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The Certification Role of Listings

Sarah Draus

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University of Naples Federico II

University of Salerno

Bocconi University, Milan

CSEF - Centre for Studies in Economics and Finance
DEPARTMENT OF ECONOMICS – UNIVERSITY OF NAPLES
80126 NAPLES - ITALY
Tel. and fax +39 081 675372 – e-mail: csef@unisa.it – info@csef.it

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Abstract

The model developed in this chapter shows that differences in incentives of firms to list can have an impact on the decision of exchanges concerning the level of listing requirements they set, and on the gains obtained by firms when they list on an exchange with stringent listing requirements. When firms bear listing costs that are uncorrelated with their quality, changing the level of listing requirements or introducing additional segments with different listing requirements changes the distribution of listed firms and affects thereby indirectly the values of listed firms. This indirect effect can either enforce or weaken the direct impact of more precise information on the value of firms. If the difference in the incentives to list among firms of the same quality is small, the exchange might be induced to set a high level of listing requirements, which leads to a high information efficiency in the economy. If these differences are large, the exchange never sets a high level of listing requirements and efficiency is impeded.

JEL Classification: G10, G14

Keywords: listing, disclosure requirements, compliance costs

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* CSEF. Corresponding address: University of Naples Federico II, Department of Economics, Via Cinthia, Monte S. Angelo, 80126 Naples, Italy. E-mail: antonio.acconcia@unina.it

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1. Introduction

This chapter analyzes to what extent listing on a stock market can reduce information asymmetries between firms and investors. One important traditional function of exchanges has been to certify the quality of listed firms. Many stock markets list firms on the basis of listing requirements going from a minimum market capitalization to specific corporate governance standards. However, the stock market industry has undergone deep changes in the last decades. The reasons for these changes are mainly that competition among exchanges for volume and listings has sharpened and that exchanges have increasingly become demutualized and even listed companies. Today a debate is taking place on whether profit maximizing and competing exchanges will or even should continue to regulate listings. Also, while regulators tend to tighten listing requirements, exchanges increasingly create lightly regulated listing venues. Although some argue that certification is not compatible with profit maximization (Macey and O'Hara (2005)), others show that exchanges might set high listing requirements in equilibrium because this enhances their reputation (Chemmanur and Fulghieri (2006)), or increases liquidity (Huddart et al. (1999)). The present analysis complements this literature by analyzing how differences in listing incentives among firms of the same quality affect the listing decision of firms, and thereby the decisions about listing requirements taken by an exchange. It also explores the consequences of the existence of differently regulated segments on the listing choices of firms.

A large part of the literature in finance and in accounting has analyzed the benefits and costs of information disclosure and enhanced listing requirements. These papers find that firms might incur important costs, such as proprietary costs, when they disclose information. Costs related to the compliance with listing requirements also seem to play an important role in the listing decision of firms.[1] These costs are not necessarily related to the quality of firms but might depend on the institutional environment of firms, or on their internal organization and corporate habits. Such costs create different incentives for firms of the same quality to list on an exchange with stringent listing requirements. The present study analyzes the impact of

[1] See Bancel and Mittoo 2001, Baba and Yamori 2001, Houston and Jones 2002 and Mittoo 1992 for enquiries of managers form Canadian, European and Japanese firms having listed their firms in the US. The World Federation of Exchanges underlined in its « Disclosure Survey » for 2003 the necessity for regulators to take into account the costs created by regulations concerning listings.

this type of costs on the listing choices of firms as well as on the decision of a profit maximizing exchange on listing requirements.

In the present analysis we show that optimal listing requirements set by a profit maximizing exchange depend on how efficiently listing requirements reveal information about firms, which in turn depends strongly on the structure of the incentives of firms to list. Consider listing requirements which contribute to the revelation of information about the quality of the firm. All else equal, firms of a high quality always benefit from precise public information, since the information increases their expected market value. Firms of a low quality, in contrast, dislike precise public information, since it reduces their expected market value. Thus, if firms only differ in quality, good firms always prefer to list on an exchange with stringent enough listing requirements to deter bad firms from listing, as this reveals perfectly the type of good firms. If however, firms of both qualities differ in compliance costs, and if cost differences are uncorrelated to the quality of firms, good firms with high costs might be deterred from listing while bad firms with low costs would still list. In this case, changes in listing requirements alter the distribution of high quality and low quality firms that list. The valuation gains which firms obtain from listing depend not only on the level of listing requirements but also on the proportion of high quality firms among all listed firms on the exchange. The sorting of firms can either enforce or weaken the effect of listing requirements on the valuation of firms. If the sorting of firms enforces the effect of higher listing requirements, a profit maximizing exchange might be induced to set a high level of listing requirements leading to high information efficiency in the economy. If, however, the sorting of firms weakens the effect of high listing requirements, the highest level of listing requirements an exchange might choose in equilibrium is always smaller than in the previous case. As a consequence, the certification role of listings depends on the differences in the incentives of firms to list.

The model developed in this chapter has the following main ingredients: There is an exchange which sets listing requirements that firms must satisfy in order to list. The quality of firms is unknown to investors. Listing requirements allow investors to observe a noisy signal about the firms' quality. Investors update their belief about the firms' value according to the public information about firms. Complying with listing requirements is costly for firms. Compliance costs differ across firms and are not correlated to the quality of firms. When firms list they can realize a growth opportunity. They will do so if the expected increase in their market value exceeds the incurred compliance costs. The exchange charges a listing fee which is proportional to the firms' market value. It faces a trade-off between listing a high

number of firms and listing a small number of highly valued firms when it determines the level of listing requirements.

The results are as follows: If there is a small difference between the highest and the lowest level of compliance costs among firms of the same quality, the main determinant of the listing decision of firms is their valuation gain stemming from listing and from public information. The valuation gain depends on the level of listing requirements and on the type and number of firms that list. It is always larger for high quality firms than for firms with a low quality. Also, the difference in the net gain from listing is large between good firms with high compliance costs and bad firms with low compliance costs. This might induce a profit maximizing exchange to optimally set a high level of listing requirements, at which high quality firms separate from low quality firms by listing. In this case, information about the values of firms is perfectly revealed through this sorting effect. This is likely to occur when the number of good firms in the economy is small.

If there is a large difference between the highest and the lowest level of compliance costs among firms of the same quality, the difference in the net gain from listing is small between good firms with high compliance costs and bad firms with low compliance costs. In this case, the effect of listing requirements is always weakened. While good firms with high costs are deterred from listing, bad firms with low costs still list. Thus the sorting of firms occurs not only according to quality but also according to compliance costs. In this case, a complete separation of firms according to their quality through the means of a listing is impossible. The exchange never sets a high listing requirement in equilibrium because the valuation gain of listed firms is smaller due to the smaller number of listed good firms. Except when only high quality firms with low costs list on the exchange, the values of listed firms are inefficient on the exchange because firms of different qualities pool. However, the sorting of firms also affects the efficiency of values outside the exchange since non listed firms of different qualities also pool. As a consequence, information efficiency in the economy is impeded when incentives to list differ strongly among firms of the same quality.

While increasing listing requirements might improve information efficiency in the economy when the difference in compliance costs is small, the fact that firms are deterred from listing might impede social welfare. Non listed firms do not bear compliance costs but forgo a growth opportunity. Since the most efficient equilibrium, i.e. the one in which firms completely separate according to their quality, is only obtained with a high level of listing requirements, it creates two sources of welfare losses: the forgone growth opportunities by all low quality firms as well as the high compliance costs borne by all high quality firms. Thus,

there is a tension between limiting welfare losses and improving efficiency. This tension is exacerbated by the existence of different compliance costs among firms of the same quality, since the level of listing requirements necessary to deter the low quality firm with the smallest compliance costs is high.

When, in addition to the existing segment, a new segment with a different level of listing requirements is introduced on the exchange, firms sort between the two segments according to their valuation gains and compliance costs, as before. The existence of an additional segment alters the valuation gain and consequently the number of listed firms on the previously existing segment. In particular, if an additional segment is created with tighter listing requirements than those prevailing on the existing segment, a smaller number of firms list on the existing segment because the expected valuation gain is smaller. This is because good firms with low costs are attracted by the segment with high listing standards, leaving the existing segment (which has lower listing standards) with mainly low quality firms. This, in turn, reduces the gain of listing on this segment.

This model yields several empirical implications on the competition for listings, on valuation effects related to changes in listing requirements, on the impact of listing requirements on the incentives of managers or controlling shareholders to extract private benefits, on the relationship between the choice of a listing place by firms and decisions of a profit maximizing exchange and on the link between the choice of a listing place by firms and what it signals about the characteristics of firms. In particular, the valuation effect related to a listing on an exchange with stringent listing requirements is not only related to individual characteristics of firms, but also to the characteristics of the firms in the same industry or country as well as to whether the exchange has several segments or not. Also, if an exchange tightens listing requirements, it is likely to lose firms from industries or countries in which firms have diverging incentives to comply with listing requirements. The debate about whether the attractiveness of US stock markets has been reduced following the introduction of the Sarbanes-Oxley Act in 2002 looks primarily on the link between firms' characteristics and the cross listing decisions of firms. The findings in this chapter suggest that this literature should also consider the characteristics of the pool of firms among which some choose to cross-list. As another implication, listing or delisting decisions of firms following changes in regulation can be an indication about the existence of hidden characteristics of firms such as proprietary costs. Also, when incentives to extract private benefits are considered, tighter listing requirements might not necessarily reduce the incentives to extract private benefits.

The distribution of listed firms might allow those firms with private benefit extraction problems to better hide among the other firms and to be recognized with a smaller probability.

This analysis complements literature on the choice of listing places by firms and literature on listing and disclosure requirements. The listing decisions of firms are often motivated by the possibility to send a signal about their quality. Staughton et al. (2001) develop a model in which firms list on a stock market in order to signal the quality of their products. Consumers infer the product quality from the stock price. [2] Surveys of managers of non US firms that are cross-listed in the US indicate that revealing information about the firm's quality is one of the most important motivations for cross-listings (Bancel and Mittoo (2001), Baba and Yamori (2001), Houston and Jones (2002), Mittoo (1992)). The idea of signalling in the context of cross-listings is related to the theories of legal bonding (Coffee (2002)) or reputational bonding (Siegel (2005)). Firms signal their quality by bonding themselves to tough listing requirements, strong regulatory bodies, or reputational intermediaries.[3] Based on these theories, Fuerst (1998) develops a model in which firms issuing high profitability reports list on the strictest regulated exchange whereas firms issuing low profitability reports list on less strict exchanges, provided that the difference in regulatory strictness between exchanges is high enough. Consistent with the signalling hypothesis, Doidge et al. (2004 and 2009) document an increase in the market value of firms cross-listed in the US (the so called "cross-listing premium").

However, some studies challenge the signalling hypothesis by showing that many other criteria than listing requirements determine the choice of listing places: the presence on a foreign product market (Biddle and Saudagaran (1995), Pagano et al. (2002)), the size, sector and strategy of firms (Pagano et al. (2002))[4], the origin as well as the economic, industrial, cultural and geographic proximity[5] of the host country relative to the home country (Sarkissian and Schill (2004), Pagano et al. (2001), Bancel and Mittoo (2001)). Tough

[2] The certification mechanism stems from the willingness of the listed firms to subject themselves to the scrutiny of outside analysts and relies on the existence of a large body of investors that engage actively in the price discovery process.

