Essays on the Theory of the Firm: Interactions Between Capital, Product and Labour Markets

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Abstract

This thesis examines some strategic interactions between financial, labour and industrial contracts signed by the manager of a firm with different stakeholders. It investigates the strategic effects of contractual or institutional arrangements when the firm faces commitment problems.

The general introduction briefly surveys the relevant literatures on the methodology, modern theories of the firm, commitment problems and interactions between markets through the firm.

The second chapter focusses on interactions between labour markets and the market for corporate control. It argues that the possibility of takeovers may affect the economic consequences of union power in wage negotiations: while union power increases wage flexibility and the firm's capacity to invest in the absence of takeovers, it decreases them when takeovers are allowed. Various takeover defence mechanisms are compared.

The third chapter analyzes the impact of competition among downstream firms on a supplier's investment and on her incentive to vertically integrate. Tougher competition decreases the downstream industry profit, but improves the supplier's negotiation position. In particular, the supplier is better off encouraging competition when the downstream firms have high bargaining power. We analyze the interactions between downstream competition and vertical integration.

The fourth chapter (joint with Dr. Antoine Faure-Grimaud, LSE) analyzes the financing decisions of a monopolist facing a buyer whose valuation is private information. It develops the idea that a high level of (renegotiable) debt, by increasing the scope for liquidation, may induce the high valuation buyer to buy early at a high price and thus increase the monopolist's expected profit. The benefit from the strategic use of debt increases with the durability of the good.

To my parents.

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Chapter 1

General Introduction

1 The Firm as a Nexus of Contracts

Modern theories describe the firm as a nexus of contractual relationships. Explicit or implicit contracts are agreed upon either within firms, e.g. employment contracts, or outside them, e.g. supply contracts. The firm is the locus where those contracts meet and interact.

This thesis examines some strategic interactions between financial, labour and industrial contracts which may be signed within and by a firm. It investigates the strategic effects of specific contractual or institutional arrangements when a firm faces commitment problems, namely the hold-up and Coasian commitment problems, Coasian dynamics and the ratchet effect.

By nature, the analysis of interactions is at the crossroads of several literatures. This chapter briefly surveys modern theories of the firm and their link to the specific domains touched by the essays.

1.1 A Brief Overview

In the neoclassical paradigm, firms are production sets (black boxes) operated by a reliable profit-maximizing manager. While this model has been successful at analysing market outcomes, it did not explain the nature, boundaries and organisation of the firm. It ignored the way in which firms organise production and deal with conflicts of interest between different stakeholders. Modern theories of the firm emerged as an attempt to open the black box.

The transaction costs theory, pioneered by Coase (1937) in his seminal paper, recognized that a large amount of resources was allocated inside the firm. In Coasian terms, such exchanges are characterized by a quantity mode rather than a price mode. Sometimes, the transaction costs when using a price mode (such as bargaining costs) are prohibitively high. Intra-firm transactions may allow to save on such costs. The costs of intra-firm transactions, namely bureaucratic costs and the scope for errors, increase with the size of the firm and determine its boundaries.

However, a number of explanations was still needed. For instance, the costs of hiring other managers and delegate tasks to reduce these costs of operating the firm and the reasons why prices are less important within the firm than in the market were not addressed.

A few decades later, in the 1970s, Williamson proposed that firms exist because of relationship-specific investments. In other words, the higher cost of transaction in the market may be due to dynamic considerations (Williamson (1985)). For instance, an employee learns the workings of the organisation and the use of specific machines within a firm or an electricity-generating plant is located close to a coal mine. If the relationship stops, then (at least part of) the investment is lost. At the extreme, after the investment is made, there is bilateral monopoly. The fundamental question is when such relationships should be governed by long-term contracts between different firms and when they should take place within a firm. Writing long-term contracts may be com-

plicated and costly. For instance, this requires to describe every contingency in a way which is understandable by the courts. These transaction costs may affect the relationship. When writing a contingent clause becomes prohibitively costly, contracts may be left incomplete, leaving scope for future bargaining when unspecified events occur. Bargaining gives rise to important problems: under asymmetric information, the efficient outcome needs not obtain. In addition, the surplus may be split in a way that gives an insufficient return to the initial investment. The latter feature leads parties to underinvest ex ante. The so called the hold-up problem may lead parties to prefer less efficient but less specific investments in order to benefit from more competition between trading partners ex post. The question is to what extent integration may reduce this hold-up problem.

Grossman and Hart (1986) address this issue by distinguishing between human and physical assets. They assume that contracts are incomplete in that all uses of every physical asset cannot be specified in every state of the world. They define property rights of the asset as the residual rights of control. In other words, the owner has the right to decide on the asset's use in cases not specified in a prior contract. Hence, although the property right does not necessarily give full bargaining power to a party (the owner for instance), it specifies the status quo point in the bargaining game. Consider that two firms want to engage in relationship-specific investments. When should they integrate? Under non integration, bargaining over the surplus often leads to moderate incentive to invest for both parties. In contrast, under integration, the firm buying (resp. bought by) the other can expect a large (small) surplus ex post and has therefore a high (resp. low) incentive to invest. According to the relative importance of either investment in generating the surplus, integration has costs and benefits.

Grossman and Hart's seminal paper raises a number of questions. The definition of ownership as residual rights of control was in line with the law

literature and was to offer a number of insights, but it was only a rough approximation of authority and control in organisations. In large organisations, some agents have some real authority in decision making even though they have no ownership right. Aghion and Tirole (1994) formalize the distinction between formal and real authority with asymmetric information. Although they have formal authority, owners may be better off delegating authority to more informed agents. The property right theory cannot address the separation of ownership and control because it defines one as the other. Distinguishing between formal and real authority may help explain this separation as well as partial integration. Burkart, Gromb and Panunzi (1996) investigate these issues and argue that the owner exerts effective control only if the costs of acquiring costly information are lower than the returns from using this information. This is the case when she owns a sufficiently high fraction of return rights. In contrast, owning a sufficiently small fraction of return rights may be a commitment not to acquire costly information and not to overrule the manager (in terms of vertical integration, the manager of the vertically integrated entity). Hence, the manager's initiative to seek profitable projects which are beneficial to him is fostered when ownership is dispersed[1].

The activities and boundaries of the firm may also be affected by strategic considerations with product market competitors or various trading partners. Before turning to these topics which are central to this thesis, we discuss the hold-up problem which has received a lot of attention in the theory of the firm as well as the incomplete contracts methodology.

[1]The distinction between formal and real authority may also be thought of as a step towards combining Grossman and Hart's theory of the firm with a theory defining ownership as return rights which give access to information (Crémer (1994)).

1.2 The Hold-Up Problem and Discussion of Contractual Solutions

Long term contracts are often signed to enable parties to undertake efficient levels of relationship-specific investments. When contracts contingent on the level of investment or on future outcomes cannot be written, each party is to some extent locked-in once the investment has been sunk and is vulnerable to an opportunistic behaviour from the other parties. The anticipation of being victim of opportunism often leads parties to underinvest. The hold-up problem arises as soon as a party is not residual claimant on her investment. A number of authors have analysed the assumptions necessary to obtain the hold-up problem and possible contractual solutions.

Hart and Moore (1988) emphasize the role of information revelation and contract renegotiation in the hold-up problem. They characterize an optimal renegotiation design in the original contract under the assumption that there may or may not be trade, i.e. they focus on at will contracts. They build a model where the buyer's valuation and seller's cost of producing a homogeneous good are non verifiable and depend on their own investment and on the state of nature. Their timing is as follows:

- The contract is signed,
- investment levels chosen by the parties,
- state of nature realized,
- revelation/renegotiation,
- trade takes place.

Once the state of nature is realized, messages can be sent to reveal information or to help renegotiate. These messages may or may not be verifiable. A general underinvestment result obtains when no satisfactory outside option can be specified and when both parties invest.

A recent literature investigates the extent to which mechanisms or contracts can solve the hold-up problem. This issue is central to literatures on both incomplete contracts and the theory of the firm. It questions when institutions emerging as a response to the hold-up problem matter.

McLeod and Malcomson (1993) and Aghion et al (1994) propose contractual arrangements allowing for contract renegotiation and solving the hold-up problem[2]. They consider a two-agent relationship with a timing similar to Hart and Moore's. McLeod and Malcomson focus on the verifiability assumptions of the state of nature. They show that when there exists a rich enough verifiable partition of the set of states of natures, the use of escalatory clauses makes sure that investment levels are efficient. However, their assumption on verifiability would be hard to satisfy in a number of markets (where, for instance, it is impossible to refer to verifiable market prices).

Aghion et al (1994) show that the underinvestment problem can often be overcome by a contractual renegotiation design. They find that with risk-neutral agents, efficient investment can be achieved when the initial contract can specify a price-quantity pair as default option in case renegotiation fails or is unnecessary and assign all bargaining power to one party[3]: The default option gives, say the buyer, his first-best expected utility and induces him to choose the first-best level of investment. In turn, the allocation of all bargaining power to the seller leads her to choose her first best level of investment (the seller gets all returns on her investment minus a fixed sum). The main difference with Hart and Moore is the assumption that courts can enforce contractually

[2]Rogerson (1992) considers complex full commitment contracts using mechanisms such as d'Aspremont and Gérard-Varet's or Crémer and Riordan's. He shows that efficient levels of investment can be obtained with a variety of different informational assumptions when the agents are risk-neutral and there is no externality (each agent's investment affect his own type only).

[3]This is formalized in an infinite horizon bargaining game with the initial contract specifying both default options and either intial transfers refundable upon agreement or per diem transfers to be paid until an agreement is reached. These two instruments influence the parties' relative degree of impatience and thus their bargaining powers and can ensure that one party is residual claimant.

specified levels of trade.

Aghion et al exhibit sufficient conditions for efficient bilateral investment in the presence of renegotiation and one sided externalities. However, bilateral direct externalities generally lead to underinvestment since the party with full bargaining power does not internalize any direct externality. Their results might also explain why efficiency may fail to hold in practice. Apart from bounded rationality, there may be legal problems of enforceability making efficient renegotiation design impossible. Legal problems in enforcing a status quo level of trade may be particularly acute in employer/employee relationships. Hence, institutional design may matter.

1.3 On Incomplete Contracts

Closely related to Williamson's and Grossman and Hart's theories are the idea that that transaction costs lead parties to leave gaps in contracts. These gaps are a key ingredient to the importance of authority, control and ownership[4] There are few economists to question that contracts are incomplete, even though they may be very sophisticated. Few would also contest the usefulness of this methodology in developing intuitions and analysing economic institutions. However, worries have arisen about the need for more robust foundations for the literature on incomplete contracts. Indeed, rigorous foundations may require a theory of bounded rationality which is not available yet. Such foundations are not within the scope of this thesis. This subsection only discusses recent contributions, most of which are masterfully discussed and developed in Tirole (1994). It may be thought of as a caveat on the limitations of the methodology used in the incomplete contracts literature and in the next chapters.

An important characteristic of complete contracts is that the cost of designing perfectly contingent contracts is asymmetric information. The ability

[4]However, it has recently appeared that these notions can sometimes be formalized with complete contracts (Tirole (1994)).

to foresee contingencies and to write and enforce contracts have no limitation. The defenders of incomplete contracts have first tried to relax these assumptions.

Various arguments have been used to justify contractual incompleteness. One is that it may be impossible to know in advance all possible contingencies. It appears that this approach may not be consistent with traditional models which typically analyse contracts between rational expected utility maximizers who know at least the set of possible payoffs. Tirole (1994), in joint work with Eric Maskin, shows that in a wide range of circumstances, there exists a mechanism with unforeseen contingencies and foreseen payoffs that implements the ex post efficient allocation which would be attained under complete contracts.

Another approach is to emphasize writing and enforcement costs. These costs are often formalized by assuming that some variable is observable to the stakeholders, but not verifiable to the courts. In other words, there is asymmetric information between the stakeholders and the courts. However, this situation boils down to a symmetric information implementation or a multi-agent moral hazard problem. In these situations, a contract contingent on non verifiable information which is observed by the stakeholders can often be implemented (Moore (1992)) or unncessary (Aghion et al (1994)). An implicit assumption may be that such implementation mechanisms are accompanied by high measurement or complexity costs. Measurement costs are already included in the complete contract paradigm and do not imply contract incompleteness, but they may lead to outcomes which look like incomplete contract ones[5]. Optimal complete contracts are often complex which implies that their robustness can be questioned (see Hart and Holmström (1987) and Moore (1992)). In contrast, traditionnal models of incomplete contracts do not require the use of complex mechanisms. However, complexity costs and robustness are difficult to formalize. Given that these models of incomplete contracts still use ingredi-

[5]Tirole (1994) discusses the examples of career concerns developed by Holmström (1982) and Gibbons and Murphy (1992) which rule out the measurement of performance.

ents from rational expectations, rigorous foundations are still a challenge (see Anderlini and Felli (1994) for a contribution based on algorithms). Another direction has been to obtain contractual incompleteness from renegotiation or other collusion constraints. Tirole (1994), in joint work with Aghion, develops an example of innovation whose outcomes are characterised by unknown payoffs where an optimal complete contract can be implemented by a random allocation of property rights.

Despite all these difficulties, few would contest the usefulness of incomplete contracts in guiding intuitions on the workings of organisations. However, another important critique (related to the discussion above) is that contractual incompleteness may give a large freedom to economic modellers. Non variability may sometimes be an assumption ad hoc and should be carefully justified. This may look reasonable when referring to an effort or a profit subject to accounting manipulations, but there is little empirical work examining the verifiability of variables. Authors have tried to develop an analysis of organisations in sticking to similar informational and contractual assumptions. This methodology, used by Laffont and Martimort (1996), has the advantage of developing a very coherent framework.

Laffont and Martimort's starting point is the revelation principle, one of the major results of contract theory. This principle states that under standard informational assumptions the party offering a contract, the principal, can restrict her analysis to cases where the agent announces his information. With the revelation principle, standard contract theory addresses conflicts of interests between different parties, but not the analysis of organisations as the principal can always include all activities in a single contract. Laffont and Martimort examine organisations by relaxing assumptions necessary to obtain the revelation principle. In their framework, contractual incompleteness comes from communication costs between principals and problems in enforcing side contracts between other members of the organisation. The multiprincipal

analysis assumes that communication costs prevent various principals who can contract on a limited and different subset of the activities of the organisation from coordinating in their contract offers.

1.4 Interactions Between Financial and Industrial/Labour Contracts

The recent theoretical literature on the interactions between financial and industrial/labour contracts is concerned with analysing of a nexus of contracts. Most of the contributions deal with the strategic use of contracts by firms either in an imperfect competition setup or facing a commitment problem in rent extraction.

The first category was pioneered by Brander and Lewis' (1986) paper arguing that in a duopoly competing in quantities, debt induces firms to compete more aggressively by convexifying the firms' objective function via the limited liability effect. This paper, however, takes the debt contract as given and does not consider renegotiation[6]. Bolton and Scharfstein (1990) provide a seminal analysis of predation via a deep-pocket argument with an optimal renegotiation-proof debt contract. Faure-Grimaud (1995) shows that this optimal renegotiation-proof debt contract leads firms to compete less aggressively, a result more consistent with empirical evidence (see, amongst others, Chevalier (1995a)). Faure-Grimaud (1995) also surveys the literature on imperfect competition with financial constraints.

This thesis is more concerned with the second category which was pioneered by Titman's (1984) contribution on the financing decision of a durable good monopolist. Titman's point is that debt increases the probability of bankruptcy and hence the expected value of after-sale services. Hence, buyers are more reluctant to buy the durable good and decreases the value of the firm[7]. Al-

[6]In the same vein, Maksimovic (1988) argues that, in a repeated oligopoly game, debt affects the firms' ability to collude.

[7]In the same spirit, Maksimovic and Titman (1991) consider situations where debt alters firms' credibility in offering high-quality products and hence decreases the value of the firm.

though this point is certainly relevant and is consistent with some empirical evidence (Titman and Wessels (1988)), Titman abstracts from the durable good monopolist pricing problem. This is the subject of the final chapter of this thesis.

Within the theoretical works on the linkages between firms' financial structure and their behaviour in input and output markets, recent papers study how a high level of debt can be used as a bargaining tool by the shareholders in the wage negotiation with a union. Perotti and Spier (1993) argue that since a high level of debt commits the shareholders not to undertake some profitable investments, their own incentives to invest are ruined unless the workers agree to renegotiate their wage contracts. Therefore, a high level of debt can be used strategically to induce the union to renegotiate wage contracts. Some debt for equity performs achieve this strategic role whenever current returns are so low that the workers (or more generally the creditors) must rely on the surplus generated by future investments for full payment. Anticipating this, the workers obtain a higher initial wage contract, which is inefficient because they are risk-averse and they bear the risk[8]. This paper, however, does not focus on the real effects of union power which are analysed in Chapter 2.

In contrast, Sarig (1992) argues that the workers' firm-specific human capital can lead the union to obtain higher wages when the debt level is high. In his paper, given that the experienced employees are more productive than the unexperienced ones, the shareholders of highly levered firms are more sensitive to employees' threats to seek alternative employment than shareholders of less levered firms: given that there are more states leading to bankruptcy and so to zero-profit for the shareholders, the value of their disagreement outcome is lower. However, Sarig only focuses on the shareholders' interest. He does not

[8]There is a legal restriction since it is usually illegal to sign a contract where the firm withdraws capital knowing she will not be able to respect the existing wage contract. However, this argument holds in other situations where the courts cannot act in such a way, that is non verifiable contracts or manipulations.

consider that in a dynamic context, this argument implies that the workers may accept a lower initial wage, which can be, as we saw, very important both for efficiency and for the maximization of the value of the firm[9].

The next chapters analyse the way financial contracts and ownership issues affect commitment problems, namely the hold-up, Coasian commitment and dynamic adverse selection (Coasian dynamics and ratchet effect) problems. In doing so, they take different approaches of the theory of the firm. The second chapter takes a Williamsonian point of view in that it focuses on hold-up problems but not property rights. The third chapter considers an approach of property rights in the style of Grossman and Hart (1986) (more precisely Hart and Tirole (1990)) although the positive effect of competition is related to the Williamsonian idea that firms may want to deal with a competitive market to be protected from opportunism. The fourth chapter focuses on the nexus of contracts in a dynamic adverse selection context like Laffont and Martimort (1996), but it uses an optimal debt contract with a usual contractual incompleteness. The commitment problems on which we shall focus and the approach adopted in the next chapters are the subject of the next sections.

2 The Hold-Up Problem with Corporate Governance Issues

This section examines the hold-up problem while analysing the real effects of union power in the absence or the presence of a takeover threat. We show that a party's investment may well decrease with her bargaining power when takeovers are possible.

[9]Moreover, he assumes that bankruptcy leads to liquidation and does not give the possibility of reorganization to the shareholders.

2.1 The Economic Consequences of Union Power

Grout (1984) formalizes the widespread idea that unions increase labour costs and lead firms to underinvest. When union power increases, the share of the surplus that the firm appropriates from its investment decreases. Hence, its investment decreases. In Grout's setup, the return is a function of the firm's investment. The only role of unions is to appropriate a share of this surplus. This opportunism from the union does not compensate any kind of (non contractible) investment or desirable activity.

Chapter 2 allows the surplus to increase with some investment from the workers as well. This investment may be either an effort or a wage concession made to allow the firm to increase a financially constrained investment. First, in the simple case where the surplus depends on the workers' effort only, a simple formalization of the hold-up problem shows that this effort and hence the surplus increases with union power. When the initial labour market is imperfect, however, the firm appropriates a smaller share of this surplus and may be either better off or worse off with a higher union power.

Second, in the case where the surplus only depends on a financially constrained investment from the firm, a higher union power ensures that workers are ready to make a temporary wage concession aiming at increasing the firm's investment. A wage concession is understood as an investment from the firm which is all the more profitable as union power is high. Hence, a simple analogy with the hold-up problem casts doubt on the conventional wisdom that union power reduces wage flexibility. A more powerful union will appropriate a larger share from the surplus from investment. Therefore, the incentive to make a wage concession in order to allow the firm to increase its investment is higher. This implies that wage flexibility increases with union power[10]. In addition, a financially constrained firm invests all the more as union power is high due to

[10]For instance, German unions' power may induce them to agree on substantial real wage concessions in bad times (Financial Times (1994)) because they are confident they can secure benefits in future good times.

a higher wage flexibility or a higher effort from the workers. We shall see that these results may not hold when there may be a takeover.

2.2 Union Power and Takeovers

We now turn to the strategic use of financial manipulations to extract rents from unions. The business press is swarming with examples of managers leading their firm to financial distress to renegotiate wages down. The corporate raider Lorenzo tried to take over firms in order to force workers to renegotiate their wages down. He repeatedly failed to obtain wage concessions as well as motivation to provide good services from the workers from his companies. A particularly illustrative example can be found in Lorenzo's raids on TWA in 1985 and Eastern Airlines in 1986. The unions approached a white knight to whom they promised substantial wage concessions to induce him to overbid Lorenzo. In particular, TWA's unions offered 300 million dollars to Carl Icahn who bought the firm (see Bernstein (1990))[11].

Shleifer and Summers (1988) point out that hostile takeovers may take place in order to breach implicit (or self-enforcing) contracts in the target firm[12]. They argue that the rationale only applies for hostile takeovers because incumbent managers are committed to respect implicit contracts. Thus, the takeover must be "hostile" as the incumbent manager must be sacked for the new shareholders to benefit from the breach of implicit contracts. Holmström (1988) further argues that only a manager with a reputation for toughness would obtain wage concessions in bad times.

[11]Clearly, this type of argument is not limited to employer/employee relationships. In the same vein, the recent spin-off of British Gas in two entities may have been realized for a rent extraction purpose. British Gas is now split into two entities: one with profitable businesses and one with the non profitable ones and to which a contract with North Sea gas producers was attached. The rationale behind this spin-off was to force these producers to renegotiate these long-term contracts to the advantage of British Gas.

[12]Long-term relationships are often governed by a sequence of shorter term contracts. The expected outcome of the subsequent (re)negotiation contracting games affects ex ante investment levels and more generally self-enforcing, i.e. implicit, agreements. Although implicit contracts are often formalized with reputation effects, we shall instead understand them as the expectation of future bargaining outcomes.

Chapter 2 begins with a very simple observation which is to be contrasted with Shleifer and Summers (1988) and Holmström (1988). A priori, only a manager who can commit to leave rents to unions in the future may obtain more wage concessions (or any other investment). However, we further show that the presence of a takeover threat may make a tough manager obtain more wage concession than a soft one. The intuition is as follows: a tough raider will take over the firm only if the cost of doing so is lower than the gains from breaching implicit contracts. When the incumbent manager is soft, the gains from breaching implicit contracts are high and the incentive for a raider to take over the firm is high. Thus, when the incumbent manager's bargaining power increases, a higher effort or a wage concession can be made without triggering a takeover. The workers' effort and wage flexibility may decrease with union power.

A further result of the next chapter is that the workers may be willing to make wage concessions in order to prevent a takeover led by a tough raider. Since they anticipate to have higher rents from the incumbent manager, they are ready to make more concessions under him than under the raider[13]. Similarly, when the incumbent manager is tough and when this implies a cost higher than the takeover cost, the workers may offer a soft possible manager, i.e. a white knight, a substantial temporary wage concession to give him an incentive to buy. Such a wage concession may not take place when the takeover cost is too high, the workers face a wealth constraint (and credit rationing) or a co-ordination failure (so that a subsequent free rider problem among the workers cannot be solved) or when they want to build a reputation for refusing wage concessions.

[13]The takeover threat allowing a transfer from the workers to the shareholders may increase the firm's investment as well as the stage A wage.

3 When Does a Monopoly Supplier want to Reduce Downstream Competition?

The nexi of contracts have also proved very useful in analysing vertically related markets, the efficiency consequences of vertical restraints and competition policy. This section discusses the argument that a monopoly supplier facing a Coasian commitment problem wants to reduce downstream competition. It further investigates the interactions between the incentive for vertical integration and downstream competition.

3.1 Foreclosure and Vertical Integration

Foreclosure on vertically related markets by firms with market power has been a hotly debated issue. Foreclosure occurs when a dominant firm restricts access to an essential input to some downstream firms "with the intent of extending monopoly power from one segment of the market [...] to the other" (Rey and Tirole (1996)).

An important intuition behind this argument is that the use of vertical restraints allows a monopoly supplier to appropriate the downstream industry profit. If the supplier could not use vertical restraints and was forced to charge linear prices (and meet the demand at that price), the supplier would generally be better off with a competitive downstream industry requiring a large quantity of input. However, the use of (price) discrimination, vertical integration and non linear tariffs may allow the supplier to increase the downstream industry profit and appropriate it.

A recent theoretical literature has focused on the analysis of the nexus of contracts in such a framework to understand and formalize foreclosure. In this section, we restrict ourselves to Hart and Tirole's (1990) formalization, and to the role of vertical integration in facilitating foreclosure[14].

[14]Foreclosure may also, for instance, arise for an insurance motive when downstream firms compete for inputs in limited supply (Bolton and Whinston (1993) and Emons (1996)).

The basic framework in Hart and Tirole (1990) and Rey and Tirole (1996) is as follows: a monopoly supplier can supply two downstream firms competing on both the input and output markets. The supplier initially proposes a menu contract to each downstream firm which orders a quantity against the payment of a tariff. Then, the downstream firms transform the input, observe each other's output and compete in quantities. In the absence of informational problems between downstream firms, the fact that the contract offers are made by the supplier would allow her to appropriate the whole downstream industry profit. Hence, only the monopoly quantity would be produced. A crucial feature of their model is that the supplier's contract offers to a downstream firm are not observable to the other downstream firms. Together with other contractual and behavioral assumptions, this implies that in equilibrium the supplier sells the Cournot quantity to the downstream industry. If she claimed to sell half of the monopoly quantity to each downstream firm against the payment of half of the monopoly profit, she would be better off secretly renegotiating this agreement ex post in order to sell additional units. Although she would be better off restricting her production to the monopoly quantity, the secrecy of transactions creates a commitment problem. Since the downstream firms anticipate that the supplier will sell the Cournot quantity, the transfers to the supplier are reduced[15]. Hence, the supplier would be better off facing a monopolistic downstream industry[16]. When the number of downstream firms increases, the cost to the supplier of her commitment problem increases.

Vertical integration may solve this commitment problem and allow the supplier to supply the monopoly quantity and foreclose the downstream market. When the supplier owns one downstream firm, her return rights lead her to

[15]This commitment problem is closely related to the Coasian dynamics, i.e. the durable good monopolist pricing problem, that we shall see in the next section and in Chapter 4. Rey and Tirole (1996) carefully analyse this analogy and refer to the present problem as the Coasian commitment problem.

[16]In the case where the supplier must invest initially, she thus faces a hold-up problem from both the downstream firms and the final consumers which is aggravated by her own impossibility to commit not to act in an opportunistic way.

internalize the cost to her subsidiary of flooding other downstream firms with the input. In this case, the benefit from vertical integration increases with competition in the downstream industry.

3.2 On the Incentive to Favour Competition

Chapter 3 is concerned with analysing to what extent the use of vertical restraints induces a monopoly supplier to reduce competition in the downstream industry. It further derives an application to vertical integration as a function of the competitive environment in the downstream industry.

