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FINANCIAL POLICY AND REPUTATION
FOR PRODUCT QUALITY*

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FINANCIAL POLICY AND REPUTATION

FOR PRODUCT QUALITY

Abstract

This paper analyzes the effect of financial policy on a firm's incentives to maintain its reputation for producing a high quality product. The paper demonstrates that in certain situations debt will reduce a firm's ability to credibly offer high quality products and, as a consequence, will reduce its value. However, for firms with assets that have high salvage values in liquidation, debt may increase their ability to credibly offer high quality products, and therefore, increase their values.

The role of bankruptcy costs in the theory of optimal capital structure has received a great deal of attention.[1] Bankruptcy costs include both direct expenses associated with the bankruptcy process, and indirect costs, such as the profits lost during financial distress and bankruptcy. These lost profits are often attributed to the reluctance of customers and other stakeholders (e.g. suppliers, providers of complementary products and employees) to do business with a firm that is likely to fail. Although the reluctance to do business with a near-bankrupt firm has been discussed for quite some time (e.g., Baxter (1967)), there has been very little theoretical work to explain this phenomenon. One exception is Titman (1984) who demonstrates a link between a firm's liquidation decision and its bankruptcy status, that causes individuals who would incur a cost if the firm went out of business (such as customers who may require future servicing or spare parts) to be less willing to do business with a firm in financial difficulties.

This paper presents a model in which, in contrast to Titman (1984), individuals may be reluctant to do business with a highly levered firm even if they suffer no costs if the firm goes out of business. This reluctance arises because financial difficulties can affect the incentive for the firm to honor its implicit contracts and in other ways maintain a favorable reputation. Although the implications of our analysis are much broader, we will focus on the incentives of firms to maintain their reputations for supplying high quality products in situations in which quality cannot be observed until after the product is purchased. The paper is related in this way to the recent work of Chung and Smith (1987), which is discussed below.[2]

The relation between product quality, as it relates to air safety, and the financial health of airlines has received attention recently from academics as well as from the popular press. Rose (1988) finds evidence that the safety records of airlines decline after they get into financial diffi-

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[1] Important contributions include Kraus and Litzenberger (1973), Scott (1976), and Kim (1978).

[2] The relation between financial structure and product quality was discussed informally in Shapiro and Titman (1985) and Cornell and Shapiro (1986). Reputation and financial structure also play key roles in Maksimovic's (1986, 1988a) analysis of tacit collusion in oligopolies.

culties.[3] The *New York Times* (April 14, 1988) reported that the recent investigation of Texas Air would, among other things,"examine... the possible impact on safety of its financial problems," and according to Gray (1987) the Department of Transportation not only inspects the maintenance and safety procedures of airlines, but also examines their financial statements to determine their incentive to provide a safe, i.e., good quality product. The analysis in this paper suggests that such a policy may have merit.[4]

Our analysis of the interaction between financial leverage and the firm's quality choice draws on two distinct literatures. The first is the literature on reputation that shows that, in a multi-period setting, firms may produce high quality goods in order to maintain their reputations for future sales.[5] The second is the literature on the effect of debt financing on investment choices.[6]

We develop a simple finite horizon model to examine the quality choice of an all-equity firm that is managed in the interests of the stockholders, and then explore how this choice is affected by leverage. The model provides conditions under which an all-equity firm will have an incentive to produce a high quality product that reduces its profits in the short run, but leads its customers to believe that it is likely to maintain high quality in the future. Debt financing, by changing the relative benefits to stockholders of immediate and future cash flows, can reduce a firm's incentive to produce a high product quality, since a reduction in quality can increase current cash flows at the expense of bondholders who may receive less in the future.

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[3] Golbe (1983) and Chow (1988) report similar findings for the railroad industry and general freight trucking respectively.

[4] There is also evidence that aspects of quality other than safety are related to financial health. A *Fortune* (October 24, 1988, p. 89) article on consumer satisfaction reports that "...relatively few gripes come from fliers on [airlines] which happen to be among the healthiest ..." The case of Beech-Nut provides additional evidence of the relationship between debt and product quality. A recent *New York Times* article (July 24, 1988) describes how Beech-Nut, suffering financial distress, sold adulterated apple juice to reduce its costs.

[5] See, for example, Klein and Leffler (1981), Shapiro (1982, 1983), Dybvig and Spatt (1983), and Allen (1984).

[6] See for example Jensen and Meckling (1976), Galai and Masulis (1976) and, in particular, Myers (1977).

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We demonstrate that under some conditions this incentive to reduce quality can be eliminated by appropriate dividend restrictions. However, if the firm's current obligations are so great that they cannot be met except by reducing quality, then dividend restrictions will not prevent the firm from reducing quality in order to avoid immediate bankruptcy. Moreover, a firm that is not facing an immediate threat of bankruptcy, but which has debt outstanding, may still choose to reduce quality in order to increase its current cash flows and thereby avoid an issue of subordinated debt at high rates in the future. Cutting quality in this instance is similar to obtaining an involuntary loan from customers. Since the reduction of future revenues resulting from the loss of reputation corresponds to the repayment of the "loan," and has greater seniority than the firm's existing debt, it dilutes the claims of existing bondholders. Since consumers recognize the incentives to reduce quality that are created by outstanding debt, they will reduce the price that they are willing to pay for the firm's product and the firm will suffer a loss in value.

The paper also analyzes how the incentive to offer high quality products is affected by the availability of alternative uses for the firm's capital assets. This analysis relates to the Klein and Leffler (1981) argument that a firm may purposely limit the salvage value of its assets in order to commit to producing a high quality product. We show that a firm with a high salvage value can credibly offer high quality products without reducing its salvage value by including the appropriate amount of debt in its capital structure. This commits the firm not to liquidate when it is controlled by its equityholders, since they are the last to be paid out of the proceeds of the firm's liquidation. We show that in some cases a levered firm can achieve a first-best solution of liquidating in exactly those states of nature in which its liquidation value exceeds its value as an ongoing concern, while commiting to the quality choice of an all-equity firm with zero salvage value. Hence, financial leverage can increase as well as decrease a firm's ability to credibly offer high quality products.

The model is developed in the next section for the case of an all-equity firm. The analysis of

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the levered firm in section 2 explores the implications of both financial distress and the threat of future bankruptcy for the firm's incentive to maintain its reputation for product quality. Section 3 shows how the opportunity to liquidate affects the relation between a firm's debt obligations and its ability to offer high quality products, and section 4 concludes the paper.

1 THE ALL-EQUITY FIRM

We are concerned with the decision of a firm to produce either a high or low quality product. It is assumed that consumers are willing to pay more for the superior product but cannot observe the product's quality until after it is purchased and consumed, and that although the product quality can be observed by consumers, it cannot be verified in a court of law. The product is assumed to be sold in each of a finite number of periods which we take, without loss of generality, to be three.

