Oligopoly, Financial Structure and Asset Liquidity

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ABSTRACT

This paper takes the oligopoly model of Brander and Lewis and extends it to examine the consequences of bankruptcy for product market competition. We find that firms are less aggressive than they predict and we also find that firms with intangible assets will be more aggressive and will have higher outputs than other firms. This effect strengthens as debt levels rise, and we show that intangible asset firms will wish to adopt higher debt levels than their competitors.

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I. INTRODUCTION

This paper analyzes the relationship between capital structure and product market behavior, being a contribution to the literature that has examined how the increases in debt that occurred in the 1980's have affected product market decisions. The best known of these papers is still Brander and Lewis (1986), who showed that in a Cournot quantity-setting model firms would expand output in the presence of debt. Firms with high debt levels achieve a commitment to having a high output level which would in turn force the opponents' output choice downwards. This idea is based upon the assumption that shareholders are only interested in maximizing the profits net of the debt payments due. An implication of this is that industries with high debt levels should be marked by more aggressive competition, and also that, despite each firm's incentive to take on debt, profits for each firm are less than they would have been in a firm entirely financed by share capital.

Their model has proved influential, but can be questioned for having only one period of product market competition and for introducing no heterogeneity across the firms involved. In this paper we examine whether their conclusions still apply when managers/shareholders are faced with a second period of competition *after* debt payments are due. The desire to earn profits in the second period proves to limit the aggressiveness of firms, as now the manager/shareholders will be faced with a possible loss of control if the firm goes bankrupt. In fact, it is possible that a firm may have a lower output than it would have had with no debt. We also introduce differences in the asset structure of firms: companies with a large endowment of human capital, or assets with considerable specificity, are likely to have a lower liquidation value and are thus more likely to be re-organized than liquidated. This

means that the threat of bankruptcy is less potent than for firms with low asset specificity, and thus implies that, in the presence of debt, high asset specificity firms may engage in more aggressive behavior. This is in contrast to much of the literature on asset structure and debt, which tends to portray firms with intangible assets as avoiding debt. We see that firms with intangible assets may be valued more highly than their rivals, due to their ability to exploit the scarcity of their human capital by aggressive pricing in the product market. We also analyze how managers of such firms use their human capital to demand higher wages, thus tying in with Shleifer and Vishny's (1988) paper on managerial entrenchment.

Another major difference between our model and Brander and Lewis's paper is that here we assume that output decisions are made by the manager(s) of the firm rather than the mass of the shareholders. This seems a more realistic characterization of the way output decisions are made in large corporations - the large literature analyzing the separation of ownership and control indicates that it is difficult to justify a model where a large, heterogeneous mass of shareholders choose the output level of a company. Such decisions are instead made by a small team of managers, and this paper tries to take into account the idea that their interests and the shareholders will not necessarily be the same. We assume that managers have similar interests to shareholders re the distribution of first period profits (this can be justified by assuming that managers receive much of their compensation in stock options, an assumption which has a reasonable amount of empirical support). But once the firm has gone bankrupt, managers and shareholder interests may diverge to some extent, and we try to capture this idea in our model.

The main question asked in the capital market - product market literature has been whether specific changes in capital structure have engendered changes in the pattern of pricing decisions. Brander and Lewis was one of the first papers in this area and obtained the result that firms with high debt levels would tend to be more aggressive than others. This is typically (and somewhat incorrectly) interpreted as saying that firms would choose high debt levels in order to commit to a high output. In fact, Brander and Lewis were unable to prove that firms would actually choose large amounts of debt, as there was a trade-off between the positive impact of forcing other firms to reduce their output and the negative impact of increased debt on the conflict between bondholders and shareholders. Glazer (1994) took their framework and extended it to two periods but chose to focus on debt being paid off at the end of the second period. He showed that in this situation product market behavior would actually be "soft" in the first period, as firms attempted to avoid placing their rivals in an adverse financial position which might provoke an aggressive response in the second period, as the rival's feelings that they had nothing to lose led to a major expansion of output. In this paper, we instead look at how the desire to retain control *after* bankruptcy affects competition before the debt becomes due.

The paper attempts to take this literature and weld it to the large literature that exists on the topic of firm restructuring and liquidation. Most of this work analyzes the relationship between the liquidation value and the value of the firm if reorganized, and models the decision of whether to reorganize the firm after bankruptcy or to liquidate it. Such work typically obtains the result that firms with high liquidation values will have high debt levels - this relationship between the collateral value of a firm's assets and its debt levels is surveyed in Titman and Wessels (1988). In Harris

and Raviv (1990), shareholders are unsure of the exact value of the firm and use debt as an informative tool to allow them to test whether the firm would be more valuable reorganized or liquidated. If the firm has a high liquidation value, then liquidation is more likely to be the correct option and thus a higher debt level is called for. In our model there is no uncertainty about firm value and thus no need to use debt as a device for gathering information.

The model has an element of the spirit of Bergman and Callen (1991) who argue that shareholders threaten to reduce the value of the assets in their control in order to gain a better bargaining position against bondholders. Managers of firms with a high proportion of intangible assets are in a better position to engage in this kind of behavior, and thus are unable to borrow as much in equilibrium. In our model, we show that shareholders/managers of firms with intangible assets would usually like to have higher debt levels. We make the strong assumption that in fact they will be allowed to borrow such funds; in reality, liquidation values will set some limits on this, a topic we discuss below [1].