The chapter begins with the observation that a supplier may not have all bargaining power with the downstream firms even though those compete for the input. For instance, the mere threat of appearance of an alternative source of supply would make the supplier impatient to sign a contract with the downstream firms, which would increase the downstream firms' bargaining power. The supplier may even be better off ex ante with downstream firms with some bargaining power to guarantee them a payoff which is high enough not to invest to find out an alternative source of supply.

Hence, the use of vertical restraints allows the supplier to appropriate only part of the downstream industry output. This would still make her better off with a monopolistic downstream industry. However, chapter three shows that competition may still be valuable to the supplier to improve her negotiation position: since the downstream firms have some bargaining power, the expected bargaining outcome depends on their offer to the supplier when negotiating. Furthermore, when they can neither coordinate nor observe the transactions between the supplier and their competitors, the downstream firms offers equal the supplier's marginal cost of producing the units they offer. When they compete for the input and the supplier's marginal cost is increasing, more competition leads to a higher expected quantity and thus to higher offers to the supplier. When downstream firms' bargaining power is high enough, the

supplier is therefore better off with fiercer downstream competition.

Chapter three applies this approach to derive a theory of vertical integration based on the competitive environment. It is assumed that vertical integration comes with an agency cost. As in Hart and Tirole (1990), vertical integration commits the supplier to sell the monopoly quantity only and allows her to appropriate the monopoly surplus whatever the supplier's bargaining power. When the supplier's bargaining power is low (resp. high), this benefit is higher than the cost of integration if the downstream market is competitive (resp. concentrated) enough.

Ex ante, the possibility of vertical integration has important repercussions on market structure. Namely, entry in the downstream industry may be restricted and horizontal mergers or spin-offs may be observed.

Firms' incentives to promote competition in vertically related markets is observed in practice. For instance, Rey and Tirole (1996) describe how a change in regulation led AT&T to divest its supplier AT&T Technology. This decision is thought to be motivated by the desire to promote competition: Divesting may have been a commitment not to have favored relationships and to discriminate against competing firms. Favored relationships might have led competing firms to engage in long-term relationships with other suppliers. Divesting was meant to favour AT&T's and AT&T Technology's development and thus maybe a profitable strategy. Firms' incentives to promote competition in vertically related markets may also help to improve the efficiency of competition policy.

4 Dynamic Adverse Selection and the Strategic Use of Debt

The two preceding sections (and the next two chapters) are concerned with the role of some institutions in (so called moral hazard) problems where rent extraction may lead to underinvestment. We now turn to another type of problem where the payoff to a monopolist is constrained by the (single) buyer's

private information about his valuation for the good. We investigate how the strategic use of debt may increase the monopolist's payoff.

4.1 Dynamic Adverse Selection

In this subsection, we describe important features of dynamic adverse selection and present the two most famous adverse selection problems, namely the ratchet effect and the durable good monopolist pricing problem. For simplicity, we restrict ourselves to the case where the buyer may only be of two types, high and low.

As a benchmark, the analysis of the static case where the monopolist can make contract offers only once typically leads to the following results (see Maskin and Riley (1984)). The high valuation buyer buys the first best allocation and benefits from an informational rent, while the low valuation buyer buys a suboptimal quantity and has no rent. The monopolist's payoff is constrained by the fact that the high valuation buyer may benefit from the contract aimed at the low valuation one and is thus led to leave him an informational rent.

Furthermore, the monopolist's payoff is generally limited by other constraints in long term relationships when she can make different contract offers over time. Namely, the buyer's response to the initial contract offers provides the monopolist with some information about the buyer's valuation. The monopolist can exploit this information when making the subsequent contract offers. More particularly, this information may allow her to reduce the high valuation buyer's informational rent. Therefore, it is costly for the high valuation buyer to reveal his type at an early stage. This implies that at each stage the contract offers are subject to the constraint that the high valuation buyer's expected rent from not revealing information is lower than the utility from revealing information now.

Research in dynamic adverse selection has been guided by the famous Coase

conjecture (Coase (1972)). Now well formalized (in a dynamic adverse selection model by Hart and Tirole (1988)), this durable good monopolist pricing problem comes from the buyer's expectation that the monopolist will decrease her price over time. In the case of one buyer with private information and unit demand, the high valuation buyer may want to mimick the low valuation one and wait for a subsequent decrease in price (due to the monopolist's updated beliefs) before buying. In other words, the monopolist competes with herself over time.

This competition over time is also a feature of the ratchet effect. This effect may be thought of either the rental situation of the durable good or the sale of a non durable one. It simply comes from the high valuation buyer's expectation that buying the good at a high price at an early stage will reveal his type and lead the monopolist to charge high prices in the future.

4.2 Potential Solutions and the Strategic Use of Debt

The Coase conjecture has been a very popular theme in the industrial organization literature over the last decades. Several solutions have been proposed to limit the intertemporal competition faced by the monopolist.

Ex ante, the monopolist may want to commit in a long-term contract to stick to the static contract offers all along the relationship and replicate her static payoff. However, this is impossible in a wide range of situations. First, long-term contracts may come with substantial costs and the sequence of short-term contracts will be subject to the constraint mentioned above. Second, even when long-term contracts are signed at an early stage, they may be subject to renegotiation (Laffont and Tirole (1993)) the outcome of which depends on the information revealed to the monopolist. One may be tempted to think that it is possible to commit to a certain behaviour with a third party. However, such a commitment would also be subject to renegotiation.

It has also been pointed out that leasing a durable good allows her to evade

the Coase conjecture. However, leasing is subject to moral hazard issues on the demand side. Another idea is that the monopolist may destroy his factory after today's production to commit not to flood the market in the future. This solution is only appropriate in a situation with several potential buyers. In the case of one buyer with unit valuation, once the good is produced, only the price at which it will be sold matters and the commitment not to flood the market is unimportant. Moreover, the monopolist could produce the durable good with another factory.

The final chapter, joint with Antoine Faure-Grimaud (LSE), goes somewhat further into this last direction. We argue that debt is a mechanism which ensures that the firm is liquidated if a high valuation buyer does not buy the good, which forces this high valuation buyer to reveal his type early.

This role of debt in favouring the elicitation of information holds because inefficient renegotiation implies that the commitment with the third party (the lender) is credible. It is sufficient for the monopolist to be so financially constrained that the buyer's decision not to reveal his information early leads to cash constrained and thus inefficient debt renegotiation implying liquidation. This leads to the somewhat provocative result that a higher level of debt may decrease the probability of inefficient liquidation.

The final chapter also investigates a number of applications. In particular, the advantage of the strategic use of debt is higher the fiercer the competition that the monopolist faces with herself over time, that is the higher the durability of the good. This point is to be contrasted with Titman's (1984) argument that a high level of debt, by increasing the probability of liquidation, decreases the expected value of after-sale services and hence buyers' willingness to buy the good and the value of the firm. Dynamic adverse selection issues may well have been overlooked in the literature on the interactions between financial and industrial contracts.

REFERENCES

Aghion, P. and P. Bolton (1987), "Contracts as a Barrier to Entry", *American Economic Review*, 77, 388-401.

Aghion, P. and P. Bolton (1992), "An Incomplete Contracts Approach to Financial Contracting", *Review of Economic Studies*, 59, 473-494.

Aghion, P., M. Dewatripont and P. Rey (1994), "Renegotiation Design under Unverifiable Information", *Econometrica*, 62, 257-282.

Aghion, P. and J. Tirole (1994), "Formal and Real Authority in Organizations", mimeo Nuffield College and IDEI.

Anderlini, L. and L. Felli (1994), "Incomplete Written Contracts: Undescribable States of Nature", *Quarterly Journal of Economics*, 109, 1085-1124.

Aoki M. (1990), "Toward an Economic Model of the Japanese Firm", *Journal of Economic Literature*, Volume XXVIII, 1-27.

Bernheim, B. and M. Whinston (1986), "Common Agency", *Econometrica*, 54, 923-42.

Bernheim, B. and M. Whinston (1986b), "Menu Auctions, Resource Allocations, and Economic Influence", *Quarterly Journal of Economics*, 101, 1-31.

Bernstein A. (1990), *Grounded: Frank Lorenzo and the Destruction of Eastern Airlines*, Simon and Schuster (ed.).

Bhattacharya, S. and G. Chiesa (1995), "A Theory of Intermediation with Proprietary Information", *Journal of Financial Intermediation*, 4, 328-57.

Bolton, P. and D. Scharfstein (1990), "A Theory of Predation Based on Agency

Problems in Financial Contracting", *American Economic Review*, 80, 93-106.

Bolton, P. and D. Scharfstein (1996), "Optimal Debt Structure with Multiple Creditors", *Journal of Political Economy*, 104, 1-25.

Bolton, P. and M. Whinston (1991), "The "Foreclosure" Effects of Vertical Mergers", *Journal of Institutional and Theoretical Economics*, 147, 207-226.

Bolton, P. and M. Whinston (1993), "Incomplete Contracts, Vertical Integration, and Supply Assurance", *Review of Economic Studies*, 60, 121-148.

Brander, J. A. and T. R. Lewis (1986), "Oligopoly and Financial Structure: The Limited Liability Effect", *American Economic Review*, 76, 956-70.

Bulow, J., J. Geanakoplos and P. Klemperer (1985), "Multimarket Oligopoly: Strategic Substitutes and Complements", *Journal of Political Economy*, 93, 488-511.

Burkart, M., D. Gromb and F. Panunzi (1996), "Large Shareholders, Monitoring and the Value of the Firm", mimeo LSE and MIT.

Caillaud, B., B. Jullien and P. Picard (1995), "Competing Vertical Structures: Precommitment and Renegotiation", *Econometrica*, 61, 621-46.

Chevalier J. (1995a), "Capital Structure and Product Market Competition: An empirical Study of Supermarket LBOs", *American Economic Review*, 85, 206-56.

Chevalier J. (1995b), "Do LBO Supermarkets Charge More? An Empirical Analysis of of the Effects of LBOs on Supermarket Pricing", *Journal of Finance*, 50, 1095-1113.

Chiappori, P. A., I. Macho, P. Rey and B. Salanié (1994), "Repeated Moral

Hazard: The Role of Memory, Commitment, and the Access to Credit Markets", *European Economic Review*, 38, 1527-53.

Coase R. (1937), "The Nature of the Firm", *Economica*, 4, 388-405.

Coase R. (1972), "Durability and Monopoly", *Journal of Law and Economics*, 15, 143-49.

Crémer J. (1994), "A Theory of Vertical Integration Based on Monitoring Costs", mimeo IDEI.

Dewatripont M. (1988a), "Commitment through Renegotiation-Proof Contracts with Third Parties", *Review of Economic Studies*, 55, 377-89.

Dewatripont M. (1988b), "The Impact of Trade Unions on Incentives to Deter Entry", *Rand Journal of Economics*, 19, 191-99.

Dewatripont M. (1989), "Renegotiation and Information Revelation Over Time: The Case of Optimal Labor Contracts", *Quarterly Journal of Economics*, 104, 589-619.

The Economist (1996), "Hot Air?", February 10, 84-85.

Edlin, A. and S. Reichelstein (1996), "Hodups, Standard Breach Remedies, and Optimal Investment", *American Economic Review*, 86, 478-501.

Emons W. (1996), "Good Times, Bad Times, and Vertical Upstream Integration", *International Journal of Industrial Organization*, forthcoming.

Farrell, J. and C. Shapiro (1989), "Optimal Contracts with Lock-In", *American Economic Review*, 79, 51-68.

Faure-Grimaud A. (1995), "Essays on Imperfect Competition with Financial Constraints", PhD Dissertation, Université de Toulouse.

Morch von der Fehr, N.-H. and K.-U. Kühn (1995), "Coase versus Pacman: Who Eats Whom in the Durable-Goods Monopoly?", *Journal of Po-*

litical Economy, 103, 785-812.

Financial Times (1994a), "Welcome Deal in Germany", March 7.

Financial Times (1994b), "The UAL Deal with Unions", March 28.

Fudenberg, D., D. Levine and J. Tirole (1987), "Incomplete Information Bargaining with Outside Opportunities", *Quarterly Journal of Economics*, 102, 37-50.

Gibbons, R. and K. Murphy (1992), "Optimal Incentive Schemes in the Presence of Career Concerns", *Journal of Political Economy*, 468-505.

Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, 94, 691-719.

Grout P. (1984), "Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach", *Econometrica*, 52, 449-60.

Harris, M. and A. Raviv (1992), "Financial Contracting Theory", in *Advances in Economic Theory, Sixth World Congress of the Econometric Society*, J. J. Laffont (ed.), Cambridge University Press.

Hart O. (1989), "An Economist's Perspective on the Theory of the Firm", *Columbia Law Review*, 89, 1757-74.

Hart O. (1995), *Contracts, Firms and Financial Structure*, Clarendon Lectures in Economics, Oxford Univesity Press.

Hart, O. and B. Holmström (1987), "The Theory of Contracts", in *Advances in Economic Theory, Fifth World Congress of the Econometric Society*, T. Bewley (ed.), Cambridge University Press.

Hart, O. and J. Moore (1988), "Incomplete Contracts and Renegotiation", *Econometrica*, 56, 755-85.

Hart, O. and J. Moore (1990), "Property Rights and the Nature of the Firm", *Journal of Political Economy*, 98, 1119-58.

Hart, O. and J. Moore (1994), "A Theory of Debt Based on the Inalienability of Human Capital", *Quarterly Journal of Economics*, 109, 841-79.

Hart, O. and J. Tirole (1988), "Contract Renegotiation and Coasian Dynamics", *Review of Economic Studies*, 55, 509-40.

Hart, O. and J. Tirole (1990), "Vertical Integration and Market Foreclosure", *Brookings Papers on Economic Activity*, Special Issue, 205-76.

Holmström B. (1982), "Managerial Incentive Problems: A Dynamic Perspective", in *Essays in Honor of Lars Wahlbeck*, Helsinki, 324-340.

Holmström B. (1988), Comment on "Breach of Trust in Hostile Takeovers", in *Corporate Takeovers: Causes and Consequences*, Edited by Alan J. Auerbach, University of Chicago press.

Jensen M. (1986), "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers", *American Economic Review*, 76, 323-29.

Katz M. (1991), "Game-playing agents: unobservable contracts as precommitments", *Rand Journal of Economics*, 22, 307-28.

Kreps D. (1990), "Corporate Culture and Economic Theory", in *Perspectives on Positive Political Economy*, J. Alt and K. Shepsle (eds.), Cambridge University Press.

Krueger A. (1974), "The Political Economy of the Rent-Seeking Society", *American Economic Review*, 64, 291-303.

Kühn, K.-U. and X. Vives (1994), "Excess Entry, Vertical Integration and Welfare", mimeo Institut d'Anàlisi Econòmica.

Laffont J. J. (1990), "Analysis of Hidden Gaming in a Three-Level Hierarchy",

Journal of Law, Economics and Organization, VI-2, 301-324.

Laffont, J. J., and D. Martimort (1996), "The Firm as a Multi-Contract Organization", mimeo IDEI.

Laffont, J. J. and J. Tirole (1988), "The Dyamics of Incentive Contracts", *Econometrica*, 56, 1153-75.

Laffont, J. J. and J. Tirole (1993), *A Theory of Incentives in Procurement and Regulation*, MIT Press.

Lichtenberg, F. and D. Siegel (1989), "The Effect of Takeovers on the Employment and Wages of Central-Office and Other Personnel", *NBER working paper No. 2895.*

MacLeod, B. and J. Malcomson (1993), "Investment, Hold-Up and the Form of Market Contracts", *American Economic Review*, 83, 811-837.

Maksimovic V. (1988), "Capital Structure in Repeated Oligopolies", *Rand Journal of Economics*, 19, 389-407.

Maksimovic, V. and S. Titman (1991), "Financial Policy and a Firm's Reputation for Product Quality", *Review of Financial Studies*, 4, 175-200.

Maskin, E., and J. Riley (1984), "Monopoly with Incomplete Information", *Rand Journal of Economics*, 15, 171-96.

Milgrom P. (1988), "Employment Contracts, Influence Activities and Efficient Organization Design", *Journal of Political Economy*, 96, 42-60.

Milgrom, P. and J. Roberts (1992), *Economics, Organization and Management* Englewood Cliffs, New Jersey, Prentice Hall.

Moore J. (1992), "Implementation, Contracts, and Renegotiation in Environments with Complete Information", in *Advances in Economic Theory, Sixth World Congress of the Econometric Society*, J. J. Laffont (ed.),

Cambridge University Press.

Nöldeke, G. and K. Schmidt (1995), "Option Contracts and Renegotiation: A Solution to the Hold-Up Problem", *Rand Journal of Economics*, 26, 163-79.

Ordover, J., G. Saloner and S. Salop (1990), "Equilibrium Vertical Foreclosure", *American Economic Review*, 80, 127-142.

Perotti, E. C. and K. E. Spier (1993), "Capital Structure as a Bargaining Tool: The Role of Leverage in Contract Renegotiation", *American Economic Review*, 83, 1131-41.

Perry M. (1989), "Vertical Integration: Determinants and Effects", *Handbook of Industrial Organization*, Schmalensee and Willig, eds.

Rey, P. and J. Tirole (1996), "A Primer on Foreclosure", mimeo IDEI.

Rogerson W. (1992), "Contractual Solutions to the Hold-Up Problem", *Review of Economic Studies*, 59, 777-94.

Rosett J. (1990), "Do union wealth concessions explain takeover premiums", *Journal of Financial Economics*, 27, 263-82.

Sarig O. (1992), "The Effect of Leverage on Bargaining with a Corporation", mimeo Tel Aviv University.

Scharfstein D. (1988), "The Disciplinary Role of Takeovers", *Review of Economic Studies*, 55, 185-199.

Scherer F. (1988), "Corporate Takeovers: The Efficiency Arguments", *Journal of Economic Perspectives*, Vol. 2, No. 1, 69-82.

Segal I. (1995), "Complexity and Renegotiation: A Foundation for Incomplete Contracts", mimeo Harvard University.

Shleifer, A. and L. Summers (1988), "Breach of Trust in Hostile Takeovers",

in *Corporate Takeovers: Causes and Consequences*, Edited by Alan J. Auerbach, University of Chicago press.

Spiegel, Y. and D. Spulber, "The Capital Structure of Regulated Firms", *Rand Journal of Economics*, 25, 424-40.

Tirole J. (1988), *The Theory of Industrial Organization*, MIT Press.

Tirole J. (1992), "Collusion and The Theory of Organizations", in *Advances in Economic Theory, Sixth World Congress of the Econometric Society*, J. J. Laffont (ed.), Cambridge University Press.

Tirole J. (1994), "Incomplete Contracts: Where do we Stand?", Walras-Bowley lecture, North American Summer Meetings of the Econometric Society.

Titman S. (1984), "The Effect of Capital Structure on a Firm's Liquidation Decision", *Journal of Financial Economics*, 13, 137-51.

Titman, S. and R. Wessels (1988), "The Determinants of Capital Structure Choice", *Journal of Finance*, 43, 1-19.

Williamson O. (1985), *The Economic Institutions of Capitalism*, Free Press.

Chapter 2

Implicit Contracts, Union Power and Takeovers

Abstract

This chapter studies the economic consequences of union power in wage negotiations. It argues that the effects of union power are very sensitive to the possibility of takeovers. In the absence of takeovers, the wage flexibility and the workers' effort are shown to increase with the union power. Hence, when the employer must invest, there are costs and benefits of union power. Under the threat of a takeover reducing the expected wages, the workers' effort and wage flexibility are restricted and they decrease with the initial union power. Various takeover defence mechanisms are compared.

1 Introduction

This chapter develops a theory of costs and benefits of union power in wage negotiations. It points out that union power may have very different effects depending on whether takeovers are possible or not. We claim that in the absence of takeovers, union power can enhance wage flexibility and the workers' incentives to work, but reduce the firm's incentive to invest. For instance, we suggest that German unions' power allows them to agree on substantial real wage concessions in bad times (Financial Times (1994)) because they are confident they can secure benefits in future good times. However, under a takeover threat, the workers' effort and wage flexibility may decrease with the union's bargaining power: the higher the latter, the higher the incentive for a raider to take over the firm to renege on future wages. Thus, when the union's power decreases, a higher effort or a wage concession can be made without triggering a takeover. Examples of strategic unions' actions with raiders can be found in the US airline industry[1].

Assume that an entrepreneur runs a project whose future return increases with a non contractible and (partly) firm-specific effort from a worker. Suppose that this long-term relationship is governed by a sequence of short-term contracts. The expected negotiation of the future short-term contracts affects ex ante investments and more generally self-enforcing, i.e. implicit, contracts[2].

[1]The tough raider Lorenzo repeatedly failed to obtain wage concessions and good services from the workers of airlines companies he took over. In particular, after his raids on TWA in 1985 and Eastern Airlines in 1986, the unions did not only refuse to make concessions, but also looked for a white knight. They promised him substantial wage concessions against his overbidding Lorenzo. This succeeded for TWA where Icahn was offered 300 million dollars by the unions, could overbid Lorenzo and finally bought the firm. This failed for Eastern Airlines where Lorenzo demanded an unacceptable price. Later on, the Lorenzo empire collapsed (see Bernstein (1990)). Icahn was less tough than Lorenzo, but not very soft either.

[2]Reputation effects can help sustain implicit labour contracts in which the workers make a non verifiable effort against the promise of a future payment by their employer (Bull (1987)). By reneging on her promise, the employer would harm her reputation so that workers would be reluctant to engage into such agreements in the future. On implicit contracts, see also Hart and Holmström (1987).

More specifically, the entrepreneur may be better off having a weak bargaining power, i.e. being soft[3]: anticipating a larger share of future profits, the worker is ready to invest more via a higher effort and a larger wage concession. Conversely, under a strong bargainer, the hold-up problem is more severe: the worker does not expect much from the future and invests less.

Symmetrically, when the return increases with a non contractible investment from the entrepreneur, a union's bargaining power that is too high induces the entrepreneur to underinvest. There is a tradeoff (from both the entrepreneur's and the social point of view) between the increased cost of labour restricting the firm's investment and the benefits of a higher wage flexibility and more investment from the worker. A socially optimal bargaining power would maximize the social surplus under the constraints that each party chooses her investment so as to maximize her payoff. Hence, we have costs and benefits of union power.

However, the sustainability of implicit labour contracts is constrained by the possibility of takeovers aimed at earning from reducing future wages. Once the investments are sunk, a tougher raider would earn more when bargaining than the incumbent entrepreneur. This gives the former an incentive to take over the firm. When the takeover is costly, the worker restricts his effort either to a level that prevents the takeover when possible or otherwise to a level that is compatible with the tough raider running the firm. Preventing the takeover can even require an effort that is lower than accommodating it. When the surplus becomes low, the worker is better off making a wage concession conditional upon the incumbent entrepreneur keeping control. Furthermore, under the threat of a takeover, the worker's effort and wage flexibility *increase* with the incumbent entrepreneur's bargaining power: increasing the latter reduces the the incentive to take over the firm.

[3]In what follows, we shall use either soft or weak and either tough or strong since we study a trivial case of reputation: a strong entrepreneur cannot commit not to use her bargaining strength, i.e. not to be tough.

Takeover defence mechanisms can help sustain implicit contracts. However, when potential raiders have different valuations which are not verifiable, anti-takeover defences should be endogenous and therefore implicit. Written anti-takeover contracts increasing the takeover cost are too rigid to satisfy this condition and introduce inefficiencies: they cannot at the same time allow all desirable takeovers and protect implicit contracts. Giving the worker the right to reject the takeover increases flexibility, but may protect inefficient implicit contracts, i.e. may allow the worker to maintain too high his bargaining power.

Our results on the impact of union power in the absence of takeovers are to be contrasted with Grout (1984). In Grout's setup, the profit as a function of the investment from the firm only makes union power reduce the firm's investment. In his setup, the main role of union power is to take away from the firm a larger share of the profit and lead her to underinvest. Here, we argue that the profit may well depend on an investment from the workers as well. In this case, a higher union power increases wage flexibility and the effort from the worker, which in turn may increase both the surplus and the profit. When the firm is financially constrained, her investment may increase with union power via either a higher wage flexibility or a higher effort from the worker. More generally, the idea that a principal may benefit from giving power to an agent has recently received a lot of attention. Aghion and Tirole (1994) show that to delegate authority may foster the agent's initiative. Burkart, Gromb and Panunzi (1995) and Habib (1994) independently developed arguments that a dispersed ownership can commit shareholders to free ride and respectively not to acquire information which may be used to overrule a manager and not to renege upon the promises of deferred compensation to workers. The manager's and workers' efforts thus decrease as the ownerhip becomes more dispersed. Our arguments, however, concern the effects of expected bargaining outcomes (rather than those of authority or free riding) on several aspects of economic activity.

Concerning takeovers, the chapter is related to Shleifer and Summers' (1988) argument that the gains in hostile takeovers may derive from the breach of implicit contracts in the target firm. The authors assume that the incumbent managers are committed to respect implicit contracts[4]. Holmström (1988)'s comment supports their point that a manager with a reputation for softness will not be able to obtain drastic concessions when necessary and that she must be replaced for the firm to obtain wage concessions. In contrast, our starting point is that when the outcome of future negotiations are at stake, only an entrepreneur who can commit not to be tough in the future can a priori change her negotiation position and obtain more concessions from the union when this can increase profits. Under takeover threats, however, the workers may work more and be better off working with a sufficiently tough incumbent manager. They may also benefit from giving away power to the incumbent manager. This suggests that the decline of unions in the US and the UK in the past decades may be positively correlated with the deregulation of financial markets leading to more takeovers in these countries.

Section 2 presents the model. Section 3 studies the effect of future wage negotiations on the worker's effort and wage flexibility and on the entrepreneur's incentive to invest. Section 4 analyzes the impact of takeovers and takeover defence mechanisms on the worker's effort. Section 5 concludes.

2 The Model

An entrepreneur wants to undertake a two-stage project:

- in stage A, a worker is hired at wage w_A and exerts an effort $e \in I\!R_+$ at cost $c(e) = e$.

[4]Thus, the bidder must sack the incumbent manager, i.e. the takeover must be "hostile", in order to renege on the implicit contracts. We shall argue in the conclusion that friendly takeovers may also lead to a breach of trust. This is consistent with empirical studies (Lichtenberg and Siegel (1989), Rosett (1990)).

- in stage B, the two parties bargain over a wage w_B and sign a wage contract. Then, a return $g(e)$ is generated and the worker receives w_B.

The entrepreneur's and worker's objective functions are respectively $\pi = g(e) - w_A - w_B$ and $w_A + w_B - e$. Let w_0 be the worker's outside opportunity wage in each stage[5]. We shall call $w_0 - w_A$ the wage flexibility[6]. For simplicity, the labour market in stage A will be considered as perfectly competitive unless otherwise specified. The worker does not consume before the end of stage B. We assume that the worker can costlessly be induced to work in stage B. There is no discounting.

