Debt as a (Credible) Collusive Device,

or: "Everybody Happy but the Consumer"*

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Abstract

The paper proposes a theory of the anti-competitive effects of debt finance based on the interaction between capital structure, managerial incentives, and firms' ability to sustain collusive agreements. It shows that shareholders' commitments that reduce conflicts with debtholders – such as hiring managers with valuable reputations or "conservative" incentives – besides reducing the agency costs of debt finance also greatly facilitate tacit collusion in product markets. Concentrated or collusive credit markets, or large banking groups, can ensure the credibility of such commitments (renegotiation-proofness), thereby "exporting" collusion through leverage in otherwise competitive downstream product markets.

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1 Introduction

Recent empirical work by Judith Chevalier (1995), Dan Kovenock and Gordon Phillips (1995, 1997), and particularly Phillips (1995) has shown that in concentrated industries, high leverage tends to be correlated with low output, high prices, and more passive investment behavior; that is, debt seems to have anti-competitive effects on product markets.

In this paper we propose a theoretical explanation for this evidence based on the interaction between capital structure, managerial incentives, and firms' ability to sustain collusive behavior. Building on Vojislav Maksimovic's (1988) leveraged oligopoly model, we show that shareholders' commitments to a "prudent" behavior aimed at reducing conflicts with debtholders and the ex ante cost of debt finance – such as choosing a manager with a valuable reputation or low-powered managerial incentives – also greatly facilitate tacit collusion in the product market. The model explains why and how collusive credit markets and large banking groups "export" collusion in otherwise competitive downstream product markets. Even when secret contract renegotiation is feasible and costless, a suitable combination of bank debt and "conservative" managerial incentives has the same product market effects of a "hidden" horizontal merger, making full collusion sustainable where unleveraged firms would be unable to collude at all.

We begin from the observation of James Brander and Michel Poitevin (1992), David Hirshleifer and Anjan Thakor (1992), and Daron Acemoglu (1997), that by committing to a prudent behavior through "conservative managers," firm owners can limit the asset substitution problem linked to limited liability and reduce the ex ante (agency) cost of debt finance.[1]

We introduce such a commitment opportunity in Maksimovic's (1988) model of repeated leveraged oligopoly to analyze its effect on collusive behavior.

We first show that if owners can commit against strategic default by hiring a manager with an established reputation – with much to lose from bankruptcy – debt needs not reduce firms' ability to collude with respect to unleveraged firms, and can instead improve it.[2] Commitments to debtholder-friendly behavior through low-powered managerial incentives are then shown to have stronger pro-collusive effects, which add to

[1] Thomas Schelling (1960) stressed that contracts with third parties can have important strategic effects. The strategic effects of managerial incentives in oligopolistic environments have been studied by John Vickers (1985), Chaim Fershtman and Kenneth Judd (1987), Steven Sklivas (1987), and others.

[2] Throughout this paper we will use the terms 'shareholders' and 'owner' interchangeably, since all the results apply independent of ownership structure. For example, a downstream oligopolistic product market can easily be reinterpreted as the strategic interaction between several competing industrial pyramids.

that of managers' reputational costs of bankruptcy to make collusion much easier to sustain for highly leveraged than for unleveraged profit-maximizing firms.

It is well known that, since delegation of control is a contractual device, its commitment value can be greatly reduced when secret renegotiation is feasible at low cost (Mathias Dewatripont, 1988; Michael Katz, 1991). In contrast, we find that when credit markets are concentrated lenders can increase their monopoly rents by controlling the choice of managers and their incentives in borrowing firms, and conferring them *full* commitment value. High levels of debt make the choice of a prudent manager and/or of conservative managerial incentives *renegotiation-proof*, making commitments to conservative (collusive) product market strategies credible even when secret renegotiation is feasible and costless. This applies independent of whether the credit market is contestable, and solves both the firms' enforcement and coordination problems. It makes the joint monopoly agreement sustainable as the unique collusive equilibrium in otherwise competitive product markets, independent of the discount rate.

Even when credit markets are perfectly competitive and/or firms have multiple lenders, choosing at least one lender in common – or, equivalently, at least a couple of distinct but "allied" lenders – remains an easy way by which oligopolistic firms can credibly commit to "friendly" behavior and enforce tacit collusive agreements that could not otherwise be sustained, as first suggested by Brander and Lewis (1986). Moreover, we find that even when no lender is in common, large independent lenders can still fully monopolize otherwise competitive product markets by having "a man of theirs" on the board of the firms they are *not* financing, that is, by creating a credible information network composed of indirectly interlocking directorships that make secret renegotiation impossible.[3]

It is well known that during the leveraged-buyout (LBO) wave of the '80s, increases in leverage were accompanied by simultaneous changes in managerial incentives. Our model suggests that, at least in mature oligopolistic industries, tacit collusion could be one channel through which the combination of increased leverage and new managerial compensation packages brought about higher profitability.

More importantly, our results offer a rationale for the common observation that "continental" and Japanese economies tend to be less competitive than Anglo-Saxon ones (e.g. Marcus Noland, 1995; Yoshiro Miwa, 1996; Maki Atsushi, 1998). The former economies, particularly the Japanese and German, are characterized by large

[3]The two mechanisms that make managerial contracts renegotiation-proof in this model – introducing third parties that can veto renegotiation and developing an information network that makes secret renegotiation impossible – are quite general. They would confer commitment value with complete information and costless renegotiation to any contract other than those we are focussing on.

banking groups and a high frequency of "bankers on (firms') boards." These are the features required in our model for debt-finance to have pro-collusive effects on product markets.[4]

From an historical point of view, the present model can be seen as the first formal account of how, in the early 1900s U.S., J.P. Morgan and other banks in the 'money trust' could

> "[create] value for shareholders by the extraction of monopoly rents from consumers..." (Bradford De Long, 1990),

and of how German and Austrian banks facilitated (and facilitate?) product market collusion among their borrowing firms (Martin Hellwig, 1991).

The model also fits well the case of Italy, where for a long time a single merchant bank, Mediobanca, has coordinated the governance structure and the financial and investment policies of most large Italian industrial and financial firms (in full agreement with their owners).[5] This institution directly or indirectly controlled top-management jobs the largest firms and banks of the country. It could truncate the Italian career of any top manager, however brilliant, that took independent initiatives instead of behaving "conservatively," that is, of following the centrally agreed, and therefore collusive plans.

The results of the model appear to go along well with several other stylized facts in empirical corporate finance. They are consistent with the consolidated evidence that debt issues are perceived as good news by the stock market (Christopher James, 1987; Milton Harris and Arthur Raviv, 1991), that the probability of a firm undertaking an LBO is positively related to its competitors' leverage (Paul Marsh, 1982; Chevalier, 1995), and that managerial incentives are often low-powered, particularly in bank-dominated economies (Jensen and Kevin Murphy, 1990; Steven Kaplan, 1994a,b, 1998; Murphy, 1998). In mature oligopolistic industries "conservative" managerial incentives are optimal contracts; they simultaneously minimize the agency cost of debt finance and maximize (collusive) profits in the product market.[6]

[4] Anglo-Saxon financial systems, in contrast, are more fragmented and competitive, with a smaller size of banks relative to firms and a lower frequency of bank representatives on firms' boards. Still, Randal Kroszner and Phillip Strahan (1998) find that even in the U.S. up to 30% of Fortune 500 firms have a "banker on board."