[3] Siegel shows that in the case of Mexican firms cross-listed in the US, the market punished firms that were accused of large-scale asset taking in Mexico, but that were not prosecuted by the SEC. Business press and analysts tracking governance abuses strengthen this reputation mechanism.

[4] Pagano et al. (2002) show that European firms that cross-listed in the U.S. between 1986 and 1998 were different from those listed in Europe only. U.S. listed firms pursued a strategy of rapid equity-funded expansion and belonged in the majority to high-tech sectors. On the contrary, in Europe listed firms were more mature and less growing, relied less on exports and didn't come from high-tech sectors.

[5] Geographic proximity is the great circle distance between the capitals of countries, economic proximity is the percentage of country i's exports to country j, industrial proximity is the correlation between industry rankings, and cultural proximity is a dummy variable equal to one if languages are the same, or if there was a colonial relationship between countries.

perfect and $\Delta I_g = (1 - f)$. Both marginal firms increase the higher the net gain form listing is. This is the case, the lower the listing fee is, the higher the growth opportunity is and the higher the difference in qualities, Δx, is. However, changes in the marginal firms affect posterior beliefs of investors and thus the information gain of firms, which in turn influence marginal firms in equilibrium. The smaller the number of listed bad firms is and the higher the number of listed good firms is, the higher is the information gain of all listed firms. This encourages more firms of both types to list. However, the higher number of listed bad firms reduces the information gain of both types of firms, causing fewer of them to list.

How the level of the listing requirements affects the number and type of listed firms depends on how changes in the marginal firms influence information gains. A change in listing requirements affects the number of listed firms directly through the change in costs and the impact of more precise information on their value. While the direct effect of an increase of the precision is always negative for the marginal bad firm (the information gain decreases but the compliance cost increases), it has an ambiguous effect on the marginal good firm since the listing cost as well as the information gain increase. A change in listing requirements has also an indirect effect through the impact of changing marginal firms on the expected information gains. For instance, if the marginal good firm increases with the signal precision, the information gain of bad firms increases, inducing more of them to list, which in turn reduces the information gain of both types of firms. In contrast, if the marginal good firm decreases with the signal precision, the information gain of bad firms diminishes, inducing less of them to list. This, however, increases the information gain of firms of both types. Consequently, the indirect effect related to changes in marginal firms can either enhance or weaken the direct effect of a change in listing requirements on the value of firms. This indirect effect finds its origin in the differing cost factors among firms of the same quality. If compliance costs were equal for all firms or correlated with their quality (bad firms incurring higher compliance costs than good ones), good firms would always list as long as bad firms list since their valuation gain is always higher.

3.2. Incentives to list and listing requirements

For a given cost factor, bad firms always benefit less from listing than good firms. Those firms among bad ones with the highest compliance costs are deterred from listing at levels of listing requirements at which all good firms still list (i.e. signal precisions for which

a profit-maximizing exchange might set a high level of listing requirement even without reputation considerations.

The article is organized as follows. Section 2 sets out the model. Section 3 describes the incentives of firms and the equilibrium choices of an exchange with regard to listing requirements. Section 4 discusses information efficiency and welfare, and shows how these are related to the incentives of firms and the exchange's optimal decisions. Section 5 discusses the existence of segments with different listing requirements. Section 6 discusses implications. Conclusions are stated in section 7. All proofs are given in the appendix.

2. Model

Consider firms which are either good (x_g), or bad (x_b), with x the firms' value known only to the firm's manager and $x_g > x_b > 0$. The proportion of good firms in the economy is $\omega \in (0,1)$ and is common knowledge. Firms can realize a growth opportunity, z, if they list on an exchange.

Firms which list must pay a fee to the exchange. It is a fraction, $f \in (0,1)$, of their market value.[6] The exchange also sets listing requirements that all listed firms must satisfy. Listing requirements might comprise reporting information about the firms' prospects as well as meeting corporate governance rules. They allow investors to observe a signal, s, about the value of listed firms. The level of listing requirements is represented by the precision of the signal, $\theta > 0.5$, which is common knowledge.[7] With probability θ investors observe the true type of listed firms. They observe the wrong type otherwise. Firms are assumed to reveal only the information required by the exchange. In a dynamic setting (which is not modeled here), this might for instance be the case if firms refrain from setting a disclosure precedent. Changes in the future towards less informative voluntary disclosure might be perceived as bad news by investors and firms might want to avoid this situation.

The exchange is a monopoly in listing. It determines the level of listing requirements to maximize its profit, Π. The listing fee is a parameter because the analysis focuses on how listing requirements can improve the informativeness of the value of firms. A listing fee

[6] A similar definition of the listing fee is used in Chemmanur and Fulghieri (2006). Many exchanges have listing fees which are staggered according to the size of the issuing firms or the number of issued shares. The case of a fixed listing fee is discussed at the end.

[7] In Chemmanur and Fulghieri (2006), the exchange selects the firms for listing. They define listing requirements in a similar way: the latter determine the probability with which the exchange accepts a firm that is not qualified for listing.

determined endogenously would affect the number of firms which choose to list. It would therefore depend on the market value of firms. It is not used in the present model because it would render the analysis intractable. In the baseline model developed in the present chapter, the exchange determines a unique signal precision that applies to all listed firms. In an extension, the exchange can set up two segments with different levels of listing requirements.

Firms of either type incur costs to comply with listing requirements: $C(\theta) = c\frac{\theta^2}{2}$. The cost scaling factor, c, is uniformly distributed over the interval $[c_l, c_h]$ for firms of both types. Thus, the compliance costs are not correlated to the value of firms. These costs represent direct costs as well as indirect costs. Direct costs are for instance the establishment of reports according to some standards, or changes in the internal structure of firms to comply with the imposed requirements. These costs may differ across firms due to differences in their internal structure, corporate habits, or cultural contexts. Listing requirements can also lead to higher costs related to private benefit extraction from the point of view of a manager. Doidge et al. (2004) develop and test a model in which enhanced investor protection rules increase the cost of private benefit extraction. They expose evidence consistent with the idea that controlling shareholders of firms cross listed in the US commit to limit extraction of private benefits only if growth opportunities that can be realized through the cross- listing are large enough. Leuz et al. (2008) as well as Marosi and Massoud (2007, 2008) find that firms (from the US as well as from outside the US) which were listed on a US exchange and which went dark or delisted after the adoption of the Sarbanes Oxley Act had not only poor future prospects but also a stronger insider control. This suggests the existence of larger costs related to the compliance with the Sarbanes Oxley Act for firms with a concentrated ownership. Indirect costs may represent costs firms incur due to more transparency and enhanced reputation. These comprise for instance proprietary costs which occur when competing firms set up more aggressive strategies on the product market on the basis of the disclosed information, and contribute thereby to lower the profit of the firm which discloses information. Empirical research has displayed evidence consistent with the existence of proprietary costs (Leuz (2004), Nichols and Street (2007)). Also, these costs seem to depend on the characteristics of firms and on the characteristics of their industry. According to Leuz (2004), for instance, firms from highly competitive industries tend not to disclose segment information on average. Leuz interprets

this as consistent with the existence of proprietary costs for these firms.[8] Another indirect cost related to more transparency is the risk of litigations since it is difficult to disentangle truthfully reported information that turned out to be wrong from disclosed false information (Healy and Palepu (2001)). According to a survey of CFO's by Graham et al. (2005), potentially enhanced litigation costs and proprietary costs are among the most important factors inducing firms not to disclose information voluntarily. The cost can also be interpreted as an opportunity cost: the time spent to comply with the requirements not used to develop new projects. Recent empirical literature on regulation changes suggests that some firms incur important costs when they have to comply with enhanced disclosure requirements. Bushee and Leuz (2005), for instance, show that after the introduction of SEC disclosure rules on the OTC Bulletin Board, firms which began complying with these rules experienced significant liquidity increases while the average stock market reaction related to the change in regulation was small or negative. They interpret this evidence as indicating the existence of costs related to the new disclosure rules. In the same vein, the Sarbanes Oxley act is associated with large costs according to Zhang (2007) and Engle et al. (2007).[9] To sum up, prior evidence indicates the existence of costs associated with listing rules and the possibility that these costs differ across firms. Since the aforementioned costs are to a large extent unobservable, I assume that compliance costs are private knowledge of the firm in this model.

Investors adjust their beliefs about the quality of firms according to the information they observe, that is whether and where a firm is listed and the signal provided by listing requirements. They do not possess private information on firms. The updated probability that a firm is a good firm is given a good signal $P(x_g \mid s = x_g) = p_{gs}$, and for a bad signal $P(x_g \mid s = x_b) = p_{bs}$. If a firm is not listed, the probability that it is a good firm is p_{nl}. All non listed firms have the same value.

The game is organized in three stages. In the first stage, the exchange determines its level of listing requirements to maximize its profit, Π. In stage 2, firms decide whether to list to maximize their market value net of the listing fee and compliance costs. In stage 3, investors update their beliefs.

[8] See for instance Verrecchia (1983, 2001) and Dye (1986) for theoretical arguments on proprietary costs in the context of voluntary disclosure decisions of firms. A similar argument was also developed in the banking literature to explain different debt financing choices of firms depending on whether they are subject to proprietary costs or not (Yosha (1995), Bhattacharya and Chiesa (1995)).

[9] See Leuz (2007) for a critical discussion of these papers.

