

WORKING PAPER SERIES

CEEApIA WP No. 21/2011

The Impact of Capital Structure on the Decision to Outsource With Long Term Contracts

João C. A. Teixeira

November 2011

The Impact of Capital Structure on the Decision to Outsource With Long Term Contracts

João C. A. Teixeira

Universidade dos Açores (DEG e CEEAplA)

Working Paper n.º 21/2011
Novembro de 2011

RESUMO/ABSTRACT

The Impact of Capital Structure on the Decision to Outsource With Long Term Contracts

This paper analyzes how capital structure affects the firms' strategic choice between outsourcing with long term contracts and outsourcing to the spot market. When outsourcing to the spot market firms are exposed to price uncertainty, whereas a long term contract allows them to set in advance the outsourcing price. We show that, to the extent that leverage and uncertainty can lead to financial distress costs in bad states of nature, firms may use long term contracts as a risk management device to hedge input price uncertainty.

Keywords: outsourcing, long term contracts, uncertainty, financial distress

JEL classification: D81; G32; G33; L23; L24

João C. A. Teixeira
Universidade dos Açores
Departamento de Economia e Gestão
Rua da Mãe de Deus, 58
9501-801 Ponta Delgada

The impact of capital structure on the decision to outsource with long term contracts *

João C. A. Teixeira[†]

This version: 02 November 2011

Abstract

This paper analyzes how capital structure affects the firms' strategic choice between outsourcing with long term contracts and outsourcing to the spot market. When outsourcing to the spot market firms are exposed to price uncertainty, whereas a long term contract allows them to set in advance the outsourcing price. We show that, to the extent that leverage and uncertainty can lead to financial distress costs in bad states of nature, firms may use long term contracts as a risk management device to hedge input price uncertainty.

Keywords: outsourcing, long term contracts, uncertainty, financial distress

JEL classification: D81; G32; G33; L23; L24

*I thank financial support from Portuguese Foundation for Science and Technology. Any errors remain my responsibility. Comments can be sent to João Teixeira (jteixeira@uac.pt).

[†]University of the Azores and Centre of Applied Economic Studies of the Atlantic - CEEAplA, Department of Economics and Business, Rua Mãe de Deus, s/n, 9501-801 Ponta Delgada, Portugal.

The impact of capital structure on the decision to outsource with long term contracts

This paper analyzes how capital structure affects the firms' strategic choice between outsourcing with long term contracts and outsourcing to the spot market. When outsourcing to the spot market firms are exposed to price uncertainty, whereas a long term contract allows them to set in advance the outsourcing price. We show that, to the extent that leverage and uncertainty can lead to financial distress costs in bad states of nature, firms may use long term contracts as a risk management device to hedge input price uncertainty.

Keywords: outsourcing, long term contracts, uncertainty, financial distress

JEL classification: D81; G32; G33; L23; L24

1 Introduction

Outsourcing has become an important part of today's business as many organizations rely on outsourcing to organize their production modes. In 2002 US manufacturers were outsourcing more than 70% of their products (Corbert (2004)) and in the UK a survey realized in 2000 shows that 68% of organizations outsource some of their activities (Manpower UK Ltd. (2003)). In recent years, benefiting from deregulation of emerging economies, increased competition, improvements in information technology and rapid dissemination of the internet, many firms have started to outsource internationally.¹ There has been, however, mixed patterns in the way firms conduct their outsourcing activities. Some firms engage in long term contractual agreements with independent suppliers, while others rely on outsourcing directly to the spot market, without any sort of long term commitment with suppliers.

There are some important differences between these two outsourcing regimes that can potentially affect the firms' profits and market value. Outsourcing to the spot market often involves price uncertainty, whereas outsourcing to independent suppliers, using a long term contract, allows firms to set in advance the outsourcing price for the duration of the contract. This suggests that long term contracts are somehow equivalent to forward contracts, and therefore can be used to rule out price uncertainty. This paper explicitly examines a buyer's strategic choice between outsourcing to the spot market and outsourcing to an independent supplier, using a long term contract, by recognizing that levered firms may use long term contracts for risk management reasons. When exposed to high input price uncertainty, levered firms may experience deadweight losses from financial distress in bad states of nature, and this provides an important incentive to outsource with long term contracts.²

¹For a survey on the forces driving international outsourcing see Spencer (2005).

²Of course, there are a number of other motivations for hedging, including taxes, managerial incentives, capital market imperfections and inefficient investment. For a review of the determinants of hedging by corporations see Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993).

Financial distress has been described in the risk management literature as a state where a levered firm incurs additional losses (deadweight costs) because its cash flows are not sufficient to cover debt payments. The papers that have analyzed the importance of risk management to reduce these deadweight costs of financial distress include Smith and Stulz (1985), Froot, Scharfstein, and Stein (1993), Brown and Toft (2002), Fehle and Tsyplakov (2005) and Purnanandam (2008). This literature usually considers three main sources of financial distress costs. First, financial distress costs arise due to the decrease in product-market competitiveness. A financially distressed firm may lose customers, valuable suppliers and key employees because these stakeholders may seek to reduce their long-term dependence on firms with a high likelihood of bankruptcy. Second, a financially distressed firm is more likely to violate its debt covenants or miss coupon/principal payments (Purnanandam (2008)). These violations impose deadweight losses in the form of financial penalties, accelerated debt-payments, operations inflexibility and managerial time and resources spent on negotiations with the lenders. Finally, a financially distressed firm may have to forego a positive NPV project due to costly external financing, as in Froot, Scharfstein, and Stein (1993).

By incorporating financial distress costs in our framework, we create an obvious link between our study and this literature. There are, however, important differences in the modeling strategy. The risk management literature focus on hedging with derivatives, whereas we assume that long term contracts can be used as a complement to derivatives to hedge input price risk. Spinler, Huchzermeier, and Kleindorfer (2003) gives the example of polyethylene companies that usually have small margins and cannot afford the high costs of some derivatives. Cohen and Agrawal (1999) and Stulz (1996) refer to the importance of long term contracts as a risk management instrument for risk averse decision makers, and Li and Kouvelis (1999) provide some examples where the outsourcing of inputs involves substantial

price uncertainty such that the use of long term outsourcing contracts is very important (paper, agriculture, electronics, textiles, commodity fibers, petro chemical).

Since financial distress costs play an important role in our model, we are specially concerned with the factors that drive these costs, and ultimately with the effect that these costs have in the outsourcing decision. We consider the outsourcing decision by a monopolist and this allows us to focus on the effect of input price uncertainty and leverage on financial distress costs, and consequently on the firm's profits.

