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**Wirtschaftswissenschaftliche Fakultät  
der Eberhard-Karls-Universität Tübingen**

**Two-Period Financial Contracts  
and  
Product Market Competition**

Manfred Stadler



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# **Two-Period Financial Contracts and Product Market Competition**

## **Summary**

This paper examines optimal two-period financial contracts between firms in a product market on the one side and banks as creditors on the other side. Similar to the Bolton-Scharfstein contracts, banks can mitigate the moral hazard problem of truthfully revealing the *ex ante* unknown profits of firms by credibly committing to terminate funding in the second period if the firms' performance in the first period is poor. In contrast to Bolton-Scharfstein contracts we assume that the firms rather than the banks have all the bargaining power. We show that the termination threat will still be used by banks, but to a lesser extent, thereby making the contracts more efficient. Efficiency decreases, however, with the banks' market power because the probability of continued funding in the second period declines. Using the consumer switching cost approach to model strategic price competition between the rivals in a product market, we can furthermore show that the need for debt financing leads to a price increase in the product market. On the one hand this effect is due to the information problem itself, on the other hand it is strengthened by the market power of banks.

## 1. Introduction

The inability to raise funds through internal financing may force a firm to apply for a loan with a commercial bank. Without a contractual loan agreement such a firm is not able to enter the market even if production would be profitable. This inefficiency is due to the firms' private information about their profits which constitutes a moral hazard problem with hidden knowledge. Ex post asymmetric information of this kind yields a debt contract as the optimal financial contract. In a static environment the standard debt contract can solve the information problem (Diamond 1984, Gale, Hellwig 1985, Townsend 1979). This contract requires a fixed repayment by the firm. Only when the firm is unable to repay does the bank verify the true profit using a costly monitoring technology and receives the residual profit. Since it is only incentive compatible for a firm not to repay if it is indeed insolvent, this event reflects the bankruptcy case and the monitoring cost correspond to the bankruptcy cost.

The standard debt contract as a solution to the information problem has at least two weaknesses. Firstly, it is not time consistent: Under the contractual agreement the firm always reports its true profits. Thus, there is no longer any need for the bank to incur monitoring cost. This immediately leads to a loss of credibility of the bank's bankruptcy threat which in turn negates the firms' incentive to report their profits truthfully. Renegotiations over a partial remission of debt can be regarded as a solution to this problem of time consistency (Bester 1994). In a perfect Bayesian equilibrium, firms and banks respectively will report true profits and verify these profits only with positive probabilities. Secondly, if the costs of the state verification are too high, neither a loan agreement with nor without renegotiations will be reached. In this case, from a static point of view, it is impossible to solve the information problem.

In a multi-period relationship between firms and banks, however, the information problem can be mitigated without costly state verification. As long as the firm requires loans over several periods the desire to build a reputation can entice the firm into truthful disclosure of profits. Bolton, Scharfstein (1990) have analyzed this case for a single firm demanding a loan in two periods from a bank with full bargaining power. In the following we will present an extended version of the Bolton-Scharfstein approach. Their model is modified in three ways.

Firstly, we derive an optimal two-period financial contract assuming that firms rather than banks have all the bargaining power. We show that the Bolton-Scharfstein solution can be interpreted as a special case of our more general model when the banks have market power in the credit market. Secondly, the firms' attainable profits in the product markets are allowed to vary between the two periods. This opens the possibility to account for strategic competition between rival firms in the product market. Thus, as the third and most important modification, we explicitly model strategic price competition between the rivals. According to the consumer switching cost model by Klemperer (1987, 1995), we assume that prices in the first period determine the firms' market

shares consisting of loyal customers who are committed to the firms even in the second period. We analyze the way in which the pricing strategies of the rivals and the loan agreements with their banks interact in a subgame perfect Nash equilibrium.

The paper is organized as follows. In Section 2 we will resolve the Bolton-Scharfstein contracts when firms rather than banks have all the bargaining power in the financial market. In Section 3 we extend the model by analyzing strategic price competition between firms in the product market. Section 4 concludes the paper.

## 2. On the Optimal Design of Intertemporal Financial Contracts

The first step in our analysis is to characterize the contractual relationships between firms and banks acting as lenders. We assume that firms make a take-it-or-leave-it offer to banks at the initial date 0, which a representative bank accepts if the contract provides nonnegative expected profit. This is in contrast to the assumption of Bolton, Scharfstein (1990), who assume that the banks rather than the firms have all the bargaining power. However, we will be able to derive the Bolton-Scharfstein result as a special case of our more general model when banks have some market power in the financial market. In reality, probably neither side has all the bargaining power.