One paper which does not explicitly analyze debt levels but which is nonetheless relevant to our analysis is by Shleifer and Vishny (1988), which considers the incentives for managers to engage in investments specific to themselves. By making such investments they reduce the outside value of the firm, reduce the probability of being fired, and extract higher levels of compensation from the shareholders. Essentially they increase the proportion of intangible or illiquid assets in the firm's asset structure, and we take this idea and use it to explain how managerial security can cause managers to be more aggressive in the product market due to the lack of repercussions should they go bankrupt. This confluence of intangible assets and debt

is one of the departures of this paper from the previous literature. We can only prove that firms with low collateral will desire more debt when *total* levels of firm debt are low, but it is still suggestive as to the possibility that low collateral firms are ones who can benefit from renegotiation advantages more than ones with higher levels of collateral.

Some of our results can be summarized as follows:

(1) In a two-period framework firms choose lower outputs than in the Brander and Lewis story.

(2) Firms with intangible assets will have higher outputs than firms with tangible assets.

(3) The higher debt levels are, the stronger this effect is.

(4) Intangible asset firms will have a greater incentive to take on debt, and therefore should have higher levels of debt.

(5) Managers of firms with intangible assets are able to demand higher wages than managers of other firms.

The layout of the paper is as follows: Section 2 sets out the basic structure of the model and section 3 analyzes the bargaining process which takes place if the firm goes into bankruptcy. Section 4 presents the implications for product market competition, and Section 5 asks what debt levels will be chosen by the firm. Section 6 concludes.

II. MODEL FRAMEWORK

In this section we outline the basics of the Brander and Lewis framework and introduce the modifications made in this paper. There are two firms competing in a

duopoly framework: firm G and firm S. They sell a homogeneous product and play a standard Cournot quantity game over two periods, with each firm assumed to have the same commonly known cost schedule. Both firms choose their quantities in the first period, a process which determines the market price, but each firm is then subject to an idiosyncratic shock which affects its profit level. Each firm i also has a debt level, which we initially assume to be fixed, and call D_i. If first period profits are sufficient to cover debt payments then the firm repeats the game in the second period. In order to focus on the main area of interest, we assume that debt levels are zero in the second period and that there is no random element to profits in that period [2]. If first period profits are less than the face value of the debt then the firm goes into bankruptcy and will be either reorganized or liquidated. We let p stand for the ex ante probability that the firm is reorganised. We assume that the bankruptcy process is costly, in terms of administrative and legal fees and thus introduce a variable, B, where B is greater than zero, to symbolize the cost incurred. This cost is paid regardless of whether the firm is reorganized or liquidated. If one firm is liquidated then its rival will not enjoy monopoly profits in the second period - we assume that another rival appears to fill the gap left by the now-liquidated firm. This is in order to avoid bringing the issue of predatory behavior into the model.

The profits for firm i can be written as (following Brander and Lewis's notation) $R_i(q_i,q_j,z_i)$. (All subscripts in this paper denote the firm they are linked to, while superscripts will refer to derivatives of the relevant functions.) Profits are a function of the firm's own quantity, the quantity of its rival, firm j, and another variable, z. This z variable is assumed to reflect the randomness that can occur in any firm's fortunes. We assume that z_i and z_j are independently and identically distributed [3].

Without loss of generality, we assume z_i is defined over the interval [0,1] according to the density function $f(z_i)$. R is assumed to satisfy the usual assumptions in these models: $R^{ii}_i < 0$, and $R^{ij}_i < 0$, where the superscript refers to a partial derivative. R^{ii}_i thus refers to the second partial of R_i while R^{ij}_i is the cross partial. Brander and Lewis argue that high values of z lead to high operating profits, that is, $R^z_i > 0$, and also assume that $R^{iz}_i > 0$, a situation which implies that marginal profits are higher in better states of the world. An example of this might be higher realizations of z corresponding to downward shifts of the marginal cost schedule facing a firm. We make the same assumption here.

Given debt levels, the managers choose output levels to maximize the expected value of the firm to the shareholders. In Brander and Lewis's model the output decision was made without considering the interests of the bondholders, and that drove the result that output was higher in the presence of debt. In our model the manager is instead assumed to maximize managerial utility over the two periods. We make the assumption that the manager's compensation package in the first period is made up of a constant share, k, which is greater than zero but less than one, of the first period profits net of debt payments plus a flat wage component. This compensation function is actually fairly general; nearly all managers are paid a flat wage and receive further compensation which depends upon the value of the firm. Shareholders will want to align managers interests with theirs, which implies that managers will be partially paid with shares and/or options [4]. We also assume that managers benefit from being in control of a major corporation, and add a fixed constant, C_t, to their utility if they are in control of the corporation in any given period t. Again, this seems entirely in line with most managerial behavior; the right to control

a large corporation is clearly a valuable commodity, with the takeover battles of the 1980's being ample proof of this. In the second period, where there is no uncertainty, managerial compensation is determined in the bargaining round at the end of the first period.

We let π_i refer to the profits earned by the firm in the second period and p refer to the probability that the firm will, given it has gone into bankruptcy, be reorganized in the second period; w_1 is the flat wage the manager is paid in the first period, $\underline{w}$ is the alternate wage she would earn if fired for the second period, and is assumed to be exogenous. We let w_2 be the wage agreed in the second period if the firm went bankrupt in the first, and w_{2n} is the wage paid if the firm did not go bankrupt. We assume that w_{2n} is always greater that w_2, so there is no incentive for the manager to see bankruptcy as a good thing. We let L_i refer to the liquidation value of the firm.

