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## Equilibrium corporate ownership structure with free-riding

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**Equilibrium Corporate Ownership Structure  
with Free-Riding**

von

Kai A. Konrad

October 1992

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**EQUILIBRIUM CORPORATE OWNERSHIP STRUCTURE  
WITH FREE-RIDING**

by

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\* I benefited from discussion with Harris Schlesinger and Hans-Werner Sinn.

**Abstract**

Management control by shareholders is a public good. In the Nash equilibrium only the largest shareholder spends effort on management control. This is an incentive not to be the largest shareholder, and this incentive determines some properties of equilibrium corporate ownership structure. In particular, a perfect market with endogenous shareholdings and Nash behavior cannot overcome the underprovision problem implied by the public good problem, even if any diversification incentive for risk sharing is absent.

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## 1. Introduction

The determinants of corporate ownership structure and the efficiency properties of the equilibrium ownership structure have received considerable attention in various fields of economics and finance. Capital market theory suggests that capital market ownership structure is determined by the risk spreading potential that is provided by these markets (Sharpe 1964, Lintner 1965, and Mossin 1966). This model suggests a powerful incentive for a very dispersed ownership structure. However, institutional and informational aspects are also relevant. Diversification is not costless. Transaction costs, for example, may reduce incentives for diversification (Mayshar 1979, Leape 1987). Corporate ownership structure has also been considered as a signalling device to overcome the asymmetric information problems, for instance in new public offerings (Leland and Pyle 1977, Myers and Majluf 1984, Welch 1989, Konrad 1991).

Perhaps similarly important for explaining the structure of corporate ownership are informational aspects, in particular the control problem discussed in the theory of the firm.<sup>1</sup> In his (1985) review article Stiglitz pointed out the incentive problems of multiple owners in sharing the burden of monitoring. A shareholder who spends effort on management control provides a pure public good; all other shareholders participate in the benefits of improved management performance.

Demsetz and Lehn (1985) and McConnell and Servaes (1990) could not find strong empirical evidence for a positive correlation between profits and ownership concentration. Krause (1988) found that stock-market performance and systematic risk measures were systematically related to the degree of control of the firm by the largest shareholder. Leech and Leahy (1989) found evidence for a positive effect of

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<sup>1</sup> Among the classical references are Berle and Means (1932) and Jensen and Meckling (1976). See Holmstrom and Tirole (1989) for an overview.

ownership control on firm performance in Great Britain. McConnell and Servaes (1990, p. 603) state "Thus, at this level of aggregation, our results are not inconsistent with the conjecture that large blockholders and inside owners operate in conjunction with each other to influence corporate values". Wruck (1989) reports significant evidence that an increase in stock ownership concentration leads to an increase in market value, and Morck, Shleifer and Vishny (1988) provide evidence that ownership concentration among CEO's as well as among outside members of the board, influence firm performance. This evidence suggests that different monitoring incentives that result from different ownership structure influence firm performance.

This paper explores the relationship between ownership structure and the incentives for provision of management control. The paper first derives the properties of the equilibrium of private provision of management control for given shareholdings. Second, and this is the main focus of this paper, it considers the incentive effects of this private provision game on corporate ownership structure. The standard model of private provision of public goods (see, e.g., Bergstrom *et al.*, 1986) seems to be a good candidate for explaining and describing properties of voluntary provision of control by shareholders. It seems to be plausible that what makes shareholders willing to spend effort on monitoring is the improvement in management performance achieved.

It may be expected that shareholders anticipate the incentive problems of management control, and, therefore, that less diversified ownership structures will result than those suggested by a capital asset pricing model that disregards the principal agent problem of corporate control. Demsetz (1983) argues that observed corporate ownership structure is an endogenous outcome in which various cost advantages and disadvantages are balanced to reach an equilibrium structure. Similarly, Jensen and Meckling (1976, p. 352) argue: "If the costs of reducing the dispersion of ownership are lower than the benefits to be obtained from reducing the



agency costs, it will pay some individual or group of individuals to buy shares in the market to reduce the dispersion of ownership."

This paper analyses a determinant of corporate ownership structure that may require these insights to be qualified. First, the paper shows that, in a Nash equilibrium, the largest shareholder bears all the burden of control while all others free ride. This is a strong incentive not to be the largest shareholder and it determines properties of an endogenous equilibrium structure of corporate ownership. The equilibrium properties reveal that history matters for ownership structure. Large shareholders turn out to be locked in. Given a particular share distribution, a Pareto superior reallocation of ownership may exist, but cannot be reached in a competitive equilibrium.