In order to compete, firms must invest a fixed amount  $F$  at the beginning of each period which has to be externally financed by a bank loan (for a discussion of variable investment levels and optimal choices of debt see, e.g. Dasgupta, Titman 1996). The firm's gross profits (before financial costs) under price competition in the two periods is either  $\pi_t^H$  or  $\pi_t^L$ ,  $\pi_t^H > \pi_t^L$ ,  $t=1,2$ , where the higher profit is expected with the objective probability  $\mu$  and the lower profit is expected with probability  $(1-\mu)$ . These profits are independently distributed across the two periods but are assumed to be identical for each firm. The expected net value of a firm's gross profit is assumed to be higher than the debt  $F$ :

$$(1) \quad \pi_t^E = \mu\pi_t^H + (1-\mu)\pi_t^L > F.$$

To make things interesting we also assume  $\pi_t^L < F$ ,  $t=1,2$ . As in the investment models with costly state verification, it is impossible to make financial contracts explicitly contingent on realized profits. Each firm would report a low profit, independent of the true outcome, so that banks would incur a loss. As in the one-period case the second-period repayment cannot depend on the second-period profit because the firm would always report the profit level corresponding to the lower repayment. Thus, the repayments in the periods  $t=1,2$  are  $R_t^H$  if the firm reports

profit  $\pi_1^H$  in the first period, and  $R_1^L$  if the firm reports profit  $\pi_1^L$  in the first period. As usual in these models, we assume an enforceable randomization scheme with  $\beta^H$  ( $\beta^L$ ) as the probability that the firm receives a further credit in the second period if it reports  $\pi_1^H$  ( $\pi_1^L$ ) in the first period. It follows from the limited liability assumption that the second-period transfer cannot exceed the sum of the net profit in the first period and the minimum gross profit in the second period.

The optimal contract maximizes the expected profit of the firm subject (i) to the incentive-compatibility constraint ensuring that the firms have no incentive to report that their profits are low when they are high, (ii) the limited liability constraints, and (iii) the banks' participation constraint. Thus the program problem can be formulated as:

$$(2) \quad V^E = \max_{\substack{R_1^L, R_2^L, \beta^L \\ R_1^H, R_2^H, \beta^H}} \left\{ \mu [\pi_1^H - R_1^H + \beta^H (\pi_2^E - R_2^H)] + (1 - \mu) [\pi_1^L - R_1^L + \beta^L (\pi_2^E - R_2^L)] \right\}$$

subject to

$$(3) \quad \pi_1^H - R_1^H + \beta^H (\pi_2^E - R_2^H) \geq \pi_1^H - R_1^L + \beta^L (\pi_2^E - R_2^L)$$

$$(4) \quad \pi_1^L \geq R_1^L$$

$$\pi_1^H \geq R_1^H$$

$$\pi_1^L - R_1^L + \pi_2^L \geq R_2^L$$

$$\pi_1^H - R_1^H + \pi_2^L \geq R_2^H$$

$$(5) \quad \mu [R_1^H + \beta^H (R_2^H - F)] + (1 - \mu) [R_1^L + \beta^L (R_2^L - F) - F] \geq \bar{W}.$$

$\bar{W}$  is the expected gross profit of a bank and reflects the reinvestment costs as well as the profit margins of banks. Thus it is an indicator of the market power of banks in the financial sector.

Substituting the participation constraint (5) into the objective function (2) yields the new objective function:

$$(2') \quad V^E = \max_{\beta^L, \beta^H} \left\{ (\pi_1^E - F) + [\mu \beta^H + (1 - \mu) \beta^L] (\pi_2^E - F) - \bar{W} \right\}.$$

If  $\pi_2^E > R_2^H$ , as will be shown to hold in the optimum, it immediately follows that  $\beta^H = 1$  since it simultaneously maximizes the objective function and relaxes the incentive constraint. Thus, the maximization problem is reduced to maximizing  $\beta^L$  subject to (3) and (4). In the optimum to this program,  $R_1^L = \pi_1^L$ ,  $R_2^L = \pi_2^L$ . The incentive constraint (3) therefore simplifies to

$$(3') \quad \pi_2^E + \pi_1^L - \beta^L(\pi_2^E - \pi_2^L) \geq R_1^H + R_2^H.$$