With a monopoly in the downstream market, we find that outsourcing to the spot market involves a trade-off between a positive convexity effect of input price uncertainty and a negative effect caused by financial distress costs. The first effect captures the idea that with no deadweight losses associated with bad states of nature, the firm's profits are increasing in input price uncertainty. Given that the buyer can fully adjust capacity for a given input price, he only cares with the upside potential, and therefore takes advantage from price uncertainty.³ The second effect shows how input price uncertainty can induce deadweight losses when the firm's profit flow in the bad states of nature is not enough to pay out debt. We derive the conditions for which the financial distress costs of the spot regime are positive, and show that they increase as the wedge between debt and the profit flow increases. Therefore, negative demand shocks or an increase in the firm's cost structure causes an increase in financial distress costs as it depresses profits.

Our model predicts that the monopolist always outsources to the spot market if financial distress costs are zero in order to fully benefit from the positive convexity effect of input price uncertainty. Rather, if financial distress costs are positive, the equilibrium depends on how severely are the firm's profits affected by financial

³This positive convexity effect derives from Jensen's inequality. Since the expected profit is a convex function of input price uncertainty, it follows that the expected value of a convex function of a random variable is greater than the value of the function evaluated at the expected value of the random variable.

distress costs. We derive a measure that captures the sensitivity of these profits to financial distress costs, and show that the long term contract regime holds when there are high financial distress costs associated with the spot regime. By outsourcing with a long term contract the monopolist can perfectly hedge input price uncertainty.

We formalize a bilateral bargaining game between the monopolist and the supplier when the long term contract is in place. The game allows us to endogenize the proportion of the profit derived by each part, and consequently to endogenize the outsourcing price. This represents a contribution to the outsourcing literature, in particular to the one that studies the decision to vertically integrate or outsource.⁴

Before we proceed, we further contrast our analysis with related work in the literature. While we motivate the use of long term contracts as a risk management device, alternative explanations have been examined in the economics and operations management literature. The economics literature builds on the incomplete contracting view of Williamson (1975). This theory argues that, in a context of incomplete contracting, long term contracts provide greater benefits when the products to be outsourced are more specific (specialized or differentiated) and spot transactions are more frequent for standard products. When products are more specific, there is a higher requirement for the parties to make a specific investment but, at the same time, the specific investment can create hold-up problems. With a long term contract the parties can mitigate the hold-up problem because they can benefit from a future relationship.

On the other hand, the operations management literature has focused more on the choice between option contracts and the spot market (see Kleindorfer, Wu, and

⁴Grossman and Helpman (2002), Levy (2006) and Fontenay and Gans (2008) develop an outsourcing model that incorporates a bilateral game between a buyer and a set of suppliers but where the proportion of the surplus collected by each part is exogenous.

Zhang (2002), Spinler, Huchzermeier, and Kleindorfer (2003) and Kleindorfer and Wu (2005)). Option contracts are common in capital intensive industries where capacity can only be expanded well in advance of output requirements. With these contracts the buyer acquires the option to buy capacity from the supplier. A reservation fee is paid ex-ante and an execution fee is paid if the option is exercised. The choice between the execution of these options and the acquisition of the input from the spot market depends on the balance between the costs involved with the option contract and the level of realized demand in the downstream market.

Although we focus on input price uncertainty and assume risk neutrality, our study also relates to the literature on the behavior of the firm under price uncertainty. Prominent contributions by Carlton (1979), Polinsky (1987) and Hubbard and Weiner (1992) examine the buyers' choice between spot sales and sales with a long term contract assuming risk aversion and demand uncertainty.

The remainder of the paper is organized as follows. In section 2 we set out the basic model and the assumptions for the monopoly structure. Section 3 concludes and summarizes some empirical predictions of our theory. Proofs of all propositions are detailed in the Appendix.

2 Monopoly in the downstream market

In this section we examine the choice between outsourcing to the spot market and outsourcing to an independent supplier, using a long term contract, when there is a monopoly in the downstream market. We start off with the derivation of the equilibrium prices and profits under each outsourcing regime, and then proceed with the analysis of the monopolist's equilibrium decision.

Consider a monopolist that produces a homogeneous product A and sells this

product in market A . One unit of product A requires one unit of input B . The monopolist can outsource input B either to the spot market B or to an independent supplier. For simplification purposes, we assume that the monopolist only operates in market A , and therefore the quantity that he outsources of input B must equal the quantity that he sells of product A .

There are two dates. At time $t = 0$ the monopolist decides which outsourcing regime he will use to acquire input B . If he outsources to the spot market, he faces input price uncertainty as he does not know what price of input B will prevail at the end of the period. At time $t = 1$ uncertainty is resolved and the monopolist decides which quantity to outsource (and to sell in market A) given the observed input prices. Alternatively, if the monopolist outsources input B to the independent supplier, at time $t = 0$ he writes a long term contract (one-period contract) with the supplier which allows him to set in advance the outsourcing price, and consequently the cost of production for the entire period. Contrary to outsourcing to the spot market, outsourcing with a long term contract rules out all input price uncertainty.

Furthermore, in order to examine the effect of the monopolist's capital structure on the outsourcing decision, we assume that he has debt outstanding in the amount D , which is due to be paid at time $t = 1$. We assume that the monopolist is, in some degree, financially constrained, and also needs debt to take advantage of investment opportunities. For simplification purposes, we assume that the independent supplier has no leverage and does not compete in the market B . The supplier produces with unlimited capacity and only incurs the marginal cost c_B .

We model the input price uncertainty of the spot regime as follows. At time $t = 1$ there are two states of nature, each with a probability of $1/2$. Input prices of B can either be high or low. We denote the bad state (high input price) and good state (low input price) by u and d , respectively. These prices are a function of the

expected spot price m and input price uncertainty, as measured by s , with $s > 0$, and they are defined as:

$$p_B^u = m + s \quad (1)$$

$$p_B^d = m - s \quad (2)$$

In the downstream market, the demand for product A can be defined as:

$$Q_A = \alpha_A - \beta_A p_A \quad (3)$$

In what follows, we denote the regime where the monopolist outsources to the spot market by S and the regime where he outsources to the independent supplier, with a long term contract, by LT . To simplify the exposition, we assume risk neutrality and a zero interest rate.