## 2. The Nash equilibrium of voluntary corporate control

Consider a single firm. The firm is managed by a director who does not own shares of the firm. This raises a control problem. The best principal agent contract that can be devised, given the available information technologies, leads to expected profit for shareholders described by a function

$$(1) \quad \pi = EF(\omega, m),$$

where  $\omega$  is a random variable with finite moments,  $m$  is the aggregate amount of monitoring and  $E$  is the expectations operator. Suppose that profit  $F$  does not change its support for different values of  $m$ , but  $\pi_m \equiv \partial EF / \partial m > 0$  and  $\pi_{mm} \equiv \partial^2 EF / (\partial m)^2 < 0$ . Expected profit is increasing with monitoring effort, but at a decreasing rate. Profit function (1) is motivated by the idea that more monitoring allows for a principal agent contract that is closer to a first best outcome.

Let  $N = \{1, \dots, n\}$  be the set of blockholding shareholders  $i \in N$ , i.e., shareholders

with non-atomistic holdings  $\alpha_i > 0$  such that  $\alpha = \sum_i \alpha_i$ . The remaining fraction  $(1-\alpha) \geq 0$  is owned by a continuum of shareholders who provide a competitive market for firm shares (a competitive fringe). They are atomless in the sense that, with regard to all strategic decisions where the size of one's ownership fraction plays some role, they act as if they owned none.<sup>2</sup> Each shareholder can spend resources on monitoring. Let  $m_i$  be the amount spent by shareholder  $i$ . Competitive fringe shareholders will never spend any effort on monitoring, non-atomistic shareholders may. Various assumptions are possible to describe how monitoring effort of shareholders translates into aggregate monitoring of the firm. This paper assumes that

$$(2) \quad m = \sum_i m_i.$$

Monitoring effort is assumed to be additive. The assumption is not critical for the results in this paper. An alternative assumption with

$$(2a) \quad m = \max\{m_i \mid i \in N\}$$

would yield very similar results. The latter would mean that two shareholders who choose the same monitoring effort simply find out about the same things. They do parallel research, and, therefore, the information that comes out is the same as if

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<sup>2</sup> This structure is adopted from Shleifer and Vishny (1986). The paper could do without competitive fringe by assuming that participation in monitoring requires some arbitrarily small amount of fixed cost. Say a shareholder has to open a book, or take up the phone before he can start monitoring, then this assumption leads precisely to the behavioral assumption that very small ownership fractions do not actively participate in monitoring.

only one of them had monitored.<sup>3</sup>

Finally, the utility function of shareholders is linear, i.e., expected utility is

$$(3) \quad Eu_i = y_0 + \alpha_i \pi - m_i,$$

where  $y_0$  is the expected value of income from other sources,  $m_i$  is  $i$ 's monitoring effort, and  $\alpha_i \pi$  is  $i$ 's share in expected profit of the firm. Risk neutrality in (3) eliminates any incentives to diversify for risk-spreading purposes. The aim of this paper is to study the consequences of the control problem for ownership structure. Therefore it makes sense to eliminate all other diversification incentives from this analysis. Utility in (3) also assumes constant marginal disutility of monitoring, and this is somewhat critical for the analysis. One may think, for instance, of shareholders who pay for an accounting agency in monetary terms. Even increasing marginal disutility of monitoring effort will not change the results of the paper if the aggregation function of different individuals' monitoring effort is sufficiently sub-additive, for instance, if it has the particular form (2a). If none of these conditions is fulfilled, then the incentive effect to be derived is weakened, but still exists qualitatively.

Consider the Nash equilibrium for given ownership fractions. Shareholder  $i$  actually chooses his own effort. His effort  $m_i$  adds to aggregate effort by all others,  $m_{-i} \equiv \sum_{j \neq i} m_j$ , and determines  $m = m_i + m_{-i}$ . In a Nash equilibrium he takes contributions of all others as given. Therefore, by choosing  $m_i$ , he actually chooses aggregate effort  $m$ . His maximization problem can therefore be seen as choosing  $m$ , the aggregate amount of monitoring effort, to maximize

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<sup>3</sup> Similar results hold for any additively separable aggregation function  $m = f(m_1, \dots, m_n)$  that is monotonically increasing in all arguments with the property that  $0 \leq df/dm_i \leq 1$  for all  $i \in N$ .