The return function g is twice differentiable with $g' > 0$, $g'' < 0$ and $g'(0) = +\infty$. For convenience, note $f(e) = g(e) - w_0$ and assume that $f(0) = 0$. The project is profitable[7]:

$$\exists e \in I\!R_+,\ g(e) \geq 2w_0 + e \tag{1}$$

Assumption 1 : *The effort is (at least partly) firm specific and not contractible.*

If the effort was not (at least partly) firm-specific, the worker could play the entrepreneur against another firm and appropriate the whole surplus created. There are many reasons why the effort may not be contractible. For instance, the tasks allocated to the worker may be numerous and difficult to specify in a contract or to monitor. If complete long term contracts were feasible, the entrepreneur could obtain the first best level of effort e^* maximizing $f(e) - e$, i.e. such that $f'(e^*) = 1$, via an incentive contract signed in stage A. In contrast, signing a contract contingent on the effort or on the profit in stage

[5]The assumption that the outside opportunity wage is identical in both stages is without loss of generality.

[6]All our results concerning the wage flexibility also hold if it is defined as $w_B - w_A$.

[7]In what follows, nothing changes when introducing uncertainty on the realization of the returns (ie: we could write Eg instead of g) except when specified in section **4.3** if the realization occurs between the effort being exerted and the stage B wage being contracted.

A is assumed to be impossible or too costly. For a high level of effort to be chosen, the parties have to rely on self-enforcing contracts.

Assumption 2 : *Long term contracts are not feasible.*

A justification of this assumption is that the return to be realized is non verifiable in stage A, but it can be made verifiable at the beginning of stage B. For instance, for $g(e)$ to be verifiable and w_B to be enforceable, the entrepreneur has to send a message (whose existence is observable but not verifiable) when the state of nature at the beginning of stage B is revealed. This could be the disclosure of a trade contract or the result of a R&D stage. Thus, while it cannot be explicitly agreed ex ante that this message will be sent, the entrepreneur must send it before signing the contract in stage B: otherwise, the entrepreneur would pretend that no return has been generated. The worker would anticipate that the wage contract is not enforceable and would not agree to sign it. No return would be realized. An alternative explanation is that accounting manipulations are possible in order to hide profits, but that they can occur only before the effort is made. In equilibrium, the profit will actually be made verifiable when bargaining in stage B.

Assumption 3 : *The stage B wage bargaining game is as follows: a take-it-or-leave-it offer is made by the entrepreneur with probability p and by the worker with probability* $(1-p)$. *We call p the entrepreneur's bargaining power.*

Several factors may affect bargaining powers. For instance, when there are several workers, the union's bargaining power is likely to increase with the number of unionized workers: more representation brings more dues which can be spent on negotiating, looking for outside options, financing industrial actions,... It may also commit more workers to the actions decided by the union. In addition, bargaining powers can reflect characteristics of the production technology and/or the nature of the effort. For instance, the entrepreneur's

bargaining power is likely to be low when the worker hired in stage A is crucial for the realization of the return and when his effort is an investment in human capital which other firms value. These factors themselves may depend on the entrepreneur's skills and the production technology[8]. The bargaining power may also be affected by the concentration in ownership structure or the delegation of control: for instance, if the entrepreneur is the most important shareholder of the firm, she is more willing to spend in haggling when her share is large[9].

Let K be the entrepreneur's initial capital. As we proceed, we shall compare the project described above with a similar project where the return is a function of an investment I from the entrepreneur. For simplicity, we shall often assume that I is not contractible. For the sake of clarity, we shall focus on the case where the entrepreneur is capital constrained and where she cannot obtain enough money from outside investors to finance I.

We shall consider that there are two possible types of entrepreneurs: soft ones S with a bargaining power p_s and tough raiders R with a bargaining power $p_r > p_s$[10]. An entrepreneur's type is common knowledge and can be viewed as a reputation that the entrepreneurs cannot manipulate[11]. The question is whether the soft or the tough entrepreneur is better off. The incumbent entrepreneur is S. R can take over the firm at cost D after e was exerted and

[8]The entrepreneur's monitoring and/or production technologies may make him more or less dependent on the initial worker. For instance, the entrepreneur may learn how to perform a number of productive and monitoring tasks. Since she will not be able to perform the tasks she did not learn, not to learn some tasks is a commitment to delegate. The worker will observe what tasks the entrepreneur can perform, what tasks will be delegated to him and thus how necessary he is likely to be.

[9]In this case, we shall see that as in Habib (1994) and Burkart, Gromb and Panunzi (1995), the entrepreneur may wish to be a small shareholder, here because this commits him not to spend much on haggling. However, we shall keep the bargaining power exogenous.

[10]We shall see that if there were a continuum of raiders with bargaining powers in $[p_s, p_r]$, then the toughest raider has the highest incentive to take over the firm.

[11]Akerlof (1983) argues that behaviour depends on education and values taught earlier and that it may be very costly to manipulate them. Similarly, one might think that people acquire and use some skills and that new skills affecting their bargaining power are difficult to acquire on the spot.

before w_B is contracted[12]. The analysis is not affected under the alternative assumption that there is no takeover, but S cannot commit not to become R at cost D.

3 Wage Negotiations and Investment

In this section, we assume away takeovers, i.e. $D = +\infty$. Only the incumbent entrepreneur can realize $g(e)$. We thus abstract from the subscript s.

3.1 Worker's Effort and Wage Flexibility

We proceed by backward induction and first derive w_B. With probability p, the entrepreneur offers $w_B = w_0$ to the worker who does not benefit from his effort. With probability $1 - p$, the worker offers $w_B = g(e)$ and appropriates the whole surplus. Hence, in expected terms, $(E)w_B$ is given by:

$$w_B = w_0 + (1 - p)f(e) \tag{2}$$

In equilibrium, the worker exerts:

$$e^{**} = \arg\max_e \{w_0 + (1 - p)f(e) - e\} \tag{3}$$

which leads to:

$$e^{**} = f'^{-1}\left(\frac{1}{1 - p}\right) \tag{4}$$

Since $f'' < 0$, f' is a mapping function and $e(p)$ and $e'(p)$ are well defined. If $f(e^{**}) - e^{**} - w_0 < 0$, the worker's effort leads to a negative profit and the project is not undertaken. We focus on the non trivial case where $f(e^{**}) - e^{**} \geq w_0$. There is underprovision of effort with respect to the social optimum as soon as the entrepreneur's bargaining power is strictly positive. When the worker is hired, his individual rationality (IR) constraint is:

[12]How the surplus is shared between the raider and the incumbent entrepreneur does not affect the analysis.

$$w_A + w_B(e^{**}) \geq 2w_0 + e^{**} \tag{5}$$

Since the initial labour market is perfectly competitive, this constraint is binding. Therefore, the initial wage is $w_A = 2w_0 + e^{**} - w_B \leq w_0 + e^{**}$ (with equality only for $e = 0$). The worker expects to enjoy rents in stage B and is ready to work at a low wage in stage A.

In addition, the competitive initial labour market enables the entrepreneur to appropriate all the rents ex ante so that her payoff coincides with the social surplus. It is an increasing function of the effort up to the first best effort level and we obtain the following result[13]:

Proposition 1 : *The worker's effort, the wage flexibility and the entrepreneur's payoff all increase with the worker's bargaining power.*

Proof: See Appendix. □

e^{**} and w_A are constrained by the entrepreneur's inability to commit to a high w_B. For instance, if the entrepreneur has all the bargaining power, she cannot commit in stage A to w_B greater than w_0. Thus, the worker does not accept a wage w_A lower than w_0 and has no incentive to exert an effort. In contrast, the first best obtains for $p = 0$ as the worker is residual claimant. A low bargaining power enables the entrepreneur to commit to a high w_B. A higher bargaining power increases the worker's marginal revenue and hence his provision of effort and his wage flexibility[14]. Since the entrepreneur needs $K \geq w_A$ to undertake the project, a direct consequence of Proposition 1 follows:

[13]A recent literature studies possible contractual solutions to hold up problems. MacLeod and Malcomson (1993) assume rich enough verifiable partition of the set of the states of nature, while Aghion, Dewatripont and Rey (1994) assume that a default trade option is contractible. We ruled out these assumptions in the present model.

[14]Similarly, for a given p, the effort and wage flexibility increase with the marginal return on effort g'. This suggests that the degree of competition in the product market should affect the impact of union power on the worker's effort. For instance, if competition decreases the marginal return on effort, union power matters more when competition decreases.

Corollary 1 : *The initial capital K necessary to finance the project is decreasing in the worker's bargaining power.*

Wage flexibility has many other advantages. For instance, it may help avoid bankruptcy. Assume $K < w_A + i$, where i is the cost of buying equipment necessary to realize the project. The liquidation value of the equipment is i at the end of stage A and 0 in stage B. Suppose that a return $g_0 \geq w_0 + i - K$ is realized in stage A with probability $1-\epsilon$. With probability ϵ, there is no return in stage A. Assume that the stage A wage contract cannot be made contingent on whether g_0 is generated or not. If no return is realized in stage A, the worker must accept a wage $K - i$ to avoid bankruptcy while he would obtain K if bankruptcy occured (leading to $g(e) = 0$). He does so $w_B - w_0 = (1-p)f(e) \geq i$. Bankruptcy will occur with probability ϵ unless the worker's bargaining power is large enough.

How are these results affected when the initial labour market is imperfect? In this case, the entrepreneur cannot appropriate the whole surplus ex ante and an increase in p may hurt her and not be Pareto-improving. For instance, if the worker must be hired at $w_0 \leq K$, the effort and the social surplus are still decreasing in p, but π is non monotonic in p (see Appendix)[15]. When $K < w_0$, the worker must agree on a wage concession for the project to be undertaken. He will only do so if $w_B - w_0 \geq w_0 + w_A$, that is if his bargaining power is high enough. But if a less profitable project can be financed with K only or if there is a risk of bankruptcy, it may not be in the interest of the entrepreneur to have a bargaining power which is low enough to obtain a wage concession or to avoid the risk of bankruptcy, although it is socially desirable. Indeed, the main conceptual changes are that when the labour market is imperfect, the entrepreneur may not be better off having a low bargaining power and that she must be financially constrained to obtain a wage concession[16].

[15]We could alternatively assume that the worker has some bargaining power in stage A.

[16]For a discussion of how she can use this strategically, see Perotti and Spier (1993).

3.2 The Costs and Benefits of Union Power

When the worker's bargaining power increases, a higher worker's effort and wage flexibility may come at the expense of the entrepreneur's incentive to invest. Assume that g is a function of I. Ex ante, the entrepreneur appropriates all the surplus, so that ex ante her incentive to invest the first best I^* is not affected by p. However, after hiring the worker, the entrepreneur's incentive to invest increases with p. But her actual investment must satisfy the budget constraint $I \leq K - w_A = K - w_0 + (1-p)f(I)$ who becomes tighter when p increases. When she cannot commit to invest at the beginning of the game, she chooses I so as to maximize $pf(I) - I$ under the constraint $I \leq K - w_0 + (1-p)f(I)$, which implies $I = \min\{f'^{-1}(1/p), K - w_0 + (1-p)f(I)\}$. We thus have costs and benefits of union power:

Corollary 2 : *The higher the worker's bargaining power, the higher the entrepreneur's capacity to undertake an investment, but the lower her incentive to invest when choosing I.*

When the worker is hired at w_0 and the entrepreneur can finance $I = K - w_0 < f'^{-1}(1/p)$, the worker makes a wage concession to finance a further investment ΔI up to $\Delta I \in \arg\max 2w_0 - \Delta I + (1-p)f(I + \Delta I)$, that is up to $(1-p)f'(I + \Delta I) = 1$. Thus, the wage concession increases with the worker's bargaining power. Nevertheless, the entrepreneur's incentive to invest may become so low when p decreases that the restriction in I may outweigh the increase in the share of the pie for the worker. In this case, the worker anticipates that a wage concession will not be fully used to invest and wage flexibility may actually decrease with his bargaining power.

Even when there is no need for wage flexibility, costs and benefits of the worker's bargaining power may come from the worker's effort and the entrepreneur's investment. Assume that the worker must be hired at w_0 and that the return g increases both with e and I. Suppose that $f(e, I) = g(e, I) - w_0$

satisfies $f_e > 0$, $f_I > 0$, $f_e(0,I) > 1$, $f_I(e,0) > 1$, $f_{e,e} < 0$, $f_{I,I} < 0$, $f_{e,I} \geq 0$. This is a double moral hazard problem. The social optimum (e^*, I^*) would maximize $f(e,I) - e - I$ and would satisfy $f_e(e^*, I^*) = f_I(e^*, I^*) = 1$, assuming that an interior solution exists. Obtaining it would require to break the budget constraint and to give the full returns of her investment to each party. However, the worker and the entrepreneur maximize respectively $(1-p)f(e,I) - e$ and $pf(e,I) - I$, so that the investment levels must satisfy $(1-p)f_e(e,I) = pf_I(e,I) = 1$. Both parties underinvest. An optimal bargaining power maximizes $\max f(e,I) - e - I$ s.t. $(1-p)f_e(e,I) = pf_I(e,I) = 1$. A general solution of this programme cannot obtain without strong additional assumptions on f.[17] The most simple intuition can be captured with $g(e,I) = A\ln\left[I^{\gamma}e^{1-\gamma}\right]$, $\forall (e,I) \in I\!R^2_+$ (with A large and $\gamma \in [0,1] - \{0.5\}$). The incentive constraints give $I = Ap\gamma$ and $e = A(1-p)(1-\gamma)$ and the unique optimal bargaining power equals $(\gamma - \sqrt{\gamma(1-\gamma)})/(2\gamma - 1)$. In this specific example, an increase in p increases I and decreases e. In this specific example, one party's marginal revenue is not affected by the other party's action. Nevertheless, for other functions, a decrease in a party's bargaining power may well increase her marginal reward of action via an increase in the other party's action.

One party's bargaining power may be either too high or too low from the social surplus viewpoint, leading to inefficient investment levels. The next section studies how the possibility of takeovers may affect our analysis. We shall see that the worker's effort and wage flexibility may well decrease with his initial bargaining power.

[17] Intuitively, when the intersection of the curves corresponding to the constraints is empty, there is no equilibrium solution. When this intersection is a discrete set, a solution is obtained by comparing the maximand in all these points. When the intersection is a more general closed set, we can study the maximization problem in this set under the unique remaining constraint.

4 Takeovers and Implicit Contracts

In this section, we analyze the impact of a takeover threat on the worker's effort and wage flexibility. We set $D < +\infty$. We first go back to the basic model where the return only depends on the effort from the worker. From now on, we shall consider the variables as functions of the entrepreneur's bargaining power: $e(p) = e^{**}(p)$, $f[p] = f \circ e(p)$, $w_A[p]$, $w_B[p]$. Choosing a level of effort and agreeing on w_A possibly lower than w_0 constitutes an implicit contract $\{e, w_A(e)\}$. The set of implicit contracts (i.e. $\{e, w_A(e)\}$ satisfying (2), (3) and (5)) depends on bargaining in stage B and the takeover threat.

4.1 Takeover Threat and Efficiency:

In this subsection, we show that potential takeovers prevent the entrepreneur from committing to some implicit contracts. A takeover threat can induce the worker to underinvest and lower the social surplus and the entrepreneur's profit. Furthermore, we show that the worker's effort and wage flexibility may decrease with his initial bargaining power. We first assume that the same return $g(e)$ can be realized under either S or R (the entrepreneurs differ in their bargaining power only)[18].

Proposition 2 : *When $D \geq (p_r - p_s)f[p_s]$, there is no takeover threat. The threat of a takeover restricts the set of implicit contracts and reduces the social surplus. There exists $\underline{e} < e(p_r)$ such that:*

1. *If $(p_r - p_s)f(\underline{e}) \leq D < (p_r - p_s)f[p_s]$, then the worker exerts the effort satisfying $(p_r - p_s)f(e) = D$ and there is no takeover. The worker's effort, the wage flexibility and the social surplus increase with p_s.*

2. *If $D < (p_r - p_s)f(\underline{e})$, then the effort is $e(p_r)$ and the takeover takes place.*

[18]If raiders with a continuum of bargaining powers could take over the firm before the worker is hired, the takeover would be led by the raider maximizing the value of the firm. It would be desirable if and only if the social surplus under the raider's bargaining power was higher than that under the incumbent entrepreneur.

Proof: See Appendix. □

The set of implicit contracts is restricted by the mere threat of a takeover. The only incentive to take over the firm for R is to breach implicit contracts. When the effort is high, the return and the incentive to breach implicit contracts are high. The worker may thus exert an effort low enough to prevent the takeover, i.e. $\hat{e}$ such that $D = (p_r - p_s)f(\hat{e})$. In addition, an increase in the incumbent entrepreneur's bargaining power reduces the incentive for a raider to take over the firm to earn from a lower w_B. Thus, the worker can exert a higher effort which still prevents the takeover.

The worker is not always better off reducing his effort to prevent the takeover. When this strategic effort reduces the pie too much, he is better off enlarging the pie, i.e. exerting $e(p_r)$, and negotiating with R. However, he may be ready to reduce the pie below that under R to keep a larger share: we may observe a lower effort under the threat of a takeover by R than $e(p_r)$. A natural question is then how the restriction result is affected when the worker can make a wage concession in stage B to prevent the takeover and when he will be better off making this wage concession.

Corollary 3 : *When possible, the worker makes a wage concession in stage B conditional upon S keeping control when* $D < (p_r - p_s)f[p_r]$. *The effort is* $e(p_r)$.

Proof: See Appendix. □

When the takeover does not take place, the incumbent entrepreneur and the worker save D (or part of it if the raider has some bargaining power). The wage concession $b \geq 0$ must satisfy $b \geq (p_r - p_s)f(e) - D$. This entrepreneur's IC constraint is binding. When making a wage concession, the worker must give away the whole surplus he would get under S compared to R net of the takeover cost. Ex ante, his effort satisfies $\max_e (1 - p_r)f(e) - e - D$ A wage concession

leads him to exert $e(p_r)$. His IC constraint, which is $(1-p_s)f[p_r]-b \geq (1-p_r)f[p_r]$ when $D < (p_r-p_s)f(\underline{e})$ and $(1-p_s)f[p_r]-b \geq (1-p_s)f(\underline{e})$ when $(p_r-p_s)f(\underline{e}) \leq D < (p_r-p_s)f[p_r]$, is satisfied when $D < (p_r-p_s)f[p_r]$, so that he is better off exerting $e(p_r)$ and conceding $b \geq (p_r-p_s)f(e)-D$. In contrast, when $D \geq (p_r-p_s)f[p_r]$, a wage concession leads the worker to exert an effort which is lower than without wage concession and the pie is smaller. He is better off not making the wage concession and preventing the takeover only by a restriction in his effort[19].

Proposition 2 also establishes that the takeover threat reduces the wage flexibility (and thus the capital necessary to undertake the project) which, however, increases with p_s. Hence, when g is a function of I, the possibility of a takeover may be either desirable or not: when the entrepreneur is not financially constrained, a takeover increases S's marginal reward of investment and is desirable. If p is high enough to allow the takeover, the worker cannot prevent it. When the entrepreneur is financially constrained, we obtain:

Corollary 4 : *Suppose that g is a function of I. A takeover increases the entrepreneur's incentive to invest, but its mere possibility tightens her budget constraint.*

When I is financially constrained and the initial labour market is perfect, the budget constraint $I \leq K - w_0 + (1-p)f(I)$ is tighter when the takeover is expected. When the initial labour market is imperfect, the worker's decision to agree on a wage concession is affected by the takeover threat: he may be better off either making the wage concession to finance an investment allowing the takeover or strategically limit his wage concession to make sure that the

[19]Similarly, if the incumbent entrepreneur were R and this implied a cost higher than the takeover cost, the worker would sometimes be better off promising a wage concession to S to induce him to take over the firm. This is what happened at TWA and Eastern Airlines. Such a wage concession may not take place when the takeover cost is too high, the workers face a wealth constraint (and credit rationing) or a coordination failure (so that a subsequent free rider problem among the workers cannot be overcome) or the workers want to build a reputation for refusing wage concessions.

actual investment will not entail a takeover. In this latter case, the possibility of a takeover may only decrease the investment[20].

4.2 Takeover Defence Mechanisms and Veto Power

When the worker's effort and wage flexibility are valuable, it may be desirable to make sure that there is no threat of breach of implicit contracts. In this section, we focus on two mechanisms which may be used to achieve this goal: takeovers defence mechanisms increasing the takeover cost and a worker's veto power on the takeover. Here, defence mechanisms may be either automatic (e.g. increases in capital) or at the discretion of the entrepreneur, but only an automatic increase in D can help because S could not commit to prevent a takeover beneficial to him if he had discretion over the takeover cost.

When the possibility of a takeover is inefficient, it is easy to see that in our setup a takeover defence mechanism, i.e. D high enough to prevent any takeover, and a worker's veto power are equivalent: they prevent the takeover. Since the takeover is purely redistributive, both systems make sure that there is no breach of implicit contracts and there is no takeover. Both systems lead to higher levels of effort and wage flexibility, more surplus and a higher S's payoff when the initial labour market is perfect. With an imperfect labour market, S may obtain more by favouring a takeover than by setting up takeover defence mechanisms. When takeovers are desirable, i.e. when I is crucial and the worker's effort and the wage flexibility are not, there should be a very low D and no veto power.

We now turn to the case where the takeover is not purely redistributive. Up to now, we have assumed that S and R had the same valuation of the firm. Assume instead that the tough raider's valuation in stage A is $\tilde{\alpha} f$, where $\tilde{\alpha}$ is an observable, but not verifiable random variable which is realized at the end

[20]In our setup, when g is a function of e and I, there is no Nash equilibrium in pure strategies under a takeover threat given the discontinuity in the payoffs. When an error term is introduced, there may be either complementarity or substitutability between e and I.

of stage A, i.e. R's valuation differs' from S's and is not known in advance. For simplicity, $\tilde{\alpha}$ is uniformly distributed on $[\underline{\alpha}, \bar{\alpha}]$ with $0 < \underline{\alpha} < 1 < \bar{\alpha}$. We say that a takeover is (ex post) value increasing (resp. value decreasing) when the realization α of $\tilde{\alpha}$ is greater (resp. lower) than 1.

The raider takes over when $\alpha p_r f(e) - D > p_s f(e)$, that is:

$$\alpha > \frac{p_s f(e) + D}{p_r f(e)} \tag{6}$$

After a takeover, $w_B = w_0 + \alpha(1 - p_r)f(e)$ instead of $w_0 + (1 - p_s)f(e)$. If $\alpha \geq \frac{1-p_s}{1-p_r}$ (the RHS is always strictly higher than 1), w_B is higher than under S and the worker profits from the takeover. Otherwise, w_B is lower than absent the takeover. Thus, a takeover must be subsequently value increasing not to lead to a lower w_B. In addition, the gains from breaching implicit contracts need not be dominated by the loss in the value of the firm: a value decreasing takeover can occur when the RHS of (6) is lower than 1.

Lemma 1 *: When the effort is sunk, a value increasing takeover may either increase or reduce w_B. Value decreasing takeovers can occur in order to breach implicit contracts.*

We now address the case where entrepreneurs also differ in their ability to run the firm. When it is known in advance who will run the firm, an anti-takeover mechanism can prevent the inefficiency due to takeovers because the cost does not need to be contingent on the raider. When $\alpha < 1$, introducing a takeover cost D at least equal to the gain from breaching implicit contracts, that is $D \geq w_B[p_s] - w_B[p_r] = (p_r - p_s)\alpha f(e)$, prevents the takeover and the worker exerts $e(p_s)$. When $\alpha > 1$, introducing $D = (p_r - p_s)\alpha f(e)$ to be given to the worker is optimal since a value increasing takeover does not breach implicit contracts and does not restrict them. If $\tilde{\alpha}$ is a non degenerated random variable, the characteristics of the future entrepreneur are unknown. We obtain:

Proposition 3 : *(1) An automatic takeover cost cannot allow all value increasing takeovers and protect all implicit contracts. (2) A worker's veto right on the sale of the firm protects all implicit contracts and allows all socially desirable takeovers.*

Proof: See Appendix □

The intuition is simple: when D is low enough to allow all possible value increasing takeovers, some of them can breach implicit contracts. On the other hand, when D is high enough to protect the implicit contracts, a value increasing takeover may be prevented. R could buy the firm, pay D and breach implicit contracts for some realizations of $\tilde{\alpha}$ and could be prevented from buying the firm for others. D should depend on R's valuation, which is impossible since $\tilde{\alpha}$ is not contractible. Thus, a takeover cost D induces inefficiencies[21]. In contrast, the veto right enables the worker to react ex post and case by case. There is no breach of implicit contracts and the takeovers which take place are exactly the socially desirable ones[22].

The proposition above, however, may become an argument against the worker's veto right when the firm invests and the worker's bargaining power is too high. The veto right may enable the worker to keep an excessive bargaining power and imply inefficient levels of investments. In the absence of a veto power, a takeover reducing the worker's bargaining power increases S's incentive to invest and may be desirable. A social planner or an entrepreneur is led to opt for no defence, a usual anti-takeover mechanism or a worker's veto power depending on the environment, that is the industry (the shape of the profit function $f(\cdot,\cdot)$), the entrepreneur's capital and the population of raiders.

[21] Moreover, a risk-averse party may want to insure against risk and increase these takeover costs to accept implicit contracts.

[22] With a competitive labour market, the worker cannot use his veto power to get a rent. But when S does not have all the bargaining power with R, the worker's veto power may enable her to extract ex ante a share of R's surplus: The worker anticipates that he can use his veto power when bargaining with R for some values of α and he can be hired at a low w_A. When the initial labour market is imperfect, the worker can use his veto power to obtain a part of the surplus, depending on his bargaining game with R.

4.3 Infinite Horizon

This section studies how the analysis above is affected when the project is infinitely repeated. It is shown that 1) the worker's effort in each period does not necessarily decrease with the entrepreneur's bargaining power in the absence of takeovers and 2) that the repetition helps enforce implicit contracts.

The two-stage game above is infinitely repeated. Stages A and B occur in each period 1, 2, ... The entrepreneur or the raider maximizes the sum of the net present value of the firm and of the earnings from a possible breach in implicit contracts (zero for the incumbent). He can thus be considered as a long run player and we assume that he is infinitely long-lived. In contrast, each generation of employees works one period. The worker only maximizes his wage within each period. If he cannot observe the past, he only plays the stage game as studied above. Instead, we assume that the worker is unionized and that the long-lived union coordinates the workers' strategies over generations. The union enables the workers to behave as long run players, for instance because it has enough resources to observe the past and build a reputation[23]. We assume that p is constant over time.

The entrepreneur would like to commit to the cooperative wage $w_B^c = g(e)$ to induce the socially optimal effort e^*. However, in each period, he can only commit to $w_B^{nc} = w_0 + (1-p)f(e)$.

We exhibit one particular equilibrium in order to show that the intuition may differ from that of the stage game. We assume that the strategy of the union is a trigger strategy: to exert a cooperative effort $e^c \geq e^{nc}$ as long as the entrepreneur's offer in the stage B wage bargaining game is $g(e^c)$ so that each worker obtains $w_B^c = g(e^c)$ and w_A binding (5); and to reject the agreement and to exert only e^{nc} during T periods as soon as the entrepreneur makes an offer strictly lower than $g(e^c)$. Effort, return and worker's stage B wage are now considered as functions of p, δ and T, where δ is the discount factor common

[23]For a theory of collective reputation, see Tirole (1996).

to all agents.