The finite horizon assumption distinguishes our model from the infinite period reputation models considered by Klein and Leffler (1981), Shapiro (1982), Dybvig and Spatt (1983), and Allen (1984), which generally support an infinite number of equilibria.[7] Although our basic results would also obtain in an infinite period setting, we employ instead the finite horizon setting of Kreps and Wilson (1982) and Milgrom and Roberts (1982) since it can lead to a unique equilibrium, which permits stronger statements about the effect of financial structure on product quality.[8]

In a finite horizon setting, firms will not be able to credibly offer high quality products if it is common knowledge that the firm is able to reduce quality without immediate detection, and is operating in the shareholders' interest. The reason for this is that if quality cannot be determined immediately a firm will invest in its reputation by maintaining product quality only if this will

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[7] This observation is generally referred to as the Folk Theorem and is discussed in Rubinstein (1979) and Aumann (1981).

[8] For an application of this framework in the finance literature see John and Nachman (1985) and Diamond (1989).

lead to a higher price in a future period. Since in the final period there is no future period the firm will then reduce quality. Thus, since customers will anticipate low quality in the final period the value of reputation in the penultimate period is also zero. Proceeding by induction it follows that the firm will not invest in reputation in any period.

However, we argue that it is unlikely for several reasons that consumers will be able to discern with certainty whether or not the firm can or will act in this manner. First, the ability of a firm to reduce quality without detection depends on factors that may be unobservable to customers such as regulatory enforcement policies and the firm's organizational structure and production technology.[9] Secondly, the extent to which the firm is operated in the interest of the shareholders may depend on unobservable factors such as the compensation of managers and the degree of shareholder control over their actions, as well as the managers' tastes and own reputation considerations.[10]

In order to represent in a simple way the inability of the consumer to observe the factors that determine whether a firm will reduce quality we shall assume that there exist two types of firms: A Type H firm constrained to produce only high quality goods, and a Type F firm which has the flexibility to produce either low or high quality goods and selects the quality of output to maximize shareholder value.[11] The customers cannot directly determine the firm's type, knowing only that

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[9] The Texas Air case discussed previously is an example in which these issues were relevant.

[10] The Beech-Nut case provides some interesting insights about why the tendency to reduce quality is uncertain. Beech-Nut is a producer of a wide variety of baby food products. In a period of financial difficulties they were offered apple juice concentrate at a price substantially below what they were currently paying. Although they had reason to believe the quality of the product was suspect they purchased the product and produced a lower quality baby apple juice as a consequence. Had they been given similar opportunities they might have reduced the quality of other products as well. However, since no such opportunity appeared, the quality of these products was not reduced.

[11] Since the issues addressed in this paper arise in part from a conflict between the interests of a firm's bondholders and stockholders, the costs associated with bankruptcy and financial distress, considered here, can be eliminated if the firm is controlled by a manager, whose compensation depends on the aggregate value of the firm's debt and equity. This, of course, abstracts from the problem of commiting equityholders, who control management, to such a compensation schedule after the firm has issued bonds. See also our discussion in the conclusion regarding the effect of reputational issues in a firm's product market on the optimal management compensation contract.

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the period t probability that a firm that has not previously produced low quality is of Type F is λ_t, with λ_0, the prior probability, being determined exogenously. For simplicity we assume that each firm produces one unit per period. The low quality product is assumed to have zero cost, while the high quality product costs c. We assume that the firms are price takers and that the market price in period t for a unit of the good is denoted by $p_t = \theta_t - \delta_t \ell$, where the price for a good known to be high quality in period t is θ_t, δ_t is the customers' assessment of the probability that the good is of low quality and the market price for a good known to be of low quality is $\theta_t - \ell$, where $c < \ell$.[12] We assume that the price p_t is known before the production decision for period t is made. To further simplify the analysis, the firm and its customers are assumed to be risk neutral and the discount rate is assumed to be zero. Until section 4 we also assume that the firm receives a value of zero if it does not produce, so that it will choose to produce in every period. Moreover, we assume in this section that the firm has no debt, and therefore no chance of bankruptcy.

The firm's customers are assumed to have the same information as managers about its financial condition and to use this information to form beliefs about product quality.[13] Since a firm will make higher profits if its customers believe that it will produce high quality goods it has an incentive to act as though it is a Type H firm and produce high quality. However, there is a short–term cost advantage to the firm from reducing quality. This short–term gain must be weighed against the cost of being identified as a firm that is able to cut quality in the future. Since reputation has no value after the last period, a Type F firm will always find it advantageous to produce low quality goods in period 3.

Suppose that in period 2 the customers believe that the firm will produce high quality, so that

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[12] Since the firms are pricetakers the beliefs of customers are not influenced by the price. We thank the referee for pointing out that multiple equilibria may exist if this assumption is not satisified.

[13] This implicitly assumes highly rational and informed customers. These "customers" should be thought of as not only final purchasers, but also intermediaries such as retailers, who are represented by purchasing agents who often check credit ratings of suppliers.

if it does its profits will be $\theta_2 - c$, while if it produces low quality its profits will be θ_2. The firm will choose to produce high quality in period 2 if the expected sum of its profits in periods 2 and 3 from producing high quality in the current period, $V_h^2(\theta_2)$, exceeds the expected profits from producing low quality, $V_\ell^2(\theta_2)$, where

$$V_h^2(\theta_2) = \theta_2 - c + E_2[\theta_3] - \lambda_3 \ell, \tag{1}$$

$$V_\ell^2(\theta_2) = \theta_2 + E_2[\theta_3] - \ell, \tag{2}$$

and $E_{t-1}[\theta_t]$ is the expectation of θ_t.

A comparison of these expressions reveals that a Type F firm that has produced high quality in period 1 will continue to produce high quality in period 2 if and only if $\lambda_3 < 1 - (c/\ell)$. We can determine in a similar way whether or not a Type F firm will produce a high quality product in the first period. The conditions under which it will do so are given in the next proposition which is proved in the Appendix.

Proposition 1

(i) If $\lambda_0 < 1 - (c/\ell)$ there exists a unique sequential equilibrium in which a Type F firm produces high quality in the first two periods and low quality in the last period.

(ii) If $1 - (c/\ell) < \lambda_0 < 1 - (c/\ell)^2$ there exists a unique sequential equilibrium in which a Type F firm always produces high quality in the first period and produces high quality in the second period with probability π_2, where $\pi_2 = (1 - \lambda_0)(\ell - c)/c\lambda_0$. The firm always produces low quality in the last period.

(iii) If $\lambda_0 > 1 - (c/\ell)^2$ there exists a unique sequential equilibrium in which a Type F firm produces high quality in the first period with probability $\pi_1 = (1 - \lambda_0)(\ell^2 - c^2)/\lambda_0 c^2$. If it produced high quality in the first period the firm produces high quality in the second period with probability $\pi_2 = c/(\ell + c)$; otherwise it produces low quality. The firm always produces low quality in the

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last period.