$$(4) \quad Eu_i = y_0 + \pi - \max\{m - m_{-i}, 0\},$$

s.t. (1) and

$$(5) \quad m - m_{-i} \geq 0.$$

The restriction (5) says that his own contribution  $m_i = m - m_{-i}$  cannot be negative. The first-order condition is

$$(6) \quad (m - m_{-i}) (\alpha_i \pi_m - 1) = 0, \quad \text{with } m - m_{-i} \geq 0.$$

Let  $m^*(\alpha_i)$  be the solution of (6) for the case where no one else contributes, i.e., for  $m_{-i} = 0$ . Investor  $i$ 's actual choice is  $m_i = \max\{m^*(\alpha_i) - m_{-i}, 0\}$ .

The solution of (6) for  $m_i = 0$  is a function  $m^*(\alpha_i)$  of the investor's ownership shares with the following property.

There is an  $\underline{\alpha} \geq 0$  with  $m^*(\alpha_i) = 0$  for all  $\alpha_i \leq \underline{\alpha}$ , and  $m^*(\alpha_i)$  strictly monotonically increasing in  $\alpha_i$  for all  $\alpha_i > \underline{\alpha}$ .

A proof follows immediately from properties of  $\pi$  and condition (6) for  $m_{-i} = 0$ . A shareholder  $i$  with a holding of  $\alpha_i \leq \underline{\alpha}$  will be called *insignificant*, a shareholder with a larger holding will be called *significant*.

### Proposition 1

Suppose that shareholders are numbered such that  $\alpha_1 \geq \alpha_2 \geq \dots \geq \alpha_n$ . Then

- The aggregate monitoring effort in the Nash equilibrium is  $m = m^*(\alpha_1)$ .
- The equilibrium is unique with  $m_1 = m^*(\alpha_1)$ , and  $m_j = 0$  for all  $j = 2, \dots, n$ , if  $\alpha_1 > \alpha_2$ .

Proof. (•) First,  $m = m^*(\alpha_1)$  is an equilibrium. Suppose  $m_1 = m^*(\alpha_1) \geq 0$ . Then the optimal contribution of  $j \neq 1$  is  $m_j = \max\{m^*(\alpha_j) - m^*(\alpha_1), 0\} = 0$ , as  $\alpha_j \leq \alpha_1$

and  $m^*(\alpha_j)$  monotonically increasing. But given  $m_j = 0$  for all  $j = 2, \dots, n$ , the optimal choice of investor 1 is  $m_1 = \max\{m^*(\alpha_1) - 0, 0\} = m^*(\alpha_1)$ . Any other aggregate effort  $\hat{m}$  is not a Nash equilibrium. If  $0 \leq \hat{m} < m^*(\alpha_1)$ , investor 1 would like to increase contributions to  $m^*(\alpha_1)$ . Suppose that  $\hat{m} > m^*(\alpha_1)$ . There would be at least one  $j$  with  $m_j > 0$ . For this  $j$ ,  $m_j = \hat{m} - m_{-j} > m^*(\alpha_1) - m_{-j} \geq m^*(\alpha_j) - m_{-j}$  which, by definition of  $m^*(\alpha_j)$ , contradicts the optimality of  $m_j$ .

(••) If  $\alpha_1 \leq \underline{\alpha}$ ,  $m_i = 0$  for all  $i \in N$ . Suppose  $\alpha_1 > \underline{\alpha}$ . If  $m_j > 0$  for some  $j \neq 1$ , then  $m_j = \max\{m^*(\alpha_j) - m_{-j}, 0\} = m^*(\alpha_j) - m_{-j}$ , or,  $m = m_j + m_{-j} = m^*(\alpha_j)$ . But by (•) of this proposition,  $m = \sum_k m_k = m^*(\alpha_1)$  is the only equilibrium level of aggregate monitoring. As  $\alpha_j < \alpha_1$ ,  $m^*(\alpha_j) < m^*(\alpha_1)$ . This is a contradiction. ■

Proposition 1 confirms Stiglitz's (1985) intuitive reasoning that shareholder control is suboptimal because control is a public good. It is evident that for  $\alpha_1 < 1$  the amount of monitoring is suboptimally low from a point of view of collective rationality of shareholders. If they could play cooperatively, they would like to choose  $m = m^*(1)$ . Only sole ownership firms are efficiently monitored by the owner. But Proposition 1 also characterizes the equilibrium more precisely. The monitoring equilibrium is determined only by the fraction of shares of the largest shareholder. He has the highest incentive to monitor and he does not only provide the major part of it, but he is the only one who monitors in the equilibrium. Consider two firms, one with a shareholder with  $\alpha_1 = .25$  and the rest owned by a competitive fringe, the other owned by 5 shareholders each holding 20 % of shares. Proposition 1 would imply that monitoring effort of the first firm is higher if Nash behavior applies to both firms. This shows that a typical concentration measure like, e.g., the percentage holding of the, say, 5 largest shareholders of a company would not say much about the intensity of management control in this firm.