3. Optimal listing requirements

3.1. Firms' incentives

A listing affects the value of firms through the possibility to realize a growth opportunity and through the signal firms provide to the market. Due to the signal, the market values of listed firms are closer to their true type than when a stock market does not exist. The market value net of listing costs (the listing fee and compliance costs) expected by firms choosing to list is for good and bad firms:

$$E(MV)_g = (1-f)\left(z + x_b + \Delta x(p_{bs} + \theta(p_{gs} - p_{bs})\right) - C(\theta) \quad (1)$$

$$E(MV)_b = (1-f)\left(z + x_b + \Delta x(p_{bs} + (1-\theta)(p_{gs} - p_{bs})\right) - C(\theta) \quad (2)$$

$\Delta x = x_g - x_b$

The expected market value of both types of firms increases with the size of the growth opportunity. The precision of information affects market values in opposite ways. While, all else equal, an increase in the signal precision allows good firms to be better recognized and increases their valuation, it renders hiding more difficult for bad firms and depresses their value. Firms list if and only if they expect their market value to increase far enough to offset listing costs. The incentives of firms to list depend not only on the quality of firms and the precision of information required by the exchange, but also on their compliance cost level, c. The firm which is indifferent between listing and not listing is the marginal firm, $\tilde{c}_i$ with $i = g, b$. Only firms with cost levels below those of the marginal firms, list. The market values of firms if they do not list are not directly influenced by the signal precision on the exchange. However, they depend on the number of good and bad firms that remain unlisted and therefore on the incentives of firms to list, which in turn are related to the signal precision. At a given signal precision, θ, incentive constraints for good and bad firms are:

$$c \le \tilde{c}_g \text{ with } \tilde{c}_g = Max\left\{ Min\left\{ \left[(1-f)z - fx_b + \Delta x \Delta I_g(\tilde{c}_g, \tilde{c}_b, \theta)\right]\frac{2}{\theta^2}, c_h \right\}, c_l \right\} \quad \text{(ICg)}$$

$$c \le \tilde{c}_b \text{ with } \tilde{c}_b = Max\left\{ Min\left\{ \left[(1-f)z - fx_b + \Delta x \Delta I_b(\tilde{c}_g, \tilde{c}_b, \theta)\right]\frac{2}{\theta^2}, c_h \right\}, c_l \right\} \quad \text{(ICb)}$$

$$\Delta I_g = (1-f)\left(p_{bs} + \theta(p_{gs} - p_{bs})\right) - p_{nl}$$
$$\Delta I_b = (1-f)\left(p_{bs} + (1-\theta)(p_{gs} - p_{bs})\right) - p_{nl}$$

ΔI_i , with $i = g,b$, represents the valuation gain of firms due to the signal they have provided to the market. It is called information gain in the rest of the analysis. The gain from listing obtained by good and bad firms differs solely in this variable. If all firms list ($\tilde{c}_g = \tilde{c}_b = c_h$), posterior beliefs of investors depend only on the signal precision and the number of firms of both types in the economy. In this case, a higher signal precision allows investors to better recognise the true type of firms. It increases the information gain of good firms while it decreases the information gain of bad firms. If the marginal firms are inside the cost interval such that only a sub-set of good and bad firms list, posterior beliefs of investors depend not only on the signal precision and the number of good firms in the economy, but also on the number of firms of either qualities that choose to list:

$$p_{gs} = \frac{\omega\theta}{\omega\theta + (1-\omega)(1-\theta)\dfrac{\tilde{c}_b - c_l}{\tilde{c}_g - c_l}} \tag{3}$$

$$p_{bs} = \frac{\omega(1-\theta)}{\omega(1-\theta) + (1-\omega)\theta\dfrac{\tilde{c}_b - c_l}{\tilde{c}_g - c_l}} \tag{4}$$

$$p_{nl} = \frac{\omega}{\omega + (1-\omega)\dfrac{c_h - \tilde{c}_b}{c_h - \tilde{c}_g}} \tag{5}$$

A higher proportion of good firms among all listed firms reduces the probability that an observed signal stems from a bad firm. This increases the updated probabilities that a firm is good given a good or a bad signal. Since a higher proportion of good firms on the exchange leads to a smaller proportion of these firms outside the exchange, the expected value of non listed firms decreases. The information gain of firms of both qualities increases always when the proportion of good firms on the exchange rises. In contrast, a decrease in this proportion lowers the information gain of all listed firms.

For any given number of firms and any given signal precision, good firms have a higher information gain than bad ones. Thus, listed good firms are more numerous than listed bad firms: $\tilde{c}_g \geq \tilde{c}_b$. If all good firms list and are the only firms to list, information revelation is

perfect and $\Delta I_g = (1 - f)$. Both marginal firms increase the higher the net gain form listing is. This is the case, the lower the listing fee is, the higher the growth opportunity is and the higher the difference in qualities, Δx, is. However, changes in the marginal firms affect posterior beliefs of investors and thus the information gain of firms, which in turn influence marginal firms in equilibrium. The smaller the number of listed bad firms is and the higher the number of listed good firms is, the higher is the information gain of all listed firms. This encourages more firms of both types to list. However, the higher number of listed bad firms reduces the information gain of both types of firms, causing fewer of them to list.

How the level of the listing requirements affects the number and type of listed firms depends on how changes in the marginal firms influence information gains. A change in listing requirements affects the number of listed firms directly through the change in costs and the impact of more precise information on their value. While the direct effect of an increase of the precision is always negative for the marginal bad firm (the information gain decreases but the compliance cost increases), it has an ambiguous effect on the marginal good firm since the listing cost as well as the information gain increase. A change in listing requirements has also an indirect effect through the impact of changing marginal firms on the expected information gains. For instance, if the marginal good firm increases with the signal precision, the information gain of bad firms increases, inducing more of them to list, which in turn reduces the information gain of both types of firms. In contrast, if the marginal good firm decreases with the signal precision, the information gain of bad firms diminishes, inducing less of them to list. This, however, increases the information gain of firms of both types. Consequently, the indirect effect related to changes in marginal firms can either enhance or weaken the direct effect of a change in listing requirements on the value of firms. This indirect effect finds its origin in the differing cost factors among firms of the same quality. If compliance costs were equal for all firms or correlated with their quality (bad firms incurring higher compliance costs than good ones), good firms would always list as long as bad firms list since their valuation gain is always higher.

3.2. Incentives to list and listing requirements

For a given cost factor, bad firms always benefit less from listing than good firms. Those firms among bad ones with the highest compliance costs are deterred from listing at levels of listing requirements at which all good firms still list (i.e. signal precisions for which

$\tilde{c}_g = c_h$). If the cost interval, $c_h - c_l$, is small, incentives of firms are mainly driven by information gains. In this case, the difference in the surplus between good and bad firms with the same cost factor remains large as the signal precision increases. This is because the common factor in the surplus, the compliance cost, weights little compared to the diverging changes in information gains. There is a level of listing requirements, $\tilde{\theta}_{sep}$, at which all bad firms are deterred from listing while all good firms list.[10] For $\tilde{\theta}_{sep}$ to be attractive for the good firms with the highest compliance costs, the cost interval, $c_h - c_l$, must be small enough. A necessary condition for separation of firms is:

$$\Delta c \leq \frac{2\Delta x}{\tilde{\theta}_{sep}^2}(1-f)\left(1-\Delta I_b(c_h, \tilde{c}_b = c_l, \tilde{\theta}_{sep})\right) = \Delta c_T \qquad (3)$$

$\Delta c = c_h - c_l$

If the interval on compliance costs is small enough to allow separation of firms, and if initially firms of both types are listed ($\theta < \tilde{\theta}_{sep}$), the marginal bad firm decreases with the signal precision. Since the number of listed good firms remains constant as long as bad firms list, the bad firms are adversely affected by an increase in θ through a higher compliance cost and a smaller information gain. If only good firms list (if $\theta \geq \tilde{\theta}_{sep}$), an increase in the precision also reduces the number of listed firms. In addition to the rising compliance costs, good firms experience a decrease in their information gain. The attractiveness of a listing diminishes for these firms because the value of non listed firms increases due to higher number of non listed good firms, although information revelation is perfect on the exchange.

If the difference in compliance costs is high ($\Delta c > \Delta c_T$), good firms with high compliance costs are deterred from listing while bad firms with small costs still list and there is no level of listing requirements separating both groups of firms. In this case, there is a range of small listing requirements at which only bad firms are deterred from listing when the signal precision increases.[11] Inside this range, the number of bad firms decreases monotonically with the signal precision. There is also a range of high listing requirements for which only good

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[10] The precision, θ_{sep} , is such that ICb is binding for the bad firm with the lowest compliance costs whereas ICg is not binding for the good firms with the highest costs.

[11] $0.5 < \theta < \sqrt{\left[(1-f)z - fx_b + \Delta x \Delta I_g(c^h, c_b^*, \theta)\right]\frac{2}{c^h}}$

firms with low costs list.[12] As the precision increases inside this range, the number of listing good firms decreases monotonically. Finally, there is a range of medium listing requirements with signal precisions between the two extreme intervals described above. In this intermediate range, good as well as bad marginal firms vary simultaneously when the signal precision changes. This is the only range of signal precisions, inside which an increase in the level of listing requirements can lead either to a higher or to a smaller number listed firms of either qualities.[13]

Lemma 1

Assume that the signal precision is inside the following interval: $\theta \in [\theta_{T1}, \theta_{T2}]$, and that $\Delta c > \Delta c_T$. As the signal precision increases inside this interval:

(i) A higher number of good firms list if the increase in their information gain due to more precise information is large.

(ii) A higher number of bad firms list if the direct impact of more precise information on the surplus of good firms is positive and large enough.

$$\theta_{T1} = \sqrt{\left[(1-f)z - fx_b + \Delta x \Delta I_g(c^h, \tilde{c}_b, \theta)\right]\frac{2}{c^h}}$$

$$\theta_{T2} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(\tilde{c}_g, c_l, \theta)\right]}$$

All else equal, a higher signal precision leads to a higher number of listed good firms if the increase in their information gain due directly to more precise information exceeds the larger compliance costs. Regarding bad firms, their number diminishes with the signal precision, all else equal. Without considering the indirect effects of changes in the signal precision on the information gains of firms, the proportion of listed good firms increases on the exchange. However, this raises the information gain of all firms, since the beliefs of investors shift upwards when the proportion of good firms increases on the exchange. Good firms benefit from the higher signal as well as the change in the proportions of firms. If these benefits offset the higher cost induced by a higher signal precision, the number of listed good

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[12] $\sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(c_g^*, c_l, \theta)\right]} < \theta < 1$

[13] Following ICg and ICb, marginal firms can only increase if $c_i^* < c_h$ with $i = g, b$

firms increases with the precision. The direct gain of good firms (which is net of compliance costs) related to a change in the precision does not need to be positive since it is complemented by the indirect effect from the changing proportion of firms.

As the signal precision increases, the unique benefit of bad firms stems from the higher proportion of good firms on the exchange. If a higher number of good firms is attracted on the exchange, the number of bad firms only increases if the additional good firms are numerous enough, i.e. when the information gain of good firms is large. In this case, the loss of bad firms related to more precise information and higher compliance costs can be offset by the general upward shift in information gains due to the higher number of listed good firms. Thus, although bad firms must disclose more precise information about their type, they benefit from a better possibility to hide among good firms. Also, since fewer good firms remain unlisted, the value of unlisted firms decreases, which induces even more bad firms to list on the exchange.

3.3. Exchange's decision

The revenue of the exchange stems only from the listing fee which is proportional to the market value of listed firms. The exchange can either set a small level of listing requirements to list many firms (including many bad firms) in which case it receives a small income per firm. The exchange can also set a high level of listing requirements excluding bad firms from listing to increase the market value of the remaining listed firms and enhance thereby the income per firm.

Proposition 1

(i) If separation of good and bad firms is possible, the exchange sets a level of listing requirements deterring all bad firms from listing if and only if $\Pi(\tilde{\theta}_{sep}) \geq \Pi(\theta)$ for all $\theta < \tilde{\theta}_{sep}$. This level of listing requirements is determined by:

$$\tilde{\theta}_{sep} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(c_h, c_l, \tilde{\theta}_{sep})\right]}. \quad (4)$$

Otherwise, the optimal level of listing requirements is always smaller than $\tilde{\theta}_{sep}$.

(ii) If separation of good and bad firms is not possible, the exchange sets a level of listing requirements at which all bad firms and good firms with high costs are deterred from listing, $\tilde{\tilde{\theta}}$, if and only if $\Pi(\tilde{\tilde{\theta}}) \geq \Pi(\theta)$ for all $\theta < \tilde{\tilde{\theta}}$. This level of listing requirements is determined by: $\tilde{\tilde{\theta}} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(\tilde{c}_g, c_l, \tilde{\tilde{\theta}})\right]}$

(iii) $\tilde{\tilde{\theta}} < \tilde{\theta}_{sep}$

If the cost interval is small enough to satisfy equation 3, the exchange can implement a separating equilibrium for a high enough level of listing requirements. This is only optimal if the small number of listed firms - only good firms list in this case - is compensated by the valuation gain of good firms. In this case, the exchange never sets the precision above θ_{sep} since this lowers the number of listing firms but does not increase their value.

