Corporate Financial Risk Management

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7 Risk management and market share

7.1 Introduction

Corporate treasurers are often concerned about the impact of their firm’s hedging strategy on its competitive position in the market. The existing literature on corporate risk management largely ignores this impact. In the previous chapter we showed that firms’ hedging strategies may affect industry equilibrium in a market characterized by imperfect competition. More specifically, we showed that hedging may affect the amount of financial slack and therefore the optimal output level chosen by the firm. Although interesting in its own right, this analysis is static and thus insufficient to capture the full complexity of product market competition. Fighting for market share often implies trade-offs over time. For example, a firm may seek to capture market share by charging lower prices (higher advertisements) in the short-run hoping to capitalize on its market share in the long-run. The interaction between building market share and risk management decisions can therefore be better analyzed in a more dynamic framework. The purpose of this chapter is to analyze the firm’s hedging decision and its impact on the firm’s competitive position in the product market in a multi-period framework of product market competition.

We study this interaction in a model which builds on the work of Chevalier and Scharfstein (1996). In this model there are two firms that compete in the product market over two periods. The market is characterized by imperfect price competition. Initially, the products are slightly heterogeneous in the sense that there is some demand for both producers’ products. However, firms can steal consumers from each other in the first period by offering them a sufficiently low price. In the second period products become homogenous but consumers face considerable switching costs. The structure of this model provides the firm with an incentive to build up
market share in the first period, and to exploit its customers in the second period by charging a relatively high price.¹

Before firms can operate they need to make an investment that requires finance. We consider two cases where the firm may finance the investment internally or externally. External financing is hampered by an agency problem between the firm and investors; the firm’s cash flows are observable but not verifiable in court. The unverifiability of the firm’s cash flow gives the manager the ability to disgorge (steal) cash from the firm for his own use. It is well known in the literature (e.g. Bolton and Scharfstein, 1990, 1996 and Gale and Hellwig, 1985) that the only way the firm can finance its investment in the presence of this agency problem is via a debt contract that requires an important down payment at the date prior to repayment.

As a result of this financing contract, a manager in the firm with external financing will value future profits lower as compared to the manager in a firm which is financed internally. The reason is that the repayment obligation on debt creates a probability of default at the end of the first period, in which case the manager will not receive the last period’s profit. As a result, a manager in a firm with debt will quote higher prices and thus put less emphasis on market share, compared to a manager in a firm that does not need external financing (Chevalier and Scharfstein, 1996 and Dasgupta and Titman, 1998). The higher the probability of default on the debt contract, the more the firm’s last period’s profits will be discounted.

We introduce price risk into this framework. More specifically, we assume that one of the two firms is exposed to hedgeable price risk (foreign exchange rate risk) with respect to the first period cash flows. We study whether firms have an incentive to engage in (costless) hedging and how such hedging might affect its product market outcome.

Our findings are as follows. A firm with sufficient internal funds will not hedge and the possibility to hedge will not affect product market equilibrium. However, a firm that needs external financing will hedge if it reduces the probability that the firm defaults on its debt obligation at the end of the first period. Moreover, the hedging decision will also affect the firm’s pricing decisions; firms that hedge will set their first period’s prices lower and thus become more long-term oriented, than firms that do not hedge. Anticipating such behavior, an internally financed firm will also quote lower prices in the first period and as a consequence competition increases in the first period. Our analysis predicts that hedging is most important in concentrated industries where firms face large exposures and depend on external financing for their investments. Hedging is especially important for externally financed firms where switching costs are high and thus the potential benefits of building market share are also high.

We then extend our framework to incorporate an extreme form of building market share. We explicitly consider the possibility that a firm with deep pockets enters into product market strategies aimed at driving an externally financed firms out of the product market. In the

¹See Klemperer (1995) for an overview of these type of models.
presence of agency problems the threat of liquidation is an important element of the financial contract. The tighter the financial contract, the less possibilities a manager has to disgorge cash. However, this ignores a potential impact of strategic firm behavior. Suppose, a firm with such a financial contract operates in a concentrated industry with a relatively healthy deep-pocketed competitor, a tight financial contract may invite predation from the competitor (see Bolton and Scharfstein, 1990). The healthy competitor can reduce its price or raise advertising expenses (even to the extent it makes a loss initially) in order to make the externally financed firm default on its debt contract and disappear from the market. If such predation is successful, the preying firm generates a monopoly profit in the second period.

If the externally financed firm is exposed to exchange rate risk in the first period, and hedging reduces the default risk of the externally financed firm, costs of predation of the healthy firm will also increase, making it less likely for that the firm will actually prey. Hedging is therefore beneficial for the externally financed firm since it increases the costs of predation for competitors. However, if hedging does not reduce the firm’s default risk, not hedging might be the optimal risk management strategy. According to this intuition, we expect hedging to be important in concentrated industries where the entry costs and therefore also the potential benefits of predatory strategies are considerable. Predation can be expected in industries where there are considerable differences in financial capacity. Firms that heavily depend on external financing have an incentive to hedge in order to prevent predatory strategies from better capitalized firms after a negative development in the market prices for the financially constrained firm.