Let  $\alpha_1 = \alpha_2 = .4$  for a particular firm. In this case the two large owners somehow share the burden of monitoring, say, a focal point is that each spends one half of total effort  $m^*(.4)$ . In this situation each of them could consider selling one percent

of his shares at the market. If the other large shareholder kept his holdings, this other shareholder would have to provide all monitoring in the future. Clearly there is an incentive not to be the largest shareholder. On the other hand, could a shareholder with, say 60 % holdings find it profitable to increase his own shareholdings to 100%? He has to provide all the monitoring anyway, so why not buy out the free-riders? The next section considers questions of this type in a two-stage game where the ownership structure is endogenous and determines properties of equilibrium ownership structures.

### 3. Endogenous ownership structure

Suppose now that, initially the ownership structure is given by the vector  $(\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_n)$  with a fraction  $(1 - \hat{\alpha})$  owned by a competitive fringe, with  $\hat{\alpha} \equiv \sum_i \hat{\alpha}_i$ . At the first stage all investors can trade in an asset market. Then, once the new share holdings  $(\alpha_1, \dots, \alpha_n)$  are determined, the private provision of monitoring game is played that has been described in the previous section.

A main issue of the game at the first stage is the equilibrium price of assets. For risk neutral shareholders, the price of the firm equals its expected profit (suppose that the time that elapses between the two stages is very short or the interest rate is equal to zero, to save on notation). Profit depends on monitoring effort, and, by Proposition 1, monitoring effort in the equilibrium depends on the fraction  $\alpha_1$  that is owned by the largest shareholder. The paper assumes that individuals trading at stage 1 correctly anticipate the equilibrium holdings of the largest shareholder, and, therefore, the amount of monitoring he provides.

Consider a vector of initial shareholdings  $(\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_n)$ . A sub-game perfect Nash equilibrium is characterized as follows. An after-trade vector of holdings  $(\alpha_1, \alpha_2, \dots, \alpha_n)$  with, say,  $\alpha_1$  the largest holding (by convention, or after renumbering)

is a perfect Nash equilibrium if, given a firm price of  $\pi = EF(\omega, m^*(\alpha_1))$ , and the properties of the private provision game described by Proposition 1, for all  $i = 1, \dots, n$ ,  $\alpha_i$  is the optimal ownership choice given the choices of others.

*One large shareholder and a competitive fringe*

The fringe acts as a price taker. It never participates in monitoring. The large shareholders, however, can take the price of shares as given only for portfolio changes that they can perceive as having no effect on aggregate monitoring  $m$  in the equilibrium. If there is only one shareholder with a substantial holding then he knows that any change in his holdings will change the equilibrium price accordingly. Once he has chosen his final holdings  $\alpha_1$ , his monitoring effort is  $m_1 = m^*(\alpha_1)$ . Therefore, the market price of the firm is a function of  $\alpha_1$ , too. If he sells or buys, say a fraction  $(\hat{\alpha}_1 - \alpha_1)$ , he pays or receives  $(\hat{\alpha}_1 - \alpha_1)EF(\omega, m^*(\alpha_1))$ . The price of selling or buying shares reflects his changed holdings. His utility is

$$(7) \quad \begin{aligned} Eu_1 &= \alpha_1 EF(\omega, m^*(\alpha_1)) - m^*(\alpha_1) + (\hat{\alpha}_1 - \alpha_1) EF(\omega, m^*(\alpha_1)) \\ &= \hat{\alpha}_1 EF(\omega, m^*(\alpha_1)) - m^*(\alpha_1). \end{aligned}$$

Maximization of expected utility (7) subject to  $m^*(\alpha_1) \geq 0$  yields the first-order condition

$$(8) \quad \left[ \hat{\alpha}_1 \frac{dEF(\omega, m^*(\alpha_1))}{dm} - 1 \right] \frac{dm^*(\alpha_1)}{d\alpha_1} = 0.$$