Next, we derive the equilibrium profits under each regime and discuss the advantages and disadvantages provided by each one. Consider first the case where the monopolist is outsourcing to the spot market. At time $t = 0$ the expected profit of the monopolist, $E(\Pi_{AS})$, is given by:

$$E(\Pi_{AS}) = \frac{1}{2} \Pi_{AS}^u + \frac{1}{2} \Pi_{AS}^d \quad (4)$$

where Π_{AS}^u (Π_{AS}^d) is the realized profit when the spot price of input B is p_B^u (p_B^d). Furthermore, we assume that the monopolist has a marginal cost c_A and a fixed cost f_A . If we denote the inverse demand function by $p_{AS}^i(Q_{AS}^i)$, with $i \in \{u, d\}$ (when the input price is p_B^u and p_B^d , respectively), and consider linear cost functions, it follows that the realized profit of the monopolist in state i is:

$$\Pi_{AS}^i = \Pi_{AS}^i \text{ NFDC} - FDC_S^i \quad (5)$$

where FDC_S^i are the financial distress costs that the monopolist may incur when outsourcing to the spot market and $\Pi_{AS}^i \text{ NFDC}$ is the realized profit when these

financial distress costs are zero. $\Pi_{AS\ NFDC}^i$ is defined as:

$$\Pi_{AS\ NFDC}^i = Q_{AS}^i (p_{AS}^i (Q_{AS}^i) - c_A - p_B^i) - f_A \quad (6)$$

Financial distress costs are associated with bad states of nature (see Brown and Toft (2002), Fehle and Tsyplakov (2005), and Purnanandam (2008)). Our formal definition of these costs is closely related to the one proposed by Fehle and Tsyplakov (2005). The idea is that when the monopolist is outsourcing with a high input price (in our model when p_B^u is realized), the firm's instantaneous profit flow (revenues less operating costs) may not be sufficient to pay debt. If this happens, the firm is in financial distress and incurs additional losses. These additional cash flow losses arise because customers, suppliers, or strategic partners may not be willing to deal with financially distressed firms. Hence, the magnitude of financial distress costs is determined by how low the firm's revenue falls relative to the debt payment and production costs. These costs are important because they may be incurred long before bankruptcy, and they provide an incentive to manage risk. Formally, we define the financial distress costs of the spot regime as:

$$FDC_S^i = k \max [0, D - \Pi_{AS\ NFDC}^i] \quad (7)$$

where the parameter $k > 0$ is a constant that captures the intensity of financial distress cost and $\Pi_{AS\ NFDC}^i$ is as stated in (6). An increase in k intensifies the value loss caused by financial distress costs.⁵ Since financial distress costs are associated with bad states of nature, we assume in this section that they can only occur when the input price is high (p_B^u), i.e. we assume that $FDC_S^u \geq 0$ and $FDC_S^d = 0$.⁶

We are now in a position to derive the equilibrium expressions for the spot regime. The monopolist optimizes his profit flow with respect to Q_{AS}^i , given the realized

⁵The parameter k has an upper bound (see expression in the Appendix) to ensure that the monopolist's equity value remains positive. Formally we require that the expression for the firm's profit, net of financial distress costs, as given by (5) is positive.

⁶The expression for the set of parameters for which $FDC_S^u \geq 0$ is presented in proposition 1.

price p_B^i at which input B is supplied. Substituting the equilibrium quantities and prices into the profit functions gives us the expressions for Π_{AS}^u and Π_{AS}^d . We further present the equilibrium expression of financial distress costs and the set of parameters for which these are positive. Proposition 1 summarizes these results. To simplify our exposition of the equilibrium, we denote by $E(\Pi_{AS})_{NFDC}$ the expected profit of the monopolist when financial distress costs are zero, i.e. $E(\Pi_{AS})_{NFDC} = E(\Pi_{AS})$ if $FDC_S^u = 0$.

Proposition 1 *If market A is a monopoly where a firm faces the demand function (3) for product A and outsources input B to the spot market, then the equilibrium expected profit of this firm at time $t = 0$ is:*

$$E(\Pi_{AS}) = E(\Pi_{AS})_{NFDC} - \frac{1}{2}FDC_S^u \quad (8)$$

where

$$E(\Pi_{AS})_{NFDC} = \frac{[\alpha_A - \beta_A(c_A + m)]^2}{4\beta_A} - f_A + \frac{s^2\beta_A}{4} \quad (9)$$

$$FDC_S^u = k \max \left[0, D - \left(\frac{[\alpha_A - \beta_A(c_A + m + s)]^2}{4\beta_A} - f_A \right) \right] \quad (10)$$

Given that $k > 0$, the monopolist incurs positive financial distress costs if:

$$s > \frac{\alpha_A - \beta_A(c_A + m) - 2\sqrt{\beta_A(D + f_A)}}{\beta_A} \equiv \hat{s} \quad (11)$$

and zero financial distress costs if otherwise. The realized profits in the bad and good state are, respectively:

$$\Pi_{AS}^u = \frac{[\alpha_A - \beta_A(c_A + m + s)]^2}{4\beta_A} - f_A - FDC_S^u \quad (12)$$

$$\Pi_{AS}^d = \frac{[\alpha_A - \beta_A(c_A + m - s)]^2}{4\beta_A} - f_A \quad (13)$$

The equilibrium output prices for product A in the bad and good state are, respectively:

$$p_{AS}^u = \frac{\alpha_A + \beta_A(c_A + m + s)}{2\beta_A} \quad (14)$$

$$p_{AS}^d = \frac{\alpha_A + \beta_A (c_A + m - s)}{2\beta_A} \quad (15)$$

Proposition 1 states that expected profit of the monopolist when outsourcing to the spot market (expression (8)) consists of the expected profit when financial distress costs are zero minus the value of financial distress costs that can arise from outsourcing at a high input price p_B^u (this latter component is multiplied by the probability of reaching the bad state). Hence, it is obvious from this expression the negative effect of financial distress costs on the monopolist's expected profit. Let us now discuss in detail what influences the value of each of these components of the expected profit, particularly the effect of input price uncertainty, leverage, demand shocks and the monopolist's cost structure.

First, consider the case where financial distress costs are zero. The expected profit is given by (9), which we decompose in two components. The first, $\frac{[\alpha_A - \beta_A(c_A + m)]^2}{4\beta_A} - f_A$, only incorporates demand and cost parameters, whereas the second, $\frac{s^2\beta_A}{4}$, provides the additional effect of input price uncertainty. The first component of the expected profit shows how positive demand shocks, like an increase in the size of market A (measured by α_A) or a reduction in the buyer's variable and fixed production costs (c_A and f_A , respectively) affects positively the firm's profit flow. Furthermore, the monopolist benefits from a decrease in the expected spot price from outsourcing (as measured by m). The second component of the expected profit represents the important positive convexity effect of uncertainty (as measured by s) on profits. If financial distress costs are zero ($s \leq \hat{s}$, with \hat{s} defined in (11)), there is no cost associated with the bad state of nature since the monopolist can fully adjust capacity and care exclusively with the upside potential (outsourcing at a lower input price). In this case, higher input price uncertainty always increases the advantage of the spot regime.⁷

⁷As noted earlier, this positive convexity effect derives from Jensen's inequality.