Our findings are consistent with the concerns of practitioners with respect to the impact of hedging on competition in the product market (see Section 6.1 for a discussion). They are also consistent with recent findings by Brown (2000). Brown studies the foreign exchange risk management program of a leading US manufacturer of durable equipment active in more than 50 countries. One of his findings was that the profits and losses on derivatives transactions were significantly positively related to market share. Our analysis provides a theoretical motivation for this finding.

The setup of this chapter is as follows. Section 7.2 presents the model. Section 7.3 derives the optimal product market and hedging strategies if both firms are internally financed. Section 7.4 analyses the case for external financing and introduces the agency problem. In Section 7.5, we discuss an extreme form of strategic behavior if one firm is financially constrained and the other has a deep pocket. We show that this may lead to predation and discuss the potential role of hedging in such a framework. Section 7.6 concludes.
7.2 The model

In this section we develop a model closely related to Chevalier and Scharfstein (1996) in order to analyze whether hedging affects product market equilibrium and firm value.\(^2\)

We consider a three-period model where all agents in the economy are risk neutral and the interest rate equals zero. Below we briefly describe the timing of the model.

Two firms (A and B) compete on prices in the product market at dates 2 and 3. Consumers incur switching costs if they want to purchase from a different firm at date 3. This provides both firms with an incentive to build up their respective market shares at date 2. Hence, firms in our model have an incentive to set low prices at date 2. They can then exploit this at date 3 by setting higher prices.

At date 1 the firms in our model have to decide how much they hedge. We assume, for simplicity, that only one firm’s date 2 profit is exposed to a hedgeable price risk (e.g. exchange rate risk).

In order to compete in the product market both firms need to make an investment \((I)\) at date 0. The investment can either be financed internally or externally. External financing is subject to an agency problem; cash flows are observable but not verifiable. A manager therefore has the ability to disgorge (steal) cash from the firm. This complicates external financing.

The intuition in our model is as follows. With external financing a firm becomes more short-term oriented on the product market. As a result of the financial contract the firm faces default risk at date 2. This induces a manager in an externally financed firm to set higher prices at date 2 (and therefore to be less inclined to build market share) compared to those firms with internal financing. Hedging that reduces the firm’s default risk will mitigate this financial contract side effect on the product market outcome by restoring the firm’s interest in building market share. In the following subsections we first develop the set-up of the model in more detail.

7.2.1 Product markets

To capture the dynamics of the product market, we use a relatively standard framework originally from Klemperer (1987, 1995). Two firms denoted by A and B compete for two periods. Both firms at dates 2 and 3 simultaneously determine the prices at which they offer their prod-

\(^2\)Dasgupta and Titman (1998) use a more or less similar model to analyze the interaction between pricing and capital structure decisions. They however model a debt contract not as one that follows from an agency problem between managers and shareholders (as we and Chevalier and Scharfstein, 1996, do), but the debt contract follows from Myers (1977) debt overhang agency problem between debtholders and shareholders. In their analysis Dasgupta and Titman (1998) focus on the impact of exogeneous large increases in debt, for example due to the threat of a takeover. This to reconcile the evidence on changes in prices after LBO’s.
ucts. The marginal costs of production for firm $B$ at date 2 are equal to $c^B_2$. Firm $A$ incurs costs in foreign currency and is therefore subject to exchange rate uncertainty $\epsilon$, which are included in its marginal costs of production, $c^A_2 \epsilon$. In the last period, we assume that both firms have the same marginal costs $c_3$ and that $A$ faces any exchange rate risk.\(^3\) Further, we assume that consumers have a reservation value $R$ for each unit that is being produced.

Both firms compete on prices at dates 2 and 3 and thereby strategically anticipate the optimal decisions of the competitor. Switching costs make the last period's demand dependent on the second period’s market share; it enables the producers to exploit the consumers in the last period by charging the consumer's reservation price. This feature in our model gives firms an incentive to build market share in the second period.

At date 2 the products are slightly heterogeneous. Assume consumers at date 2 are uniformly distributed along a line segment $[0, 1]$. Heterogeneity of the products is modelled as follows. Assume that $A$ and $B$ are located at the opposite end of this line segment, $A$ at 0 and $B$ at 1. Consumers face a transportation cost that depends on the location of the consumer vis-a-vis the producers. More particularly, a consumer located at $y$ faces a transportation cost equal to $T y$ if he buys from $A$ and $T (1 - y)$ if he buys from $B$.\(^4\) As a result, a consumer will buy from $A$ if and only if the price offered ($p^A_2$) plus the transportation cost of the consumer is lower than or equal to the sum of the price that firm $B$ offers ($p^B_2$) and the transportation costs that the consumer faces when he purchases from $B$ or

$$p^A_2 + T y \leq p^B_2 + T (1 - y)$$  \hspace{1cm} (7.1)

Solving for $y$, we find

$$y \leq 1/2 + \frac{p^B_2 - p^A_2}{2T}$$  \hspace{1cm} (7.2)

so that the demand for the products of firm $A$ in the second period can be represented as

$$\sigma^A_2 = 1/2 + \frac{p^B_2 - p^A_2}{2T}$$  \hspace{1cm} (7.3)

where $\sigma^A_2$ refers to the demand for firm $A$'s products. The last equation describes the demand for the firm's product in the second period as a function of the prices quoted by both $A$ and $B$ and $T$ per unit transportation costs.