The optimal choice of holdings depends on initial holdings. Recall that  $m^*(\alpha_i)$  is strictly monotonically increasing in  $\alpha_i$  for  $\alpha_i > \underline{\alpha}$ . Therefore, by the properties of  $\pi$ ,  $\alpha_i$  is an increasing function of holdings. The first order condition is sufficient by strict concavity of  $\pi$  in  $m$ . It turns out that the single large shareholder does not

even want to change his holdings at all:

### Proposition 2

For a single large shareholder and a competitive fringe ( $n = 1$ ,  $\hat{\alpha}_1 \in (0,1)$ ), it is optimal for the shareholder not to change his holdings. This optimal choice is unique if the large shareholder is significant, i.e., if  $\hat{\alpha}_1 > \underline{\alpha}$ .

Proof. Consider first the case  $\hat{\alpha}_1 > \underline{\alpha}$ . By strict monotonicity of  $\pi_m$  in  $m$ , and  $dm^*(\alpha_i)/d\alpha_i > 0$  for all  $\alpha_i > \underline{\alpha}$ , there is only one  $\alpha$  that fulfills (8), and, by definition of  $m^*(\alpha_i)$ , this is  $\alpha_1 = \hat{\alpha}_1$ . This proves optimality and uniqueness for  $\hat{\alpha}_1 > \underline{\alpha}$ . Suppose now that  $\hat{\alpha}_1 < \underline{\alpha}$ . In this case  $m^*(\hat{\alpha}_1) = 0$ . Any  $\alpha_1 \in [0, \underline{\alpha})$  solves (8), as, for all these values,  $\frac{dm^*(\alpha_1)}{d\alpha_1} = 0$ . Therefore, in particular  $\alpha_1 = \hat{\alpha}_1$  is a solution. Finally consider  $\hat{\alpha}_1 = \underline{\alpha}$ . In this case  $Eu_1(\alpha_1 = \underline{\alpha}) = Eu_1(\alpha_1 < \underline{\alpha})$  for all  $\alpha_1 \in [0, \underline{\alpha}]$ . Moreover,  $\frac{dEu_1}{d\alpha_1} < 0$  for all  $\alpha_1 > \underline{\alpha}$  as, in this range,

$$(9) \quad \frac{dEu_1}{d\alpha_1} = \left[ \underline{\alpha} \frac{dEF(\omega, m^*(\alpha_1))}{dm} - 1 \right] \frac{dm^*(\alpha_1)}{d\alpha_1}$$

with  $\frac{dm^*(\alpha_1)}{d\alpha_1} > 0$  for  $d\alpha_1 > 0$  for all  $\alpha_1 \geq \underline{\alpha}$ , but  $\left[ \underline{\alpha} \frac{dEF(\omega, m^*(\alpha_1))}{dm} - 1 \right] = 0$  for  $\alpha_1 = \underline{\alpha}$  and  $\left[ \underline{\alpha} \frac{dEF(\omega, m^*(\alpha_1))}{dm} - 1 \right] < 0$  for  $\alpha_1 > \underline{\alpha}$  by strict concavity of  $\pi$ . ■

Proposition 2 states that the perfect equilibrium is a no-trade equilibrium. The best the large shareholder can do is to keep the fraction of shares he owns. All changes of holdings are reflected in the equilibrium price. For example, if he tries to buy additional shares, he has to pay a price for these shares that anticipates that his monitoring effort will be higher. So he benefits from his increased monitoring only on that fraction of shares he already owns. But for this fraction, his former monitoring effort was just optimal. If, in the course of changing his holdings, he also makes a different monitoring effort, he will lose compared to keeping his holdings constant. The large shareholder is trapped. He cannot sell his holdings to become



part of the fringe, and he cannot increase his holdings to  $\alpha_1 = 1$  and eliminate the free rider problem without losing utility compared to keeping his holdings.