[5] In a very similar fashion to how J.P. Morgan's money trust "coordinated" large American firms in the early 1900s.

[6] Brian Hall and Jeffrey Liebmann (1998) have documented how the widespread adoption of stock-related incentive plans has increased U.S. top managers' pay-performance sensitivity in the last fifteen years. Consistent with the results of this paper, Giancarlo Spagnolo (1998) finds that these highly-powered stock-related incentives are also usually designed so that they facilitate tacit collusion in product markets.

On the theoretical ground, Jeffrey Zwiebel (1996) has convincingly argued that an important weakness of many earlier models of the disciplinary role of debt is that financial decisions must be made *ex ante* and must be out of managers' control, since debt leaves managers worse off. In Zwiebel's words:

> "...this contrasts with common perception of leveraged choices being in the domain of standard managerial decisions. Managers commonly undertake capital decisions without any apparent extraordinary external threat..."

For example, in the LBO wave of the '80s it was managers who usually took the initiative. One nice feature of the present model is that it provides a clear explanation for why managers themselves may be willing to choose high leverage, to put themselves under the threat of bankruptcy. In mature oligopolies a combination of debt and prudent managers is a commitment to profitable, collusive behavior and, for the commitment to be credible, managers themselves must receive a stake of the collusive rent.

Among the policy implications of the model, particularly relevant for bank-dominated economies, are that the banking industry should be high up on the agenda of the competition authorities; that the identity of, and the relation between firms' lenders and directors must be taken into account as factors facilitating coordination in concentrated industries; that relaxing the Glass-Steagall Act's restrictions in the U.S. could enhance banks' ability to monopolize downstream product markets; and that the tasks of banking supervision and of ensuring banking competition should be attributed to distinct authorities.

1.1 Related Literature

The paper is related to most previous work on the interaction between firms' financial structure and product market competition, and stands in contrast to the two more established theories on the subject, the "long purse" and the "limited liability" ones. These two theories are not well suited to explain anti-competitive effects of debt finance, since their natural implication is that debt should lead either the leveraged firms or their competitors to behave more aggressively. According to John McGee's (1958) and Lester Telser's (1966) "long purse" or "deep pockets" theory, when some firms issue debt, their unleveraged competitors will find it convenient to engage in a market war in order to drive them bankrupt and eventually out of the market.[7] According to Brander and Tracy Lewis' (1986) "limited liability" theory, the "asset

[7] This argument has been formalized in models of "predation," for example, by Jean-Pierre Benoit (1984), Drew Fudenberg and Jean Tirole (1986), and Patrick Bolton and David Scharfstein (1990).

substitution" problem highlighted by Michael Jensen and William Meckling (1976) should lead shareholders of leveraged firms to disregard low product market states – from which they are protected by limited liability – and therefore choose overly aggressive product market strategies.[8]

The paper to which this work is most closely related is probably Poitevin (1989), since it also focuses on the coordinating role of common lenders in oligopolies.[9] Within a two-stage model analogous to Brander and Lewis (1986), Poitevin has shown that when firms borrow from a common lender this may partly curb leveraged firms' overly aggressive product market behavior through a suitable choice of the interest rates. Though, as Poitevin remarks, in that model the overall effect of debt finance remains pro-competitive. The common-lender leveraged-oligopoly equilibrium output is still larger than the unleveraged Cournot output. In contrast, in our model a common lender (or a group of allied lenders) can fully monopolize the product market, it can implement the joint monopoly industry output, whatever the discount rate is. Moreover, here product markets monopolization occurs even when fully independent lenders have loyal directors on each others' borrowers' boards, that is, even when firms have no common/allied lenders whatsoever.

The present paper is also related to the work of Sudipto Battacharya and Gabriella Chiesa (1995) where again, as in Poitevin (1989), the effects of a common lender on firms' strategic behavior are analyzed (they call it "multilateral lending," taking the bank's point of view). Battacharya and Chiesa focus on a different set of firm strategies than Poitevin – information disclosure and R&D investments – and show that a common lender internalizes externalities between firms, allows for efficient

[8] This argument was also made by Maksimovic (1986). The strictly related argument that owners' limited liability limits leveraged firms' ability to sustain tacit collusion was developed by Maksimovic (1988), and extended by Rune Stenbacka (1994) and Ulrich Hege (1998).

[9] A paper by Dick Deamon (1997), close in spirit (and in title) to the present one, analyzes an infinitely repeated version of the Brander and Lewis (1986) model and attempts to demonstrate a pro-collusive effect of debt. Unfortunately, the results of that paper are flawed. In the proof of Proposition 1 (and in the remainder of the paper) the author fails to acknowledge that the positive per-period probability of bankruptcy induced by debt increases the effective rate at which owners discount future profits. Moreover, the author neglects that – besides reducing firm owners' short-run gains from deviation and payoffs in the non-cooperative punishment phase – debt also directly reduces their per-period payoffs during the collusive phase; and that this last effect alone dominates that on short-run gains from deviation. After taking these effects into account, it is straightforward to realize that in that model collusion is more easily sustained by *unleveraged* firms who threaten to punish deviations by issuing debt during non-cooperative punishment phases. In other words, the repetition of Brander and Lewis' (1986) model leads to a theory of how – when firms use trigger strategies – the *opportunity* to issue debt facilitates collusion between unleveraged firms by lowering owners' payoffs during the punishment phase. However, such a theory would predict that firms are leveraged only during punishment phases, with empirical implications opposite to the evidence discussed in the beginning of the introduction.

information-sharing in the R&D phase, and ensures that only one firm among multiple inventors enters the product market.

This paper, Poitevin (1989), and Battacharya and Chiesa (1995) are all related to the work of Douglas Bernheim and Michael Whinston (1985), where it is demonstrated that a common marketing agent can be used by firms that act non-cooperatively to facilitate collusion. The logic common to the three papers and to part of the present one is that a contractual device (debt here, in Poitevin and in Battacharya and Chiesa, marketing agency in Bernheim and Whinston) is used to transfer a fraction of firms' returns, to "sell out" to a single party who internalizes part or all (market or R&D) externalities.

Several other theories have been proposed to rationalize the positive empirical relation between leverage and markups. For example, Phillips (1992) and Kovenock and Phillips (1995) obtain a negative output/leverage relation by focusing on the constraints imposed by debt on managers' ability to finance new investments. Jacob Glazer (1994), Dean Showalter (1995), Antoine Faure-Grimaud (1997), and Erland Nier (1998) obtain analogous results by modifying the assumptions of Brander and Lewis' (1986) model. Glazer introduces an additional product market interaction before debt is due, and finds that accumulated profits curb firms' overly aggressive behavior. Showalter assumes price instead of quantity competition, and obtains higher profits for leveraged firms when demand is uncertain. Faure-Grimaud assumes that lenders cannot observe the realized state of nature nor firms' profits, and finds that the truth-telling constraint generates debt contracts that lead firms to produce lower output. Nier – in a spirit close to this paper – introduces "conservative" managers whose objective is to avoid bankruptcy. Under the assumption of upward sloping reaction functions he finds that shareholders' conflicts with both debtholders and competitors are softened, although managers are still left with no incentives to issue debt in the first place.

