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## On Competition for Listings

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## Abstract

We construct a model whereby stock exchanges take a new role as an information intermediary, notably absent in their roles. We show that exchanges differentiate themselves at subgame perfect equilibrium and will not race to the top or the bottom.

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# 1 Introduction

The rapid integration of the world capital markets has resulted in intensive competition in the securities exchange industry in recent years. Stock exchanges have aggressively sought to consolidate or formulate alliance with their competitors locally and across national borders. One ponders over what exchanges could do next? We suggest that exchanges leverage on their reputation capital to serve as information intermediaries for listings firms. The advantage of this suggestion is twofold. First, it sets a barrier to mimicry. Second, it will put the reputable exchanges in a better position to take advantage of the growth opportunities arising from the emerging economies. The latter advantage is particularly important because future potential listing growth is more likely to come from emerging economies. Evidently, the number of Sponsored Depository Receipts (SDRs) created from the emerging economies of Asia and Latin America has grown dramatically over the past few decades. Such numbers have grown from zero to 480 and 277 for Asia and Latin America, respectively.<sup>1</sup> As there exists severe information asymmetry with regard to the quality of firms in these emerging economies, our suggested (currently absent) role for exchanges to be information intermediaries is imperative. To serve as information intermediaries, the exchanges will need to do more than what they currently practice and conduct due diligence on the listing firms beyond merely checking for compliance with their listing requirements, an expanded set of requirements. We refer to this expanded set of requirements as simply the “listing requirements” in our model.

We model an adverse selection game, where two stock exchanges compete for listing by setting their listing requirements in the first stage. Unlike what has been common in most of the literature, we assume that market participants are fully informed about the reputation of the exchanges (for example, see Yates (1997)). We capture the effect of exchange’s reputation by assuming that the costs borne by an exchange is increasing at an increasing rate with the number of listings or with the decline in listing requirements. In other words, it is more costly at the margin to list the next lower quality firm because it is more likely that an exchange will sustain damages to its reputation. In the second stage, firms decide which exchange to list their securities. To be listed on an exchange, a firm must meet the listing requirements of the exchange and hence will incur a compliance costs. Compliance costs are assumed to be inversely proportional to a firm’s quality since a lower quality firm will find it more costly to meet the listing requirements. This is in the same spirit as Spence (1973) where he assumes that education is less costly for more productive workers.

Our model is closely related to Chemmanur and Fulghieri (2006) and Doidge et al. (2004). Similar to our model, Chemmanur and Fulghieri investigate the interaction between the reputation of competing exchanges and

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<sup>1</sup>The data is from Bank of New York Mellon and includes major depository banks such as Bank of New York Mellon, Citibank, Deutsche Bank, J. P. Morgan Chase and Computershare Trust. See Tay and Oladi (2011) for more details.

listing standards but there are two shortcomings in their model which we address in our model. First, they model the effect of reputation by assuming the presence of a *standard maximizing* exchange that is not concerned with maximizing value. Second, they ignore the compliance costs that listing firms will have to incur if they choose to list on an exchange. This is an important consideration for listing firms since there is a tension between the potential of gaining value from listing on a high quality exchange and the incurrence of higher compliance costs imposed by a high quality exchange. Both assumptions in Chemmanur and Fulghieri are unrealistic. We endogenized the effect of reputation in the payoff function for the exchange and incorporate the compliance costs in the payoff function for the listing firms. Doidge et al. (2004) take the exchange's listing requirement as exogenous. Unlike Doidge et al. (2004), we investigate the equilibrium that emerges as a result of the dynamic interaction between the decisions of competing exchanges and listing firms where both sides are striving to maximize their value. Hence our model is able to shed light on the decision of the exchange and firms. Thus, our paper fills a crucial gap in this stream of literature.<sup>2</sup>

## 2 The analysis and results

Assume there are two stock exchanges, H and L, competing for listing. These exchanges self-regulate by self-imposing a minimum listing requirements. Unlike the usual interpretation of listing requirements, we assume here that listing requirements include all the necessary due diligence to assess the prospective value of a firm. As we have explained in the introduction, this is essential for exchanges to serve as information intermediaries. Any firm that is listed on an exchange must then meet this level of requirements. The true value of a firm is uncertain to investors and both stock exchanges. However, they know the probability distribution of the value. Assume that the value of every firm, denoted by  $v$ , is uniformly distributed along the unit interval, i.e.,  $v \in [0, 1]$ . We normalize the number of firms in the economy to unity. The management of each firm tries to maximize the value of his firm, as perceived by investors, net of listing costs. We further assume that each firm has one share.