\(^3\)This simplifies our analysis. We will show that firms in our model will have an incentive to hedge the risk at date 2 only. Therefore, this simplification does not affect our results.

\(^4\)Transportation costs can be seen as a physical transportation costs, but can also capture to which extent the product differs from a consumers' ideal set of preferences.
Assume that at date 3 these differences in products disappear, but that at that time consumers face a switching cost if they would like to purchase the good from a different producer. If the switching cost satisfies the following condition: $s > 1/2(R - c_3)$ where $s$ represents the switching cost, $R$ is the reservation value of the product and $c_3$ is the unit cost of production at date 3, then Klemperer (1995) has shown that a unique equilibrium holds where each firm charges the consumers’ reservation value $R$ in the last period. The firm’s last period’s profits as a function of the second period market share can then be described as

$$\pi_3^{a}(\sigma_2^a) = (R - c_3)\sigma_2^a$$

We consider one source of uncertainty in our model, exchange rate uncertainty.\(^5\) Firm $A$ incurs its costs in the second period in foreign currency, while its competitor (firm $B$) does not. We assume that the risk factor $\epsilon$ can be high ($\epsilon_H$) with probability $1 - \alpha$ or low ($\epsilon_L$) with probability $\alpha$. For simplicity, we assume that the firm is only exposed to exchange rate changes at date 2 and not at date 3.\(^6\) Uncertainty with respect to the realization of the exchange rate is revealed after both firms have set their prices.

7.2.2 Financing and hedging decisions

In order to be able to compete we assume that firms have to make an investment equal to $I$ at date 0. If a firm makes this investment, it can produce, otherwise it cannot enter the market. With respect to the financing of this investment we consider two possibilities: (i.) firms finance the investment internally and (ii.) firms use external financing. An agency problem between the manager and the outside investors will drive the optimal financing contract when external financing is required.

At date 1, firm $A$ has the ability to enter into hedging its date 2 foreign exchange exposure with a forward contract. Firm $A$ is exposed with respect to its date 2 costs in foreign currency $c_2^A\sigma_2^A$.\(^7\) Now assume that firms can purchase a forward contract. The forward contract is priced such that the forward rate is equal to the expected future spot rate ($E(\epsilon) = f$). Note that the hedging decision takes place after the financing decision. In our model, firm $A$ therefore does not have the possibility to commit to a hedging strategy over the life of the financing contract.

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\(^5\)Chevalier and Scharfstein (1996) only consider demand uncertainty and do not consider such a market price risk. Dasgupta and Titman (1998) consider uncertainty with respect to liquidation value.

\(^6\)Our analysis will provide a rationalization for hedging at the intermediate date. Hedging the last period’s exposure is irrelevant as we will discuss later. This particular assumption therefore is unlikely to affect our basic results.

\(^7\)Note that firm $A$’s market share $\sigma_2^A$ depends on the firm’s (and its competitor’s) optimal pricing decisions. Hence, the exposure that is being hedged is an anticipated exposure.
7.3 Hedging and product markets with internal financing

We have developed a model where both firms’ initial date 2 pricing decisions affect their respective market shares and thus their third period’s profit. In order to analyze the impact of the financial contract and hedging on the product market we solve the model backwards. That is we first study the firms’ optimal pricing decisions at date 3 and 2 respectively, and subsequently analyze the impact of external financing and hedging on the equilibrium in the product market.

Firm A’s second period’s expected profit is equal to

\[
E[\pi^A(p^A_2, p^B_2, \epsilon)] = (1 - \alpha)(p^A_2 - \epsilon_H c^A_2)(\sigma^A_2) + \alpha(p^A_2 - \epsilon_L c^A_2)(\sigma^A_2)
\]  

(7.5)

Firm A chooses the price of its product \(p^A_2\), that given its conjecture about firm B’s optimal pricing decision \(p^B_2\), maximizes the expected value of profits over the two periods \(\pi^A\). Hence, firm A chooses \(p^A_2\) such that

\[
\max_{p^A_2} E[\pi^A(p^A_2, p^B_2, \epsilon)] = E[(p^A_2 - \epsilon c^A_2)(\sigma^A_2) + (R - c_3)\sigma^A_2]
\]

The first order condition of this maximization problem is

\[
\frac{1}{2} + \frac{p^B_2}{2T} - \frac{2p^A_2 - c^A_2 E(\epsilon)}{2T} - \frac{R - c_3}{2T} = 0
\]  

(7.6)

After some rewriting, we have firm A’s reaction curve to the pricing decisions of firm B

\[
p^A_2 = \frac{p^B_2}{2} + \frac{T}{2} + \frac{c^A_2 E(\epsilon)}{2} - \frac{R - c_3}{2}
\]  

(7.7)