The proposition may be understood as follows. If λ_0, the prior probability that the firm is of Type F is low, then in the last period consumers will believe that the probability is high that they are purchasing from a Type H firm if the firm has produced high quality in the first two periods. This gives a Type F firm a strong incentive to maintain its reputation in the first two periods. If λ_0 is high, consumers will tend to believe that the firm is of Type F regardless of its prior actions so that there will be very little benefit from maintaining a reputation. However, it is not the case that if λ_0 is very high the Type F firm will always produce low quality in period 2. If this were so, the gain from producing high quality in the first two periods would be high since it would lead to the classificaion of the firm as a Type H and allow it to reap large period 3 profits. Thus, for λ_0 sufficiently high, the equilibrium must involve mixed strategies, in which Type F firms choose to reduce quality with sufficiently high probability that the probability assessed by consumers of the firm being Type H, after having produced high quality, is just sufficient to make the profits under the alternative strategies equal.

2 THE LEVERED FIRM

The previous section presented conditions under which an all–equity firm would choose to produce high quality goods. This section examines the quality choice of a Type F firm given that it has an exogenous obligation to make debt repayments of d_2 and d_3 at the end of periods 2 and 3 respectively. We assume that any new financing the firm might raise consists of debt with a lower priority (or equivalently, equity).[14] In addition we assume that the firm cannot renegotiate

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[14] The firms may have initially issued debt rather than equity for tax reasons or to reduce agency costs (see Grossman and Hart (1982) or Jensen (1986)). If these benefits of debt financing are independent of the firm's type, then since the Type F firm can costlessly mimic any decision made by a Type H firm and since it achieves a smaller profit if its type is revealed, debt cannot be used to signal a firm's type. The level of debt that is optimal from the perspective of a type H firm will also be chosen by the type F firm.

its debt obligations to avoid bankruptcy and, as in the previous section, that the firm's financial condition is known to its customers as well as to its investors.[15] This assumption will be relaxed later in the section.

In the analysis that follows, a firm becomes bankrupt, and its equity has zero value, if it is unable to meet its debt obligations even if it reduces quality. Our analysis also considers a condition that we call financial distress in which the firm is unable to raise sufficient capital from the credit market to finance the production of high quality (because its senior obligations are sufficiently greater than its expected future cash flows), but may be able to avoid immediate bankruptcy by reducing quality. A third condition which is relevant for this analysis arises when the firm is in need of additional cash that can be raised by issuing junior bonds so that the firm need not reduce the quality of its product. We will henceforth refer to this condition as a financial shortfall.

We initially examine a Type F firm's quality choice in period 2 under the assumption that it produced high quality in period 1. (If the firm had produced low quality in period 1, it would have revealed its type and would therefore continue to produce low quality in all subsequent periods.) Without loss of generality we also assume in this section that the first period cash flow of a firm that produces high quality is zero.

2.1 Future Bankruptcy and Quality Choice

In this sub-section we examine the effect of the possibility of bankruptcy on quality choice. This issue was previously examined by Chung and Smith (1987), who showed that a firm might reduce quality because of the threat of future bankruptcy. The following proposition demonstrates that their result depends crucially on the assumption that a firm's profit in any given period can

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[15] In cases where renegotiation is possible, we expect it to occur only when the benefits exceed the costs. The analysis of this paper suggests that the benefits will be related to the importance of reputational considerations in the firm's line of business. For example, we expect that firms that produce a product whose quality is unobservable before purchase will have a greater tendency to renegotiate their debt obligations in the event of financial distress.

immediately be paid out to shareholders.

Proposition 2

For d_3 sufficiently large (but not large enough that the firm is sure to go bankrupt), a Type F firm will produce a low quality product in period 2 if it pays out all of its period 2 earnings in the form of a dividend. If in period 2 the firm can pay no more than its profit from producing a high quality product, $p_2 - c$, in debt payments and dividends, it will produce high quality in this period with the same probability as an all–equity firm, regardless of its period 3 debt obligation.

Proof

We prove this for the case in which the all-equity firm produces a high quality product in the first and the second periods with probability 1. As shown in Proposition 1 this occurs if $\lambda_0 < 1 - (c/\ell)$. The proof for the case in which $\lambda_0 > 1 - (c/\ell)$ is similar, and is omitted in the interest of brevity.

The following beliefs are shown to be consistent if $\lambda_0 < 1 - (c/\ell)$: the Type F firm will produce a high quality product in periods 1 and 2 and a low quality product in period 3. Given this belief, if the firm produces high quality its equity value, $S_h^2(\theta_2)$, is

$$S_h^2(\theta_2) = \theta_2 - c - d_2 + E_2[max(\theta_3 - \lambda_0\ell - d_3, 0)]. \tag{3}$$

If the firm cannot pay more than $\theta_2 - c - d_2$ in dividends then its equity value from producing low quality is

$$S_\ell^2(\theta_2) = \theta_2 - c - d_2 + E_2[max(\theta_3 - \ell + c - d_3, 0)]. \tag{4}$$

A comparison of the above equilibrium values reveals that $S_h^2(\theta_2) \geq S_\ell^2(\theta_2)$ as long as $\lambda_0 < 1 - (c/\ell)$, where the inequality is strong as long as there is some probability that the firm producing high quality does not go bankrupt. Hence the assumed beliefs are consistent.

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If the firm can pay its entire income as a dividend

$$S_\ell^2(\theta_2) = \theta_2 - d_2 + E_2[max(\theta_3 - \ell - d_3, 0)]. \tag{5}$$

It can then be shown that for d_3 sufficiently large $S_\ell^2(\theta_2) > S_h^2(\theta_2)$, so that the firm can increase the value of equity by reducing quality and the firm's optimal actions are inconsistent with the customer's beliefs.   ∎

The previous proposition demonstrates how a firm's debt level and dividend policy affect its ability to credibly offer a high quality product. This proposition is closely related to Myers' (1977) analysis of the effect of debt and dividend policy on the firm's investment choice. The relation between the two results can be seen most clearly if we view the investment in the Myers model as maintenance of a machine. If a firm can pay a dividend equal to its profits, equityholders have an incentive to forgo the maintenance since they can capture the entire short–term saving from avoiding the costs, while the debtholders share the loss associated with the subsequent decline in the equipment's value. Similarly, the incentives of equityholders to maintain a reputation diminish as the firm's debt level increases. If, however, the dividend is constrained so that the firm cannot increase its payout by reducing quality, then a reduction of standards no longer increases the period 2 payouts to equityholders. Moreover, it will not increase their period 3 payouts if the firm is bankrupt, since in this case they receive zero regardless of their quality choice. In the event that the firm is not bankrupt, the loss in reputation affects their payouts in exactly the same way as it affects the payout of an all–equity firm. Hence, the quality choice of the firm will not be affected by its period 3 debt obligation as long as its dividends are constrained.

The Myers model has been applied by John and Kalay (1982) and others to explain observed bond covenants that restrict dividends to the firm's reported earnings.[16] However, since unobserved

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[16] Kalay (1982) finds that dividend restrictions are not binding in most firms. However, as DeAngelo and DeAngelo (1988) show, the restrictions are likely to be relevant in near bankrupt firms. Such firms are the ones that have the greatest incentive to reduce quality.