Thus we can write total managerial utility, which we denote V_i as being equal to:

$$\begin{aligned} V_i = {} & w_1 + k \int_{z^*}^{d} (R_i(q_i,q_j,z_i) - D_i)\, f(z_i)dz_i + C_1 + [k\pi_2 + w_{2n} + C_2] \int_{z^*}^{d} f(z_i)dz_i \\ & + (1 - p)[k(\int_0^{z^*} (R_i(q_i,q_j,z_i) - D_i)\, f(z_i)dz_i + \int_0^{z^*} f(z_i)dz_i\, (L_i - B)) + \underline{w}] \\ & + p[k(\int_0^{z^*} (R_i(q_i,q_j,z_i) - D_i)\, f(z_i)dz_i + \int_0^{z^*} f(z_i)\, dz_i\, (\pi_2 - B) + C_2 + w_2] \qquad (1) \end{aligned}$$

where z^*_i is defined by

$$R_i(q_i,q_j,z^*_i) - D_i = 0 \qquad (2)$$

When $z_i = z^*_i$ the firm can exactly meet its debt obligations but will have nothing left over for payments to shareholders. When $z_i < z^*_i$ the shareholders earn no profits and the firm is considered bankrupt. In order to interpret equation (1) we can say that, (i) the first three terms refer to the utility gained in the first period, (ii) the fourth

term is the utility gained in the second period if the firm successfully meets its debt obligations, (iii) the fifth term is the manager's second period utility if the firm goes bankrupt in the first period and is liquidated and consists of the probability of bankruptcy multiplied by the managers share of the liquidated assets, (iv) the sixth term is the manager's second period utility of the firm goes bankrupt in the first period but is reorganised.

III. THE BARGAINING GAME

If the firm is unable to satisfy its first period debt obligations, control passes to the bondholders, who are faced with a decision as to whether to liquidate the firm or reorganize it. We introduce heterogeneity into the model by elaborating on the difference between type G and type S, assuming that a type G firm has a high proportion of asset re-deployability and can be either liquidated or placed in some other use without significant loss of value. Firm S has a very specific type of asset make-up and any attempt to liquidate or re-deploy it under a different management team will see a considerable reduction in its value. We should make clear that liquidation in this sense refers to the best outside value for the assets; this may mean continuing in the same industry but with a different manager. In the case of type S this change would result in a greater expected reduction in value than in the case of G, thus firm S can be interpreted as a firm where much of the value-added resides in the skills of the managerial team [5]. A high-tech computer firm, where most of the value is embodied in the technical skills and know-how of the workers, would be a good example of type S. In any case, this difference in outside options influences the bargaining that takes place. We allow the liquidation value to vary within a range of

parameters; this takes into account the possibility that liquidation values will depend upon macroeconomic and cyclical factors - a situation analyzed by Shleifer and Vishny (1992). Each firm has an ex ante distribution for its possible liquidation value which we assume, for simplicity, is distributed uniformly. Thus the manager faces a possible range of liquidation values going from $[L_l, L_h]$ We assume that $L_{lS} < L_{lG}$ and $L_{hS} < L_{hG}$, and that π_2 is constant. To simplify the analysis, we assume that B is sufficiently large so that even if the liquidation value is higher than the value of second period profits, paying the cost of bankruptcy means that second period profits are always higher than liquidation value minus bankruptcy costs. This means that, from a perspective of firm value, bankruptcy is never a desirable event. This can be written as:

$$\pi_2 > L_{hG} - B \tag{3}$$

If the firm does go bankrupt then what happens to the debtholders ? Following Harris and Raviv (1990), we assume that any renegotiation requires debtholder approval, implying that, in such a reorganization, they must be given a claim worth at least what they would have received if the firm was liquidated. We assume they have no bargaining power and thus that their expected payment is the same whether the firm is liquidated or reorganized. This is important in that it means that the bargaining game takes place between the manager and the shareholders, subject to the constraint that the bondholders are paid in full. We assume that there are always sufficient funds available to pay off first period debt and the cost incurred in the bankruptcy process, if reorganization or liquidation occurs, regardless of the outcome in the first period. This condition implies:

$$\pi_{1min} + \min\{\pi_2, L\} > D + B \tag{4}$$

Here π_{1min} represents the lowest possible value of first period profits. The implication that debtholders are guaranteed to be paid back in full is basically dependent upon there being a fixed, commonly-known income in period 2, which allows debtholders to be reassured about the prospects of being paid eventually. This assumption is strong and we make it to keep the analysis manageable. It can be interpreted as implying a debt capacity for the firm, or if the assumption does not hold, we could assume that debtholders do not pay the full face value of the debt when purchasing it.

The bargaining game is adapted from the well-known alternating offers model originally analyzed by Rubinstein and summarized in Osborne and Rubinstein (1990). The game is assumed to occur between the end of the first period and the start of the second, and will decide whether the firm should be reorganized or liquidated, and also determines the wage paid to the manager in the second period. If the firm is reorganized, then the total payoff to be divided between the manager and the shareholders is:

$$\pi_1 + \pi_2 - D \tag{5}$$

If the firm is liquidated then the total payoff is:

$$\pi_1 + L_i - D \tag{6}$$

In this model, the manager's outside option is $\underline{w}$, the best alternate wage available to her, while the shareholders can choose to liquidate the firm and obtain $\pi_1 + L_i - D$, and any bargain struck must see all parties obtain at least their outside options [6]. We also assume that bargaining is costly in that failure to reach agreement will result in some reduction in the value of the firm - the rate of reduction is represented by ∂, a

form of discount rate [7]. This could be through a reduction in capital, or through the affect on the firm's image and client base.