Our game is a game of adverse selection similar to Akerlof (1970). It is a sequential game. First, two stock exchanges, denoted by  $H$  and  $L$ , choose their listing requirements  $\theta_i \in [0, 1], i = H, L$ . Second, firms choose where to list their stock by essentially selecting their listing levels (i.e., disclosure levels), denoted by  $\theta$ , where  $\theta \in [0, 1]$ .<sup>3</sup> It is worth emphasizing that the list requirements is chosen endogenously. The payoff functions for the stock

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<sup>2</sup>See also Cihaka and Podpiera (2008) and Tay and Oladi (2011).

<sup>3</sup>See also Chakrabarti (2003) for a similar set up in the context of spatial distribution of FDI, Long et al. (2005) and Bond (2005) for production fragmentation continuum, Marjit (2007) for trade theory and time zones, and Beladi and Oladi (2011) for spacial distribution of goods and technical progress.

exchanges are given by:

$$u_i = PQ_i - C_i(Q_i) \quad i = L, H \quad (1)$$

where  $P$  and  $Q_i$  are the the combined fees<sup>4</sup> and the number of firms listed respectively. Moreover,  $C_i$  is the cost faced by the exchange for managing the listed firms. We normalize the combined fees to unity and assume that  $0 < C_i < 1$ ,  $C'_i > 0$  and  $C''_i \geq 0$ . We also assume that the marginal cost for exchange  $H$  is higher than for  $L$ , for any given listing level, i.e.,  $C'_H(Q) > C'_L(Q), \forall Q \in [0, 1]$ . This assumption is at the core of the reputation capital aspect of our model. Generally, it is customary that a more efficient or better quality firm enjoys lower marginal (or unit) cost of production than a lower quality firm does. In contrast in the present context the better quality exchange has a higher marginal cost. This stems from the higher reputation capital of the better quality exchange. In other words, to list a marginal firm it will cost the reputable exchange more due to the possible consequences this may have on its reputation. Note that a higher listing level implies a lower listing requirement. This assumption states that for additional listing, it costs more to the higher quality exchange than the lower quality. In the rest of the paper we assume a simple quadratic form for the cost function,  $C_i = c_i Q_i^2, i = H, L,$ , where  $c_i \in (0, 1)$ .<sup>5</sup>

The payoff function for a firm with true value  $v$  is given by:<sup>6</sup>

$$\Pi = E(v|i) - \frac{\theta^2}{v} \quad i = H, L \quad (2)$$

where  $E(v|i)$  is the expected value of the firm conditional on being listed on stock exchange  $i = H, L$ . This is the value that investors in the market place on the firm. The firm's value is conditional on being listed on an exchange. As investors face asymmetric information, listing reduces information asymmetry. That is, listing conveys information about the value of the firms to the investors, where  $(\theta^2/v)$  represents the listing cost of the firm. Note that the marginal cost of listing is decreasing in the value of the firm. As noted earlier, this is consistent with Spence (1973), where he assumes that education is less costly for more productive workers.

We shall now investigate the behavior of the exchanges and firms in a subgame perfect equilibrium. Note that the management of any firm knows the true value of its firm. Given a level of listing requirements announced by an exchange and the fact that listing is costly, there must exist a lower bound on the value of the firm below which the

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<sup>4</sup>This includes listing and trading fees. Further, we assume that each listed firm brings about a constant trading volume so each listed firm will contribute a constant dollar amount for the trading fees.