If the cost interval is high and separation impossible, good and bad firms always pool either on the exchange or outside the exchange. In equilibrium, the exchange sets either a signal precision at which only good firms list, $\tilde{\tilde{\theta}}$, or a lower signal precision at which firms of both types list. As in the previous case, a signal precision higher than $\tilde{\tilde{\theta}}$ is never optimal since it reduces the number of listed firms without increasing their value. It is implicitly assumed here that good firms with high compliance costs stop listing while bad firms with small costs still list. This lowers the gain of a listing of bad firms since the proportion of good firms on the exchange is smaller compared to a situation in which separation of firms is possible. Therefore, the bad firm with the smallest compliance cost level is deterred from listing at a smaller signal precision than when separation is possible: $\tilde{\tilde{\theta}} < \tilde{\theta}_{sep}$.

The highest level of listing requirements the exchange can set in equilibrium, $\tilde{\theta}_{sep}$, increases the higher the gain is that bad firms obtain from listing. This is the case the higher

the growth opportunity is, the smaller the minimum quality is, the higher the difference in qualities is, and the smaller the listing fee is. However, the higher $\tilde{\theta}_{sep}$ is, the smaller is the valuation gain that good firms obtain through separating from bad firms through a listing on the exchange. This reduces the additional profit of separation and renders a separating equilibrium less likely. Although a high proportion of good firms in the economy translates into a high number of listed firms in the case of separation, it also reduces the valuation gain good firms obtain from separation. Thus, a high proportion of good firms in the economy reduces the likelihood that the exchange implements the separating equilibrium and sets the highest level of listing requirements.

4. Information efficiency and welfare

4.1. Information efficiency

The efficiency of expected values increases, the closer these values are to their true value. The signal released when firms list contributes to render the values of listed firms more efficient, ceteris paribus. However, since listing requirements influence the distribution of firms on and outside the exchange, the existence of an exchange also affects the efficiency of the values of non listed firms. The measure for efficiency used here reflects the magnitude of the reduction of information asymmetry in the entire economy. The less information asymmetry remains after the listing, the more informative is the listing and the more efficient is the equilibrium. Initially the market values of all firms are distorted as bad firms are overvalued and good firms undervalued. The listing is able to reduce this distortion at least for a sub-set of firms by revealing information about the firms' type. In the best case, firms are valued at their true value after the listing has taken place.

The precision of information affects efficiency in several ways. Its direct effect contributes to improving the efficiency of the values of all listed firms since it leads to a positive information gain for good firms and a negative information gain for bad firms. The indirect effects of the signal precision can either enhance efficiency or reduce it compared to a situation without exchange. However, since the number of good firms that list is always higher than the number of bad ones, the proportion of good firms listed on the exchange is higher than in the entire economy. As a consequence, the value of good listed firms is always more efficient when the exchange exists. The same effect contributes to an increase in the value of bad firms and can make their value less efficient. Also, the value of non-listed good

firms becomes less efficient whereas the value non-listed of bad firms becomes more efficient. This is because the values of all non-listed firms decrease due to the smaller proportion of good firms among non listed firms compared to a situation without exchange. Thus, only the values of listed good firms and non-listed bad firms become more efficient with the introduction of the exchange because of the different distributions of firms on and outside the exchange.

Lemma 2

The separating equilibrium leads to the highest efficiency in the economy as well as on the exchange since all firms are valued at their true value. All other equilibria lead to a lower efficiency.

When the signal precision increases, the values of listed firms become more efficient provided that the distributions of listed firms are held constant. In this case, the signal precision has no impact on the efficiency of the values of non listed firms. However, except if the conditions of lemma 1 are satisfied, a smaller number of firms list. Thus, a smaller number of good firms benefits from a more efficient value. The additional non listed good firms incur an efficiency loss. Since also more bad firms are not listed, the impact of an increase in the signal precision on non listed firms is undetermined. Thus, while higher listing requirements improve the efficiency of a small group of firms, it leads to a higher number of firms incurring efficiency losses. As a result, its effect on the average efficiency in the economy is unclear. Depending on differences in the incentives of firms to list, and depending on how listing requirements affect the information gain of firms, a higher level of listing requirements does not necessarily improve efficiency in the economy.

In all equilibria, a listing conveys information to the market unless the exchange sets its listing requirement level at 0.5. However, inefficiency arises due to two factors: the imperfect precision of the signal conveyed by the listed firms and the listing behavior of firms. If all good firms list, non listed firms are only bad ones. Information outside the exchange is perfectly revealed, whereas there is information asymmetry on the exchange as long as some bad firms list. In this case the value of non listed firms is perfectly efficient. Although the signal precision is small, information is released by many firms. Economy wide efficiency is improved compared to a situation without exchange (provided that the direct effect of listing requirements is large enough for the values of bad listed firms to decrease). If only good firms list, information is perfectly revealed on the exchange. If only a fraction of

good firms list, information asymmetry exists outside the exchange. Since there is no individual information release, inefficiency of non listed firms can be large. Only when firms completely separate according to their quality, information asymmetry is removed and all firms are valued at their true value.

Proposition 1 shows that if the cost interval is small and under some particular economic circumstances, the exchange sets a high enough level of listing requirements to achieve separation of firms in equilibrium. In this case, a listing certifies efficiently the quality of firms. Otherwise, information asymmetry on the exchange and/or outside the exchange always impedes efficiency, in which case the listing does not certify efficiently the quality of firms. The certification role of listing is indeed related to the level of listing requirements. However, it is determined by the incentives of firms to list and in particular by the possibility for firms to separate according to their quality. The differences in firms' incentives determine not only the optimal decision of the exchange, but also the feasibility of an efficient certification through listing. If firms differ strongly in listing incentives, an efficient certification is not possible because of self-selection of firms that adversely affects the efficiency of the values of firms.

4.2. Welfare

Because signalling is costly and because these costs differ across firms, listing requirements do not necessarily enhance welfare. Listed firms realize a growth opportunity which increases welfare, but this occurs at the expense of compliance costs which reduces welfare. Social welfare is also affected by the inefficient valuations of firms. However, with some additional assumptions, the welfare gains and losses related to information asymmetry offset each other. If a firm lists, the old shareholders sell the firm entirely to new shareholders. If the firm is a good one and there is information asymmetry, they sell the firm below its value and incur therefore a welfare loss. However, this welfare loss is also a welfare gain for investors who buy the firm cheaper than its final payoff. Thus gains and losses are offset. If the old shareholders sell an overvalued bad firm, they have a welfare gain which corresponds to the welfare loss of new shareholders. If the firm does not list, old shareholders keep their shares until the payoff is realized and are therefore not affected by changes in the value of their shares due to information revelation. Under these conditions, changes in the value of firms do not affect social welfare.

To assess welfare effects related to changes in listing requirements, a measure, W, is computed by adding compliance costs and realized growth opportunities by listed firms. The level of listing requirements impacts welfare directly by influencing the size of compliance costs and indirectly by determining the number of realized growth opportunities. A higher number of listed firms has an ambiguous effect on welfare since more firms realize their growth opportunity but more firms also bear compliance costs.

Lemma3

(i) If separation of firms according to their quality is possible ($\Delta c < \Delta c_T$), welfare increases in the level of listing requirements if the growth opportunity is small and if the change in the marginal bad firm is large.

(ii) If separation of firms is not possible($\Delta c > \Delta c_T$), welfare increases in the level of listing requirements in two cases:

a. If more firms are attracted on the exchange and the growth opportunity is large
b. If fewer firms are attracted on the exchange and the growth opportunity is small

Whether welfare increases or decreases with the level of listing requirements depends on the listing behavior of firms. If separation of firms according to their quality is possible and the exchange sets a level of listing requirements which is smaller than θ_{sep}, increasing the precision reduces the number of listed bad firms and increases the compliance costs of those firms that remain listed. If the growth opportunity is smaller than the cost savings, welfare increase in the signal precision only if the change in the marginal bad firm is large enough. Otherwise, welfare never increases with the signal precision. The cost savings related to the smaller number of bad listed firms must compensate not only their forgone growth opportunity but also the higher costs borne by all other listed firms. If the exchange sets θ_{sep} in equilibrium, the negative welfare effects due to fewer realized growth opportunities and higher compliance costs are the highest. Thus, there is a tension between achieving a high information efficiency and keeping a high welfare in the economy. The most efficient equilibrium does not necessarily correspond to the highest level of welfare. If separation of firms is not possible, the effects of an increasing precision on welfare depend on the listing behavior of firms. If more firms are attracted into the market, more firms will also bear higher compliance costs. In this case, welfare increases only if the growth opportunity is large

enough. If, in contrast, the number of listed firms diminishes, the size of the forgone growth opportunity must be small enough as compared to the decrease in compliance costs, for welfare to increase.

Information efficiency may not be socially beneficial (according to the definition of social welfare given above) because it occurs at a cost which is not necessarily compensated by social gains. However, information efficiency can bring many advantages. If good firms are not confounded with bad ones, they may be able to raise capital at lower cost and thus realize more investment opportunities. Informative prices are also useful to structure the incentives of managers (Holmström and Tirole (1993)), or the incentives of an insider to engage in value-increasing activities (Faure-Grimaud and Gromb (2004)). Also, consumers may be able to infer the quality of the firms' products from the stock price (Staughton et al. (2001)).

5. Segmentation

In many countries, listing requirements are at least partially imposed by regulators (Macey and O'Hara (2005)). However, some exchanges have created lightly regulated segments which provide listing services but are not subject to the regulation prevailing on their main segments. This is for instance the case with the Alternative Investment Market (AIM) which has been created by the London Stock Exchange: firms listing on the AIM have to comply neither with requirements imposed by the European Directives nor with full FSA requirements.[14] Over the last years, a growing number of exchanges have set up lower tier segments resembling the AIM in London.[15] This is in particular the case in the US where a new listing venue - OTCQX - has been created, on which firms can list without complying with SEC rules.[16] At the opposite, some exchanges have also created segments with stricter regulation than the one imposed by their national regulator. This has been the case on the Brazilian stock market, which created tightly regulated segments (Chavez and Silva (2006)). This has also been the case on the Frankfurt Stock Exchange, a case which is extensively described and analyzed in the third chapter of this thesis.

[14] The Financial Services Authority (FSA) determines and controls the admission rules for firms wishing to list their shares on the regulated market on the London Stock Exchange. EU Directives concerning listing requirements are the Transparency Directive (2004/109/EC), the Prospectus Directive (2003/71/EC) and the Directive on statutory audits and annual accounts (2006/43/EC).

[15] The Italian stock exchange created the Mercato Expandi, the pan-European stock market Euronext launched Alternext, Deutsche Börse launched the Entry Standard and the Scandinavian Exchange Nordic OMX created the First North. See Mendoza (2008) for a discussion about the creation of these segments.