Input price uncertainty can also have, however, a negative effect on the monopolist's expected profit when there are financial distress costs caused by the firm's leverage. Before we discuss the overall effect of input price uncertainty on this expected profit, let us analyze what exactly determines the magnitude of these financial distress costs. From (10), one can see that these costs depend positively on the parameter k associated with the intensity of financial distress costs and also on the positive wedge between debt (D) and the profit flow realized in the bad state of nature ($\frac{[\alpha_A - \beta_A(c_A + m + s)]^2}{4\beta_A} - f_A$). All else equal, an increase in the uncertainty measure s in the bad state of nature induces a higher input price p_B^u , and as a consequence an increase in financial distress costs.⁸

Therefore, there are two opposite effects of an increase in input price uncertainty on the monopolist's expected profit from outsourcing to the spot market: the positive convexity effect versus the negative effect caused by financial distress costs. We show that the intensity of financial distress costs, as measured by k , plays an important role in the overall effect of uncertainty as:

$$\frac{\partial E(\Pi_{AS})}{\partial s} > (<)0 \text{ if } k < (>) \frac{2\beta_A s}{\alpha_A - \beta_A(c_A + m + s)} \equiv k^* \quad (16)$$

The intuition behind condition (16) is that if the intensity of financial distress costs is low ($k < k^*$), the positive convexity effect dominates and an increase in s increases the monopolist's expected profit. Hence, even with positive financial distress costs the monopolist may benefit from increased uncertainty in the spot market. Conversely, if the intensity of financial distress costs is high ($k > k^*$), the financial distress cost effect dominates and the monopolist has an incentive to avoid outsourcing to the spot market.

Next, we consider the case where the monopolist outsources the production of

⁸When the condition for positive financial distress costs (11) is satisfied, we show that financial distress costs depend positively on s as $\frac{\partial FDC_s^u}{\partial s} = k \frac{\alpha_A - \beta_A(c_A + m + s)}{2} > 0$.

input B to the independent supplier, using a long term contract. We assume that the negotiation process in the long term contract is formalized as Nash bargaining, where the bargaining power is split between the monopolist and the supplier.⁹ The distribution of the bargaining power is given exogenously and is described by the parameter $\eta \in [0, 1]$, where η is defined as the monopolist's bargaining power. As a result of bargaining, each side receives a fraction of the total profit under global maximization.¹⁰ We start off with the determination of the total profit under global maximization, and subsequently derive the optimal sharing rule and the firms' profits.

If we denote the inverse demand function by $p_{ALT}(Q_{ALT})$, it follows that the total profit under global maximization, Π_{GM} , is:

$$\Pi_{GM} = Q_{ALT} (p_{ALT}(Q_{ALT}) - c_A - c_B) - f_A \quad (17)$$

Let w be the outcome of the Nash bargaining process such that the monopolist receives a fraction w of the total profit under global maximization and the supplier receives $1 - w$, with $w \in [0, 1]$. The proportion of the total profit received by each side depends on the value of the firms' outside options. These are the profits the parties would make in case they decide to quit the negotiation. We assume that the monopolist's outside option consists of outsourcing to the spot market, and therefore its value is given by the profit expression $E(\Pi_{AS})$, previously stated in proposition 1 (equation (8)). For simplification purposes, we assume that the supplier has no outside option. Therefore, the fraction received by the monopolist must be the

⁹The game in is modeled as in Fan and Sundaresan (2000). In order to focus on the role of financial distress on the outsourcing decision, we ignore repeated interactions between the buyer and the supplier (see Dawid and Kopel (2003) and Hadlock and Lewis (2003) for a dynamic model of bargaining in subcontracting).

¹⁰This is the maximum profit the parties can make together if negotiation is possible, where they act jointly as a global optimizer.

solution to the Nash bargaining game (maximization with respect to w):

$$\max_w [w \Pi_{GM} - E(\Pi_{AS})]^\eta [(1-w) \Pi_{GM} - 0]^{1-\eta} \quad (18)$$

It follows that the optimal sharing rule is:¹¹

$$w = \frac{\eta [\Pi_{GM} - E(\Pi_{AS})] + E(\Pi_{AS})}{\Pi_{GM}} \quad (19)$$

These results show that if the monopolist's outside option is zero ($E(\Pi_{AS}) = 0$), he receives a fraction of the total profit under global maximization equal to his exogenous bargaining power ($w = \eta$). Alternatively, if the expected profit from outsourcing to the spot market equals the total profit that is possible to generate with the long term contract ($E(\Pi_{AS}) = \Pi_{GM}$), he is able to collect the full surplus of the long term contract as $w = 1$. Expression (19) also shows another important result concerning the effect of input price uncertainty on the proportion of the profits collected by each firm, and as a consequence on the profits they realize with the long term contract. Given that the magnitude of input price uncertainty (as measured by s) has effect on the monopolist's expected profit from outsourcing to the spot market ($E(\Pi_{AS})$), the proportion that he derives with the long term contract is naturally affected by this uncertainty.

Next, denote the buyer's and the supplier's profit with the long term contract by Π_{ALT} and Π_{BLT} , respectively. Given the assumption above, these profits sum up to the profit under global maximization, $\Pi_{GM} = \Pi_{ALT} + \Pi_{BLT}$, and can be defined as $\Pi_{ALT} = w\Pi_{GM}$ and $\Pi_{BLT} = (1-w)\Pi_{GM}$. Also, if we denote the agreed input price of the long term contract by p_{BLT} , and assume as before that $Q_{ALT} = Q_{BLT}$, it follows that these profits are given by:

$$\Pi_{ALT} = w\Pi_{GM} = Q_{ALT} (p_{ALT}(Q_{ALT}) - c_A - p_{BLT}) - f_A \quad (20)$$

¹¹The optimization problem is solved only for the relevant case where the monopolist's outside option is lower than the total profit under global maximization, i.e. $E(\Pi_{AS}) \leq \Pi_{GM}$.

$$\Pi_{BLT} = (1 - w) \Pi_{GM} = Q_{ALT} (p_{BLT} - c_B) \quad (21)$$

With these results, we can easily determine the equilibrium outsourcing price agreed for input B under the long term contract. It is obtained by solving any of these profit functions for p_{BLT} (equation (20) or (21)), after substituting the proportion w by the expression previously derived in (19). It follows that the outsourcing input price is given by:

$$p_{BLT} = \frac{(1 - \eta) [\Pi_{GM} - E(\Pi_{AS})]}{Q_{ALT}} + c_B \quad (22)$$

As expected, in both scenarios where the monopolist is able to collect the whole surplus from the long term contract (as discussed earlier, when the profit under global maximization equals the outside option ($\Pi_{GM} = E(\Pi_{AS})$) or when $\eta = 1$), the outsourcing price converges to the marginal cost of the supplier, and the supplier makes a zero profit.