Bargaining proceeds in rounds, with the manager initially deciding whether to make an offer or accept her outside option. If she makes an offer, the shareholders decide whether to accept it, make a counteroffer, or take their outside option (liquidating the firm). This process could continue indefinitely, but Rubinstein showed that the parties will reach agreement in the first round of bargaining and will agree on the following split:

$$\text{Share of party j} = \frac{\Omega \ln(\partial_j)}{\ln(\partial_k) + \ln(\partial_j)} \qquad (7)$$

Here Ω stands for the total value of the "pie" to be distributed, while ∂ refers to the discount factors of the respective parties, which, for simplicity, we assume to be identical. This means that the total value should be split equally between both parties if the share is greater than each party's exit values. Following standard parlance, we say that an exit option is "weak" if it is lower in value than the bargained-for share. In order to characterize the outcome, we can first see that the reorganization will only take place if:

$$\pi_1 + L_i - D < \pi_1 + \pi_2 - D - \underline{w}$$

This simplifies to: $L_i + \underline{w} < \pi_2$

(8)

Any bargain struck must see each party achieving at least their outside option. Equation (8) will hold as long as both outside options are not "strong"; if options are

indeed strong for both parties then $w + \pi_i + L_i - D$ will be greater than the total value of the firm, and no bargain will occur. Note that the realized value of first period profits is irrelevant to the decision process. Once the firm is bankrupt the only important factor should be whether value is higher in reorganization or liquidation, and the degree to which the firm failed to meet its debt obligations is irrelevant. This preserves the essential structure of the Brander and Lewis framework, that managers should only care about first period profits when they are greater than the debt level [8]. The shares for the bargaining parties depend upon whose exit options are "weak". If both are weak then payoffs are each $(\pi_1 + \pi_2 - D)/2$ (which is greater than $\underline{w}$, the reservation wage, by definition) in which case managerial wages don't depend upon the type of asset structure. If $(\pi_1 + \pi_2 - D)/2 < \pi_1 + L_i - D$ then the shareholders will obtain their exit option and managers will be left with a second period wage of $\pi_2 - L_i > \underline{w}$. If $\underline{w}$ is greater than $(\pi_1 + \pi_2 - D)$, then the manager's outside options are strong, with the shareholders being weak. We would argue that this is the least likely of the possible scenarios that would lead to a bargain.

This analysis describes what will happen if the firm is actually in bankruptcy. In this simple, complete information world, bargaining is efficient and the firm will only be reorganized if it is socially efficient to do so. The crucial points are that: (i) managers earn a higher wage if retained for the second period if they are in a firm of type S. Essentially, the higher the liquidation value, the weaker the manager's bargaining position, and the higher the likelihood that the shareholders position will be strong which implies a smaller payoff for the manager. This confirms Shleifer and Vishny's point that managerial entrenchment and specific investments will yield higher wages and greater tenure for managers; (ii) as the outside wage, $\underline{w}$, rises,

bargaining power for managers increases, implying that their outside options are more likely to be strong and that they will be able to obtain higher wages [9]; and, most importantly, (iii) managers are unsure of the *realized* liquidation values before making their output decision. But they know the ex ante probability that the firm will be reorganized, and, as $L_G > L_S$, the probability of the liquidation value of firm S being greater than second period profits is than for firm G. Thus p_S, which we call the probability that firm S will be reorganized given bankruptcy, is higher than p_G, the probability that firm G will be reorganized given bankruptcy. Armed with this, we now proceed to apply this idea to the B&L framework.

IV. OUTPUT DECISIONS WHEN DEBT LEVELS ARE FIXED

In the B&L framework the shareholders maximized the value of their profits, and this led them to produce more output than they would have done in a world with no debt obligations. The intuition behind this is fairly straightforward: equity holders are only residual claimants in good states of the world, that is, when z is high. An increase in debt levels causes the critical value, z*, to rise which implies that the range of states of the world in which the firm is bankrupt is expanded. As they put it "debt…(in)…low marginal states becomes irrelevant, for in those states the firm is turned over to the debtholders and the equityholders get zero in any case. Since the firm restricts attention to higher marginal profit states, it adopts a more aggressive stance", (Brander and Lewis, p 961). We take this intuition and modify it somewhat as now the manager has to allow for the fact that she will still want to be in control in the second period.

First, we follow Brander and Lewis in noting the following four derivatives:

$$dz^*_i/dD_i = 1/R^z_i(q_i,q_j,z^*_i) > 0 \tag{9}$$

$$dz^*_i/dD_j = 0 \tag{10}$$

$$dz^*_i/dq_i = -R^i_i(q_i,q_j,z^*_i)/R^z_i(q_i,q_j,z^*_i) \tag{11}$$

$$dz^*_i/dq_j = -R^j_i(q_i,q_j,z^*_i)/R^z_i(q_i,q_j,z^*_i) > 0 \tag{12}$$

In this section we are assuming that the debt level, D, is fixed, as it is set by the shareholders at the start of the first period. In the next section we will analyze whether the different types of firm will take on different types of debt level. The manager chooses the optimal output level by maximizing (1) with respect to q_i. Note that now, with the exact liquidation value unknown, the manager uses the expected liquidation value, which we denote as $E(L_i)$. Using Leibnitz's rule gives us the following first order condition:

$$V^i_i = k\int_{z^*}^{1} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i - dz^*_i/dq_i\, f(z_i)\,[k\pi_2 + C_2 + w_{2n}] +$$

$$(1-p)\,[k(\int_0^{z^*} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i) + [dz^*_i/dq_i\, f(z_i)]\,(k(E(L_i) - B) + \underline{w})] +$$

$$p\,[k\,(\int_0^{z^*} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i + [dz^*_i/dq_i\, f(z_i)]\,(k(\pi_2 - B)) + C_2 + w_2)] = 0 \tag{13}$$

The second order condition is: $V^{ii}_i < 0$ (14)