The explanation proposed in this paper does not contrast with those above, but it has the advantage of being more robust: our results do not depend on modelling details, they apply whatever the mode of competition prevalent in product markets.[10] Of course, the relative importance of each of these theories will depend on the industry's characteristics, and should ultimately be established empirically.

The rest of the paper is organized as follows. In Section 2 we introduce Maksimovic's (1988) model and extend it to show how managers' reputational losses from bankruptcy and debtholder-friendly managerial incentives affect the relation between debt and collusion. In Section 3, the heart of the paper, we show how a concentrated

[10]Here we focus on Cournot competition, but it is easy to verify that the results hold also when firms compete on prices (the case of Bertrand competition is fully developed in Spagnolo, 1999).

credit market can monopolize otherwise competitive downstream product markets by ensuring the credibility of commitments through "prudent managers." In Section 4 we show that the pro-collusive effect of debt remains when credit markets are competitive and firms have multiple lenders, and even when there are no common/allied lenders at all, and we discuss the role of asymmetries in bank loans and of the seniority of bank debt. In Section 5 we discuss possible extensions of the model, its implications for competition policy and the regulation of the banking industry, and briefly conclude. All proofs are in the Appendix.

2 "Creditors' managers" and collusive behavior

2.1 The model

Maksimovic (1988) studies a repeated oligopoly model in which leveraged firms repay their debt by periodic installments (coupons), which can alternatively be thought of as repayments of several debt contracts with different maturities (in line with, for example, Oliver Hart and John Moore, 1995). Maksimovic's well known finding is that there is a negative relation between a firm leverage and its ability to sustain tacit collusion.[11] Because firm owners have limited liability, there exists a maximum level of debt at which any stationary collusive agreement can be supported, and above which owners will prefer to deviate, cash short-run gains from deviation, and then let the firm go bankrupt. Limited liability protects the owners from part of the losses from the price-quantity war triggered by a deviation, making deviations more attractive.

Maksimovic's model, which we will use as a workhorse, is approximately as follows. There are N identical firms interacting in an infinitely-repeated Cournot oligopoly. Let r denote the market discount rate, π_i^A the profit realized in each period by firm i when firms are sticking to a (stationary) collusive agreement A, π_i^{NC} the firm's profit in each period in which the static Cournot-Nash equilibrium is played, and – abusing notation – let $\widehat{\pi}_i^A$ denote one-period profits from deviating if the other firms adhere to the tacit collusive agreement, and $\underline{\pi}_i^A$ the one-period profits from sticking to the agreed output when another firm deviates unilaterally. The collusive agreement can be sustained in subgame perfect equilibrium by trigger strategies (James Friedman, 1971) if short-run gains from deviating are not larger than discounted losses from the punishment phase, that is, if

$$\widehat{\pi}_i^A - \pi_i^A \leq \frac{\pi_i^A - \pi_i^{NC}}{r},\ \forall i,\ \Leftrightarrow\ r \leq r^* = \frac{\pi_i^A - \pi_i^{NC}}{\widehat{\pi}_i^A - \pi_i^A},\ \forall i. \tag{1}$$

[11] The same result is found by Stenbacka (1994), who extends the model to the case of demand uncertainty, and by Hege (1998), who characterizes the relative pro-competitiveness of different kinds of debt (bank vs. publicly traded).

Suppose firms simultaneously increase leverage by issuing long-term debt or, as in Maksimovic, that when the industry was founded all firms simultaneously issued debt in the form of bonds sold for a lump-sum amount D_i against the obligation to pay bondholders an amount b_i in every following period, with $D_i = \frac{b_i}{r}$. In each period firms are free to distribute dividends after having paid the coupon b_i. If in one period a firm cannot meet its debt-service obligation, bankruptcy occurs. Bankrupt firms are sold to new profit-maximizing owners.[12] The period after a firm becomes bankrupt old shareholders – or whoever else is in called to run the firm before it is sold to new owners – have a short horizon and therefore maximize short-run profits.[13] The condition for the collusive agreement to be respected by each firm i under the threat of trigger strategies becomes therefore

$$\pi_i^A - b_i + \frac{\pi_i^A - b_i}{r} \geq \widehat{\pi}_i^A - b_i + \max\left\{\frac{\pi_i^{NC} - b_i}{r}, 0\right\},$$

or, equivalently,

$$\widehat{\pi}_i^A - \pi_i^A \leq \frac{\pi_i^A - b_i}{r} - \max\left\{\frac{\pi_i^{NC} - b_i}{r}, 0\right\}. \tag{2}$$

As long as $b_i \leq \pi_i^{NC}$, the right hand side (RHS) of the inequality can be simplified to $\frac{\pi_i^A - \pi_i^{NC}}{r}$, and condition (2) reduces to (1). Instead, at higher levels of leverage, with $\pi_i^{NC} < b_i < \pi_i^A$, condition (2) becomes

$$\widehat{\pi}_i^A - \pi_i^A \leq \frac{\pi_i^A - b_i}{r} \;\Leftrightarrow\; r \leq r^{**} = \frac{\pi_i^A - b_i}{\widehat{\pi}_i^A - \pi_i^A}.$$

It is evident that, at this level of debt, condition (2) becomes more stringent and collusion more difficult to sustain (r^{**} decreases) when firm leverage increases, pushing the coupon b_i up towards π_i^A.

Maksimovic also shows that more complex financial instruments, such as warrants and convertible debt, allow shareholders' to commit to a more prudent behavior, reducing the agency costs of outside finance and the pro-competitive effect of straight debt. In the next section we will consider an alternative form of commitment against strategic defaults: the choice of "prudent" managers.

[12] The alternative assumption, that after bankruptcy firms exit from the product market, readily transforms the model into a "predation" one. It can easily be shown that in this case debt makes collusion impossible: it greatly increases firms' incentives to deviate, drive competitors bankrupt, and monopolize the market, while no credible punishment is available to firms as a deterrent.

[13] Maksimovic notes that after bankruptcy is declared shareholders are indifferent about profits, so that many static equilibria exist, but that the most reasonable assumption is that the Cournot-Nash one is played.

2.2 Managers' costs of bankruptcy and tacit collusion

Maksimovic's result is derived under the standard assumption of profit maximizing firms. However, large firms are often led by managers whose incentives may not perfectly coincide with shareholders' objectives.[14] Even when incentive contracts are so well designed as to lead managers to maximize owners' discounted profits under normal conditions, top managers usually face extra costs when their firms become bankrupt. For professional managers bankruptcy implies a substantial loss of reputation, together with either the loss of the job, or a drastic wage cut. For example, Stuart Gilson (1989) and Gilson and Michael Vetsuypens (1993) find that about half of the managers of firms facing financial distress are replaced and are not rehired by comparable (exchanged-listed) firms for the following three years; and that those who are retained experience very large reductions in salary and bonuses. Moreover, lenders often explicitly ask shareholders to hire top managers with a particularly solid reputation for "prudent behavior," who have very much to lose from driving the firm into bankruptcy.[15]

Managers' reputational costs of bankruptcy have already been taken into account in models addressing firms' financial policy (Stephen Ross, 1977; Hirshleifer and Thakor, 1992) or business cycles (Bruce Greenwald and Joseph Stiglitz, 1990, 1993), it is therefore time to analyze their effects on product markets.

