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Financial Transaction Costs and
Industrial Performance

by

Julio J. Rotemberg

WP# 1554-84

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Financial Transactions Costs and Industrial Performance

Abstract

This paper presents a model in which asset and factor markets are perfectly competitive while goods markets are not. It studies the equilibrium of this model letting demands for individual products be random while assuming that managers maximize shareholder utility. When managers maximize the utility of current shareholders, equilibrium output is below the profit maximizing level. Output in an industry is lower, the lower are financial transactions costs, and the more correlated are the demands in an industry. Instead, when precommitment is possible and the utility of sellers of shares is maximized, output is above the profit maximizing level.

I. Introduction

This paper presents a model in which firms, acting in the interest of their shareholders, tend to act collusively when their shareholders have diversified portfolios. Therefore, government interventions which reduce diversification, such as taxing trades in stocks and redistributing the proceeds, are potentially beneficial since they promote competition.

More generally the paper is concerned with situations in which the markets for goods produced by the corporate sector are imperfectly competitive while the market for financial claims is perfectly competitive. It thus blends the desire to diversify one's portfolio in an efficient asset market considered by finance together with the structural interactions among firms considered by industrial organization. In contrast to what is typically assumed in the latter field (see Scherer (1980)) firms do not seek to maximize their profits. Instead, as they do in the literature on competitive stock markets (Dreze (1974), (Grossman and Hart (1979), Makowski (1983)) they pursue shareholder welfare. Of course if shareholders are fully diversified as they are in the Sharpe (1964)-Lintner (1965) capital asset pricing model then all firms have the same objective, namely maximizing total corporate profits.¹ On the other hand, as Friend and Blume (1975) show, individual portfolios are not fully diversified.² As Mayshar (1979, 1981) shows, this is a natural consequence of the presence of transactions costs. With these costs, diversification becomes incomplete and some competition reemerges.

Rubinstein and Yaari (1983) also show that diversification in stocks can lead to collusion. However, in their model diversification doesn't arise from the desire of risk averse individuals to spread risk. Rather there is no uncertainty. Their two shareholders-managers trade shares with each other

because they know this will increase both their profits as their actions become more collusive. Here, instead shareholders are small and do not act strategically when buying shares.

The model has two periods. In the beginning of the first period investors spend their endowment of capital on shares of firms. Then the firms, which produce differentiated products, choose a level of output. This output is available for sale in the second period. At this point random demand is realized so that the price received by each firm is a random variable when the level of output is chosen. The resulting profits are then distributed to the shareholders who derive utility from these dividends. Thus the return from investing in any one firm is random from the point of view of investors. The investors therefore diversify their portfolios to some extent. The lower are financial transaction costs, the more diversified are their portfolios. Managers of firms are, at first, assumed to maximize the utility of their period one shareholders. The output of each firm maximizes this utility under the Nash assumption that the outputs of other firms are fixed. This Nash equilibrium has lower output the more diversified are individual portfolios. This occurs because, as individuals become more diversified, they are concerned with the profits of more firms. Thus managers who work for these investors help other firms more. In particular output of each firm is equal to the output which would prevail if firms maximized expected profits under the assumption that other firms' output are fixed if and only if each shareholder owns stock in one firm. Otherwise output is lower.

I consider not only a situation with n symmetric firms but also one in which firms are grouped into two industries. Goods within an industry are better substitutes for each other than goods of different industries. The industries differ also in that the demands are subject to industry-wide demand shocks. As either the variance of firm specific shocks in an industry falls or the variance of that industry's industry-wide shock increases, the demands

in that industry become more correlated. This also makes the returns from investing in two firms that belong to this industry more correlated. Thus, in the presence of financial transaction costs, investors hold shares of fewer firms belonging to this industry. This makes the managers of these firms act less collusively so that their output rises relative to the output in the other industry. Without transaction costs investors are fully diversified; they hold shares of all firms. When the variance of the demands in an industry rises, the total invested in that industry falls while the total invested in the other industry rises. This induces managers in the industry whose variance has risen to help the firms in the other industry more. Thus they lower their output. This occurs independently of whether the variance in demand rises due to increased firm specific variance or to increased industry-wide variance.

Finally, I contrast the outcome when managers maximize the utility of period one shareholders with the case in which they maximize the utility of those individuals who sell their shares to period one shareholders. These sellers of shares simply consume the proceeds of their sales at the beginning of period one. They thus wish to see the market value of their portfolio maximized. To make these sellers of shares happy managers must precommit before shares are traded to a given level of output for period two. The ensuing Nash equilibrium has each firm producing a level of output which exceeds the level of output that would prevail if each firm maximized expected profits while assuming other firms' outputs are fixed. This occurs because it is in the seller of shares' best interest to have his companies lose some money as long as other companies lose too. Those losses will depress the value of the other companies' shares relative to those of his company.

The paper proceeds as follows. Section II lays out the model with n symmetric firms while Section III considers its equilibrium when managers maximize the utility of period one shareholders. Section IV shows that the

stockholders with different portfolios are in fact unanimous in this model. This result is shown, however, to depend on the homogeneity of stockholders and firms. Section V considers the alternative situation in which managers maximize the utility of sellers of shares. Section VI studies the presence of two industries while assuming, once again, that managers care about period one shareholders. Section VII concludes.

II. The Model

A. Investors

There are m identical individual investors. Each starts out with K units of capital at the beginning of the first period. The individuals invest this capital in stocks of n firms. These provide the investors with a random return which accrues the second period. The investors are assumed to be concerned with the value of their wealth in the second period. In particular the utility of investor i , U_i is given by

$$U_i = E(W_i) - \frac{b}{2} E(W_i - E(W_i))^2 \quad (1)$$

where W_i is the individual i 's wealth in the second period, b is a parameter and E takes expectations conditional on information available at the beginning of period 1. This development is intended to mimic that of the static capital asset pricing model of Sharpe (1964) and Lintner (1965). This mean-variable utility function has many drawbacks. However, its main implication, that investors will diversify their portfolio when firm returns are random and imperfectly correlated is well known to carry over to more general settings.

Note that shareholders only care about the value of their wealth in terms of the numeraire which can be capital. Implicitly it is assumed that they can exchange this wealth for consumption goods bought at fixed prices. These goods might include labor services as well as foreign goods. Thus when firms

where \bar{R} is a constant while

$$E\tilde{\epsilon}_i = E\tilde{\epsilon}_i\tilde{\epsilon}_j = E\tilde{\epsilon}_i\tilde{\eta} = E\tilde{\eta} = 0$$

$$E\tilde{\epsilon}_i^2 = \sigma^2$$

$$E\tilde{\eta}^2 = \omega^2$$

These distributions are identical because I'll consider a symmetrical equilibrium among firms. Since the stocks are ex ante identical the individual's problem reduces to picking the number S of stocks he holds. To minimize the risk of his portfolio he then invests K/S in each. So, his utility from investing in S firms is given by:

$$U_i = \bar{R}K - SF - b \frac{\sigma^2 K^2}{2S} - \frac{\omega^2 K^2}{2} \quad (4)$$

if S were continuous the optimal S would satisfy

$$S^* = K\sigma \sqrt{\frac{b}{2F}} \quad (5)$$

since S is an integer, the optimal, S, \bar{S} , is an integer equal to either S^* rounded up or S^* rounded down.

If either F increases or σ^2 decreases, S^* clearly falls. The following argument establishes that \bar{S} also either stays the same or falls in this case. Suppose we start at an optimal S equal to S_0 and F goes up to $F + \epsilon$. Then, since S_0 is optimal for F

$$-S_0 F - \frac{b\sigma^2 K^2}{S_0} \geq -(S_0 + 1)F - \frac{b\sigma^2 K^2}{S_0 + 1}$$

therefore

$$-S_0 (F + \epsilon) - \frac{b\sigma^2 K^2}{S_0} \geq -(S_0 + 1)F - \frac{b\sigma^2 K^2}{S_0 + 1} - S_0 \epsilon > -(S_0 + 1)(F + \epsilon) - \frac{b\sigma^2 K^2}{S_0 + 1}$$

So, $(s_0 + 1)$ is never optimal when F increases. Since the optimal S is unaffected when U_i is multiplied by a constant, the effect of an increase in F is the same as that of a fall in $\sigma K b$.