We are now in a position to determine the equilibrium quantities, prices and profits under the long term contract regime. The equilibrium quantities Q_{ALT} are derived by optimizing the total profit under global maximization defined in equation (17). By substituting this quantity into the demand function (3), we obtain the equilibrium prices in market A p_{ALT} . Finally, by substituting these quantities and prices into the profit functions (20) and (21), we determine the expressions for the equilibrium profits of the monopolist and the supplier, respectively. These results are summarized in proposition 2.

Proposition 2 *If market A is a monopoly where a firm faces the demand function (3) for product A and outsources input B to an independent supplier, using a long term contract, then the equilibrium profit under global maximization that is possible*

to generate with the contract is:

$$\Pi_{GM} = \frac{[\alpha_A - \beta_A (c_A + c_B)]^2}{4\beta_A} - f_A \quad (23)$$

The equilibrium profits of the monopolist and the supplier are, respectively:

$$\Pi_{ALT} = E(\Pi_{AS}) + \eta [\Pi_{GM} - E(\Pi_{AS})] \quad (24)$$

$$\Pi_{BLT} = (1 - \eta) [\Pi_{GM} - E(\Pi_{AS})] \quad (25)$$

where Π_{GM} is given by (23) and $E(\Pi_{AS})$ is the value of the monopolist's outside option as given by (8). The equilibrium output price for product A is:

$$p_{ALT} = \frac{\alpha_A + \beta_A (c_A + c_B)}{2\beta_A} \quad (26)$$

Proposition 2 shows that input price uncertainty, as measured by s , has no effect on the downstream price of product A, and consequently on the profit under global maximization. As to be expected, the long term contract allows the monopolist to perfectly hedge input price uncertainty by setting in advance the outsourcing price. If there are relevant reasons for hedging input price uncertainty, then long term contracts can represent an important tool for risk management. We discuss next, under which circumstances the use of long term contracts can create value for the firm.

2.1 Monopolist's choice of the outsourcing regime

We now examine the monopolist's choice of the outsourcing regime at time $t = 0$. The monopolist compares the expected profit from outsourcing to the spot market with the profit under global maximization from outsourcing with the long term contract and chooses the regime with the highest expected profit. Let us denote the extra profit or surplus from outsourcing to the spot market by:

$$Surplus \equiv E(\Pi_{AS}) - \Pi_{GM} \quad (27)$$

In order to focus our discussion of the equilibrium on the effect of input price uncertainty and financial distress costs, we ignore any cost differences between the two regimes, i.e. we assume that the expected input price from the spot market is the same as the supplier's marginal cost ($m = c_B$). Under this assumption, one can show that the surplus from the spot market regime is given by:

$$Surplus = \frac{s^2 \beta_A}{4} - k \max \left[0, D - \left(\frac{[\alpha_A - \beta_A (c_A + m + s)]^2}{4\beta_A} - f_A \right) \right] \quad (28)$$

This expression states that the advantage of the spot market regime relies on the trade-off between a positive convexity effect of uncertainty (first term of (28)) and a negative effect caused by financial distress costs (second term of (28)). This result has several interesting implications, which we state in the following two propositions. Proposition 3 summarizes the equilibrium if financial distress costs are zero, whereas proposition 4 considers positive financial distress costs.

Proposition 3 *Assume that the expected spot price is the same as the supplier's marginal cost ($m = c_B$) and consider the input price uncertainty level \hat{s} as stated previously in (11). If $0 < s \leq \hat{s}$ such that financial distress costs are zero, the monopolist always outsources to the spot market.*

This proposition shows that if the level of input price uncertainty is not enough to cause any financial distress costs, the monopolist has no deadweight losses associated with the spot regime, and thus chooses this regime in order to benefit from the positive convexity effect of uncertainty. He derives a surplus from outsourcing given by $\frac{s^2 \beta_A}{4}$.

Now, let us assume that the level of uncertainty is such that financial distress costs from outsourcing to the spot regime are positive, i.e. $s > \hat{s}$, with \hat{s} once again as given by the right hand side of (11). In that case, one can show that the surplus

expression (28) can be rearranged and expressed as:

$$Surplus (FDC > 0) = \frac{s^2 \beta_A}{4} - \frac{1}{2} k (D + f_A) + \frac{1}{2} k \frac{[\alpha_A - \beta_A (c_A + m + s)]^2}{4 \beta_A} \quad (29)$$

The surplus from outsourcing is a quadratic function of s , which means that if we solve this function for s , there are two levels of the uncertainty measure where the monopolist is indifferent between one regime and the other. We denote these levels by s_j^* , with $j \in \{1, 2\}$ and $s_1^* < s_2^*$.¹² One can show that s_j^* is:

$$s_{1,2}^* = \frac{k [\alpha_A - \beta_A (c_A + m)] \pm \sqrt{2 \beta_A} \sqrt{2 (D + f_A) \beta_A (2 + k) k - k [\alpha_A - \beta_A (c_A + m)]^2}}{\beta_A (2 + k)} \quad (30)$$

These levels of the uncertainty measure play an important role in the derivation of the outsourcing equilibrium, as we summarize in proposition 4 below.

Proposition 4 *Assume that the expected spot price is the same as the supplier's marginal cost ($m = c_B$) and consider the two levels of the input price uncertainty measure s_1^* and s_2^* given by (30), for which the monopolist is indifferent between outsourcing to the spot market and outsourcing with a long term contract. Furthermore, consider the input price uncertainty level \hat{s} as stated previously in (11).*

If $s > \hat{s}$ such that financial distress costs are positive, the outsourcing choice represents a trade-off between the positive convexity effect associated with uncertainty and the level of financial distress costs. It consists of one of the following three cases:

A) If $\hat{s} < s < s_1^$ the monopolist outsources to the spot market as the positive convexity effect dominates.*

B) If $s_1^ < s < s_2^*$ the monopolist outsources with a long term contract as the negative effect of financial distress costs associated with the spot regime dominates.*

¹²Note, however, that there is an upper bound for s_j^* as it has to ensure positive input prices ($0 < s_j^* < m$) and positive quantities in the bad state of nature ($0 < s_j^* < \frac{\alpha_A - \beta_A (c_A + m)}{\beta_A}$). See proof of proposition 4 for this derivation.