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reductions in quality standards temporarily increase reported earnings, the dividend payout allowed under these covenants increases with quality reductions. As a result, standard dividend restrictions observed in bond covenants may be less effective in controlling the quality reduction problem than they are in curtailing most under–investment problems.[17]

In the remainder of the paper we show that even if the problems created by dividend payouts can be solved, leverage will still affect the firm's ability to credibly offer a high quality product. To do this we will examine the firm's product quality choice under the assumption that the firm is restricted to pay no dividends until the final period.

2.2 The Effect of a Financial Shortfall and Financial Distress on Quality Choice

In the preceding section, the firm's product quality choice was shown to be analogous to the investment choice in the Myers model. If we extend the analysis to consider the case in which the firm requires outside financing in period 2, the investment analogy no longer provides the correct intuition about the firm's incentive to maintain product quality.

Consider first the case in which equipment maintenance rather than product quality choice is the relevant investment and suppose that the firm's cash flow in period 2, $\theta_2 - c$, is less than its current debt obligation, d_2. To cover this shortfall the firm can either raise cash internally by reducing maintenance or it can issue equity or new debt that is junior to its original period 3 debt obligation. In this case equityholders may prefer to cut back on maintenance even when maintenance has a positive net present value since part of the cost of deferring maintenance is borne by the current debtholders.

In this example, although the firm reveals its intention to reduce maintenance when it chooses not to borrow to cover its shortfall, this revelation has no relevant consequences since it does not

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[17] For the same reasons as discussed above, under-investment in maintenance will also not be corrected by a dividend constraint tied to reported earnings.

affect the firm's costs or revenues. In this regard the quality decision differs from the maintenance decision since the firm's borrowing decision will affect customer perceptions about the quality of its product. If customers observe that the firm does not borrow when $\theta_2 - c$ is less than d_2, they will infer that the firm will produce low quality, and will reduce the price they are willing to pay for the product accordingly. This will of course eliminate the immediate benefits of producing low quality while the firm will still suffer the loss of reputation. Therefore, as the next proposition demonstrates, if customers are able to observe the firm's financial condition, the firm will prefer to raise funds by borrowing rather than by reducing quality.

Proposition 3

If its financial condition is known, a Type F firm with a financial shortfall that can be covered with additional borrowing will not reduce quality.

Proof

We prove this for the case in which the all-equity firm produces a high quality product in the first and the second periods with probability 1. As shown in Proposition 1 this occurs if $\lambda_0 < 1 - (c/\ell)$. The proof for the case in which $\lambda_0 > 1 - (c/\ell)$ is similar, and is omitted in the interest of brevity.

Let the customers believe that the firm will produce high quality output in period 2 if it borrows and not otherwise. If the amount of the shortfall, $s \equiv d_2 - (\theta_2 - c)$ is such that

$$s < (1 - \lambda_0)E_2[max(\theta_3 - \lambda_0\ell - c - d_3, 0)] + \lambda_0 E_2[max(\theta_3 - \lambda_0\ell - d_3, 0)], \qquad (6)$$

the firm can finance its period 2 production by borrowing. We first show that if (6) is satisfied and a Type F firm borrows sufficient funds to cover its shortfall it will not reduce quality. Then we show that the firm will prefer to borrow rather than not borrow and produce low quality. Assume

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first that the firm raises s with a debt issue and let d_n be the face amount of this debt. If, after issuing new debt, the firm produces high quality its equity value, $S_h^2(\theta_2)$, is

$$S_h^2(\theta_2) = E_2[max(\theta_2 - c + \theta_3 - \lambda_0 \ell + s - d_n - d_2 - d_3, 0)]. \tag{7}$$

If the firm produces low quality its equity value, S_ℓ^2 is

$$S_\ell^2(\theta_2) = E_2[max(\theta_2 + \theta_3 - \ell + s - d_n - d_2 - d_3, 0)]. \tag{8}$$

Since $\lambda_0 < 1 - (c/\ell)$, $S_h^2 > S_\ell^2$ implying that if the firm borrows it will produce high quality. Now suppose the firm decides not to borrow and to produce low quality. In this case, having observed that the firm has not borrowed, the customers realize that it must reduce quality. However, the shortfall in the second period will be $d_2 - (\theta_2 - \ell) > s > 0$, implying that the firm will immediately become insolvent. Hence, the firm will produce high quality, confirming the customers' beliefs. ∎

The above proposition indicates that in order for a levered firm to deviate from the period 2 policy of an all-equity firm, it must either be unable to borrow, or alternatively, its financial condition must be unknown. Now consider the case in which the firm's financial condition is known, but because its current shortfall producing high quality $(\theta_2 - c - d_2)$ exceeds the present value of its period 3 net cash flows, it is in financial distress and faces certain bankruptcy unless it reduces the quality of its product. In this case, there can exist no equilibrium in which the Type F firm produces high quality. The financially distressed Type F firm will produce low quality and in some cases will still go bankrupt while in other cases it will avoid bankruptcy. The following proposition provides conditions under which it will in fact be able to avoid bankruptcy in financial distress.

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Proposition 4

A firm that is in financial distress can avoid immediate bankruptcy by reducing quality if and only if $c > (\lambda_2 - \delta_2)\ell$, where δ_2 is the probability that an all-equity Type F firm that has produced high quality in the first period produces low quality in the second period, and

$$\delta_2 = \begin{cases} 0 & \text{if } \lambda_0 < 1 - c/\ell \\ \frac{\pi_1(1-\pi_2)\lambda_0}{\pi_1\lambda_0 + 1 - \lambda_0} & \text{if } \lambda_0 > 1 - c/\ell. \end{cases}$$

Proof

This can easily be seen by comparing the necessary condition for financial distress to occur, $d_2 > \theta_2 - \delta_2\ell - c$, with the condition that a firm in financial distress can escape immediate bankruptcy by reducing quality, $d_2 \leq \theta_2 - \lambda_2\ell$. ∎

2.3 Financial Condition Unobservable

The previous analysis suggests that in period 2 the firm will not deviate from the quality choice of an all-equity firm except in those cases when it would have gone bankrupt otherwise. An important assumption of this analysis is that all individuals have the same information about the firm's financial condition. In reality, while a decision to issue new debt is public, it is very likely that a firm's management is better informed about its past cash flows and off-balance-sheet liabilities than are its customers or creditors. Hence, a firm suffering a financial shortfall may be much stronger financially than the market expects. As the following proposition demonstrates, a firm may, in this case, choose to reduce quality rather than borrow, because the cost associated with borrowing at unfavorable terms more than offsets the benefits of credibly revealing its intention to produce high quality by raising additional funds.

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Proposition 5

Assume that

(i) With probability $\kappa > 0$ the firm has debt obligations d_2^* and d_3^* such that the firm is not in financial distress but that risky borrowing is required to finance high quality production in the second period. With probability $1 - \kappa$ the firm has no debt obligations.