We modify firms' objective function to incorporate such costs, as done in Ross (1977). Managers' direct costs from financial distress may be fixed, or may vary depending on "how bad" financial problems are. To consider both cases, let $C_i \geq 0$ denote the fixed loss that a manager incurs when his firm can't meet debt service obligations, and let $c_i(b_i - \pi_i)$, with $c_i \geq 0$, be a variable managerial cost increasing with the amount of debt the firm cannot honor. To simplify exposition it is also useful to define $\mathbf{C}_i = C_i + c_i(b_i - \pi_i^{NC})$.

To isolate the effects of debt and bankruptcy on managerial behavior and tacit collusion here we focus on managers under a long-term profit-sharing compensation plan, which leads them to maximize an objective function equivalent in all aspects to that of shareholders except in the evaluation of bankruptcy.

Definition 1 ***Net profit sharing long-term contract (NPS):*** *In every period managers are paid a fixed wage (normalized to zero, together with the reservation*

[14] Classical references include Herbert Simon (1957), William Baumol (1958), Oliver Williamson (1964), and Jensen and Meckling (1976).

[15] Let us give an Italian example. When Mediaset, Berlusconi's media empire, got into financial troubles a few years ago, banks required that Franco Tató – probably the most highly reputed Italian top manager – should be hired as CEO as a condition *sine qua non* for renewing Mediaset's credits.

More generally, Gilson (1989) finds that a significant number of changes of management are initiated by creditors during debt restructuring.

wage) plus a share of the period's net profits, $\alpha(\pi_i^t - b_i)^+$, with $0 < \alpha < 1$.[16]

The following lemma will be useful below.

Lemma 1 *When firms are led by managers under NPS contracts, debt and managerial bankruptcy costs do not affect the Nash equilibrium of the static market game.*

The long-term incentive contract between a manager and an owner ends when a change of control occurs. Therefore, after bankruptcy, debtholders can choose whether to replace old managers, or to retain them at a wage reduced by the negative effects of bankruptcy on their reservation wage. Suppose first that debtholders replace managers when the firm goes bankrupt. With managers under NPS contracts and positive managerial bankruptcy costs, the necessary and sufficient condition for the manager being willing to respect a stationary, collusive agreement delivering per-period profits π_i^A is

$$\alpha\left[(\widehat{\pi}_i^A - b_i) - (\pi_i^A - b_i)\right] \leq \alpha\frac{(\pi_i^A - b_i) - (\pi_i^{NC} - b_i)}{r} \tag{3}$$

for $b_i \leq \pi_i^{NC}$, which also reduces to (1), and

$$\alpha\left[(\widehat{\pi}_i^A - b_i) - (\pi_i^A - b_i)\right] \leq \alpha\frac{\pi_i^A - b_i}{r} + \mathbf{C}_i, \;\; \Leftrightarrow \;\; r \leq r^{'} = \frac{\pi_i^A - b_i}{\widehat{\pi}_i^A - \pi_i^A - \frac{\mathbf{C}_i}{\alpha}} \tag{3a}$$

for $b_i > \pi_i^{NC}$. Suppose instead that managers are retained after bankruptcy. Condition (3) remains unchanged, while condition (3a) becomes

$$\alpha\left[(\widehat{\pi}_i^A - b_i) - (\pi_i^A - b_i)\right] \leq \alpha\frac{\pi_i^A - b_i - \pi_i^{NC}}{r} + \mathbf{C}_i \Leftrightarrow r \leq r^{''} = \frac{\pi_i^A - \pi_i^{NC} - b_i}{\widehat{\pi}_i^A - \pi_i^A - \frac{\mathbf{C}_i}{\alpha}}. \tag{3b}$$

Comparing these conditions with (2) one obtains the following result.

Lemma 2 *Suppose managers are under long-term NPS contracts. Then:*

(i) If leverage is "low" ($0 \leq b_i \leq \pi_i^{NC}$), managerial bankruptcy costs do not affect firms' ability to collude.

(ii) If leverage is "high" ($b_i > \pi_i^{NC}$) and managers are replaced when bankruptcy occurs, any positive managerial bankruptcy costs ($\mathbf{C}_i > 0$) increase the maximum discount rate (the minimum discount factor) at which firms can support any collusive agreement in subgame perfect equilibrium.

(iii) If leverage is "high" ($b_i > \pi_i^{NC}$) and managers are not replaced when bankruptcy occurs, managerial bankruptcy costs increase the maximum discount rate at which firms can support any collusive agreement as long as $\mathbf{C}_i > \alpha(\widehat{\pi}_i^A - \pi_i^A)\frac{\pi_i^{NC}}{\pi_i^A - b_i}$.

[16] Gross profit sharing contracts have even stronger effects, since then the manager's wage is not affected by financial transactions and the negative effect of debt on collusion found by Maksimovic disappears by assumption.

Lemma 2 leads one to think that sufficiently high managerial costs of bankruptcy could even make collusion easier for leveraged than for unleveraged firms, reverting Maksimovic's result. Indeed, for positive levels of bankruptcy costs there is a range of "high" debt levels – increasing in such costs – at which (3a) and (3b) are both strictly less stringent than (1). However, (3a) and (3b) are the relevant conditions for collusion being supportable only if bankruptcy does eventually occur. Instead, when (1) is not satisfied, provided managers are unconstrained regarding dividend policy, a deviating manager has enough cash to avoid bankruptcy. He can either use short-run gains from deviation to buy back all debt, or simply retain and invest them at the market rate r in order to pay future coupons. When this is the case, the incentive compatibility condition for collusion to be supported by managers under NPS contracts is not affected by bankruptcy costs, it is precisely condition (1). If, instead, managers are restricted to pay out part of the realized profits as dividends, then even when (1) is not satisfied it can be impossible for a deviating manager to avoid bankruptcy. Then, sufficiently high managerial bankruptcy costs can indeed revert Maksimovic's result making collusion easier for highly leveraged firms than for unleveraged ones.

The following proposition formalizes this intuition.

Proposition 1 *Suppose managers are under NPS contracts. Then:*

(i) When managers are unconstrained regarding dividend policy and managerial bankruptcy costs are large, high leverage (with $b_i > \pi_i^{NC}$) does not limit firms' ability to collude.

(ii) When managers are constrained to pay out (part or all) realized profits as dividends and managerial bankruptcy costs are large, high leverage (with $b_i > \pi_i^{NC}$) enhances firms' ability to collude (highly leveraged firms can sustain any given collusive agreement at strictly higher discount rates than unleveraged firms).

In other words, sufficiently high managerial (e.g. reputational) costs of bankruptcy, whatever their shape (whether $C_i > 0$ and $c_i = 0$, or $C_i = 0$ and $c_i > 0$, or C_i,$c_i > 0$), make collusion *at least* as easy for highly leveraged firms as for unleveraged ones.