C) If $s > s_2^$ the monopolist outsources to the spot market as the positive convexity effect associated with uncertainty dominates.*

In case *A*, the monopolists outsources to the spot market because although financial distress costs have been triggered, they are not high enough to offset the positive convexity effect of input price uncertainty. Case *B* is the opposite case where the monopolist is outsourcing to the independent supplier in order to avoid the deadweight losses associated with financial distress costs. Finally, we are likely to end up in case *C* when there is a combination of high uncertainty and low intensity of financial distress costs (low k), such that the positive convexity effect of uncertainty dominates.

Figure 2.1 illustrates an example of the monopolist's optimal choice of the outsourcing regime. It depicts the expected profit of the monopolist when outsourcing to the independent supplier and to the spot market, Π_{ALT} and $E(\Pi_{AS})$ respectively, and the total profit under global maximization with the long term contract, Π_{GM} , as a function of our measure of input price uncertainty s .¹³ It shows that for low values of the input price uncertainty measure ($s \leq 1.72$), the expected profit of the monopolist under the spot regime $E(\Pi_{AS})$ is increasing because financial distress costs have not been triggered. Once these costs are positive, the expected profit from the spot regime starts decreasing. There is a small range for which this profit is decreasing but is still higher than the profit of the long term contract. This means that although financial distress costs are positive, there are not high enough to offset the positive effect of input price uncertainty, and therefore the monopolist outsources to the spot market. Then, as the input price uncertainty measure in-

¹³The set of input parameters used is as follows: monopolist's bargaining power $\eta = 0.5$, expected spot price $m = 20$, marginal cost of the supplier $c_B = 20$, size of market A $\alpha_A = 70$, slope of demand function $\beta_A = 1$, marginal cost of monopolist $c_A = 20$, fixed cost of monopolist $f_A = 0$, debt $D = 200$ and intensity of financial distress costs parameter $k = 0.8$. In the example it follows that only s_1^* exists.

creases, the expected profit of the spot regime is more severely affected by financial distress costs such that it is below the profit of the long term contract. When this occurs the long term contract regime dominates.

(Insert Figure 2.1 here)

Up to this point, we have mainly discussed the effect of uncertainty on financial distress costs, and consequently on the choice of the outsourcing regime. We should note, however, that what drives these costs is the existence of debt on the firm's capital structure. Next, we determine the debt level D^* that makes the monopolist indifferent between the two regimes. This is obtained by solving equation $E(\Pi_{AS}) - \Pi_{GM} = 0$ for D . It follows that:

$$D^* = \frac{1}{2} \frac{s^2 \beta_A}{k} + \frac{[\alpha_A - \beta_A (c_A + m + s)]^2}{4\beta_A} - f_A \quad (31)$$

This indifference level can be interpreted as the maximum debt the monopolist can afford if outsourcing to the spot market. For any debt level above D^* the surplus from the spot regime is negative, and therefore the monopolist chooses to outsource to the independent supplier in order to avoid financial distress costs. A change in the parameters that increase the profit flow, as an increase in the size of market A (α_A) or a decrease in the operational costs (c_A , m and f_A), increases this indifference level, which means that the monopolist can afford to use more debt when outsourcing to the spot market.

Furthermore, from expression (31) one can see that the effect of the uncertainty measure s on D^* depends on the parameter k associated with the intensity of financial distress costs. We show that $\frac{\partial D^*}{\partial s} > (<) 0$ if $k < (>) k^*$ where k^* is as previously defined in (16). This suggests that if we combine high intensity of financial distress costs and high input price uncertainty, firms tend to reduce their debt level in order to stay in the spot regime or, alternatively, they prefer to outsource with long term

contracts. This prediction captures Froot, Scharfstein, and Stein (1993) idea that when long term contracts are used as a risk management device they can be seen as a mean of increasing debt capacity.

3 Conclusions

This paper develops a model that examines a firm's choice between outsourcing to an independent supplier, using a long term contract, and outsourcing to the spot market. It incorporates one important dimension of the problem: capital structure. The main difference between the two outsourcing regimes relies on the uncertainty associated with the outsourcing price. Outsourcing to the spot market involves input price uncertainty, whereas outsourcing with a long term contract allows the buyer to set in advance this price and rule out uncertainty. We investigate the outsourcing decision by a monopolist, where we focus on the effect of leverage and uncertainty on financial distress costs. The main conclusions and empirical implications of the paper are discussed below.

We find that outsourcing to the spot market involves a trade-off between a positive convexity effect of input price uncertainty and a negative effect derived from financial distress costs. If the level of debt and input price uncertainty is not sufficient to induce positive financial distress costs in the bad state of nature, the monopolist chooses to outsource to the spot market in order to take advantage of the positive effect of uncertainty on profits. The monopolist's profits increase with input price uncertainty because he can fully adjust capacity for a given input price, and therefore focuses on the upside potential of the spot regime.

However, to the extent that leverage and input price uncertainty can induce financial distress costs in bad states of nature, there is an incentive for the monopolist

to outsource with a long term contract. A long term contract provides a perfect hedge of input price uncertainty, and consequently creates value by eliminating these costs. We find that the equilibrium depends on how severely the firm's profits are depressed by financial distress costs, and derive a measure that captures the sensitivity of the firm's profits to these costs. Our model predicts that these costs are positively related with leverage, input price uncertainty, negative demand shocks and the buyer's marginal and fixed costs. This result is in line with Opler and Titman (1994) as they show that during industry downturns more highly levered firms experience higher drops in equity values than less levered firms. We model the long term contract regime as a Nash bargaining game between the monopolist and the supplier, which allows to endogenize the outsourcing price and the proportion of the surplus each firm derives.

Our theory provides new predictions that can be empirically testable. In the monopoly section we derive the level of debt that makes the monopolist indifferent between outsourcing to the spot market and outsourcing to the independent supplier. We show that in the presence of financial distress costs, firms that outsource to the spot market have limited debt capacity as they need to avoid these costs. Thus, our model predicts that firms outsourcing with long term contracts have greater debt capacity and that firms outsourcing to the spot market may be underlevered.

Further research could be aimed at testing empirically some of our predictions. There are also some ways of extending the study theoretically. First, incorporate the possibility of partial outsourcing where the buyers could outsource a proportion of the input to the spot market and another proportion to the independent supplier. Second, allow for an outside option of the supplier and consider some capacity constraints in production such that this production is not enough to satisfy all buyers.

