of various information, financial statements and other disclosures in a due diligence process. The investors have no access to such information.

[8]In principle, the issuer could also assess the same technology as the stock exchange but I assume that since issuers are protected by limited liability (not modeled here), their incentives to list are always sustainable (receive a private benefit). In Mathis et al. (2009), the issuer is cashless and the project quality is unknown including to himself.

gically to maximize its future expected profits.[9] The type of the stock exchange is chosen ex-ante and is known only to the stock exchange itself. I denote by q_t the belief of the investors at period t that the stock exchange is truthful, and $(1 - q_t)$ that it is strategic. The probability q_t measures the stock exchange's reputation. Its strategy at period t, consists of listing a good project with probability 1 and a bad project with probability $x_t(q_t) \in [0, 1]$.[10] To simplify notation, I denote: $x_t(q_t) = x_t$. The strategy of stock exchange x_t whether to lie or not about the project type is determined at equilibrium. Figure 1 below illustrates the decision tree.

[insert **Figure 1** here]

At the end of each period, 3 possible outcomes are observed:

- Not listing when a bad project is rejected.

- Success when a good project is listed and succeeds.

- Failure either when a bad project is listed or when a good project fails.

Investors observe the listing decision, use their subjective belief about the project's probability of success and decide whether to invest or not. If they invest and if the project fails, the investors receive zero (they lose their initial investment). If

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[9]This assumption is in line with DeMarzo et al. (2005), Townsend (1979) and Mookherjee and Png (1989) who model the intermediary-investor relationship by assuming that intermediaries have private information on the project and may misreport this information to deceive investors.

[10]In principle, the stock exchange could also lie by not listing a good project but given our assumptions this never happens at equilibrium. (See Appendix A.3).

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the project is not listed, their payoff is zero. If they invest and if the project succeeds, the issuer promises them a repayment D. This repayment is determined endogenously to guarantee the participation constraint. That is, D must be such that:

$$Pr(S|L).D = I, \tag{2}$$

where S refers to the outcome success and L refers to the listing decision. Investors are willing to finance the project if and only if the investment required is at least equal to the project's expected payoff. Using Bayes's rule, it can be derived that:

$$D = \frac{Pr(L)}{Pr(L|S).Pr(S)}I. \tag{3}$$

I assume that the stock exchange requires a listing fee such that the issuer has zero profit:[11]

$$Pr(L|S)(1 - D) = 0. \tag{4}$$

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[11]An issuer with a bad project even if he knows that the expected value of his project is going to be zero, is willing to pay the same fee that an issuer with a good project pays to reveal his type. One implicit assumption is that the project listing is value enhancing. The extended model includes a private benefit for the issuer from listing a project.

Substituting (3) in (4), the fee f_t at period t becomes such that:

$$\frac{Pr(L|S)Pr(S) - Pr(L|F)Pr(F)}{Pr(S)} I = 0. \tag{5}$$

2.2   Equilibrium without stock exchange (autarky):

To understand the certification role of listing, I first examine the game without a stock exchange. Consider the full information case in which the project type, whether it is good or bad, is known.

Lemma 1. *Under full information and provided that $p > I$, a good project has a positive NPV and obtains financing, while a bad project does not because it has a negative NPV. The expected welfare at the first best is:*

$$\alpha(p - I). \tag{6}$$

Now, consider the case in which there is incomplete information about the project type. I define the probability cutoff α^* such that the project expected payoff equals the investment cost:

$$\alpha^* = \frac{I}{p}. \tag{7}$$

Lemma 2. *If $\alpha < \alpha^*$, then no investment takes place when investors are completely uninformed about the project type and the expected welfare equals zero.*

Indeed, in this case, even if the project was good, it would be damaged by the suspicion of being a bad project.

Lemma 3. *If $\alpha > \alpha^*$, then investment takes place. The expected welfare equals:*

$$EW_0 = \alpha p - I, \tag{8}$$

where the subscript 0 refers to the expected welfare under incomplete information.

Whether an investment takes place or not under incomplete information, the expected welfare is reduced compared with the full information, since bad projects could be financed and good ones may not be. Consequently, when a good project is not confounded with a bad one, issuers may be able to raise capital at a lower cost thus, giving rise to more investment opportunities. Therefore, the stock exchange, as an intermediary and a quality certifier, can improve the welfare.

3 The certification role of stock exchanges

3.1 Beliefs

In this section, a monopolistic stock exchange is introduced. I focus on the most interesting case: $\alpha < \alpha^*$. In the alternative, there is no room for welfare improvement by the stock exchange.

At period t, investors come to the market with prior beliefs q_t^0 about the stock

exchange type. If the project is not listed, then the investors' updated belief following Bayes rule is :[12]

$$q_t^{NotListed} = \frac{q_t^0}{1 - x_t(1 - q_t^0)}.$$

(9)

A bad project would not be listed either by a truthful stock exchange or by a strategic stock exchange with a probability $(1 - x_t)$. In this case, Not listing a bad project increases reputation.

When investors observe a listing, their beliefs about q_t become:

$$q_t^{Listed} = \frac{\alpha q_t^0}{\alpha + (1 - \alpha)(1 - q_t^0)x_t}.$$

(10)

A project would be listed either by a truthful or a strategic stock exchange if it is good, or with a probability x_t by a strategic stock exchange if it is bad. One can see that listing a project before observing the outcome decreases reputation, because of the probability that the stock exchange will lie and list a bad project. The investors observe the listing decision and decide whether to invest or not. If

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[12]See the Appendix A.1.

they observe a listing, their belief that the project will succeed is :

$$s(q_t, x_t) = Pr(S|L)$$

$$= q_t^{Listed}p + (1 - q_t^{Listed})\frac{\alpha p}{\alpha p + \alpha(1 - p) + (1 - \alpha)x_t}$$

$$= \frac{\alpha p}{\alpha + (1 - q_t)(1 - \alpha)x_t}, \tag{11}$$

where $Pr(S|L)$ refers to the probability that the listed project succeeds. A project would succeed with probability p, if it were listed either by a truthful or a strategic stock exchange. The latter depends on the probability of a good project succeeding, but I take into account the fact that a strategic stock exchange may list a bad project with probability x_t.

Investors are willing to finance the project if and only if $s(q_t, x_t)D \geq I$: the investment required is lower than the project's expected payoff.

Once the project's outcome is observed, investors update their beliefs about the stock exchange once again for the following period. Their beliefs are summarized in q_{t+1}^z which refers to the posterior probability that the stock exchange is truthful, given a prior probability q_t^0 and a realized outcome $z \in \{S, F, N\}$ where S, F and N refer respectively to the outcomes success, failure and not listing. If a strategic stock exchange lists a bad project with probability $x_t \in [0, 1]$ then

from Bayes' rule the investors' posterior beliefs are:

$$q_{t+1}^S = q_t^0,$$ (12)

$$q_{t+1}^F = \frac{q_t^0}{1 + (1 - q_t^0)\frac{(1-\alpha)x_t}{\alpha(1-p)}} \leq q_t^0,$$ (13)

and if $x_t < 1$, (14)

$$q_{t+1}^N = \frac{q_t^0}{1 - (1 - q_t^0)x_t}, \; if \; x_t < 1.$$ (15)

When the success outcome is observed, the stock exchange maintains its initial reputation, q_t^0. The success outcome is not informative because when faced with a good project, the strategy of both truthful and strategic stock exchanges is to list it. Conversely, failure decreases stock exchanges' reputation because of the probability that they will list a bad project x_t. Carried to its logical conclusion, when $x_t = 0$, there is no change in the stock exchange's reputation because the failure is not due to strategic behavior. If the project is not listed, and $x_t = 1$ then the outcome N is a zero-probability event and it is not well-defined: $q_{t+1}^N = 0$.