2.3 Debtholder-friendly managerial incentives and tacit collusion

Suppose reputational concerns were absent, that managers were not "afraid" of bankruptcy. Shouldn't informed lenders be expected to anticipate the strategic default problem identified by Maksimovic, and ask for some alternative form of commitment before lending money to limitedly liable borrowers?

Brander and Poitevin (1992), and more recently Acemoglu (1997) have shown that conservative (low-powered) managerial incentive contracts can do at least as well as reputational concerns in inducing managers to take into account debtholders' interests. In particular, Brander and Poitevin (1992) have shown – within a two-stage model which abstracts from the effects on the product market – that by committing to debtholder-friendly strategies by means of an external manager under a suitable incentive scheme shareholders can moderate the asset substitution problem, minimize the cost of debt finance, and maximize firm value. They analyze two kinds of managerial incentive schemes. The first one is a *penalty contract,* which gives managers a fixed salary W when the firm is solvent, and the same salary minus a penalty T when the firm goes bankrupt (T may consist simply of the managers' bankruptcy costs discussed in the previous section). The second one is the widely used *bonus contract,* which implies a per-period wage composed of a salary W plus a fixed monetary bonus B paid only in periods in which the firm's accounting profits are above a target level π^B.[17]

For the sake of simplicity, in evaluating the product-market effects of these debtholder-friendly contracts we focus on the case when managers are replaced after bankruptcy, and assume that when a manager is indifferent among two or more available strategies he chooses the one that maximizes firm profits.[18] Also – to abstract from the reputational issues considered in the previous section – we assume that managers' reservation wage is not affected by bankruptcy, and we maintain its normalization to zero (without loss of generality).

Consider first managers under *penalty contracts.* Suppose the manager is unconstrained with regard to dividend policy. Then, when (1) is not satisfied, a deviating manager can avoid bankruptcy by retaining short-run profits from the deviation forever, invest them at the market rate r, and pay the debt's coupons. Given his flat wage, he is indifferent between respecting a collusive agreement and deviating, and therefore chooses to deviate to maximize the firm's profits. On the other hand, when (1) is satisfied, when $b_i > \pi_i^{NC}$ a deviation drives the deviating firm bankrupt in the following period. Then the manager strictly prefers to respect a collusive agreement as long as

$$W + \frac{W}{r} \geq W + \frac{1}{1+r}(W - T)$$

which, because the manager's individual rationality constraint requires $W \geq 0$, is always satisfied. Suppose instead that the manager cannot retain profits forever, that

[17] Brander and Poitevin show that the bonus contract is an "optimal contract," since through a suitable choice of the target π^B it leads to the ex ante first best outcome, maximizing firm value.

[18] This lets the Nash-reversion threat remain credible when managers run the firms. Alternatively, one could let managers' compensation contain a small profit-sharing component, or assume that managers own a small amount of the firm's shares.

he is constrained to distribute (part or all) net profits to shareholders. Then, even when (1) is not satisfied, when $b_i > \pi_i^{NC}$ the market war that follows a deviation may drive also the deviating firm bankrupt, so that the condition for the manager being willing to support a collusive agreement is the one above, which is always satisfied. This reasoning is summarized by the following proposition.

Proposition 2 *Suppose shareholders hire managers under "penalty contracts" to reduce the agency costs of debt finance. Then:*

(i) When managers are unconstrained regarding dividend policy, leverage does not affect firms' ability to collude.

(ii) When managers are committed to distribute net profits as dividends, highly leveraged firms ($b_i > \pi_i^{NC}$) can support any feasible stationary profit stream that leaves firms solvent in subgame perfect equilibrium in the market supergame at any level of the discount rate.

The penalty T has the same pro-collusive effect as the managerial costs analyzed in the previous section, while the fixed wage removes any incentive for managers to deviate from a collusive agreement.

One would expect that the (apparently) more aggressive and common *bonus contracts* would have less pro-collusive effects. Instead, we can borrow and adapt a result from Spagnolo (1996) showing that quite the opposite is true.

Proposition 3 *Suppose shareholders hire managers under bonus contracts to reduce the agency costs of debt finance. Then any stationary collusive agreement that allows managers to receive their bonuses can be supported in subgame-perfect equilibrium in the market supergame at any level of the discount rate.*

The point is that the bonus incentive scheme, as the penalty one, is "capped."[19] If managers can sustain a stationary collusive agreement delivering per-period profits higher than, or equal to the trigger level π^B, they will have no incentive to deviate whatsoever. They cannot capture any further gain from a deviation, while the following punishment phase makes them lose future bonuses independent of whether their firm goes bankrupt. And this holds whatever the discount rate is.[20]

[19] Bonus schemes used in the real world are usually capped (see Murphy, 1998; Robert Holthausen *et al.*, 1995; Paul Joskow and Nancy Rose, 1994; or Paul Healy, 1985).

[20] These results reinforce Brander and Poitevin's argument by which the relatively low power of real world managers' incentive schemes found by Jensen and Murphy (1990) could be attributed to the role of "conservative" managerial contracts as commitments towards borrowers. In oligopolies low-powered incentives, such as flat wages or bonus contracts, besides reducing the agency costs of debt finance also maximize firms' value by allowing higher (collusive) profit streams to be supported in equilibrium. As mentioned in the introduction, even the now fashionable and apparently more

Finally, it's worth noting that the pro-collusive effect of managerial bankruptcy costs identified in the previous section is independent of the shape of managers' compensation contracts. The NPS contracts are clearly the "less pro-collusive" among the incentive contracts one observes in reality. Following the steps of Section 2.2, it can be easily shown that the pro-collusive effect of managers' reputational concerns is also present when managerial incentive contracts are of the kind considered in this section. Therefore, the pro-collusive effect of managers' reputational costs of bankruptcy adds to that of conservative managerial incentive schemes to determine the overall pro-collusive effect of debt.

3 The role of debt: concentrated credit markets

In the previous section we worked under the implicit assumption that the choice of a manager and of his incentive contract is an effective commitment device. First, for this to be the case both managerial losses from bankruptcy and managerial incentive contracts must be observable by outsiders. This is not a problem, since a top manager's reputation is observable by definition and, when they are not already in the public domain, managerial incentive contracts can easily be disclosed if this is in the interest of the firm. However, to have strategic effects commitments must be credible, besides being observable, and this may be problematic. As pointed out by Dewatripont (1988), Katz (1991), and others, in the case of contracts with a third party the credibility of the commitment can be undermined by agents' ability to secretly renegotiate the contract. The same reasoning applies to managers' bankruptcy costs: when breaking a collusive agreement is in the owner's interest, the owner can secretly contract extra compensation for the manager in case of bankruptcy in order to induce him to break the collusive agreement, distribute profits as dividends, and strategically default on debt. If this could be done at zero cost, we would be back to Maximovic's original result.

In this section we show that one important way in which a concentrated or collusive credit market can facilitate collusion in downstream product markets is by conferring credibility on shareholders' commitments to debtholder-friendly product market strategies through the choice of conservative (collusive) managerial incentives.

"competitive" incentive schemes related to stock price (stock options, cash bonuses linked to stock price, etc.) are usually designed so that they have strong pro-collusive effects (Spagnolo, forthcoming). In fact, a proposition analogous to Proposition 3 could be stated here for incentive contracts related to stock price as well.