(ii) Customers do not observe whether or not the firm has debt obligations.

Then, if the second period price is sufficiently low, there is a positive probability that a Type F firm will reduce quality rather than borrow to finance high quality production.

Proof

To prove the proposition assume the converse, that the firm produces high quality with certainty. Then the firm will receive θ_2 for its product whether or not it borrows. Let $s = d_2^* - (\theta_2 - c)$ be the shortfall. To borrow this amount, the firm must take on an additional obligation, d_n, which is junior to d_3^*, where d_n solves the equality:

$$s = (1 - \lambda_0) E_2[min(d_n, max(\theta_3 - \lambda_0 \ell - c - d_3^*, 0))]$$

$$+ \lambda_0 E_2[min(d_n, max(\theta_3 - \lambda_0 \ell - d_3^*, 0))]. \tag{9}$$

The terminal value of a Type F firm's equity if it produces low quality in the second period is

$$S_\ell^2 = E_2[max(\theta_2 - d_2^* + \theta_3 - \ell - d_3^*, 0)]. \tag{10}$$

If it produces high quality and borrows to meet the shortfall its expected terminal value is

$$E_2[max(\theta_3 - \lambda_0 \ell - d_3^* - d_n, 0)] \leq E_2[max(\theta_2 - c - d_2^* + \theta_3 - \lambda_0 \ell - d_3^*, 0)], \tag{11}$$

since d_n must be greater than the amount of the shortfall. However, since the right hand side of (11) equals S_ℓ^1 if $\lambda_0 = 1 - c/\ell$, if λ_0 is sufficiently close to $1 - c/\ell$, or alternatively d_n is sufficiently greater than s, the probability that the Type F firms will reduce quality is strictly positive. ∎

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The existence of firms in the preceeding example that do not need to borrow to meet their period 2 debt obligations means that Type F firms can choose not to borrow without immediately revealing their types. In the above example Type F firms will continue to produce high quality if they do not have a cash shortfall; however, for a sufficiently large shortfall and a sufficiently larger amount of existing debt, the cost to the equityholders of borrowing with junior debt is higher than the cost of losing the firm's reputation for product quality. The reason is that the cost of new borrowing is borne exclusively by equityholders, whereas the cost of reducing quality is partially borne by existing debtholders.

2.4 The Quality Choice in the First Period

The previous subsection analyzed the period 2 quality choice of a Type F firm that produced high quality in period 1. In this subsection we again assume that the firm's financial condition is observable and examine the period 1 quality choice. This allows us to determine how the potential for suffering financial distress or a shortfall in the future affects the firm's ability to maintain a reputation in the current period.

Most reputation models exhibit what is generally referred to as an unravelling effect. If customers know that a Type F firm will produce low quality in period t, then in period $t - 1$ the firm's incentive to maintain its reputation will be reduced. This logic suggests that since financial distress will cause a Type F firm to produce low quality, the possibility of suffering financial distress in period 2 will reduce the firm's incentive to maintain its reputation in period 1.

Whether or not the firm reduces quality depends in part on λ_2, the customers' assessment of the probability that a firm that produces high quality in period 1 is of Type F. For sufficiently high values of λ_2, a Type F firm can increase the sum of its period 1 and period 2 cash flows by reducing quality in period 1 and thereby avoid bankruptcy or financial distress in some period 2

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states of nature. If the firm produces low quality the sum of these period 1 and 2 cash flows is

$$p_1 + \theta_2 - \ell. \tag{12}$$

If the firm produces high quality in period 1 and gets into financial distress and produces low quality in period 2 the sum of its period 1 and 2 cash flows is

$$p_1 - c + \theta_2 - \lambda_2 \ell. \tag{13}$$

Comparing expressions (12) and (13) we see that if $\lambda_2 > 1 - (c/\ell)$, and if the probability of financial distress is sufficiently high, the firm is better off producing low quality initially. However, the motivation to reduce quality can be much stronger than this if there is some probability that the firm may have to raise capital in the future. As we show in the next proposition, the firm may have an incentive to reduce quality in period 1 even if there is no chance that it will suffer financial distress in period 2.

Proposition 6

A levered Type F firm may have a greater tendency to reduce quality in period 1 than an all-equity firm even if there is no possibility of financial distress or bankruptcy in period 2.

Proof

This proposition is proved by presenting an example in which a levered firm that does not have sufficient debt obligations to be in danger of financial distress produces low quality with a higher equilibrium probability in the first period than an all-equity firm. The example assumes: (i) $\lambda_0 > 1 - (c/\ell)^2$ so that an all-equity Type F firm produces high quality output with a probability less than one in periods 1 and 2, (ii) a two-state density in the final period where $\theta_3 = \theta_1 + a$ or $\theta_1 - a$ and where the two states are equally likely, (iii) that the state of the world in the second period is known with certainty, i.e., $\theta_2 = \theta_1$, (iv) that d_2 is such that a firm that has produced

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low quality in the first period has a zero cash flow net of debt repayment in the first two periods, i.e., $d_2 = p_1 + \theta_1 - \ell$, (v) that d_3 is sufficiently high that the Type F firm becomes bankrupt if the price declines in the third period regardless of its quality decision and that (vi) $\ell > 2c$. Given these assumptions the value of the equity of a firm that produces low quality in period 1 is given by

$$S_\ell^1 = \frac{1}{2}[p_1 + \theta_1 - \ell + \theta_1 + a - \ell - d_2 - d_3]. \tag{14}$$

A Type H firm will have a shortfall in period 2 of $s = 2c - \ell + \delta_2'\ell$, where δ_2' is the customers' assessment that the good will be of low quality, and must finance this shortfall by borrowing. A Type F firm that has produced high quality in the first period must borrow the same amount in order not to reveal its type. If it does this its equity value is given by

$$S_h^1 = \frac{1}{2}[p_1 - c + \theta_1 - \delta_2'\ell + s + \theta_1 + a - \ell - d_2 - d_3 - d_n], \tag{15}$$

where $d_n = 2s$ is the face value of the newly issued debt. In equilibrium $S_h^1 = S_\ell^1 \Rightarrow \delta_2' = (\ell - c - s)/\ell$. The equilibrium condition that $S_h^2 = S_\ell^2$ implies that $c + \delta_3'\ell = \ell$, where δ_3' is the customers assessment of the probability that good is of low quality and δ_2' and δ_3' depend on the π_1 and π_2, the probabilities that the Type F firm produces the high quality good in periods 1 and 2. Solving for π_1 and π_3 and comparing with the corresponding probabilities for the all-equity firm derived in Proposition 1, it can be demonstrated that the probability of producing high quality in the first period is less than for the all-equity firm. ∎

The incentive to reduce quality in period 1 arises when the firm is likely to suffer a financial shortfall and be forced to borrow at unattractive rates in period 2. Reducing quality in period 1 provides an alternative way of borrowing that is not socially efficient, but may be attractive to the firm's equityholders. As mentioned above, reducing quality is like issuing senior debt, so its costs are shared with the firm's existing bondholders. The incentive to reduce quality in period 1 is

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therefore similar to the period 2 incentive to reduce quality when there is asymmetric information about the firm's financial condition. However, in period 2, the firm is unable to meet its debt obligations by reducing quality when there is symmetric information about its financing needs since its failure to borrow at this time reveals its intention to reduce quality. This problem does not exist in period 1 since in this period the firm cannot take actions that reveal its type.