Table 1 summarizes the notations.

[insert **Table 1** here]

An equilibrium consists of the optimal choices at each period by the stock exchange about its strategy when faced with a bad project that maximizes profits, and by investors on whether to invest. I look for a Markov perfect equilibrium which is defined as follows:

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Definition 1. *A Markov perfect equilibrium is a couple (x_t, q_{t+1}) such that for all q_t:*

$$
\begin{cases}
(i) \ x_t \ \text{maximizes the profit of the stock exchange.} \\[1ex]
(ii) \ \text{Investors rationally update their beliefs using Bayes' rule.} \\[1ex]
(iii) \ q_{t+1}^N = 0 \ \ \text{if} \ x_t = 1.
\end{cases}
$$

To determine the strategy of a strategic stock exchange, I describe its value function before observing the project quality, $V_t(q_t)$. To simplify expressions, I introduce the following notation:

$$
V_t = V_t(q_t),
$$

where $V_t(q_t)$ is the stock exchange value function at time t, when its reputation is q_t. Implicitly, the fee is also a function of reputation that is $f_t = f(q_t)$. When a stock exchange has a reputation q_t, playing the strategy x_t and investors have posterior beliefs q_{t+1}^z, its value function is:

$$
V_t(q_t) = \alpha \underbrace{\left[f(q_t) + \delta \{ p V_{t+1}(q_{t+1}^S) + (1-p) V_{t+1}(q_{t+1}^F) \} \right]}_{\text{Profits from listing a good project}}
$$

$$
+ (1-\alpha) x_t \underbrace{\left[f(q_t) + \delta V_{t+1}(q_{t+1}^F) \right]}_{\text{Profits from listing a bad project}}
$$

$$
+ (1-\alpha)(1-x_t) \underbrace{\delta V_{t+1}(q_{t+1}^N).}_{\text{Profits from not listing a bad project}} \tag{16}
$$

One can see from equation (16) that an increase in the probability x_t of cheating,

leads to an increase in the contemporaneous gain and a decrease in the discounted future gain, due to a fall in reputation and its impact on investors' trading. Therefore, whenever the project is bad, a strategic stock exchange faces a trade-off between short-term profits and reputation. By contrast, the value function $W_t(q_t)$ of the truthful exchange is:

$$W_t(q_t) = \alpha \underbrace{\left[f(q_t) + \delta\{pV_{t+1}(q_{t+1}^S) + (1-p)V_{t+1}(q_{t+1}^F)\}\right]}_{\text{Profits from listing a good project}} + (1-\alpha) \underbrace{\delta V_{t+1}(q_{t+1}^N)}_{\text{Profits from not listing a bad project}}. \qquad (17)$$

Comparing equations (16) and (17), one can see that the value function of a strategic exchange exceeds the one of the truthful exchange because of the probability of listing a bad project and receiving the listing fee.

3.2 Equilibrium

I now present the equilibrium. I solve the model backwards and present an analytical solution in period 2 and period 1. In principle, stock exchanges operate for longer periods but assuming two periods makes the analysis more tractable while still capturing the effect of reputation.

3.2.1 Last period $T=2$

In the last period, that is $T = 2$, the game ends and stock exchange no longer cares about its reputation.

Lemma 4. *At period $T = 2$, the equilibrium strategy is $x_2^* = 1$.*

At period $T = 2$, the strategic stock exchange has no reputational concerns. If the project is bad then the strategic stock exchange will still list it and get the fees, $x_2^* = 1$.

In the absence of reputational concerns, a strategic stock exchange will always list a project even if it is a bad one. In this case, being truthful means that the stock exchange gives up the listing fee in the short term. Thus, if the model lasts one period, the optimal strategy of a strategic stock exchange faced with a bad project is to list it.

The fee received at period $T = 2$ equals:

$$f(q_2) = \frac{\alpha p - \alpha(1 - p) - (1 - \alpha)(1 - q_2)}{\alpha p} I. \tag{18}$$

The fee is increasing with reputation q_2. To understand the mechanism, one has to observe Equation (4). Repayment D, that investors demand after a listing, decreases with the stock exchange's reputation. This is because when reputation increases, the listing is less likely to represent a strategic behavior of the stock exchange; for the same reason the probability of the project's success $s(q_2, x_2)$ increases. As a result, the stock exchange acts to maximize reputation in order to maximize fees.

Finally, the value function at the end of the game is simply the payoff received

at period $T = 2$, that is:

$$V_2^* = (1 - \alpha)f(q_{2F}).$$ (19)

This payoff will be used by the stock exchange at period $t = 1$.

3.2.2 Period 1

At period $T = 2$, a strategic stock exchange will always list a bad project as showed in Lemma 4. I derive the equilibrium strategy at $t = 1$ by backward induction. From equation (16), the value function of a strategic stock exchange at $t = 1$, faced with a bad project simplifies to:

$$V_1(q_1) = (1 - \alpha)\{x_1[f(q_1) + \delta f(q_2^F)] + (1 - x_1)\delta f(q_2^N)\}.$$ (20)

When faced with a bad project, a strategic stock exchange compares the value function from being truthful to that of being strategic in order to maximize its profits. The fee at $t = 1$ becomes:

$$f(q_1) = \frac{\alpha p - \alpha(1 - p) - (1 - \alpha)(1 - q_1)x_1}{\alpha p} I.$$ (21)

Proposition 1 follows.

Proposition 1. *The equilibrium strategy at $t = 1$ is*

$$
x_1^* = \begin{cases}
0 & \text{if } \quad q_2^F \leq 1 - \frac{\alpha p - \alpha(1-p)}{\delta(1-\alpha)} \ , \\[3ex]
\frac{\alpha p - \alpha(1-p) - \delta(1-\alpha)(1-q_2^F)}{(1-\alpha)(1-q_1)} & \text{if } \quad 1 - \frac{\alpha p - \alpha(1-p)}{\delta(1-\alpha)} \ < q_2^F < 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)}, \\[3ex]
1 & \text{if } \quad q_2^F \geq 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)},
\end{cases}
$$

where $q_2^F = \frac{q_1}{1 + (1-q_1)\frac{(1-\alpha)x_1}{\alpha(1-p)}}$.

Proposition 1 implies that the stock exchange's strategy towards a bad project at $t = 1$, depends on investors' posterior belief when outcome failure q_2^F is observed at $T = 2$ and implicitly on stock exchange's reputation q_1. When q_2^F is high, reputation costs are low and a stock exchange is more likely to take advantage of short-term profits by listing a bad project. Conversely, when q_2^F is low, the reputation costs are high, and a strategic stock exchange is more likely to tell the truth by not listing a bad project thereby creating information for investors. In intermediary situations, a strategic stock exchange has a mixed strategy as $0 < x_1^* < 1$. Corollary 1 follows.

Corollary 1. *In equilibrium, x_1^* is increasing in q_1.*

The probability for a strategic stock exchange to list a bad project tends to increase with reputation. This is because the cost of lying decreases when reputation increases, since investors impute failure to an unsuccessful good project rather than to listing a bad project.