[16] See : www.otcqx.com

An argument advanced against strong regulation is that firms differ in their need for regulation (Mendoza (2008)). Lemmata 2 and 3 show that differences in incentives of firms to list lead to the exclusion of many firms from listing and might impede efficiency as well as welfare, and eventually weaken the beneficial effect of listing requirements. In this context, creating differently regulated segments may mitigate negative effects due to the self-selection of firms. This section analyses the consequences related to the creation of a more regulated segment (upper tier segment) or a less regulated segment (lower tier segment) if a level of listing requirements, θ_{reg}, is imposed exogenously by a regulator.

If the exchange creates an additional segment (with $\theta \neq \theta_{reg}$), the segment with the signal precision imposed by the regulator, θ_{reg}, is labelled the "main segment" further on. Compared to the situation in which only the main segment exists, the possibility to list on another differently regulated venue induces some firms that would have listed anyway, to list on the additional segment instead of the main one, and might also induce firms that would not have listed otherwise, to list on one of both segments. Firms which list on the exchange when there is no segmentation, list on the additional segment if and only if the valuation gain they obtain is larger than the additional compliance costs in the case of an upper tier segment, or if the valuation loss is compensated by compliance cost savings in the case of a lower tier segment. The growth opportunity and the listing fees are assumed to be the same on both listing venues.

If two segments exist, the proportion of good firms on the main segment is likely to change. In this case, the valuation gain firms obtain by listing on the main segment also changes, even though the listing requirements remain the same. The informativeness of a listing on both listing venues depends now on the marginal firms listing on the main segment, $c^*_{g,m}$ and $c^*_{b,m}$, and on the marginal firms listing on the additional segment created by the exchange: $c^*_{g,s}$ and $c^*_{b,s}$.[17] Since the creation of an additional segment changes the number of listing firms and their listing place, it changes also the value of unlisted firms.

[17] Marginal firms listing on the main segment are determined by the following equations:

$$Max\left\{Min\left\{\left[(1-f)z - fx_b + \Delta x \Delta I_g(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta_{reg})\right]\frac{2}{\theta^2}, c_h\right\}, c_l\right\} = c^*_{g,m}$$

$$Max\left\{Min\left\{\left[(1-f)z - fx_b + \Delta x \Delta I_b(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta_{reg})\right]\frac{2}{\theta^2}, c_h\right\}, c_l\right\} = c^*_{b,m}$$

Marginal firms listing on the additional segment are determined by the following equations

$$Max\left\{Min\left\{2\Delta x\left[\Delta I_g(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta) - \Delta I_g(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta_{reg})\right]\left[\theta^2 - \theta^2_{reg}\right]^{-1}, c_h\right\}, c_l\right\} = c^*_{g,s}$$

Proposition 2

(i) If the exchange creates an upper tier segment, the number of firms listing on the main segment decreases compared to the situation without segmentation: $c^*_{g,m} < c^*_g$ and $c^*_{b,m} < c^*_b$.

(ii) If the exchange creates a lower tier segment, the total number of listed firms always increases. The number of listed firms on the main segment decreases.

5.1. Upper tier segment

If the exchange sets up an upper tier segment with $\theta > \theta_{reg}$, firms listing on this segment bear a higher cost than if they list on the main segment. Thus, firms only list on the upper tier segment if they expect a valuation increase that offsets the higher cost. If some good firms with low costs expect an information gain which is large enough to offset the higher compliance costs, they list on this segment (instead of listing on the main segment). However, if there are only good firms on the additional segment, some bad firms with low costs might also list join it. Despite the higher signal precision which reduces their direct gain from listing on the upper tier segment, they can better hide among good firms and expect therefore a large information gain. Good firms always benefit more from a more tightly regulated segment than bad firms. Therefore, the marginal good firm listing on the upper tier segment, $c^*_{g,s}$, is always higher than the marginal bad firm, $c^*_{b,s}$.

The proportion of good firms among listed firms differs on both segments. Since a higher number of good firms than bad ones lists on the upper tier segment instead of the main one, the proportion of good firms on the upper tier segment is larger than on the main segment all else equal. This reduces the benefit of a listing on the main segment since the beliefs of investors to observe a good firm shift down. Although the signal precision remains the same on the main segment, the information gain of firms listing on this segment is smaller than in the case without segmentation. This is only due to the self-selection of firms into both segments and to the resulting improved separation of firms according to their quality. The main segment retains mainly bad firms while the upper tier segment attracts mainly good firms. The smaller information gain leads to smaller marginal firms of both types of firms listed on the main segment.

$$Max\left\{Min\left\{2\Delta x\left[\Delta I_b(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta) - \Delta I_b(c^*_{b,m}, c^*_{b,s}, c^*_{g,m}, c^*_{g,s}, \theta_{reg})\right]\left[\theta^2 - \theta^2_{reg}\right]^{-1}, c_h\right\}, c_l\right\} = c^*_{b,s}$$

The proportions of listed firms on the main segment changes for two reasons: firms with small costs list on the upper tier segment and firms with high costs leave the exchange completely. If creating an upper tier segment is optimal for the exchange, the proportion of good firms is always higher on this segment than on the main segment. If these proportions were equal, no bad firm would list on the upper tier segment since in addition to paying higher compliance costs and releasing a more precise signal, they would not obtain a valuation gain related to the proportion of good firms. However, since this segment still remains attractive for good firms, the proportion of good firms is equal to one on the upper tier segment (good firms are the only firms to list on this segment) and lower than one on the main segment which contradicts the assumption of equal proportions. Thus, it cannot be true in equilibrium. If the proportion of good firms was higher on the main segment, bad firms would incur an even higher loss if they listed on the upper tier segment. By a similar argument, this cannot be an equilibrium situation either. An equilibrium is only possible if the proportion of good firms on the upper tier segment is higher than on the main segment. This reduces the value of firms remaining on the main segment and deters more firms of both types from listing on this segment. To sum up, the creation of a listing venue with higher standards on which firms with low costs can better signal their type leads to the exclusion of firms with high costs from the less regulated segment. The valuation gain on the main segment diminishes although the level of listing requirements remains the same.

When separation of firms according to their quality is possible, only bad firms which would list without segmentation are excluded from listing on the main segment. Their value is then equal to their true type which enhances overall efficiency. The values of good firms listing on the upper tier segment become more efficient. These efficiency gains stem not only from the higher signal precision on the upper tier segment, but also from the induced self selection of good firms into the upper tier segment and bad firms outside the exchange. However, the induced changes in listing venues create social costs since fewer firms implement their growth opportunity and some firms bear higher compliance costs. If the size of the growth opportunity is large enough to offset the compliance cost savings of excluded firms, an upper tier segment always deteriorates welfare.

When separation of firms is not possible, the existence of an upper tier segment also deters good firms with high costs from listing on the main segment. In this case, efficiency deteriorates outside the exchange for good firms with high costs which pool with bad ones. The crowding out effect leads also to a smaller number of realized growth opportunities than when separation is possible. Thus, if incentives of firms of the same quality differ strongly

and if marginal firms decrease with the precision, creating an upper tier segment exacerbates the welfare loss and does not necessarily improve efficiency. Only the good firms listed on the upper tier segment always benefits from a high efficiency. If the marginal good firms increase in the precision, the exchange lists more good firms on its upper tier segment. This increases the attractiveness of this segment and induces even more firms to list on the upper tier segment instead of the main segment. In this case, more firms benefit from a better efficiency. However, this also exacerbates the exclusion effect of firms with high costs since expected revaluations on the main segment become smaller.

5.2. Lower tier segment

If the exchange creates a lower tier segment, firms with high compliance costs which would have listed on the main segment without segmentation, list on the lower tier segment instead. The lower signal precision benefits to bad firms since they must reveal less precise information. Good firms incur a valuation loss directly related to the lower signal precision. Firms of both types also benefit from the smaller compliance costs. Since bad firms benefit more from lower listing requirements than good ones, more of them switch down to the lower tier segment. Thus, the proportion of bad firms is higher on the lower tier segment than on the main segment. In, contrast, this proportion diminishes on the main segment which leads to higher valuations on this segment. The lower tier segment not only attracts firms with low costs that would have listed on the main segment without segmentation, it also attracts firms with even higher compliance costs that would not have listed without segmentation.

If the cost difference of firms is small enough to allow for separation of firms, new listing firms are only bad firms since all good firms list anyway. As before, firms separate not only according to their costs but also according to their quality. The main segment looses mainly listings from bad firms. Thus, the value of the remaining good firms becomes more efficient although the listing requirements remain the same. Good firms listing on the lower tier segment incur, as before, an efficiency loss. Efficiency also decreases for newly listed bad firms since they were valued at their true value outside the exchange, but are pooled with some good firms and are thus on average overvalued. As a consequence, the effects of the existence of a lower tier segment on information efficiency in the economy are mixed compared to a situation without segmentation. Only the main segment benefits in terms of efficiency. More firms realize their growth opportunity which improves welfare. However, more high cost firms also pay compliance costs reducing welfare. If the listing requirements

on the lower tier segment are small and the growth opportunity high enough, introducing a lower tier segment improves welfare.

If firms cannot separate, a lower tier segment allows also some good firms to list and to realize their growth opportunity. Since these firms were pooled with bad firms outside the exchange and benefit from the release of information on the exchange (even though it is not precise), their values become on average more efficient. This also increases efficiency outside the exchange. Thus, compared to a situation without the lower tier segment, introducing such a segment if the incentives of firms are very diverging has better efficiency and welfare consequence than when these incentives are similar.

Regardless of whether an exchange creates an upper or lower tier segment, firms listed on the more tightly regulated segment benefit from a higher valuation in the case of segmentation. However, the source of the valuation gain is different depending on which of both segments is implemented. In both cases, firms listed on the more regulated segment benefit from a separation effect since, in the case of segmentation, the proportion of good firms is higher on the more regulated segment than in a situation in which the firms concerned can only list on the main segment. However, firms on the upper tier segment benefit in addition from the higher level of listing requirements. If the exchange implements a lower tier segment, firms listed on the main segment only benefit from the separation of good and bad firms since the signal precision remains the same on the main segment.