Note that the reaction curve of firm A is increasing in the price set by firm B. This is a standard result; with Bertrand competition prices are strategic complements.\(^8\) Now let us examine firm B’s reaction curve. We focus on the fully symmetric case with one exception, firm B is unexposed to exchange rate risk. As a result B maximizes

\[
\max_{p^B_2} E[\pi^B(p^A_2, p^B_2, \epsilon)] = E[(p^B_2 - c^B_2)(\sigma^B_2) + (R - c_3)\sigma^B_2]
\]

(7.8)

Taking the first order condition and rewriting as before gives firm B’s reaction curve

\[
p^B_2 = \frac{p^A_2}{2} + \frac{T}{2} + \frac{c^B_2}{2} - \frac{R - c_3}{2}
\]  

(7.9)

\(^8\)For more on this see Bulow et al. (1985).
Now we solve for the equilibrium prices and market shares. Substituting $A$'s reaction curve (7.7) into $B$'s reaction curve (7.9) yields the equilibrium price for firm $B$. Using this, we can calculate the optimal (equilibrium) prices set by firm $A$ and $B$, respectively:

$$p_{2A}^* = T + \frac{1}{3}(c_2^B + 2c_2^A E(\epsilon)) - (R - c_3)$$  \hspace{1cm} (7.10)

$$p_{2B}^* = T + \frac{1}{3}(c_2^A E(\epsilon) + 2c_2^B) - (R - c_3)$$  \hspace{1cm} (7.11)

Finally, substituting these prices into equation (7.3) will give us the demand $\sigma_{2A}^*$ and in a similar way we can calculate $\sigma_{2B}^*$.

After having analyzed the equilibrium pricing decisions when firms have the ability to finance their investment internally, we now study the firm's hedging decision. We are interested in two questions: (i.) is there a rationale for corporate risk management and (ii.) how does corporate hedging affect product market equilibrium, if at all?

With internal financing it is relatively easy to show that a (risk neutral) manager in a firm has no incentive to hedge. Moreover, hedging decisions have no impact on the product market.

**Proposition 18** Managers of a firm in an industry in which firms can finance their investment internally do not have an incentive to enter into risk management. Moreover, risk management decisions do not affect decisions concerning the product market.

**Proof.** Risk-neutral managers maximize the expected value of date 2 and 3 profits. Now assume that the firm hedges (part) of its date 2 exposure. Since $E(\epsilon) = f$, the expected value of the cash flows at date 2 is unaffected by the hedging decisions of the firm.

Moreover, the firm's maximization problem with respect to setting prices does not change and as a result, the hedging decisions will not affect market prices in this setting. Hence, hedging also has no indirect effect on product market outcomes. As a result, the hedging decision is irrelevant.

Therefore, we may conclude that financially unconstrained firms have no rationale for hedging that is related to the product market. This result serves as a benchmark. In the following section we consider the more interesting case where firms in the industry use external financing.

### 7.4 Hedging and product markets with external financing

#### 7.4.1 Derivation of the optimal debt contract

Consider now the second case where the initial investment ($I$) has to be financed externally at date 0. First, we will derive some important properties of the optimal financial contract in
the presence of an agency problem. Then, we consider the impact of such a financial contract on the firm’s pricing decision at date 2. Finally, we analyze the firms incentive to engage risk management and how this affects its product market (and/or pricing) decisions.

We assume that the exposed firm $A$ is the one that needs external financing. However, there is a capital market imperfection that hampers such external financing; the firm’s cash flow is observable for managers and outside investors but is not verifiable in court. As a result, financial contracts cannot be made contingent on cash flows which gives a manager the possibility to divert cash flows from the firm. This agency problem has been analyzed in Bolton and Scharfstein (1990, 1996).

With non-verifiable cash flows, firms can only obtain external finance if there is some payment $D$ at an intermediate date. The threat of liquidation at the intermediate date is the only way investors can force a manager to repay the firm’s debt. Liquidation at the intermediate date is costly for the manager since he loses the possibility to extract money from the firm in the last period.  

The optimal financial contract therefore requires some down payment $D$ at the intermediate date, in effect at date 2. If this payment is not be made the lenders will liquidate the firm. By liquidating, the lenders become owners of the firm and receive a fraction of the firm’s third period profits, $\lambda \pi_A^3(\sigma_A^2)$. The condition $\lambda < 1$ reflects the idea that the value of the firm in the hands of investors (liquidation value) is lower than the going concern value (dissipative loss).

In a financing contract over two periods investors have the possibility to receive more than the lowest possible profit. More precisely, the maximum amount they can extract from the manager is $\pi_A^3(\sigma_A^2)$, thus $D \leq \pi_A^3(\sigma_A^2)$. This is an incentive compatibility condition. If $D > \pi_A^3(\sigma_A^2)$ it is not in the manager’s interest to repay the firm’s debt in the first period, since the value that the manager receives if he continues with the firm (the third period’s profits) is smaller than the payment he needs to continue. Thus, as long as $D$ is smaller than $\pi_A^3(\sigma_A^2)$, the manager will repay the firm’s debt if the second period’s profit ($\pi_A^2(\sigma_A^2)$) is sufficient.