B. Firms

Firms accept investments from all interested individuals. They are committed to distribute the profits from operations to the shareholders in proportion to the shareholder's investments. The demand (by workers and possibly foreigners) for the output of firm j , Q_j is linear in its own and its competitor's prices:

$$Q_j = a_j - \delta P_j + \gamma \sum_{z \neq j} P_z \quad j = 1, \dots, n \quad (6)$$

where P_j is the price of the good produced by firm j while a_j is possibly random at the time the production decision is made. To ensure that an increase in all prices lowers demand δ must exceed $(n-1) \gamma$. The demands are assumed linear for simplicity and ease of comparison with the standard models considered in the industrial organization literature. Again for simplicity all goods are assumed to be symmetric.

The production function of each firm is given by

$$Q_j = K_j^j + L_j^j/c \quad j=1, \dots, n \quad (7)$$

where

$$K_j^j = \sum_{i=1}^m K_{ij} \quad (8)$$

and L_j^j is the amount of labor hired by firm j . Labor can be hired in a competitive market at a wage that is normalized (by appropriate choice of c) to equal one. This elastic supply of labor can be due to the presence of a

competitive sector in which labor is used to produce one unit of the numeraire good. Note that capital must be in place in period 1 to produce output in period two while labor can be hired in period two.

The firms are assumed to act in the best interest of the owners of their capital. This assumption has a long tradition in the competitive theory of stock markets (Dreze (1974), Grossman and Hart (1979), Makowski (1983)).

I will initially assume that firms care about their stockholders in proportion to the amount of capital they have invested in the firm. So firm j 's objective is:

$$V_j = \sum_{i=1}^m K_{ij} U_i \quad (9)$$

This weighted average is equivalent to the weighted average considered by Dreze (1974). Grossman and Hart (1979) weight the different shareholders by the shares they own before trade in shares begins. This is discussed in Section V below. Makowski (1983) shows that in his competitive world all stockholders agree on the firm's optimal plan. Thus the weighting of the U_i in (9) is irrelevant. In fact Makowski's (1983) condition for competition in asset markets is satisfied here since individuals are indifferent between buying a particular stock or not. Here too as will be seen in Section IV, under certain conditions all stockholders are unanimous.

If all investors hold an equal number of shares of S firms it is possible to simplify (9). The return R_j is given by

$$R_j = \frac{P_j Q_j - L_j}{K_j} = \frac{\Pi_j}{K_j}$$

where Π_j are the accounting profits of firm j . Hence the utility of individual i who holds stocks in a subset J_i of firms is given by

$$U_i = E \sum_{j \in J_i} \frac{\Pi_j K_j}{K_j^S} - \frac{bE}{2} \left[\sum_{j \in J_i} \frac{\Pi_j K_j}{K_j^S} - \frac{E \Pi_j K_j}{K_j^S} \right]^2$$

So

$$U_i = \frac{K}{S} \sum_{j \in J_i} \left[\frac{E \Pi_j}{K^j} - \frac{bK}{2S} \text{Var} \frac{\Pi_j}{K^j} - \frac{bK}{2S} \sum_{\substack{x \in J_i \\ x \neq j}} \text{Cov} \frac{\Pi_j \Pi_x}{K^j K^x} \right]$$

Hence

$$V_j = \left(\frac{K}{S} \right)^2 \sum_{i=1}^m \delta_{ij} \sum_{z \in J_i} \left[\frac{E \Pi_z}{K^z} - \frac{bK}{2S} \text{Var} \frac{\Pi_z}{K^z} - \frac{bK}{2S} \sum_{\substack{x \in J_i \\ x \neq j}} \text{Cov} \frac{\Pi_x \Pi_z}{K^x K^z} \right]$$

where δ_{ij} is one if i has shares in firm j and 0 otherwise. If all individuals hold shares in S firms and the S shares are picked randomly, each firm will have as shareholders mS/n individuals. These individuals will not all have the same portfolio unless S equals n . If firms are picked randomly the probability that an individual also has shares of a particular firm z given that he has shares of firm j is simply $(S-1)/(n-1)$. So, as long as m is large (9) can be written as

$$V_j = \frac{K^2 m}{S n} \left[\frac{E \Pi_j}{K^j} - \frac{bK}{2S} \text{Var} \frac{\Pi_j}{K^j} + \frac{(S-1)}{(n-1)} \sum_{z \neq j} \left(\frac{E \Pi_z}{K^z} - \frac{bK}{2S} \text{Var} \frac{\Pi_z}{K^z} - \frac{bK}{S} \text{Cov} \frac{\Pi_z \Pi_j}{K^z K^j} - \frac{Kb(S-2)}{2S(n-2)} \sum_{\substack{x \neq z \\ x \neq j}} \left(\text{Cov} \frac{\Pi_z \Pi_x}{K^z K^x} \right) \right) \right] \quad (11)$$

where the last term, which is zero when S is less than 3, is proportional to $[(S-2)/(n-2)]$ because the probability of holding assets in firm k given that one holds assets of firms j and z is equal to $(S-2)/(n-2)$. Note that in (11) the coefficient on the profits of other firms is only equal to the coefficient of the profits of firm j if S is equal to n .

III. Nash Equilibrium

The equilibrium in this model is constructed as follows. In Period 1 firms pick levels of employment (and hence output) to maximize (11) taking as given the output decisions of the other firms. In Period 2 this output is available for sale. At this point the uncertainty in demand given by the a_j gets resolved and prices adjust so as to make demand equal to available supply. So prices are given by inverting (6):

$$P_j = \alpha_j - \mu Q_j - \phi \sum_{z \neq j} Q_z \quad j = 1, \dots, n \quad (12)$$

$$\mu = \frac{\delta - (n-2)\gamma}{(\delta + \gamma)(\delta - \gamma(n-1))}$$

$$\phi = \frac{\gamma}{(\delta + \gamma)(\delta - \gamma(n-1))}$$

$$a_j = (\mu a_j + d \sum_{s \neq j} a_s) / [(\delta + \gamma)(\delta - \gamma(n-1))]$$

As long as δ exceeds $(n-1)\gamma$ both μ and ϕ are positive while μ is larger than ϕ .

Profits of firm j , Π_j are thus given by

$$\Pi_j = Q_j [a_j - \mu Q_j - d \sum_{z \neq j} Q_z] - L^j$$

so

$$E \Pi_j = Q_j [E \alpha_j - \mu Q_j - \phi \sum_{z \neq j} Q_z] - L^j \quad (13)$$

$$\text{Var } \Pi_j = Q_j^2 \text{Var } \alpha_j \quad (14)$$

$$\text{Cov } \Pi_j \Pi_z = Q_j Q_z \text{Cov } \alpha_j \alpha_z$$

To simplify the analysis the variances and covariances of the a 's are first assumed to be independent of the identity of the firms. This can be

derived for the assumption that the α 's depend on two random components.

The first is common to all firms while the second is independent across firms.

$$\alpha_j = \eta + \epsilon_j + \bar{\alpha} \quad j = 1, \dots, n \quad (15)$$

where: $E\eta = E\epsilon_j = E\epsilon_j\epsilon_z = E\epsilon_j\eta = 0$; $E\eta^2 = \omega^2$, $E\epsilon_j^2 = \sigma^2$, so that $E\alpha_j^2 = \sigma^2 + \omega^2$ and $E\alpha_j\alpha_z = \omega^2$.

