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Abstract

This paper investigates product-market competition under the assumption that managers maximize shareholder value. This contrasts with the standard assumption in studies of industrial organization that managers maximize their expected discounted value of firm profits. These assumptions are not equivalent when shareholders are imperfectly informed about firm profitability. We demonstrate conditions under which shareholder-value maximization leads to more aggressive product- market strategies than profit maximization. This effect arises because rival firm's profits provide information about a firm's value: lower profits of rivals leads investors to believe that the firm is more valuable. Thus, firms try to reduce their rivals' profits in an effort to increase their own stock price. We draw implications of these effects for corporate financial structure.

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1. Introduction

Financial economists typically assume that firms maximize shareholder value. Industrial economists typically assume that firms maximize the discounted value of profits. Sometimes these assumptions amount to the same thing; often they do not. In this paper, we explore the product-market effects of shareholder-value maximization when these assumptions are not equivalent.

The equivalence breaks down in many realistic environments. A leading example is when firms have outstanding debt obligations. In this case, shareholders receive the residual cash flows after payments to creditors. Thus, when cash flows are uncertain, managers who maximize share value care less about cash flows in those states in which bondholders receive all the cash flows and shareholders receive none. By contrast, managers who maximize total firm value do not care how these cash flows are divided. Jensen and Meckling (1976) show that neglecting bondholders can lead to overinvestment relative to profit maximization; Myers (1977) demonstrates that this can also lead to underinvestment.[1]

As Miller and Rock (1985) and Stein (1989) show, differences between profit maximization and share value maximization can also arise for pure equity-financed firms when information is imperfect. Given that stock prices represent the (rational) forecast of the discounted value of profits this may seem surprising. How can the maximization of this rational forecast differ from the maximization of the present value itself? The answer according to these authors is that under imperfect information, firms may have the ability to enhance investor perceptions (and thus the share price) even without actually increasing profits. In particular, firms can increase current profits at the expense of future profits by foregoing valuable investment projects. If investment is unobservable, and firms vary according to their inherent profitability, high current profits lead investors to believe that the firm is inherently more profitable.

This raises the question of why managers would maximize share value rather than their expectation of the firm's present discounted value of profits. One possibility is that

[1] Jensen and Meckling show that the option-like features of debt can lead to excessive risk-taking. Myers shows that because the benefits of investment accrue first to bondholders (who have higher priority), shareholders are reluctant to invest when the firm is in financial distress.

the former objective is also that of current shareholders. Indeed, shareholders prefer value maximization if they intend to sell their shares for liquidity reasons or in response to a takeover bid. Shareholders will also want a high future stock price if the firm plans to issue more equity to finance new investment.

To exhibit the effects of shareholder-value maximization on product-market competition, we reconsider the standard Cournot oligopoly model. In our model, share-value maximizing firms maximize a weighted average of expected profits and stock price. We introduce imperfect information by assuming that firms' costs and the level of market demand are stochastic and not directly observable by investors. Firms' costs are serially correlated, while market demand is serially independent.

The stock market tries to infer a firm's costs (and hence future profitability) based on the firm's realized profits and those of its rivals. Rivals' profits are useful because their profits are jointly determined by the level of market demand. When profits are low for all firms it suggests that industry demand was low. In contrast, if one firm has high profits and the others have low profits, it suggests that the former received a favorable, firm-specific cost shock. As a result, firms wish to outperform each other to increase their stock price. They can do so not just by ensuring that their own profits are high, but also by lowering their rivals' profits.

These effects make firms more aggressive in the product market. In our Cournot model it means that firms will produce more output than they would if they were pure profit maximizers. To see this, suppose that firms' production decisions were the same as those in the standard Cournot model. A small increase in a firm's output reduces its expected profits to the second order, but decreases its rivals' expected profits to the first order by lowering the market price. So raising output above the Cournot level increases shareholder value, by raising current stock price.

The basic structure of our model is similar to the "signal- jamming" model of Holmstrom (1982a), Fudenberg and Tirole (1986) and others. In these models, managers do not have private information about their characteristics so they are not signaling models. Instead, managers learn along with the market about their types. Nevertheless, managers

try to manipulate the market's assessments through unobservable actions. Similarly, in our model, firms are not privately informed about their inherent profitability, but try to influence the market's assessments through their unobservable product-market strategies.

Our analysis has several implications for the effect of the stock market on industrial performance. It has been argued that U.S. firms care more about short-term results than Japanese firms because U.S. shareholders (typically institutional investors) have shorter investment horizons than Japanese shareholders (typically banks and corporations with long-term relationships with firms). In addition, the active takeover market in the U.S. forces American firms to maintain a high stock price, whereas the concentrated pattern of shareholdings in Japan insulates Japanese companies from the threat of takeover. Indeed, this observation is borne out in the data: in a survey reported by Abegglen and Stalk (1985), Japanese managers list share-price maximization as last on a list of ten objectives, while American managers list it second.

The result is that American managers are more reluctant than their Japanese counterparts to take projects with deferred payoffs, though they may be valuable. One such project is investment in market share: Scherer (1988) is one of many to argue that the Japanese are more willing to incur short-term losses by competing more aggressively for current market share and hence greater future market power. Stein (1989) presents a model in which this seemingly myopic project choice exists in equilibrium.

Our model points to a potential weakness of this argument. It is true that low profits are a negative signal of a firm's profitability. As a result firms might avoid valuable projects with low short-term payoffs (such as competing aggressively) if the market cannot observe their actions and thus the reason profits are low. But this only focuses on part of the story, by ignoring the other firms in the market. Aggressive product-market strategies may lower profits, but they lower the profits of other firms as well. The positive reputational effect of lowering rivals' profits can outweigh the negative reputational effect of lowering one's own profits.

The implication is that a stock market with short investor horizons or with considerable takeover activity may induce firms to compete more, not less, aggressively. Note,

however, that while this improves the efficiency of the product market and increases social welfare, it lowers overall industry profits.

The framework presented here also has implications for the choice of financial structure. Firms with ample cash are less likely to issue equity in future periods. As a result, they are less concerned with their stock price and thus are less aggressive in their product-market strategies. Such firms lose market share to their leaner rivals.