If the firm fails to pay $D$ at date 2, the firm will be liquidated by the investors and the manager loses his discretion over the firm’s assets. This happens when $\pi_A^2(\sigma_A^2) < D$; that is, if the second period’s profits are insufficient to repay $D$ at date 2. Observe that the firm cannot attract external financing at date 2, since no investor would be willing to finance the firm with one period

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9To see this, consider the financial contract if there is only one remaining period. The maximum amount investors can retrieve in this case is the minimum verifiable profit level at the final date. Managers maximizing the value of their claim on the firm however will always claim that cash flows are low (zero in our particular case) and keep the rest for themselves. They can do so because the liquidation threat of investors in a one-period model is incredible; the liquidation value of the firm (some fraction of future profits) is equal to zero. Anticipating this behavior, investors will not finance the investment unless there is some intermediate payment.
remaining. The threat of liquidation at the intermediate date will give the manager an incentive to pay $D$ if he has the cash to do so. Payment of $D$ gives the manager the ability to capture the third period's cash flows $\pi_3^A(\sigma_2^A)$ because creditors lack the ability to force repayment at that date (creditors have no further bargaining power at that point).

Investors will only enter such a financial contract if the expected value of the repayment on the debt provides the investors with sufficient compensation. Now assume that only after a high realization of the exchange rate, firm $A$ defaults on its debt. With risk neutral investors and a zero risk-free rate, this implies that the expected value of the repayments should at least be equal to the amount the firm initially needed ($I$) or

$$\alpha D + (1 - \alpha)\lambda\pi_3^A(\sigma_2^A) - I \geq 0$$

where $1 - \alpha$ reflects the probability of default on the debt contract. Alternatively speaking, $\alpha$, reflects the probability that $D > \pi_2(\sigma_2)$. If the firm does not default investors receive $D$, otherwise they receive the liquidation value of the firm ($\lambda\pi_3^A(\sigma_2^A)$). We assume that financial markets are competitive and thus the former equation will turn into an equality. That implies that the financial contract is feasible if: $D^* = [I - (1 - \alpha)\lambda\pi_3^A(\sigma_2^A)]/\alpha$. We argued before that the debt contract was incentive compatible if

$$D^* \leq \pi_3^A(\sigma_2^A).$$

Now assume that the parameters in the model are such that incentive compatible contracts are feasible, then $D^*$ is the optimal financial contract.

With such a debt contract the manager’s expected payoff at date 2 turns into

$$V^A = \alpha[\pi_2^A(\sigma_2^A) - D + \pi_3^A(\sigma_2^A)] + (1 - \alpha)[\pi_2^A(\sigma_2^A)]$$

(7.13)

The first term reflects the manager’s payoff in case the firm does not default on its debt obligation $D$ at date 2. The manager then has the ability to extract $\pi_2^A(\sigma_2^A) - D$ in the second period and $\pi_3^A(\sigma_2^A)$ in the third period. If the firm defaults at date 2, the manager diverts all the date 2 profits $\pi_2^A(\sigma_2^A)$ to himself leaving the investors with the liquidation value of the firm, $\lambda\pi_3^A(\sigma_2^A)$.

7.4.2 An analysis of the consequences of the debt contract for the optimal strategy on the product market

Now assume that firm $A$ raises external financing with the financial contract we just specified. That is, there is a feasible and incentive compatible debt contract that specifies a repayment

\[ ^{10}\text{However, the investors might ex post decide not to liquidate if they can renegotiate the contract. With the possibility of renegotiation financing depends on the bargaining power of the parties involved. These issues are considered in for example Bolton and Scharstein (1990).} \]

\[ ^{11}\text{Note that only after a high exchange rate will the firm default on its debt. The probability that } c = c_H \text{ is equal to } 1 - \alpha. \]
of $D$ at date 2. *After* entering into the financial contract, the manager in firm $A$ maximizes his expected payoff conditional on the debt contract and the anticipated pricing decisions of firm $B$. The first order condition of this maximization problem is

$$
\frac{\partial V^A}{\partial p_2^A} = \alpha \left[ \frac{\partial \pi^A_2 (\sigma^A_2)}{\partial p_2^A} + \frac{\partial \pi^A_3 (\sigma^A_3)}{\partial p_2^A} \right] + (1 - \alpha) \frac{\partial \pi^A_2 (\sigma^A_2)}{\partial p_2^A} 
$$

(7.14)

$$
= \left[ \frac{1}{2} + \frac{p_2^B}{2T} - \frac{p_2^A}{2T} \right] + \frac{c_2^A E'(\epsilon)}{2T} - \alpha \frac{R - c_3}{2T} = 0
$$

If we now compare this first order condition (7.14) with the first order condition in the case of internal financing (7.6), we then see a difference in the last term. With internal financing, the firm never defaults and a manager will receive the total third period’s profits. However with external financing, there is a chance that the firm will be liquidated at date 2. The manager receives nothing from the firm’s third-period profit in that case. The probability that the firm does not default and receives the third period’s profits is $\alpha$. With external financing, the manager receives the firm’s second period’s profits only if the firm does not default in the first period. This has important consequences for the optimal pricing decisions. A marginal increase in $p_2^A$ reduces the third period’s profits by $\frac{p_2^A}{2T}$ if financed internally while it reduces the third period’s profits by $\frac{R - c_3}{2T}$ if it is externally financed. As a result, firm $A$ will charge a higher current price $p_2^A$ with external than with internal financing. In other words, firms with external financing will be more short-term oriented and thus will have less incentive to build market share as compared to a firm that finances the investment internally.