Equation (11), the objective function of firms is thus proportional to:

$$\begin{aligned} V_j = & \frac{Q_j}{K^j} \left[\bar{\alpha} - \mu Q_j - \phi \sum_{z=j} Q_z \right] - \frac{L^j}{K^j} - \frac{b}{S} \frac{K}{2} \left(\frac{Q_j}{K^j} \right)^2 [\sigma^2 + \omega^2] \\ & + \frac{(S-1)}{(n-1)} \sum_{z \neq j} \left[\frac{Q_z}{K^z} \left[\bar{\alpha} - \mu Q_z - \phi \sum_{x \neq z} Q_x \right] - \frac{b}{2} \frac{K}{S} \left(\frac{Q_z}{K^z} \right)^2 [\sigma^2 + \omega^2] \right. \\ & \left. - \frac{bK}{S} \frac{Q_z}{K^z} \frac{Q_j}{K^j} \omega^2 - \frac{bK}{2S} \frac{S-2}{n-2} \sum_{\substack{x \neq z \\ x \neq j}} \frac{Q_z}{K^z} \frac{Q_x}{K^x} \omega^2 \right] \end{aligned} \quad (16)$$

Firm j maximizes V_j in (16) with respect to Q_j taking as given the output levels of its competitors. Moreover K^j is fixed. As long as K^j is sufficiently small (7) implies that an increase in employment of c is required to increase output by one unit. Therefore:

$$\begin{aligned} \frac{dV_j}{dQ_j} = 0 = & (1/K^j) [\bar{\alpha} - 2\mu Q_j - \phi \sum_{z \neq j} Q_z - c] - \frac{bK}{S} \frac{Q_j}{K^j} [\sigma^2 + \omega^2] \\ & - \frac{S-1}{n-1} \sum_{z \neq j} \phi \frac{Q_z}{K^z} - \frac{K\omega^2 Q_z}{SK^j K^z} \end{aligned} \quad (17)$$

In a symmetric equilibrium, all K^j are equal to \bar{K} and all outputs are equal to \bar{Q} . So in equilibrium (17) becomes:

$$\begin{aligned} \bar{\alpha} - 2\mu\bar{Q} - (n-1) \phi\bar{Q} - c - bK\bar{Q}[\sigma^2 + \omega^2]/\bar{K}S \\ - (S-1) \phi\bar{Q} - (S-1) b K\omega^2 \bar{Q}/(S\bar{K}) = 0. \end{aligned}$$

$$\bar{Q} = \frac{\bar{\alpha} - c}{2(\mu + (n-1)\phi) + (S-n)\phi + bK/\bar{K}(\sigma^2/S + \omega^2)} \quad (18)$$

A number of features of (18) deserve comment. First, ignore the variance terms. Then, (18) says that output is between the collusive level $(\bar{\alpha}-c)/2(\mu+(n-1)\phi)$ and the level predicted by the sheer maximization of individual profits $(\bar{\alpha}-c)/(2\mu+(n-1)\phi)$. As S rises, output falls towards the monopolistic level. The interpretation of this is straightforward. A rise in S makes each shareholder concerned about the profits of more firms. This makes managers cooperate more with managers of other firms. Note that this collusion need not be "enforced" with penalties against cheaters. In fact managers never need to meet each other. Managers collude simply as a result of looking out for their shareholders.³

The presence of uncertainty also reduces output in this model. This occurs because an increase in output raises both the variance of firm specific profits and even the variance of a fully diversified portfolio. This provides firms with an incentive to cut their output below the one they would produce under certainty since the shareholders are risk averse. This result is, as can be inferred from Leland (1972) fairly general. He shows that when managers are risk averse and the uncertainty in demand is such that a high realization of the uncertainty raises marginal revenue (in addition to revenue at fixed output), an increase in uncertainty lowers firm output. If instead marginal revenue is not affected neither is output. A different form of uncertainty which has this property will be studied below. This leads to a level of output given by (18) with the variance terms set to zero. Note that the effect of the uncertainty in demand on equilibrium output falls as the individual holdings of equity K become small relative to total equity \bar{K} . Then, the uncertainty becomes relatively unimportant to the individual

investor. Similarly, the firm specific variance σ^2 is less important than the market variance ω^2 since the former can be diversified to some extent. Thus only σ^2/S matters.

Now consider an increase in the transactions costs F . Such an increase tends to improve industrial performance by raising output. This occurs because people end up with less diversified portfolios and thus firms compete more. This can be seen by differentiating (18) and thus ignoring that S is an integer:

$$\frac{d\bar{Q}}{\bar{Q}} = \frac{-[\bar{\phi} - bK\sigma^2/\bar{K}S^2]dS}{2(\mu+(n-1)Q)+(S+n)\phi+b(K/\bar{K})(\sigma^2/S + \omega^2)}$$

So as long as S is relatively big an increase in S reduces output. The countervailing force, which is important when σ^2/S^2 is big, is that an increase in S reduces the importance of the uncertainty in demand. This tends to increase Q . This countervailing force must be small enough to make increases in S lead to falls in Q for the system to be stable in a certain sense. This can be seen as follows. Increases in Q away from an equilibrium increase $\tilde{\sigma}$ since $\tilde{\sigma}$ is given by $Q\sigma/K$. Thus S rises and for stability this must lead to a fall in Q back towards the equilibrium. If the system is stable in this sense increases in F both lower S and raise Q .

One key question is whether inducing these rises in Q by increasing taxes on transactions is socially desirable.⁴ Clearly, on average, the valuation by buyers of an additional unit of any good $[\bar{\alpha}-(\mu+(n-1)\phi)Q]$ exceeds the marginal cost c . Moreover, if the distribution of α has sufficiently small support the marginal valuation of a unit of a good exceeds its cost in all states of nature. So if outputs were increased consumers would be able to more than compensate stockholders as a whole. In particular raising output of each good by one unit and asking consumers to pay $\alpha-(\mu-(n-1)\phi)Q$ more in each state of nature would leave these indifferent. Transferring these

resources minus marginal cost to stockholders in addition to their original receipts would make the shareholders strictly better off. Unfortunately, simply increasing F makes stockholders less happy not only because monopoly profits fall but also because now their portfolios are riskier since they are less diversified. Restoring the original level of utility of shareholders via state dependent lump sum transfers seems farfetched.

On the other hand, if portfolios with a relatively small number of shares have fairly similar risk characteristics to completely diversified ones, then investors do not lose much by being restricted to holding few shares. In other words, very small transactions costs can reduce optimal diversification considerably and only marginally reduce investor welfare while significantly improving industrial performance.

IV. Stockholder Unanimity

Stockholders in this model unanimously desire that their firms produce the level of output given by (18). This is only mildly surprising since the shareholders are ex ante identical. However their portfolios differ. This could be a source of conflict since the managers are concerned with the utility of shareholders after they have picked their portfolios. On the other hand, while the portfolios differ, firms themselves affect each other symmetrically. Thus if the individual is concerned about the profits of S firms it is immaterial to the manager of any of these firms which other companies are being held by the individual. To show this more formally consider the utility of a typical stockholder who holds S assets given by (10). By substituting (13), (14) and (15) in (10) one obtains:

$$U_i = \frac{K}{S} \sum_{j \in J_i} \frac{Q_j}{K_j} [\bar{\alpha} - \mu Q_j - \phi \sum_{z \neq j} Q_z] - \frac{L^j}{K_j} - \frac{bK}{2S} \left(\frac{Q_j}{K_j} \right)^2 (\sigma^2 + \omega^2)$$

$$- \sum_{\substack{x \in J_i \\ x \neq j}} \frac{Q_x Q_j}{K_x K_j} \omega^2$$

Suppose firm j maximizes U_i by picking Q_j while expecting all other firms in J_i not to change their output. Then

$$\frac{dV_i}{dQ_j} = 0 = (1/K^j)(\bar{\alpha} - c - 2\mu Q_j - \phi \sum_{z=j} Q_z) - \frac{bK}{S} \frac{Q_j}{K_j^2} (\sigma^2 + \omega^2) - S \sum_{\substack{x \in J_i \\ x \neq j}} \left[\frac{\phi Q_x}{K^x} - \frac{bKQ_x \omega^2}{S K^x K^j} \right]$$

And in a symmetric equilibrium in which K^j equals \bar{K} while Q^j equals \bar{Q} :

$$\bar{\alpha} - c - (2\mu + (n-1)\phi)\bar{Q} - \frac{bK\bar{Q}}{S\bar{K}} (\sigma^2 + \omega^2) - (S-1)\phi\bar{Q} - \frac{bK\bar{Q}\omega^2(S-1)}{\bar{K}S} = 0$$

which is equivalent to (18).