6. Implications

6.1. Competition for listings

Although this model is developed under the assumption of a monopoly exchange, its insights about the incentives of firms to list on a more tightly regulated exchange can be useful in considerations about how tighter listing requirements affect competition in listings. There is a debate about whether the US exchanges have lost their competitiveness with respect to listings as a consequence of the adoption of the Sarbanes-Oxley Act in 2002. Studies highlight the existence of a pike of voluntary SEC deregistrations or delistings of US firms as well as foreign firms that seems to be related to the Sarbanes-Oxley Act. Deregistrations are related to individual characteristics of firms such as their size, their future prospects or their ownership structure since these characteristics determine the ability of firms

to bear possibly larger costs[18] as well as the components of these costs (as an example: firms with a concentrated ownership are assumed to be more subject to diversion of cash flows and might therefore incur larger costs to comply with SOX than firms with a dispersed ownership).The results of these studies show that firms which deregister are on average smaller and less profitable than firms which remained listed. In a similar perspective, Doidge at al. (2009) find that the smaller number of non US firms which cross listed on an American exchange following the introduction of the Sarbanes Oxley Act is related to changes in the characteristics of firms. According to their evidence, the probability to cross list has not changed after the passage of the Sarbanes Oxley Act when individual characteristics of firms are taken into consideration. They conclude that although fewer firms cross-list, US exchanges have remained attractive for foreign firms since those firms that cross-list experience a cross-listing premium. Piotroski and Srivinasan (2008), find that while the attractiveness of the NYSE relative to the LSE Main market has not changed after the adoption of the Sarbanes Oxley Act, the Nasdaq has become less attractive relative to the AIM. The SOX Act has deterred small firms from listing in the US. The present analysis shows that individual characteristics of firms are not the only factors that have an influence on the gains and costs of firms related to more stringent listing requirements. The characteristics of the entire population of firms, among which some might list, also affect the gains related to an increase in listing requirements. The net gain firms obtain from listing if they come, for instance, from an industry in which some firms bear high proprietary costs and others not, is small and therefore these firms are less likely to list when listing requirements become more stringent. If an exchange tightens its listing requirements, it is likely to lose in particular the listings of firms from industries with diverging preferences regarding listing requirements.

6.2. Valuation effects related to listing requirements

Several studies have highlighted positive valuation effects related to the tightness of listing requirements when firms cross-list (Doidge et al. 2004, 2009, Roosenboom and van Dijk 2007). They link these valuation changes to the existence of growth opportunities as well as the investor protection rules the firm is subject to in its home country. The findings in the present analysis complement these studies by proposing a theory for a finer analysis of these valuation effects. Since the effect of a particular level of listing requirements depends not only on the precision of the information revealed through compliance, but also on the type

[18] Whether firms listed on US exchanges bear higher costs due to the Sarbanes-Oxley Act is debated.

and number of firms that comply, valuation effects after cross listings or changes of listing places should differ depending on three elements: the characteristics of the firms which cross list or change their listing place, the characteristics of the firms in the same sector or industry or coming from the same country, and the characteristics of firms listed on the exchange in question. In addition, the valuation effect should also depend on the structure of the exchange industry. Depending on whether there are several segments with different regulations, the firms listing on the most regulated segment will not be the same. In particular, the values of firms which list on an exchange with stringent listing requirements should increase more, if there are several differently regulated listing venues in the economy than if there were only this exchange.

6.3. Incentives to extract private benefits

The present analysis shows that bad firms are not necessarily better recognized the higher the level of listing requirements is, because changes in listing requirements affect the distribution of listed firms. Thus, if a high level of listing requirements attracts many good firms and few bad firms on the exchange, bad firms might be able to hide better than with a lower level of listing requirements. If this is the case, the higher level of listing requirements does not induce a manager or a controlling shareholder to extract a smaller amount of private benefits when the cost of private benefits is proportional to the probability to be recognized. This can be illustrated by transforming the model exposed in Doidge et al. (2004). The authors assume, following La Porta et al. (2002) that the cost a controlling shareholder incurs when he diverts cash-flows increases the stricter investor protection rules are. As a result, the fraction of diverted cash flows diminishes with a more stringent regulation. Assume similar to Doidge et al. (2004) that a controlling shareholder detains a fraction k in the capital of its firm and diverts a fraction φ of the cash flows, x_g. If he is recognized he is punished and bears a cost $0.5\varphi^2 g(p_{bs}, p_{gs})x$ for this activity, where the function $g(p_{bs}, p_{gs})$ represents the probability to be recognized with $\partial g/\partial p_{bs} < 0$ and $\partial g/\partial p_{gs} < 0$. He determines the fraction of cash flows he diverts to maximize its objective function: $\underset{\varphi}{Max} k(x_g(1-\varphi) - 0.5\varphi^2 g(p_{bs}, p_{gs})x_g) + \varphi x_g$. The optimal fraction of diverted cash flows is: $\varphi^* = \dfrac{1-k}{kg(p_{bs}, p_{gs})}$. Hence, if an increase in listing requirements changes the distribution of

listed firms in a way that increases the probabilities p_{bs} and p_{gs}, the fraction of extracted private benefits increases.

6.4. Listing place choices and the decisions of a profit maximizing exchange

The reaction of firms to changes in regulations and the choice of listing places by firms from different sectors, industries or geographical regions is observable. Studies on the choice of cross-listing places link the cross-listing decision to characteristics of firms such as the existence of growth opportunities or their profitability (see for instance Pagano et al. (2002) and Doidge et al. (2009)) or to characteristics of home and host countries (see for instance Sarkissian and Schill (2004, 2009)). These studies show that differences in these characteristics affect the choice of a cross-listing place. This information can be useful to assess decisions of a profit maximizing exchange upon listing requirements or the existence of differently regulated segments. Fama and French (2004) observe that the death rate of listed firms has increased in the last decades because a higher number of young and less profitable firms has been admitted on stock markets. They argue that listing requirements have become more lax as a result of the changing demand and supply of shares. An implication of the present model is that a self-regulated profit maximizing exchange adapts its listing standards to economic conditions. If, for instance, the difference in compliance costs is initially small to allow separation of firms, but increases in a way that makes separation impossible, the exchange necessarily reduces the level of listing requirements because the listing behavior of firms reduces the gain of listed firms related to any level of listing requirements. Thus, observing the overall characteristics of firms and the listing behavior of firms allows implications about how a profit maximizing exchanges takes decisions on listing requirements. This is of particular interest today, since exchanges are increasingly turned into profit maximizing entities and some have discretion in setting listing standards. Such observations could contribute to the intensifying policy debate about whether exchanges should keep the power to set listing requirements.

6.5. Listing place choices and the characteristics of firms

Observing the listing behavior of firms also allows inferences on hidden characteristics of firms. In particular, analyzing listing and delisting decisions as well as

valuation gains in relation to listing and disclosure requirements may be an indication about the existence of proprietary costs of firms. This could complement the approach used to detect the existence of proprietary costs which consists in analyzing the content of information released by firms, in particular whether firms release detailed information about their business segments (Healy and Palepu (2001), Leuz (2004), Nichols and Street (2007)).

If an exchange creates an additional listing venue which has a different regulation than the existing one, some firms switch to the new venue because of their compliance costs and not because of their quality. Thus, if a segment with a low regulation is created, firms changing their listing place from the highly regulated segment to the new segment are not necessarily bad firms since they may simply bear high compliance costs and a lower level of listing requirements may lead to a higher market value (net of listing costs) for these firms. The same is true for firms switching to a more tightly regulated segment since they may be bad firms with low costs. The idea that a change in the listing place form a more regulated to a less regulated listing venue or vice versa is not necessarily a signal about the quality of firms, is consistent with result in Jenkinson and Ramadorai (2008) who show that initial stock price reactions after firms listed on the London Stock Exchange switch from the main market to the AIM and vice versa are reversed after some months.

7. Conclusion

The model developed in this chapter shows that differences in incentives of firms to list can have an impact on the decision of exchanges concerning the level of listing requirements they set, and on the gains obtained by firms when they list on an exchange with stringent listing requirements. When firms bear listing costs that are uncorrelated with their quality, changing the level of listing requirements or introducing additional segments with different listing requirements changes the distribution of listed firms and affects thereby indirectly the values of listed firms. This indirect effect can either enforce or weaken the direct impact of more precise information on the value of firms.

If the difference in the incentives to list among firms of the same quality is small, the exchange might be induced to set a high level of listing requirements, which leads to a high information efficiency in the economy. If these differences are large, the exchange never sets a high level of listing requirements and efficiency is impeded.

This analysis yields a number of empirical implications. They concern competition for listings, valuation effects related to changes in listing requirements, the impact of listing requirements on the incentives of managers or controlling shareholders to extract private benefits, the relationship between the choice of a listing place by firms and decisions of a profit maximizing exchange, and finally, the link between the choice of a listing place by firms and what it signals about the characteristics of firms.

In this model, firms are assumed not to disclose their type voluntarily. An interesting extension of the present model would be to analyze how changes in listing requirements affect the decision of firms to voluntarily disclose information to the market. Due to the different compliance costs, good firms are likely to be imitated by bad firms regarding the choice of information precision. Because changes in listing requirements affect the distribution of listed firms, they might have an impact on the decisions regarding voluntary disclosure by listed and non listed firms. This question is left for future research.

References

Baba T., N. Yamori, 2001. Japanese management views on overseas exchange listings: survey results. Journal of International Financial Management and Accounting 12, 286 - 316

Bancel F., U. Mittoo, 2001. European managerial perceptions of the net benefits of foreign stock listings. European Financial Management 7, 213 - 236

Barth M., G. Clinch, T. Shibano, 1999. International accounting harmonization and global equity markets. Journal of Accounting and Economics 26, 201 - 235

Bhattacharya S., G. Chiesa, 1995. Proprietary information, financial intermediation, and research incentives. Journal of Financial Intermediation 4, 328 - 357

Biddle G., S. Saudagaran, 1995. Foreign listing location: a study of MNCs and stock exchanges in eight countries. Journal of International Business Studies 26, 319 - 341

Bushee B., C. Leuz, 2005. Economic consequences of the SEC disclosure regulation: evidence from the OTC bulletin board. Journal of Accounting and Economics 39, 233 – 264

Chavez G., C. Silva, 2006. Improved corporate governance: market reaction and liquidity implications. Working Paper

Chemmanur T., P. Fulghieri, 2006. Competition and co-operation among exchanges: a theory of cross-listing and endogenous listing standards. Journal of Financial Economics 82, 455 – 489

Coffee J., 2002. Racing towards the top? The impact of cross-listings and stock market competition on international corporate governance. Columbia Law Review 102, 1757 - 1831

Doidge C., A. Karolyi, R. Stulz, 2009. Has New York become less competitive in global markets? Evaluating foreign listing choices over time. Journal of Financial Economics 91, 253–277

Doidge C., A. Karolyi, R. Stulz, 2004. Why are foreign firms listed in the US worth more? Journal of Financial Economics 71, 205 - 238

Dye R., 1986. Proprietary and non-proprietary disclosures. Journal of Business 59, 331 - 366

Easley D., M. O'Hara, 2007. Microstructure and ambiguity. Working Paper

Engel E., R. Hayes, X. Wang, 2007. The Sarbanes-Oxley act and firms' going-private decisions. Journal of Accounting and Economics 44, 116 – 145

Fama E., K. French, 2004. New Lists: Fundamentals and survival rates. Journal of Financial Economics 73, 229 - 269

Faure-Grimaud A., D. Gromb, 2004. Public trading and private incentives. Review of Financial Studies 17, 985 - 1014

Fuerst O., 1998. A theoretical analysis of the investor protection regulations argument for global listing of stocks. Working Paper

Graham J., H. Campbell, S. Rajgopal, 2005. The economic implications of corporate financial reporting. Journal of Accounting and Economics 40, 3 – 73

Healy P., K. Palepu, 2001. Information asymmetry, corporate disclosure, and the capital markets: a review of the empirical literature. Journal of Accounting and Economics 31, 405 – 440

Holmström B., J. Tirole, 1993. Market liquidity and performance monitoring. Journal of Political Economy 101, 678 - 709