Notice that since $p < 1$, when there is failure, investors cannot know for sure whether this results from the failure of good project, or from the listing of a bad

project. This gives rise to potential strategic behavior from the stock exchange since failure may be an equilibrium even for a truthful stock exchange. So as long as q_0 is high, q_2^F is high, a stock exchange's future gain is hardly contingent on its actual strategy so it has an incentive to lie in order to maximize its present revenue. This also implies that stock exchange reputation fluctuates since failure could also come from a truthful stock exchange.

In sum, even if reputation costs create incentives for stock exchanges to tell the truth, the credibility argument does not hold and reputation is not sufficient to discipline strategic behavior of a monopolistic stock exchange.

4 Competition

4.1 The extended model

Regulators often believe that competition acts as a disciplinary device on stock exchanges behavior. In this section, I examine this argument by extending the model to the game where two stock exchanges compete at each period to list the project.

Competition is modeled as follows. Consider the framework presented in Section 2 and assume that stock exchange, now denoted by A, faces competition from stock exchange B. The issuer can approach only one of the stock exchanges. The probability that a stock exchange is chosen in fact depends on its reputation

and on the listing fee paid by the issuer. The type of each stock exchange is unknown except by the stock exchange itself. Issuer and investors put probability $q_{i,t}$, $i \in \{A, B\}$ on *stock* exchange i being truthful and $(1 - q_{i,t})$ on its being strategic.

The strategy of stock exchange A becomes $x_t(q_{A,t}|q_{B,t})$, the probability that stock exchange A will list a bad project, when its reputation is $q_{A,t}$ and its competitor's reputation is $q_{B,t}$. For simplicity, I will write $x_{A,t} = x_t(q_{A,t}|q_{B,t})$.

Investors have prior beliefs about stock exchange i, $q_{i,t}^0$. They update their beliefs conditionally first on the listing decision and second on the projects outcome. Investors' posterior beliefs about the stock exchange are computed as in the monopolistic case.

Each stock exchange has an initial reputational level that for simplicity is the same for both stock exchanges, $q_{A,t}^0 = q_{B,t}^0$. In this case, both stock exchanges are identical ex-ante and the issuer is equally likely to hire either of them at period t. At period $t+1$, the reputational level of the stock exchange approached at period t is updated as before, and the reputational level of the competitor remains equal to $q_{i,t}^0$.

In this case, two scenarios arise:

1. If $\forall i \in \{A, B\}$, $I \le s(q_{i,t}, x_{i,t})D$, the issuer will randomly choose one of the stock exchanges, i.e. the project goes to both stock exchanges with equal probability.

2. If $\forall i \in \{A, B\}$, $I > s(q_{i_t}, x_{i_t})D$, the project does not get financed.

The probability that the issuer approaches stock exchange A and not its competitor for a listing at period t equals:

$$\pi_A = \pi(q_{A,t}|q_{B,t}) = \frac{\frac{1}{2}(s(q_{A,t}, x_{A,t}) - \alpha p)}{(1 - \alpha)p}. \tag{22}$$

The probability $\pi(q_{A,t}|q_{B,t})$ depends on the stock exchange and its competitor's reputation reputations. Thus, fees will also depend on $q_{A,t}$ and $q_{B,t}$, that is $f(q_{A,t}) = f(q_{A,t}|q_{B,t})$.

Figure 2 illustrates the tree of outcomes as a function of A and B's strategies..

[insert **Figure 2** here]

Suppose that the issuer chooses to be listed on stock exchange A. If the stock exchange A is truthful then it will list only the good project. However, if it is strategic, then its strategy depends on the project quality. If the project is good, we have seen that it will always be listed. If the project is bad, the stock exchange decides whether to list it thus obtaining the fees, or refuse the listing. If it lists the bad project, its reputation falls when the failure outcome is observed $q_{A,t+1}^F < q_{A,t}^0$. If it refuses the listing $x_{A,t} = 0$, its reputation rises because it will obtain greater market share in the future. A similar analysis holds for stock exchange B if it is approached for a listing.

To determine the strategy of a strategic stock exchange, I describe its profits

before observing the project quality. $V_t(q_{A_t}|q_{B_t})$ is the value function of stock exchange A; this denotes its discounted future profits given its reputation q_{A_t} and its competitor's reputation q_{B_t}. The value function of stock exchange A before observing the project type is:

$$
\begin{aligned}
V_t(q_{A_t}|q_{B_t}) = \pi_A \Big\{ &\underbrace{\alpha\{f(q_{A,t}|q_{B,t}) + \delta[pV_{t+1}(q^S_{A_{t+1}}|q_{B_{t+1}}) + (1-p)V_{t+1}(q^F_{A_{t+1}}|q_{B_{t+1}})]\}}_{\text{Profits from listing a good project}} \\
&+ \underbrace{(1-\alpha)x_{A_t}\{f(q_{A,t}|q_{B,t}) + \delta V_{t+1}(q^F_{A_{t+1}}|q_{B_{t+1}})\}}_{\text{Profits from listing a bad project}} \\
&+ \underbrace{(1-\alpha)(1-x_{A_t})\delta V_{t+1}(q^N_{A_{t+1}}|q_{B_{t+1}})}_{\text{Profits from not listing a bad project}} \Big\} \\
&+ (1-\pi_A)\Big\{\alpha\{\delta[pV_{t+1}(q_{A_{t+1}}|q^S_{B_{t+1}}) + (1-p)V_{t+1}(q_{A_{t+1}}|q^F_{B_{t+1}})]\} \\
&+ (1-\alpha)[(1-q_B)x_{B_t}\delta V_{t+1}(q_{A_{t+1}}|q^F_{B_{t+1}}) + (q_{B_t} + (1-q_{B_t})(1-x_{B_t}))\delta V_{t+1}(q_{A_{t+1}}|q^N_{B_{t+1}})]\Big\}.
\end{aligned}
$$

$$(23)$$

Comparing this with the monopolistic case, in its value function, the stock exchange now has to take into account the fact that the project may be listed by the competitor, thus implicitly it has to take account of its competitors reputation. Indeed, there is a probability that the issuer will approach the competitor. In this case, the fee is received by stock exchange B, stock exchange A is only affected through a change in its competitor's reputation.

Regarding the investors, they obtain the promised repayment as in the monopolistic case (equation 3). However, the listing fee is calculated in a different

26

way. The process that generates the fee is similar to the one that generates the price in a Bertrand model. Assuming that stock exchange A is approached, the issuer's expected profit equals: $Pr(L_A|S)(1 - D_A) - f(q_A)$,

where $Pr(L_A|S)$ is the probability that the project listed by stock exchange A succeeds. To accept the listing in stock exchange A, the issuer's profit should be at least equal to that made by approaching stock exchange B, that is: $Pr(L_B|S)(1 - D_B) - f(q_B)$.

For stock exchange A to be approached, the following condition must hold:

$$Pr(L_A|S)(1 - D_A) - f(q_A) \geq Pr(L_B|S)(1 - D_B) - f(q_B), \qquad (24)$$

that is the issuer's expected profit from approaching stock exchange A is higher than its expected profit if he approaches stock exchange B. Thus, to be attractive, stock exchange A should set a fee such that the issuer will still approach stock exchange A whatever the competitor's fee. In this case, the fee f_A is such that:

$$Pr(L_A|S)(1 - D_A) \geq Pr(L_B|S)(1 - D_B). \qquad (25)$$

Thus, compared with the monopolistic case (equation 4), when setting its listing fee, the stock exchange now has to take into account the fee set by its competitor in order to maintain its attractiveness. Using equation (5), the fee at time t can

be written as:

$$f(q_A) = \frac{Pr(S)[Pr(L_A|S) - Pr(L_B|S)] - Pr(F)[Pr(L_A|F) - Pr(L_B|F)]}{Pr(S)}I, \quad (26)$$

where S refers to the outcome success and F refers to the outcome failure.