Makowski (1983) shows that when both asset and goods markets are competitive stockholders unanimously want the firm to maximize value. His result differs from this one in several respects.

First, the unanimity result here is not nearly as robust as Makowski's. Indeed, even with symmetric firms, if different shareholders differ in their endowment, they differ in their optimal S . Richer individuals hold shares of more companies and therefore wish the companies to collude more than do poorer shareholders. With less symmetric firms the composition of the portfolios themselves could lead to disagreements. Suppose we consider three firms A, B, and C. From the point of view of the maximization of (1) individuals may be indifferent between holding A and B or B and C. Thus some will hold the former combination while others will hold the latter. However the strategic interactions between the firms may differ. Then B would act differently depending on whether it is colluding with A or with C. Finally disagreements among shareholders may result from differences in their tastes for the goods produced by the firms themselves. These "consumption effects" are mentioned in the early literature on competitive stock markets (see for instance Grossman and Stiglitz (1977)). As Makowski (1983) points out they are in fact

irrelevant when markets are truly competitive. Then, firms cannot rationally conjecture that changing their production plans will change the consumption sets of their shareholders. However when firms have market power in the goods markets these conjectures become rational. In this paper these "consumption effects" don't arise because shareholders implicitly purchase their consumption elsewhere.

This is realistic for economies in which stockholding is very concentrated. Nonetheless it is crucial for the results. This can be seen by contrasting the model in this paper to the "representative individual" paradigm. If all individuals in a closed economy have identical tastes and portfolios managers pursuing the welfare of these individuals will produce the competitive level of output. Robinson Crusoe qua producer does not seek to exploit Robinson Crusoe qua consumer. Presumably, a situation in which shareholding is concentrated while, nonetheless, shareholders care somewhat about the prices of the goods produced by the corporate sector has an equilibrium somewhere in between the one considered here and the competitive allocation. However, such a model appears intractable.

Second, when all markets are competitive sellers of shares agree with buyers of shares that value maximization is best. The model presented so far has no sellers of shares. However when the model is suitably modified to allow such sellers to exist, the sellers and the buyers disagree. To see this, note first that it is easy to reinterpret the model to allow for the presence of sellers. Buyers of shares continue to spend their endowment K on shares. On the other hand, capital in place at the firms is \bar{K} . The amount $n\bar{K}$ need not bear any relationship to mK . If one adopts the convention that shares are claims on a unit of the capital in place then, in equilibrium, the amount of the capital good that will be paid for a single share is $mK/n\bar{K}$. Instead, when firms are created with the capital of the initial shareholders nK

is equal to $m\bar{K}$ and Tobin's q is one.⁵ However, the formulae of the previous section use K and \bar{K} separately and are thus valid in either case. The main difference between the case in which capital has been put in place by the sellers of a fixed number of shares and the case considered previously is that now the level of profits is given by $[\text{Revenues} - (\bar{Q}-\bar{K})c]$. Before it was given by $[\text{Revenues} - (Q-mK/n)c]$. However, it is now apparent that equation (18) describes the equilibrium when managers are concerned with the utility of the buyers of shares.

This is intuitively plausible since the current owners of the companies can dictate manager compensation. Thus managers will probably try to please them.⁶ Then the price of shares will reflect the fact that the production plan will follow shareholder's wishes. It might be argued that if this plan doesn't maximize the value of the firm an individual could buy the firm, change its production plan so that market value is maximized and resell the firm at the higher price. The ability to do this hinges on the possibility of precommitting to a production plan. If potential reorganizers or more generally sellers of the firm's shares cannot precommit to a specific level of output then output will equal \bar{Q} and the shares will be priced accordingly. Obviously some forms of precommitment are possible for example by signing long term contracts with suppliers. The extent of this ability to precommit is obviously an empirical question. The next section shows the importance of this empirical question by pointing out that sellers of shares do indeed disagree with buyers.

V. The Interests of Old Shareholders

To simplify the analysis I assume that sellers of shares intend to use the proceeds of their sales to purchase goods from foreigners at fixed relative prices. Thus they are interested in maximizing the market value of their portfolio. Here it is assumed that managers will pick output for the next period to maximize this value.

Let the market price of firm j 's shares be q_j . Each seller is assumed to hold an equal number of shares of S companies. If the subset of companies investor i holds is J_i then he wants managers to maximize

$$U_i = \sum_{j \in J_i} q_j \quad (19)$$

Once again, since firms are symmetric it is irrelevant whether a manager of a firm in J_i maximizes (19) or whether he maximizes a weighted average of the U_i where individuals are weighed by their shareholdings.

Under fairly general circumstances the derivative of q_j with respect to an increase in the expected value of profits in the next period is positive. Suppose in particular that for simplicity the demand curves in the previous section are modified so that marginal revenue is deterministic:

$$P_j Q_j = Q_j [\bar{\alpha} - \mu Q_j - \phi \sum_{z \neq j} Q_z] + \alpha \quad (20)$$

where α is random with mean zero and is unrelated to the quantities Q_i . Then firms cannot affect the randomness to which shareholders are subject. Buyers will be willing to pay more for shares of companies whose expected profits rise for two reasons. First the price must rise to keep the expected return constant. But if the expected return is constant and the price rises the variance of the return per dollar invested becomes smaller and the stock more desirable. So the price must rise more than in proportion to the expected profits.

In any event the fact that $dq_j/d\Pi_j$ is positive where Π_j is expected profits should be uncontroversial. On the other hand if the buyers have a fixed number of resources to spend on stocks then the increase in Π_j cannot affect the value of the whole market. If each firm has the same number of shares this means that:

$$\sum_{j=1}^n \frac{dq_j}{d\Pi_z} = 0$$

Moreover if all firms are symmetric so that all q_z other than q_j are affected in the same way by increases in Π_j :

$$\frac{dq_j}{d\Pi_j} = -(n-1) \frac{dq_z}{d\Pi_j} \quad z \neq j. \quad (21)$$

So, naturally q_z falls as Π_j increases. Now suppose firm j which is included in J_i tries to maximize (19) by varying Q_j while assuming all other outputs are constant. Differentiating (19):

$$\frac{dU_i}{dQ_j} = \sum_{z \in J_i} \sum_{x=1}^n \frac{dq_z}{d\Pi_x} \frac{d\Pi_x}{dQ_j} \quad (22)$$

Assuming all firms are symmetric so that $dq_f/d\Pi_f$ is the same for all firms and that both $dq_f/d\Pi_x$ and $d\Pi_x/dQ_f$ are the same for all f not equal to x (22) becomes:

$$\frac{dU_i}{dQ_j} = \frac{dq_j}{d\Pi_j} \frac{d\Pi_j}{dQ_j} + (n-1) \frac{dq_f}{d\Pi_x} \frac{d\Pi_x}{dQ_j} + (S-1) \left[\frac{dq_j}{d\Pi_j} \frac{d\Pi_x}{dQ_j} + (n-2) \frac{dq_f}{d\Pi_j} + \frac{d\Pi_j}{dQ_j} \right]$$

and using (21):

$$\frac{dU_i}{dQ_j} = \frac{dq_j}{d\Pi_j} \left[\frac{d\Pi_j}{dQ_j} - \frac{d\Pi_x}{dQ_j} \right] \left[1 - \frac{S-1}{n-1} \right] \quad (23)$$

First assume that S is different from n . Profits of firm x always decline when Q_j rises. Therefore at the profit maximizing point in which $d\Pi_j/dQ_j$ is zero increases in output are desirable. When firms maximize U_i output must exceed the profit maximizing output so that $d\Pi_j/dQ_j$ is negative and equal to $d\Pi_x/dQ_j$.