Note that the first term of this expresssion is identical to the marginal utility in Brander and Lewis. The rest of the expression is capturing the idea that the manager is aware of her payoff in the second period, and takes that into account when making her first period output decision. Note that we show in the proof to proposition 1 that dz^*_i/dq_i is greater than zero, which implies that the first term of equation (13) must be

greater than zero. We also make some fairly standard assumptions (similar to reaction functions being downwards sloping):

$$V^{ij}_{i} < 0 \tag{15}$$

$$V^{ii}_{i} V^{jj}_{j} - V^{ij}_{i} V^{ji}_{j} > 0 \tag{16}$$

We now consider the core questions of the paper: whether firms will be more or less aggressive than in the Brander-Lewis case, and, whether firms with specific capital will display a different pattern of output behavior. Intuitively, the extra probability that the manager will still be there in the second period instills a greater aggression in the output decision in the first period. If the manager is too aggressive and the firm is bankrupted, then there is still, if the manager is in possession of a high degree of specific asset capability, a high probability that she will still be in charge in the second period. This acts as a "safety valve", as it were, for the manager and allows her to "go for broke" in the first period. She can choose the first period output to maximize the value of equity without worrying about whether the debt will be paid off, and still be kept on in the second period. When she is retained with probability one, her decision problem is similar to the one-period model of Brander and Lewis, and output will be the same in both cases, and higher than it would be if the possibility of her not being retained is non-zero. So, the manager with limited asset-specific bargaining power will have to trade off the benefits of choosing an aggressively high level of output in the first period against the risks of going into bankruptcy in the event of a low value of z_i and the probability of not being re-employed in the second period. This will encourage type G firms, with a lower probability of being re-employed, to choose a lower level of output than type S firms.

We should note that from now on we will use the subscript G to refer to the profits or quantity of a firm of type G, and will use the subscript S for a firm of type S. We formalize the result in the following proposition:

Proposition 1: (i) If p is less than one, then the quantity produced is less than that produced by the Brander-Lewis type firm.

(ii) Given identical cost functions, c_i, the quantity produced by firm G, q_{iG}, is less than that produced by firm S, q_{iS}.

Proof: See appendix

An immediate consequence of this is that it allows for the possibility of firms with higher costs producing more than firms with lower costs. Depending on the parameter values, firm S may have higher costs than firm G - which should, in the usual sense of a Cournot model, imply that firm S will produce less than, and, in some sense, be smaller than firm G - yet may, because of the incentive structure, produce more than its more efficient rival. We can also state the following corollary:

Corollary 1: As C_2, the control rent in the second period, rises, q_i will fall.

Proof: See appendix

This corollary shows that managers who obtain a large amount of perquisites from running their companies will be more worried about losing control, and will hence set lower outputs. Jensen's "free cash flow" theory is relevant here; it argues that firms with high debt will be forced to pay revenue out as debt repayments, and

will thus enjoy a low control rent. This is suggestive, as higher debt levels would mean lower control rents and thus higher outputs. This would mean that in a period when firms have high debt levels, we might expect more aggressive competition, a confirmation of B&L's results, albeit for a different reason.

This analysis has been conducted for fixed levels of debt. We now want to consider whether this difference in output is the same for a variety of different levels of D. In particular, does the incentive for firm S to choose higher levels of output change when D is different ? We show that for higher levels of D, the difference between q_{iS} and q_{iG} is greater than for low values of D. This is formalized in the following Lemma:

Lemma 1: The change in quantity resulting from changes in debt, $dq_{iS}/dD > dq_{iG}/dD$.

Proof: See appendix

This result tells us that when D is high, perhaps for reasons not directly related to this model, then managers of firms with high human capital will have a greater strategic advantage than before. Thus tax changes which encourage the use of debt, such as those instituted in the US in the mid 1980's, will lead to firms which rely on human capital choosing much more aggressive product market strategies. It is possible that dq_i/dD can be negative, which would be a direct reversal of the results of B&L, implying that increases in debt lead to a less aggressive product market strategy.

So far we have referred to the strategic difference accruing to type S firms as if it were an advantage. However, even in the basic Brander-Lewis framework this is not usually the case. With two identical firms each playing a Cournot game and both

setting high outputs, the ex post outcome will be that industry output will be at too high a level (from the perspective of the firms, not consumers), resulting in lower profits than would have been earned. This is a somewhat paradoxical, and rarely referred to, result of the Brander-Lewis model, and leads to some potentially troubling conflicts with some of the observed patterns in empirical corporate finance. In particular, in a non-cooperative framework, taking on debt is a rational way to increase firm value. But if both firms in the industry raise debt levels, then increased competition will result, and the stock market should see this and adjust the firm's stock price downwards. This contradicts the commonly accepted idea that increased debt levels should lead to higher stock prices, regardless of whether one's competitors follow the same course of action.

Our model allows for some industry variation: industries characterized by high degrees of human capital should see more intense competition than the traditional "smokestack" industries where the main value of the firm is embodied in its physical capital. There is some casual evidence that this was in fact the case in the late 1980's; the computer industry in particular was racked by intense competition, with firms raising outputs (or lowering prices) much more than in most other industries. Traditional industries with higher debt levels may still, of course, exhibit intense competition, and this leads us to consider what determines debt levels in different types of industry. We will turn to this question in Section 4.