4.2 Equilibrium

I now present an analytical solution backwards. I solve the model numerically in period 2 then in period 1.

4.2.1 Last period $T{=}2$

Let A be the stock exchange approached by the issuer at the last period $T = 2$. Following the same argument as in the monopolistic case, this stock exchange always lists a bad project at this period due to the absence of reputational concerns. Therefore, from equation (26), the fee paid by the issuer to the stock exchange is:

$$f(q_{A,2}|q_{B,2}) = \frac{-(1-\alpha)[(1 - q_{A,2}) - (1 - q_{B,2})x_{B,2}]}{\alpha p}I. \quad (27)$$

since $x_{A_2} = 1$ at period $T = 2$.

Now, the stock exchange not only wants to maximize its reputation in order to increase the fee, but also needs to keep a reputational level higher than its

competitor in order to be approached at this period. This is the disciplinary device that stock exchanges mentioned to regulators.

The value function at the end of the game is simply the payoff received at period $T = 2$, that is:

$$V_2(q_{A,2}|q_{B,2}) = (1 - \alpha)f(q^F_{A,2}|q_{B,2}). \tag{28}$$

This payoff will be used by the stock exchange at period $t = 1$.

4.2.2 Period 1

Let's examine the equilibrium strategy at $t = 1$. At period $T = 2$, the strategic stock exchange will always list a bad project. At $t = 1$, the expected payoff for the strategic stock exchange towards a bad project is:

$$
\begin{aligned}
V_1(q_{A,1}|q_{B,1}) = (1 - \alpha)\pi_A \Big\{ & x_{A,1}[f(q_{A,1}|q_{B,1}) + \delta.V_2(q^F_{A,2}|q_{B,2})] \\
& + (1 - x_{A,1}).\delta.V_2(q^N_{A,2}|q_{B,2}) \Big\} \\
& + (1 - \alpha)(1 - \pi_A) \Big\{ [(1 - q_{B,1})x_{B,1}.\delta.V_2(q_{A,2}|q^F_{B_2})] \\
& + [(q_{B,1} + (1 - q_{B,1})(1 - x_{B,1})).\delta.V_2(q_{A,2}|q^N_{B,2})] \Big\}.
\end{aligned}
\tag{29}
$$

The listing fee becomes:

$$f(q_{A,1}|q_{B,1}) = \frac{-(1-\alpha)[(1-q_{A,1})x_{A,1} - (1-q_{B,1})x_{B,1}]}{\alpha p} I. \tag{30}$$

The fee still increases in q_{A_1} and decreases in q_{B_1}. Therefore, the stock exchange not only has to maximize its reputation but also needs to maintain a higher reputation that that of its competitor's.

Proposition 2 follows.

Proposition 2. *The equilibrium strategy at $t = 1$ is*

$$x^*(q_{A,1}|q_{B,1}) = \begin{cases} 0 & if \quad q_{A,2}^F \leq 1 + C - (1-q_{B,2})x_{B,2} \ , \\[2mm] \frac{(1-q_{B,1})x_{B,1} - \delta.f(q_{A,2}^F|q_{B,2})[(1-q_{A,2}^F)-(1-q_{B,2})x_{B,2}] - \delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2}}{(1-q_{A,1})} & \\[2mm] \quad if \ 1 + C - (1-q_{B,2})x_{B,2} \ < q_{A,2}^F < 1 + \frac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + C - (1-q_{B,2})x_{B,2}, \\[2mm] 1 & if \quad q_{A,2}^F \geq 1 + \frac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + C - (1-q_{B,2})x_{B,2}, \end{cases}$$

where $C = \frac{\delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2} - (1-q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})}.$

Proposition 2 implies that the strategy of stock exchange A depends both on its own and on its competitor's reputation. When $q_{A,2}^F$ is high, stock exchange A always lists a bad project. The equilibrium strategy in this case is a pure strategy, $x^*(q_{A,1}|q_{B,1}) = 1$. Conversely, when $q_{A,2}^F$ is low, a strategic stock exchange does not list a bad project. The equilibrium in this case is a pure strategy in which $x^*(q_{A,1}|q_{B,1}) = 0$. In the intermediate range, a strategic stock exchange has a

mixed strategy as $0 < x^*(q_{A,1}|q_{B,1}) < 0$ since there is no difference between listing or not listing a bad project.

Corollary 2. *In equilibrium, $x^*_{A,1}$ is increasing in $q_{A,1}$ and decreasing in $q_{B,1}$.*

The results imply that strategic stock exchange tends to lie more when its reputation increases and to behave more truthfully when its competitor's reputation increases. Indeed, when competitor's reputation increases, the issuer could be more tempted to approach the competitor, thus in order to maintain its market leader position and market share, incumbent stock exchange tries to behave truthfully.

In summary, competition has two opposing effects on strategic behavior: a short term effect and a disciplinary effect. In terms of the short term effect, a stock exchange prefers to list a bad project in order to receive fees today, since any future expected income will be shared with its competitor. As for the disciplinary effect, a stock exchange prefers to act honestly as this is more attractive than lying in order to maintain its market leader advantages.

However, reputation concerns do not avoid strategic behavior, and this strategic behavior still occurs whenever stock exchanges are in competition for listing.

5 Monopoly vs Competition

In this section, I compare monopoly and competition in terms of manipulation and welfare. Indeed, it is often suggested that introducing more competition in

the stock exchange industry can alleviate the problem of improper incentives and strategic behavior.

5.1 Manipulation

First, I examine whether any benefits can arise from competition in terms of reputational concerns, by comparing stock exchange strategy in the case of competition, $x(q_{A,1}|q_{B,1})$ with that of a monopoly, $x(q_{A,1}|0)$ at period $t = 1$:

$$\text{Excess manipulation of A} = x(q_{A,1}|q_{B,1}) - x(q_{A,1}|0). \tag{31}$$

A positive value of this measure means that the strategic stock exchange tends to lie more in a competitive environment.

Corollary 3. *A strategic stock exchange is more likely to list a bad project in the competitive environment whenever $q_{A,2}^{F} > q_2^{F}$.*

At equilibrium, the expression $q_{A,2}^{F} > q_2^{F}$ holds whenever $p > \frac{1}{2}$ and $(1 - q_{A,1}) > (1 - q_{B,1})x_{B,1}$. The excess manipulation of the strategic stock exchange in competition depends on the probability of project success and on the reputation of the incumbent stock exchange and its competitor. In particular, competition leads to laxer behavior than monopoly when the reputation of the approached stock exchange is higher than that of its competitor.

5.2 Welfare

Second, I analyze the expected welfare under monopoly and competition to see which cases result in a welfare gain when a stock exchange exists. Notice that expected welfare includes the total surplus of both issuer and investors.

5.2.1 Monopolistic case

Let us denote $x_{M,t}$ the strategy of the monopolistic stock exchange which is strategic faced with a bad project. Under monopoly, the expected welfare is:

$$EW_M = \alpha(p - I) - (1 - \alpha)x^*_{M,t}I, \tag{32}$$

where the subscript M refers to the monopoly case. When the stock exchange could be strategic, account must be taken of its strategy $x_{M,t}$ that is the probability of listing a bad project in order to maximize its profits.