Definition 1 : *The intrinsic net present value $V[p, \delta, T]$ of the firm (or INPV) is the sum of its profits if it is run by an entrepreneur with the same bargaining power all the time:*

$$V[p, \delta, T] = \sum_{\tau=t}^{\infty} \delta^{\tau-t} \Big[g[p, \delta, T] - w_A - w_B \Big] \tag{7}$$

The workers exert e^c such that breaching does not pay, i.e. such that the gain from breaching is lower than the loss on the value of the firm.

$$g(e^c) - w_0 - (1-p) f(e^c) \leq \frac{\delta(1-\delta^T)\Big[f(e^c) - e^c - [f(e^{nc}(p)) - e^{nc}(p)]\Big]}{1-\delta} \tag{8}$$

This entrepreneur's incentive compatibility constraint can be rewritten:

$$\left[1 - \frac{p(1-\delta)}{\delta(1-\delta^T)}\right] f(e^c) - e^c \geq f(e^{nc}(p)) - e^{nc}(p) \tag{9}$$

For the condition to be satisfied, $\left[1 - \frac{p(1-\delta)}{\delta(1-\delta^T)}\right]$ must be large enough, and in particular positive. Given that $\left[1 - \frac{p(1-\delta)}{\delta(1-\delta^T)}\right]$ increases with δ, T, e^c is only realized when δ and T are high enough.

Proposition 4 : *The worker's effort and INPV of the firm increase with δ, T and (1) they increase with the union's bargaining power when δ and/or T are low enough, (2) they either increase or decrease with p when δ and T are moderately high, (3) the first best is attained for any p not too close to 1 when δ and T are high enough.*

Proof: See Appendix.

There are two conflicting effects. On the one hand, raising the union's bargaining power increases w_B^{nc} and thus reduces the gain from breaching implicit contracts. This eases the sustainability of implicit contracts and hence

increases the value of the firm. On the other hand, when the union's bargaining power decreases, the non cooperative INPV decreases (since everything is as in the stage game), and so the loss on the value of the firm in case of breach increases when δ and T are high enough to make cooperation sustainable.

The assumption that p is constant over time is not crucial for the INPV discipline effect. Consider that the entrepreneur can manipulate the union power and that the initial labour market is imperfect. In case of breach, the union will go back to the non cooperative investment. It anticipates that the entrepreneur will choose his power p_m in order to maximize his profit. When investing ex ante, the workers know that the loss on the value of the firm in case of breach will be $V^c - V^{nc}[p_m]$. Such a loss would depend on the initial entrepreneur's bargaining power as long as there is a rigidity in the union's bargaining power.

When the horizon is infinite, an optimal union's bargaining power may be strictly lower than 1 even when only the worker's investment matters. The INPV discipline enables the entrepreneur to obtain a higher investment than the one obtained in the stage game for a given bargaining power. This is important when the entrepreneur must invest. If the union's strategy is credible, the entrepreneur can commit not only to give the wages necessary to obtain a high level of investment, but also to undertake a high investment.

Furthermore, when f is not constant, but increasing over time (for all t, $f_{t+1} > f_t$), or may increase with the levels of effort exerted in the preceeding stages, the set of implicit contracts is enlarged, which in turn increases the profits. In contrast, when f decreases over time,i.e. in declining industries, the set of feasible implicit contracts is restricted, which reduces the profits. There is an accelerating (and self-fulfilling under uncertainty) effect.

The results above are less clear-cut under some cases of uncertainty. In the stage game, when the return to be realized is unknown in stage A, the results above do not change if the return is revealed after the stage B wage contract

has been signed. However, it is shown in Appendix that if the return is revealed after the effort has been exerted and before the stage B wage contract is signed, the set of feasible implicit contracts may be restricted. Profits higher than expected, i.e. booms, would enable the entrepreneur to gain from breaching implicit contracts if the constraint (9) is binding. Anticipating this, the workers face a more demanding constraint. The effect of the union's static bargaining power on her investment also depends on uncertainty.

Proposition 5 *: The threat of a takeover led either by a soft or a tough raider in order to breach implicit contracts may reduce the workers' investment. If the overall takeover cost is too low to prevent the takeover, then the investment is non cooperative and the toughest raider takes over the firm.*

Sketch of Proof: See Appendix.

The existence and the importance of this restriction depends on the population of raiders, on the discount factor and on the horizon of the union. If δ and T are so high that no potential raider has interest to breach (5), then there is no restriction. In this case, the prospects of the firm help sustain implicit contracts. If δ and T are too low to avoid restriction, then other enforcement mechanisms may help. Considering that raiders may have different valuations and proceeding, the same discussion about takeover defence mechanisms applies when these mechanisms are necessary. Since the workers' investment increases with δ, T, anti-takeover mechanisms can be seen as a remedy against the financial market myopia and the union's inability to sustain long term strategies. In contrast, their existence is not justified when this remedy is not necessary to enter (efficient) implicit contracts.

Furthermore, when the INPV is large due to a high cooperative investment, there are no takeovers initiated to lead the firm to bankruptcy. A bad raider would have to pay a high price and the loss on the value of the firm in case of breach would be important. This suggests that financial manipulations and

takeovers with breach of trust rarely take place in organizations where the union has the ability to retaliate in case of breach.

5 Concluding Remarks

This chapter studied a two-stage game where the entrepreneur's incentive to invest versus the workers' effort and wage flexibility are costs and benefits of union power in wage negotiations. The threat of a takeover leading to a reduction in the future bargained wage lowers the workers' effort and wage flexibility and hence may also lower the social surplus and the firm's payoff. Under such a threat, the workers' effort and wage flexibility decrease with the initial union power. In the repeated game, the workers' effort is not necessarily monotonic in the union's bargaining power. There is a tradeoff between the earnings of breaching implicit contracts and the loss on the value of the firm. Hence, the future is a discipline and increasing the discount factor and the workers' ability to retaliate in case of breach may be desirable. This control mechanism is likely to help enforce efficient implicit contracts since they increase the value of the firm while inefficient ones lower it. When this discipline cannot help, anti-takeover mechanisms or workers' veto power may be used, but they create inefficiencies.

While this work focused on takeovers, the main points remain valid for other cases such as the effect of financial manipulations on wage negotiations (Perotti and Spier (1993) and Sarig (1992)) and supplier/buyer relationships (Chemla (1996)). Potential financial manipulations may restrict wage flexibility and implicit contracts. Manipulations maximizing the shareholders' payoff ex post may lower the social surplus and the actual shareholders' payoff. To commit not to manipulate a financial structure may be difficult as the financial structure has many other effects on signalling, agency relationships, corporate control contests and the industrial markets (see Harris and Raviv (1992)). However, to make renegotiation costly through an optimal debt structure (Bolton and

Scharfstein (1996)), to encourage the formation of unions or to give the workers or trading partners a veto right on some manipulations may sometimes be desirable[24].

In addition, an agency problem between shareholders and a manager could lead to other kinds of inefficient implicit contracts than those considered here. For instance, implicit contracts can be agreed on between any two parties within shareholders, entrepreneur and workers. Hence, a takeover may be such that the implicit contracts between the shareholders and the entrepreneur (resp. the workers) are not breached, but that those involving the workers (resp. the entrepreneur) are breached. The raider can induce the entrepreneur to breach implicit contracts and compensate him for the loss he incurs by breaching, such as a loss in reputation. Thus, a friendly takeover as defined in Shleifer and Summers could breach implicit contracts. However, takeovers also have a disciplinary role against inefficient implicit contracts that takeover defence mechanisms or a union's veto power may help sustain. The tradeoff between these opposite effects should be considered when debating the role of unions and agreeing on takeover defence mechanisms.

The one principal - one agent approach considered here should be considered as an intermediary step towards a better understanding of unions. A highly stylized extension of our model is to consider that independent employees exert an effort equal to 0 or 1. Hence, a higher effort may lead to a higher level of employment (assuming that other considerations such as moral hazard in teams do not offset this effect). There is a tradeoff between this positive effect on the economic activity and on employment and the effects of a higher labour cost. In addition, one would expect that when the effect of union power on wage flexibility is negatively correlated with its effect on unemployment fluc-

[24]In Perotti and Spier, financial manipulations led in order to force the workers to renegotiate their wage make risk-averse workers bear some risk, which is inefficient. The workers' veto right would be Pareto-improving since it would make the risk-neutral party bear the risk by preventing the strategic use of financial manipulations.

tuations. However, the setup in the present chapter may well be too simple. A challenge to a more satisfactory theory of unions is to endogeneize the number of workers and to study problems of coordination, monitoring, collusion and the constitution of unions which are likely to play a key role in practice.

Finally, this work emphasized the importance of understanding where a bargaining power comes from and the extent in which it can be endogeneized in long run industrial relations and in corporate finance. The union power should depend on the corporate and financial structure, the discount factor, the population of raiders, uncertainty, the industry (according to its prospects, to the importance of implicit contracts, to the possibility to hide profits and to the pie to bargain on), the set of credible strategies and the organizational form of the firm. This should be taken into account in studying how the charter of the firm or side contracts may affect bargaining outcomes.

APPENDIX

Proof of Proposition 1 : We only have to prove that w_A increases with p and that it is lower than w_0.

$$\forall p' > p,\ \forall e \in I\!R_+,\ (1-p')f(e) - e < (1-p)f(e) - e \tag{10}$$

This implies that:

$$\forall p' > p,\ \max_e(1-p')f(e) - e < \max_e(1-p)f(e) - e \tag{11}$$

i.e. $w_A[p'] > w_A[p]$. Last, the worker exerts the effort e if and only if $e \leq (1-p)f(e)$. Therefore, $w_A \leq w_0$.

However, π is not monotonic in p when the worker must be hired at wage w_0. In this case, the total wage is $2w_0 + (1-p)f(e)$ so that his IR constraint (5) is slack. The worker still maximizes (3) and e^{**} still decreases with p, while the entrepreneur's payoff is now:

$$\pi(e) = \Big[1 - \frac{1}{f'(e^{**})}\Big] f(e^{**}) - 2w_0 \tag{12}$$

The derivative is:

$$\pi'(e) = f'(e^{**}) + \frac{[f \cdot f''](e^{**})}{f'^2(e^{**})} - 2 \tag{13}$$

When $p = 0$, the effort is e^*, so that $\pi' = [f \cdot f''](e^*) - 1 < 0$, while when $p = 1$, the effort is zero and $\pi'(0) > 0$ (because $f'(0) = +\infty$). □

Proof of Proposition 2 : R takes over if and only if $p_r f(e) - D > p_s f(e)$, that is:

$$D < (p_r - p_s)f(e) \tag{14}$$

The RHS of (14) increases with e. When D is so high that (14) is not satisfied for $e = e(p_s)$, R never bids and the worker chooses $e = e(p_s)$ (which

decreases with p_s). When $D \in \Big[(p_r - p_s)f[p_r], (p_r - p_s)f[p_s]\Big)$, the worker can deter the takeover by exerting a level of effort $\hat{e} \in [e(p_r), e(p_s)]$ such that $D = (p_r - p_s)f(\hat{e})$. Knowing this, he will choose an effort satisfying:

$$\max\{\max_{e\in[0,\hat{e}]}(1-p_s)f(e) - e, \max_{e\in[\hat{e},e(p_s)]}(1-p_r)f(e) - e\} \tag{15}$$

Given that:

$$\begin{aligned}
\max_{e\in[\hat{e},e(p_s)]}(1-p_r)f(e) - e &\leq \max_{e\in[0,e(p_s)]}(1-p_r)f(e) - e \\
&= (1-p_r)f[p_r] - e(p_r) \\
&< (1-p_s)f[p_r] - e(p_r) \qquad (16)
\end{aligned}$$

The worker anticipates that he always loses from the takeover and he exerts $\hat{e}$ in order to prevent it. He expects $w_B = (1-p_s)f(\hat{e})$ and obtains his stage A wage is $w_A(\hat{e})$. When p_s varies and p_r and D are given, $\hat{e} = f^{-1}\Big[\frac{D}{p_r - p_s}\Big]$ increases with p_s until $\hat{e} = e(p_s)$ and then the effort decreases with p_s. The wages satisfy:

$$w_B = w_0 + D\frac{1-p_s}{p_r - p_s} \tag{17}$$

$$w_A = w_0 + f^{-1}\Big[\frac{D}{p_r - p_s}\Big] - D\frac{1-p_s}{p_r - p_s} \tag{18}$$

$$\begin{aligned}
w'_A &= \frac{D}{(p_r - p_s)^2}\Big[\frac{1}{f' \circ f^{-1}[D/(p_r - p_s)]} - (1-p_r)\Big] \\
&= \frac{D}{(p_r - p_s)^2}\Big[\frac{1}{f'(\hat{e})} - \frac{1}{f'(p_r)}\Big] < 0 \qquad (19)
\end{aligned}$$

w_A decreases and w_B increases with p_s. The entrepreneur's bargaining power p_t which maximizes the worker's effort satisfies $(p_r - p_t)f[p_t] = D$ ($p_t \in [p_r, p_s]$).

When D is so low that (14) is satisfied for $e = e(p_r)$, the worker can either choose a low effort $\underline{e} < e(p_r)$ satisfying $D = (p_r - p_s)f(\underline{e})$ (the existence of $\underline{e}$ is ensured by continuity) so as to prevent the takeover and bargain w_B with S

or choose $e(p_r)$ knowing that R will take over the firm. He will choose $\underline{e}$ if and only if:

$$(1-p_s)f(\underline{e}) = (1-p_s)\frac{D}{p_r-p_s} \geq (1-p_r)f[p_r] \tag{20}$$

It is worthwile to choose a low effort to prevent the takeover when D is slightly lower than $(p_r - p_s)f[p_r]$. When D or p_s are very low, however, the worker chooses $e[p_r]$ (which does not vary with p_s) and R takes over the firm. In addition, it is clear that $\underline{e}$ increases with p_s. □

Proof of Corollary 3 : Allow the worker to make a wage concession b conditional upon the incumbent entrepreneur keeping control. Assume without loss of generality that the incumbent entrepreneur gets the entire surplus in case of takeover. In stage B, the worker's wage concession to induce the entrepreneur to keep control satisfies:

$$\max_{e,b} \quad (1-p_s)f(e) - b \tag{21}$$

$$s.t. \quad b \geq (p_r - p_s)f(e) - D \tag{22}$$

$$b \leq (p_r - p_s)f(e) \tag{23}$$

$$b \geq 0 \tag{24}$$

The entrepreneur's IC constraint (22) is clearly binding, while the worker's IC constraint (23) is slack. Ex ante, the worker's effort is thus a solution of $\max_e(1-p_r)f(e) - e$ which leads to $e(p_r)$ and $b = (p_r - p_s)f[p_r] - D$ when $D < (p_r - p_s)f[p_r]$ to $\hat{e}$ and $b = 0$ otherwise. □

Proof of Proposition 4 :

(1) Call α_1 and $\alpha_2 > \alpha_1$ two possible realizations of $\tilde{\alpha}$ in $(1, \frac{1-p_s}{1-p_r})$ and note $D_i = (p_r - p_s)\alpha_i f(e)$ with $i \in \{1,2\}$. If the firm sets $D > D_1$, then a value increasing takeover is deterred when α_1 is realized. If $D < D_2$, then the hold

up problem arises when α_2 is realized. Since D_1 is lower than D_2, no D can protect implicit contract and allow value-increasing takeovers.

(2) If the worker has a veto right on the sale of the firm (and D is exogenous), he refuses any sale reducing his compensation ex post. If $\alpha(1-p_r) \geq (1-p_s)$, he benefits from a takeover and will accept it. Otherwise, he accepts the takeover if and only if he gets a complementary transfer N such that $N + \alpha(1-p_r)f(e) \geq (1-p_s)f(e)$. The takeover takes place if and only if $(\alpha p_r - p_s)f(e) - N \geq D$. □

Proof of Proposition 4 : Note $r^{\delta,T} = \frac{(1-\delta)}{\delta(1-\delta^T)}$ and $k^{\delta,T}(p) = 1 - r^{\delta,T}p$. Given that $k^{\delta,T}(p)$ increases with T and δ ($\frac{(1-\delta)}{\delta(1-\delta^T)} = [\sum_1^T(\delta^t)]^{-1}$), the set of cooperative efforts verifying (9) becomes larger when T and δ increase. So, e^c increases with T and δ (when (9) is not satisfied, $e^c = e^{nc}$ and, as the non cooperative INPV V^{nc}, is independent of δ and T).

Discuss now how e^c varies with p. Consider the curves $G^{nc} : e^{nc} \longrightarrow pf(e^{nc}) - e^{nc}$, $G^c : e^c \longrightarrow k^{\delta,T}(p)f(e^c) - e^c$ and $J : e \longrightarrow f(e) - e$. In each point G^{nc} and G^c are below J. Moreover, cooperation only occurs when G^c is above G^{nc}, that is when, $1 - r^{\delta,T}p \geq p$ or:

$$(1 + r^{\delta,T})p \leq 1 \tag{25}$$

If $\delta = 0$, then only the stage game matters. Cooperation does not arise and the INPV decreases with p. If $\delta = 1$ and T tends to infinity, then $k^{\delta,T}(p) = 1$ for all p. So, $J \equiv G^c$: the constraint is satisfied for all $e^c (\geq e^{nc})$ and the first best is attained for all p. More generally, when condition (25) is not met, the effort is e^{nc} and decreases with p.

Consider now that (25) is satisfied. The following cases may be observed:

1) When (9) is not satisfied, $e = e^{nc}$ decreases with p. This happens in each point when δ and T are very low (the limit level depends on f).

2) When (9) is satisfied and not binding at the first best, $e^c = e^*$ does not depend on the union's bargaining power. This happens when δ and T are large enough. This case arises in many points when at the first best level of effort, G^c is largely above the cost curve, here the 45 degree line, and closely below J.

3) When (9) is binding before attaining the first best, e^c is chosen so that (9) is binding. We study how e^c varies with p by considering the implicit function $x^{\delta,T}$ such that:

$$x^{\delta,T}(p,e^c) = (1-r^{\delta,T}p)f(e^c) - e^c - \left[f\left[f'^{-1}\left(\frac{1}{1-p}\right)\right] - f'^{-1}\left(\frac{1}{1-p}\right)\right] = 0 \quad (26)$$

The partial derivatives satisfy:

$$\begin{aligned}
\frac{\partial x}{\partial p}^{\delta,T}(p,e^c) &= \frac{1}{(1-p)^2}\left[1 - f'\left[f'^{-1}\left(\frac{1}{1-p}\right)\right]\right][f'^{-1}]'\left(\frac{1}{1-p}\right) - r^{\delta,T}f(e^c) \\
&= -\frac{p}{(1-p)^3}[f'^{-1}]'\left(\frac{1}{1-p}\right) - r^{\delta,T}f(e^c) \qquad (27) \\
\frac{\partial x}{\partial e^c}^{\delta,T}(p,e^c) &= (1-r^{\delta,T}p)f'(e^c) - 1 \qquad (28)
\end{aligned}$$

Using the implicit function theorem, when the partial derivative $\frac{\partial x}{\partial e^c}^{\delta,T}(p,e^c)$ is non zero, $e^{c\prime}(p)$ is given by:

$$\begin{aligned}
e^{c\prime}(p) &= -\frac{\partial x^{\delta,T}/\partial p}{\partial x^{\delta,T}/\partial e^c}(p,e^c) \\
&= \frac{\frac{p}{(1-p)^3}[f'^{-1}]'\left(\frac{1}{1-p}\right) + r^{\delta,T}f(e^c)}{(1-r^{\delta,T}p)f'(e^c) - 1} \qquad (29)
\end{aligned}$$

Remember that $f'(e^c) \geq f'(e^*) = 1$. Then, three subcases arise:

- when $1 - r^{\delta,T}p > \max\{\frac{1}{f'(e^c)}, p\}$ (ie: the slope of G^c is higher than the slope of the 45 degree line), the cooperative effort increases with the

entrepreneur's bargaining power if and only if the numerator of $e^{c\prime}(p)$ is positive, that is when:

$$r^{\delta,T} > -\frac{p}{(1-p)^3 f(e^c)}[f'^{-1}]'\Big(\frac{1}{1-p}\Big) \tag{30}$$

Call $X^f(p,e^c)$ the right hand side of this condition. Since $f'^{-1\prime} = \frac{1}{f'' \circ f'^{-1}} < 0$, $X^f(p,e^c)$ is positive. According to the sign of f'', it may increase or decrease with p.

- when $p \leq 1 - r^{\delta,T}p < \frac{1}{f'(e^c)}$, (ie: the slope of G^c is lower than the slope of the 45 degree line), then the cooperative effort increases with the union power if and only if (30) is satisfied.

- when $p \leq 1 - r^{\delta,T}p = \frac{1}{f'(e^c)}$, then $e^c = f'^{-1}\big[1/(1-r^{\delta,T}p)\big]$ is an explicit function of p and decreases with p.

Therefore, if (9) is satisfied and binding, when $r^{\delta,T} < \min\{\frac{1}{p}-1, X^f(p,e^c), \frac{1}{p}[1-\frac{1}{f'(e^c)}]\}$, i.e. when δ and T are high enough, the cooperative effort increases with the union bargaining power. When $r^{\delta,T} > \max\{X^f(p,e^c), \frac{1}{p}[1-\frac{1}{f'(e^c)}]\}$, i.e. when δ and T are low enough, the cooperative effort decreases with p. When p and e^c can take values such that $\frac{1}{p}-1 \geq r^{\delta,T} \in \Big(\min\{X^f(p,e^c), \frac{1}{p}[1-\frac{1}{f'(e^c)}]\}, \max\{X^f(p,e^c), \frac{1}{p}[1-\frac{1}{f'(e^c)}]\}\Big)$, i.e. when δ and T are "moderately" high, the cooperative effort decreases with the union power. □

Uncertainty solved before contracting w_B : Assume that $z \to f(.,z)$ is strictly increasing in the state z to be revealed at the beginning of stage B and uniformly distributed in [0.1]. When he observes z, the entrepreneur does not deviate if and only if the realized return is such that:

$$f(e^c,z) \leq \frac{\delta(1-\delta^T)\big[Ef(e^c) - e^c - (Ef(e^{nc}) - e^{nc})\big]}{p(1-\delta)} \tag{31}$$

Here, everything depends on the distribution of the random variable ($z \in [0,1]$). If there exists a e^c such that $f(e^c,1)$ satisfies (31) for δ and T, then the highest e^c verifying this is chosen. While adequate δ and T can help satisfy the inequality above, they may not be sufficient. When for all e^c, $f(e^c,1)$ does not satisfy (31), the workers face the constraint (31) when choosing their level of effort and therefore the only equilibrium is no cooperation: e^{nc}. The point is that for all e^c, there exists a $\bar{z}$ such that $z \geq \bar{z}$ implies that their wage will be $w_B(e^{nc})$. Anticipating this and given that the returns are strictly increasing with z, the workers will act as though the expectation was reduced and choose a lower level of effort, which reduces the expectation of the returns. Repeating this, we obtain that the only possible level of effort is e^{nc}. □

Sketch of Proof of Proposition 5 : Consider that the incumbent entrepreneur M has a bargaining power $p \in (p_s, p_r)$. Since w_B can either increase or decrease with p, respectively either S or R could earn from taking over. The workers anticipate this and choose an effort such that no raider has an incentive to breach implicit contracts. Instead of one entrepreneur's incentive compatibility (IC) constraint, the cooperative effort must satisfy the IC constraint of all possible raiders. Depending on δ and T, p_r and p_s may or may not be such that the additional constraints are binding. As in Proposition 2, in case of threat, the workers reduce their cooperative effort so as to prevent the takeover. If this is not enough, the takeover cost even under the non cooperative effort is too low to prevent the takeover. Everything is as in the stage game and the toughest raider takes the firm over. □

REFERENCES

Aghion, P., M. Dewatripont and P. Rey (1994), "Renegotiation Design under Unverifiable Information", *Econometrica*, 62, 257-282.

Aghion, P. and J. Tirole (1994), "Formal and Real Authority in Organizations", mimeo Nuffield College and IDEI.

Akerlof G. (1983), "Loyalty Filters", *American Economic Review*, 73, 54-63.

Bernstein A. (1990), *Grounded: Frank Lorenzo and the Destruction of Eastern Airlines*, Simon and Schuster (ed.).

Binmore, K., A. Rubinstein and A. Wolinsky (1986), "The Nash Bargaining Solution in Economic Modelling", *Rand Journal of Economics*, 17, 176-188.

Blanchard O. J. and S. Fisher (1989), *Lectures on Macroeconomics*, MIT Press.

Bolton, P. and D. Scharfstein (1994), "Optimal Debt Structure with Multiple Creditors", mimeo ECARE and MIT Sloan School of Management.

Bull C. (1987), "The Existence of Self-Enforcing Implicit Contracts", *Quarterly Journal of Economics*, 147-159.

Burkart, M., D. Gromb and F. Panunzi (1995), "Large Shareholders, Monitoring and Fiduciary Duty", mimeo MIT Sloan School of Management.

Chemla G. (1996), "Competition, Investment and Vertical Integration", *LSE STICERD Theoretical Economics Discussion Paper No. TE/96/308.*

Financial Times (1994), "Welcome Deal in Germany", March 7.

Freeman, R. and J. Medoff (1984), *What Do Unions Do?*, Basic Books, Inc.

Fudenberg, D., Kreps D. and E. Maskin (1990), "Repeated Games with Long-run and Short-run Players", *Review of Economic Studies*, 57, 555-573.

Fudenberg, D. and J. Tirole (1991), *Game Theory*, MIT Press.

Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, 94, 691-719.

Grout P. (1984), "Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach", *Econometrica*, 52, 449-60.

Habib M. (1994), "Why are Leveraged Buyouts Not Permanent?", mimeo LBS.

Harris, M. and A. Raviv (1991), "Financial Contracting Theory", in *Advances in Economic Theory, Sixth World Congress of the Econometric Society*, J. J. Laffont (ed.), Cambridge University Press.

Hart, O. and B. Holmström (1987), "The Theory of Contracts", in *Advances in Economic Theory, Fifth World Congress of the Econometric Society*, T. Bewley (ed.), Cambridge University Press.

Hart, O. and J. Moore (1988), "Incomplete Contracts and Renegotiation", *Econometrica*, 56, 755-85.

Hart, O. and J. Moore (1994), "A Theory of Debt Based on the Inalienability of Human Capital", *Quarterly Journal of Economics*, November.

Holmström (1988), Comment on "Breach of Trust in Hostile Takeovers", in *Corporate Takeovers: Causes and Consequences*, Edited by Alan J. Auerbach, University of Chicago press.

Jarrell, G., J. Brickley and J. Netter (1988), "The Market for Corporate Control: The Empirical Evidence Since 1980", *Journal of Economic Perspectives*, Vol. 2, No. 1, 49-68.

Layard R., S. Nickell and R. Jackman (1991), *Unemployment*, Oxford University Press.

Lichtenberg, F. and D. Siegel (1989), "The Effect of Takeovers on the Employment and Wages of Central-Office and Other Personnel", *NBER working paper No. 2895.*

MacLeod, B. and J. Malcomson (1993), "Investment, Hold-Up and the Form of Market Contracts", *American Economic Review*, 83, 811-837.

Perotti, E. C. and K. E. Spier (1993), "Capital Structure as a Bargaining Tool: The Role of Leverage in Contract Renegotiation", *American Economic Review*, 83 (December).

Rosett J. (1990), "Do union wealth concessions explain takeover premiums", *Journal of Financial Economics*, 27, 263-82.