<sup>5</sup>This specific functional form simplifies our model significantly as it becomes more tractable without much loss in generality. Employing simple quadratic cost functions are not uncommon in economics literature, for example, see Oladi et al. (2008).

<sup>6</sup>Since we assume that each firm has one share and  $P$  is a constant and normalized to one, the contribution of the combined listing and trading fees to the costs faced by listed firms is just a constant and therefore may be omitted from the payoff function. The only remaining relevant costs is the compliance costs for the firms which we represent as  $\theta^2/v$ . Note also that although firms choose the minimum level set by an exchange at equilibrium, their set of actions includes all level of listing requirements on zero-one interval. For this reason we drop the subscript for  $\theta$  in their payoff functions.

management will not be willing to list their shares on that exchange. Consider a firm with a true value  $v$ . For this firm to be willing to list on exchange  $H$ , the lower bound for the firm value should satisfy  $v - \theta_H^2/v = 0$ .<sup>7</sup> That is, the management would be willing to list on  $H$  if the true value of the firm is at least equal to  $\theta_H$ . Recall that only the management knows the firm's true value. Even though investors do not know the true value of the firm, they are aware of the lower bound face by the management. Thus, to the investors, the expected value of any firm that lists on a stock exchange, say  $H$ , is equal to  $(1 + \theta_H)/2$ . The investors can evaluate the value of all other firms in a similar way. Therefore, given the listing requirement self-imposed by stock exchanges, i.e.,  $\theta_i, i = H, L$ , a firm maximizes the following payoff function:

$$\Pi = \begin{cases} (1 + \theta_H)/2 - \theta^2/v & \theta \geq \theta_H \\ (\theta_H + \theta_L)/2 - \theta^2/v & \theta_L \leq \theta < \theta_H \\ \theta_L/2 & \theta < \theta_L \end{cases} \quad (3)$$

**Proposition 1.** *In a subgame perfect equilibrium (i) all firms with values  $v \in [2(\theta_H^2 - \theta_L^2)/(1 - \theta_L), 1]$  will list only on stock exchange  $H$ ; (ii) all firms with values  $v \in [2\theta_L^2/\theta_H, 2(\theta_H^2 - \theta_L^2)/(1 - \theta_L))$  will list only on exchange  $L$ ; (iii) all firms with values  $v \in [0, 2\theta_L^2/\theta_H)$  will not list on either exchange.<sup>8</sup>*

*Proof.* Since listing is costly, any firm that lists on an exchange  $i = H, L$ , will choose to disclose only the minimum level ( $\theta_i$ ) that is required by the respective exchange. Consequently, a firm with value  $v$  will be indifferent between listing on exchange  $H$  or  $L$ , if its payoff satisfies  $(1 + \theta_H)/2 - \theta_H^2/v = (\theta_H + \theta_L)/2 - \theta_L^2/v$ . From this condition, we observe that firms that choose to list on exchange  $H$  must have a value of at least  $\hat{v} = 2(\theta_H^2 - \theta_L^2)/(1 - \theta_H)$ . Using a similar argument, firms that choose to list on exchange  $L$  must have a value of at least  $2\theta_L^2/\theta_H$ .  $\square$

Now consider the first stage of the game where the stock exchanges choose their listing requirements. Stock exchange  $H$  maximizes (1) subject to its market share defined by Proposition 1, that is,  $\max_{\theta_H} u_H$  such that  $Q_H = 1 - 2(\theta_H^2 - \theta_L^2)/(1 - \theta_L)$ . By substituting this condition into  $H$ 's payoff function the maximization problem reduces to  $\max_{\theta_H} u_H(\theta_H, \theta_L)$ . Let  $\phi_H(\theta_L) \in \text{argmax}_{\theta_H} u_H(\theta_H, \theta_L)$ .  $\phi_H(\theta_L)$  is the best response correspondence of exchange  $H$  and is characterized by the following lemma.