Comparing expected welfare when the stock exchange could be strategic to the incomplete information case in which no stock exchange exists, we have:

$$EW_M - EW_0 = (1 - \alpha)(1 - x^*_{M,t})I. \tag{33}$$

At equilibrium, proposition (1) shows that $x^*_{M,t}$ can take three values. If $x^*_{M,t} = 0$, we reach the first best since the stock exchange acts truthfully. In this case, there is a welfare gain thanks to the certification role of listing since only good projects

are listed. By contrast, if $x^*_{M,t} = 1$, there is no room for welfare improvement by the stock exchange. Intuitively, this is even worse than the case with no stock exchange since untruthful behavior leads participants to erroneously list a bad project while certifying it to be a good one. Finally, if $0 < x^*_{M,t} < 1$, there is a welfare gain compared to the incomplete information case since the probability of listing a bad project is lower than 1.

5.2.2 Competition

Consider now that stock exchange A is approached by the issuer. The expected welfare at each period is:

$$EW_D = \alpha(p - I) - (1 - \alpha)x^*(q_{A,t}|q_{B,t})I, \tag{34}$$

where subscript D refers to the duopoly. In this case, when faced with a bad project, a strategic stock exchange choosing strategy $x^*(q_{A,t}|q_{B,t})$ has to take account of its competitor's reputation.

5.3 Comparison

In order to see whether competition yields benefits in term of welfare compared to monopoly, I compare the expected welfare in presence of a strategic stock

exchange in both cases at period $t = 1$:

$$EW_D^S - EW_M^S = (1 - \alpha)I[x_{M,1}^* - x^*(q_{A,1}|q_{B,1})], \tag{35}$$

where superscript S refers to strategic behavior.

Corollary 4. *Strategic behavior in competition worsens welfare compared with strategic behavior in monopoly.*

Competition may reduce welfare when $q_{A,2}^F > q_2^F$ which holds whenever $p > \frac{1}{2}$ and $(1 - q_{A,1}) > (1 - q_{B,1})x_{B,1}$.

In general, competition could be thought to have a disciplinary effect on the strategic behavior of stock exchanges by increasing incentives to behave truthfully to maintain market share. However, results show that competition may actually increase strategic behavior compared with the monopolistic case when the incumbent stock exchange's reputation under competition exceeds its reputation under monopoly.

6   Conclusion and policy implications

This paper has two main implications for policy. The first relates to the incompatibility between certification and profit-maximization in the financial industry. In particular, the paper concludes that greater regulatory intervention is needed for a stock exchange that is self-regulated, profit-maximizing and that sets listing

standards. Regarding this situation, Jeffrey Garten, Dean of the Yale School of Management, declares :

> "If the exchange goes public, its self-regulating authority would create huge conflicts of interest between the Big Board's legitimate mandate to enrich its shareholders by attracting new listings, and the requirement to regulate many of those same shareholders as they trade on the exchange's floor. A second conflict would arise in setting listing requirements for new companies, as there would be a temptation to dilute standards or relax surveillance over them in order to sign up more corporate clients. A far better option is to strip the exchanges of most of their regulatory authority and to create one independent national self-regulating body. It could apply uniform standards on all market participants."[13]

In fact, conflicts between public and private interests may arise when stock exchanges act in their shareholders' interest by maximizing shareholder value at the expense of undertaking regulatory duties in the public interest. A company which aims to maximize profits and dividends for its shareholders, is tempted to commercialize services and charge fees for selling data and trade information that has traditionally been offered free of charge. In this context, the Australian Stock Exchange came under severe criticism in its inquiry about over-selling the

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[13]Source: "How to Keep NYSE's Stock High," Wall Street Journal, January 11, 2000. A somewhat similar proposal was also endorsed by former SEC chairman Arthur Levitt (see, e.g., "SEC seeks One Market Regulator," Washington Post, Sept 22, 1999).

range of all ordinaries index, (Akhtar, 2002). It has also been proven that a profit-maximizing exchange has less incentive to take enforcement action against customers and users, who are a source of future income. For example the Chicago Stock Exchange (CHX) failed to implement surveillance procedures to prevent abuse of the validated cross system.[14]

Moreover, many assessors believe that a profit-maximizing stock exchange is hopelessly self-interested and therefore unable to carry out serious regulation. DeMarzo et al. (2001) show that stock exchanges organized as self-regulatory organizations tend to choose a laxer enforcement policy with less frequent investigations and lower penalties. Pescatori and Caglio (2013) mention that the evolution of market centers from mutual-ownership to profit-driven competitors has raised concerns that the conflict of interest between their regulatory function and their business operations could trigger a race to the bottom in market surveillance in order to attract trading activity and minimize regulatory costs. Consequently, assessors quickly tend to reach the conclusion that regulation must be removed from the profit-maximizing exchange.

The second implication of this paper is about competition among stock exchanges. In particular, the model shows that when two stock exchanges compete

---

[14]"From December 2006 to December 2010, CHX failed to implement policies and procedures reasonably designed to detect and prevent violations of the order protection rule, in connection with the use of the exchange's proprietary validated cross trade reporting functionality[...] Moreover, from at least December 2006 to August 2008, CHX failed to implement surveillance procedures reasonably designed to monitor or enforce IB compliance with the exchange's rules governing the use of the validated cross system." Securities Exchange Act Release, August 15, 2013.

for listing, the quality of the certification role is penalized. Consequently, there is a crucial need to increase resources devoted to monitoring activity, charging penalties in case of misconduct and dissuading these bodies from deceiving investors.

In sum, while additional competition from new platforms is emerging, listing services present an opportunity for stock exchanges to differentiate themselves from these trading platforms, since such platforms do not offer these services. Listing services are also important to maintain the pricing information necessary for data sales (another important revenue stream for stock exchanges). Therefore, rigorous listing requirements may present an important differentiator for stock exchanges seeking to protect their reputation.

A. Appendix

A.1. *Equations (9)-(10)*

Equation (9): $q_t^{NotListed} = \frac{(1-\alpha)q_t^0}{(1-\alpha)q_t^0+(1-\alpha)(1-q_t^0)(1-x_t)} = \frac{q_t^0}{1-x_t(1-q_t^0)}$.

Equation (10): $q_t^{Listed} = \frac{\alpha q_t^0}{\alpha q_t^0+\alpha(1-q_t^0)+(1-\alpha)(1-q_t^0)x_t} = \frac{\alpha q_t^0}{\alpha+(1-\alpha)(1-q_t^0)x_t}$.

A.2. *Equations (12)-(13)*

Equation (12): $q_{t+1}^S = Prob(q_t/S) = \frac{Prob(q_t\cap S)}{Prob(S)} = \frac{\alpha p q_t^0}{\alpha p q_t^0+\alpha p(1-q_t^0)} = q_t^0$.

Equation (13): $q_{t+1}^F = Prob(q_t/F) = \frac{Prob(q_t\cap F)}{Prob(F)} = \frac{\alpha(1-p)q_t^0}{\alpha(1-p)q_t^0+(1-q_t^0)(1-\alpha)x_t} = \frac{q_t^0}{1+(1-q_t^0)\frac{(1-\alpha)x_t}{\alpha(1-p)}}$.