The reaction curve of firm $A$ with external financing changes from equation (7.7) into

$$
p_2^A = \frac{T}{2} + \frac{p_2^B}{2} + \frac{c_2^A E'(\epsilon)}{2} - \alpha \frac{R - c_3}{2} 
$$

(7.15)

The difference is again in the last term. With internal financing, the last term in equation (7.7) is $\frac{(R - c_3)}{2}$. When the firm uses external financing, the last term changes into $\alpha \frac{(R - c_3)}{2}$, where $\alpha$ reflects the probability that the firm does not default.

Now the equilibrium price depends on firm $B$. Assume that firm $B$ does not require external funding, firm $B$’s reaction curve then does not change

$$
p_2^B = \frac{T}{2} + \frac{p_2^A}{2} + \frac{c_2^B}{2} - \frac{(R - c_3)}{2} 
$$

(7.16)

There is an equilibrium where these reaction curves cross. Substituting each firm’s reaction curves into the other’s gives the equilibrium prices.
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$$p_2^A = T + \frac{1}{3}(c_2^B + 2c_2^A E(\varepsilon)) - \frac{2}{3}\alpha(R - c_3) - \frac{1}{3}(R - c_3)$$

$$p_2^B = T + \frac{1}{3}(c_2^A E(\varepsilon) + 2c_2^B) - \frac{1}{3}\alpha(R - c_3) - \frac{2}{3}(R - c_3)$$

Note that in the new equilibrium, not only has a higher price but also that firm B increases its price. This follows directly from the fact that the slope of the reaction curves are positive. Because products are strategic complements in the face of price competition, a higher anticipated price by firm A implies a higher price by firm B as well. If firm B also needs external financing, the prices of both firms in equilibrium will increase even further. A debt contract make firms more short-term oriented and less focused on building up market share compared to firms that have access to internal financing funds. This was also the intuition developed in the papers by Dasgupta and Titman (1995) and Chevalier and Scharfstein (1996).

Before we discuss the impact of hedging in this framework let us briefly review some important aspects of the financing contract that drives the results presented above. First, it is important to note that our model has a clear end point; at the end of date 3 the world ends. This feature is important as it implies that investors will focus on the second date repayment because they know that at date 3 the manager will run away with the money. If the world ends at date 3, as in our model, there are no repercussions from this behavior (except for the terms of the financing contract). If we allowed a model with a longer time horizon, we might expect that reputational concerns of the manager make him more willing to repay the firm's debt. An important question thus is, would investors still require some repayment at an intermediate date in a more dynamic model that captures these potential repercussions? It is well known from the literature on optimal debt maturity that a shorter debt maturity gives investors more control. Generally, the larger the agency problems in a firm, the lower the debt maturity. This suggests that frequent debt repayments are important especially when agency problems are large and implies that the strategic issues raised here are of importance also in a model with a longer time horizon.

### 7.4.3 Hedging and its impact on the product market

We will now examine firm A's hedging decision. We first analyze if a manager has an incentive to hedge and then examine the impact of a firm's hedging decisions on outcomes in the product market. We have argued in the previous section that firms financed with internal funds do not have any incentive to hedge. But consider now firms that need external financing to make the investment. Do these firms have an incentive to hedge this and might there be an impact of such hedging on product markets?

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12There are many other factors that affect the firm's debt maturity decision. See, Ligterink (1995a) for a short review.
For this purpose, first consider what happens when firm $A$ hedges if it also entered into a financial contract. Hedging changes the distribution of the date 2 profits and reduces the spread of potential outcomes. Given the financial contract, a change in the default probability will affect the outcome on the product market.

**Proposition 19** Assume that initially there is an equilibrium in the product market where firm $A$ has a debt contract that requires a repayment $D$ at date 2, and faces a probability of default equal to $1 - \alpha$, but where there is no opportunity for hedging. Now instead assume that the exposed firm $A$ has the ability to hedge. Then, the exposed firm $A$ will want to hedge. As a result of the hedge, both firms will set lower prices in the first period.

**Proof.** We first analyze the impact of hedging on the product market equilibrium. Hedging the date 2 exposure reduces the firm’s default risk back to 0.

The manager of firm $A$ maximizes the value of his claim such that

$$V^A = \alpha[\pi_A^A(\sigma_A^A) - D + \pi_A^A(\sigma_A^A)] + (1 - \alpha)[\pi_A^A(\sigma_A^A)]$$  \hfill (7.17)

However, with the decline of the default probability to zero, the firm will be in the same situation as an internally financed firm. As a result, the manager will quote lower prices than in the equilibrium without the possibility to hedge. This follows from the new reaction curves

$$p^A_2 = \frac{T}{2} + \frac{p^B_2}{2} + \frac{c^A_2E(\epsilon)}{2} - \frac{(R - c_3)}{2}$$ \hfill (7.18)

$$p^B_2 = \frac{T}{2} + \frac{p^A_2}{2} + \frac{c^B_2}{2} - \frac{(R - c_3)}{2}$$ \hfill (7.19)

Although the second period’s profits of firm $A$ are lower than without hedging (the firm sets a lower second period price and thus enters into more aggressive competition), the firm will be able to fully benefit in the last period from its increase in market share.