**Lemma 1.** *There exists a level of  $\theta_L$  above (below) which  $\phi_H(\theta_L)$  is increasing (decreasing) in  $\theta_L$ . Moreover,  $\phi_H(\theta_L) > \theta_L, \forall \theta_L \in [0, 1)$ , if  $c_H > 1/2$ .*

<sup>7</sup>Put this differently, a firm will not list on  $H$  if such a listing leads to a negative payoff. A borderline firm, for which this zero payoff condition is met, may still list on  $H$ .

<sup>8</sup>Here we assume that there exists an over-the-counter listing option where firms with lower value list their shares if they do not meet the requirements of exchange  $H$  and  $L$ .

*Proof.* It could be shown that the first order condition of exchange  $H$  is satisfied if:

$$1 - 2c_H + \frac{4c_H(\theta_H^2 - \theta_L^2)}{1 - \theta_L} = 0 \quad (4)$$

By totally differentiating this equation with respect to  $\theta_H$  and  $\theta_L$  we obtain:

$$\frac{d\theta_H}{d\theta_L} = \frac{2\theta_L - \theta_L^2 - \theta_H^2}{2\theta_H(1 - \theta_L)} \quad (5)$$

It is clear that the denominator is always positive while the sign of the numerator is ambiguous. However, for relatively low levels of  $\theta_L$ , the numerator is negative.<sup>9</sup> It remains to show that equation (4) gives maxima. The second order condition for the exchange  $H$  is given by:

$$\frac{d^2u_H}{d\theta_H^2} = -\frac{32c_H\theta_H^2}{(1 - \theta_L)^2} < 0 \quad (6)$$

Note that we used the first order condition to simplify the second order condition. Finally, equation (4) will be satisfied, given that  $c_H > 1/2$ , if and only if  $\theta_H > \theta_L$ . Thus,  $\phi_H(\theta_L) > \theta_L$  if  $c_H > 1/2$ .  $\square$

Similarly, exchange  $L$  maximizes  $\max_{\theta_L} u_L$  such that  $Q_L = 2(\theta_H^2 - \theta_L^2)/(1 - \theta_L) - 2\theta_L^2/\theta_H$ . We can reduce this maximization problem to  $\max_{\theta_L} u_L(\theta_H, \theta_L)$ . Denote the best response correspondence of this stock exchange by  $\phi_L(\theta_H)$ , that is,  $\phi_L(\theta_H) \in \text{argmax}_{\theta_L} u_L(\theta_H, \theta_L)$ . The following lemma characterizes this best response correspondence.

**Lemma 2.**  $\phi_L(\theta_H)$  is non-increasing (increasing) in  $\theta_H$  for low (high) value of  $\theta_L$ . Moreover,  $\phi_L(\theta_H) < \theta_H, \forall \theta_H \in (0, 1]$ .

*Proof.* Since  $c_L > 0$ , first order condition of exchange  $L$  could be reduced to:

$$1 - 2c_L \frac{2\theta_H^3 - 2\theta_H\theta_L^2 - 2\theta_L^2 + 2\theta_L^3}{(1 - \theta_L)\theta_H} = 0 \quad (7)$$

Totally differentiate this equation with respect to  $\theta_H$  and  $\theta_L$  to obtain:

$$\frac{d\theta_L}{d\theta_H} = \frac{1 - \theta_L - 4c_L(3\theta_H^2 - \theta_L^2)}{\theta_H - 4c_L(2\theta_H\theta_L + 2\theta_L - 3\theta_L^2)} \quad (8)$$

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<sup>9</sup>At the extreme when  $\theta_L = 0$  we have  $d\theta_H/d\theta_L = -\theta_H/2$ .