Sarig O. (1992), "The Effect of Leverage on Bargaining with a Corporation", mimeo Tel Aviv University.

Scharfstein D. (1988), "The Disciplinary Role of Takeovers", *Review of Economic Studies*, 55, 185-199.

Scherer F. (1988), "Corporate Takeovers: The Efficiency Arguments", *Journal of Economic Perspectives*, Vol. 2, No. 1, 69-82.

Shleifer, A. and L. Summers (1988), "Breach of Trust in Hostile Takeovers", in *Corporate Takeovers: Causes and Consequences*, Edited by Alan J. Auerbach, University of Chicago press.

Tirole J. (1996), "A Theory of Collective Reputations with applications to the persistence of corruption and to firm quality", *Review of Economic Studies*, 63, 1-23.

Chapter 3

Competition, Investment and Vertical Integration

Abstract

This chapter analyzes the impact of competition among downstream firms on a supplier's investment and on her incentive to vertically integrate. It argues that tougher competition decreases the downstream industry profit, but improves the supplier's negotiation position. In particular, the supplier is better off encouraging competition when the downstream firms have high bargaining power. Whether vertical integration occurs with a concentrated or a competitive downstream market depends on the demand and cost curves, the impact of investment and the bargaining game. The possibility of vertical integration may constitute a barrier to entry and may trigger strategic horizontal spin-offs or mergers.

1 Introduction

This chapter studies the impact of competition between downstream firms on a monopoly supplier's incentive to engage in industry-specific investment and to vertically integrate one downstream firm. The downstream firms compete both to buy input from the supplier and to sell output to consumers. Hence, fiercer competition among downstream firms has two opposite effects on the supplier's surplus: it erodes the downstream industry profit, but it improves the supplier's negotiation position, i.e. she gets a larger share of a lower industry profit. In a world of incomplete contracts, the supplier's incentives to engage in an industry-specific investment increases with the industry surplus and the share of the industry surplus she captures. As a result, more downstream competition may either increase or decrease the supplier's investment, total industry output, consumer surplus and social welfare. In particular, we show that the supplier is better off with a competitive downstream industry in situations where her bargaining position would otherwise be weak. Building on these results, we analyze the case where the supplier vertically integrates one downstream firm. Since this affects the total quantity supplied and the number of active downstream firms, the decision to vertically integrate depends on the market environment.

Consider an industry where a monopoly supplier sells an input to downstream firms competing both for the input and on the output market. The supplier can invest to increase the demand for the downstream firms' output (e.g. in quality). The benefit from trade increases with the supplier's investment. We consider a world of incomplete contracts where the trade contract between the supplier and each downstream firm is not observable to the other parties and cannot be made contingent on outputs. Hence, competition as measured by the number of downstream firms has two effects: on the one hand, fiercer competition between downstream firms improves the negotiation position of the supplier. It leads the downstream firms to make higher bids for

the supplier's input. This negotiation effect alone makes competition favor ex ante investment as the supplier receives a larger share of the surplus generated by her investment. On the other hand, the transfer is contingent on the total industry profit which is reduced by more competition in the output market, i.e. there is a rent reduction effect[1]. Thus, competition has an ambiguous effect on the supplier's surplus, investment and the social surplus. In particular, in situations where the supplier obtains a small share of a non competitive downstream industry profit, she is better off with a more competitive downstream industry.

Following the above reasoning, the possibility of vertical integration is analyzed. We assume that vertical integration gives the owner of the integrated firm residual return rights, but makes this integrated firm bear some cost[2]. We investigate the interaction between the competitive environment and the decision to vertically integrate: since the firms have no alternative source of supply, vertical integration leads to total foreclosure and monopolization of the downstream market. Thus, the supplier's surplus under integration does not depend on the number of downstream firms while the supplier's payoff under non-integration is subject to the effects explained above. When the rent reduction (resp. negotiation) effect dominates, vertical integration is most valuable when there is a high (resp. low) level of competition.

Suppose that downstream firms may initially enter the market freely. The mere possibility of vertical integration may act as a barrier to entry: potential entrants into the downstream market can be deterred if they anticipate that their entry would trigger vertical integration which would in turn imply market foreclosure. When there is no entry, but when the downstream firms may

[1]An example for this argument is provided by the case of the European telecommunications suppliers which used to enjoy a close relationship with state monopolies. The prospect of deregulation eventually leading to some competition between national telecom companies is widely believed to constitute a pressure on suppliers as well.

[2]Vertical integration may come with agency costs (Crémer (1994)) as well as legal or informational costs.

separate or merge, horizontal mergers or spin-offs may take place in order to prevent vertical integration. From the supplier's viewpoint, the mere threat of vertical integration may act as a disciplining device for downstream firms.

The literature on second-sourcing (Farrell and Gallini (1988)) identifies private incentives to promote competition: when demand increases with a good-specific investment from consumers, a monopolist may want to attract competition (e.g. by licensing its technology) to commit to charge low prices in the future so as to induce the buyers to invest more[3]. In this setup, a firm wants to attract competition in its own industry to induce a trading partner to invest. In addition, the incentive to promote competition in the present chapter affects the supplier's investment itself. Rajan (1992) develops a theory of arm's-length debt related to our negotiation effect where arm's-length debt reduces the creditors' bargaining power. However, in his paper, the lower bargaining position of creditors is due to their inability to acquire information about the borrower rather than competition.

The rent reduction effect is related to the change-in-the-relative-value-of-actions effect and to the profit reduction effect present in Hermalin's (1992) and Schmidt's (1994) papers on competition and managerial slack. Hermalin shows that competition affects the relative value of effort. He also points out that whether the owner or the manager has the bargaining power when the manager's compensation is decided crucially affects the efficiency consequences of competition. In Schmidt's paper, competition increases the probability of liquidation, which induces the manager to work more in order to avoid a utility loss associated with liquidation, but it may also decrease the value of a cost decreasing effort, which lowers his incentives to exert an effort[4]. These papers, however, consider competition in only one market. In particular, the manager supplies one firm and her investment adversely affects competitors. In contrast,

[3]Shepard (1987) develops a similar argument for a commitment to quality.

[4]Previous papers in this area consider frameworks where competition primarily affects the informational structure (Scharfstein (1988)).

our supplier can supply a large number of downstream firms and her investment benefits the whole industry.

The present chapter is closely related to the literature on vertical relationships and market foreclosure in which an upstream firm can appropriate (some of) the downstream industry profit via exclusivity contracts, (price) discrimination and/or vertical integration (see Rey and Tirole's (1996) survey). In this literature, the supplier is better off reducing competition in the downstream industry. While this argument also appears in this chapter, we further argue that downstream competition may be desirable to the supplier as it enables her to increase her share of the downstream industry profit. The papers closest in spirit to ours are Bolton and Whinston (1991, 1993) (hereafter BW) and especially Hart and Tirole (1990) (hereafter HT) who consider a framework where one or two upstream firms supply two downstream firms competing both for input and in the output market. They analyze conditions favoring vertical integration, when vertical integration leads to market foreclosure and when it is socially desirable. These papers, however, do not analyze the suppliers' private incentives to promote competition.

Although it has often been overlooked in IO theory, the analysis of private and public incentives to promote competition in vertically related markets is of practical importance for both firms and regulators. For instance, following a change in the regulatory environment, AT&T has recently decided to divest its supplier AT&T Technology so as to promote competition among downstream firms (Rey and Tirole (1996)). Under integration, AT&T Technology could not have committed not to discriminate against AT&T's rivals. The rivals would then have turned to alternative suppliers. The short-term gains from monopolization would have been more than offset by the long-term costs of the subsequent new relationships and competition. In this chapter, increasing downstream competition aims at improving the negotiation posi-

tion, but it may take place because of a supply assurance motive as well[5]. A good understanding of how these incentives depend on technology, demand or the competitive environment may guide contract design and decisions about vertical integration and spin-offs as well as competition policy.

The chapter proceeds as follows. Section 2 presents the model. Section 3 describes the negotiation and rent reduction effects and derives costs and benefits of competition. Section 4 develops a theory of vertical integration based on the market environment. Section 5 concludes.

2 The Model

A monopoly supplier S produces an input that she can sell to n downstream firms D_1, ..., D_n competing in quantities in an output market. The supplier's production cost is $C(Q) = cQ^2/2$, where Q is the total quantity of input she produces. The supplier can raise the demand on the output market by undertaking an investment $e \in \mathbb{R}_+$ at cost $\gamma(e) = e^3/3$ (she can invest in advertising for the output or in R&D or quality of the input leading in turn to a higher quality for the output[6]). More specifically, the inverse demand function in the output is $P(Q) = ve - Q$, with $v > 0$[7]. The downstream firms need one unit of the input to produce one unit of the homogeneous output. Downstream firm D_i has a zero production cost and has no alternative supply source. The timing is the following:

- in stage 0, S decides whether to integrate one downstream firm or not.
- in stage 1, S chooses her investment e and incurs $\gamma(e)$,

[5]Although vertical integration may take place for a supply assurance motive (Emons (1996)), this motive may also lead a firm to promote competition upstream to insure against a potential inability of one of its suppliers to supply the good.

[6]The argument holds as well when the supplier's investment reduces her marginal cost and does not affect demand.

[7]When $e = 0$, there is no exchange in the downstream market and thus no exchange in the input market.

- in stage 2, S and the downstream firms bargain over quantities of input and transfers. S supplies the downstream firms who produce and sell in the downstream market.

Our contractual assumptions are similar to those in HT.

Assumption 1 : *The supplier's investment is observable, but non verifiable.*

Assumption 2 : *Downstream firms' production is not contractible.*

There may be several technical reasons why parties might be unable or reluctant to sign such contracts. For instance, there may be a probability that a technological innovation or a shock creates an alternative source of supply whose use is not verifiable or decreases the supplier's cost. Hence, a contract may lead downstream firms to give away excessive rents to the supplier[8].

Assumption 3 : *Contracts and transactions between the supplier and any of the downstream firms are not observable by the other downstream firms.*

HT thoroughly justify this assumption. In particular, they stress the difficulty for a downstream firm to "monitor or control shipments made by $[S]$ to other parties without having residual rights of control over the assets of $[S]$, including buildings, trucks and inventories." Given this assumption, contracts conditional on other contracts (in particular exclusive dealing contracts) are not feasible: When she negotiates with one downstream firm, the supplier cannot commit not to supply inputs to other downstream firms[9]. Since contracts are unobservable, there is no possible precommitment via a contract (see Katz

[8]For instance, in the 80s, British Gas signed a contract with North Sea gas producers where it committed to buy gas at a price which is today higher than the market price. The producers are reluctant to renegotiate this contract which proves very costly to British Gas.

[9]Any other motive for the supplier not to be able or willing to commit to supply only a limited amount to the industry would do the trick. For instance, allowing for several production periods might induce the supplier to keep competition to play the downstream firms against one another in a "once out always out" setup.

(1991)). More specifically, S cannot induce the downstream firms to undertake ex post inefficient actions in the output market.

Furthermore, we assume that there is no trade between the downstream firms. This may be the case, for instance, when only the supplier has the technology to design the input for the use of each downstream firm or the ability to transport the input.

The surplus generated is divided through bargaining between the supplier and the downstream firms. The bargaining game between S and D_i is as follows: with probability α, S simultaneously makes each D_i a take-it-or-leave-it offer of quantity $q_{S,i}$ against a transfer $T_{S,i}$. Then, each D_i either accepts or rejects the offer it was made. With probability $1-\alpha$, all downstream firms simultaneously make take-it-or-leave-it offers $\{q_{i,S}, T_{i,S}\}$, $i = 1, ..., n$ to S. Then, S either accepts or rejects each offer[10]. The parameter α can be thought of as the supplier's bargaining power. When the quantity q_i is exchanged against a transfer T_i, D_i's profit π_i is given by:

$$\pi_i = (ve - Q)q_i - T_i \tag{1}$$

where $Q = \sum_{j=1}^{n} q_j$. S's surplus U is given by:

$$U = \sum_{i=1}^{n} T_i - cQ^2/2 - \gamma(e) \tag{2}$$

and her reservation utility is normalized to 0. The consumer surplus[11] is $CS = Q^2/2$, so that the social welfare SW can be written:

$$SW = U + \sum_{i=1}^{n} \pi_i + CS = [ve - (1+c)Q/2]Q - e^3/3 \tag{3}$$

[10]This bargaining game could be seen as an extension of the one in BW (1991) and HT. BW's game with two downstream firms considers a similar structure, but with only one unit traded. In HT, only the supplier makes the offers and he offers a menu to the downstream firms.

[11]Although here CS is proportional to Q^2, there is no reason for CS to be comonotonic with Q with a more general inverse demand curve $P(e, Q)$.

We assume that an (out-of-equilibrium) offer by S to a downstream firm cannot affect this firm's beliefs about S's offer to another downstream firm[12]. This is natural because the offers are secret and S tries to extract as much rent as she can from each downstream firm. This assumption rules out any manipulation of beliefs and will guarantee the uniqueness of the pure strategy Perfect Bayesian Equilibria we shall derive.

Last, we assume that the owner of a production unit's assets is entitled to all returns generated by this unit and all decision rights concerning production and trade involving this unit. Ownership will matter because of contract incompleteness. We followed the literature in assuming that no contract can be signed before the investment is made. The characteristics of the input may be difficult to write in a contract in advance[13]. We could have assumed that a state of nature is revealed after the investment is sunk. For clarity, we simply assume instead that contracts are not feasible at stage 0. As in Grossman and Hart (1986), different ownership structures will lead to different allocations of returns and thus to different incentives to invest.

Following BW and HT, we assume:

Assumption 4 *: A vertically integrated structure must bear an agency cost A that a non integrated structure does not have to bear*[14].

Furthermore, S merges with either 0 or 1 downstream firm. This may be either because a vertical structure with more than one downstream firm has to bear a prohibitively high agency cost or, as we shall see in section 4, because monopolization and total foreclosure in equilibrium make only the integration of one firm profitable.

[12]In that, we follow HT who call this assumption "market-by-market bargaining".

[13]Grossman and Hart (1986), BW and HT discuss this assumption at length.

[14]Another striking difference between the BW and HT's approach that we follow here and Grossman and Hart's (1986) theory is that the investment is industry specific rather than relationship specific.

3 Costs and Benefits of Competition

In this section, we rule out the possibility of vertical integration in stage 0. We argue that downstream competition may either increase or decrease the supplier's surplus and social welfare. We identify the negotiation and rent reduction effects and compare them to the traditional dead-weight loss reduction effect of competition. We shall see that the level of downstream competition resulting from free entry to the industry is not optimal in general and that the supplier may be better off with a competitive downstream industry.

In this simple moral hazard problem, the downstream firms cannot monitor the supplier's investment. As a benchmark, we first discuss cases where offers and transactions are publicly observable.

If she could offer a contract to all downstream firms and to the consumers, the supplier would appropriate the whole surplus from trade. Thus, she would maximize this surplus and eliminate the dead-weight loss, i.e. the perfect competition quantity would be produced, and she would undertake the socially optimal level of investment. A contract offer from the downstream firms or the consumers would also lead to the perfect competition quantity. However, underinvestment would arise from a hold-up problem: once the supplier has invested, the party making the offer can reap the whole surplus. Anticipating that she will get no reward from her investment, the supplier does not invest.

In our setup, however, a contract with the consumers cannot be signed[15]. If the supplier's offers were publicly observable, they would satisfy:

$$\begin{array}{ll} \max_{(q_{S,i}),(T_{S,i})} & \sum_{i=1}^{n} T_{S,i} - \frac{c}{2}\Big[\sum_{i=1}^{n} q_{S,i}\Big]^2 \\ s.t. & T_{S,i} \leq (ve - q_{S,-i} - q_{S,i})q_{S,i},\ \forall i \in \{1,...,n\} \end{array} \tag{4}$$

The downstream firms' participation constraints are binding. In equilibrium, the monopoly quantity $Q = ve/(2+c)$ is exchanged. Any allocation of

[15] An interpretation is that there are many small consumers who can free-ride.

the monopoly quantity among downstream firms is an equilibrium. In stage 1, the supplier chooses the investment so as to maximize her expected surplus:

$$\max_e [ve - \frac{ve}{2+c}]\frac{ve}{2+c} - \frac{c}{2}[\frac{ve}{2+c}]^2 - \gamma(e) \tag{5}$$

The first best solution is[16]:

$$e^{FB} = v^2/(2+c) \tag{6}$$

$$Q^{FB} = v^3/(2+c)^2 \tag{7}$$

For a given e, the total quantity produced is (not surprisingly) the monopoly quantity. Under complete information, S can commit to sell a given amount of input to the industry and appropriate the whole industry surplus, which is maximized under the monopoly quantity. Thus, the supplier's investment, industry production and social welfare do not depend on n. Note that the first-best is regardless of whether the offer is made before or after the investment is sunk and whether the downstream firms can coordinate or not.

If, instead, the downstream firms were to make take-it-or-leave-it offers to the supplier and were able to coordinate, they would choose the monopoly quantity ex post, but the hold-up problem would result in no investment. Here, the firms cannot coordinate. Given the simultaneity assumption, whether the offers are secret or not is irrelevant. The case where the downstream firms make the offers is studied in the next subsection.

From now on, we assume that the transactions between the supplier and a downstream are not observable to other downstream firms. In this setup, we shall see that the supplier is unable to credibly commit to a low production or not to supply some firms.

[16]Throughout the chapter, $e = 0$ will not satisfy the second order condition.

3.1 The Negotiation Effect

We first set $\alpha = 0$, i.e. the downstream firms simultaneously make contract offers to the supplier. We solve the problem by backward induction and first determine the parties' payoffs in stage 2. D_i's program can be written:

$$\max_{(q_{i,S},T_{i,S})} \quad \left(ve - q^a_{-i} - q_{i,S}\right)q_{i,S} - T_{i,S} \tag{8}$$

$$s.t. \qquad T^a_{-i} + T_{i,S} - \frac{c}{2}\left[q^a_{-i} + q_{i,S}\right]^2 \geq T^a_{-i,q_i=0} - \frac{c}{2}\left[q^a_{-i,q_i=0}\right]^2 \tag{9}$$

where q^a_{-i} and T^a_{-i} (resp. $q^a_{-i,q_i=0}$ and $T^a_{-i,q_i=0}$) denote the sum of the quantities and transfers that S is expected to exchange with all firms but D_i when D_i's offer is accepted (resp. refused) by S. In other words, D_i's offer maximizes π^a_i under S's individual rationality (IR) constraint[17]. The IR constraint is binding in each D_i's program. Therefore, the reaction functions are $(2+c)q_i = ve - (1+c)q^a_{-i}$, or $q_i = ve - (1+c)Q^a$, for all i. The quantity q bought by each firm satisfies:

$$q = \frac{ve}{(1+c)n + 1} \tag{10}$$

For a given e, we are in the traditional Cournot case and the corresponding industry Cournot quantity $Q = nq$ increases with the number of downstream firms. The subsequent reduction in the dead-weight loss tends to make competition desirable. Furthermore, the average offer per unit $T(q)/q = c(2n-1)q$ increases with n. This is due to S's increasing marginal cost of production.

The supplier's surplus is:

[17]The subscript $-i$ takes into account that offers from other firms may be rejected and that some transactions may not take place. A priori, the sets of the other downstream firms which are expected to trade with the supplier when D_i's offer is accepted or rejected are not identical. In equilibrium, however, all offers are accepted. This implies that these sets are identical and that the IR constraint specifies that the transfer offer must be at least equal to S's cost of supplying q_i units to D_i when q^a_{-i} units are expected to be supplied to the other downstream firms.

$$U = n[C(nq) - C((n-1)q)] - C(nq) - \gamma(e) \quad (11)$$

$$= \frac{cn(n-1)v^2e^2}{2[(1+c)n+1]^2} - \gamma(e) \quad (12)$$

and increases with n for a given e. This result is due to the increasing marginal cost of production. The supplier chooses her investment so as to maximize her surplus, which leads to:

$$e(n) = \frac{cn(n-1)v^2}{[(1+c)n+1]^2} \quad (13)$$

Since $U = e^3/6 > 0$, S's IR constraint is satisfied. The supplier's investment and utility both increase with n. This effect of competition on investment makes the total quantity increase with n. Moreover, it is easy to see from (11) that investment increases with n for two reasons. First, more competition increases the total quantity exchanged. Second, more competition increases the offers made by downstream firms to the supplier for the units they buy and hence S's share of the surplus. We call this latter effect the negotiation effect. Moreover, as e and Q increase, the consumer surplus $CS = Q^2/2$ and social welfare increase as well.

Lemma 1 : *When $\alpha = 0$, as the number of downstream firms increases, the negotiation and dead-weight loss reduction effects both lead to an increase in:*

- *the firms' average offers,*
- *the supplier's investment and surplus,*
- *total production and the consumer surplus,*
- *social welfare.*

The negotiation effect leads downstream firms to make offers to S which increase with the degree of competition as measured by the number of downstream firms. When n increases, the total demand for the input and the average

transfer per unit of input both increase. The key ingredient for this result is the increasing marginal cost (the investment is unnecessary). While it is modeled through an increasing marginal cost, such an effect is robust to a number of alternative specifications of the bargaining procedure. This effect is absent in BW because they assumed zero marginal cost for the supplier. In HT, the offers are always made by the upstream firms and this effect is ignored.

Assume now that in stage 0 the supplier publicly picks n potentially active downstream firms ($n \leq N$ where N is a large number of potential downstream firms). For instance, one may think that she has to communicate her technology to n downstream firms in stage 0 for them to be potentially active later. Then, in equilibrium, the supplier picks as many downstream firms as she can, i.e. N. Since the supplier has no bargaining power, she promotes competition (rather than foreclose the market) between the downstream firms to induce them to make higher offers.

3.2 The Rent Reduction Effect

We now set $\alpha = 1$. The supplier makes simultaneous take-it-or-leave-it offers to all downstream firms which satisfy:

$$\begin{array}{ll} \max_{(q_{S,i},T_{S,i})} & \sum_{i=1}^{n} T_{S,i} - \frac{c}{2}\left(\sum_{i=1}^{n} q_{S,i}\right)^2 \\ s.t. & (ve - q^a_{-i} - q_{S,i})q_{S,i} \geq T_{S,i} \end{array} \tag{14}$$

Each downstream firm's IR constraint is binding. For a given investment level, the quantity offered to each firm is, as in the preceding subsection, the Cournot quantity determined by (10). The dead-weight loss reduction effect is still present.

The transfer proposed to each downstream firm is $T = (ve - nq)q$, that is each downstream firm's Cournot revenue[18]. Therefore, the supplier's expected surplus ex ante can be written:

[18]Note that these results also hold if, instead of assuming that S offers $\{q_{S,i}, T_{S,i}\}$, we

$$U = [2nve - (c+2)n^2q]q/2 - \gamma(e) \quad (15)$$

$$= \frac{(cn+2)n}{2[(1+c)n+1]^2}v^2e^2 - \gamma(e) \quad (16)$$

leading to:

$$e(n) = nv^2\frac{cn+2}{[(1+c)n+1]^2} \quad (17)$$

$$Q(n) = n^2v^3\frac{cn+2}{[(1+c)n+1]^3} \quad (18)$$

$$SW(n) = \frac{[(1+c)n+2]nv^2e^2}{2[(1+c)n+1]^2} - e^3/3$$

$$= v^6\frac{n^3(cn+2)^2[(3+c)n+2]}{6[(1+c)n+1]^6} \quad (19)$$

whose derivatives can be written:

$$e'(n) = -v^2\frac{2(n-1)}{[(1+c)n+1]^3} \quad (20)$$

$$Q'(n) = v^3\frac{n[4+n(c-2)]}{[(1+c)n+1]^4} \quad (21)$$

$$SW'(n) = v^6n^2(cn+2)\frac{-2n^2+(2+c)n+2}{[(1+c)n+1]^7} \quad (22)$$

Thus, e and $U = e^3/6$ is decreasing in the number of firms. Since the supplier appropriates the industry surplus which decreases with the number of downstream firms, she invests more when the number of firms decreases: we refer to this as the rent reduction effect of competition. The total quantity, however, may either increase or decrease with n, as the rent reduction effect conflicts with the traditional static quantity increase due to fiercer competition[19].

consider that S offers a menu $T_{S,i}(q_i)$ to each D_i (restricting to increasing transfer functions) and each D_i then picks its quantity.

[19]Note that the linear price charged by the downstream firms to the consumer is

$$p(n) = \frac{v^3n(cn+1)(cn+2)}{[(1+c)n+1]^3}$$

The consumer surplus $CS = Q^2/2$ decreases with n when $n(2-c) > 4$. $SW'(n)$ is positive if and only if $4n \leq (2+c) + \sqrt{(2+c)^2 + 16}$. SW decreases with the number of firms when n is not too low and c is not too large. A low level of downstream competition may be socially desirable because of the effect of competition on the industry-specific investment.

Lemma 2 : *When $\alpha = 1$, as the number of downstream firms increases, the rent reduction effect conflicts with the dead-weight loss reduction effect and leads to a decrease in:*

- *the supplier's investment and surplus,*
- *production and the consumer surplus when $n(2-c) > 4$,*
- *social welfare when $4n \geq (2+c) + \sqrt{(2+c)^2 + 16}$.*

In particular, the supplier's investment is maximized under monopoly. The hold-up here is by both the downstream firms and the consumer. The consumer indirectly appropriates part of the surplus created by the supplier's investment. Since the supplier cannot discriminate, she benefits from a less competitive environment which enables her to extract a larger part of the consumer surplus. When the rent reduction effect dominates, the consumer might be better off signing a contract with one or several downstream firms to commit not to play the downstream firms against each other. Doing so would induce the supplier to invest more, which would make the consumer better off.

The argument is fairly robust. For instance, it holds with or without fixed costs, when S's surplus comes from profit sharing or two-part tariffs and when the investment and production take place simultaneously[20].

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whose derivative

$$p'(n) = \frac{v^3[-3cn^2 + 2(c-2)n + 2]}{[(1+c)n+1]^4}$$

is negative as soon as $n \geq 1$. In this setup, the price is decreasing in the number of firms.

[20]This result could be seen as a wedge between the Schumpeterian argument of dynamic efficiency and the Hicksian argument that monopoly rents weaken incentives for cost reduction.

The rent reduction effect would obtain in HT's framework with one upstream firm and n downstream firms. In their setup with two downstream firms and one upstream firm, the upstream firm makes the contract offers and her utility is contingent on downstream firms' profit. Had they focused on the effect of downstream competition, they would have obtained our rent reduction effect. Here, we start from the observation that when there are less downstream firms, the supplier suffers less from her inability to supply them all.

If, in stage 0, the supplier can choose the number of potentially active downstream firms, she forecloses the market ($n = 1$). Given that she has all the bargaining power, she appropriates the whole industry surplus which is maximized under monopoly. Thus, the supplier's choice of downstream competition crucially depends on her bargaining power.