3.1 The debt game

To emphasize the importance of debt as a collusive device, we adopt the following extreme assumptions:

Assumption 1 *Secret contract renegotiation is both feasible and costless.*[21]

Assumption 2 *Condition (1) is not satisfied for any agreement A, that is,*

$$\forall A, \exists i : r > r_i^* = \frac{\pi_i^A - \pi_i^{NC}}{\widehat{\pi}_i^A - \pi_i^A}.$$

When credit markets are concentrated or collusive, lenders internalize externalities between them and act as a single lender. Therefore, in what follows we will normally refer to one monopolist lender, named L. However, it is important to keep in mind that in the remainder of the paper *wherever we write about "a (common) lender," one could substitute "several distinct but 'allied' lenders,"* who are cooperating/colluding either in the classical sense, or because they belong to the same "financial coalition" (e.g. there is one large shareholder in common, they have joint ventures with each other or with a common partner, etc.).

Also, to simplify exposition, we restrict attention to an infinitely repeated product market duopoly (the extension to N firms is straightforward) where managers that drive their firm bankrupt are replaced, and retain the normalization of managers' reservation wage to zero.

When credit markets are highly concentrated or collusive, the lender will have the most bargaining power and extract most of the collusive rent from the product market. Then it does not matter much whether loans are offered simultaneously or sequentially to the two firms. With competitive credit markets, instead, owners will capture most of the collusive rent, and this will have to be anticipated by the lender. Then the timing with which debt is issued becomes important, since if a lender has sunk some costs with one firm, it might then find himself in a bad bargaining position towards the other. Therefore, we make clear already the timing with which the "capital structure game" develops, when for some reason it cannot be arranged to be simultaneous for firms' owners.

[21] The assumption of zero costs of secret renegotiation is clearly heroic: in the real world such costs can be substantial, particularly for public corporations with dispersed ownership and multiple lenders (see e.g. Spagnolo, 1996). It will become clear, though, that considering positive renegotiation costs could only strengthen the model's results.

1. The lender offers the debt contract to one owner.
2. The owner decides whether to accept/sign the debt contract.
3. If the first owner has signed, the lender offers the debt contract to the second owner.
4. The second owner decides whether to accept/sign the contract.
5. If both owners have signed the contracts, the lender decides whether to sign the contracts and finance the firms.
6. If everybody signed the contracts, debt is issued and the leveraged firms interact in the product market supergame. Otherwise, no debt is issued and the firms interact unleveraged in the product market supergame.

3.2 Veto power to the lender(s)

Suppose at the foundation of the industry, or in a downturn of the business cycle where both firms are in financial distress (or in any other period τ), the lender L makes a take-it-or-leave-it offer to each firm owner of a debt contract that assigns him veto power on the renegotiation of the top managers' incentive contracts. For example, L can offer the following contract:

Definition 2 ***The Debt Contract:*** *"Shareholders receive today the amount of cash D_i against the promise of the coupon payment b_i in each future period, where $D_i = \frac{b_i}{r} - g_i$, under the condition that an external manager is hired under a long-term bonus contract (as defined in the previous section, with W_i normalized to 0, and $B_i > 0$) with target profits π_i^B, and $\pi_i^B \geq \pi_i^{NC}$."*

Here g_i denotes the amount of future collusive profits that the lender extracts in advance from each firm by selling overpriced debt. Can this debt contract, if accepted by owners, confer credibility to managerial contracts and implement collusion in the product market?

Suppose the contract is accepted by firms' owners. Consider first the case of a "low" debt contract ($b_i \leq \pi_i^{NC}$). When leverage is low the lender loses little from a deviation in the product market, since firms are able to repay debt even when they are stuck at the static Cournot-Nash equilibrium. Moreover, L may even gain from a deviation by obtaining control of the non-deviating firm if this can't meet the coupon the period of the deviation. Because owners' gains from deviating from a collusive agreement are always sufficient to compensate the manager for the loss of future bonuses and to induce him to deviate, all required parties may eventually agree to

a joint secret renegotiation of debt and managerial contracts, leading to a deviation from the collusive agreement. Still, we can state what follows.

Lemma 3 *(i) At very low levels of debt, such that* $b_i \leq \underline{\pi}_i^A < \pi_i^{NC}\ \forall i$*, managerial bonus contracts are not renegotiation-proof and leverage does not affect firms' ability to collude.*

(ii) At low levels of debt, such that $\underline{\pi}_i^A < b_i < \pi_i^{NC}\ \forall i$*, when*

$$\frac{\pi_i^{NC} - b_i}{r} < b_i - \underline{\pi}_i^A, \text{ and } b_i - \underline{\pi}_i^A - \frac{\pi_i^{NC} - b_i}{r} > \widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - \pi_i^{NC}}{r},$$

debt makes managers' contracts renegotiation-proof and collusion sustainable; it does not affect firms' ability to collude otherwise.

That is, even low levels of debt, with b_i smaller but close to π_i^{NC}, can facilitate collusion by making sure that if a firm deviates, the lender loses from the side of the other firm. When the owners' net gains from deviation are small, compensating the lender for this loss is not possible and renegotiation cannot occur.

This effect becomes much stronger with "high" debt levels ($b_i > \pi_i^{NC}$). Then we can state the following.

Lemma 4 *Suppose a "high" debt contract* ($b_i > \pi_i^{NC}$) *is accepted by both owners. Then:*

(i) For given managerial bonuses B_i*, target profit levels* π_i^B*, and collusive profits* π_i^A ($\pi_i^A \geq \pi_i^B$)*, the maximum discount rate at which the managerial contracts are renegotiation-proof is higher than that at which owners can collude, and is monotonically increasing in firms' leverage.*

(ii) As long as

$$0 < B_j \leq \pi_i^A + \pi_j^A - \widehat{\pi}_i^A - \underline{\pi}_j^A$$

and

$$\pi_i^A - B_i \geq b_i \geq \widehat{\pi}_j^A + \underline{\pi}_i^A - \pi_j^A\ \forall i, j,$$

contracts are renegotiation-proof and collusion supportable at any level of the discount rate.

That is, for high levels of debt there is a smooth positive relation between firms' leverage and the ability of the debt contract to confer credibility on pro-collusive conservative managerial contracts.[22] The debt contract makes collusion supportable at discount rates at which unleveraged owners cannot collude, and for high enough leverage full collusion can be supported at any level of the discount rate.

We can now state the proposition.

[22]Whether managerial contracts are renegotiation-proof may depend on the discount rate because the lender's losses from a deviation are in terms of expected future repayments.

Proposition 4 *By offering each firm a debt contract with* $b_i = \pi_i^B = \pi_i^M - B_i$*, the lender can make managerial contracts renegotiation-proof and implement the joint monopoly agreement as the unique subgame perfect collusive product market equilibrium independent of the discount rate.*

Moreover, when the lender leaves an however small stake of the collusive rent to the owners – by choosing $g_i < \frac{\pi_i^M - B_i - \pi_j^{NC}}{r}$ *– accepting the debt contract is owners' (strictly) dominant strategy.*

In other words, everybody is happy – shareholders, debtholders, and managers – except the consumers (and the competition authority when it has not been captured as well).