Using the demand functions (20) and the production functions of the previous section

$$\frac{d\Pi_j}{dQ_j} = \bar{\alpha} - 2\mu Q_j - \phi \sum_{z \neq j} Q_z - c$$

$$\frac{d\Pi_x}{dQ_j} = -\phi Q_x$$

So at a symmetric equilibrium in which dU_1/dQ_j is zero for all individuals and all firms

$$Q^* = \frac{\bar{\alpha} - c}{2\mu + (n-2)\phi} \quad (24)$$

which is indeed bigger than the profit maximizing level $(\bar{\alpha}-c)/(2\mu+(n-1)\phi)$. However, Q^* is still smaller than the perfectly competitive level of output which equates expected price to marginal cost. That output is given by $(\bar{\alpha}-c)/(\mu+(n-1)\phi)$.

Note that the optimal level of output is independent of S until S equals n . This can be interpreted as follows. When $d\Pi_j/dQ_j$ is equal to $d\Pi_x/dQ_j$ an increase in Q_j has no effect on the value of firm j . The loss in Π_j reduces this value but the profits of all other $(n-1)$ firms fall by the same amount as Π_j . Since a fall by one dollar in Π_x increases the value of firm j by the same amount as an increase in $1/(n-1)$ dollars in Π_j the two effects cancel. Also, when $d\Pi_j/dQ_j$ is equal to $d\Pi_x/dQ_j$ a rise in Q_j leaves unaffected the value of the other firms. The fall in Π_x hurts q_x . All other profits except Π_j fall by the same amount however. So, ignoring the effect of the fall in Π_j the effect of the increase in Q_j is $1/(n-1)$ of the effect that would prevail if only Π_x were affected. This deleterious effect is exactly compensated by the fall in Π_j .

So, all sellers agree, independently of their portfolios. The value of each stock is maximized. If S were equal to n however, the amount buyers will pay for a typical portfolio is independent of the outputs, dU_i/dQ_j is always zero. The managers might as well act in the interest of the buyers of shares. Presumably if S were indeed equal to n the value of the total portfolio would actually depend on the choice of outputs insofar as the total investment of the buyers is affected by the rate of return. This probably minor effect is ignored here for simplicity.

This section thus establishes a surprising result. As long as stock sellers are not fully diversified they are content to ask their firms to take actions that will reduce profits. Such actions are worthwhile as long as they also reduce other firms' profits thereby increasing the market value of the original firm. This is applied here to the choice of output but it may well also explain other predatory practices that appear irrational since they reduce profits.

VI. Uncertainty and Industrial Performance

So far all firms have been assumed to be symmetric and only two types of uncertainty have been introduced. In Sections III and IV there were firm specific shocks and aggregate shocks. An increase in the variance of firm specific shocks increased S and thus collusion. On the other hand an increase in the aggregate variance left S unaffected. In this section the implications of a richer class of uncertainty are explored. In particular I consider two symmetric industries. Each has n firms subject to random demand. Once again precommitment is impossible so that managers maximize the utility of current shareholders. I start with the individual shareholder's problem. The return to investing a unit of capital in firm i of industry j is:

$$R_{ij} = \mu_j + \overset{\sim}{\epsilon}_{ij} + \overset{\sim}{\eta}_j \quad \begin{array}{l} i = i, \dots, n \\ j = 1, 2 \end{array} \quad (25)$$

where the μ 's are constant and

$$E \epsilon_{ij}^{\sim} = E \eta_j^{\sim} = E \epsilon_{ij}^{\sim} \eta_z^{\sim} = E \epsilon_{ij}^{\sim} \epsilon_{xz}^{\sim} = 0 \quad \begin{matrix} z = 1, 2 \\ j = z \rightarrow x \neq i \end{matrix}$$

$$E \epsilon_{ij}^{\sim 2} = \sigma_j^{\sim 2} \quad E \eta_j^{\sim 2} = \omega_j^{\sim 2}$$

The individual must therefore decide on S_1 , and S_2 , the number of stocks he wants to purchase in each industry as well as on V_1 , and V_2 , the amount he wants to spend on a single firm in each industry. His budget constraint is given by

$$S_1 V_1 + S_2 V_2 = K \quad (26)$$

using (1), (25) and (26) the utility of individual i is:

$$U_i = K\mu_1 + S_2 V_2 (\mu_2 - \mu_1) - \frac{b}{2} [(K - S_2 V_2)^2 \Gamma_1 + (S_2 V_2)^2 \Gamma_2 + K^2 \omega_m^{\sim 2}] - (S_1 + S_2)F \quad (27)$$

$$\Gamma_j = (\sigma_j^{\sim 2} / S_j) + \omega_j^{\sim 2}$$

So, maximizing (27) with respect to $S_2 V_2$, S_1 and S_2 (thus ignoring for simplicity the fact that the S 's are integers) one obtains:

$$\frac{dU_i}{dS_2 V_2} = \mu_2 - \mu_1 + b(K - S_2 V_2) \Gamma_1 - S_2 V_2 \Gamma_2 = 0 \quad (28)$$

$$\frac{dU_i}{dS_2} = V_2 \frac{dV_i}{dS_2 V_2} + \frac{b}{2} (S_2 V_2)^2 \frac{\sigma_2^{\sim 2}}{S_2^2} - F = 0 \quad (29)$$

$$\frac{dU_i}{dS_1} = \frac{b}{2} (K - S_2 V_2)^2 \frac{\sigma_2^{\sim 2}}{S_2^2} - F = 0 \quad (30)$$

Using (28):

$$S_2 V_2 = (\mu_2 - \mu_1 + bK\Gamma_1) / b(\Gamma_1 + \Gamma_2) \quad (31)$$

Equating F in (29) and (30), taking square roots and using (26) and (31):

$$(\mu_1 - \mu_2 - bK\omega_1^2) \tilde{\sigma}_2 S_1 + (\mu_1 - \mu_2 + bK\omega_2^2) \tilde{\sigma}_1 S_2 = (\tilde{\sigma}_1 - \tilde{\sigma}_2) \tilde{\sigma}_1 \tilde{\sigma}_2 bK \quad (32)$$

Taking the square root of (29) and (30) and adding, one obtains:

$$K = \sqrt{\frac{2F}{b}} \left[\frac{S_1}{\tilde{\sigma}_1} + \frac{S_2}{\tilde{\sigma}_2} \right] \quad (33)$$

Equations (32) and (33) are a system of two linear equations whose solution is

$$S_1 = \frac{\tilde{\sigma}_1 (\mu_1 - \mu_2 + bK\omega_2^2 + \sqrt{2Fb} (\tilde{\sigma}_2 - \tilde{\sigma}_1))}{\sqrt{2Fb} (\omega_1^2 + \omega_2^2)} \quad (34)$$

$$S_2 = \frac{\tilde{\sigma}_2 (\mu_2 - \mu_1 + bK\omega_1^2 + \sqrt{2Fb} (\tilde{\sigma}_1 - \tilde{\sigma}_2))}{\sqrt{2Fb} (\omega_1^2 + \omega_2^2)} .$$

So, increasing the mean return in an industry increases both the number of firms in that industry whose shares are bought and the amount spent in that industry's shares. Similarity increases in $\tilde{\omega}_1$, reduce both S_1 and $S_1 V_1$. Changes in σ_j lead to an ambiguous effect on S_j . Diversifying one's holdings in the industry becomes more desirable but the industry itself becomes less attractive. Which effect is likely to dominate in equilibrium is discussed below.