2.5 Senior Versus Junior Debt

Throughout this analysis we have made the assumption that the firm's existing debt is protected so that any new debt issued must be of lower priority. However, since some of the problems that we have discussed relate to the firm's incentive to raise cash internally by reducing quality rather than resorting to relatively expensive junior borrowing, it is apparent that these problems would at least be mitigated if the firm's debt were not protected. The intuition for this is quite simple. The firm will have less of an incentive to expropriate its creditors by reducing quality when it can more efficiently expropriate existing bondholders by issuing senior debt.

The preceding discussion is similar to Stulz and Johnson's (1985) argument that the underinvestment problem of Myers can be eliminated if new investments can be financed by secured debt. Our analysis takes this argument one step further and suggests that there are costs associated with limiting a firm's senior borrowing even in instances in which it is not financing new investments. Of course, allowing the firm to issue senior debt in the future is only a short term solution to the problem since an incentive to reduce quality to expropriate these new bondholders will exist once the new debt is issued.

3 THE OPTION TO LIQUIDATE

In the preceding analysis the firm's assets had no alternative use, and hence, had a liquidation value of zero. If the firm's assets do have an alternative use, it may choose to liquidate its

assets rather than continue to produce. In the following analysis we assume that the firm has the opportunity to liquidate its assets in the second period, before production takes place, but after the state of nature has been revealed. Although increasing the opportunities available to a firm generally increases its value, in the present context the option to liquidate can have the adverse effect of decreasing the firm's ability to offer a high quality product. This is shown in the following proposition.

Proposition 7

If an all-equity firm has the opportunity to liquidate in period 2, it will (weakly) reduce its probability of producing high quality in the first period. When $\lambda_0 > 1 - (c/\ell)^2$ it will always reduce the probability of producing high quality goods. The value of a firm that has the opportunity to liquidate may be lower than that of firm that does not.

Proof See Appendix.

The proposition demonstrates that in some cases the optimal liquidation policy of an all–equity firm is time-inconsistent. In these cases, the firm would be better off if it could commit not to liquidate since its enhanced ability to credibly offer high quality products in the first period would more than offset the expected loss associated with the loss of the option to liquidate in the second period. For similar reasons Klein and Leffler (1981) have argued that firms will purposely design their assets to reduce their salvage values as a means of committing to a policy of producing high quality. The following demonstrates that the firm can also commit to such a policy without distorting the salvage value of the firm by selecting the appropriate capital structure.

As in Titman (1984) this can be done by issuing senior claims, such as debt and preferred stock, whose face values exceed the firm's liquidation value, without issuing so much debt that the

firm goes bankrupt.[18] Since these senior claimants will receive the entire liquidation proceeds with such a capital structure, the firm's equityholders, who control this decision, will never choose to liquidate the firm. However, the firm may be able to do better than this. In particular, since the period 1 incentives of the firm's equityholders are only affected by liquidations that occur when the firm is not bankrupt, the firm can, by choosing the appropriate capital structure, achieve the period 2 benefits of liquidation without adversely affecting their incentives to decrease product quality in period 1. Such a capital structure will have the property that the firm is bankrupt in those states of nature where it would optimally want to liquidate. This will not necessarily lead to the first best outcome, that the firm produces at the quality level of an all-equity firm without the liquidation option, since the debt level that allows the firm to be bankrupt in period 2 states of nature in which liquidation is optimal may also create a potential for financial distress in other states in which immediate bankruptcy can be avoided by reducing quality. However, as the following proposition demonstrates, under certain conditions this first best solution can be achieved.

Proposition 8

Assume that the following conditions are satisfied:

(i) $E_2[\theta_3|\theta_2]$ is increasing in θ_2,

(ii) $d_2 = p_1 - c + \theta^H - \delta_2\ell - c$ and $d_3 = E_2[\theta_3|\theta^H] - \delta_3\ell$,

(iii) $c < (\lambda_2 - \delta_2)\ell$,

where δ_2 and δ_3 are the customers' assessments of the probability that the good is of low quality for a firm that has an all–equity financial structure and does not have a liquidation option and where θ^H is the period 2 state of nature in which an all-equity Type H firm is indifferent between

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[18] Preferred stock may be useful here since it affects the firm's incentive to liquidate as its claim is senior to that of shareholders, but does not affect whether or not the firm is in financial distress.

operating and liquidating. Then there exists an equilibrium where the firm will produce high quality with the same probability as an all-equity firm with a zero liquidation value, and will liquidate when doing so is optimal.

Proof

The proposition is proved by showing that the customers' belief that the Type F firm described in the proposition produces high quality output with the same probability as an all-equity firm without the liquidation option is consistent with the firm's strategies given the belief. Specifically we show that δ_2' and δ_3', the probabilities that the Type F firm with the liquidation option produces low quality in periods 2 and 3 respectively, are equal to δ_2 and δ_3, the corresponding probabilities for the firm without the liquidation option. With these beliefs it follows from Proposition 1 that the sum of the period 2 and 3 cash flows for a Type H firm and for a Type F firm which has produced low quality in period 1 are equal. As a result, they will liquidate in the same states. A Type F firm that has produced high quality in the first period will also liquidate in exactly these states in order not to reveal its type. Thus, since $E_2[\theta_3|\theta_2]$ is increasing in θ_2, the firm, regardless of type maximizes value by always liquidating when θ_2 is below θ^H.

If d_2 just exceeds $p_1 - c + \theta^H - \delta_2'\ell - c$ and $d_3 = E_2[\theta_3|\theta_2 = \theta^H] - \delta_3'\ell$, then the Type F firm cannot finance production of the high quality good from internal funds for $\theta_2 \leq \theta^H$ and cannot borrow to do so either. If $c < (\lambda_2 - \delta_2')\ell$, then the firm also cannot remain solvent by cutting quality when it is unable to borrow. Thus the firm will become bankrupt in the second period for $\theta_2 < \theta^H$ and will be optimally liquidated by the debtholders.