Moreover, an increase in $\alpha$ through hedging also increases $V^A$. This is the case as long as the third period’s profits are larger than $D$. However, note that the incentive compatibility constraint was that $D \leq \pi_3^A(\sigma_A^A)$ and therefore an increase in the survival probability increases the manager’s value.

With this hedging strategy, firm $A$ sets a lower price at date 2 to attract a larger market share. Firms that hedge will become more long-term oriented and will quote the lower first period prices in order to attract more market share. Anticipating these risk management decisions of firm $A$, an internally financed competitor $B$ will also quote lower prices in equilibrium. ■

Proposition 19 shows that an exposed firm in need of external financing has an incentive to hedge. Without hedging in our model, an externally financed firm would become more short-term oriented and as a result would set higher prices in the second period. This would cost the firm market share in the last period, but because of the probability of default a firm with risky
debts places less value on such a loss. Hedging completely mitigates this important drawback of the financial contract on the product market. However, we also expect our result to hold in a more general setup.

Reducing the default risk on debt repayment at the intermediate date affects both firms' optimal pricing strategies; both firms will fight more intensely in the first period (at date 2) for market share. External financing and the possibility of default changes the manager's valuation of short-term versus long-term profits. This affects the pricing decisions of a firm. With external financing, the firm will quote higher prices in the first period and will be less interested in building market share. The proposition derived here shows that if a firm is exposed such that this has an impact on the probability of default, a manager using external finance will want to hedge to safeguard the value of his future consumption from the firm. These hedging decisions have an impact on the pricing decisions of firms. If risk management reduces the probability of default, a manager will value future income higher and thus will lower current prices to increase market share. This brings the firm back in the direction where it was without external financing. In equilibrium, we expect lower prices in the first period compared to the case without risk management. Risk management enables firms to fight for market share and mitigates an important strategic effect of debt.

Note that hedging does not always reduce the probability of default. Imagine that the repayment on debt to be paid at date 2 is very high. Even with a full hedging policy the probability of financial distress is nearly 100%. Only when the exchange rate is sufficiently low will the firm not default. It is clear that in such a particular case the optimal risk management strategy (which reduces the probability of default) is to leave the exposure open. Hence, the exposed firm will make pricing decisions identical to those we initially derived for the firm with external financing. Externally financed firms therefore do not always hedge. If they do hedge, however, we may expect that the impact of debt on pricing decisions is alleviated.

Proposition 19 also gives a clear guide as to which risks the firm needs to hedge. In our model, it is the default risk of the intermediate debt repayment. The larger the consumers' reservation value \( R \) over the marginal costs in the firm, the more a manager can extract in the last period. This directly follows from the inspection of the derivative of the manager's value with respect to \( \alpha \).\(^{13}\) An increase in \( \alpha \) also increases \( V^{A} \). The higher the marginal profitability in the last period (reservation price over costs), the more important hedging becomes for firms that have debt. Moreover, the more impact risk management has on the probability of default, the more beneficial risk management decisions are.

The lower the liquidation value of the firm for the investors \( \lambda \pi^{A}_d(\sigma^{A}_d) \), the more beneficial is the hedging decision. That implies that firms with firm-specific assets (for example where

\(^{13}\)This takes into account that the incentive compatibility constraint holds.
management is an important determinant) will have lower liquidation values and thus investors will only finance the investment if debt repayment $D$ compensates them for this risk.

Our analysis leads to several testable implications. First, we expect that there is a positive relationship between the use of derivatives and the benefits of building market share. In markets where switching costs are high and therefore the benefits of building market share are also high, we expect relatively more hedging. For example, this suggests that hedging may be important for industries where building a distribution network is important. It is well-known that maintaining a market share is important for keeping the distribution network intact. Moreover, our analysis predicts that the most profitable and well capitalized firms in an industry will hedge less than their less profitable and capitalized counterparts. The latter are more likely to need external funding and therefore might benefit most from hedging.

Moreover, our analysis suggests that there is a positive relationship between firms that hedge and market share. This is not inconsistent with the studies by Brown (2000), which considers the foreign exchange risk management strategy of a US multinational in durable products. Among other things his analysis shows that there is a strong positive relationship between derivative profits (as a percentage of actual exposure) and market share. The economic impact of these estimates seems substantial (Brown, 2000, p. 23).