I now turn to the firms' problem. Revenue from sales of good i of industry j is given by:

$$P_{ij}Q_{ij} = Q_{ij}[\alpha - \mu Q_{ij} - \phi \sum_{z \neq i} Q_{zj} - \psi \sum_{z \neq i}^n Q_{zk}] + \epsilon_{ij} + \eta_j \quad (35)$$

j=k j=1,2 k=1,2

$$E(\epsilon_{ij}) = E\eta_j = E\epsilon_{ij}\eta_z = E\epsilon_{ij}\epsilon_{xz} = 0 \quad j, z = 1, 2 ; j=z \rightarrow x \neq i$$

$$E(\epsilon_{ij})^2 = \sigma_j^2 \quad E(\eta_j)^2 = \omega_j^2$$

So, once again randomness affects revenues and not marginal revenues. The increase in the output of any firm decreases the prices of all firms in equilibrium. It decreases its own price the most, followed by the decreases it causes in the prices in its own industry. So μ is bigger than ϕ . Falls in the prices of the goods of the other industry are smaller than those of the prices of the same industry. ϕ is bigger than ψ . This has the interpretation that goods within an industry are better substitutes than goods across industries.⁷ Moreover, the two different industries are subject to different industry wide demand shocks as well as firm specific shocks whose variance may differ across industries.

Since the randomness in revenues is independent of firm actions, the randomness in returns (as long as investors are uniformly distributed over firms within industries) is given by

$$\tilde{\sigma}_j = n\sigma_j/mV_jS_j \quad \tilde{\omega}_j = n\omega_j/mV_jS_j \quad (36)$$

Similarly the mean return of firm i in industry j , μ_{ij} is given by:

$$\mu_{ij} = \frac{n\bar{\Pi}_{ij}}{mV_jS_j} = \frac{nQ_{ij}[\bar{\alpha} - \mu Q_{ij} - \phi \sum_{z \neq j} Q_{zj} - \psi \sum_{z=1}^n Q_{kj}] - L_{ij}}{mV_jS_j} \quad (37)$$

i = 1, ..., n
j = 1, 2 h = 1, 2
j ≠ k

where L_{ij} is the amount of labor hired by firm i in industry j . Equation (37) implicitly defines Π_{ij} as the expected value of the profits of the firm. Thus ignoring the variance terms which are outside the firm's control the individual's utility is proportional to:

$$V_1 \sum_{i \in J_{i1}} \Pi_{i1} + V_2 \sum_{i \in J_{i2}} \Pi_{i2}$$

where J_{ij} is the subset of firms in industry j held by the individual.

Therefore if firm z in sector j maximizes (9) it must maximize

$$\bar{v}_{zj} = \sum_{i=1}^m \delta_{izj} [V_1 \sum_{x \in J_{i1}} \Pi_{i1} + V_2 \sum_{x \in J_{i2}} \Pi_{i2}]$$

where δ_{izj} is one if individual i holds firm z in industry j and zero otherwise. The probability, if individuals are uniformly distributed across firms within industries, that an individual who holds assets of firm z in industry j also holds assets of firm k in industry j is $(S_j - 1)/(n - 1)$. The probability he holds any one asset in the other sector is S_x/n where x is different from j . So firm z in sector j maximizes:

$$\hat{v}_{zj} = \Pi_{zj} + \frac{S_j - 1}{n - 1} \sum_{i \neq z} \Pi_{ij} + \frac{V_x S_x}{V_j n} \sum_{i=1}^n \Pi_{ix} \quad x \neq j \quad (38)$$

using the definition of Π_{zj} in (37), taking into account that dL_{ij}/dQ_{ij} is c , the maximum of \hat{v}_{zj} must satisfy:

$$\begin{aligned} \bar{\alpha} - 2\mu Q_{zj} - \phi \sum_{i=z} Q_{ij} - \psi \sum_{i \neq 1}^n Q_{zx} - c - \frac{S_j - 1}{n - 1} \sum_{i \neq z} \phi Q_{ij} \\ - \frac{V_x S_x}{V_j n} \sum_{i=1}^n \psi Q_{ix} = 0 \quad j = 1, 2 \quad x \neq j \end{aligned} \quad (39)$$

In the symmetric case in which Q_{xj} is equal to Q_j , (39) reduces to the following two equations:

$$[2(\mu - \phi) + (S_1 + n)\phi]Q_1 + \psi [n + (V_2/V_1)S_2]Q_2 = (\bar{\alpha} - c) \quad (40)$$

$$[n\Psi + (V_1/V_2)S_1]Q_1 + [2(\mu-\phi)+(S_2+n)\phi]Q_2 = (\bar{\alpha}-c)$$

A symmetric equilibrium thus solves (26), (31), (34), (37) and (40) simultaneously. This gives the values, in equilibrium of the two Q's, S's, μ 's and SV's. The solution of these equations is, in general, quite complicated. So, to analyze the effects of changes in uncertainty I differentiate the system at the symmetric equilibrium in which the two industries are subject to randomness of the same size. The values of the variables at this equilibrium are starred:

$$\begin{aligned} \sigma_j^* &= \sigma^* = \frac{\tilde{\sigma}_{mK}^*}{2n} \\ \omega_j^* &= \omega^* = \frac{\tilde{\omega}_{mK}^*}{2n} \quad j = 1, 2 \\ S_j^* &= S^* = \frac{\tilde{\sigma}_K}{2} \sqrt{\frac{b}{2F}} \\ S^* V^* &= S_j^* V_j^* = K/2 \\ \mu_j^* &= \mu^* = 2n\bar{\pi}_j^*/K_m = 2n\bar{\pi}^*/K_m \\ Q_j^* &= Q^* = \frac{\bar{\alpha} - c}{2(\mu+\phi(n-1)+\Psi n) + (S^*-n)(\phi+\Psi)} \end{aligned} \tag{41}$$

Note that, again when S equals n, output is equal to the collusive output while when S equals 1 it equals the profit maximizing one. Moreover, an increase in the substitutability of goods which increases Ψ reduces output independently of S. An increase in Ψ not only makes reductions in the output of firms in one sector more profitable to firms in the other sector, which helps when firms collude, but also lowers marginal revenue at each level of output.

I will consider the effects of increasing σ_1 , and ω_1 . This will naturally reduce $S_1 V_1$ so that ω_1 won't move as much as ω_1 for instance. However, ω_1 must

still increase when ω_1 rises for $S_1 V_1$ to be affected at all. So, since I am only interested in the sign of the changes, I will, for simplicity, differentiate the system with respect to σ_1 and ω_1 . Differentiating (34):

$$dS_1 = S^* + \left(\frac{\sigma_1^*}{2\omega_1^*} \frac{d\sigma_1}{\sigma_1^*} \right) - \frac{S^* d\omega_1^2}{2\omega_1^*} + \frac{S^*(d\mu_1 - d\mu_2)}{bK \omega_1^*} \quad (42)$$

$$dS_2 = \frac{\sigma_1^*}{2\omega_1^*} d\sigma_1 + \frac{S^* d\omega_1^2}{2\omega_1^*} - \frac{S^*(d\mu_1 - d\mu_2)}{bK \omega_1^*}$$

Note that $dS_1/d\sigma_1$ is positive as long as S^* exceeds half the ratio of firm specific variance to industry variance. So, S_1 will usually rise when σ_1 rises unless industry variance is a relatively unimportant factor. Clearly if industry variance were nonexistent and we start at the symmetric equilibrium, an increase in σ_1 without any changes in μ would make industry 1 shares be dominated by the shares of industry 2. Then S_1 would become zero. On the other hand if industry variance is big enough an increase in σ_1 leads to a desire to diversify more one's holdings of industry 1.