The period 1 value of the firm's equity conditional on it producing high quality in the first period is given by:

$$S_h^1 = qE_1[E_2[max(p_1 - c + \theta_2 - \delta_2'\ell + \theta_3 - \ell - d_2 - d_3, 0)]|\theta_2 > \theta^H], \qquad (17)$$

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where $q = Pr(\theta_2 > \theta^H)$. The equity value achieved by producing low quality is given by

$$S_\ell^1 = qE_1[E_2[max(p_1 + \theta_2 - \ell + \theta_3 - \ell - d_2 - d_3, 0)|\theta_2 > \theta^H]. \tag{18}$$

If the firm is to produce high quality in period 1 with a probability between 0 and 1, then $S_h^1 = S_\ell^1$. Equating expressions (17) and (18) yields $c + \delta_2' \ell = \ell$. Similarly the equilibrium condition $S_h^2(\theta_2) = S_\ell^2(\theta_2)$ for $\theta_2 > \theta^H$, yields $c + \delta_3' \ell = \ell$. Since the restrictions on δ_2' and δ_3' are identical to the equilibrium restrictions on δ_2 and δ_3 for the all-equity firm without the liquidation option derived in Proposition 1, it follows that the belief that $\delta_2' = \delta_2$ and $\delta_3' = \delta_3$ is consistent with the equilibrium. ∎

The above proposition indicates that debt need not have a negative affect on a firm's ability to credibly offer high quality products. In industries in which capital goods have high salvage values, debt may serve to commit the firm to produce higher quality goods then it might otherwise produce.

4 CONCLUSION

This paper proposes a theory in which the effect of debt financing on a firm's ability to maintain a reputation for product quality is a determinant of its capital structure choice. The model can thus be viewed as part of the recent body of literature that relates the firm's capital structure choice to characteristics of its product market.[19] The model is particularly close in its predictions to Titman (1984), which argues that the price a firm can charge for a good that may need servicing will fall if it is likely to go bankrupt and liquidate in the near future. Both models provide explanations for why Chrysler and International Harvester suffered losses in sales (relative to their competition) subsequent to their financial difficulties. However, the model presented in this paper suggests that

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[19] See, for example, Titman (1984), Allen (1986), Brander and Lewis (1986), and Maksimovic (1986, 1988a).

consumers of non-durable goods and services (such as hospitals, pharmaceuticals and air travel) might also be concerned with the financial status of the producer.

The analysis demonstrates that a firm in financial distress may have an incentive to cut costs and reduce the quality of its product in order to avoid immediate bankruptcy. Moreover, in certain situations a firm has an incentive to produce low quality products when it has reason to expect financial difficulties in the future. Since rational consumers anticipate that the product's quality will suffer, the market price for the firm's output falls, which in turn decreases the firm's profits. This decrease in profits, associated with financial distress, is consistent with evidence pertaining to indirect costs of bankruptcy found in Altman (1984).

Our analysis also demonstrates that if the firm's assets have alternative uses, (i.e., the firm has the option to liquidate) it will place a lower value on its reputation and will therefore be less able to credibly offer a high quality product. The reduction in value associated with its inability to offer a high quality product can potentially be greater than the gain associated with having the option to liquidate. However, the use of debt financing, by altering the equityholders' payoff in the event of liquidation, may increase the firm's incentives to maintain its reputation. This suggests that the effects of debt financing may be different in industries in which assets are firm-specific than in industries in which they have high opportunity costs.

We noted in the introduction that the analysis could be applied to many types of implicit contracts other than product quality. The model suggests that both capital structure and dividend policy will play an important role in any transaction in which the terms of trade are determined in part by reputation considerations. Examples might include a firm's reputation for treating suppliers and employees fairly, its reputation for being a tough competitor in cases in which it would want to deter entry (as in Kreps and Wilson (1982) and Milgrom and Roberts (1982)) and its reputation for being a friendly rival in an oligopolistic setting (as in Green and Porter (1984)

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and Maksimovic (1986, 1988b)).

Our analysis can also be extended to explore the effect of management incentives on the ability to maintain reputations. If managers have an incentive to increase the firm's current share price (perhaps to decrease the possibility of unwanted suitors or to increase current compensation), they may have the same incentive to temporarily increase cash flows as they would when facing financial distress. Hence, the firm's ability to maintain a reputation for high quality products and to enter into implicit contracts will also be affected by its management's desire to increase its current share price. This suggests that reputation issues may have important implications for optimal managerial contracts and takeover defenses as well as for financial policy.

The analysis in this paper also has implications that relate to the recent macro literature on financial structure and aggregate economic activity. The models developed in this literature suggest that the increase in leverage brought about by a recession leads to various adverse selection and moral hazard problems between borrowers and lenders which reduce investment and ultimately prolong and worsen the downturn.[20] Our analysis suggests that recessions may also lead to a breakdown in the ability of many firms to make implicit contracts, and thereby do business effectively with their customers, suppliers, and other stakeholders. As a result, the effects of financial structure on reputation analyzed here may have an effect not only on the firm itself, but also on the economy as a whole.

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[20] See Gertler (1988) for an excellent review of this literature.

APPENDIX

Proof of Proposition 1

(i) The following beliefs are shown to be consistent if $\lambda_0 < 1 - (c/\ell)$: the probability that the firm is of Type F is λ_0 in period 1 and also in periods 2 and 3 if it previously produced only high quality. The probability is 0 if it has produced low quality. Given these beliefs, a firm that has produced high quality in the first period is valued in period 2 as, $V_h^2(\theta_2) = \theta_2 - c + E_2[\theta_3] - \lambda_0\ell$ and a firm that produces low quality is valued as, $V_\ell^2(\theta_2) = \theta_2 + E_2[\theta_3] - \ell$. Hence, $V_h^2(\theta_2) > V_\ell^2(\theta_2)$ if and only if $\lambda_0 < 1 - (c/\ell)$ confirming that the beliefs are consistent. It can similarly be shown that if the firm finds it advantageous to produce superior quality in period 2, it will also choose to produce superior quality in the first period.

More generally, if $\lambda_0 < 1 - (c/\ell)$ it is optimal for the Type F firm to produce high quality in periods 1 and 2 regardless of the customers' beliefs about its actions since for these parameter values the cost of producing high quality, c is smaller than the minimum possible gain from doing so, $(1 - \lambda_0)\ell$. This implies that the above equilibrium is unique.

(ii and iii) We first establish that there does not exist a pure strategy equilibrium if $\lambda_0 > 1 - (c/\ell)$. Suppose that producing high quality in the first period is an equilibrium for a Type F firm. Then, as shown above, since $\lambda_0 > 1 - (c/\ell)$ a Type F firm that produced high quality in the first period would optimally produce low quality in the following two periods.

The total profit from producing high quality in the first period is then

$$\theta_1 - c + E[\theta_2] - \lambda_0\ell + E[\theta_3] - \ell. \tag{A1}$$

By contrast, a Type F firm that deviates and produces low quality in the first period earns $\theta_1 + E[\theta_2] - \ell + E[\theta_3] - \ell$, which is greater than the profit from producing high quality. Thus a deviation is optimal and producing high quality is not an equilibrium strategy.

Similarly, it can be shown that always producing low quality is not an equilibrium strategy. The above analysis indicates that if an equilibrium exists, it must be the case that the type F firm randomly decides whether to provide low or high quality in period 1. This implies that the value of a Type F firm choosing high quality must equal its value choosing low quality in the first period.