The monopolist lender has most of the bargaining power, therefore he extracts most of the collusive rent, leaving the owners with the minimum "fair" share $\frac{\pi_i^M - B_i - \pi_j^{NC}}{r} - g_i$ that guarantees their acceptance. The discounted flow of bonuses is the stake of the collusive rent appropriated by managers, and can be interpreted as the intrinsic cost of the commitment technology.

Note that the results above apply independent of the degree of contestability of the concentrated credit market – which only affects the distribution of the collusive rent between lender(s) and borrowers (i.e. the size of g_i) – and of whether L is a single monopolist or a collection of distinct but allied lenders.[23]

3.3 'Bankers on boards' and other collusive devices

One could argue that debt contracts with explicit clauses that assign to the lender veto power on the renegotiation of top managers' incentives are not so common in reality. The answer would be that in bank-dominated economies such veto power is typically part of the long-run implicit contract between large firms and their main bank.[24] However, the issue is not essential since in this section and in Section 4.3 we show that there are other devices, very often observed in reality, that replicate the effect of a formal assignment of veto power, allowing the lender to make managerial contracts renegotiation-proof and monopolize otherwise competitive product markets.

[23] Let us take, again, an Italian example. Most Italian banks have been semi-public in the last decade, and the government's and central bank's objective has been financial stability rather than competition in product markets. Banks' officials had no incentive whatsoever to compete, and full incentives to monopolize product markets, since collusive industries are safe sources of income for the banking sector. The few private financing sources have been controlled indirectly by Mediobanca which, we argued in the introduction, has had veto power on the choice of top managers in most, if not all large Italian groups (financial and non).

[24] Our model could easily be reinterpreted as one stage (of finite but uncertain length) of a longer-run relationship between lenders and borrowers.

Suppose the debt contract does not assign the lenders any formal rights on the choice of managers and their incentives, but the lender is (the 'allied' lenders are) represented on the borrowing firms' board of directors, as is the norm in continental Europe and Japan. An alternative but fully equivalent situation is that where the lender is not represented on firms' boards, does not have veto power on the renegotiation of managerial contracts, but has the right to be informed when any such renegotiation is occurring.[25]

Then, to monopolize downstream product markets, the lender can begin with requiring firms to hire an external manager under a long-term bonus contract as defined in the previous section as a precondition for financing firms. Once firms have fulfilled this pre-condition, the lender finances firms simultaneously, or according to the timing described in Section 3.1. We obtain the following result.

Proposition 5 *Suppose the lender is (the allied lenders are) represented on firms' boards, or has the right to be informed when boards renegotiate managers' contracts.*

Then, as long as $\underline{\pi}_i^{NC} > \underline{\pi}_j^M$ *and*

$$\widehat{\pi}_i^M + \underline{\pi}_j^M - \pi_i^{NC} - \pi_j^{NC} \leq B_i < \frac{\pi_i^M + \pi_j^M - \pi_j^{NC} - \pi_i^{NC}}{r} + \pi_i^M + \pi_j^M - \widehat{\pi}_i^M - \underline{\pi}_j^M, \ \forall i, j,$$

high levels of debt (with $b_i = \pi_i^M - B_i = \pi_i^B, \forall i$*) make managerial contracts renegotiation-proof and implement the joint monopoly agreement in the product market as the unique subgame perfect collusive equilibrium.*

Moreover, as long as $g_i < \frac{\pi_i^M - B_i - \pi_j^{NC}}{r}$ *accepting the debt contract is owners' (strictly) dominant strategy.*

As when they have veto power on renegotiation, lenders represented on borrowers' boards or with the right to be informed of managers' contract renegotiation can solve both enforcement and coordination problems of the downstream firms, implementing the joint monopoly agreement as the unique collusive equilibrium in the otherwise competitive product market.

Even though the lender has no formal control of the renegotiation process, as long as it is represented on the board of directors, it knows in time when secret renegotiation is occurring in a firm. Then, the lender can block a firm owner's attempt to renegotiate his manager's contract and induce an unilateral breach of the collusive

[25] Another simple way in which powerful lenders may make managerial contracts renegotiation-proof, when the borrowing firms are publicly owned, is by requiring them to amend their charter introducing a rule by which changes of CEO and of his compensation must be approved at (public) shareholders' meetings. By making renegotiation public, such simple rule guarantees the credibility of commitments through conservative managers and ensures debtholder-friendly collusive product market behavior.

agreement by credibly threatening to reveal that renegotiation is occurring to the competing firm, who would immediately react nullifying all gains from renegotiation. The same happens when the lender must be notified of any occurring renegotiation of the manager's contract. The condition in the proposition ensures that the threat of revealing to the competitor that contract renegotiation is occurring is a credible one (right hand side inequality), and that the lender is effectively interested in blocking renegotiation (left hand side inequality). As long as $\underline{\pi}_i^{NC} > \underline{\pi}_j^M$, which holds for most standard specifications of the Cournot game, the condition is satisfied when (1) is not. Moreover, the condition is weaker when there are more allied lenders each specialized with a different firm, and is always satisfied when the asymmetry in loans is substantial and even when there is no common lender at all! (See Sections 4.3 and 4.4.)

Again, it is worth noting the results apply independent of whether the concentrated credit market is contestable.

In what follows we will mainly refer to the debt contract discussed in the previous section, but analogous results can be derived for the other cases discussed in this section.

4 Competitive credit markets, multiple and asymmetric lenders, no common lenders, and seniority

4.1 Competitive credit markets

Is a competitive banking industry sufficient to prevent the pro-collusive effects of debt finance considered above? The answer "no" follows naturally from the results in the previous sections. Even with perfect competition, as long as firms borrow from the same lender – or from two distinct but allied lenders (for instance, belonging to the same large banking group) – such a lender internalizes product market externalities and is therefore able to guarantee the credibility of commitments to conservative (collusive) product market strategies. By inspection:

Remark 1 *Even when the credit market is competitive, Lemmas 3 and 4 apply as long as firms borrow from a common lender (or from "allied" lenders).*

The difference, of course, is that with competitive credit markets the lender(s) won't be able to extract much of the collusive rent. Now owners have all the bargaining power, and they can make take-it-or-leave-it offers to any large enough lender. In this case, the timing with which debt is issued becomes important. Because the rent goes

to firm owners, the lender has to pay them in advance the equivalent of future gains from collusion. If the lender begins to finance one firm, it makes some costs sink and increases the other firm's bargaining power, which may leave the lender with negative profits even though after debt is issued collusion is sustained. Anticipating this, no lender would be willing to finance firms sequentially. The first owner may give up some of his rent in order to induce the lender to finance him, but then no owner will want to issue debt first; owners will be caught in a "chicken" game.

One way out of this problem is to arrange for a simultaneous capital structure game, that is, to make sure that owners decide simultaneously whether or not to accept the debt contract. However, this may be impractical, unrealistic, or subject to the judgement of the competition authority. The fact that debt contracts need not be signed simultaneously by the two parties means that this problem can be overcome by designing the "capital structure game" in the way described in Section 3.1. Then, in line with Propositions 4, one can state the following result.