A.3. Proof

The strategy of the strategic stock exchange faced with a good project is to list it.

Proof. Suppose that the strategic stock exchange gets a good project and that its strategy is y_t. Then, if:

- if $y_t = 1$, we have $f(q_t)\mathbb{1}_L + \delta V_{t+1}(q_{t+1}^F) > \delta V_{t+1}(q_{t+1}^N)$. If the stock exchange does not list a bad project, it will receive $\delta V_{t+1}(q_{t+1}^N)$, and $f(q_t)\mathbb{1}_L + \delta V_{t+1}(q_{t+1}^F)$ if it lists it.

  Since $f(q_t)\mathbb{1}_L + p\delta V_{t+1}(q_{t+1}^S) + (1-p)\delta V_{t+1}(q_{t+1}^F) \geq f(q_t)\mathbb{1}_L + \delta V_{t+1}(q_{t+1}^F) \geq \delta V_{t+1}(q_{t+1}^N)$, the strategic stock exchange does not want to deviate.

- if $y_t = 0$, $q_{t+1}^N = q_{t+1}^F = q_t$. Reputation in this case becomes irrelevant and

the strategic stock exchange does not have incentive to deviate and not list

a bad project.

- if $0 < y_t < 1$, we have $f(q_t)\mathbb{1}_L + \delta V_{t+1}(q^F_{t+1}) = \delta V_{t+1}(q^N_{t+1})$.

  Thus, $f(q_t)\mathbb{1}_L + p\delta V_{t+1}(q^S_{t+1}) + (1-p)\delta V_{t+1}(q^F_{t+1}) \geq f(q_t)\mathbb{1}_L + \delta V_{t+1}(q^F_{t+1}) = \delta V_{t+1}(q^N_{t+1})$. The strategic stock exchange does not want to deviate by not

  listing a good project.

This implies that a strategic stock exchange always lists a good project. This is

because it gets a lower payoff if it deviates by not listing a good project.[15]   □

A.4. Proof of Lemma 4

At period $T = 2$, the equilibrium strategy is $x^*_2 = 1$.

Proof. At period $T = 2$, the strategic stock exchange does not have any repu-

tational concerns. If the project is bad then the strategic stock exchange will

always list it and get the fees, $x^*_2 = 1$.   □

A.5. Proof of Proposition 1

The equilibrium strategy at $t = 1$ is

$$
x^*_1 = \begin{cases} 0 & \text{if } q^F_2 \leq 1 - \frac{\alpha p - \alpha(1-p)}{\delta(1-\alpha)}, \\ \frac{\alpha p - \alpha(1-p) - \delta(1-\alpha)(1-q^F_2)}{(1-\alpha)(1-q_1)} & \text{if } 1 - \frac{\alpha p - \alpha(1-p)}{\delta(1-\alpha)} < q^F_2 < 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)}, \\ 1 & \text{if } q^F_2 \geq 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)}. \end{cases}
$$

---

[15]This is true even if I allow for a no listing of a good project.

In addition, in equilibrium, x_1 is increasing in q_1.

Proof. Let's examine the equilibrium strategy at $t = 1$. At period, $T = 2$, the strategic stock exchange will always list a bad project. I derive the equilibrium strategy at $t = 1$. The expected payoff of the strategic stock exchange at $t = 1$, facing a bad project is:

$$V_1(q_1) = (1 - \alpha)\{x_1[f(q_1) + \delta V_2(q_2^F)] + (1 - x_1)\delta V_2(q_2^N)\}$$

$$= (1 - \alpha)\{x_1[f(q_1) + \delta f(q_2^F)] + (1 - x_1)\delta f(q_2^N)\}. \qquad (36)$$

While the value function of the truthful exchange is:

$$W_1(q_1) = (1 - \alpha)\delta V_2(q_2^N)$$

$$= (1 - \alpha)\delta f(q_2^N). \qquad (37)$$

Then I derive the exchange's maximization problem to x_1, to find its strategy at equilibrium:

$$\underset{0 \leq x_1 \leq 1}{\text{Max}} \quad x_1[f(q_1) + \delta f(q_2^F)] + (1 - x_1)\delta f(q_2^N). \qquad (38)$$

In equilibrium, the sign of:

$$f(q_1) + \delta f(q_2^F) - \delta f(q_2^N) = 0. \qquad (39)$$

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is positive(negative) when the strategic stock exchange lists a bad project (not list) and is equal to zero when the stock exchange is indifferent. The fee at $t = 1$ becomes:

$$f(q_1) = \frac{\alpha p - \alpha(1 - p) - (1 - \alpha)(1 - q_1)x_1}{\alpha p} I. \tag{40}$$

Substituting (40) in (39) and $x_2^* = 1$ when the outcome failure is observed and $x_2^* = 0$ when the project is not listed, we have:

$$\{\frac{\alpha p - \alpha(1 - p)}{\alpha p} - \frac{(1 - \alpha)}{\alpha p}[(1 - q_1)x_1 + \delta(1 - q_2^F)]\}I = 0. \tag{41}$$

Solving, I obtain:

$$x_1 = \frac{\alpha p - \alpha(1 - p) - \delta(1 - \alpha)(1 - q_2^F)}{(1 - \alpha)(1 - q_1)}, \tag{42}$$

for $0 < x_1 < 1$. This holds when $1 - \frac{\alpha p - \alpha(1 - p)}{\delta(1 - \alpha)} < q_2^F < 1 - \frac{\alpha p - \alpha(1 - p) - (1 - q_1)}{\delta(1 - \alpha)}$.

Clearly, x_1 is increasing in q_1. $\square$

A.6. Proof of Proposition 2

The equilibrium strategy at $t = 1$ is

$$
x^*(q_{A,1}|q_{B,1}) = \begin{cases}
0 & \text{if } q_{A,2}^F \leq 1 + C - (1 - q_{B,2})x_{B,2}, \\[2mm]
\dfrac{(1-q_{B,1})x_{B,1} - \delta.f(q_{A,2}^F|q_{B,2})[(1-q_{A,2}^F)-(1-q_{B,2})x_{B,2}] - \delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2}}{(1-q_{A,1})} & \\[2mm]
\quad \text{if } 1 + C - (1 - q_{B,2})x_{B,2} \;<\; q_{A,2}^F < 1 + \dfrac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + C - (1 - q_{B,2})x_{B,2}, \\[2mm]
1 & \text{if } q_{A,2}^F \geq 1 + \dfrac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + C - (1 - q_{B,2})x_{B,2},
\end{cases}
$$

where $C = \dfrac{\delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2} - (1-q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})}$.

In addition, in equilibrium, $x_{A,1}^*$ is increasing in increasing in $q_{A,1}$ and decreasing in $q_{B,1}$.