To overcome this problem, firms try to gain competitive advantage by paying out free cash flows, thereby committing to return to the capital market for further financing. It is optimal for individual firms to pay high dividends, repurchase stock, or issue debt, to commit to compete more aggressively. Although individually optimal, it is collectively inefficient from firms' viewpoint. It means that all firms will compete more aggressively, reducing industry profits.

The paper has three sections following this one. In Section 2 we describe the model and present the main result that share-value maximizing firms may compete more aggressively than profit- maximizing firms. Section 3 considers the implications of these product-market effects for financial policy along the lines discussed above. Section 4 puts our results in the context of some related work and discusses the empirical implications of the model. Section 5 contains concluding remarks.

2. The Model

We consider an industry with n firms producing a homogeneous product. The inverse demand function for this industry is $p(Q, \epsilon) = P(Q) - \epsilon$, where Q is the industry's output and ϵ is a normally distributed[2] random variable with mean zero and variance σ_ϵ^2. The n firms choose simultaneously the quantity of output to sell as in the standard Cournot model. The equilibrium price is the one that clears the market given these quantities.

Each firm $i = 1, ..., n$ produces output q_i at constant, but stochastic, marginal cost. In particular, the marginal cost of firm i, denoted θ_i, is normally distributed[3] with mean $\bar{\theta}$ and

[2] The use of the normal distribution facilitates exposition (without affecting the main conclusions) because Bayesian updating is particularly simple in this case. This simplicity comes at the cost of ignoring that the price people are willing to pay for the good is negative for really large realizations of ϵ.

[3] The normal distribution again simplifies the presentation. In the case of costs, normality of θ has the disadvantage that costs are sometimes negative. This feature too could be eliminated without affecting the main conclusions but at the cost of substantial complication.

variance σ_θ^2. The random variable θ_i is a permanent firm characteristic; it measures the efficiency of the firm's managers or the productivity of its durable assets. In contrast, the demand uncertainty, ϵ, is transitory and does not affect firms' future profitability.[4] This asymmetry plays an important role in our results. We give reasons for this assumption in Section 3 below.

We make two key informational assumptions. The first is that outside investors observe only the level of profits. They observe neither the random variables θ_i and ϵ nor the equilibrium prices and quantities. The assumption that outside investors are imperfectly informed about the random variables affecting the industry is plausible. Below we argue that these random variables are so difficult to isolate that even the firm's managers lack complete information about them.

What may be more controversial is our assumption that investors do not observe the equilibrium prices and quantities. In our model, all goods are identical so there is a single market price which all consumers can presumably observe. Thus, it would appear unrealistic to assume that investors do not observe the price while consumers do. But, in a more realistic model, in which firms produce a variety of different products for different customers, the observation of a few prices conveys little information about the firm's chosen output. Rather than work with a complicated multi-product model, we focus instead on a simple homogeneous goods model. We nonetheless retain the assumption that outsiders know nothing about prices and quantities.

Our second informational assumption is that firms cannot observe θ_i and ϵ directly. Therefore, our model is not a signaling model; firms do not have private information that they signal through their actions. Since firms are uninformed about θ, all firms must take the same action in equilibrium. We make this informational assumption for two reasons.

First, it is reasonable to suppose that when firms choose the quantity to produce (which can also be thought of as their investment in production capacity) they do not know the level of demand when the products must actually be sold. This rationalizes the non-observability of ϵ. Moreover, when the firm chooses quantities it is also uncertain of

[4] While it is more plausible to view this random variable as affecting industry demand, the analysis is formally identical if ϵ is viewed as affecting marginal cost of all firms in the industry.

its marginal costs. This uncertainty could stem from partial ignorance of actual input costs, like the cost of labor or materials. But, this uncertainty is perhaps best thought of as uncertainty about the firm's underlying technical efficiency. For example, the firm's managers might learn only slowly about the productivity of the firm's assets or how effective they are at controlling costs.

A second reason for assuming that firms, like investors, are uninformed about θ_i and ϵ is that it simplifies the analysis without sacrificing realism. Unlike signaling models where different "types" take different actions, in our model, all types of firms take the same action. Nonetheless, our model shares an important feature with signaling models: firms spend resources to try to manipulate investors beliefs about their characteristics. And like so-called separating equilibria in signaling models, firms are unable to fool the market in equilibrium.[5]

In the Cournot model, firms simply maximize current profits. For the type of model considered here that is equivalent to maximizing the managers' expected discounted value of profits. By contrast we assume that firms maximize the current stock price (or, equivalently, shareholder value). The stock price is simply the discounted value of profits expected by outside investors. Therefore, under symmetric information the maximization of shareholder value is equivalent to the maximization of discounted profits.

This equivalence breaks down when the outside investors know less than do the managers of the company. Then managers concerned with value maximization are willing to take actions that reduce the present value of profits if these actions enhance investor perceptions of future profits.

Formally, we assume that managers maximize a weighted average of current profits and the stock price at the end of the period. As Miller and Rock and Stein point out, and as discussed in the Introduction, this is in the average shareholder's interest in a number of realistic environments. First, investors might have to sell their shares for liquidity reasons, in which case the weight on the share price would be the fraction of shareholders who must sell their shares. Second, there might be the threat of a takeover. Finally, if the firm must

[5] Holmstrom (1982a) is perhaps the first to take this approach. Fudenberg and Tirole (1986) call this type of model "signal-jamming."

issue equity, it will put some weight on its share price. We develop this last interpretation in more detail in Section 4.

For the moment, we assume that firm i maximizes current shareholder value (or current stock price) V_i which is given by:

$$V_i = E[\pi_i + \alpha p_i], \tag{1}$$

where α is a positive constant, p_i is the firm's share price at the end of the period, and the expectation operator, E, refers to the firm's expectations over ϵ and the n realizations of θ. We assume risk-neutral valuation and a discount rate of zero. Note that if $\alpha = 1$ and the firm distributes all its profits as dividends, (1) simply restates the familiar equality between the value of the firm and the current dividend plus the discounted end-of-period stock price.

We now come to the forces determining the stock price itself. One assumption we could make is that the competition among firms is carried out several times. The stock price is then the investors' expectation of the firm's profits in future rounds of competition. We avoid this assumption because it introduces other effects that are not the focus of our paper. As Riordan (1986) shows in a model with repeated rounds of competition, firms have an incentive to influence their rivals' perceptions of their productivity. Firms want to convince others that they have low costs to induce them to produce less. This has the same qualitative effects as those we study: firms compete more aggressively. However, we wish to abstract from this effect to focus on those which are mediated through financial markets.