Hence, only the sum  $R_1^H + R_2^H$  and not the individual values of  $R_1^H$  and  $R_2^H$  affects the objective function and the constraints. It can be shown that both constraints, (3') and (5) are binding and therefore hold with equality. Solving the two-equation system yields

$$(6) \quad \beta^L = [\mu(\pi_2^E - F) + \pi_1^L - F - \bar{W}] / [\mu(\pi_2^E - F) - \pi_2^L + F]$$

Thus, the probability of granting a further credit in the second period depends positively on  $\pi_1^L$ ,  $\pi_2^L$  and  $\pi_2^H$ , negatively on  $F$  and  $\bar{W}$ , but not on  $\pi_1^H$ . For the repayments  $R_1^H$  and  $R_2^H$  it must hold that  $R_1^H + R_2^H \leq \pi_2^E + \pi_1^L$  and  $R_1^H > \pi_1^L$ , implying that  $\pi_2^E > R_2^H$ . For  $\pi_1^E = \pi_2^E$  and  $\bar{W} = [\mu(\pi_2^E - F) + \pi_1^L - F]$  the results simplify to the Bolton-Scharfstein solution with  $\beta^L = 0$ . Therefore, Bolton-Scharfstein contracts can be interpreted as a special case of our more general model when banks have market power in the financial market.

If we assume strategic competition between rivals on the product market, as outlined above, the profits will obviously differ in both periods. Further, since in a subgame perfect equilibrium prices and profits in the first period will depend on the strategic effect in the second period, they will also depend on the probability of receiving a credit in the second period and thus on  $\beta^L$ . This means that we have to treat (6) as an implicit rather than as an explicit solution. Therefore, to study the effects of the information problem and of the market power of banks on the strategic behavior of firms, we have to explicitly model product market competition.

### 3. Strategic Price Competition with Consumer Switching Cost

On the product market we adopt a two-period model of price competition with consumer 'switching costs' (Klemperer 1987, 1995). In this approach, two firms, A and B, try to establish market shares in the second period by keeping prices down in the first period. Market share is valuable because consumers find it costly to switch firms, and this gives firms market power over their repeat customers. We assume that the firms' marginal cost of production is constant and equal to  $c$  in both periods. Consumers have a reservation value of  $\bar{p}$  for each unit they purchase. They are distributed with uniform density on the Hotelling line  $x \in [0,1]$  with unit length, where firm A is located at  $x=0$  and firm B is located at  $x=1$ . In period 1, they bear a cost of  $k$  per unit of distance along the line to the firm (and the product) of their choice. This cost measures how far each firm's product is from a consumer's ideal set of product characteristics. For simplicity, we



assume that this cost is negligible in the second period. Instead, consumers incur a high switching cost if they were to buy from the rival firm.

Demand in the product market may vary across the two periods. In each period it can be high,  $\theta^H$ , with probability  $\mu$  or low,  $\theta^L$ , with probability  $(1-\mu)$ . According to Chevalier, Scharfstein (1996) we can interpret a high value of  $\mu$  as a boom and a low value of  $\mu$  as a bust. When the discount rate of firms is negligible intertemporal profits of firms  $i=A,B$  can be expressed as

$$(7) \quad V^i = (p_i - c)\theta^E (k - p_i + p_j) / 2k - F + [\mu + (1-\mu)\beta^L] [(\bar{p} - c)\theta^E (k - p_i + p_j) / 2k - F],$$

$i, j = A, B, i \neq j.$

From the first order conditions we get the reaction curves of both firms in the first period as

$$(8) \quad p_i = [k + c + p_j - [\mu + (1-\mu)\beta^L](\bar{p} - c)] / 2.$$

The symmetric Nash equilibrium prices of both firms are then determined by

$$(9) \quad p^* = k + c - [\mu + (1-\mu)\beta^L](\bar{p} - c).$$

In contrast, with internal financing or in the absence of any information problem, continuing financing is guaranteed, so that we can set  $\beta^L = 1$  in (8) and (9) to get the corresponding reaction curves

$$(10) \quad p_i = [k + c + p_j - (\bar{p} - c)] / 2$$

and the equilibrium prices

$$(11) \quad p^{**} = k + c - (\bar{p} - c).$$

The equations (8) to (11) imply that for all  $\beta^L < 1$  the equilibrium price is higher when firms are externally financed than when they are internally financed. This can be seen in [Figure 1](#), which shows the reaction curves of firm A and firm B under the two financial regimes. Since prices are strategic complements the reaction curves have positive slopes. The Nash equilibrium prices are  $p^*$  in the first period when the firms are externally financed by credit agreements. If firms were able to finance themselves internally, the reaction curves would shift downwards leading to lower first period prices  $p^{**}$ . Thus, prices are higher if firms need external financing than if they are

internally financed. Since firms may default, they have less incentive to invest in market shares because they may not reap the benefits of investing in market share. These results are compatible with the empirical findings by Phillips (1995) and Chevalier (1995).