Proof. Let's examine the equilibrium strategy ar $t = 1$. At period, $T = 2$, the strategic stock exchange will always list a bad project. I derive the equilibrium strategy at $t = 1$. The expected payoff of the strategic stock exchange at $t = 1$,

facing a bad project is:

$$V_1(q_{A,1}|q_{B,1}) = (1-\alpha)\pi_A\Big\{x_{A,1}[f(q_{A,1}|q_{B,1}) + \delta.V_2(q_{A,2}^F|q_{B,2})]$$

$$+ (1-x_{A,1}).\delta.V_2(q_{A,2}^N|q_{B,2})\Big\}$$

$$+ (1-\alpha)(1-\pi_A)\Big\{[(1-q_{B,1})x_{B,1}.\delta.V_2(q_{A,2}|q_{B_2}^F)]$$

$$+ [(q_{B,1} + (1-q_{B,1})(1-x_{B,1})).\delta.V_2(q_{A,2}|q_{B,2}^N)]\Big\}$$

$$= (1-\alpha)\pi_A\Big\{x_{A,1}[f(q_{A,1}|q_{B,1}) + \delta.f_2(q_{A,2}^F|q_{B,2})]$$

$$+ (1-x_{A,1}).\delta.f_2(q_{A,2}^N|q_{B,2})\Big\}$$

$$+ (1-\alpha)(1-\pi_A)\Big\{[(1-q_{B,1})x_{B,1}.\delta.f_2(q_{A,2}|q_{B_2}^F)]$$

$$+ [(q_{B,1} + (1-q_{B,1})(1-x_{B,1})).\delta.f_2(q_{A,2}|q_{B,2}^N)]\Big\}. \qquad (43)$$

While the value function of the truthful exchange is:

$$W_1(q_{A,1}|q_{B,1}) = (1-\alpha)\pi_A\Big\{\delta.V_2(q_{A,2}^N|q_{B,2})\Big\}$$

$$+ (1-\alpha)(1-\pi_A)\Big\{[(1-q_{B,1})x_{B,1}.\delta.V_2(q_{A,2}|q_{B_2}^F)]$$

$$+ [(q_{B,1} + (1-q_{B,1})(1-x_{B,1})).\delta.V_2(q_{A,2}|q_{B,2}^N)]\Big\}$$

$$= (1-\alpha)\pi_A\Big\{\delta.f_2(q_{A,2}^N|q_{B,2})\Big\}$$

$$+ (1-\alpha)(1-\pi_A)\Big\{[(1-q_{B,1})x_{B,1}.\delta.f_2(q_{A,2}|q_{B_2}^F)]$$

$$+ [(q_{B,1} + (1-q_{B,1})(1-x_{B,1})).\delta.f_2(q_{A,2}|q_{B,2}^N)]\Big\}.$$

$$. \qquad (44)$$

In equilibrium, the sign of:

$$f(q_{A,1}|q_{B,1}) + \delta.f(q_{A,2}^F|q_{B,2}) - f(q_{A,2}^N|q_{B,2}) = 0. \tag{45}$$

is positive(negative) when the strategic stock exchange lists a bad project (not list) and is equal to zero when the stock exchange is indifferent.

The fee at $t = 1$ becomes:

$$f(q_{A,1}|q_{B,1}) = \frac{-(1-\alpha)[(1-q_{A,1})x_{A,1} - (1-q_{B,1})x_{B,1}]}{\alpha p} I. \tag{46}$$

Substituting (46) in (45) and $x_{A_2}^* = 1$ when the outcome failure is observed and $x_{A_2}^* = 0$ when the project is not listed, we have:

$$\frac{-(1-\alpha)[(1-q_{A,1})x_{A,1} - (1-q_{B,1})x_{B,1}]}{\alpha p}.I$$
$$+ \delta.f(q_{A,2}^F|q_{B_2})\frac{-(1-\alpha)[(1-q_{A,2}^F) - (1-q_{B,2})x_{B,2}]}{\alpha p}.I$$
$$- \delta f(q_{A,2}^N|q_{B,2})\frac{(1-\alpha)(1-q_{B,2})x_{B,2}}{\alpha p}.I = 0 \tag{47}$$

Solving, I obtain:

$$x(q_{A,1}|q_{B,1}) = \frac{(1-q_{B,1})x_{B,1} - \delta.f(q_{A,2}^F|q_{B,2})[(1-q_{A,2}^F) - (1-q_{B,2})x_{B,2}] - \delta.f(q_{A,2}^N|q_{B_2})(1-q_{B,2})x_{B,2}}{(1-q_{A,1})}$$

for $0 < x(q_{A,1}, q_{B,1}) < 1$.

This holds when $1 + C - (1 - q_{B,2})x_{B,2} < q_{A,2}^F < 1 + \frac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + C - (1-q_{B,2})x_{B,2}$.

Clearly, $x(q_{A,1}|q_{B,1})$ is increasing in $q_{A,1}$ and decreasing in $q_{B,1}$ $\qquad\square$

A.7. Proof of Corollary 3

A strategic stock exchange is more likely to list a bad project in the competitive environment whenever $q_{A,2}^F > q_2^F$.

Proof. The excess manipulation of A is

$$
x(q_{A,1}|q_{B,1}) - x(q_{A,1}|0)
$$
$$
= \frac{(1-q_{B,1})x_{B,1} - \delta.f(q_{A,2}^F|q_{B,2})[(1-q_{A,2}^F) - (1-q_{B,2})x_{B,2}] - \delta.f(q_{A,2}^N|q_{B_2})(1-q_{B,2})x_{B,2}}{(1-q_{A,1})}
$$
$$
- \frac{\alpha p - \alpha(1-p) - \delta(1-\alpha)(1-q_2^F)}{(1-\alpha)(1-q_1)}. \tag{49}
$$

That is:

- $x(q_{A_1}|q_{B_1}) = 1$ when
$$
q_{A,2}^F \geq 1 + \frac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + \frac{\delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2} - (1-q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})} - (1-q_{B,2})x_{B,2}.
$$

- $x(q_{A,1}|0) = 1$ when $q_2^F \geq 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)}$.

If $q_{A,2}^F - q_2^F > 0$ that is

$$
1 + \frac{(1-q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + \frac{\delta.f(q_{A,2}^N|q_{B,2})(1-q_{B,2})x_{B,2} - (1-q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})} - (1-q_{B,2})x_{B,2} > 1 - \frac{\alpha p - \alpha(1-p) - (1-q_1)}{\delta(1-\alpha)},
$$

then a strategic stock exchange is more likely to list a bad project in the competition than in monopoly.

This expression is positive whenever $p > \frac{1}{2}$ and $(1-q_{A,1}) > (1-q_{B,1})x_{B,1}$. $\qquad\square$

A.8. Proof of Corollary 4

Strategic behavior in competition worsens welfare compared with strategic behavior in monopoly.

Proof.

$$EW_S^D - EW_S = (1 - \alpha)I[x_M^* - x^*(q_{A,1}|q_{B,1})]. \tag{50}$$

The excess manipulation of A is

$$
\begin{aligned}
&x(q_{A,1}|q_{B,1}) - x(q_{A,1}|0) \\
&= \frac{(1 - q_{B,1})x_{B,1} - \delta.f(q_{A,2}^F|q_{B,2})[(1 - q_{A,2}^F) - (1 - q_{B,2})x_{B,2}] - \delta.f(q_{A,2}^N|q_{B_2})(1 - q_{B,2})x_{B,2}}{(1 - q_{A,1})} \\
&\quad - \frac{\alpha p - \alpha(1 - p) - \delta(1 - \alpha)(1 - q_2^F)}{(1 - \alpha)(1 - q_1)}.
\end{aligned} \tag{51}
$$

That is:

- $x(q_{A_1}|q_{B_1}) = 1$ when

$$q_{A,2}^F \geq 1 + \frac{(1 - q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + \frac{\delta.f(q_{A,2}^N|q_{B,2})(1 - q_{B,2})x_{B,2} - (1 - q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})} - (1 - q_{B,2})x_{B,2}.$$

- $x(q_{A,1}|0) = 1$ when $q_2^F \geq 1 - \frac{\alpha p - \alpha(1 - p) - (1 - q_1)}{\delta(1 - \alpha)}$.