In our simple case of a duopoly with one firm of type S and one firm of type G, profit levels will be higher for firm S than firm G. Here debt does have a positive commitment value: the manager of type S will, not worrying so much about bankruptcy, choose higher levels of output and thus reap higher profit levels than the

manager of firm G. But this may not be the case when firms of the same type are in the same industry. We summarize the different effects in Lemma 2:

Lemma 2: For fixed debt levels, D: (i) if the two firms in the industry are both of the same type: (a) the value of type G firms is greater than that of type S firms (b) the probability of bankruptcy is higher for type S firms than type G firms.
(ii) If the firms are of different types: (a) the value of the type S firm is greater than the type G firm (b) the probability of bankruptcy is lower for the type S firm than the type G firm.
Proof: See appendix

This result indicates that, for fixed debt levels, the value of debt will depend upon the characteristics of other firms in the industry. Committing to an aggressive product market policy may be disastrous if you are of a similar structural type to your rival, as they may expand also with negative consequences for the whole industry's profits. But such commitment may be effective if you enjoy an asset structure which relies heavily upon a specific form of knowledge. The strong position you will be in come default permits you to take more chances than your opponent, and this translates into higher profits and a lower risk of bankruptcy than your competitor.

This suggests that firms who have a specific difference from the rest of the industry may be more successful, and valued at higher levels, than their competitors. We should potentially expect to see a firm which is unusually rich in human capital for its industry being valued very highly by the stock market for reasons not related to its growth potential, but simply due to its scarcity. In particular, it could indicate that

firm which were valued above their industry average in the 1980's were valued at a premium because of their heavy investment in human capital. Such capital meant that if they got into financial distress, the best option was simply to reorganize them again. This argument would be strengthened if put in a Klemperer switching-cost model, where type G firms would be unable to build market share in the presence of debt due to the risk of being fired if they went into bankruptcy.

V. FIRM'S CHOICE OF DEBT LEVELS

So far we have kept debt levels fixed, and asked what kind of product market behavior would arise from this degree of leverage. Given that most of the debt changes that took place in the 1980's probably occurred for reasons other than product market considerations, this seems to be a reasonable mode of analysis. But now we turn to the question of what debt levels will be chosen by different types of firm. Here the question of who actually makes the decision is rather unclear in practice. Most papers in this literature assume that the shareholders choose the level of debt, and indeed frequently do so in order to discipline the managers and prevent them from either consuming too many perquisites or investing in some project with negative net present value [9]. On the other hand, many of the debt changes that occurred were debt-for-equity swaps that were initiated by the management and did not need shareholder approval. In this section we chane the setup somewhat by assuming that shareholders do have the final decision as to the debt level of the company, and that managers base their output decisions on this.

Following Brander and Lewis, we assume that the goal of the owners (shareholders) is to maximize the value of the firm, which consists of the equity value

E_i, and the debt value W_i. Given the debtholders are always guaranteed to be paid the full value of their claim, the debt level chosen will have no effect on the firm's value except in two possible ways. One is that given managers' reluctance to liquidate, debt might help in forcing assets into a better alternative use. This has been analyzed in a number of papers, such as Harris and Raviv (1990), and we will not dwell on it here. The second reason is that the value will depend upon the output level, and the output level will depend upon the debt level. We look for a Nash equilibrium in debt levels where all parties know that output levels are determined by the debt levels obtained as solutions to equation (13). The expression for the value of the firm is simply the expected value of operating profits over all states of the world plus either L_i or π_2. We denote the value of firm i as Y_i, and write:

$$Y_i = \int_0^{z^*} R_i(q_i(D),q_j(D),z_i)\, f(z_i)dz_i + \int_{z^*}^{1} R_i(q_i(D),q_j(D),z_i)\, f(z_i)dz_i$$

$$+ (\pi_2) \int_{z^*}^{1} f(z_i)dz_i + (\max\{\pi_2, L_i\} - B) \int_0^{z^*} f(z_i)dz_i \qquad (17)$$

The first two terms are identical to those in the case of Brander and Lewis, while the remaining ones reflect the value of the firm in the second period: either the value of second period profits or liquidation value.

The marginal effect of an increase in D_i on firm value is:

$$Y^{Di}_i = [\int_0^{z^*} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i]\, dq_i/dD_i + [\int_{z^*}^{1} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i]\, dq_i/dD_i$$

$$+ [\int_{z^*}^{1} R^j_i(q_i,q_j,z_i) f(z_i)dz_i + \int_0^{z^*} R^j_i(q_i,q_j,z_i)\, f(z_i)dz_i]\, dq_j/dD_i$$

$$- dz^*/dq_i\, [dq_i/dD_i]\, (\pi_2) + dz^*/dq_i\, [dq_i/dD_i]\, (\max\{\pi_2,L_i\} - B)$$

(18)

There are five separate terms in this equation: the first term measures the effect of a debt-induced change in firm i's quantity on the debt value of the firm. Note that the marginal derivative of profits with respect to firm i's quantity, R^i_i in the first term must be less than R^i_i evaluated at the critical level of z, z*, which we already know to be negative. As we have already shown that the change in firm i's quantity as a result of a change in its debt level, dq_i/dD_i, is positive, we know that the whole first term must be negative. Essentially, extra debt worsens the conflict of interest between debtholders and shareholders. The second term is positive, because of lemma 1. The third term represents the strategic effect of debt where a higher debt level for firm i induces a lower equilibrium output for firm j. Given that firm i's profits are decreasing in the quantity of firm j, R^j_i is less than zero, and firm j's quantity is decreasing in i's debt level, the entire third term must be greater than zero; thus the strategic effect of debt is to add to firm value. The fourth and fifth terms represent the effect that an increased debt level will have on the probability of bankruptcy, and thus on whether the firm will be efficiently reorganized or not. We know that dz^*/dq_i, the change in the critical value of z with respect to firm i's quantity, and dq_i/dD_i, the change in firm i's quantity with respect to it's debt level, are both positive. Given this, by equation (3), the overall sign will be negative.