We thus assume that there is only one oligopolistic interaction while the stock price nonetheless depends on investor perceptions about θ_i. What we have in mind is that the firms have available to them projects in the second period whose expected return is related to their cost parameter, θ_i. Firms with lower values of θ_i are better managed or have more productive physical assets, so the return they can hope for on other projects is higher. It is in this sense that θ_i is a permanent shock to costs.

In this section, we assume that the stock price is a function $g(\hat{\theta}_i)$, where $\hat{\theta}_i$ represents the stock market's expectation of θ_i. Thus, the stock price depends only on this investor

expectation. We assume that this function is decreasing in its argument so that firms with higher costs are worth less. In the next section we derive $g(.)$ from more fundamental features of the model, but now we treat $g(.)$ as fixed.

Given this assumption, firms maximize

$$E[\pi_i + \alpha g(\hat{\theta}_i)]. \tag{2}$$

Note that since a firm cannot affect its payoffs from the second period project in the first period, the actual project payoffs are omitted from (2).

The next step is to calculate $\hat{\theta}_i$ given any realization of π_k for the $k = 1, ..., n$ firms. While investors cannot observe the outputs of the n firms, they can make rational conjectures about the outputs chosen in equilibrium. Let q_k^* be the conjectured equilibrium outputs of the n firms. Of course, a requirement of the equilibrium is that these conjectures are correct. Thus, investors recognize that profits are determined by the following equation:

$$\pi_k = [D(Q^*) - (\theta_k + \epsilon)]q_k^*. \tag{3}$$

where $Q^* = \sum_k q_k^*$. From equation (3), investors can infer the realization of $\theta_k + \epsilon \equiv z_k$. Given the conjectured output of the n firms,

$$z_k \equiv \theta_k + \epsilon = D(Q^*) - \pi_k/q_k^*. \tag{4}$$

From the n realizations of π_k, investors derive z_k. They then update their prior about each θ_k in Bayesian fashion. Suppose this prior is also normal with mean $\bar{\theta}$. Standard arguments then imply that $\hat{\theta}_i$ is given by:

$$\hat{\theta}_i = \frac{n}{s+n}\bar{\theta} + \frac{s+n-1}{s+n}z_i - \sum_{k \neq i} \frac{1}{s+n} z_k, \tag{5}$$

where $s = \sigma_\theta^2/\sigma_\epsilon^2$ is the signal to noise ratio and the weights on the $n+1$ variables sum to one.

There are two important features of this updating rule. First, $\hat{\theta}_i$ is increasing in z_i and thus decreasing in π_i; a higher profit realization for firm i leads investors to believe

that the cost parameter θ_i is low. Second, the revision in θ_i is decreasing in all other firms' realizations of z; high profit realizations for these firms lead investors to believe that ϵ is low so that firm i is likely to have a high cost parameter θ_i.

Note also the effect of the informativeness of the signals on the updating rule. An increase in the signal to noise ratio s increases the weight on the firm's own z_i and reduces the weight on the other z_k's. The rationale for this is simple. An increase in s amounts to an increase in the variance of the idiosyncratic component, θ, relative to the variance of the common component, ϵ. Other firms' profits are less useful in gauging individual performance because firms' costs are less similar. Stated differently, any difference between a given firm's performance and prior expectations is more likely to be due to an unusual realization of θ_i.

The updating rule captures the simple notion that relative performance is a valuable tool in assessing ability when there are common shocks to performance. Similar effects arise in the tournaments literature (Lazear and Rosen (1981), Holmstrom (1982b), and Nalebuff and Stiglitz (1983). There, relative performance provides information about the actions of individual agents since performance is affected by a common shock to all agents' performance.

3. Equilibrium

This section analyzes product-market equilibrium in light of the updating rules discussed above. We study Nash equilibria in which firms choose output taking as given all other firms' output choices. They also take as given the updating rule (5) that investors use. Finally, the updating rules themselves take as given the strategies of the n firms. Of course, in equilibrium, everyone is at an optimum given the others' strategies and the conjectured strategies are the chosen ones.

There are two effects that a firm considers when it chooses output. First, output directly affects profits; second, it alters the market's assessment of θ_i and hence determines the firm's stock price. This latter effect arises because output affects the profits of all firms and hence affects z_k for all firms. The effect of output on the profits of the other firms is the driving force behind our results.

We now determine the effects on $\hat{\theta}_i$ of an increase in output for a given realization of θ_i and ϵ. To do this we differentiate (5) with respect to q_i:

$$\frac{d\hat{\theta}_i(\theta_i,\epsilon)}{dq_i} = -(\frac{s+n-1}{s+n})\frac{\pi_i'(\theta_i,\epsilon)}{q_i^*} + \sum_{k\neq i}\frac{P'(Q^*)}{s+n}, \tag{6}$$

where $\pi_i'(\theta_i,\epsilon) = [P(Q^*) - \epsilon - \theta_i] + P'(Q^*)q_i$ is the derivative of profits of firm i with respect to its output for a particular realization of θ_i and ϵ.

Note that we take $q_k^* = 1,..,n$ as given when determining the effect of an increase of q_i on all π_k and hence z_k. This is because q_k^* is the market's conjecture of the chosen output, not the output itself. So we simply determine the direct effect of q_i on the π_k.

The first term on the right-hand side of (6) reflects the effect of q_i on z_i. It lowers the market's assessment of θ_i if and only if expected profits are increasing in output. The second term captures the effect of q_i on the profits of the $(n-1)$ other firms. Increasing q_i unambiguously lowers the assessment of θ_i because it lowers market price and hence lowers all firms' profits.

We are now ready to derive the first-order condition for the firm's choice of output. This will give us each firm's reaction function – its optimal choice of output given all other firms' output choices. Differentiating (2) with respect to q_i yields:

$$E\left[\left\{1 - \frac{g'(\hat{\theta}_i)\alpha(s+n-1)}{(s+n)q_i^*}\right\}\pi_i'\right] + E[g'(\hat{\theta}_i)]\alpha\sum_{k\neq i}\frac{P'(Q^*)}{s+n} = 0. \tag{7}$$

The standard Cournot condition is a special case of equation (7). We first discuss this case to serve as a benchmark against which to compare the more general case. When $\alpha = 0$, firms maximize profit; they place no weight on the second-period stock price. Thus, all the terms with α drop out and equation (7) simply states that the firm sets the expected marginal profits of output equal to zero: this is the stochastic version of the familiar Cournot condition. This condition is also optimal when investors are perfectly informed about θ_i even if $\alpha > 0$. In that case, $\hat{\theta}_i$ cannot be affected by the firm's output choice so that all term with g' drop out. Again, equation (7) states that firms set expected marginal profits equal to zero.