The rent reduction effect is to be contrasted with the literature on linear pricing. Consider the following market game: the supplier chooses her investment and sets a linear price t; then, each downstream firm chooses the quantity to buy at that price so as to maximize $\pi_i = (ve - t - Q)q_i$, which leads to $q_i = (ve - t)/(n + 1)$. Hence, the supplier will choose e and t so as to maximize $tQ - cQ^2/2 - \gamma(e)$, that is:

$$(e, t) \in \arg\max \frac{nt(ve - t)}{n + 1} - cn^2\Big(\frac{ve - t}{n + 1}\Big)^2 - e^3/3 \tag{23}$$

The first order conditions of this program are $t = [(1 + 2c)n + 1]ve/2[(1 + cn) + 1]$ and $(n + 1)t - 2cn(ve - t) = (n + 1)^2e^2/nv$, which leads to:

$$e(n) = nv^2/2[(1 + c)n + 1] \tag{24}$$

$$Q(n) = nve/2[(1 + c)n + 1] = n^2v^3/4[(1 + c)n + 1]^2 \tag{25}$$

With linear pricing, e and U both increase with n. Q and SW increase with n more than in the absence of investment. More competition leads downstream firms to buy and produce more for a given t. Thus, the supplier's marginal

revenue of investment is higher and hence her incentive to invest is higher. Social welfare increases not only because (for a given investment) a higher quantity is exchanged, but also because a higher n increases the investment[21]. This result, however, is very sensitive to the assumption of linear pricing. If the supplier offered a general menu $T_i(q_i)$, a two-part tariff or a profit-sharing scheme, she could appropriate all or part of the downstream firms' profits and the rent reduction effect of Lemma 2 would hold[22].

3.3 Costs and Benefits of Competition

Analyzing two polar cases ($\alpha = 0$ and $\alpha = 1$) enabled us to identify two antagonistic effects of competition to be added to the dead-weight loss reduction effect. We address now the trade-off between these effects. More competition between downstream firms improves the supplier's negotiation position, but decreases the industry profit. For $\alpha \in [0,1]$, we obtain the following proposition:

Proposition 1 : *The effect of competition on the supplier's investment and surplus, total production, the consumer surplus and social welfare depends on the supplier's bargaining power. In particular:*

- *there exist* (α_1, α_2) *such that* e *and* U *both increase with* n *when* $\alpha < \alpha_1$, *decrease with* n *when* $\alpha > \alpha_2$, *and first increase and then decrease with* n *when* $\alpha \in (\alpha_1, \alpha_2)$,

- *there exists* α_3 *such that* Q *and* CS *increase with* n *when* $\alpha < \alpha_3$. *When* $\alpha > \alpha_3$, Q *and* CS *may either decrease or first increase and then decrease*

[21]This result would also hold if the investment were a consumer's decision variable. The only difference with our setup would be that the downstream firms' decision variable affecting the investment would be the price they would charge to the consumer, while in the result above it was the quantity they bought from the supplier.

[22]Our approach in this section could also be seen as a principal-agent relationship in the style of Maskin and Tirole (1992) where the principal performs hidden actions (the sale to other downstream firms). Given the degree of competition in the downstream market, the supplier's hidden action enters the downstream firms' objective function. Here, as soon as $n \geq 2$, the supplier is strictly worse off than if the downstream firms could observe her action.

with n,

- *there exist (α_4, α_5) such that when $\alpha < \alpha_4$, SW increases with n and when $\alpha > \alpha_5$, SW either decreases or first increases and then decreases with n.*

Proof: See Appendix. □

The investment, total quantity and consumer surplus may be maximized under a concentrated, moderately competitive or very competitive downstream industry, depending on which effect dominates. Social welfare depends on the three effects and may take various shapes (especially when $\alpha \in (\alpha_4, \alpha_5)$). It also appears that a degree of competition maximizing social welfare does not in general maximize the supplier's surplus and investment.

When she has high bargaining power, the supplier appropriates a large share of the downstream industry profit while the effect of competition on the downstream firms' offers is not very important. She is thus better off facing a non competitive downstream industry. In contrast, when her bargaining power is low, she appropriates a small share of the industry profit in the absence of competition. Competition increases her share of the industry profit.

Corollary 1 : *Assume that the supplier can choose the number $n \leq N$ of potentially active downstream firms. Then, there exists (α_1, α_2) such that she chooses $n = N$ when $\alpha < \alpha_1$, $n = 1$ when $\alpha > \alpha_2$ and a limited number of downstream firms when $\alpha \in (\alpha_1, \alpha_2)$.*

Having limited bargaining power leads the supplier to promote competition. Note that the number of downstream firms chosen will not be socially optimal in general.

Assume now that in stage 0, the downstream firms enter the market at cost $f > 0$. They enter as long as their expected profit is positive, i.e.:

$$(1-\alpha)(2+c)v^2e^2/2[(1+c)n+1]^2 \geq f \qquad (26)$$

Corollary 2 : *Entry at cost f may result in either too many or too few downstream firms from the supplier's and social viewpoints. An entry tax/subsidy can increase efficiency.*

Entry by a downstream firm creates an externality on the other downstream firms, the supplier's investment and the consumer surplus. The equilibrium number of downstream firms is in general different from a number maximizing social welfare. Note that the supplier's investment is a public good for downstream firms. Each of them would like to have the others give away a larger share of their profits to the supplier: they would benefit from the subsequent higher investment. A social planner can fine tune f via a lump-sum tax or subsidy so as to make the equilibrium number of firms coincide with an optimal number.

4 Vertical Integration

In this section, we investigate the incentive for the supplier to vertically integrate one downstream firm[23]. First consider how vertical integration affects bargaining and production in stage 2:

Lemma 3 : *Under vertical integration, the supplier supplies her subsidiary only. She supplies the monopoly quantity $Q^m = ve/(2+c)$.*

Proof: See Appendix. □

Since she obtains all the returns of the vertical structure, the supplier can appropriate the whole industry surplus by supplying only the firm she owns.

[23]As in HT, since we allow general transfers and in particular two-part tariffs, there is no double marginalisation that vertical integration might aim at eliminating.

This surplus is maximized under the monopoly quantity. If she supplies another downstream firm, she will supply more than the monopoly quantity in equilibrium. Thus, the only equilibrium is that S supplies the monopoly quantity to her downstream firm and does not supply any other firm. There is monopolization and total foreclosure (here, the absence of an outside option for downstream firms is crucial. The payoff to the integrated structure does not depend on the number of firms in the market.

We now study the supplier's incentive to vertically integrate one downstream firm. We first set $\alpha = 0$. Given the agency cost A of vertical integration, the supplier integrates only if:

$$\begin{aligned} U^{vi} - U^{ni} &= [ve - (2+c)Q^m/2]Q^m - A - cn(n-1)q^2/2 \\ &= \frac{v^2e^2}{2(2+c)} - A - \frac{cn(n-1)v^2e^2}{2[(1+c)n+1]^2} \geq 0 \end{aligned} \tag{27}$$

Thus, there is vertical integration when the number of downstream firms is low enough provided that $\frac{v^2e^2}{2(2+c)(1+c)^2} < A < \frac{v^2e^2}{2(2+c)}$ (If A is higher than this upper bound, there is never vertical integration, while if it is lower than the lower bound, vertical integration always takes place). When many firms are in the downstream market, the supplier's surplus is already quite high under non-integration and the profit increase under vertical integration may be outweighed by the agency cost. In contrast, when there are few downstream firms, the payoff under non integration may be so low that vertical integration is worthwhile.

We now set $\alpha = 1$. S integrates one downstream firm if and only if:

$$U^{vi} - U^{ni} = \frac{v^2e^2}{2(2+c)} - A - \frac{(cn+2)nv^2e^2}{2[(1+c)n+1]^2} \geq 0 \tag{28}$$

which occurs when n is large enough when $0 < A < \frac{v^2e^2}{2(2+c)(1+c)^2}$. For such values of A, the benefit from vertical integration is higher than the agency cost only when the non integrated payoff is low enough, which occurs when n is large

enough because of the rent reduction effect. These arguments hold whether e is given or endogenous.

For $\alpha \in [0,1]$, we obtain:

Proposition 2 *: The supplier's incentive to integrate a downstream firm may either increase or decrease with the number of downstream firms. In particular, there exist α_6 and $\alpha_7 > a_6$ such that:*

- *when $\alpha < \alpha_6$ and A is in a given interval, there is vertical integration when the number of downstream firms is low enough.*
- *when $\alpha > \alpha_7$ and A is in a given interval, vertical integration is profitable when the number of downstream firms is large enough.*

Proof: See Appendix. □

The intuition is that under non-integration, competition leads the downstream firms to make high offers, but restricts their profit. When the rent reduction effect dominates, the supplier's payoff decreases with n under non-integration while she has monopoly profit under integration. Thus, the incentive to integrate increases with n. When the negotiation effect dominates, the opposite conclusion holds.

We showed that social welfare function under non-integration may take various shapes. Here, the effect of vertical integration on social welfare may be either positive or negative. In addition, since the consumer appropriates part of the surplus created by the supplier's investment (even under vertical integration), the incentive to vertically integrate can be either too high or too low relative to the social optimum.

Corollary 3 *: Some socially desirable vertical integrations may not take place, i.e. they may not be privately profitable.*

This result is to be contrasted with BW and HT who find that downstream competition results in an excessive tendency towards vertical integration. Non desirable integration may appear in their model because the benefits from the vertical merger go to the merging parties, while the consumers are either worse off or unaffected[24]. Here, vertical integration may either increase or decrease the consumer surplus. In cases where the consumer surplus is higher under integration than under non-integration, the consumer would like to commit to give away part of his benefit but he cannot. A hold-up problem may arise due to the consumer's opportunism, which may lead to non-integration even when integration is socially desirable.

When there is entry at stage 0, the setup cost f affects the incentive to integrate. The number of downstream firms in equilibrium is sensitive to the possibility of vertical integration. When α is low, a sufficiently low entry cost induces enough entry to prevent vertical integration. But a high entry cost constrains the downstream industry to a level of concentration sufficient to trigger vertical integration, which implies that only one downstream firm actually enters the market. When α is high, a high entry cost leads to non-integration. But the possibility of vertical integration may reduce the number of entrants enticed by a low entry cost: a potential entrant which would have made a positive profit in the absence of vertical integration may realize that entry would trigger vertical integration and thus prefer to stay out[25]. Thus, the mere possibility of vertical integration can be a barrier to entry and can sustain profits in an industry.

Corollary 4 : *The possibility of vertical integration can be a barrier to entry.*

[24]Kühn and Vives (1994) study a model with product variety and with upstream monopoly and downstream monopolistic competition. They identify conditions on consumer preferences under which vertical mergers are welfare improving or welfare reducing.

[25]In particular, a lump-sum tax or subsidy also affects entry via its impact on the incentive to integrate. Increasing f can be welfare improving while reducing it can be socially harmful.

Horizontal mergers and spin-offs may constitute an important decentralized way to prevent vertical integration and market foreclosure. Assume that there is no entry but that horizontal mergers and spin-offs are allowed. The downstream firms may strategically merge or separate in order to prevent vertical integration and market foreclosure. They may be better off either separating and weakening their bargaining position (and maybe duplicating fixed costs) or merging and reducing their market share. This result holds, for instance, when the owners of two merging downstream firms share the profit equally and when two downstream firms resulting from a horizontal spin-off compete in quantities:

Corollary 5 : *Horizontal integrations or spin-offs may take place in order to prevent vertical integration.*

5 Concluding Remarks

The conflicting effects of competition on investment developed in this chapter are robust to a number of alternative specifications. For instance, they hold if, instead of assuming an increasing marginal cost for the supplier, downstream firms have a stochastic transformation cost. However, a number of further steps are needed for a more thorough understanding of the economic consequences of competition in such a setup. First, one might expect that competition affects investment even when conditional contracts (and in particular exclusive dealing agreements) are allowed. Under this assumption, it would be useful to investigate, for instance, the case of several production periods. Second, the use of vertical restraints may also be affected by the competitive environment.

In addition, the result of monopolization under vertical integration is very sensitive to the assumption that the downstream firms have no alternative source of supply. Upstream competition would probably affect the payoff of a vertical structure and thus the decision to integrate would depend both on

the level of upstream and downstream competition. Another direction is to investigate the dynamics of integration and separation. While we assumed that vertical integration is irreversible, vertical mergers and spin-offs may take place sequentially. This chapter suggests that a shift in the demand curve or a change in the competitive environment may trigger such mergers or spin-offs.

Finally, it would be useful to analyze interactions between financial decisions and input/output markets with such vertical relationships. For instance, financing decisions could affect the supplier's marginal cost of production and thus the offers from the downstream firms. Alternatively, the supplier may choose to be financially constrained to commit not to produce too much input.

APPENDIX:

Proof of Proposition 1:

We saw that the quantities exchanged are Cournot quantities whether the offers are made by the downstream firms or the supplier. The expected payoff for downstream firms is:

$$\pi_i = (1-\alpha)[ve - nq - c(2n-1)q/2]q \tag{29}$$

and the supplier's expected surplus can be written:

$$U = \frac{\alpha(cn+2)+(1-\alpha)c(n-1)}{2[(1+c)n+1]^2} nv^2e^2 - \gamma(e) \tag{30}$$

leading to:

$$e(n) = nv^2 \quad \frac{\alpha(cn+2)+(1-\alpha)c(n-1)}{[(1+c)n+1]^2} \tag{31}$$

$$Q(n) = n^2v^3 \quad \frac{\alpha(cn+2)+(1-\alpha)c(n-1)}{[(1+c)n+1]^3} \tag{32}$$

$$SW(n) = v^6n^3 \quad \left[\alpha\frac{(cn+2)^2[(3+c)n+2]}{6[(1+c)n+1]^6} + (1-\alpha)\frac{c^2(3+c)(n-1)^2(n+2)}{6[(1+c)n+1]^6}\right] \tag{33}$$

whose derivatives can be written:

$$e'(n) = v^2 \quad \frac{(1-\alpha)c[(3+c)n-1]-2\alpha(n-1)}{[(1+c)n+1]^3} \tag{34}$$

$$Q'(n) = v^3n \quad \frac{\alpha[4+n(c-2)]+(1-\alpha)c[(4+c)n-2]}{[(1+c)n+1]^4} \tag{35}$$

$$SW'(n) = v^6n^2 \quad \left[\alpha\frac{(cn+2)[-2n^2+(2+c)n+2]}{[(1+c)n+1]^7} + (1-\alpha)\frac{c^2(3+c)(n-1)[n^2+(2+c)n-1]}{[(1+c)n+1]^7}\right] \tag{36}$$

The supplier's investment increases with n if and only if:

$$(\alpha_2 - \alpha)[2 + c(3 + c)]n \geq (\alpha_1 - \alpha)(2 + c) \tag{37}$$

where $\alpha_1 = c/(c + 2) < c(3 + c)/[2 + c(3 + c)] = \alpha_2$. Therefore:

- when $\alpha < \alpha_2$, e increases with n,
- when $\alpha > \alpha_2$, e increases with n when $n \leq (\alpha - \alpha_1)(c+2)/(\alpha - \alpha_2)[2+c(3+c)]$ and decreases with n otherwise. Since the right hand side decreases in α in $[\alpha_2, 1]$ from $+\infty$ to 1, there exists α_2' such that e decreases with n when $\alpha > \alpha_2'$. When α tends to α_2, e increases with n. When $\alpha \in (\alpha_2, \alpha_2')$, e first increases and then decreases with n.

The total production and the consumer surplus increase with n if and only if:

$$(\alpha_3 - \alpha)[2 + c(3 + c)]n \geq 2(\alpha_1 - \alpha)(2 + c) \tag{38}$$

where $\alpha_3 = [c(4 + c)/(2 + c(3 + c)] > \alpha_1$. Therefore:

- when $\alpha < \alpha_3$, Q increases with n,
- when $\alpha > \alpha_3$, Q increases with n when $n \leq 2(\alpha - \alpha_1)(c+2)/(\alpha - \alpha_3)[2 + c(3 + c)]$ and decreases with n otherwise. The right hand side decreases in α in $[\alpha_2, 1]$ from $+\infty$ to $4/(2 - c)$. When α tends to α_3, Q increases with n. When $c > 2$, the limit of right hand side is negative and there exists α_3' such that Q decreases with n when $\alpha > \alpha_3'$ and first increases and then decreases with n when $\alpha \in (\alpha_3, \alpha_3')$. When $c < 2$, the right hand side is higher than one: when $\alpha \in (\alpha_3, 1]$, Q first increases and then decreases with n.

Social welfare increases with n if and only if:

$$\alpha(cn + 2)[2n^2 - (2 + c)n - 2] \leq (1 - \alpha)c^2(3 + c)(n - 1)[n^2 + (2 + c)n - 1]] \tag{39}$$

or:

$$
\begin{aligned}
&[3c + c^2 - \alpha(2 + 3c + c^2))]cn^3 \\
&+[c^2(3 + 4c + c^2) - \alpha(4 - 2c + c^2(2 + 4c + c^2)]n^2 \\
&+[\alpha(4 + 4c + c^2(3 + c)^2) - c^2(3 + c)^2]n \\
&+c^2(3 + c) + \alpha[4 - c^2(3 + c)] \geq 0
\end{aligned}
$$

Social welfare depends on the three effects which may dominate alternatively and may take various shapes. However, when α is low enough, SW always increases with n. When α is large enough, SW either decreases or first increases and then decreases with the number of downstream firms. □

Proof of Lemma 3:

Once she bargained and she supplied the non integrated firms, the supplier supplies her downstream firm the quantity q_1 satisfying:

$$\max_{q_1}(ve - q_{-1} - q_1)q_1 - c(2q_{-1} + q_1)q_1/2 \tag{40}$$

that is $q_1 = [ve - (1 + c)q_{-1}]/(2 + c)$. Therefore, the supplier's and downstream firms' offers respectively satisfy:

$$
\begin{aligned}
\max_{(q_{S,i}),i\in\{2,...,n\}} \quad & \Big[ve - \sum_{i=2}^{n} q_{S,i} - \frac{ve - (1 + c)\sum_{i=2}^{n} q_{S,i}}{2 + c}\Big]\frac{ve - (1 + c)\sum_{i=2}^{n} q_{S,i}}{2 + c} \\
& + \sum_{i=2}^{n}\Big[ve - q^a_{S,-i-1} - q_{S,i} - \frac{ve - (1 + c)(q^a_{S,-i-1} + q_{S,i})}{2 + c}\Big]q_i \\
& - c\Big[\sum_{i=2}^{n} q_{S,i} + \frac{ve - (1 + c)\sum_{i=2}^{n} q_{S,i}}{2 + c}\Big]^2/2
\end{aligned} \tag{41}
$$

whose unique solutions are $q_{S,i} = 0, \forall i \in \{2, ..., n\}$ and:

$$
\begin{aligned}
\max_{q_{i,S},T_{i,S}} \quad & \Big[ve - q_{i,S} - q^a_{-i-1} \\
& - \frac{ve - (1 + c)(q^a_{-i-1} + q_{i,S})}{2 + c}\Big]q_{i,S} - T_{i,S}
\end{aligned} \tag{42}
$$

$$
\begin{aligned}
s.t. \quad & T_{i,S} + T^a_{-i-1} + \Big[ve - q^a_{-i-1} - q_{i,S} \\
& - \frac{ve - (1+c)(q^a_{-i-1} + q_{i,S})}{2+c}\Big] \frac{ve - (1+c)(q^a_{-i-1} + q_{i,S})}{2+c} \\
& - c[q_{i,S} + q^a_{-i-1} + \frac{ve - (1+c)(q^a_{-i-1} + q_{i,S})}{2+c}]^2/2 \\
& \geq T^a_{-i-1,q_i=0} + \Big[(ve - q^a_{-i})q^a_{-i}\Big]_{q_i=0} - c{q^a_{-i,q_i=0}}^2/2
\end{aligned}
$$

The constraint is binding, so that the solutions of this programs satisfy:

$$
\begin{aligned}
\max_{q_{i,S}} \quad & [(1+c)ve - q_{i,S} - q^a_{-i-1}][ve - (1+c)q^a_{-i-1} + q_{i,S}] \\
& - c[q_{i,S} + q^a_{-i-1} + ve]^2/2
\end{aligned} \tag{43}
$$

whose unique solutions are $q_{i,S} = 0, \forall i \in \{2, ..., n\}$. □

Proof of Proposition 2:

First consider e as given. There is vertical integration when:

$$
U^{vi} - U^{ni} = \frac{v^2e^2}{2(2+c)} - A - \frac{\alpha(cn+2) + (1-\alpha)c(n-1)}{2[(1+c)n+1]^2} nv^2e^2 \geq 0 \tag{44}
$$

whose derivative is:

$$
[U^{vi} - U^{ni}]' = \frac{(1+c)(2+c)\alpha - c(3+c)]n - [(2+c)\alpha - c]}{2[(1+c)n+1]^3} v^2e^2 \tag{45}
$$

Thus, when $\alpha > c(3+c)/(1+c)(2+c)$, the derivative is positive $\forall n \geq 1$: the incentive to vertically integrate increases with n when $v^2e^2/2(2+c)(1+c)^2 < A < v^2e^2(1-\alpha)/(2+c)$. When $\alpha < c(3+c)/(1+c)(2+c)$, the incentive to integrate either first increases and then decreases or decreases. There exists $\alpha_2 \in [c(3+c)/(1+c)(2+c), 1]$ such that the incentive to integrate decreases with n for all $\alpha > \alpha_2$ when $v^2e^2/2(2+c)(1+c)^2 > A > v^2e^2(1-\alpha)/(2+c)$.

Taking the supplier's investment into account, it is easy to see that since $U = e^3/6$ in all cases, the analysis above is not affected when integration and non-integration lead to different investment levels. □

REFERENCES

Aghion, P. and P. Bolton (1987), "Contracts as a Barrier to Entry", *American Economic Review*, 77, 388-401.

Bernheim, B. and M. Whinston (1986a), "Common Agency", *Econometrica*, 54, 923-42.

Bernheim, B and M. Whinston (1986b), "Menu Auctions, Resource Allocations, and Economic Influence", *Quarterly Journal of Economics*, 101, 1-31.

Bolton, P. and M. Whinston (1991), "The "Foreclosure" Effects of Vertical Mergers", *Journal of Institutional and Theoretical Economics*, 147, 207-26.

Bolton, P. and M. Whinston (1993), "Incomplete Contracts, Vertical Integration, and Supply Assurance", *Review of Economic Studies*, 60, 121-48.

Crémer J. (1994), "A Theory of Vertical Integration Based on Monitoring Costs", mimeo IDEI.

Emons W. (1996), "Good Times, Bad Times, and Vertical Upstream Integration", *International Journal of Industrial Organization*, forthcoming.

Farrell, J. and N. Gallini (1988), "Second-Sourcing as a Commitment: Monopoly Incentives to Attract Competition", *Quarterly Journal of Economics*, 673-94.

Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, 94, 691-719.

Hart, O. and J. Tirole (1990), "Vertical Integration and Market Foreclosure", *Brookings Papers on Economic Activity*, 205-76.

Hermalin B. (1992), "The Effects of Competition on Executive Behavior", *Rand Journal of Economics*, 23, 350-65.

Katz M. (1991), "Game-playing agents: unobservable contracts as precommitments", *Rand Journal of Economics*, 22, 307-28.

Kühn, K.-U. and X. Vives (1994), "Excess Entry, Vertical Integration and Welfare", mimeo Institut d'Anàlisi Econòmica.

Maskin, E. and J. Tirole (1992), "The Principal-Agent Relationship with an Informed Principal, II: Common Values", *Econometrica*, 60, 1-42.

McAfee, R. P. and M. Schwartz (1993), "Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity and Uniformity", *American Economic Review*, 84, 210-30.

Ordover, J., G. Saloner and S. Salop (1990), "Equilibrium Vertical Foreclosure", *American Economic Review*, 80, 127-142.

Rajan R. (1992), "Insiders and Outsiders: The Choice Between Relationship and arm's-length Debt", *Journal of Finance*, 47, 1367-1400.

Rey, P. and J. Tirole (1996), "A Primer on Foreclosure", mimeo IDEI.

Scharfstein D. (1988), "Product-Market Competition and Managerial Slack", *Rand Journal of Economics*, 19, 147-155.

Schmidt K. (1994), "Managerial Incentives and Product Market Competition", University of Bonn Discussion Paper No. A-430.

Shepard A. (1987), "Licensing to Enhance Demand for New Technologies", *Rand Journal of Economics*, 18, 360-368.

Tirole J. (1988), *The Theory of Industrial Organization*, MIT Press.

Tirole J. (1994), "Incomplete Contracts: Where do we Stand?", Walras-Bowley lecture, North American Summer Meetings of the Econometric Society.

Chapter 4

Dynamic Adverse Selection and Debt

(joint work with Dr. Antoine Faure-Grimaud, LSE)

Abstract

This chapter argues that the strategic use of debt favours the revelation of information in dynamic adverse selection problems. We analyse the financing decision of a monopolist facing a buyer whose valuation is private information. A high level of (renegotiable) debt, by increasing the scope for liquidation, may induce the high valuation buyer to buy early at a high price and thus increase the monopolist's expected payoff. By affecting the buyer's strategy, it may reduce the probability of excessive liquidation. We compare the monopolist's payoff and debt levels under production to order and under production to market and we investigate the effects of asset and good durability.

1 Introduction

This chapter analyses the financing decision of a monopolist selling a good to a buyer with private information about his valuation. We argue that when the relationship is a long term one, that is when the monopolist can charge a price to the buyer at least twice, the strategic use of debt favours the elicitation of information from the buyer. Even renegotiable, debt may give room for inefficient liquidation. The possibility of liquidation lowers a buyer's expected rent of mimicking a lower valuation buyer. Thus, the monopolist can charge higher prices at an early stage. The strategic use of debt increases the value of the monopolist. We investigate the effect of good and asset durability.

Crucial features of dynamic adverse selection problems are that the buyer's early decision reveals information about his type and that the monopolist (or principal) can use information strategically when deciding on her subsequent contract offers. Hence, it is costly for the buyer to reveal information and the monopolist's contract offers are subject to the constraint that the buyer's expected rents from not revealing information are lower than the utility from revealing it at an early stage. We point out that the strategic use of debt may relax this constraint: since debt leaves scope for liquidation, the buyer's expected rent from not revealing information is lower. More precisely, not revealing information may itself lead to cash constrained and thus inefficient debt renegotiation ending up in (partial) liquidation while revealing information gives the monopolist enough cash to make inefficient liquidation impossible. Using debt as a mechanism to elicit information enables the monopolist to extract a higher share of the expected surplus she generates and thus to increase her profit. A high level of debt may also reduce the probability of inefficient liquidation and decreases social surplus.

The two basic problems of dynamic adverse selection are the Coasian dynamics faced by a durable good monopolist and the ratchet effect in long term relationships between a monopolist and a buyer with private information. We

first investigate the Coasian idea that the monopolist's profit is constrained by the buyer's expectation that the price will decrease over time. The usual Coasian intuition is that the durable good monopolist competes with herself over time. When the monopolist can charge different consecutive prices, following the rejection of a price, she updates her beliefs about the buyer's valuation and decreases her price over time. Anticipating this, the buyer with a high valuation may be better off waiting for a decrease in the price before buying. However, a buyer with a high valuation may choose to buy early when the monopolist may be (partly) liquidated before the price decreases. Hence, the monopolist may wish to choose a high level of debt to commit to this ex post inefficient behaviour.