Taken all together, which of these effects will dominate ? Like Brander and Lewis, we cannot be sure. In the absence of making further assumptions about the functional form of the distribution of output we cannot unambiguously sign the overall effect. Brander and Lewis do point out that when debt levels are zero, the first term will be zero, due to z*, the critical level of z, being strictly equal to 0, the lower bound for z.

The fourth and fifth terms will also be zero, and the remainder of the terms will be strictly positive. Thus they claim that debt levels will be strictly positive. We echo this claim, but we also say that this effect is greater for type S firms than type G. Note that dq_j/dD_i, (the response of the rival firms quantity to a change in firm i's debt level) is greater for a firm of type S than type G, and thus we can see that, given an existing debt level sufficiently close to zero, the incentive to take on more debt will always be greater for type S firms than type G. Essentially, the shareholders recognize the security that managers enjoy, and know this will allow them to commit to high outputs. Thus they choose a higher debt level than firms with low amounts of specific capital. We cannot sign the overall effect, because the response of firm i's quantity to a change in its own debt level is also greater for firm S than firm G, ($dq_i/dD_{iS} > dq_i/dD_{iG}$) and by exactly the same proportion as before. Thus for type S firms the conflict of interest between bondholders and shareholders also grows and it is impossible to say which will dominate. But at low debt levels, (perhaps the general level would be dictated by tax issues) we can be reasonably sure that firms with high human capital will wish to have more debt.

All this analysis was predicated on the assumption that the liquidation value for all firms was sufficiently large for the debtholders to be paid back in full. This is obviously a strong assumption and one that does not hold in many situations. Where the minimum profit level that can be earned in period one plus the liquidation value of firm i is less than its debt level, then we may have something analogous to a debt capacity for firms with high human capital. This may prevent their being able to take on as much debt as they would like, and would lead to a kind of analysis similar to Hart and Moore (1989) where the lack of sufficient collateral prevents loans being

made. The situation would be somewhat more complex, however, as the return from the project would depend upon the amount of debt loaned, and investors would have to weigh the benefits of lending to a type S company which would obtain stochastically higher returns against the smaller payout if the firm went bankrupt.

VI. CONCLUSION

In this paper we have looked at an extension of the Brander and Lewis framework. We have shown that when managers and shareholders take into account the second period, firms are in general not as aggressive in their product market strategies as Brander and Lewis suggest, and may actually choose lower outputs than they would have had they had no debt. This is because the limited liability factor which they alluded to will not be as important when the next period is taken into account. We focused primarily on the difference between firms with high human/specific capital and firms with high general capital, and found that the latter are more likely to be liquidated after bankruptcy than the former. This is because the low liquidation values of the former typically render them more useful reorganized than the latter. This high probability of reorganization permits managers to make more aggressive output decisions, but this will only result in higher profits and firm value in an asymmetric situation where the competitor is of a different type from the firm in question. We saw that this could explain the phenomenon of seemingly high-cost firms outproducing lower-cost rivals.

We also saw that firm debt levels may well be higher for firms with intangible assets - a departure from most previous results. In general, we think more attention should be focused on asymmetries between firms in different industries, and on how

firms with different characteristics will have different attitudes towards their capital structure.

Appendix

Proof of Proposition 1:

(i) From equation (13) we know that V^i_i is equal to zero. Let us first assume that qi here is the same as it was in B-L, and then demonstrate that this leads to a contradiction. If $q_i = q_{iB\text{-}L}$, then $\int_{z^*}^{d} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i$ must be equal to zero.

We also need to find the sign of dz^*_i/dq_i, which by equation (11) is equal to:

$$- R^i_i(q_i,q_j,\underline{z}_i)/R^z_i(q_i,q_j,\underline{z}_i).$$

We show that it must be greater than zero, and we do this by contradiction. Assume it is less than zero. We now rewrite equation (13) as:

$$k \int_{z^*}^{d} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i + k \int_{0}^{z^*} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i + dz^*_i/dq_i\, f(z_i)\, [(1 - p)kE(L_i) - kB - (1 - p)k\pi_2 - (1 - p)C_2 - w_{2n} + (1 - p)\underline{w} + pw_2] \quad = \quad 0$$

The term multiplied by dz^*_i/dq_i is negative, as we know that $L_i < \pi_2$. If the first term is equal to zero, then the second term, $k \int_{0}^{z^*} R^i_i(q_i,q_j,z_i)$ must be less than zero.

If dz^*_i/dq_i is also less than zero, then the first term $\int_{z^*}^{d} R^i_i(q_i,q_j,z_i)\, f(z_i)\, dz_i$, must be positive. If this is the case then R^i_i evaluated at z^*_i must also be negative, as R^i_i rises with z by assumption.

But dz^*_i/dq_i is equal to $- R^i_i(q_i,q_j,z^*_i)/R^z_i(q_i,q_j,z_i)$, and the denominator is positive by assumption. This means that in order for dz^*_i/dq_i to be negative $R^i_i(q_i,q_j,z^*_i)$ must be positive. But this implies a contradiction, so dz^*_i/dq_i cannot be negative.

So, given this, we see that $\int_{z^*}^{d} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i$ must be greater than zero. But in Brander-Lewis, this term was equal to zero. This implies that in our model,

$R^i_i(q_i,q_j,z_i)$ is greater than $R^i_i(q_i,q_j,z_i)$ in Brander-Lewis, which means that q_i is greater in Brander-Lewis than it is here.