Let π_1 be the probability that a firm of Type F produces high quality in the first period and let π_2 be the probability that a Type F firm, which has produced high quality in the first period, produces high quality in the second period. The customer expects, in period 2, that a firm that previously produced high quality will produce goods worth, on average,

$$p_2 = \theta_2 - \delta_2 \ell \text{ and } p_3 = E_2[\theta_3] - \delta_3 \ell, \tag{A2}$$

in the second and third periods respectively where $\delta_2 = \frac{\pi_1(1-\pi_2)\lambda_0}{\pi_1\lambda_0+1-\lambda_0}$, $\delta_3 = \frac{\pi_1\pi_2\lambda_0}{\pi_1\pi_2\lambda_0+1-\lambda_0}$ are determined using Bayes' Rule. Given these prices, $V_h^2(\theta_2) = p_2 - c + E_2[\theta_3] - \delta_3\ell$ and $V_\ell^2(\theta_2) = p_2 + E_2[\theta_3] - \ell$. It follows that $V_h^2(\theta_2) = V_\ell^2(\theta_2)$ if and only if $c + \delta_3\ell = \ell$.

If $V_h^2(\theta_2) = V_\ell^2(\theta_2)$, then in setting quality in the first period a firm of Type F need only compare the profits from producing low quality in every period to the profits from producing high quality in the first period and then producing low quality. If the firm produces low quality in the first period its profits are $V_\ell^1 = p_1 + E[\theta_2] - \ell + E[\theta_3] - \ell$. If the firm produces high quality in the first period its profits are $V_h^1 = p_1 - c + E[\theta_2] - \delta_2\ell + E[\theta_3] - \ell$. The firm will then be indifferent between producing high or low quality in the first period if and only if $c + \delta_2\ell = \ell$. The period 1 and period 2 equilibrium conditions yield $\pi_1 = (1 - \lambda_0)(\ell^2 - c^2)/\lambda_0 c^2$ and $\pi_2 = c/(\ell + c)$. If $\lambda_0 > 1 - (c/\ell)^2, \pi_1 \leq 1$. By construction π_1 and π_2 are unique.

(iii) If $\pi_1 = 1$, $\pi_2 = (1 - \lambda_0)(\ell - c)/c\lambda_0$ and $\lambda_0 > 1 - (c/\ell)^2$, then $V_h^1(\theta_1) > V_\ell^1(\theta_1)$ and $V_h^2(\theta_2) = V_\ell^2(\theta_2)$. ∎

Proof of Proposition 7

The proposition is proved by showing that there exists an equilibrium in which a Type F firm

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with the liquidation option produces high quality output in period 1 with a lower probability than an all-equity firm without the liquidation option. This is proved for the case where $\lambda_0 > 1 - (c/\ell)^2$, so that the Type F firm mixes in periods 1 and 2 when there is no liquidation option and the customers use Bayes' Rule to update their probability assessments. The proof for cases where the above inequality is reversed so that the firm does not mix in period 1 is similar.

First we determine the levels of θ_2 at which the firm liquidates optimally. If the hypothesized equilibrium exists, then the consumers' assessment of the probability that in period 2 the firm is of Type F is higher when the firm has a liquidation option. It then follows from inspection of the equilibrium conditions in the proof of Proposition 1 that the cash flows in periods 2 and 3 are at least as great for a Type H firm as for a Type F firm which has already produced low quality. As a result, a firm known to be of Type F firm liquidates in at least as many states as a Type H firm. In order not to reveal its type, a Type F firm that has produced high quality in the first period liquidates in those states in which a Type H does so.

Let Θ_F be the set of values of θ_2 for which a Type F firm which has produced low quality in the first period does not liquidate, Θ_H be the set of values of θ_2 for which a Type H firm does not liquidate, so that $\Theta_F \subseteq \Theta_H$ and let $\Theta_\Delta = \Theta_H - \Theta_F$. Also let $q_1 = Pr(\theta_2 \in \Theta_F)$, $q_2 = Pr(\theta_2 \in \Theta_\Delta)$ and $1 - q_1 - q_2 = Pr(\theta_2 \in \Theta_H^c)$, where the superscript c denotes the complement of a set. In a mixed strategy equilibrium the firm is indifferent between producing high or low quality goods in period 1, so $V_h^1 = V_\ell^1$. The expected profits from producing high quality in the first period are given by

$$V_h^1(\theta_1) = (q_1 + q_2)E_1[E_2[p_1 - c + \theta_2 - \delta_2^L \ell + \theta_3 - \ell]|\theta_2 \in \Theta_H] + (1 - q_1 - q_2)E_1[p_1 - c + L|\theta_2 \in \Theta_H^c]. \quad (A3)$$

where L is the salvage value of the firm's assets and δ_2^L is the consumers' assessment that in period 2 the firm with the liquidation option produce a low quality product. The V_ℓ^1 is given by

$$V_\ell^1(\theta_1) = q_1 E_1[E_2[p_1 + \theta_2 - \ell + \theta_3 - \ell|\theta_2 \in \Theta_F] + (1 - q_1)E_1[p_1 + L|\theta_2 \in \Theta_F^c]. \quad (A4)$$

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Equating the values of the firm given in (A3) and (A4) and rearranging yields

$$-c + (q_1 + q_2)(1 - \delta_2^L)\ell + q_2 E_1[E_2[\theta_2 - \ell + \theta_3 - \ell - L|\theta_2 \in \Theta_\Delta] = 0. \qquad (A5)$$

Since the Type F firm that has produced low quality in the first period liquidates when $\theta_2 \in \Theta_\Delta$, the last term in this expression is negative. From the proof of Proposition 1, the equivalent equilibrium condition for a firm that does not have the liquidation option is $\delta_2 \ell + c = \ell$. It follows that δ_2^L is less than δ_2. In conjunction with the equilibrium condition that $V_h^2 = V_\ell^2$ for $\theta_2 > \Theta_F$, expression (A5) implies that in equilibrium the probability that a Type F firm with a liquidation option produces high quality in the first period is (weakly) less than the corresponding probability for a firm without the liquidation option.

The value of the all-equity Type F firm when it does not possess the liquidation option is higher than when it does if

$$p_1 + E_1[E_2[\theta_2 - \ell + \theta_3 - \ell]] < p_1^L + q_1 E_1[E_2[\theta_2 - \ell + \theta_3 - \ell|\theta_2 \in \Theta_F]] + (1 - q_1)L, \qquad (A6)$$

where p_1^L is the equilibrium price in the first period when the firm has the liquidation option. Rearranging expression (A6) the value of the firm is higher when it does not have the option if

$$p_1 - p_1^L > (1 - q_1)(L - E_1[E_2[\theta_2 - \ell + \theta_3 - \ell|\theta_2 \in \Theta_F^c]]). \qquad (A7)$$

It is straightforward to verify by direct calculation that there exist parameter values for which the condition (A7) is satisfied. ∎

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