A related result shows up in the analysis by Jensen and Meckling (1976, pp. 318n.) of the impact of a sale of a fraction of a firm that is initially owned by the manager. The decline in total firm value is shown there to be entirely imposed on the manager. In the approach here the large outside shareholder bears a similar burden. The effect derived here is also related to effects derived in models that consider the market for corporate control (see, e.g., Grossman and Hart 1980, and Shleifer and Vishny 1986). If there is a takeover attempt by another firm, and if shareholders of the firm that is to be taken over anticipate the extent of efficiency enhancing measures of the potential new management, then the firm that is taking over cannot appropriate any of the value increase of the firm. Only if firms that attempt a takeover are allowed to, and are able to, buy a substantial fraction of shares before the takeover attempt becomes publicly known, can they gain in expected value terms. The result in this paper is somewhat stronger, though; in the takeover case, if the firm that makes the takeover attempt already owns some shares, it can make some profits on these shares; it can appropriate only the fraction of gains that is proportional to its shareholdings. Even if the firm has no holdings, the firm does not lose profits when carrying out the takeover. Here, however, the large shareholder strictly loses if he changes his holdings.

One could think about relaxing the informational assumption applied so far; the large shareholder may be able to sell or to buy some shares before his intention to change his ownership share becomes public. In this case he can make some profits on these hidden transactions. Suppose that shareholder 1 is the largest shareholder and changes his holdings marginally by  $\Delta = \alpha_1 - \hat{\alpha}_1$ , where  $\gamma\Delta$  is the amount of share purchases that is made under the price  $\pi = EF(\omega, m^*(\hat{\alpha}_1))$  that describes expected profit for the case where investor 1 does not change his holdings. In this

case his change in utility will be

$$\Delta E u_1 = (\hat{\alpha}_1 + \gamma \Delta) [EF(\omega, m^*(\alpha_1)) - EF(\omega, m^*(\hat{\alpha}_1))] + m^*(\hat{\alpha}_1) - m^*(\alpha_1),$$

which is negative for  $\gamma = 0$  and positive for  $\gamma = 1$ . Reduced market transparency reduces the lock-in effect.

The considerations for one large shareholder will be useful when considering the main issue of this paper; the constraints on an equilibrium ownership structure.

### *Several large shareholders*

Suppose now that there are several shareholders with significant holdings, described by a vector  $(\hat{\alpha}_1, \dots, \hat{\alpha}_n)$ , and a competitive fringe. Define  $m^{\min}(\alpha_i)$  implicitly by the condition

$$(10) \quad \alpha_i EF(\omega, m^*(\alpha_i)) - m^*(\alpha_i) = \alpha_i EF(\omega, m^{\min}(\alpha_i)).$$

A shareholder with holdings  $\alpha_i$  is indifferent between a situation in which he himself provides the aggregate amount of monitoring and a situation in which he does not monitor, but where someone else provides aggregate monitoring to the amount  $m^{\min}(\alpha_i)$ . First notice that  $m^{\min}(\alpha_i)$  is an increasing function of  $\alpha_i$ : total differentiation of (10) yields

$$(11) \quad \frac{dm^{\min}}{d\alpha_i} = \frac{EF(\omega, m^*(\alpha_i)) + \left[ \alpha_i \frac{dEF(\omega, m^*(\alpha_i))}{dm} - 1 \right] \frac{dm^*(\alpha_i)}{d\alpha_i} - EF(\omega, m^{\min}(\alpha_i))}{\alpha_i \frac{dEF(\omega, m^{\min})}{dm}}$$

This expression is non-negative, and positive for significant  $\alpha_i$ . The denominator is positive. The numerator consists of 3 terms. The sum of terms 1 and 3 is

non-negative and positive for significant  $\alpha_i$ . Term 2 equals zero by definition of  $m^*(\alpha_i)$ .

### Proposition 3

Suppose that the initial shareholdings of at least one shareholder are significant.

Then, every perfect equilibrium  $(\alpha_1, \dots, \alpha_n)$  has  $\max\{\alpha_1, \dots, \alpha_n\} \leq \max\{\hat{\alpha}_1, \dots, \hat{\alpha}_n\}$ .

Suppose  $k$  is the largest shareholder, i.e.,  $\hat{\alpha}_k = \max\{\hat{\alpha}_1, \dots, \hat{\alpha}_n\}$  and  $m^*(\hat{\alpha}_k) > 0$ .

The proof of Proposition 3 is by contradiction. Let  $\alpha_h = \max\{\alpha_1, \dots, \alpha_n\}$  and

$\alpha_h > \hat{\alpha}_k$ . Shareholder  $h$ 's ownership share  $\alpha_h$  must be significant, as  $\alpha_h > \hat{\alpha}_k > \underline{\alpha}$ .