Houston C., R. Jones, 2002. Canadian manager perceptions of the US exchange listings: recent evidence. Journal of International Financial Management and Accounting 13, 235 - 253

Huddart S., J. Hughes, M. Brunnermeier, 1999. Disclosure requirements and stock exchange listing choice in an international context. Journal of Accounting and Economics 26, 237 – 269

Jenkinson T., T. Ramadorai, 2008. Do investors value high levels of regulation ? Working paper

Karolyi A., 2004. The role of American depositary receipts in the development of emerging equity markets. Review of Economics and Statistics 86

La Porta R., F. Lopez-de-Silanes, A. Shleifer, R. Vishny, 2002. Investor protection and corporate valuation. Journal of Finance 57, 1147 - 1170

Leuz C., A. Triantis, T. Wang, 2008. Why do firms go dark? Causes and economic consequences of voluntary SEC deregistrations. ECGI - Finance Working Paper No. 155/2007

Leuz C., 2007. Was the Sarbanes-Oxley act of 2002 really this costly? A discussion of evidence from event returns and going – private decisions. Journal of Accounting and Economics 44, 146 - 165

Leuz C., 2004. Proprietary versus non proprietary disclosures: evidence from Germany. Oxford University Press 2004

Macey J., M. O'Hara, 2002. The economics of stock exchange listing fees and listing requirements. Journal of Financial Intermediation 11, 297 - 319

Macey J., M. O'Hara, 2005. From markets to venues: securities regulation in an evolving world. Stanford Law Review 58, 563 – 599

Marosi A., N. Massoud, 2007. Why do firms go dark. Journal of Financial and Quantitative Analysis 42, 421 - 442

Marosi A., N. Massoud, 2008. You Can Enter but You Cannot Leave. . ." : U.S. Securities Markets and Foreign Firms. Journal of Finance 63, 2477 - 2506

Mendoza J., 2008. Securities regulation in low-tier listing venues: the rise of the alternative investment market. Fordham Journal of Corporate and Financial Law

Mittoo U., 1992. Managerial perceptions of the net benefits of foreign listing: Canadian evidence. Journal of International Financial Management and Accounting 4, 40 - 62

Nichols N., D. Street, 2007. The relationship between competition and business segment reporting decisions under the management approach of IAS 14 revised. Journal of International Accounting, Auditing and Taxation 16, 51 - 68

Pagano M., O. Randl, A. Roell, J. Zechner, 2001. What makes stock exchanges succeed? Evidence from cross-listing decisions. European Economic Review 45, 770 - 782

Pagano M., A. Roell, J. Zechner, 2002. The geography of equity listing: why do companies list abroad? Journal of Finance 57, 2651 – 2694

Piotroski J., S. Srinivasan, 2008. Regulation and bonding; the Saarbanes-Oxley Act and the flow of international listings. Journal of Accounting Research 46, 383 - 425

Roosenboom P., M. van Dijk, 2007. The market reaction to cross-listings: does the destination market matter? Working Paper

Sarkissian S., M. Schill, 2004. The overseas listing decision: new evidence of proximity preference. Review of Financial Studies 17, 769 - 809

Sarkissian S., M. Schill, 2009. Are there permanent valuation gains to overseas listing? Review of Financial Studies 22, 371-412

Siegel J., 2005. Can foreign firms bond themselves effectively by renting U.S. securities laws? Journal of Financial Economics 75, 319 – 359

Stoughton N., K. Wong, J. Zechner, 2001. IPOs and product quality. Journal of Business 74, 375 – 408

Verrecchia R., 2001. Essays on disclosure. Journal of Accounting and Economics 32, 97 – 180

Verrecchia R., 1983. Discretionary disclosure. Journal of Accounting and Economics, 5, 179 – 194

Yosha O., 1995. Information disclosure costs and the choice of financing source. Journal of Financial Intermediation 4, 3 – 20

Zhang I., 2007. Economic consequences of the Sarbanes-Oxley Act of 2002. Journal of Accounting and Economics 44, 74 – 115

Appendix

Lemma 1

The derivatives of the marginal firms are determined by the following equations:

$$\frac{\partial \tilde{c}_b}{\partial \theta} = \left(1 - \frac{2}{\theta^2}\Delta x \frac{\partial \Delta I_b}{\partial \tilde{c}_b}\right)^{-1} \frac{2}{\theta^2}\left(-\frac{2}{\theta}\left[(1-f)z - fx_b + \Delta x \Delta I_b\right] + \Delta x \frac{\partial \Delta I_b}{\partial \theta} + \Delta x \frac{\partial \Delta I_b}{\partial \tilde{c}_g}\frac{\partial \tilde{c}_g}{\partial \theta}\right) \quad \text{(A1)}$$

$$\frac{\partial \tilde{c}_g}{\partial \theta} = \left(1 - \frac{2}{\theta^2}\Delta x \frac{\partial \Delta I_g}{\partial \tilde{c}_g}\right)^{-1} \frac{2}{\theta^2}\left(-\frac{2}{\theta}\left[(1-f)z - fx_b + \Delta x \Delta I_g\right] + \Delta x \frac{\partial \Delta I_g}{\partial \theta} + \Delta x \frac{\partial \Delta I_g}{\partial \tilde{c}_b}\frac{\partial \tilde{c}_b}{\partial \theta}\right) \quad \text{(A2)}$$

First case: $\Delta c < \Delta c_T$

If $\Delta c < \Delta c_T$, firms separate at θ_{sep}. For levels of listing requirements below this threshold, $\theta < \theta_{sep}$, $\frac{\partial \tilde{c}_g}{\partial \theta} = 0$. It follows that $\frac{\partial \tilde{c}_b}{\partial \theta} < 0$. For levels of listing requirements above this threshold, $\theta > \theta_{sep}$, bad firms do not list and $\frac{\partial \Delta I_g}{\partial \theta} = 0$ so that $\frac{\partial \tilde{c}_g}{\partial \theta} < 0$.

Second case: $\Delta c > \Delta c_T$

If $\Delta c > \Delta c_T$, there is a range of θ in which the good and the bad marginal firms change simultaneously when the listing requirements change. The lower bound of this range, θ_{T1}, is such that ICg is binding for the good firms with the highest costs. Since the information gain of the bad firms with the highest costs is smaller than the one of the good firms with the highest costs, $\tilde{c}_b < c_h$ at this level of signal precision. The upper bound of this range, θ_{T2}, is such that ICb is binding for the bad firm with the lowest cost. Since the condition stated in equation 3 is not satisfied by assumption, $\tilde{c}_g < c_h$ at this level of signal precision.

$$\theta_{T1} = \sqrt{\left[(1-f)z - fx_b + \Delta x \Delta I_g(c^h, c_b^*, \theta)\right]\frac{2}{c^h}}\,,\ \theta_{T2} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(\tilde{c}_g, c_l, \theta)\right]}$$

Rearranging terms in equations A1 and A2 and solving for $\frac{\partial \tilde{c}_g}{\partial \theta}$ and $\frac{\partial \tilde{c}_b}{\partial \theta}$ yields:

$$\frac{\partial \tilde{c}_g}{\partial \theta} = \underbrace{\left(1 - D_g^{-1}\frac{2}{\theta^2}\frac{\partial \Delta I_b}{\partial \tilde{c}_g}\frac{\partial \Delta I_g}{\partial \tilde{c}_b}\Delta x^2\right)^{-1}}_{>0} D_g^{-1}\frac{2}{\theta^2}\left(G + D_b^{-1}B\frac{\partial \Delta I_g}{\partial \tilde{c}_b}\frac{2}{\theta^2}\Delta x\right) \quad \text{(A3)}$$

$$\frac{\partial \tilde{c}_b}{\partial \theta} = \underbrace{\left(1 - D_b^{-1}\frac{2}{\theta^2}\frac{\partial \Delta I_b}{\partial \tilde{c}_g}\frac{\partial \Delta I_g}{\partial \tilde{c}_b}\Delta x^2\right)^{-1}}_{>0} D_b^{-1}\frac{2}{\theta^2}\left(B + D_g^{-1}G\frac{\partial \Delta I_b}{\partial \tilde{c}_g}\frac{2}{\theta^2}\Delta x\right) \quad \text{(A4)}$$

$B = -\frac{2}{\theta}\left[(1-f)z - fx_b + \Delta x \Delta I_b\right] + \Delta x \frac{\partial \Delta I_b}{\partial \theta} < 0$ represents the loss directly related to a change in θ incurred by bad firms. The left term is the impact of the higher cost due to a higher θ and the right term is the decrease of the information gain of bad firms.

$D_b = \left(1 - \frac{2}{\theta^2}\Delta x \frac{\partial \Delta I_b}{\partial \tilde{c}_b}\right) > 1$ represents the effect of a change in the marginal bad firm on the valuation gain of bad firms. The more bad firms list, the smaller is their valuation gain which induces less of them to list. D_b reduces $\frac{\partial \tilde{c}_b}{\partial \theta}$.

$G = -\frac{2}{\theta}\left[(1-f)z - fx_b + \Delta x \Delta I_g\right] + \Delta x \frac{\partial \Delta I_g}{\partial \theta}$ is the valuation gain directly related to a change in θ experienced by good firms . The left term is the impact of higher costs when θ increases and the right term is the higher valuation gain.

$D_g = \left(1 - \frac{2}{\theta^2}\Delta x \frac{\partial \Delta I_g}{\partial \tilde{c}_g}\right)$ represents the effect of a change in the marginal good firm on the valuation gain of good firms. The more good firms list, the higher is their information gain which induces more of them to list. In what follows, I make the assumption that $D_g > 0$. Although mathematically, $D_g < 0$ is possible for some parameters, it makes little economic sense to assume that an increase in the marginal good firms leading to a higher valuation gain reduces the equilibrium marginal good firm.

The marginal good firm increases in θ if and only if the valuation gain of good firms directly related to an increase in θ is large enough:

$$\frac{\partial \tilde{c}_g}{\partial \theta} > 0 \;\Leftrightarrow\; G > -D_b^{-1} B \frac{\partial \Delta I_g}{\partial \tilde{c}_b}\frac{2}{\theta^2}\Delta x$$

The direct gain associated with the change in θ has not to be necessarily positive for this condition to hold, since the right hand side of the inequality is negative.

The marginal bad firm increases in θ if and only if G is positive and large enough:

$$\frac{\partial \tilde{c}_b}{\partial \theta} > 0 \;\Leftrightarrow\; G > -B\frac{D_g \theta^2}{2\Delta x \;\partial \Delta I_b / \partial \tilde{c}_g} > 0$$

Proposition 1

First case: $\Delta c < \Delta c_T$

Separation is possible if $\Delta c < \Delta c_T$. The exchange sets the level of listing requirements separating good firms from bad firms, θ_{sep}, if and only if the income from the listing fee is larger than when also bad firms list: $MV_g \omega + MV_b \frac{(\tilde{c}_b - c_l)}{\Delta c}(1-\omega) \leq x_g \omega$. θ_{sep} is such that $\tilde{c}_b = c_l$ and $\tilde{c}_g = c_h$: $\theta_{sep} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(c_h, c_l, \theta_{sep})\right]}$. For levels of listing requirements above θ_{sep}, $\theta > \theta_{sep}$, the value of the listed good firms does not increase in θ since it is their true value x_g but the number of listed firms decreases since $\frac{\partial \tilde{c}_g}{\partial \theta} < 0$. As a consequence the profit of the exchange decreases for $\theta > \theta_{sep}$. The exchange never sets the listing requirement above θ_{sep}. If the listing income is not the highest in the case of separation of firms, the exchange optimally sets a smaller level of listing requirements, $\theta < \theta_{sep}$.