Figure 1 below shows the reaction curves of the two firms in a duopoly. The two lines labelled $R_i(0)$ give the optimal reaction of firm i to the output of firm j when firms maximize profit ($\alpha = 0$). As is standard, we assume that the Cournot reaction curves slope downward.[6] That is, an increase in rivals' conjectured output reduces the amount that an individual firm wishes to produce. The Nash equilibrium occurs at the intersection of the two curves: at that point neither firm has an incentive to change its output given the other's output choice.

Equation (7) shows that the combination of share-value maximization and imperfect information has two effects on equilibrium. The first (and, in our context, less interesting) effect is that the firm weighs marginal profitability of quantity increases by $1 - kg'$ where k is a positive constant. If g' depends on $\hat{\theta}$, these weights on profits affect the firm's output. For example, suppose that g is sensitive to changes in $\hat{\theta}$ only for high values of $\hat{\theta}$, i.e. when the firm's profits are low. Then the firm is most concerned with increasing its profits in these states. This will lead firms to reduce output below the Cournot point because the marginal profitability of output in the high $\theta + \epsilon$ states is negative. If, in contrast, g is only sensitive to changes in $\hat{\theta}$ for low values of $\hat{\theta}$ the firms tend to produce more than the Cournot level.

This effect is similar in some respects to one that Brander and Lewis (1986) consider. They analyze the effect of debt financing on product-market equilibrium when there is uncertainly, but symmetric information. Assuming that the value of equity is zero when firms cannot fully meet their debt obligations, share-value-maximizing managers place no weight on small profit realizations. Formally, this is similar to assuming that $g(\hat{\theta})$ is insensitive to large values of $\hat{\theta}$. Like our model, this implies that under Cournot competition, firms produce more output than the standard Cournot level. We wish to abstract from the effects analyzed by Brander and Lewis because, with equity financing, there is no *a priori* reason to expect g' to be particularly large for either high or low realizations of

[6] Provided the second-order condition is met, the reaction curves slope downward if the derivative of (7) with respect to rivals' outputs is negative. This will be the case if

$$P'(Q^*) + P''(Q^*)q_i^* \leq 0.$$

$\hat{\theta}$. We therefore assume for the moment that g' is a negative constant. Also, since this effect would arise for a monopolist as well, we ignore it to focus on the competitive effects of share-value maximization. In the next section, however, we derive g' from more fundamental determinants of firm profitability.

The second – and, in our context, more interesting – effect of imperfect information and share-value maximization is apparent from the second term in (7). This term (which includes $P'(Q)$) is positive. This means that, when g' is constant, at an optimum, the expected value of π' is negative. Thus, holding fixed its competitors' outputs, each firm produces more output than the level which maximizes profits. It does so because small increases in output have no effect on its own profits. But, the increase in output lowers rivals' profits by lowering the market price. This lowers the market's assessment of θ_i.

This effect amounts to a shift out in firms' reaction curves; given the output of rival firms, each firm produces more output. Provided the reaction curves slope downward, this translates into an increase in the equilibrium output of all firms. One can indeed show that if the reaction curves slope downward in the standard Cournot case, they will slope downward here as well.[7]

We illustrate this graphically in Figure 1 for the duopoly case. As discussed above, the intersection of the two lines labelled $R_i(0)$ is the standard Cournot equilibrium. When α is positive, both reaction curves shift out to $R_i(\alpha)$. Equilibrium output increases.

Several important features of this equilibrium are worth noting. First, since output is greater than the profit-maximizing equilibrium level (and hence further away from the monopoly level), firms' profits are lower when they maximize shareholder value.

Second, investors are not fooled in equilibrium. They correctly predict the equilibrium outputs and make correct estimates of $\theta_i + \epsilon$. Nonetheless, firms try to manipulate the

[7] The derivative of (7) with respect to the output of other firms is:

$$\left[1 - \frac{g'(\hat{\theta}_i)\alpha(s+n-1)}{(s+n)q_i^*}\right]\left[P'(Q^*) + P''(Q^*)q_i\right] + \frac{\alpha g' P''(Q^*)}{s+n}.$$

For the reaction curves to slope downward, this expression must be negative. In the usual case (which corresponds to α equal to zero) the corresponding condition is that

$$\left[P'(Q^*) + P''(Q^*)q_i\right]$$

must be negative. Simple algebra establishes that this condition implies the one stated above.

market's beliefs through their output choices. In the end, they fool no one, but the market's expectations drive them towards this seemingly sub-optimal strategy.[8]

This implies that the second-period stock price is the same regardless of whether firms maximize profits or shareholder value. Given that profits are lower this means that although firms set out to maximize shareholder value, shareholders are worse off than when firms maximize profits. But, note that because the firms' outputs are greater in this equilibrium than when firms maximize profits, prices are closer to expected marginal costs and social welfare is higher.

We conclude this section with a discussion of some comparative static results and their economic implications.

Importance of stock price. From the above discussion it should be clear that an increase in the weight firms place on second-period share price, shifts out firms' reaction curves and increases equilibrium output, lowers profits and shareholder value, and increases social welfare.

Uncertainty. An increase in the signal to noise ratio, s, has the opposite effect. In this case, firms are more dispersed in their characteristics so that a firm's individual performance is more important in affecting the market's beliefs. Thus, firms are more reluctant to compete aggressively to lower their rivals' profits. Reaction curves shift inward, equilibrium output declines, profits and shareholder value rise, and social welfare declines.

One interpretation of this result is that an increase in idiosyncratic uncertainty decreases real economic activity. If we interpret q_i as investment in production capacity, our model predicts that greater variability in firm-specific cost or demand variables, reduces corporate investment. In contrast, increases in uncertainty that affect all firms – for example, common demand shocks – increase corporate investment because then relative performance is a better measure of firm profitability.