4 Appendix

Proof of proposition 1

In order to determine the equilibrium profits in each state, we first derive the equilibrium quantities and prices in market A. The monopolist optimizes the profit flow (5) with respect to Q_{AS}^i , and this for a given price p_B^i at which input B is supplied. We further assume that financial distress costs are zero in the good state, i.e. $FDC_S^d = 0$. It follows that the equilibrium quantities in state u and d are, respectively:

$$Q_{AS}^u = \frac{\alpha_A - \beta_A (c_A + m + s)}{2} \quad (32)$$

$$Q_{AS}^d = \frac{\alpha_A - \beta_A (c_A + m - s)}{2} \quad (33)$$

Substituting these quantities into the corresponding demand functions gives us the expressions for the equilibrium prices (14) and (15) as stated in the proposition. The expressions for the equilibrium profits in each state (12) and (13) are then obtained by substituting these equilibrium quantities and prices into the profit expression (5).

The expression for the monopolist's equilibrium expected profit is derived as follows. First, we denote the component of the equilibrium profit Π_{AS}^u that is not affected by financial distress costs by $\Pi_{AS\ NFDC}^u$, i.e. we define $\Pi_{AS\ NFDC}^u$ as:

$$\Pi_{AS\ NFDC}^u = \frac{[\alpha_A - \beta_A (c_A + m + s)]^2}{4\beta_A} - f_A \quad (34)$$

It follows from (12) that Π_{AS}^u can be expressed as $\Pi_{AS}^u = \Pi_{AS\ NFDC}^u - FDC_S^u$. Second, we show that the expression of the monopolist's expected profit $E(\Pi_{AS}) = \frac{1}{2} \Pi_{AS}^u + \frac{1}{2} \Pi_{AS}^d$ simplifies to $E(\Pi_{AS}) = \frac{1}{2} [\Pi_{AS\ NFDC}^u - FDC_S^u] + \frac{1}{2} \Pi_{AS}^d$. Third, denoting by $E(\Pi_{AS})_{NFDC}$ the component of the monopolist's expected profit that do not depends on financial distress costs, it follows immediately that the equilibrium expected profit is given by:

$$E(\Pi_{AS}) = E(\Pi_{AS})_{NFDC} - \frac{1}{2} FDC_S^u \quad (35)$$

where

$$E(\Pi_{AS})_{NFDC} = \frac{1}{2}\Pi_{AS}^u_{NFDC} + \frac{1}{2}\Pi_{AS}^d \quad (36)$$

After expanding the expressions for $\Pi_{AS}^u_{NFDC}$ and Π_{AS}^d and rearranging some terms we obtain the equilibrium expression $E(\Pi_{AS})_{NFDC}$ as given by (9).

Inequality (11) is derived by solving the RHS of the financial distress costs expression (10) for the input price uncertainty measure s , such that $FDC_S^u > 0$.

Finally, to ensure that the monopolist's equity value remains positive, we derive an upper bound for k . Formally, we require that the expression for the firm's profit, net of financial distress costs, as given by (5), is positive. Solving $\Pi_{AS}^i \geq 0$ for k gives:

$$k \leq 2 \frac{[\alpha_A - \beta_A(c_A + m + s)]^2 - f_A}{4\beta_A(D + f_A) - [\alpha_A - \beta_A(c_A + m + s)]^2} \quad (37)$$

Derivation of Inequality (16)

We start with equation (8) that defines $E(\Pi_{AS})$. It follows that:

$$\frac{\partial E(\Pi_{AS})}{\partial s} = \frac{\partial E(\Pi_{AS})_{NFDC}}{\partial s} - \frac{1}{2} \frac{\partial FDC_S^u}{\partial s} \quad (38)$$

where

$$\frac{\partial E(\Pi_{AS})_{NFDC}}{\partial s} = \frac{1}{2}s\beta_A > 0 \quad (39)$$

$$\frac{\partial FDC_S^u}{\partial s} = k \frac{\alpha_A - \beta_A(c_A + m + s)}{2} > 0 \quad (40)$$

Thus, the total derivative is positive if the following inequality holds:

$$\frac{1}{2}s\beta_A - \frac{1}{2}k \frac{\alpha_A - \beta_A(c_A + m + s)}{2} > 0 \text{ and negative, if otherwise. Solving this inequality}$$

for k , gives us the condition:

$$\frac{\partial E(\Pi_{AS})}{\partial s} > (<) 0 \text{ if } k < (>) \frac{2\beta_A s}{\alpha_A - \beta_A(c_A + m + s)} \equiv k^*.$$

Proof of proposition 2

The global optimizer maximizes the profit under global maximization (17) with respect to the optimal quantity Q_{ALT} . This quantity is also the one that will prevail with the long term contract. It follows that the equilibrium quantity is:

$$Q_{ALT} = \frac{\alpha_A - \beta_A(c_A + c_B)}{2} \quad (41)$$

Substituting this quantity into the demand function we obtain the equilibrium price in market A as given by (26). Finally, by substituting this quantity and price into the profit function of the global optimizer we obtain the equilibrium profit as stated in the proposition.

The expressions for the equilibrium profit of the buyer and the supplier are derived by substituting the expression of the proportion of the surplus captured by the buyer w , given by (19), into the profits expressions (20) and (21), respectively.

Proof of proposition 3

The monopolist chooses to outsource to the spot market if the surplus from outsourcing under this regime, as given by (28), is positive, and to the independent supplier if otherwise. Further, we know from proposition 1 that if $0 < s \leq \widehat{s}$, where $\widehat{s} \equiv \frac{\alpha_A - \beta_A(c_A + m) - 2\sqrt{\beta_A(D + f_A)}}{\beta_A}$, the financial distress costs from outsourcing to the spot market are zero. Therefore, for this set of parameters, the surplus from outsourcing to the spot market is always positive ($\frac{s^2\beta_A}{4} > 0$) and this regime always dominates.

Proof of proposition 4

Given the two zeros s_1^* and s_2^* (expression (30)), we know that the surplus from the spot market regime is negative for $s_1^* < s < s_2^*$ and positive if otherwise. Hence, the long term contract regime holds if $s_1^* < s < s_2^*$ and the spot market regime if

otherwise.

The upper bound on s_j^* is necessary to ensure two conditions. First, positive input prices in the good state $p_B^d > 0$, or equivalently $m - s_j^* > 0$, which gives $s_j^* < m$. Second, positive quantities in the bad state $Q_{AS}^u = \frac{\alpha_A - \beta_A(c_A + m + s_j^*)}{2} > 0$, or equivalently $s_j^* < \frac{\alpha_A - \beta_A(c_A + m)}{\beta_A}$.