Note first that there cannot be another  $j$  with  $\alpha_j = \alpha_h$  in equilibrium;  $\alpha_h$  would not be optimal for  $h$ . Further,

$$Eu_h(\alpha_h) = \hat{\alpha}_h EF(\omega, m^*(\alpha_h)) - m^*(\alpha_h) < \hat{\alpha}_h EF(\omega, m^*(\hat{\alpha}_h)) - m^*(\hat{\alpha}_h).$$

The inequality holds by  $\hat{\alpha}_h \leq \hat{\alpha}_k < \alpha_h$  and the definition of  $m^*(\hat{\alpha}_h)$ . If the investor chooses  $\alpha_h > \hat{\alpha}_h$ , his utility is lower than the one he could reach at least, for instance, by choosing  $\alpha_h = \hat{\alpha}_h$ . Note that his utility from choosing a share equal to his initial shareholdings of  $\hat{\alpha}_h$  may even be higher if, for example, aggregate provisions by others exceed  $m^*(\hat{\alpha}_h)$ . ■

Proposition 3 states that there is no perfect Nash equilibrium in pure strategies in which ownership concentration is increased in the sense that the largest shareholder in the resulting equilibrium owns a larger fraction of the firm than the largest shareholder in the arbitrary initial historical situation. If there is any incentive to change the ownership structure, it must be an incentive for decreasing ownership concentration. There is no incentive to overcome the free rider problem of underprovision of monitoring by increases of ownership concentration.

### Proposition 4

Let  $\hat{\alpha}_k = \max\{\hat{\alpha}_1, \dots, \hat{\alpha}_n\}$ , and define  $J = \{j | m^*(\hat{\alpha}_j) > m^{\min}(\hat{\alpha}_k)\}$ , where  $m^{\min}$  is defined in (10). Any  $(\alpha_1, \dots, \alpha_n)$  with  $\hat{\alpha}_j = \alpha_j$  for a particular  $j \in J$ , and  $\alpha_h$  for

all other shareholders  $h \in N \setminus \{j\}$ , such that  $m^{\min}(\hat{\alpha}_j) \geq m^*(\alpha_h)$  for all  $h \in N \setminus \{j\}$  is a perfect equilibrium.

Proof. Suppose that all  $h \neq j$  choose  $\alpha_h$  such that  $m^*(\alpha_h) < m^{\min}(\hat{\alpha}_j)$ . Then, by Proposition 2,  $\alpha_j = \hat{\alpha}_j$  is optimal for  $j$ . Suppose now that  $\alpha_j = \hat{\alpha}_j$ . For all  $h$  with  $\hat{\alpha}_h < \hat{\alpha}_j$ , any  $\alpha_h < \hat{\alpha}_j$  is optimal. In this case, the utility of  $h$  decreases for increasing  $\alpha_h$  for  $\alpha_h > \alpha_j$  and is independent of  $h$ 's choice of  $\alpha_h \in [0, \alpha_j]$ . Therefore a choice  $\alpha_h$  such that  $m^*(\alpha_h) \leq m^{\min}(\hat{\alpha}_j)$  is optimal for all  $h \in N \setminus \{j\}$ . Suppose now that  $\hat{\alpha}_h > \hat{\alpha}_j$ . Then  $h \in J$ . By definition of  $J$  one obtains  $m^*(\hat{\alpha}_j) > m^{\min}(\hat{\alpha}_k) \geq m^{\min}(\hat{\alpha}_h)$  for all  $h \in J \setminus \{j\}$ . Therefore,  $\alpha_j = \hat{\alpha}_j$  implies that

$$\hat{\alpha}_h EF(\omega, m^*(\hat{\alpha}_j)) > \hat{\alpha}_h EF(m^*(\hat{\alpha}_h)) - m^*(\hat{\alpha}_h) \geq \hat{\alpha}_h EF(m^*(\alpha_h)) - m^*(\alpha_h)$$

for any  $\alpha_h$ . The last inequality is evident from the proof of Proposition 2. But  $\hat{\alpha}_h EF(\omega, m^*(\hat{\alpha}_j))$  is what shareholder  $h$  gets if he chooses  $\alpha_h$  sufficiently small such that  $m^*(\alpha_h) < m^{\min}(\hat{\alpha}_j)$ . ■

Proposition 4 shows that there may be a multiplicity of equilibria. In all these equilibria there is one large shareholder where the other shareholders are sufficiently small to prevent the large shareholder from diversification. By Proposition 4, even though one of the equilibria is that where the holdings of the largest shareholder, and therefore monitoring effort, are unchanged, there are different equilibria possible in which, after trade, there is a different largest shareholder, and this shareholder's share of holdings is smaller than that of the previous, before trade, largest shareholder.