The durable good case makes the monopolist's competition with herself over time extreme. However, when the good is not durable and buyers are not anonymous, the monopolist's profit is still constrained by the well-known ratchet effect. The intuition behind this effect is that a high valuation buyer who buys a good at a high price at an early stage leads the monopolist to charge a high price in next stages, which lowers the buyer's future rent. Hence, a high valuation buyer may be reluctant to buy the good at a high price at an early stage. He may first want to mimick a lower valuation buyer to increase his future rent. Since debt comes together with a possibility of liquidation, it still lowers the expected rent of mimicking a lower type buyer. However, the benefit from debt is smaller than in the durable good case[1].

The analysis suggests a number of extensions. First, our argument holds when liquidation affects the quantity to be sold in the future. In a two-stage model, the monopolist produces to order or adopts just in time manufacturing. If there is production to market, the quantity offered will be available at any time after it is available on the market. Thus, partial liquidation will

[1]When the good is not durable and buyers are anonymous, there is no dynamic adverse selection. The monopolist does not compete with himself over time and debt loses its positive value.

not restrict the quantity offered at the next stage and the traditional Coasian dynamics appear. Hence, in the separating equilibrium, the monopolist's payoff and debt are higher under production to order than under production to market.

Second, for a given financial constraint, the monopolist's payoff decreases with the durability of the asset. The more durable the asset, the higher the sum that the monopolist can commit to pay later to the creditor and the lower the scope for early liquidation. However, our results prove to be very robust to a change in asset durability.

Third, the benefit of the strategic use of debt to the monopolist increases with the durability of the good. The more durable the good, the higher the possible increase in price in the first stage and the lower the profit to be made in the second stage[2]. This suggests that ceteris paribus debt should increase with the durability of the good.

The idea that debt may increase the expected profit of a monopolist selling a durable good is to be contrasted with Titman (1984). Titman argues that when the buyers' valuation depends on after-sale services, debt decreases the value of durable good monopolists: the higher the debt level, the higher the probability of bankruptcy and the lower the possibility of being able to grant after-sale services. In Titman, the buyers' valuation depends on the existence of the firm after the good is bought. Here, we abstract from after-sale services. So the buyer's valuation is independent of the fate of the firm after the good is bought. Debt induces the buyer to purchase earlier at a higher price and allows the monopolist to appropriate a higher share of the surplus.

Section 2 describes the strategic use of an optimal debt contract in Coasian dynamics and provides a number of extensions and applications such as the effects of money diversion and cost padding, the timing of production and

[2]In contrast, if the creditor has some bargaining power with the monopolist, the sum that the monopolist can commit to pay to the creditor during the renegotiation and the debt capacity decrease with the durability of the good.

asset and good durability. In section 3, we address the ratchet effect with menu offers and the possibility for the buyer to quit the relationship. We also briefly discuss how the buyer's capital structure affects the monopolist's pricing strategy. Section 4 concludes.

2 Coasian Dynamics and The Optimal Debt Contract

In this section, we first address the financing decision of a durable good monopolist. We then give a number of comparative statics results. We focus on debt renegotiation and describe an "ideal" property of an optimal debt contract. Debt forces a high valuation buyer to pay the static monopoly price at the beginning of the game. In addition, there is no scope for *inefficient* liquidation after the sale takes place. The debt level is chosen to ensure that no sale triggers default. This leads to cash constrained (and thus inefficient) debt renegotiation and total liquidation of the firm.

2.1 The Model

The product market follows Hart and Tirole (1988). The financial side borrows from Hart and Moore (1989) and Hart (1995)[3].

2.1.1 The product market

A monopolist M has the capacity to produce $q \in \{0, 1\}$ units of a durable good to be sold in stage 1 or 2 to a single buyer. The production cost is 0. A durable good is defined such that when the sale takes place in stage 1, the buyer consumes the good in both stages 1 and 2.

[3]A Bolton-Scharfstein debt contract would also capture our point. In Bolton and Scharfstein (1996), there is no temporal correlation between the payoffs to the monopolist. In their setup, this implies that the optimal financial contract is less "tough" than a standard debt contract. In a product market characterized by dynamic adverse selection, the monopolist competes with herself over time. This implies that the optimal Bolton-Scharfstein financial contract is a standard debt contract where there is liquidation with probability 1 (resp. 0) if low (resp. high) profits are reported by the monopolist.

The buyer has private information about his valuation $v \in \{V_l, V_h\}$, with $V_h > V_l$. Initially, it is common knowledge that $v = V_h$ (type h) with probability λ_1 and $v = V_l$ (type l) with probability $1 - \lambda_1$. We make the usual assumption that, in a static framework without financial constraints the monopolist would prefer selling the good at $p_1 = V_h$ with probability λ_1 to selling it for sure at price $p_1 = V_l$, i.e. $\lambda_1 > \bar{\lambda_1} \equiv V_l/V_h$. Let q_t^i be the amount that the buyer of type $i \in \{l, h\}$ buys in stage t.

2.1.2 The financial contract

The monopolist has an initial wealth of w and needs capital $K > w$ to buy an asset necessary to enter the product market. K only needs to be paid once in stage 1. The firm can be liquidated (and the asset sold), generating a return L_t at the end of stage t whether the good was produced and sold or not. The asset depreciates. In particular, $K > L_1 > \delta L_2$, where δ is the discount factor common to all agents. The liquidation decision can be made either by the monopolist or by the creditor. Entering the product market is profitable. We assume $L_1 < \delta(V_l + L_2)$, i.e. liquidating the asset at the end of stage 1 is inefficient if the good is not sold. Except when specified and without loss of generality, we shall assume $L_2 = 0$.

Following Hart and Moore (1989, 1996) and Bolton and Scharfstein (1996), we assume that the monopolist can divert cash flows more easily than physical assets. Formally, returns from liquidation are verifiable while profits from the sale of the good are not (they can be used for perks) [4].

We now turn to the set of financial contracts. The monopolist can borrow an amount $B \geq K - w$ from a creditor against the pledge to repay R_1 and R_2 at the end of stages 1 and 2 whenever possible. As profits are non-verifiable, feasible contracts can only specify that the firm repays the promised amount

[4] In other words, the monopolist cannot be convicted of stealing the operational profit. One reason for this is that there is a probability that this profit is null.

or the creditor has the right to liquidate (part of) the asset. Let f_t denote the fraction of the asset remaining at date t (with $f_0 = 1$).

In the final stage, the creditor can obtain nothing from the operational profit as the monopolist will always divert it. However, before this, the monopolist may be prepared to give up some of the operational profit to the creditor to avoid liquidation. Before liquidation takes place, the stream of promised repayments can be renegotiated[5]. We point out that the renegotiation outcome may be constrained by the monopolist's financial constraint. Renegotiation is not fully efficient because product market returns are non verifiable. For simplicity, we also assume that the monopolist has all bargaining power in case of renegotiation in stage 1 and that the creditor cannot seize the monopolist's savings (that is, in stage 1, $B - (K - w)$).

Without loss of generality, we assume that the market for creditors is perfectly competitive and that before borrowing, the monopolist can invest $w_0 \leq w$ in a two period project with a zero rate of non verifiable return so that she invests only $w_p = w - w_0$ in the project described above[6]. All parties are risk-neutral.

2.1.3 Definition of the equilibrium

The sequence of events is as follows:

- In stage 1, the monopolist chooses w_p and w_0 and borrows an amount B from the creditor against the pledge to repay $\{R_t\}$. M charges a price p_1. The buyer decides whether to buy or not. Accordingly, M produces and sells the quantity ordered and decides whether to sell the asset or not. Renegotiation may take place and M satisfies her financial obligations.

[5]This is a central feature of our model: introducing a commitment possibility with a third party would allow the monopolist to commit to a price and, of course, would solve the coasian dynamics. However, such an agreement is not renegotiation-proof because the monopolist could always bribe the third party ex post to lower the price.

[6]The money can be secretly invested in a tax haven and to bring it back would disclose tax evasion and lead the monopolist to jail or to pay a heavy penalty. In this case, w_p would be the publicly known initial wealth of the monopolist.

- In stage 2, if the monopolist carries on (i.e. $f > 0$), she chooses a price p_2. The buyer chooses to buy or not to buy. M sells the asset and repays the creditor.

For a given financial contract, a Perfect Bayesian Equilibrium in the product market is defined by:

i) a sequence of prices $\{p_1, p_2\}$ characterizing the monopolist's strategy, conditional upon her beliefs regarding the buyer's type (an offer at date t occurs only if prior offers have been rejected). At this price, M is able to supply either a quantity f_t or 0 at stage t.

ii) a sequence of buyer's decisions to order the quantity $q_t \in \{0, f_t\}$ at date t. The buyer buys the good supplied at price p_t with probability $x_t^i(p_t)$ and buys nothing with probability $1 - x_t^i(p_t)$.

iii) a probability distribution defining the monopolist's beliefs derived from equilibrium strategies using Bayes' rule whenever possible.

Our equilibrium definition does not involve the creditor's strategy. This is because, from the creditor's perspective, the market equilibrium is irrelevant since returns are non-verifiable: his strategy depends only on the liquidation values.

2.2 Coasian Dynamics and Financial Constraints

We proceed by backward induction. The strategy of a buyer of type i in stage 2 is:

$$x_2^i(p_2) = \begin{cases} 1 & if\ p_2 \leq v_i \\ 0 & otherwise \end{cases} \tag{1}$$

Let $\lambda_2(p_1)$ be the probability that $i = h$ knowing that p_1 was rejected. The monopolist plays:

$$p_2 = \begin{cases} V_h & if\ \lambda_2 V_h > V_l \\ V_l & otherwise \end{cases} \tag{2}$$

Since the monopolist has all the bargaining power with the creditor in the renegotiation game at the end of stage 1, the creditor cannot be repaid more than L_1. Thus, w_p must satisfy $w_p \geq K - L_1$ so that the monopolist gets her initial investment back. Indeed, the creditor will get $D_1 = \min\{R_1, L_1\}$ and $D_2 = 0$. Given that the market for creditors is perfectly competitive, $D_1 = B$. Therefore:

$$K - w_p \leq B = D_1 \leq L_1 \tag{3}$$

Two cases arise:

- if the buyer bought in stage 1, M closes the firm and sells the assets. The creditor is repaid D_1[7].

- if the buyer did not buy in stage 1, then the continuation value is at least $\delta V_l > L_1$. When the creditor liquidates a fraction $1 - f$ of the assets in stage 1, the monopolist loses at least $(1 - f)(\delta V_l - L_1)$. Thus, the monopolist will prefer to pay back in cash first and liquidate as little as possible. Since $B = D_1$, $B - (K - w_p) < D_1$, the monopolist will not be able to pay all of D_1 in cash. She will pay as much as she can in cash, but will have to accept the liquidation of a fraction $1 - f$ of the assets such that $B - (K - w_p) + (1 - f)L_1 = D_1$:

$$f = 1 - \frac{K - w_p}{L_1} \tag{4}$$

Note that forgiving some of the debt today or contracting a new loan to partly repay the debt against a reimbursement in $t = 2$ is impossible: as $L_2 = 0$, D_2 is null[8].

[7]The proceeds of a liquidation triggered by the monopolist are verifiable.

[8]One may think that following a liquidation M could decide to buy a new asset to replace the initial investment of K. The cost of such a policy is K. It seems natural to assume that the depreciation process is identical to the one which occurred during the first period. Hence, the liquidation value of an asset bought at the beginning of the second period is also L_1 at the end of $t = 2$. But the difference is that now M has no more cash w_p to invest in the project. As $K > L_1$ such a solution is not feasible.

In stage 1, buyers' strategies can be characterized as follows. The buyer of type l cannot expect any surplus if he waits. His strategy in stage 1 is:

$$x_1^l(p_1, R_1) = \begin{cases} 1 & if\ p_1 \leq V_l(1+\delta) \\ 0 & otherwise \end{cases} \tag{5}$$

Indeed, if $p_1 = V_l(1+\delta)$, then the buyer accepts with probability 1 whatever his type. Consider now $p_1 > V_l(1+\delta)$. A type h buyer is willing to buy at $t = 1$ if and only if he gets at least what he would obtain by deferring his purchase. If he expects a fraction $1-f$ of the asset to be liquidated in case he does not buy, then he buys with probability 1 up to $\hat{p}_1$ satisfying $V_h(1+\delta) - \hat{p}_1 \geq \delta f(V_h - p_2)$. Since a buyer of type h buys with probability 1 at $\hat{p}_1$ and a buyer of type l does not buy, the ex post beliefs of the monopolist are such that $\lambda_2 = 0$, i.e. the equilibrium is fully separating. Hence, $p_2 = V_l$ and:

$$\hat{p}_1 = V_h(1+\delta) - \delta f(V_h - V_l) \tag{6}$$

Let us now consider the case where the monopolist charges $p_1 > \hat{p}_1$. In this case, the buyer of type h may play a mixed strategy[9]. He accepts p_1 with probability x making the monopolist indifferent between $p_2 = V_h$ and $p_2 = V_l$[10]. We thus get:

$$\lambda_2 = \frac{\lambda_1(1-x)}{\lambda_1(1-x) + (1-\lambda_1)} = \frac{V_l}{V_h} = \bar{\lambda}_1 \tag{7}$$

The only possible equilibrium strategy for the buyer is to set $x_1^h(p_1) = x$ for all $p_1 \in (\hat{p}_1, V_2(1+\delta)]$ and for all R_1. In equilibrium, the buyer of type h must be indifferent between accepting and rejecting. Let $\sigma_2 = Prob\{p_2 = V_l\}$. Hence, $\sigma_2 = \frac{V_h(1+\delta)-p_1}{\delta f(V_h - V_l)}$. If the buyer did not buy, then, for any $p_1 \in (\hat{p}_1, V_h(1+\delta)]$, the monopolist's expected payoff at stage 2 is $\delta[\sigma_2 V_l + (1-\sigma_2)\bar{\lambda}V_h] = \delta V_l$. Thus, her semi-separating payoff is maximised for $p_1 = V_h(1+\delta)$.

[9]To accept with probability 1 is not an equilibrium as it would lead to a fully revealing rejection ($\lambda_2 = 0$) implying that the buyer of type h should wait.

[10]If $p_2 = V_l$ with probability 1, then if $p_1 \leq \hat{p}_1$ we go back to the previous case. If $p_1 \geq \hat{p}_1$, type h waits and we get a pooling equilibrium with no buying at $t = 1$. But this last strategy is always suboptimal from the monopolist perspective. Last, it is not possible for the buyer with a high valuation to be indifferent in $t = 1$ if $p_2 = V_h$ with probability 1.

Therefore, the pooling, separating and semi-separating expected utilities to the monopolist are:

$$U_p \equiv V_l(1+\delta) + L_1 - (K - w) \tag{8}$$

$$U_s \equiv \delta f_s V_l + \lambda_1[V_h(1+\delta(1-f_s)) + L_1 - (K - w_{p,s})] + w_{0,s} \tag{9}$$

$$U_{ss} \equiv \frac{\lambda_1 - \bar{\lambda}}{1-\bar{\lambda}}[V_h(1+\delta) - (K - w_{p,ss}) + L_1] + \frac{1-\lambda_1}{1-\bar{\lambda}}\delta f_{ss} V_l + w_{0,ss} \tag{10}$$

where subscripts p, s and ss hold for pooling, separating and semi-separating, respectively. For a given financial contract, depending on λ_1, the monopolist's equilibrium strategy is to choose p_1 leading to either the separating or the semi-separating outcome. Clearly, the financial contract chosen by the monopolist depends on the anticipated equilibrium in the product market.

U_s decreases with f_s and since $f_s = 1 - \frac{K - w_{p,s}}{L_1}$, it increases with K and $K - w_{p,s}$ and decreases with $w_{p,s}$. Since $w_{0,s} = w - w_{p,s}$ can be stuck in a two period project with a zero rate of non verifiable return, the monopolist can endogeneize $f_s = 1 - (K - (w - w_{0,s}))/L_1$ and $w_{0,s}$ is chosen so as to make $f_s = 0$. Thus, when the monopolist expects a separating equilibrium in the product market, she makes sure that there is complete liquidation if the buyer does not buy in stage 1. In this separating equilibrium, the expectation of liquidation induces the buyer to buy which makes complete liquidation optimal ex post[11].

In contrast, the semi-separating utility is increasing in f_{ss} and $w_{p,ss}$ and decreasing in K. A decrease in f_{ss} reduces the stage 2 profit if the buyer did not buy in stage 1. But it can neither lead to an increase in p_1 nor affect the probability that the buyer will buy in stage 1. Thus, when she expects a semi-separating equilibrium in the product market, the monopolist invests all

[11]This point is similar to Fudenberg et al (1987) where a fixed cost of continuation corresponds here to a decrease in the liquidation value.

her wealth in the durable good project so as to minimize f_{ss}. We thus obtain the following results:

Lemma 1 : *Assume that a given w_p is invested in the durable good project. There exists a threshold $\hat{\lambda} \equiv \hat{\lambda}(w_p, K)$ such that the equilibrium in the product market is semi-separating when $\lambda_1 > \hat{\lambda}$ and separating when $\lambda_1 \leq \hat{\lambda}$. $\hat{\lambda}$ is positive, decreases with w_p, increases with K and equals 1 when $K - w_p = L_1$, i.e. when the totality of the assets is liquidated in case of default.*

$$\hat{\lambda} = \frac{\bar{\lambda}[V_h(1+\delta) - \delta f V_l - (K - w_p) + L_1]}{\bar{\lambda}V_h(1+\delta) + \delta f((1-\bar{\lambda})V_h - V_l) + \bar{\lambda}(L_1 - (K - w_p))} \tag{11}$$

Hence, for a given financial contract, a sufficiently high fraction of the assets liquidated in case of default may ensure that a semi-separating equilibrium in the traditional Coasian dynamics case without debt is replaced by a unique fully separating equilibrium.

Proposition 1 : *For all λ_1, the monopolist invests $w_p = K - L_1$ in the durable good project and borrows $B = L_1 = K - w_p$ (borrowing capacity). Hence, default triggers her complete liquidation. The only equilibrium in the product market is a fully separating one with a stage 1 price $p_1 = V_h(1+\delta)$.*

Proof: See Appendix.

The monopolist chooses the fraction to be liquidated in case of default so as to obtain a fully separating equilibrium in the product market. Investing $w_0 = w - (K - L_1)$ in the alternative project commits the monopolist to be completely liquidated if the high valuation buyer does not buy. This forces the high valuation buyer to purchase with probability 1 for prices up to his valuation in stage 1. This commitment arises from the financial constraint that she needs to borrow up to her borrowing capacity. Debt restores full static monopoly power.

Note that if the equilibrium is semi-separating without money diversion, then some inefficient liquidation occurs with probability $(1 - \lambda_1)/(1 - \bar{\lambda})$. Being financially constrained allows the monopolist to switch to a separating

equilibrium which implies that inefficient liquidation only occurs with probability $1 - \lambda_1$. Thus, a harder financial constraint and a higher level of debt may decrease the probability of inefficient liquidation.

In addition, in the traditional Coasian dynamics without debt, the low valuation buyer purchases the good when the price goes down. In contrast, the strategic use of debt makes sure that the good is produced and sold to the high valuation buyer only, i.e. with probability λ_1 only. The price is always too high for the low valuation buyer to buy the good. Hence, the strategic use of debt decreases social surplus. This is natural since debt enables the monopolist to restore her static monopoly power.

2.3 Extensions and Applications

2.3.1 Cost Padding and Money Diversion

We have seen that the binding financial constraint, $L_1 = K - w_p$, can be obtained by investing in another two period project. Alternatively, the monopolist could make sure that the liquidation value L_1 is low enough, i.e. that the asset depreciates fast enough. For this, she could initially spend her resources in perks rather than in acquiring skills or material to maintain the asset to a good second-hand value. Cost padding with no "shadow cost", where the manager can appropriate every unit of an increase in K, is also similar to investing in the alternative project. The monopolist could increase K and spend the additional cost in perks.

Corollary 1 *: Cost padding up to $K = w + L_1$ is optimal and leads to a unique separating equilibrium with $p_1 = V_h(1 + \delta)$.*

The results above are very clear-cut because they assume that the monopolist can fully use the resources she diverts. It may be the case, though, that she can only partly benefit from the resources she diverts. Our results are reasonably robust to this assumption. As a benchmark case, we turn to a monopolist

who cannot enjoy anything from the diverted resources.

Proposition 2 : *Assume that the monopolist cannot use the resources she diverts. Then, there exist* λ_a *and* λ_b, *with* $\lambda_b > \lambda_a$ *for some parameter values, such that when* $\lambda_1 \in [\lambda_a, \lambda_b]$, *the monopolist initially burns* $w - (K - L_1)$, *borrows* $B = L_1$ *(debt capacity) and charges a fully separating price* $p_1 = W_h(1+\delta)$.

Proof: See Appendix.

The strategic use of debt in promoting information revelation arises from the feature that no sale triggers complete liquidation. This occurs if no money is left to renegotiate at the end of stage 1. When the only possibility is to burn the money taken away from the project, restoring the static monopoly power entails an additional cost. The range of λ_1 such that the equilibrium is separating is reduced by the monopolist's inability to benefit from money diversion.

When λ_1 is large (when the incentive to discriminate is high), the utility in the separating equilibrium decreases with w_p. She is willing to burn money as it allows her to restore her monopoly power. Nonetheless, she only does so if her utility after burning money is higher than what she would obtain in another equilibrium. This condition is met when λ_1 is not too large. By burning money, the monopolist can endogeneize f because it reduces her initial wealth.

If money burning is impossible and $\lambda_1 \in [\lambda_a, \lambda_b]$, then a high cost to undertake the project and/or a low initial wealth (respectively up and down to $K = w + L_1$) are utility increasing. The higher K and the lower w, the greater the scope for liquidation if the buyer of type h does not buy in stage 1 and the higher his willingness to buy in stage 1. A high cost reduces the profitability of the project, but increases the monopolist's expected payoff.

2.3.2 Financial Constraints and Production to Order versus Production to Market

A key assumption driving our results in Section 2.2 is that the monopolist produces after the buyer decided to buy, i.e. she produces to order. If she produced to market (before the buyer decision is made), debt could not constrain her capacity to supply the good: even if the firm was totally liquidated, the good would still be available to the buyer and the threat of liquidation would not affect the buyer's decision (unless the monopolist owns the delivery technology). Thus, we have:

Corollary 2 *: Retaining the assumptions of Proposition 1 or 2 under which the equilibrium in the product market is separating, under production to order, the monopolist's utility and debt are higher than under production to market.*

However, in the semi-separating equilibrium, liquidation does not affect the buyer's probability of ordering the good in stage 1. Producing to market in stage 1 allows the monopolist to produce 1 unit before being at least partly liquidated. This increases her stage 2 expected profit. Thus, in the semi-separating equilibrium, production to market dominates production to order.

2.3.3 When the Asset is Durable

We have discussed comparative statics with respect to L_1. We now consider $L_2 > 0$ and focus on the effect of L_2 on our previous results. A strictly positive liquidation value at $t = 2$ allows the monopolist to promise to repay up to $f'L_2$ to the creditor. The actual repayments are $D_2 = \min\{R_2, f'L_2\}$ and $D_1 = \min\{R_1, L_1 - \delta f'L_2\}$. The debt value is $B = D_1 + \delta D_2$. Clearly, a change in L_2 does not affect the stage 2 equilibrium strategies on the product market.

We turn to its effect on f'. If the buyer bought one unit in stage 1, it is optimal to sell the asset at the end of stage 1, i.e. $f' = 0$. Indeed, M has

$p_1 + B - (K - w_p) + (1 - f')L_1 + \delta f' L_2$ whose maximum is attained for $f' = 0$. Therefore, she repays $D_1 + \delta D_2 = D_1 = \min\{R_1, L_1\}$.

If the sale did not take place in stage 1, the monopolist still prefers not to sell the assets. Note that whatever the financial contract and whatever its term, it is always optimal to have $R_2 = f' L_2$ (i.e to promise as much as possible in $t = 2$). To see this, assume $R_2 < f' L_2$. Then, it is possible to propose dD_1 and dD_2 such that the payoff of the creditor is unchanged: $-dD_1 + \delta dD_2 = 0$. As $R_2 < f' L_2$, $dD_2 = dR_2$. Some debt is forgiven (in a long term financial contract) or a new loan is contracted to reduce R_1 (as for a sequence of short term debts). Yet, as D_1 decreases, M can save a greater fraction of the asset. This increases her expected utility by at least $d[\delta(V_l + L_2) - L_1] > 0$. Hence, we restrict ourselves to contracts with $D_2 = f' L_2$. However, liquidation will still occur at the end of period 1 if $B - (K - w_p) + (1 - f')L_1 \leq D_1$. But $B = D_1 + \delta f' L_2$ and the fraction of the asset eventually liquidated is such that:

$$f' = min\{1, \frac{L_1 - (K - w_p)}{L_1 - \delta L_2}\} \tag{12}$$

If $\delta L_2 \geq K - w_p$, then liquidation never occurs and we are back to the unlevered case. f' is higher than f for given K, L_1, w_p: the higher L_2, the more repayment the monopolist can postpone to the end of stage 2 and the less liquidation occurs[12].

Lemma 2 : *For a given w_p, the separating (resp semi-separating) equilibrium will yield a lower (resp higher) payoff to the monopolist the more durable the asset.*

To obtain $f' = 0$ still requires $w_p = K - L_1$. The monopolist's utilities under the three different possible equilibria are still given by (8), (9) and (10) (with f' instead of f). Therefore, it is easy to check that:

[12] As before, there is no need to consider the case where the monopolist buys a new fraction of the asset at the end of stage 1.

Proposition 3 : *If the monopolist can divert resources to her own benefit ex ante, $L_2 > 0$ does not affect Proposition 1. If she cannot, the results of Proposition 2 still hold with $\lambda'_a \leq \lambda_a$ and $\lambda'_b < \lambda_b$ decreasing with L_2.*

Proof: See Appendix.

The borrowing limit remains at L_1 whatever $L_2 < L_1/\delta$. The monopolist will borrow the same amount as before to secure the separating equilibrium. A higher L_2 allows the monopolist to postpone some of its repayment and increases f (M keeps a larger share of the asset) for a given w_p. Diverting (or burning) one unit of cash entails a lower increase in $1-f$ the higher L_2. In a semi-separating equilibrium, there is no room for a strategic use of debt and the monopolist is better off with f as high as possible. Therefore, the durability of the asset favours this type of equilibrium relative to the separating one.

2.3.4 Debt and the Durability of the Good

Assume that, with probability α, a buyer ordering the good at stage 1 can still consume it at stage 2. With probability $1-\alpha$, he cannot consume it any more. In this case, he can buy another good at stage 2, given his first period decision gave information to the monopolist about his type. We refer to α as the durability of the good. Whether the good is durable or not is revealed at the beginning of stage 2.