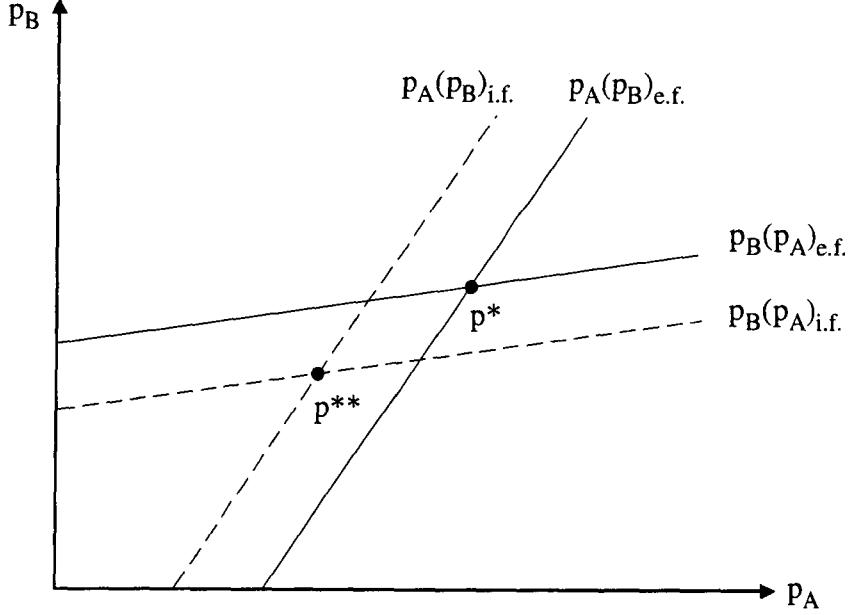


Figure 1: Reaction curves and Nash equilibria for firms A and B with external and internal financing.

Given the pricing behavior of firms in the two periods, the profits in the two periods are specified as

$$(12) \quad \pi_1^L = [k - (\mu + (1-\mu)\beta^L)(\bar{p} - c)]\theta_1^L/2$$

$$(13) \quad \pi_1^H = [k - (\mu + (1-\mu)\beta^L)(\bar{p} - c)]\theta_1^H/2$$

$$(14) \quad \pi_2^L = (\bar{p} - c)\theta_2^L/2$$

$$(15) \quad \pi_2^H = (\bar{p} - c)\theta_2^H/2.$$

As already derived in (6), the probability of granting a credit in the second period depends on the profits  $\pi_1^L$ ,  $\pi_2^L$  and  $\pi_2^H$ , but not on  $\pi_1^H$ . However, according to (12),  $\pi_1^L$  depends negatively on the probability  $\beta^L$ . With our specification of the model, we are able to unambiguously determine a negative effect of banks' market power on the profitability of granting a further loan in period 2 and thereby on the efficiency of the financial contract:

$$(16) \quad d\beta^L / d\bar{W} = [\partial\beta / \partial\bar{W}] / [1 - (\partial\beta / \partial\pi_1^L)(\partial\pi_1^L / \partial\beta)] < 0.$$

When the probability of granting a further loan in the second period declines, prices in the first period increase since the investment incentive is reduced. This effect is due to the moral hazard information problem, but it is strengthened by the market power of banks.

#### 4. Conclusion

In this paper we analyzed the design of optimal two-period financial contracts between banks and firms in need of debt financing as well as the resulting consequences on the strategic competition of firms in product markets. The two-period financial contracts are structured in a way that granting of a follow-up loan in the second period depends on the repayments of the firms in the first period. The threat to terminate a further loan induces an incentive compatible repayment behavior by firms, even without a costly monitoring technology in place. We show that the moral hazard information problem regarding the repayments of firms leads to a situation where further loans are not granted with certainty in contrast to the case where there is no information problem. Due to strategic interactions between firms in the product market, prices are set relatively low in the first period in order to establish a loyal customer base. However, the uncertainty about the continued financing reduces the importance of investment activities in the first period and prices increase. The larger the market power of banks, the less likely follow-up loans become. This in turn leads to a lower importance of prices as strategic variables and a subsequent increase in prices in product markets.

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