If $q_{A,2}^F - q_2^F > 0$ that is

$$1 + \frac{(1 - q_{A,1})}{\delta.f(q_{A,2}^F|q_{B,2})} + \frac{\delta.f(q_{A,2}^N|q_{B,2})(1 - q_{B,2})x_{B,2} - (1 - q_{B,1})x_{B,1}}{\delta.f(q_{A,2}^F|q_{B,2})} - (1 - q_{B,2})x_{B,2} > 1 - \frac{\alpha p - \alpha(1 - p) - (1 - q_1)}{\delta(1 - \alpha)},$$

then a strategic stock exchange is more likely to list a bad project in the competition than in monopoly and $EW_S^D < EW_S$, the total surplus in the competitive

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case is lower than in the monopolistic case. This expression is negative whenever

$p > \frac{1}{2}$ and $(1 - q_{A,1}) > (1 - q_{B,1})x_{B,1}$. $\qquad\qquad\qquad\qquad\square$

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B. Figures
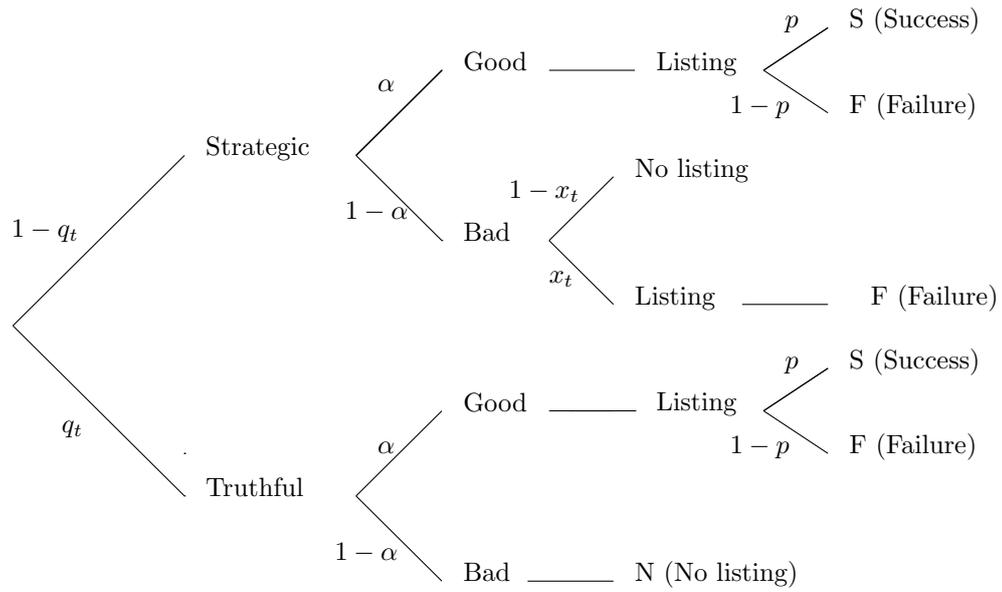
Figure 1: Decision tree for a strategic stock exchange.

I	Project cost.
$R = 1$	Project cash flow.
D	Repayment for investors.
α	Probability that the project is good.
p	Probability that a good project succeeds.
F	Listing fee.
δ	Discount factor.
q_t	Probability that a stock exchange is truthful.
x_t	Strategy of a strategic stock exchange when the project is bad.
$s(q_t, x_t)$	Probability that of success of the project when it is listed.

Table 1: Summary of notations
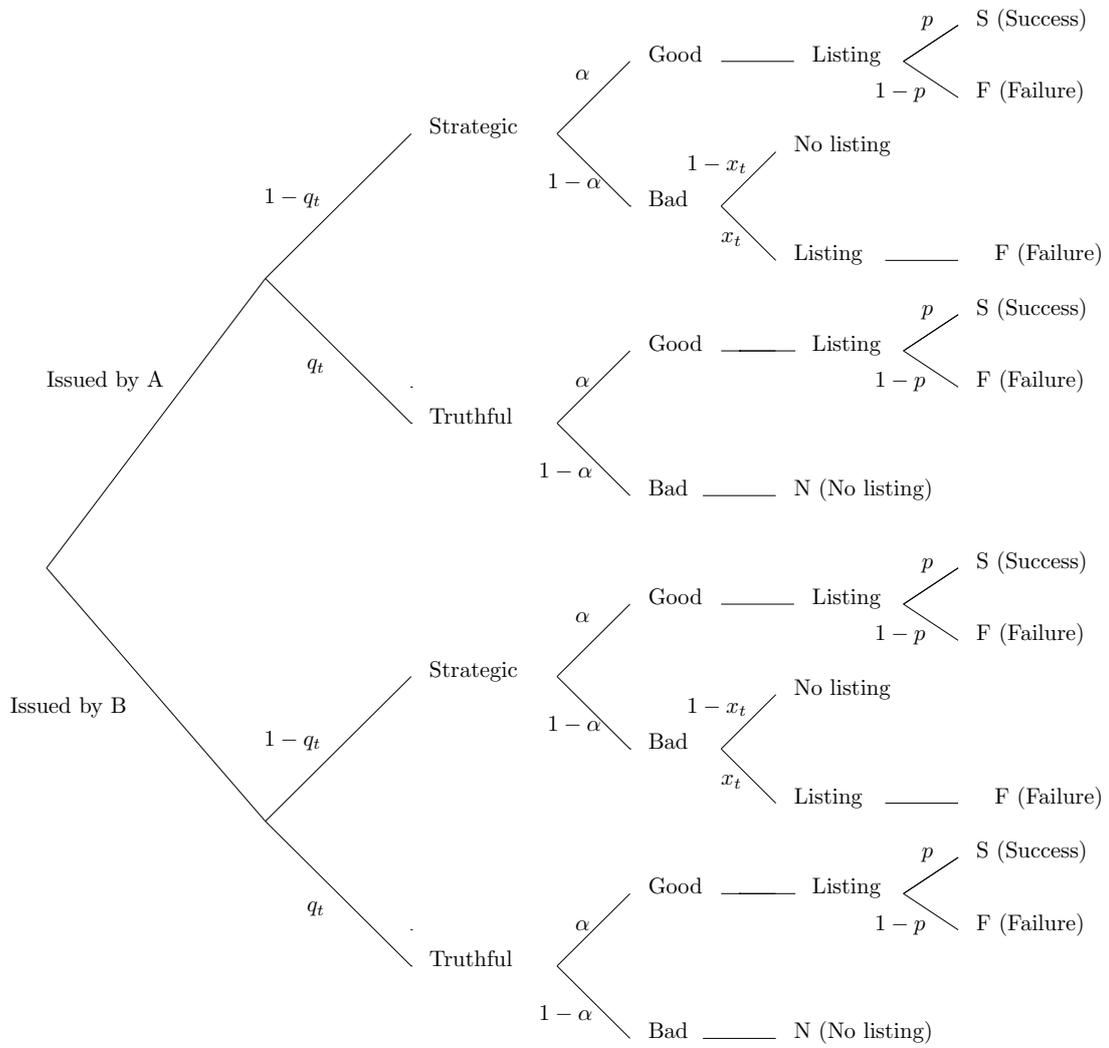
Figure 2: Decision tree for the strategic stock exchange A.