Clearly, the final stage strategies in the product market are as in the durable good case. f is also determined as before. Proceeding as in section 3, we obtain:

$$\hat{p}_1 = V_h(1+\alpha\delta) - \delta f(V_h - V_l) \tag{13}$$

$$U_p = (1+\delta\alpha)V_l + \max\{L_1, \delta(1-\alpha)\lambda_1 V_h\} - (K-w) \tag{14}$$

$$\begin{aligned} U_s &= \lambda_1[V_h(1+\alpha\delta) + \max\{L_1, (1-\alpha)\delta V_h\} - L_1] \\ &- (K-w) + L_1 \end{aligned} \tag{15}$$

$$U_{ss} = \frac{\lambda_1 - \bar{\lambda}}{1-\bar{\lambda}}[V_h(1+\alpha\delta) + \max\{L_1, (1-\alpha)\delta V_h\} - (K-w)]$$

$$+ \quad \frac{1-\lambda_1}{1-\bar{\lambda}}\delta V_l[L_1-(K-w)]/L_1 \tag{16}$$

$$U_s - U_{ss} = \frac{1-\lambda_1}{1-\bar{\lambda}}[V_l(1-\delta+\alpha\delta)+\bar{\lambda}\max\{L_1,(1-\alpha)\delta V_h\}]$$

$$+ \quad (1-\lambda_1)L_1 + \frac{1-\lambda_1}{1-\bar{\lambda}}(K-w)(\delta V_l/L_1-1) \tag{17}$$

It is still true that $U_s > U_p$ and that $U_s - U_{ss}$ is positive and increases with α. We thus obtain:

Proposition 4 : *There is a unique fully separating equilibrium with* $w_{p,s} = K - L_1$ *and maximum indebtness. The increase in the monopolist's utility due to this strategic use of debt increases with the durability of the good.*

In other words, the benefit from being financially constrained increases with the durability. It is natural that the advantage of debt increases with the durability of the good since the less durable the good, the less competition the monopolist faces with herself over time.

The special case $\alpha = 0$ refers either to the sale of a non durable good or to the rental of a durable good. In this case, it is well known that the supplier faces a ratchet effect: the type h buyer anticipates that the monopolist is going use her updated information in stage 2, which will lower the future buyer's utility if he reports the truth in stage 1. Hence, mimicking the type l buyer in stage 1 may be profitable in stage 2, which sets an upper constraint to the stage 1 price charged by the monopolist. In this case again, the threat of bankruptcy if the buyer does not purchase allows the monopolist to charge the same price as in the static case.

In a richer setup, the higher benefit from using debt associated with a more durable good may have to be balanced with a lower debt capacity. If the creditor had some bargaining power, the debt capacity (and, for a given w_p, $1-f$) would decrease with the durability of the good. Indeed, when the good is more durable, the expected profit at stage 2 is higher and the monopolist is ready to pay more to keep a high fraction of the asset. Hence, a more durable

good implies a higher incentive to be financially constrained but a lower debt capacity.

3 Ratchet Effect with Menu Offers and Debt

In this section, we consider a non durable good monopolist facing the same demand at each date. We allow the monopolist to make menu offers stipulating a quantity and a tariff corresponding to a particular quantity. Typically, in a dynamic setting, the ratchet effect limits the ability of the monopolist to discriminate between types: the buyer compares his future rent when he misreports his type today with what he will obtain when reporting his true valuation. As there exists a positive rent differential, information revelation is more difficult than in the static case (although the problem is not as severe as in Coasian Dynamics).

In this new setting, there is still room for a strategic use of debt: the possibility of bankruptcy reduces the high valuation buyer's incentive to mimick the low valuation one. The rent differential decreases with the probability of liquidation. Second, it is shown that the positive effect of debt on information revelation pertains even though the buyer is not pivotal. So far, the incentives for a high valuation buyer to buy early were maximized: no sale at $t = 1$ triggered complete liquidation of the monopolist. Here, instead of focusing on renegotiation issues between the monopolist and the creditor, we assume that the former can be liquidated independently of the buyer's decision.

In a two stage case, the seminal paper by Laffont and Tirole (1988) shows that screening amongst agents is impossible when the private information parameter is a continuous variable. This negative result comes from an "extreme" version of the ratchet effect in the sense that privately informed agents are allowed to quit the relationship in the second stage. The non screening result still holds in our model with a continuum of types. Nonetheless, debt increases the scope for screening and reduces the ratchet effect.

3.1 The Product Market

We extend the previous model to the case where the quantity is variable and where the monopolist may use non linear pricing rules (second degree price discrimination). We adapt Laffont and Tirole's approach to this dynamic version of Maskin and Riley's (1984) model.

The good is perishable, i.e. it can be consumed for 1 stage only. Alternatively, one may consider that the buyer can only rent the durable good. It is assumed that the buyer is not anonymous: in stage 2, the monopolist remembers the first stage offer and the buyer's previous decision. Following Laffont and Tirole (1988), we assume that a buyer who bought at $t = 1$ can refuse to consume at $t = 2$ (these authors refer to this strategy as a "take the money and run" strategy). At each stage, the buyer's utility is:

$$U_t = \theta_i V(q_t) - T_t, \qquad t = 1, 2. \tag{18}$$

with $\theta_i \in \{\theta_l, \theta_h\}$ and $V' > 0$, $V'' < 0$. Denote the probability $Prob(\theta = \theta_h) = \lambda_1$. At each date, the monopolist offers a contract $\{q_t, T_t\}$. Therefore, the product market of the previous section is a special case with $q_t \in \{0, 1\}$ and $V_i = \theta_i V(1)$.

For the sake of exposition, we recall the usual results in the static case. If θ_i is perfectly observable by the monopolist, the optimal contract maximizes $T_i - cq_i$, where c is the marginal cost, subject to $\theta_i V(q_i) - T_i \geq 0$. For each type, the monopolist offers the first best quantity (such that $\theta_i V'(q_i^{fb}) = c$) and the buyer receives zero rent. Now, if θ_i is private information to the buyer, the monopolist discriminates the two types by solving:

$$\begin{aligned} & \max_{q_i, T_i} && \lambda_1(T_h - cq_h) + (1 - \lambda_1)(T_l - cq_l) \\ s.t. \quad & (IC_h) && \theta_h V(q_h) - T_h \geq \theta_h V(q_l) - T_l \\ & (IR_l) && \theta_l V(q_l) - T_l \geq 0 \end{aligned}$$

It is well-known that the optimal solution entails no distortion at the top

and a second-best quantity for the buyer of type l (see Maskin and Riley, 1984):

$$\theta_h V'(q_h^{fb}) = c \tag{19}$$

$$\theta_l V'(q_l^{sb}) = c + \frac{\lambda_1}{1-\lambda_1}\Delta\theta.V'(q_l^{sb}) \tag{20}$$

where $\Delta\theta = \theta_h - \theta_l$. Letting π^{AI} be the monopolist's profit under asymmetric information[13]:

$$\pi^{AI} = \lambda_1(\theta_h V(q_h^{fb}) - cq_h^{fb}) - \lambda_1\Delta\theta V(q_l^{sb}) + (1-\lambda_1)(\theta_l V(q_l^{sb}) - cq_l^{sb}) \tag{21}$$

3.2 The Two-Stage Case with Debt

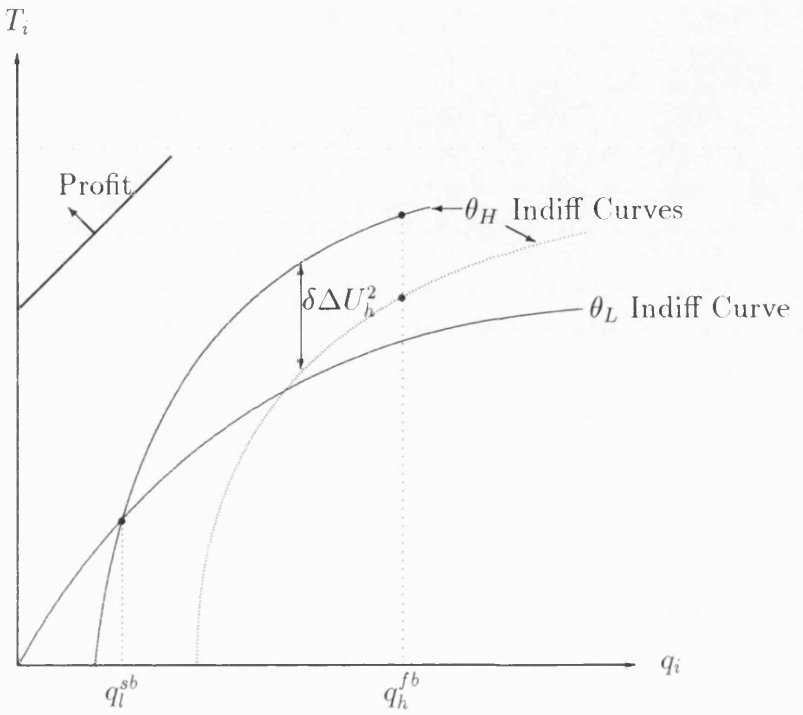
We assume that, when the firm is indebted, there is an exogenous probability of liquidation, $1-f$. Once more, the analysis in the preceding section may justify why this probability is non null even though liquidation is inefficient.

When the monopolist cannot commit to a particular future contract, the stage 2 contract is the optimal one (ex post) given her beliefs. Let λ_2^k be her belief that the buyer is of type h after the contract k was chosen at stage 1. If $\lambda_2^k < 1$, then the stage 2 offer is the second best static one with beliefs λ_2^k and the profit is $\pi^{AI}(\lambda_2^k)$ (this holds when $\lambda_2^k = 0$ as well). If $\lambda_2^k = 1$, M knows that the buyer has a high valuation and offers the first best quantity at a price $\theta_h V(q_h^{fb})$. Consequently, the high valuation buyer's rent is null ($U_h = 0$).

We now turn to stage 1. Assume, for the sake of the argument, that the usual second-best contract is offered in stage 1. A type h buyer's incentive constraint is binding, meaning that in stage 1 he is indifferent between choosing $\{q_h^{fb}, T_h^{fb}\}$ and $\{q_l^{sb}, T_l^{sb}\}$. If he picks $\{q_h^{fb}, T_h^{fb}\}$, he is identified as a type h buyer, which implies that $U_2^h = 0$ and that his intertemporal utility equals his first stage utility $\Delta\theta V(q_l^{sb})$. If he chooses $\{q_l^{sb}, T_l^{sb}\}$, he still gets a stage 1 utility $\Delta\theta V(q_l^{sb})$, but since he is not identified as a type h buyer, he has a positive rent in stage 2 ($\delta U_2^h > 0$). Hence, his intertemporal utility is higher, i.e. the

[13]In this static case, we assume that no shutdown occurs: it is optimal to sell to the type l buyer because neither λ_1 nor $\Delta\theta$ is very high.

usual second-best contract is no longer incentive compatible. The following figure illustrates the intuition.



The two points on the bold θ_h-indifference curve represent the static solution. For the high valuation buyer to consume the first best quantity at $t = 1$, the monopolist must lower the first stage payment by $\delta\Delta U_2^h$. ΔU_2^h represents the differential at $t = 2$ for a high valuation buyer between utility deriving from his choices at $t = 1$ ($\{T_l, q_l^{sb}\}$ or $\{T_h, q_h^{sb}\}$). The high valuation buyer's rent in stage 2 is greater when the monopolist believes that the type is low. The third point is incentive compatible. Yet, for a high second stage "extra" rent, a high valuation buyer reveals his type only for a large decrease in t_h^1. For this reason, a low valuation buyer may prefer to choose the allocation proposed for the high valuation buyer. This is possible if the low type erroneously identified as a high type can quit the market at $t = 2$: at this date, the monopolist, believing that the buyer's type is θ_h, makes an offer that is binding out the high valuation buyer's individual rationality constraint. If the low type is forced to accept

this contract, his utility is negative and incentive compatibility at $t = 1$ is restored. Under the alternative assumption, screening the different types may not be possible. In particular, if $\theta_h - \theta_l$ is small (in the continuous case), the translated θ_h-indifference curve crosses $q = q^{fb}$ below the θ_l-indifference curve. Even in a 2 type case, different classes of equilibria may arise (according to which incentive constraint binds) and pooling may be the optimal strategy.

In this setting, debt alleviates the dynamic adverse selection problem. A type h buyer will enjoy an "extra" rent at $t = 2$ with probability f only: the benefit of misreporting his type is lower since the buyer's utility at $t = 2$ will be null with probability $1 - f$[14]. Graphically, the θ_h-indifference curve is translated by $f\delta\Delta U_2^h$).

Proposition 5 *There exists $\delta_0(f)$ such that the equilibrium is separating for any $\delta \leq \delta_0(f)$ and pooling otherwise. $\delta_0(\cdot)$ increases with the probability of liquidation.*

Proof: Appendix.

An increase in the probability of liquidation favours separating equilibria. The fact that the monopolist may not serve the market in the future decreases the benefit of mimicking a low valuation buyer. The strategic use of debt reduces the informational rent given up to the buyer. The cost of debt is that the monopolist may lose the second stage profit. When the discount factor is low, she puts more weight on the present gain than on future losses. The threshold increases with the probability of liquidation as more liquidation increases both the first stage gain and the second stage loss.

Interestingly, this effect of debt on the revelation of information would persist if *the buyer* instead of *the monopolist* may liquidate. In this case, debt only advantages the monopolist, provided a bankrupt buyer is replaced by

[14]The existence of a new entrant in stage 2 would not affect our result as long as the monopolist's information is not transferable.

a new one at $t = 2$ (otherwise, debt entails a cost identical to the previous one). An indebted buyer, who decides at $t = 1$ to misreport his type, expects an extra gain at $t = 2$ with probability f. This observation is particularly relevant in the original Laffont-Tirole setting where the "buyer" is a regulated firm. If this firm is indebted, the regulator may obtain information about its cost more easily. Debt forces the firm to adopt short term objectives. As a result, problems of dynamic adverse selection are less severe. In a regulation framework, our conclusion would be that debt is welfare increasing and that the regulator would benefit from its use. This result has to be contrasted with Spiegel and Spulber's (1995) paper where a regulated firm uses debt as a way of extorting rents from the regulator: to avoid bankruptcy, the regulator increases the price that the regulated firm is allowed to charge. The total effect of debt may depend upon the magnitude of both effects.

4 Concluding Remarks

This paper has shown that debt can be thought of as a mechanism to elicit information in dynamic adverse selection problems. We believe that this property is worth investigating in more sophisticated environments. For instance, in multi-period models, it may be interesting to analyze the possibility of obtaining a non monotonic sequence of prices (particularly in the durable good case). When the monopolist is financially constrained, buyers must buy at a high price if they want to buy the good at all. But once they have bought, the firm may be less financially constrained for a few periods. The price goes down due to the Coasian commitment problem until the firm is financially constrained again, which induces the monopolist to charge a high price again.

We saw how financial constraints may help alleviate the commitment problem faced by a monopolist in asymmetric information environments. We explored the idea that debt may allow a monopolist to capture the informational rents of his trading partners. It may be interesting to study further the prop-

erties of debt in dynamic adverse selection problems and draw parallels and differences with the role of debt in (dynamic) moral hazard problems. Although the use of debt in rent extraction in static moral hazard problems is well recognized (see, amongst others, Jensen (1986) or Perotti and Spier (1993)), its use in dynamic agency problems has been surprisingly overlooked.

Appendix:

Proof of Proposition 1:

The monopolist allocates w between w_p and w_0. The way she allocates money among the two projects enables her to manipulate the fraction of the asset she can keep if the buyer does not buy the good in stage 1.

$$U_s = \delta f_s V_l + \lambda_1[V_h(1+\delta(1-f_s)) + L_1 - (K - w_{p,s})] + w - w_{p,s} \quad (22)$$

$$U_{ss} = \frac{\lambda_1 - \bar{\lambda}}{1-\bar{\lambda}}[V_h(1+\delta) - (K - w_{p,ss}) + L_1] + \frac{1-\lambda_1}{1-\bar{\lambda}}\delta f_{ss} V_l + w - w_{p,ss} \quad (23)$$

U_s decreases with f_s and U_{ss} increases with f_{ss}. The monopolist chooses between a separating equilibrium with $f_s = 0$ (investing $L_1 - (K - w_{p,s})$ in the alternative project) and a semi-separating equilibrium with a f_{ss} as high as possible (where $w_{p,s} = w$, i.e. all the money is invested in entering the durable good market). The separating payoff dominates the semi-separating one if and only if:

$$\lambda_1 V_h(1+\delta) + w - (K - L_1) > \frac{\lambda_1 - \bar{\lambda}}{1-\bar{\lambda}}[V_h(1+\delta) + L_1 - (K-w)] + \frac{1-\lambda_1}{1-\bar{\lambda}}[L_1 - (K-w)]\delta V_l / L_1 \quad (24)$$

which is always satisfied. In addition, it is easy to check that the pooling equilibrium is always dominated by the separating one with $f_s = 0$. □

Proof of Proposition 2:

Assume now that the monopolist cannot appropriate any resources she diverts from the project. She cannot manipulate f (which is fully determined by L_1

and $K - w_p$) without completely wasting the resources she diverts. In this case, there is a tradeoff between having more money initially and making more profit by being financially constrained. The separating outcome with money burning requires that:

- The separating utility decreases with w_p. This holds if and only if $\lambda_1 > \delta V_l/[(\delta V_h - L_1)$. In this case, U_s is maximised when $w - (K - L_1)$ is burnt, which implies $f = 0$ and leads to $U_s = \lambda_1 V_h(1 + \delta)$.

- This outcome is preferred to both the semi-separating one and the pooling one (when no money is burnt since the monopolist's utility increases with w in both cases). This holds if and only if:

$$\lambda_1 \leq \lambda_b \equiv \frac{V_l(1+\delta) - (\delta V_l/L_1 - V_l/V_h)(L_1 - (K-w))}{V_l(1+\delta) - (\delta V_l/L_1 - 1)(L_1 - (K-w))} \quad (25)$$

$$\lambda_1 \geq V_l/V_h + (L_1 - (K-w))/V_h(1+\delta) \quad (26)$$

λ_b increases with K, decreases with w and equals 1 when $L_1 = K - w$.

The result is obtained with $\lambda_a \equiv \max\{\delta V_l/[(\delta V_h - L_1)], V_l/V_h + (L_1 - (K - w))/V_h(1+\delta)\}$. □

Proof of Proposition 3:

The proof is similar to that of Proposition 2 with:

$$\lambda'_a \equiv \max\{\frac{\delta V_l}{\delta V_h - (L_1 - \delta L_2)}, \frac{V_l}{V_h} + \frac{(L_1 - (K-w))}{V_h(1+\delta)}\} \quad (27)$$

$$\lambda'_b \equiv \frac{V_l(1+\delta) - [\delta V_l/(L_1 - \delta L_2) - V_l/V_h](L_1 - (K-w))}{V_l(1+\delta) - [\delta V_l/(L_1 - \delta L_2) - 1](L_1 - (K-w))} \quad (28)$$

both decreasing with L_2. □

Proof of Proposition 5:

Following Laffont and Tirole, we assume that the monopolist offers two contracts in stage 1: $\{q^0, T^0\}$ for the low valuation buyer and $\{q^1, T^1\}$ for the high valuation one. Let x be the probability that a high valuation buyer chooses $\{q^0, T^0\}$ and y be the probability that a low valuation buyer chooses $\{q^0, T^0\}$. The updated probability that $\theta = \theta_h$ given that $\{q^k, T^k\}$ was chosen in stage 1, λ_2^k, satisfies:

$$\lambda_2^1 = \frac{\lambda_1(1-x)}{\lambda_1(1-x)+(1-\lambda_1)(1-y)} \tag{29}$$

$$\lambda_2^0 = \frac{\lambda_1 x}{x\lambda_1 + y(1-\lambda_1)} \tag{30}$$

We solve the game by backward induction. In stage 2, the monopolist's program, offers and profit are those of the static case given λ_2^k. In stage 1, the monopolist's program can be written:

$$\begin{aligned}
&\max_{\{q^0,T^0,q^1,T^1\}} && \lambda_1[x(T^0 - cq^0) + (1-x)(T^1 - cq^1)] \\
&&& +(1-\lambda_1)[y(T^0 - cq^0) + (1-y)(T^1 - cq^1)] \\
&&& +\delta f[(\lambda_1 x + (1-\lambda_1)y)\pi^{AI}(\lambda_2^0) \\
&&& +(\lambda_1(1-x) + (1-\lambda_1)(1-y))\pi^{AI}(\lambda_2^1)] \qquad (31) \\
&s.t. \quad (IC_h) && \theta_h V(q^1) - T^1 + \delta f U_2^h(\lambda_2^1) \geq \theta_h V(q^0) - T^0 + \delta f U_2^h(\lambda_2^0) \\
&\quad (IC_l) && \theta_l V(q^0) - T^0 \geq \theta_l V(q^1) - T^1 \\
&\quad (IR_h) && \theta_h V(q^1) - T^1 + \delta f U_2^h(\lambda_2^1) \geq 0 \\
&\quad (IR_l) && \theta_l V(q^0) - T^0 \geq 0
\end{aligned}$$

It is clear that (IR_l) is binding. In the Laffont-Tirole setting, 3 cases may arise: either only (IC_h) is binding, or only (IC_l) is binding or both bind. It turns out that in our case either only (IC_h) is binding or the solution is

pooling. This difference arises because, in the Laffont-Tirole monopolist case, the isoprofit curves are strictly convex. So we have two types of equilibria.

In type I equilibrium, (IC_h) only is binding, so that the low valuation buyer strictly prefers $\{q^0, T^0\}$ and the high valuation buyer randomizes between $\{q^0, T^0\}$ and $\{q^1, T^1\}$. As a result, $\lambda_2^1 = 1$ and $\lambda_2^0 = x\lambda_1/[x\lambda_1 + 1 - \lambda_1]$. Therefore, $U_2^h(\lambda_2^1) = 0$ and the second period payoff to the monopolist is first best. With probability $\lambda_1(1-x)$, $\pi_2 = \pi^{AI}(1) \equiv \pi_1^{FI}$. With the complementary probability, $U_2^h(\lambda_2^0) = \Delta\theta V'(q_l^{sb}(\lambda_2^0)) > 0$. The expected payoff to the monopolist is:

$$\begin{aligned}
\Pi &= \lambda_1[x(\theta_l V(q_l^{sb}) - cq_l^{sb}(\lambda_1)) + (1-x)(\theta_h V(q_h^{fb}) - cq_h^{fb})] \\
&\quad -\lambda_1[\Delta\theta V(q_l^{sb}(\lambda_1)) + \delta f \Delta\theta V(q_l^{sb}(\lambda_2^0))] \qquad (32) \\
&\quad +(1-\lambda_1)[\theta_l V(q_l^{sb}(\lambda_1)) - cq_l^{sb})] \\
&\quad +\delta f[(\lambda_1 x + (1-\lambda_1))\pi^{AI}(\lambda_2^0) + \lambda_1(1-x)\pi_1^{FI}] \qquad (33)
\end{aligned}$$

Type II equilibrium is pooling. The best pooling equilibrium is such that $\theta_l V'(q^p) = c$, i.e. $q^p = q_l^{fb}$ and gives the monopolist a payoff:

$$\Pi^p = \pi_1^p + \delta f \pi^{AI}(\lambda_1) \qquad (34)$$

The best type I equilibrium is separating with $x = 0$, yielding an expected payoff:

$$\begin{aligned}
\Pi^s &= \lambda_1(\theta_h V(q_h^{fb}) - cq_h^{fb}) - \lambda_1[\Delta\theta V(q_l^{sb}(\lambda_1)) + \delta f \Delta\theta V(q_l^{sb}(\lambda_2^0))] \\
&+ (1-\lambda_1)[\theta_l V(q_l^{sb}(\lambda_1)) - cq_l^{sb})] \\
&+ \delta f[(1-\lambda_1)\pi^{AI}(\lambda_2^0) + \lambda_1 \pi_1^{FI}] \qquad (35)
\end{aligned}$$

In this case, since $\lambda_2^0 = 0$, we obtain, by denoting $\pi_0^{FI} \equiv \pi^{AI}(0)$:

$$\Pi^s = \pi^{AI}(\lambda_1) - \delta f \lambda_1 \Delta\theta V(q_l^{fb})$$

$$+ \quad \delta f[(1-\lambda_1)\pi_0^{FI} + \lambda_1 \pi_1^{FI}] \tag{36}$$

By definition of $\pi^{AI}(\lambda_1)$, we have:

$$\lambda_1 \pi_1^{FI} + (1-\lambda_1)\pi_0^{FI} - \Delta\theta\lambda_1 V(q_l^{fb}) < \pi^{AI}(\lambda_1) \tag{37}$$

Otherwise, the optimal second best contract would not maximise the monopolist's payoff in the static case. Using the same argument, it is clear that $\pi^{AI}(\lambda_1) > \pi_1^p$. Hence, $\Pi^p < \Pi^s$ if and only if:

$$\pi_1^p - \pi^{AI}(\lambda_1) < \delta f[(1-\lambda_1)\pi_0^{FI} + \lambda_1 \pi_1^{FI} - \Delta\theta V(q_l^{fb}) - \pi^{AI}(\lambda_1)] \tag{38}$$

that is if and only if:

$$\delta < \frac{\pi^{AI}(\lambda_1) - \pi_1^p}{f[\Delta\theta V(q_l^{fb}) + \pi^{AI}(\lambda_1) - (1-\lambda_1)\pi_0^{FI} - \lambda_1 \pi_1^{FI}]} \tag{39}$$

Denoting the right hand side by $\delta_0(f)$ gives the result. □

REFERENCES

Bolton, P. and D. Scharfstein (1990), "A Theory of Predation Based on Agency Problems in Financial Contracting", *American Economic Review*, 80, 93-106.

Bolton, P. and D. Scharfstein (1996), "Optimal Debt Structure with Multiple Creditors", *Journal of Political Economy.*

Coase R. (1972), "Durability and Monopoly", *Journal of Law and Economics*, 15, 143-49.

Dewatripont M. (1988), "Commitment through Renegotiation-Proof Contracts with Third Parties", *Review of Economic Studies.*

Morch von der Fehr, N.-H. and K.-U. Kühn (1995), "Coase versus Pacman: Who Eats Whom in the Durable-Goods Monopoly?", *Journal of Political Economy*, 103, 785-812.

Fudenberg, D., D. Levine and J. Tirole (1987), "Incomplete Information Bargaining with Outside Opportunities", *Quarterly Journal of Economics*, 37-50.

Hart O. (1995), *Contracts, Firms and Financial Structure*, Clarendon Lectures in Economics, Oxford Univesity Press.

Hart, O. and J. Moore (1989), "Default and Renegotiation: A Dynamic Model of Debt", MIT working paper no. 520.

Hart, O. and J. Moore (1996), "Debt, Default and Renegotiation, mimeo Harvard University and LSE.

Hart, O. and J. Tirole (1988), "Contract Renegotiation and Coasian Dynamics", *Review of Economic Studies*, 55, 509-40.

Jensen M. (1986), "Agency Costs of Free Cash Flow, Corporate Finance, and

Takeovers", *American Economic Review*, 76, 323-29.

Laffont, J. J. and J. Tirole (1988), "The Dyamics of Incentive Contracts", *Econometrica.*

Laffont, J. J. and J. Tirole (1993), *A Theory of Incentives in Procurement and Regulation*, MIT Press.

Maskin, E., and J. Riley (1984), "Monopoly with Incomplete Information", *Rand Journal of Economics.*

Perotti, E. C. and K. E. Spier (1993), "Capital Structure as a Bargaining Tool: The Role of Leverage in Contract Renegotiation", *American Economic Review*, 83 (December).

Spiegel, Y. and D. Spulber, "The Capital Structure of Regulated Firms", *Rand Journal of Economics.*

Tirole J. (1988), *The Theory of Industrial Organization*, MIT Press.

Titman S. (1984), "The Effect of Capital Structure on a Firm's Liquidation Decision", *Journal of Financial Economics*, 13, 137-51.