Again, as in best response for exchange  $H$ , the slope sign of best response for exchange  $L$  depends on magnitudes of  $\theta_H$  and  $\theta_L$  for any given  $c_L$ . At one extreme, when  $\theta_L = 0$ , we have  $d\theta_L/d\theta_H = (1 - 12c_L\theta_H^2)/\theta_H$ . Let us first consider the case when  $c_L \in [1/4, 1]$ . Note from equation (7) that in this case  $\theta_H \in [1/2, 1]$ , that is the range at which the equation (7) is satisfied when  $\theta_L = 0$ . It then follows that  $(1 - 12c_L\theta_H^2)/\theta_H < 0$ . Now, consider the case when  $c_L < 1/4$ . Then, the best response of exchange  $L$  intersects the  $\theta_H$  axis at  $\theta_H > 1$ , which is not in the space of strategies for exchange  $H$ . In such cases (i.e., when  $c_L < 1/4$ ) the best response for  $L$  is vertical, i.e., non-increasing. Therefore, we conclude that the best response function for exchange  $L$  is non-increasing at  $\theta_L = 0$  for all  $c_L$ . To see that  $\phi_L(\theta_H)$  becomes increasing at some sufficiently large  $\theta_L$ , note that it is evident from equation (7) that  $\theta_L$  approaches 1 when  $\theta_H$  approaches 1 for any  $c_L$ , given that  $\theta_L > 0$ . (Recall that we can also have  $\theta_L = 0$  when  $\theta_H = 1$ . However, we have already considered this case.) It remains to show the sufficient condition. The second order condition for exchange  $L$  is given by:

$$\frac{du_L}{d\theta_L^2} = -2c_L\Omega^2 < 0 \quad (9)$$

where  $\Omega = (2\theta_L^2 + 2\theta_H^2 - 4\theta_L)/(1 - \theta_L)^2 - 4\theta_L/\theta_H$ .

It is left to show that  $\phi_L(\theta_H) < \theta_H, \forall \theta_H \in (0, 1]$ . To prove this assume the negation, i.e., along the best response we have  $\theta_L \geq \theta_H$ . Then using equation (7), we conclude that  $1 = 2c_L[2(\theta_H^3 - \theta_H\theta_L^2) - 2\theta_L^2(1 - \theta_L)]/[(1 - \theta_L)\theta_H] < 0$ , which is a contradiction. The inequality follows from the observation that the numerator is negative since  $\theta_H^3 \leq \theta_H\theta_L^2$  by our earlier assumption.  $\square$

Lemmas (1) and (2) express that both best response correspondences have a minimum level of  $\theta_H$ . Moreover, Lemma 1 states that that exchange  $H$  never lowers its requirements below that of exchange  $L$ , while according to Lemma 2 exchange  $L$  never leapfrogs exchange  $H$ .

We now turn to our main result. Let  $\hat{\theta}_i$  denote an equilibrium strategy of exchange  $i = H, L$ . The following proposition characterizes these strategies.

**Proposition 2.** *If  $c_H > 1/2$ , there exists a stable subgame perfect equilibrium that permits two viable exchanges such that  $0 = \hat{\theta}_L < \hat{\theta}_H < 1$ .*

*Proof.* In the second stage of the game firms behave as characterized by Proposition 1. In the first stage, both exchanges choose their stage game equilibrium  $\hat{\theta}_H$  and  $\hat{\theta}_L$ , where  $\hat{\theta}_i = \phi_i(\hat{\theta}_j), \forall i, j = H, L$ . We will show that such a fixed point exists. Define  $\bar{\theta}_H \equiv \phi_H(0) = \sqrt{2c_H - 1}/(2\sqrt{c_L})$ . Clearly,  $\bar{\theta}_H > 0$  if  $c_H > 1/2$ . Also, let  $\tilde{\theta}_H = \max\{\theta_H | \phi_L(\theta_H) = 0\}$ , that is,  $\tilde{\theta}_H$  is the greatest value of  $\theta_H$  for which  $\phi_L = 0$ . It follows from equation (7) that



$\tilde{\theta}_H = 1/2\sqrt{c_L}$ . These imply that  $\bar{\theta}_H = \tilde{\theta}_H \sqrt{c_L/c_H} \sqrt{2c_H - 1}$ , which in turn implies that  $\bar{\theta}_H < \tilde{\theta}_H, \forall c_H \in [1/2, 1)$ , as  $c_L < c_H$ . This as well as Lemmas 1 and 2 indicate that a fixed point exists at which  $\hat{\theta}_L = 0 < \hat{\theta}_H$  (see also Figure 1). Finally, note that  $\hat{\theta}_H = \bar{\theta}_H$ , concluding that  $\hat{\theta}_H < 1, \forall c_H \in (1/2, 1)$ .