Bernanke (1983), Pindyck (1988), and others have also shown that increases in uncertainty can reduce investment. Their idea is that uncertainty increases the option value

[8] In this sense, the model is similar to the labor-market model of Holmstrom (1982). In his model, workers exert effort to influence the market's assessment of their abilities. Of course, in equilibrium they have no affect on the market's beliefs. But, given the market's beliefs, a worker who shirked would be viewed as less able. Workers might be better off if they could band together and reduce their effort, but non-cooperative behavior makes this impossible. This equilibrium feature is also found in other contexts in papers by Riordan (1986), and Fudenberg and Tirole (1986).

of investments; the more uncertainty there is the more can be learned about the value of investing. Thus, firms tend to defer investments when their investment decisions are irreversible. Our results suggest that different types of uncertainty have different impacts on investment. Provided the uncertainty is idiosyncratic, similar results to those of Bernanke and Pindyck will hold. But, if the uncertainty is systematic, the opposite result will hold.

This comparative static result also has implications for how the informativeness of the stock market affects real economic activity. If stock prices are determined to some extent by noise trading, prices deviate from fundamental values, and firm behavior has less impact on stock prices. Thus, firms have less incentive to invest in production capacity and compete aggressively. Interestingly, however, the noisier is the market, the greater is firm profitability since the product-market outcome is closer to the standard Cournot equilibrium.

Number of firms. The analysis also has implications for the relationship between the number of firms and product-market equilibrium. In the standard Cournot model, an increase in n does not affect firms' reaction functions; the optimal response to total output of $\bar{Q}$ produced by $n-1$ firms is the same as the optimal response to total output of $\bar{Q}$ produce by n firms. However, since there are more firms, industry output increases in equilibrium.

The analysis is substantively different if firms maximize value rather than profits. An increase in the number of rivals shifts out firms' reaction functions and induces them to compete more aggressively. This can bee seen formally by differentiating (7) with respect to n. Increasing the number of rivals, increases the number of $\theta + \epsilon$ realizations, and so makes it easier to distinguish the common demand shock from the idiosyncratic cost shock. As a result, the market places more weight on other firms' profits when it tries to infer θ_i. Hence, firm i recognizes that reductions in other firms' profits have a more favorable impact on the market's assessment of θ_i. The implication is that if n firms produce a total output of $\bar{Q}$, firm i will produce more than if $n-1$ firms produce $\bar{Q}$. Total industry output rises in equilibrium both because there are more firms and because firms compete more aggressively.

The results of this section are driven by the assumption that the only determinant of second-period profitability is a firm- specific characteristic, θ_i. Suppose instead that ϵ, which we regarded as a transitory demand shock actually has a permanent effect on both demand and firm profitability. In this case, second-period profits are $g(\theta, \epsilon)$ where $\partial g/\partial \epsilon$ is positive. Thus realizations in which all firms' profits are low suggests in part that demand was low and will be low in the subsequent period. This tempers aggressiveness in goods markets. Firms realize that actions which increase other firms' profits tend to make financial markets believe that the current and future levels of demand are high. This effect acts in the opposite direction of the one we have analyzed.

Indeed, if this effect is strong enough, it may even lead firms to compete less aggressively than in the standard Cournot model. We believe that this is an unlikely outcome in many environments. First, in a stable, proven industry, uncertainty about individual firm performance is likely to be greater than uncertainty about the industry as a whole. Second, if firms are expanding into other businesses the industry demand uncertainty, ϵ, will be less important while the firm-specific efficiency measure, θ, will be more important.

4. Implications for Financial Policy

Above, we argued that firms care about their stock price because they may need to issue equity to finance investment. This section presents a more detailed analysis of the effect of equity issues on product-market equilibrium. We show that issuing equity makes firms more aggressive in the product market. Therefore, firms wish to commit to an aggressive product-market strategy by increasing the importance of external, equity financing. They can do so by distributing cash flows in the form of dividends, stock repurchases, or debt payments.

To explore these ideas we consider the following extension of our basic framework. Suppose that each firm has an investment project in the second period that requires I as an initial outlay. The return on the investment is inversely related to θ, the firm's measure of cost efficiency. In particular, we assume that the cash flows from this project are $e^{-b\theta}$, where $b > 0$. This particular functional form simplifies the analysis for reasons we discuss below.

In the first period, the firm has C in cash, where $I > C$. It must decide prior to choosing its output how much of C to distribute to shareholders. Define x as the payout to shareholders. This distribution is publicly observable to all investors and competing firms. For the moment, and for simplicity, we assume that the firm distributes all of its first- period profits as a dividend. We later discuss the implications of dropping this assumption.

If a firm distributes x it must raise $I - (C - x)$ from the equity market to finance the investment. The equity issue gives new investors a claim on a fraction γ of the firm's second-period cash flows. The fraction, γ, is set so that the new shareholders receive the appropriate rate of return on their investment of I. As before, we set this rate of return equal to zero.

Summarizing, the timing of the model is as follows. First, managers distribute cash to shareholders. Then, all firms compete in the product market, distributing all of their profits to shareholders. Finally, firms issue equity to finance the second-period project, undertake the project, and distribute its cash flows as a liquidating dividend.

We begin the analysis by first considering the equity issue process. Investors who buy the new equity form expectations about its value based on the observations of all firms' profits. Thus, they demand a fraction, γ, of the cash flows such that

$$\gamma E(e^{-b\theta_i}) = I - C + x, \tag{8}$$

where the expectation is conditioned on the observations of all firms' profits.[9]

Let $N(\theta_1, \ldots, \theta_n, \epsilon)$ represent the multivariate normal distribution of the θ_i's and ϵ. As before, investors observe all firms' profits and thus observe the set of variables $z_1 \ldots z_n$. Their conditional expectation of the firm's cash flows is therefore:

$$E(e^{-b\theta_i}) = \int_{\epsilon} e^{-b\theta_i} N(z_1 - \epsilon, \ldots, z_n - \epsilon, \epsilon) d\epsilon = e^{-b\hat{\theta}_i + \frac{b^2}{2}\hat{\sigma}^2}. \tag{9}$$

where $\hat{\theta}_i$ and $\hat{\sigma}$ are the conditional mean and the conditional variance of θ_i, respectively.