Subtracting μ_2 from μ_1 in (37), using (26) and (31) one obtains:

$$\mu_1 - \mu_2 = \frac{n\pi_1 b(Q_1 + Q_2)}{m(\mu_1 - \mu_2 + bK\Gamma_2)} - \frac{n\pi_2 b(\Gamma_1 + \Gamma_2)}{m(\mu_2 - \mu_1 + bK\Gamma_1)}$$

which, when total differentiated, yields

$$d\mu_1 - d\mu_2 = \frac{nb \Gamma^*(d\pi_1 - d\pi_2)}{(2\mu^* + bK\Gamma^*)m} + \frac{\mu^* bK}{2\mu^* + bK\Gamma^*} \left(d\omega_1^2 + \frac{2\sigma_1^* d\sigma_1}{S^*} - \frac{\sigma_1^*}{S^*} (dS_1 - dS_2) \right) \quad (43)$$

An increase in either σ_1 or ω_1 reduces $S_1 V_1$ and thus raises $(\mu_1 - \mu_2)$. An increase in S_1 raises $S_1 V_1$ and thus lowers μ_1 .

Using (42):

$$dS_1 - dS_2 = \left(\frac{S^*}{\tilde{\sigma}^*} - \frac{\tilde{\sigma}^{*2}}{\omega^{*2}} \right) d\sigma_1 - \frac{S^*}{\omega^{*2}} d\omega_1^2 + \frac{2S^*(d\mu_1 - d\mu_2)}{bK\omega^{*2}} \quad (44)$$

Equations (43) and (44) can be viewed as a system of two linear equations in $(dS_1 - dS_2)$ and $(d\mu_1 - d\mu_2)$ whose solution is:

$$dS_1 - dS_2 = \frac{1}{\Delta} \left[\left(\frac{S^*}{\tilde{\sigma}^*} - \frac{\tilde{\sigma}^{*2}}{\omega^{*2}} + \frac{4c^*\mu^*}{\omega^{*2}(2\mu^* + bK\Gamma^*)} \right) \tilde{\sigma}_1 \right. \\ \left. - \frac{S^*bKQ^*d\omega_1^2}{\omega^{*2}(2\mu^* + bK\Gamma^*)} + \frac{2S^*n\Gamma^*(d\Pi_1 - d\Pi_2)}{mK\omega^{*2}(2\mu^* + bK\Gamma^*)} \right] \quad (45)$$

$$d\mu_1 - d\mu_2 = \frac{1}{\Delta} \left[\frac{\tilde{\sigma}^*\mu^*bK}{S^*(2\mu^* + bK\Gamma^*)} \left(1 + \frac{\tilde{\sigma}^{*2}}{\omega^{*2}S^*} \right) \left(d\sigma_1^* + \frac{S^*}{\tilde{\sigma}^*} d\omega_1^2 \right) + \frac{nb\Gamma^*(d\Pi_1 - d\Pi_2)}{m(2\mu^* + bK\Gamma^*)} \right] \quad (46)$$

$$\Delta = 1 + \frac{\mu^*\tilde{\sigma}^{*2}}{S^*(2\mu^* + bK\Gamma^*)\omega^{*2}}$$

So, increases in either $\tilde{\sigma}_1$ or $\tilde{\omega}_1$ raise $(\mu_1 - \mu_2)$. On the other hand the former tend to raise $(S_1 - S_2)$ while the latter always lowers it.

To analyze the effects on output of the changes in uncertainty I now differentiate (40) and solve for dQ_1 and dQ_2 :

$$dQ_1 = \frac{-Q^*}{\Delta} [2(\mu - \phi)\phi + (S^* + n)(\phi^2 - \Psi^2)] dS_1 + 2(\mu - \phi)\Psi dS_2 + [2(\mu - \phi) + (S^* + n)(\phi + \Psi)] S^*\Psi d(V_2/V_1)$$

$$dQ_2 = \frac{-Q^*}{\Delta} [2(\mu - \phi)\phi + (S^* + n)(\phi^2 - \Psi^2)] dS_2 + [2(\mu - \phi)\Psi dS_1 - [2(\mu - \phi) + (S^* + n)(\phi + \Psi)] S^*\Psi d(V_2/V_1)]$$

$$\hat{\Delta} = [2(\mu-\phi) + (\phi-\Psi)(S+n)][2(\mu-\phi) + (\phi+\Psi)(S+n)] \quad (47)$$

Increases in either S_1 or S_2 reduce both outputs since they make collusion more desirable from the point of view of shareholders. Naturally S_1 has a stronger effect on Q_1 than on Q_2 and vice versa for increases in S_2 . Increases in (V_2/V_1) lower Q_1 and raise Q_2 . This occurs because, as can be seen in (38) and (39), the more investors spend on shares of industry 2 the more they want firms in Sector 1 to help those in Sector 2 by restricting their output. Instead they become less interested in making firms in industry help those in industry 1. Instead of using (47) it is easier to focus on $(dQ_1 - dQ_2)$ since this only depends on $(dS_1 - dS_2)$ and on $d(V_2/V_1)$. When $(Q_1 - Q_2)$ goes up it means that industry 1 becomes relatively more competitive, i.e. its output gets relatively nearer to the level of output that makes price equal to marginal cost. So:

$$dQ_1 - dQ_2 = \frac{-Q^*[(\phi-\Psi)(dS_1 - dS_2) + 2S^*\Psi d(V_2/V_1)]}{2(\mu-\phi) + (S^*+n)(\phi-\Psi)} \quad (48)$$

The ratio (V_2/V_1) is given by:

$$\frac{V_2}{V_1} = \frac{S_1(\mu_2 - \mu_1 + bK\Gamma_1)}{S_2(\mu_1 - \mu_2 + bK\Gamma_2)} \quad (49)$$

So at the symmetric equilibrium:

$$d(V_2/V_1) = \frac{\tilde{\omega}_1^*}{\Gamma^*S^*} (dS_1 - dS_2) - \frac{2(d\mu_1 - d\mu_2)}{bK\Gamma^*} + \frac{d\tilde{\omega}_1^2}{\Gamma^*} + \frac{2\tilde{\sigma}^*d\tilde{\sigma}_1}{\Gamma^*S^*}$$

And using (44) to substitute for $dS_1 - dS_2$:

$$d(V_2/V_1) = \left(\frac{1}{\Gamma^*} + \frac{\tilde{\sigma}^*}{\Gamma^*S^*} \right) \tilde{d\sigma}_1$$

Increases in $\tilde{\sigma}_1$ always reduce V_1 relative to V_2 . But (V_2/V_1) is not

affected near the symmetric equilibrium by changes in $\tilde{\omega}_1$ or $(\Pi_1 - \Pi_2)$.

Hence increases in σ_1 tend to raise both V_2/V_1 and $(S_1 - S_2)$. So as can be seen in (48) both because investors have a more diversified portfolio of firms in sector 1 and because they spend relatively less on each company of this sector, Q_2 rises relative to Q_1 .

This analysis abstracts from the second round effects produced by the changes in $(\Pi_1 - \Pi_2)$. These accounting profits change as a result of the changes in $(Q_1 - Q_2)$ even when capital in place is fixed.⁸ These second round effects can only dampen or exacerbate the effects discussed so far and not change their sign. If $(\Pi_1 - \Pi_2)$ rises when $(Q_1 - Q_2)$ falls then this will make $(S_1 - S_2)$ go up and $(Q_1 - Q_2)$ will fall further. If, instead $(\Pi_1 - \Pi_2)$ falls this will dampen the fall in $(Q_1 - Q_2)$. It can't reverse this fall because otherwise $(\Pi_1 - \Pi_2)$ would rise leading to a contradiction. As will be discussed below the effect on $\Pi_1 - \Pi_2$ is indeed ambiguous.