#### 4. Discussion

The propositions in the previous section make some predictions that are empirically testable, at least in principle. In a world with risk neutral investors who are unanimously interested in maximizing expected firm profit and who all participate

in firm profits proportionally to their ownership shares, firms that have gone public should have at most one very large shareholder. There should be a gap between the size of his holdings and the holdings of the second largest shareholder.

However, the theory of corporate ownership is much more complex than the model just developed suggests. Usually several types of owners are distinguishable; like insiders (shareholdings of management), and outsiders. The latter can be differentiated into private or institutional investors, blockholding shareholders or atomistic shareholders and other categories. Some shareholders may have family ties to the managers; some may have a seat on the board of directors; and there may be further distinctions. The analysis in this paper concentrated only on blockholding outsiders and a competitive fringe of outsiders. The paper also disregards all other channels for corporate control, like a board of directors (cf, e.g., Baysinger and Butler 1985), the influence of employees (Aoki 1983) and unions, monitoring by banks (Stiglitz and Weiss 1981, Cable 1985), takeover threats (Grossman and Hart 1980, Scharfstein 1988). Further, the paper treated shareholders' rights as symmetric. In reality, a large shareholder may actually have disproportionately more control over the firm; in most corporate law large shareholders get additional rights (veto rights, particular influence on dividend policy, etc.). Further, his interests and the interests of minority shareholders may not coincide. Large shareholders also obtain seats on the board of directors and that may generate some fringe benefits. Also, large shareholders and small shareholders may be differently affected by takeover attempts. All these institutional details are likely to matter, but are disregarded here. This is done to isolate the incentive effects of the private provision game of management control on diversification. To isolate this effect, the risk sharing argument, one of the major reasons for diversification, has also been eliminated by assuming risk neutral shareholders. The analysis in this paper may be considered as a benchmark case that reveals three effects that can be expected to be at work also in more complex model specifications.

First, the largest shareholder bears a disproportionately large burden of aggregate monitoring costs. Second, this property causes a kind of *inertia*. The person that has to exert control in the equilibrium may not be able to appropriate the efficiency gains of a change of the ownership structure. Third, other shareholders have an incentive to diversify, in order not to become the largest shareholder, that is, to avoid bearing the burden of management control.

To test the empirical predictions of the model may be difficult, though. Shleifer and Vishny (1986) report that, for a sample of 456 firms based on the data from Corporate Data Exchange *Stock Ownership Directory: Fortune 500*, compiled for December 1980, the largest shareholder held 15.4 % of common stock on average, where the next four largest shareholders *sum up* only to 9.4 % of common stock. This suggests some kind of gap between the largest shareholder and the others with regard to the ownership fraction. However, it can be expected that the effect is diluted in the data for several reasons. Control of a company is not proportional to shareholdings. The willingness to pay for an additional share at the 50 percent margin is probably higher than that for the first share; particularly in a world with conflicting owner interests. The monitoring function  $m^*(\alpha)$  may be different for different types of owners; finally, ownership shares often do not say much about how the different owners are related. It looks like counter evidence if two companies A and B have equal ownership shares of 40 percent in a firm X, but, for instance, A and B could be affiliates of the same mother company.

To sum up: the perfect equilibria considered in this paper revealed two sources of inefficiency. Management control by shareholders in the equilibrium with diversified ownership is underprovided. Moreover, in a non-cooperative setting the shareholders have no incentive to change the ownership structure to reach a more efficient one. This may explain why, under most corporate law, majority shareholders or shareholders with qualified ownership fractions are endowed with

particular rights and obtain additional fringe benefits of ownership. Such provisions generate an incentive for large shareholders to increase their holdings, and may therefore improve the provision of management control.

## 5. Conclusions

This paper considered a novel determinant for equilibrium ownership structure. The private provision equilibrium of management control by shareholders typically has a solution in which only the largest shareholder bears the burden of control effort. Given everything else constant, this is an incentive not to be the largest shareholder. However, the largest shareholder is locked in. He cannot simply sell his shares to become the second largest, without incurring some losses in a rational expectations equilibrium of share prices. A two stage game setting reveals that there is a perfect Nash equilibrium in which one large shareholder remains and all others reduce their shares sufficiently to lock the large shareholder in.

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