[9] There may exist realizations of the θ's and ϵ such that $E(e^{-b\theta_i})$ is less than $I - C + x$. In this case, the firm would have to set $\gamma > 1$ to satisfy (8), which is clearly infeasible. Taking full account of this possibility introduces technical complications into the model that we think are economically irrelevant. So we assume this effect is mathematically small and ignore it in what follows.

Thus, given investors' beliefs:

$$\gamma = \frac{I - C + x}{e^{-b\hat{\theta}_i + \frac{b^2}{2}\hat{\sigma}}}. \tag{10}$$

It follows from (10) that if investors believe that θ_i is low (and the returns on the second-period project are high) the firm must issue less equity to finance the investment.

Firm i's objective is to maximize shareholder value:

$$V_i = x_i + \int_{\theta_1 \ldots \theta_n, \epsilon} \left[[P(Q) - \theta_i - \epsilon] q_i + (1 - \gamma) e^{-b\theta_i} \right] N(\theta_1 \ldots \theta_n, \epsilon). \tag{14}$$

In the first stage of the game, each firm i simultaneously chooses an amount to distribute, x_i. Then, given these distributions, firms simultaneously choose outputs.

We solve the model first by determining the equilibrium of the product-market game given all firms' choices of x. To do so, we differentiate (11) with respect to q_i. Using (10), this gives:

$$\frac{dV}{dq_i} = \int_{\theta_1 \ldots \theta_n, \epsilon} \left[[P(Q^*) - \epsilon - \theta_i] + P'(Q^*) q_i] - b \frac{d\hat{\theta}_i}{dq_i} \frac{I - C + x}{e^{-b\hat{\theta}_i + \frac{b^2}{2}\hat{\sigma}}} e^{-b\theta_i} \right] N(\theta_1 \ldots \theta_n, \epsilon) = 0. \tag{12}$$

Changing the variables of integration and using (9) this simplifies to:

$$\int_{z_1 \ldots z_n} \left[[P(Q^*) - z_i] + P'(Q^*) q_i] - b \frac{d\hat{\theta}_i}{dq_i} [I - C + x] \right] N^m(z_1, \ldots, z_n) = 0. \tag{13}$$

where $N^m(z_1, \ldots, z_n)$ is the marginal distribution of $(z_1 \ldots z_n)$.

Finally, using equation (5), equation (13) becomes:

$$\left[1 + \frac{b(s + n - 1)(I - C + x)}{(s + n) q_i^*}\right] \left[P(Q^*) - \bar{\theta} - P'(Q^*) q_i\right] + \frac{b(n - 1)}{s + n} (I - C + x) P'(Q^*) = 0. \tag{14}$$

The second term in equation (14) is negative. Therefore, firms set expected marginal profits from increased output, $[P(Q^*) - \bar{\theta} - P'(Q^*) q_i]$, equal to a negative number. Thus, holding fixed its competitors' outputs, each firm produces more than the profit-maximizing level of output. This is just another version of our result in the previous section.

Next, we consider the firm's decision of how much cash, x to distribute to shareholders in the first period. We show that in equilibrium firms set $x = C$; they distribute all their cash to shareholders.

To see this, suppose that firm i did not distribute all its cash: $x_i < C$. Consider a small increase in x_i. We first show that an increase in x_i shifts out the firm's reaction curve and then show that this unilateral shift increases shareholder value.

To show that an increase in x_i indeed shifts out the reaction curve of firm i we differentiate (14) with respect to x_i. Given that the second-order condition is met, dq_i/dx_i (holding fixed all other firms' outputs) is positive provided the derivative of (17) with respect to x_i is positive. Differentiating with respect to x_i we have:

$$\frac{d^2V_i}{dq_i dx_i} = \frac{b(s+n-1)}{(s+n)q_i^*}\Big[P(Q^*) - \bar{\theta} - P'(Q^*)\Big] + \frac{b(n-1)}{s+n}P'(Q^*)$$
$$= \frac{b}{(s+n)q_i^*}\Big[(s+n-1)(P(Q^*) - \bar{\theta}) - sP'(Q^*)q_i^*\Big] \geq 0. \qquad (15)$$

The inequality in (15) is strict as long as either price exceeds marginal cost (so that P exceeds $\bar{\theta}$) or the demand curve is slopes downward (so that P' is negative). Holding the reaction curves of all other firms fixed, this change in x_i increases the firm i's equilibrium output, while decreasing the outputs of all other firms. The increase in firm i's output has only a second order effect on its profitability, while the decrease in other firms' outputs increases the equilibrium price and hence has a first-order positive effect on the profits of firm i.

This establishes that given other firms' cash distributions, each firm has an incentive to distribute all of its first-period cash. Such distributions make the firm more aggressive. This, in turn, leads competitors to reduce their output, making the distribution of cash worthwhile. These reductions are more valuable the larger is the difference between price and marginal cost. Moreover, the reductions themselves are larger the larger is the effect of one's own output expansion on price.

Given that each firm wants to distribute all its cash, the equilibrium has all firms doing so. While such a policy is individually rational, it lowers all firms' profits. Given that, in equilibrium, firms have no effect on second-period stock price, shareholder value (first-period stock price) is also lower. Note, however, that social welfare is higher in this equilibrium as firms compete more aggressively and prices move closer to expected marginal costs.

If the product market is perfectly competitive price equals marginal cost while the relevant demand curve for the firm has zero slope. In this case, (15) implies that firms have no incentive to distort their balance sheets. Indeed, the incentive to distribute cash is strictly increasing in the excess of price over marginal cost and the steepness of demand.

Our basic result in this section has a simple interpretation. The distribution of cash makes a firm more concerned with its reputation in financial markets because of the increased reliance on the stock market for future financing. This increased reputational concern leads it to act more aggressively vis a vis its product-market competitors. Each firm sacrifices more of its current profits to tarnish its competitors' image.

Formally, our model is similar to many that analyze strategic interactions in the product market. For example, Spence (1977) and Dixit (1980) show that for competitive reasons there is an excessive incentive to invest in cost-reducing technologies. By lowering marginal costs, a firm's reaction curve shifts out, thus lowering the equilibrium output of rivals. This is analogous to the result presented here: firms distribute cash, shifting out their reaction curves, and lowering rivals' outputs. And, as in our model, in the Spence-Dixit framework, if all firms follow this individually rational strategy, industry profits will be lower.