### 7.5 Corporate hedging and predation

In the previous section an agency problem between investors and the manager of a firm determined the terms of the optimal financial contract. Such a financial contract is particularly sensitive to the first period's performance of the firm. One possibility that we have thus far ignored in our analysis is that the debt contract may invite predation by a firm with deep pockets (firm $B$).\(^{14}\)

Consider the previous case where firm $A$ requires external financing and also faces hedgeable exchange rate uncertainty. However, rather than the respective firms' market shares let us focus on the potential consequences of predation by firm $B$. Firm $B$ will enter into predation if the expected gains exceed the expected costs. There are several ways in which a firm may pursue a predatory strategy. For example, it can lower its price or increase advertisement expenditures. These strategies are costly; that is, they reduce the firm's initial profits compared to the first-best strategy without predation. The benefit of predation is that firm $B$'s expected last period's

\(^{14}\)Bolton and Scharfstein's (1990) paper focuses on this issue in more detail. They show that "the financial contract that minimizes the agency problem maximizes the rival's incentive to prey" (Bolton and Scharfstein 1990, p. 101). Investors anticipating such predation will adapt their debt agreement with the firm.
profits increase. If the firm succeeds and indeed drives firm A out of the market it will capture a monopoly profit. If predation fails profits are much lower in post-predation period.

If exchange rate exposure affects firm A's probability of financial distress it also affects firm B's costs of predation. The higher the exposure and the more debt firm A has, the higher is its probability of financial distress and therefore the lower will be the cost of a predation strategy for firm B. If hedging mitigates firm A's probability of default it makes it more difficult (increase the cost of predation) for its rival to prey.

This suggests that a hedging policy that reduces firm A's default risk also increases the costs of predation for the competitor with deep pockets (firm B). Risk management then has an additional role; it reduces the likelihood of predation. Note that a reduced likelihood of predation implies that more investments can be financed externally since the financial contract can better tackle the underlying agency problem.

The benefit of hedging becomes even more important if we consider the possibility that firms make pricing decisions after they realize the exchange rate. The probability that firm A defaults increases after a depreciation of the country's currency where it A sells its products. Firm B can then make its strategy contingent on the realization of the exchange rate. After a (sufficiently) negative development in the exchange rate for firm A its default probability increases significantly. Thus, the cost of predation for firm B declines. In this case, reducing the default risk of firm A is even more effective. Hence, in industries where long-term strategic decisions (prices, output, etc.) are made and it is impossible to adapt to changing circumstances in addition to significant barriers to enter (such that the preying firm really can capture a monopoly profit), we may expect hedging to be more beneficial for financially constrained firms. A successful hedging strategy makes it more difficult for rival firms to prey. Because such predatory strategies are destructive and value decreasing for firms without deep pockets, reducing the likelihood of such actions will increase firm value.

7.6 Conclusion

Capital market imperfections are important for the design of financial contracts. The recent literature, however, has shown that the financial structure of a firm also interacts with its strategy in product markets. The design of financial contracts therefore cannot be analyzed in isolation, but should include the interaction with product markets.

The purpose of this chapter was to show that risk management decisions also play an important role in this interaction. We have shown that if a firm is subject to a large exposure of hedgeable price risks and requires external financing, there exists interaction between the security design decision of the firm (design of the financial contract), the firm's hedging decision, and its optimal pricing strategy in the product market.
Our analysis has shown that in the presence of an agency problem, the optimal financial contract has a direct impact on the firm’s pricing decisions. Compared to an internally financed firm, external financing makes the firm more short-term oriented and less interested in building market share. Corporate hedging that reduces the probability of default on the financial contract also reduces the impact of the financial contract on the product market. With such hedging the firm will regain its interest in building market share and will therefore become more aggressive (set lower prices) in the first period. Hedging, therefore partly mitigates a negative effect of the contracts.

In the second part of this chapter, we considered an extreme case of strategic interaction, the possibility of predation in the product market by a well-capitalized rival. If this is anticipated, the threat of predation will affect the optimal financial contract. The financial contract leaves more room for opportunistic behavior (will be more lenient) if the feasibility constraint is not violated. If it is violated investors will not want to finance the investment and the firm cannot even enter the market. Is there a role for corporate hedging in this case? Yes, if corporate hedging reduces the default risk of the intermediate repayments, it increases the costs of preying for the rival firm making predation less likely to occur. Hedging in this case should be directed at a reduction of the default risk of debt. Hedging smoothes the financial contract; it reduces the probability of predation which makes tighter financial contracts possible. This may lead to lower agency costs and more debt. It will also have an impact on the product market. We may expect less predation if such hedging is effective.

The more dynamic considerations that we discussed in this chapter are especially interesting for concentrated markets where building a large market share is important. In Chapter 6, we showed that even in a simple static setting with no agency problems and value-maximizing firms there was a link between the hedging decision and the product market. Hedging in both cases affects product markets through (the costs of) external financing. Note, the two channels by which hedging and product markets may interact need not to be mutually exclusive.

Our work provides an interesting agenda for future research. First, theoretically we have assumed throughout this paper that the only uncertainty was with respect to the exchange rate. It may be interesting to relax this assumption. For instance, a more realistic model may include demand uncertainty. It is well-known that with demand uncertainty debt financing may also bring about a strategic commitment to compete more aggressively. Therefore, it may be interesting to analyze the hedging decisions in such a framework when there is both exchange rate and demand uncertainty. Especially, since there may be cases where demand and changes in exchange rates are positively or negatively correlated. This may further enhance our understanding of the interaction between hedging and product markets.
7. Risk management and market share