It is left to show that this equilibrium is stable. We use the well-known condition, i.e.,  $\Lambda = (\partial^2 u_H / \partial \theta_H^2)(\partial^2 u_L / \partial \theta_L^2) - (\partial^2 u_H / \partial \theta_H \partial \theta_L)(\partial^2 u_L / \partial \theta_L \partial \theta_H) > 0$ . By differentiating equations (4) and (7) with respect to  $\theta_L$  and  $\theta_H$ , respectively, and using equations (6) and (9) we obtain  $\Lambda = c_L(64c_H + 8 - 12\theta_H)\Omega^2$ , where  $\Omega$  is defined as in Lemma 2. However, at our equilibrium we have  $(64c_H + 8 - 12\sqrt{1 - 1/2c_H}) > 0$ , where the inequality is due to the fact that  $\sqrt{1 - 1/2c_H} < 1/2, \forall c_H \in (1/2, 1)$ . This concludes that  $\Lambda > 0$ .  $\square$

It is worth noting that the condition on the viability of both exchanges is necessary for the equilibrium requirement levels characterized by the proposition. In fact if the cost of listing for exchange  $H$  is low enough, the equilibrium requirement for both exchanges will be zero, implying that all firms list on exchange  $H$  and the exchange  $L$  ceases to exist. It could be shown that such a result appears as an equilibrium if  $c_H \leq 1/2$ .

### 3 Some concluding remarks

The rapid integration of the world capital markets has led to an intense competition in the securities exchange industry. We have formulated a model where exchanges take an informational intermediary role. This is particularly crucial as evidently most of the growth will likely come from listing and trading the securities of firms from those emerging economies that results in information asymmetry when dealing with the emerging markets. To demonstrate that such a strategy will not lead to a race to the top or race to the bottom, we develop a game theoretic model of the interaction between exchanges and listing firms that focuses on the expanded role of an exchange as an information intermediary. Our model bears some resemblance to the adverse selection model of Akerlof (1970). Our results reveal that a stable sub-game perfect equilibrium exists in which an exchange with high (low) reputational capital chooses to impose more (less) stringent listing requirements and attract firms with better (lesser) prospects. Our results also suggest that higher quality firms from emerging economies such as China will gain more by listing with more reputable exchanges.

The model developed in this paper can be extended in several directions. First, it would be interesting for one to do similar analysis at the presence of variable combined fee. Second, one can use our model to study cooperation among exchanges.

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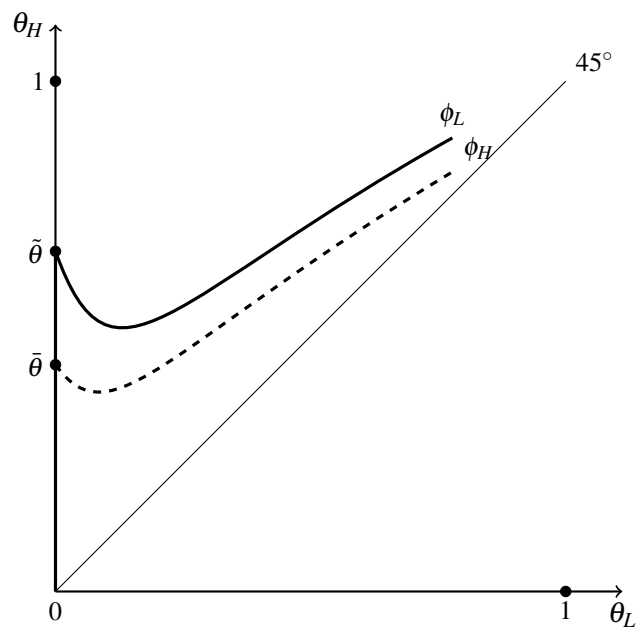


Figure 1: Best response correspondences and Nash equilibrium in the first stage