So far I have only shown that $(Q_1 - Q_2)$ falls as $\tilde{\sigma}_1$ goes up. Q_1 itself will always fall if S exceeds $\tilde{\sigma}^{*2}/2\tilde{\omega}^{*2}$. Then, since $(\mu_1 - \mu_2)$ rises (42) says that S_1 as well as $(S_1 - S_2)$ rise so that, according to (48) Q_1 falls. The effect on Q_2 is ambiguous. S_2 may well rise when $\tilde{\sigma}_1$ goes up so, in (48) the effects of S_1 and S_2 run counter to the effect of V_2/V_1 .

Increases in $\tilde{\omega}_1$ lower $(S_1 - S_2)$ so that unambiguously $(Q_1 - Q_2)$ goes up, industry 1 becomes relatively more competitive. Since the effects of ω_1 and $(\mu_1 - \mu_2)$ in (42) on S_1 and S_2 are of the same magnitude and of opposite sign, we know that the fall in $(S_1 - S_2)$ corresponds to a fall in S_1 and a rise in S_2 . Q_1 rises and Q_2 falls. So, as the returns in an industry become more correlated either because σ falls or because ω rises, individuals hold fewer firms in that industry and competition increases.

At this point, it might be suspected that if transactions costs are zero and therefore individuals are fully diversified ($S = n$) the effect of changes in

$\tilde{\sigma}_1$ and $\tilde{\omega}_1$ has the same sign. Indeed in this case Γ_j is equal to $(\tilde{\sigma}_j^2/n + \tilde{\omega}_j^2)$ so that it rises when either variance rises. Consumers can then be characterized by (49) with S equal to n. The mean return in industry j, μ_j is simply given by Π_j/mV_j . Differentiating (49) together with this definition one obtains, at the symmetric equilibrium:

$$(dV_2-dV_1)(2\mu^*+bK\Gamma^*) = (2\mu^*/\Pi bK\Gamma^*)(d\Pi_2-d\Pi_1)+(d\Gamma_1-d\Gamma_2)/\Gamma^*$$

So, ignoring changes in profits, increases in Γ_1 raise (V_2/V_1) and thus, according to (47) lower Q_1 and raise Q_2 . Without transactions costs more noise makes an industry less competitive since individuals invest less in each one of the firms.

I now briefly explore the ambiguity surrounding the change in $(\Pi_1-\Pi_2)$ when (Q_1-Q_2) changes and capital in place is fixed. This ambiguity alone naturally makes profitability per se a bad measure of the distortion introduced by the lack of perfect competition. Differentiating the definition of profits in (37) for typical firms in sectors 1 and 2:

$$d\Pi_1 = [\bar{\alpha}-c-2(\mu+(n-1)\phi)Q_1 - n\Psi Q_2]dQ_1 - n\Psi Q_1 dQ_2$$

$$d\Pi_2 = [\bar{\alpha}-c-2(\mu+(n-1)\phi)Q_2 - n\Psi Q_2]dQ_2 - n\Psi Q_2 dQ_1$$

So, at the symmetric equilibrium:

$$d\Pi_1 - d\Pi_2 = (\bar{\alpha} - c - 2(\mu+(n-1)\phi)Q^*)(dQ_1 - dQ_2) \quad (50)$$

The bigger is the level of output at the symmetric equilibrium the more an increase in Q_1 hurts Π_1 relative to Π_2 . Using (41) to replace Q^* in (50)

$$d\Pi_1 - d\Pi_2 = \frac{(\bar{\alpha}-c)[S^*\Psi - (\phi-\Psi)n](dQ_1 - dQ_2)}{2(\mu-\phi) + (n+S^*)(\phi+\Psi)}$$

If S is equal to $(\phi/\Psi-1)$ the effect on $(\Pi_1 - \Pi_2)$ is nil. As S gets bigger, Q^* rises and profits in sector 1 rise relative to those in sector 2 when $(Q_1 - Q_2)$ rises.

VII. Conclusions

This paper attempts to deal with a variety of issues that arise when firms have market power in the goods markets while they behave competitively in asset and factor markets. In this context financial transactions costs play a crucial role in determining industrial performance. The framework presented here is simple enough that a number of extensions appear worthwhile.

In the first place the model doesn't explicitly consider mutual funds. These, by lowering the costs of diversification naturally induce more collusion if managers follow the wishes of the ultimate recipients of dividends. However, in the light of this paper, it may well be that the funds which concentrate on specific industries and those whose portfolio is very broad do the most harm.

Secondly, entry is ignored. If existing firms are acting very collusively, the market becomes very attractive to an entrant who can produce a similar product. This however will only tempt someone willing to incur a lot of risk by not diversifying. So the equilibrium of this paper can be supported if the potential entrants are very risk averse. Nevertheless a common pattern in the U.S. is for industries to have a few corporate giants together with a large number of smaller closely held firms. In a model such as the one presented here such a pattern might emerge in equilibrium if entry were allowed while entrants must be closely held and thus undiversified. Then, one might want to know how the size of the competitive fringe responds to changes in financial transactions costs as well as to changes in the uncertainty of demand.

Thirdly, the model presented here assumes managers doggedly pursue shareholders' interests. Here a contract that ensures this is easy to construct since knowledge of the level of output is sufficient to know whether the managers deserves to be paid. More generally monitoring of effort may be imperfect. The best possible contract with managers may not produce the most desired outcomes from the point of view of shareholders. Whether these optimal contracts involve behavior which is more competitive than when shareholders get their way is an open question which deserves further study.

Finally, a related question is whether large shareholders have more power than small ones. Then, these large stockholders might pick their portfolio strategically knowing that this will affect the actions and profits of their firms. Unfortunately, this seems to require these large stockholders to behave noncompetitively in asset markets since, when firms' plans change, so will firms' market values. Rubinstein and Yaari (1983)'s assumption that in such a context shareholders act competitively seems unappealing.

Footnotes

¹ This paradox has been attributed to Jeremy Bulow.

² However, since individuals hold stocks in institutions who, in turn, hold other stocks, their ultimate sources of income are somewhat more diversified than their holdings suggest.

³ This result doesn't depend on the use of quantities as strategic variables. Under certainty with the same demand and production functions, it can be shown that output also decreases towards the collusive level as S increases when prices are used as strategic variables. I have opted for the use of quantities because this makes the uncertainty which leads to diversification easier to interpret in a model without inventories.

⁴ What is pursued here is a tax which reduces diversification. It might be thought that individuals who buy individual equity issues diversify their portfolio over time by purchasing shares in different companies as they save. Nonetheless an increase in the fixed transactions costs of buying shares will induce these individuals to convert their shares into equity less often and to buy fewer firms' shares each time. They will thus have a less diversified portfolio at each point in their life cycle.

⁵ One of the motivations of starting with a model in which anybody can add his capital to a company is that it shows that q can be one even with extensive collusion. Naturally q might differ from one if the firms acted monopolistically in the asset markets and chose to issue shares in the amount that maximizes the welfare of current stockholders.

Footnotes (cont.)

6 This assumes that compensation schemes can be devised which make managers follow the shareholders' wishes. Some of the caveats that arise due to the difficulties in implementing these schemes are mentioned in the conclusion.

7 Ignoring the uncertainty the condition that Ψ be smaller than ϕ is equivalent to making the quantity demanded rise more when a firm in the same industry raises its price than when this is done by a firm in the other industry.

8 Accounting profits also change when the amount of physical capital of a firm changes. This is neglected in the text. If physical capital in firms of sector 1 is mS_1V_1/n then as σ rises, S_1V_1 falls so that $(\Pi_1 - \Pi_2)$ rises. This also tends to increase $(S_1 - S_2)$ and therefore $(Q_2 - Q_1)$.

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