Second case: $\Delta c > \Delta c_T$

If separation is not possible, the exchange sets θ'_{sep} at which no bad firm and a subset of good firms list. This is optimal if and only if:

$MV_g \omega(\tilde{c}_g - c_l) + MV_b(\tilde{c}_b - c_l)(1-\omega) \leq x_g \omega(\tilde{c}_g(\theta'_{sep}) - c_l)$. θ'_{sep} is determined such that $\tilde{c}_b = c_l$ and $c_l < \tilde{c}_g < c_h$: $\theta'_{sep} = \sqrt{\frac{2}{c_l}\left[(1-f)z - fx_b + \Delta x \Delta I_b(\tilde{c}_g, c_l, \theta'_{sep})\right]}$. A higher precision ($\theta > \theta'_{sep}$) is never optimal for the exchange since the number of listed firms decreases but their value remains constant at x_g. If it is not optimal to exclude bad firms from listing, the exchange sets $\theta < \theta'_{sep}$ in equilibrium. As $\Delta I_b(c_h, c_l, \theta_{sep}) > \Delta I_b(\tilde{c}_g, c_l, \theta'_{sep})$, $\theta'_{sep} < \theta_{sep}$.

Lemma 2

The efficiency measure is computed by adding the average misevaluations of all firms (differences between their true value and their market value gross of listing costs) weighted by the number of firms concerned by the specific misevaluation. It accounts for the size of

misevaluation as well as for the number of firms concerned. It is positive by construction. Efficiency is the highest when $E = 0$.

$$E = \frac{\omega}{\Delta c}\left((\tilde{c}_g - c_l)(x_g - \overline{MV}_g) + (c_h - \tilde{c}_g)(x_g - MV_{nl})\right) + \frac{(1-\omega)}{\Delta c}\left((\tilde{c}_b - c_l)(\overline{MV}_b - x_b) + (c_h - \tilde{c}_b)(MV_{nl} - x_b)\right) \quad \text{(A5)}$$

Rearranging terms yields:

$$E = \frac{\Delta x}{\Delta c}\left(-\omega(\tilde{c}_g - c_l)(p_{bs} + \theta(p_{gs} - p_{bs}) - p_{nl}) + (1-\omega)(\tilde{c}_b - c_l)(p_{bs} + (1-\theta)(p_{gs} - p_{bs}) - p_{nl})\right) + \Delta x(\omega + (1-2\omega)p_{nl}) \geq 0 \quad \text{(A6)}$$

In the case of the separating equilibrium, $p_{gs} = p_{bs} = 1$, $\tilde{c}_g = c_h$, $\tilde{c}_b = c_l$ and $p_{nl} = 0$. This gives $E = \Delta x\omega - \Delta x\omega = 0$. The separating equilibrium yields the highest possible efficiency. In all other equilibria, at least one term of equation (A5) is strictly positive. Thus, efficiency is never the highest.

$$\overline{MV}_g = x_b + \Delta x(p_{bs} + \theta(p_{gs} - p_{bs})$$

$$\overline{MV}_b = x_b + \Delta x(p_{bs} + (1-\theta)(p_{gs} - p_{bs})$$

$$MV_{nl} = p_{nl}x_g + (1 - p_{nl})x_b$$

Lemma 3

The welfare measure is computed by subtracting total compliance costs from the sum of realized growth opportunities:

$$W = z\left(\frac{\tilde{c}_g - c_l}{\Delta c}\omega + \frac{\tilde{c}_b - c_l}{\Delta c}(1-\omega)\right) - \omega\frac{\theta^2}{2}\int_{c_l}^{\tilde{c}_g}\frac{c}{\Delta c}dc - (1-\omega)\frac{\theta^2}{2}\int_{c_l}^{\tilde{c}_b}\frac{c}{\Delta c}dc \quad \text{(A7)}$$

Developing and rearranging terms yields:

$$W = \frac{1}{\Delta c}\left(z\left(\omega\tilde{c}_g + (1-\omega)\tilde{c}_b - c_l\right)\right) - \frac{\theta^2}{4}\left(\omega(\tilde{c}_g)^2 + (1-\omega)(\tilde{c}_b)^2 - c_l^2\right) \quad \text{(A8)}$$

In the case separation is possible, $\tilde{c}_g = c_h$. Welfare increases in the precision if and only if:

$$\underbrace{\frac{\partial\tilde{c}_b}{\partial\theta}}_{<0}(1-\omega)\left(z - \frac{\theta^2}{2}\tilde{c}_b\right) > \frac{\theta}{2}\underbrace{\left(\omega(\tilde{c}_g)^2 + (1-\omega)(\tilde{c}_b)^2 - c_l^2\right)}_{>0} \quad \text{(A9)}$$

The inequality (A9) can only hold if z is small enough: $z - \frac{\theta^2}{2}\tilde{c}_b < 0$.

If separation is not possible, welfare increases in the precision if and only if:

$$\frac{\partial \tilde{c}_b}{\partial \theta}(1-\omega)\left(z-\frac{\theta^2}{2}\tilde{c}_b\right)+\frac{\partial \tilde{c}_g}{\partial \theta}\omega\left(z-\frac{\theta^2}{2}\tilde{c}_g\right)>\frac{\theta}{2}\left(\omega(\tilde{c}_g)^2+(1-\omega)(\tilde{c}_b)^2-c_l^2\right) \quad \text{(A10)}$$

The inequality (A10) can only hold if its left hand side is positive: $\frac{\partial \tilde{c}_b}{\partial \theta}(1-\omega)\left(z-\frac{\theta^2}{2}\tilde{c}_b\right)>-\frac{\partial \tilde{c}_g}{\partial \theta}\omega\left(z-\frac{\theta^2}{2}\tilde{c}_g\right)$.

Proposition 2

First case: upper tier segment (UTS)

θ is the signal precision on the UTS and θ_{reg} is the signal precision on the main segment.

Good firms list on the UTS if and only if $\Delta I_g(\theta)-\Delta I_g(\theta_{reg})>\frac{c}{2}\left(\theta^2-\theta_{reg}^2\right)$. Bad firms list on the UTS if and only if $\Delta I_b(\theta)-\Delta I_b(\theta_{reg})>\frac{c}{2}\left(\theta^2-\theta_{reg}^2\right)$. Consider h as the proportion of good firms among listed firms on the UTS and h_{reg} as the proportion of good firms among listed firms on the main segment. If $h \geq h_{reg}$, and $\Delta I_b(\theta)-\Delta I_b(\theta_{reg})$ <0. Bad firms never list and good firms list as long as $\Delta V_g>\frac{c}{2}\left(\theta^2-\theta_{reg}^2\right)$. However, in this case, $h<h_{reg}$, which contradicts the assumption. Thus, $h \geq h_{reg}$ cannot hold in equilibrium. If $h>h_{reg}$, $\Delta I_g(\theta)-\Delta I_g(\theta_{reg})>0$ and $\Delta I_b(\theta)-\Delta I_b(\theta_{reg})>0$ if $h_{reg}-h$ is high enough. Good firms list as long as $\Delta V_g>\frac{c}{2}\left(\theta^2-\theta_{reg}^2\right)$ and bad firms list until $h_{reg}-h$ is such that $\Delta V_b=\frac{c}{2}\left(\theta^2-\theta_{reg}^2\right)$. Since the latter equation holds only if $h<h_{reg}$, this case can be an equilibrium.

Crowding out effect in the case of an UTS

Assume that $\tilde{c}_g=\tilde{c}_{g,m}$ and $\tilde{c}_b=\tilde{c}_{b,m}$. For $h<h_{reg}$ to hold, the number of good firms listing on the UTS instead of the main segment must be higher than the number of bad firms listing on the UTS instead of the main segment. $\tilde{c}_{g,s}>\tilde{c}_{b,s}$. This implies that the proportion of good firms among listed firms on the main segment in the case of segmentation is higher than without segmentation: $\frac{\tilde{c}_b-c_l}{\tilde{c}_g-c_l}<\frac{\tilde{c}_b-\tilde{c}_{b,s}}{\tilde{c}_g-\tilde{c}_{g,s}}$. However, in this case, the information gains of firms listing on the main segment, $\Delta I_g(\theta_{reg})$ and $\Delta I_b(\theta_{reg})$, diminish. This leads to smaller

marginal firms on the main segment: $\tilde{c}_g > \tilde{c}_{g,m}$ and $\tilde{c}_b > \tilde{c}_{b,m}$. Because the marginal firms on the main segment change when there is segmentation, the proportion of good firms on this segment also changes. If following the exit of some firms, this proportion increases to reach its former level or become larger, there is no reason for the firms that left to remain outside the market. However, the equilibrium condition for segmentation requires the proportion on the main segment to diminish for equal marginal firms. Therefore, this cannot be an equilibrium. As a consequence an equilibrium with segmentation is only possible, if the proportion of good firms on the main segment remains below its level without segmentation.

Second case: lower tier segment (LTS)

θ is the signal precision on the LTS and θ_{reg} is the signal precision on the main segment.

The argument for the existence of an equilibrium with a lower tier segment is similar to the previous case. Good firms list on the LTS if and only if $\Delta I_g(\theta_{reg}) - \Delta I_g(\theta) < \frac{c}{2}\left(\theta_{reg}^2 - \theta^2\right)$. Bad firms list on the LTS if and only if $\Delta I_b(\theta) - \Delta I_b(\theta_{reg}) > \frac{c}{2}\left(\theta^2 - \theta_{reg}^2\right)$. Since $\theta < \theta_{reg}$, the compliance costs on the lower tier segment are smaller and good firms might list on this segment even if $\Delta I_g(\theta_{reg}) - \Delta I_g(\theta)$ is positive. Assume that the proportion of good firms is equal on both segments, $h = h_{reg}$. In this case $\Delta I_b(\theta) - \Delta I_b(\theta_{reg}) > 0$ and $\Delta I_g(\theta) - \Delta I_g(\theta_{reg}) < 0$. All bad firms list on the lower tier segment instead of the main one and good firms list as long as the cost savings offset the smaller valuation gain. However, in this case, the proportion of good firms on the main segment is higher than on the LTS: $h < h_{reg}$. Thus segmentation cannot be an equilibrium with equal proportions of firms on both segments. The same contradiction exists if the proportion of good firms is assumed to be larger on the LTS. If $h > h_{reg}$, all bad firms gain from listing on the LTS instead of the main segment. However, in this case $h < h_{reg}$,which contradicts the assumption. If the proportion of good firms is larger on the main segment than on the LTS, $h < h_{reg}$,bad firms list as long as the smaller proportion of good firms on the LTS does not offset the valuation gains from the lower listing requirements and the cost savings. Good firms list only if their valuation loss is offset by cost savings. Thus, an equilibrium with a LTS is only possible if $h < h_{reg}$.