(ii) We note that p_S is greater than p_G, and that p enters equation (13) in the form of $[(p - 1)k\pi_2 - w_{2n} + pw_2 + (1 - p)\underline{w} + (p - 1)C_2 + kB - (p - 1)kE(L_i)]$, which is always negative. However, when $p_S > p_G$, this term will be smaller in absolute value, implying that R^i_{iG} must be greater than R^i_{iS}, which means that q_{iG} is less than q_{iS}.

Q.E.D.

Proof of Corollary 1:

By equation (15), the higher C_2 is, the higher $\int_{z^*}^{d} R^i_i(q_i,q_j,z_i)\, f(z_i)dz_i$ must be. This implies that q_i must be smaller over all ranges of z_i. Q.E.D.

Proof of Lemma 1:

We can totally differentiate the first-order condition for firm i and firm j. Putting the resulting system in matrix form and using Cramer's rule give us:

$$dq_i/dD_i = \frac{-V^{iDi}_i V^{ij}_j}{V^{ii}_i V^{ij}_j - V^{ij}_i V^{ji}_j}$$

To sign this we need to find V^{iDi} by differentiating (13) with respect to D_i. This gives:

$$- (k)R^i_i(z^*_i)[(dz^*_i/dD_i)\, f(z_i)] + (k)\, R^i_i(z^*_i)[(dz^*_i/dD_i)\, f(z_i)] + (dz^*_i/dq_i)/dD_i\, f(z_i)$$

$[(p - 1)\pi_2 - B + (p - 1)C_2 + (p - 1)w_2 + (1 - p)E(L_i)]$

Given $p_S > p_G$, $dq_{iS}/dD_i > dq_{iG}/dD_i$ if and only if $(dz_i/dq_i)/dD_i > 0$

which is equal to $- [R^z_i(dR^i_i/dz^*_i)dz^*_i/dD_i - R^i_i(dR^z_i/dz^*_i)dz^*_i/dD_i]/(R^z_i)^2$

Note that the denominator is positive. In the numerator, dR^i_i/dz^*_i is less than zero, while dR^z_i/dz^*_i will be zero. This means that this expression is always positive.

Q.E.D.

Proof of Lemma 2:

(i) Here we assume the industry is either of type GG (two general capital firms) or SS (two specific capital firms).

The value of the firm is given by equation (17):

$$Y_i = \int_0^{z^*} R_i(q_i,q_j,z_i)\, f(z_i)dz_i + \int_{z^*}^{d} R_i(q_i,q_j,z_i)\, f(z_i)dz_i$$

$$+ \int_{z^*}^{1} f(z_i)dz_i\,(\pi_2) \qquad + \qquad \int_{0}^{z^*} f(z_i)dz_i\,(\max\{\pi_2, L_i\} - B)$$

Now if both firm i and firm j are of type G, then the total industry quantity, $q_i + q_j$, is less than total industry quantity in the case of two type S firms. Thus expected firm profits will be smaller in the case of type S firms. For fixed debt levels, this implies a lower probability of bankruptcy for type G firms, and as second period profits are assumed to be greater than the maximum value of second period profits or liquidation value minus the cost of bankruptcy, this means that the total value of a type G firm will be greater than a type S firm.

(ii) Now we assume the industry is characterized by one firm of type G and one firm of type S. Looking at the equation for firm value, we know from Lemma 1 that the quantity of firm S is greater than the quantity of firm G. Thus, in this Cournot framework, expected profits for firm S must be greater than for firm G, for all values of z. This implies that the risk of bankruptcy is smaller for firm S than firm G, and thus that firm value is higher for firm S than firm G.

Q.E.D.

Endnotes

1. This was explored in some depth by Shleifer and Vishny (1992), who developed a model in which liquidation values actually placed stringent limits on the ability of firms to take on debt, focusing on liquidation as an endogenous variable which responds to cyclical conditions in the given industry.

2. The assumption that there is neither uncertainty or debt in the second period is obviously a strong one. We make it to keep the analysis manageable, and note that Glazer makes a similar assumption in one of the periods in his model. Allowing debt in the second period might mean that Glazer's result - that first period competition is less intense due to fear of triggering a negative second period response - might make firms in our model even less aggressive in period one. Allowing there to be uncertainty about future demand conditions could imply the effect noted by Showalter (1999); that increased demand uncertainty would lead to more debt being issued.

3. This assumption is not uncontroversial as it denies the possibility of there being an overall recession or boom within an industry which affects all the firms within it in a non-partisan fashion.

4. The higher the value of k, the closer the manager's interests are to the shareholders. Changing k has an ambiguous effect on output levels.

5. Liquidation values are assumed to be the value of the assets under a different managerial team - this might mean actual liquidation of the physical assets, but does not have to.
6. The bargaining game is marked by the fact that managers are also shareholders, and have to account for the fact that higher wages for them may reduce firm profits. We assume, however, that they prorportion of votes is sufficiently small that they do not determine the decisions of the shareholders.
7. The assumption that parties can choose to end the bargaining in this fashion is probably overly simplistic. When shareholders are actually bargaining with creditors there are usually (at least in the US) Chapter 11 provisions in place which prevent the creditors, at least, from unilaterally deciding to liquidate. This issue is explored in Gertner and Scharfstein (1992), and an analysis of reorganization in the context of differing legal regimes is provided by Baird and Pickering (1992), who use a bargaining framework broadly similar to ours.
8. We rule out the possibility of partial liquidation. Such liquidation is quite possible if the firm has a number of different activities, and is considered as an equilibrium outcome by Hart and Moore (1989).
9. Examples include Jensen's well-known free cash flow theory. A similar approach, concentrating on the need to prevent specific investments, is taken by Hart (1991).

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