References

- BROWN, G. W., AND K. B. TOFT (2002): “How Firms Should Hedge,” *Review of Financial Studies*, 15, 1283–1324.
- CARLTON, D. W. (1979): “Contracts, Price Rigidity, and Market Equilibrium,” *Journal of Political Economy*, 87, 1034–1062.
- COHEN, M. A., AND N. AGRAWAL (1999): “An Analytical Comparison of Long and Short Term Contracts,” *IIE Transactions*, 31, 783–796.
- CORBERT, M. F. (2004): *The Outsourcing Revolution*. Dearborn Trade Publishing.
- DAWID, H., AND M. KOPEL (2003): “A Comparison of Exit and Voice Relationships under Common Uncertainty,” *Journal of Economics and Management Strategy*, 12, 531–555.
- FAN, H., AND S. M. SUNDARESAN (2000): “Debt Valuation, Renegotiation and Optimal Dividend Policy,” *Review of Financial Studies*, 13, 1057–1099.
- FEHLE, F., AND S. TSYPLAKOV (2005): “Dynamic Risk Management: Theory and Evidence,” *Journal of Financial Economics*, 78, 3–47.
- FONTENAY, C., AND J. S. GANS (2008): “A Bargaining Perspective on Strategic Outsourcing and Supply Competition,” *Strategic Management Journal*, 29, 819–839.
- FROOT, K. A., D. S. SCHARFSTEIN, AND J. C. STEIN (1993): “Risk Management: Coordinating Corporate Investment and Financing Policies,” *Journal of Finance*, 48, 1629–1658.
- GROSSMAN, G. M., AND E. HELPMAN (2002): “Integration vs. Outsourcing in Industry Equilibrium,” *Quarterly Journal of Economics*, 117, 85–120.

- HADLOCK, C. J., AND T. LEWIS (2003): “Bargaining When Exchange Affects the Value of Future Trade,” *Journal of Economics and Management Strategy*, 12, 557–589.
- HUBBARD, R. G., AND J. R. WEINER (1992): “Long-Term Contracting and Multiple-Price Systems,” *Journal of Business*, 65, 177–198.
- KLEINDORFER, P. R., AND D. J. WU (2005): “Competitive Options, Supply Contracting and Electronic Markets,” *Management Science*, 51, 452–466.
- KLEINDORFER, P. R., D. J. WU, AND J. E. ZHANG (2002): “Optimal Bidding and Contracting Strategies for Capital-Intensive Goods,” *European Journal of Operations Research*, 137, 657–676.
- LEVY, N. (2006): “The Organization of Supply: a Vertical Equilibrium Analysis,” University of Albany Working Paper.
- LI, C., AND P. KOUVELIS (1999): “Flexible and Risk-Sharing Supply Contracts Under Price Uncertainty,” *Management Science*, 45, 1378–1398.
- MANPOWER UK LTD. (2003): “Outsourcing Survey,” Technical report.
- OPLER, T., AND S. TITMAN (1994): “Financial Distress and Corporate Performance,” *Journal of Finance*, 49, 1015–1040.
- POLINSKY, A. M. (1987): “Fixed Price versus Spot Price Contracts: A Study of Risk Allocation,” *Journal of Law, Economics, and Organization*, 3, 27–46.
- PURNANANDAM, A. K. (2008): “Financial Distress and Corporate Risk Management,” *Journal of Financial Economics*, 87, 706–739.
- SMITH, C. W., AND R. M. STULZ (1985): “The Determinants of Firms’ Hedging Policies,” *Journal of Financial and Quantitative Analysis*, 20, 391–405.

- SPENCER, B. J. (2005): “International Outsourcing and Incomplete Contracts,” *Canadian Journal of Economics*, 38, 1107–1135.
- SPINLER, S., A. HUCHZERMEIER, AND P. KLEINDORFER (2003): “Risk Hedging via Options Contracts for Physical Delivery,” *OR Spectrum*, 25, 379–395.
- STULZ, R. M. (1996): “Rethinking Risk Management,” *Journal of Applied Corporate Finance*, 9, 8–24.
- WILLIAMSON, O. E. (1975): *Markets and Hierarchies: Analysis and Antitrust Implications*. Free Press, New York.

Figure 2.1: Monopolist's Optimal Decision

Expected profit of the monopolist under the spot regime, $E(\Pi_{AS})$, profit of the monopolist under the long term contract regime, Π_{ALT} , and total profit under global maximization, Π_{GM} , as a function of the input price uncertainty measure s . The expected profit under the spot regime is increasing (decreasing) when financial distress are zero (positive). The spot regime dominates if $E(\Pi_{AS}) > \Pi_{ALT}$, and the long term contract regime dominates if otherwise.

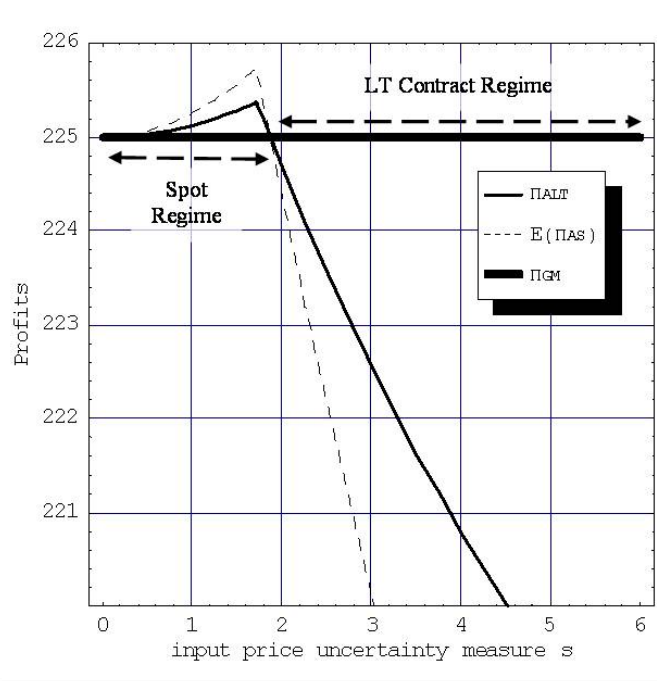


Figure 2.2: Oligopoly Equilibrium with Zero Financial Distress Costs

Expected profit of each buyer under the spot regime, $E(\pi_{AS})$, and under the long term contract regime, $E(\pi_{ALT})$, as a function of the number of firms outsourcing to the spot market, if financial distress costs are zero, and assuming that the outsourcing price provided by the supplier is the same as the expected spot price, $p_{BLT} = m$. In equilibrium, all firms outsource to the spot market as $E(\pi_{AS})$ is always greater than $E(\pi_{ALT})$.