It is worth comparing the implications of our model to those of Jensen's (1986) theory of "free cash flows." In Jensen's view, managers with control over corporate cash would rather invest the cash in negative present value investments than distribute it to shareholders. Shareholders can curb this form of managerial slack – emphasis on growth over profitability – by forcing managers to distribute cash flows to them in the form of dividends, stock buybacks, or debt. In this way, investments must be financed externally, and thus must receive careful scrutiny from the capital market. In support of this view, Jensen cites numerous event studies showing that cash distributions and debt-equity exchange are associated with increased share prices.[10]

Our model also predicts profit increases and positive share price responses to these changes in financial structure. But, these do not stem from a reduction in managerial

[10] This evidence is also consistent with signaling models of financial structure in which dividends, stock buybacks and debt-equity exchanges are interpreted as positive signals. See, for example, Myers and Majluf (1984).

slack: in our model, there are no agency problems between shareholders and managers. Rather, cash distributions induce firms to compete more aggressively, behavior which may look like a reduction in managerial slack. This implies that while the firm's own share price should rise after a cash distribution, the share prices of other firms in the industry should fall.

There are other important differences between the models. First, there is a subtle distinction between unilateral actions that increase an individual firm's profits and its share price, and industry-wide actions that have the opposite effect. In our model, if all firms distributed cash there would be a reduction in each firm's profits and share price. In contrast, there are no such interactions in Jensen's model so that each firm's profits and share price should rise even if all firms distribute their cash.

Second, in our model, cash distributions are associated with increases in investment and sales. This unilateral investment and sales increase lead to greater profits and share prices. In contrast, in Jensen's framework cash distributions result in *less* investment and sales and this reduction raises profits and share price by eliminating unnecessary capital expenditures and growth.

One of the problems with Jensen's interpretation of the evidence is that, according to McConnell and Muscarella (1985), investment itself is associated with positive share price responses. Their research indicates that when firms announce an increase in capital expenditure, share prices rise. This evidence raises some doubts about whether over-investment is a pervasive part of the U.S. economy, and hence whether cash distributions are intended to overcome this problem.[11]

Unfortunately, there is no direct evidence on the effects of cash distributions on investment. However, the recent wave of leveraged buyouts (LBOs) provides useful information about the validity of the ideas presented above. In the typical LBO, the firm is purchased for a large premium, financed mainly by issuing new debt. Although LBOs typically involve taking the firm private, successful LBOs generally end with a new public offering of the company's shares. Indeed, the often stated objective of an LBO is to reorganize the

[11] The one exception is capital expenditure on oil exploration and development, for which McConnell and Muscarella show that share prices fall upon their announcement. Jensen has presented strong evidence that oil companies have over-invested and that the recent takeover wave in that industry has been a response to these inefficient investments.

company so that it can be taken public once again.

In this way, an LBO makes a company's fortunes more dependent on the stock market's perception of its profitability. Our theory thus predicts that one of the benefits of an LBO is that it leads competitors to retrench (or perhaps to respond with an LBO of their own). As a result, investment and sales by the newly leveraged firm should rise, while those of its competitors should fall.

Kaplan's (1988) study of management-led LBOs provides some evidence which bears on these issues. His most relevant results are summarized in Table 1. The table reports changes in sales and capital expenditures from one year before the buyout to two years after the buyout. These changes are normalized so that they would equal zero if buyout companies had the same rate of growth as non-buyout companies in the same industries.

Our theory has mixed success in explaining the results. In contrast to the theory's predictions, the first column of Table 1 shows that sales and capital expenditure fall relative to firms in the same industry. However, in interpreting these results one should keep in mind two caveats.

First, most of these declines occur between the year before the buyout and the year of the buyout itself. In this year industry adjusted capital expenditures fall by 1.63 while they fall only by 1.34 from the year before the buyout to two years after the buyout. If the effect of the buyout is felt only after the fiscal year of the buyout, this suggests that buyouts actually *raise* capital expenditure by roughly .31.[12] Indeed, this interpretation of the evidence gains in attractiveness once one looks at pre-buyout growth in sales and capital expenditure. From two years before the buyout to one year before, buyout companies have lower growth in sales and capital expenditure than their industry peers. Thus, the poor performance in the year of the buyout seems to be part of a previous downward trend.

A second caveat in interpreting this evidence is that LBO companies are more likely to sell divisions than other companies in their industry. This tends to depress sales and capital expenditures even if the companies become more aggressive in the lines of business in which they remain.

[12] This is not exactly true because the firms in the two samples differ somewhat.

The results presented in the second column of Table 1 provide evidence in favor of our model. This column shows the change in sales and capital expenditure for LBO firms who went back to the capital market either to resell themselves to the public or to another firm. These firms had substantially higher growth in sales and capital expenditure than their industry rivals. These are precisely the LBO firms that we would expect to outperform their rivals because they are more likely to be concerned with the capital market's perception of their value. In contrast, firms that did not undergo a subsequent sale exhibit lower growth in sales and capital expenditure. These firms probably underwent an LBO for reasons other than to commit to a more aggressive product-market strategy.

A different interpretation is that only successful firms go back to the capital market and that successful firms also expand capacity and sales more rapidly than unsuccessful firms. While this alternative interpretation is plausible, we note that it runs counter to Jensen's free cash flow theory which posits that successful companies are the ones that reduce their capital expenditure the most.

Table 1

The Effects of Management Buyouts on Sales and Investment

	Industry adjusted growth from one year before buyout to two years after buyout	
	Overall difference	IPO, sale and releveraged companies
Sales	-8.31	17.36
Capital Expenditures	-1.34	0.33

See Kaplan (1988) for variable definitions

Our theory also predicts that there should be a share price rise at the announcement of an LBO and that the share price of other firms in the industry should fall. The former prediction is obviously true, while there is no evidence on the latter. Of course, the actual magnitude of stock price increases accompanying LBOs is so large that it is unlikely to

be due exclusively to this phenomenon. LBOs almost certainly have other advantages.[13] If we add these other benefits to our model, its predictions concerning the share prices of competitors are weakened. The reason is that a successful LBO by a firm in the industry may convey information about the ease with which LBOs (and their attendant efficiencies) can be carried out by the competitors. Therefore, even when one of the benefits is the retrenchment of competitors, the price of competitors' shares may increase if investors are led to revise upwards their estimate of the profitability of LBOs in the industry.

5. Conclusions

Classical studies of financial markets treat the productive part of the firm as an abstract generator of cash flows; they ignore the product-market structure that gives rise to these cash flows. Similarly, studies of industrial organization, typically neglect the role played by financial markets; instead, they start by postulating that firms maximize the present discounted value of cash flows without asking what financial structure gives rise to this objective. In this paper, we have tried to bridge both of these shortcomings. The resulting model enables us to explore the effect of financial markets on product-market competition and, in turn, the effect of product-market competition on corporate financial structure.

This paper is not the first to take this approach. We have already mentioned Brander and Lewis (1986) and its formal connection to our model. Bhattacharya and Ritter(1983), Gertner, Gibbons, and Scharfstein (1988), Rotemberg (1984,1988), and Bolton and Scharfstein (1989) also analyze the interaction between the product and capital markets. This last paper is most relevant to our work. In their framework, creditors prevent managers from diverting resources to themselves by threatening to cut off funding if the firm's performance is poor. This optimally designed "shallow pocket" reduces agency problems, but makes firms vulnerable to aggressive product-market competition. Rivals understand that predatory actions which reduce the firm's profits are likely to be followed by the firm's exit. The optimal financial structure balances the agency and product- market effects.

[13] Amongst the advantages mentioned in the literature are tax reductions, bondholder expropriations, and increased efficiency of investment plans. See Kaplan (1988) and Shleifer and Vishny (1988) for a review of the reasons firms undertake LBOs.

This result conflicts in some ways with the one presented here. In our model, firms commit to return to the capital market for further financing as a way of ensuring that they compete more aggressively in the product market; this commitment gives them a competitive advantage. In contrast, in the Bolton-Scharfstein model, the commitment to return to the capital market for further financing makes the firm more vulnerable in the product market by inducing rivals to compete more aggressively. Our view is that both of these effects can be at work, but that for most firms only one of the effects is important. Cash-poor firms for whom exit is relatively likely will be unwilling to distribute needed cash for fear of inducing predatory behavior by rivals. More liquid firms who are less vulnerable to predatory behavior may be more willing to distribute cash as a way of committing to commit more aggressively. More generally, the two theories suggest that there are product-market costs and benefits of distributing cash.

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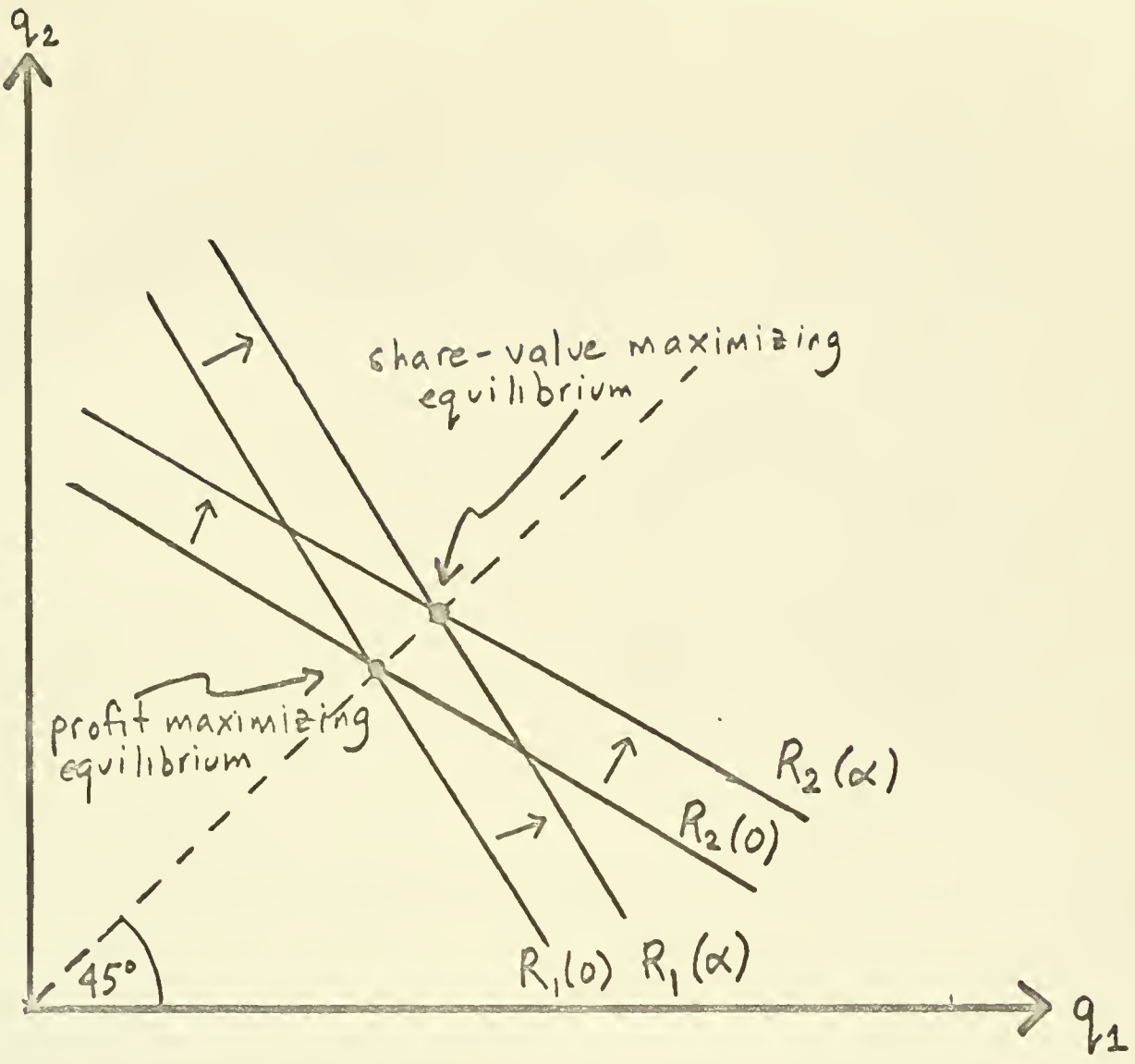
q_2
share-value maximizing equilibrium
profit maximizing equilibrium
$R_2(\alpha)$
$R_2(0)$
$R_1(0)$ $R_1(\alpha)$
45°
q_1

Figure 1

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