Proposition 6 *Suppose credit markets are competitive and the "capital structure game" is as in Section 3.1 (or is simultaneous for owners).*

Then, by raising high levels of debt (with $b_i = \pi_i^B = \pi_i^M - B_i$, $\forall i$*) from the same lender, owners can make managerial contracts renegotiation-proof and implement the joint monopoly agreement as the unique subgame perfect collusive equilibrium at any discount rate.*

Moreover, accepting the debt contract is owners' (strictly) dominant strategy.

Of course, the common (allied) lender(s) must be large enough to finance both firms, which implies that the size of competing credit institutions must be large relative to firms in the product market.

4.2 Multiple lenders

One might think that, with competitive credit markets, a multiplicity of unrelated firm lenders would greatly reduce the pro-collusive effects of debt. So, what if no lender or coalition of lenders is large enough or willing to completely finance both firms? Suppose that each firm i is financed by a pool of many, say N_i independent lenders, that credit markets are competitive, and that only one lender is in both pools (or is allied to one of the lenders in the other pool), holding a share γ_i, where $0 < \gamma_i < 1$, of each firm i's debt.

As a benchmark, consider first the case of equal involvement of the common (allied) lender(s) with the two competing firms, so that $\gamma_i = \gamma_j = \gamma$, and suppose that all debt has the same seniority (the pro-collusive effect does not depend on these simplifications; see the following sections). We obtain the following result.

Proposition 7 *Suppose that (at least) one of the firms' lenders is in common with a share γ of the debt, and that the "capital structure game" is designed as described in Section 3.1 (or is simultaneous for owners). Then, by raising high levels of debt (with $b_i = \pi_i^B = \pi_i^M - B_i$, $\forall i$) owners can:*

(i) Make managerial contracts renegotiation-proof and implement the joint monopoly collusive agreement at any discount rate as long as $\gamma \geq \frac{\widehat{\pi}_i^M - \pi_i^M}{\pi_j^M - \underline{\pi}_j^M - B_j}$ $\forall i$.

(ii) For any positive γ, they can make managerial contracts renegotiation-proof and implement the joint monopoly collusive agreement as the unique collusive equilibrium at higher discount rates than the maximum at which owners can sustain it.

Moreover, accepting the debt contract is a (strictly) dominant strategy for each owner.

In other words, as long as loans from a common lender are not too small, the pro-collusive effect is still very strong. Then, an owner's short-run gains from deviation will not suffice to compensate the manager for the expected bonus (and/or reputational) losses, the independent lenders for the loss of future coupon repayments, and the common lender for the losses from both the competing firms' financial distress. And even when the common lender is very small, the pro-collusive effect remains, since the maximum discount rate at which leveraged firms are able to sustain any collusive agreement is always higher than that at which unleveraged firms (owners) can sustain it.

4.3 Asymmetries

To understand the role of asymmetries in the common lender's claims towards the two firms we assume here $\gamma_i \neq \gamma_j$. The case of a **single common lender** is straightforward. We can state the following proposition without proof.

Proposition 8 *Given the total amount of the common lender's claims, the pro-collusive effect of debt decreases with the asymmetry in firms' loans.*

This happens because the pro-collusive effect of debt applies only as long as it prevents deviations from *both* firms. When $\gamma_i > \gamma_j$, the common lender (or the couple of allied lenders) loses less when firm i deviates than when firm j does so, and hence the cost of a secret renegotiation that leads the manager to deviate from a collusive agreement is smaller for firm i. Because owners of firm j are aware of this, they will stick to collusion only if firm i's cost of secret renegotiation (increasing in γ_j) is high enough to prevent it. It follows that the pro-collusive effect of a common lender's debt is increasing in $\min\left\{\gamma_i, \gamma_j\right\}$, and therefore is maximal when $\gamma_i = \gamma_j$.

One might think of this result as an easy rule of thumb to distinguish between cases in which common lending may or may not have serious anti-competitive consequences. However, such a rule of thumb would be misleading, since it applies *only* to the case of a single common lender (or a single couple of allied lenders).

In fact, consider the more interesting case of **more than one common lender**. Suppose that, say, two of the N_i and N_j lenders, named L^1 and L^2, are in both pools of creditors. Let γ_i^h, $h \in \{1,2\}$, denote the share of lender h's total loans to the industry that goes to firm i, and suppose that the common lenders' exposure is strongly asymmetric, so that each lender specializes by lending much more to one firm than to the other.

Proposition 9 *Suppose two (or more) lenders are in common but specialize with different firms. Then the pro-collusive effect is not dependent on the asymmetry of each common lender's claims, but decreases with the asymmetry of total claims from common lenders, that is, it increases with* $\min\left\{\gamma_i^1+\gamma_i^2;\ \gamma_j^1+\gamma_j^2\right\}$.

The point is that when a common lender is specialized, he suffers a big loss if secret renegotiation followed by a deviation takes place for the firm with which he is *not* specialized. Therefore, when two common lenders are specialized with different firms, for each firm there will be one non-specialized common lender with a strong interest in blocking secret renegotiation. This guarantees against renegotiation in both firms and allows collusion to be implemented.

To see how misleading a rule of thumb based on the asymmetry of each common lender's claims could be, consider the case of two common lenders of equal size, with $\gamma_i^1+\gamma_j^1=\gamma_i^2+\gamma_j^2$. In this case the maxima of $\min\left\{\gamma_i^1+\gamma_i^2;\ \gamma_j^1+\gamma_j^2\right\}$ are obtained whenever $\gamma_i^1+\gamma_i^2=\gamma_j^1+\gamma_j^2$. From this follows a simple consideration.

Remark 2 *The anti-competitive effect is* maximal *when the two common lenders specialize almost completely in different firms, maintaining in the other firm only the* minimum *amount of claims necessary to block (to be informed of) managerial contracts' renegotiation.*

That is, with more than one common lender, what would appear to be a "marginal" degree of common lending, with strong asymmetries at each lender's level, has the strongest possible anti-competitive effect. And when each common lender is composed of a couple of allied but distinct lenders, so that a lender L_i^1 in N_i holding γ_i^1 of firm i's debt is cooperating with a lender $L_j^1 \in N_j$ holding γ_j^1 of firm j's debt, and the same happens with two other lenders $L_i^2 \in N_i$ and $L_j^2 \in N_j$, such a highly pro-collusive degree of common lending will appear even more marginal, if it appears at all (most cooperative relations between banks are implicit and carefully concealed to outsiders).

This is even more evident when renegotiation is deterred by "bankers on boards," as shown in Section 3.3. Then the condition for the threat of making renegotiation public being credible is less stringent the more specialized the two common lenders are. Again, this is because when common lenders are specialized with different firms, for each firm there will be the representative of the bank specialized with the *other* firm with a strong interest in blocking/revealing renegotiation. It is straightforward to check that there is a level of asymmetry above which the threat of making contract renegotiation public is always credible (at any discount rate), so that the statement Proposition 4 applies unchanged to the case of "bankers on boards" with no veto power.

4.4 No common lenders: Independent banks with interlocking directors

Suppose now that our firms are financed by distinct and fully independent lenders, and that lenders have no men on the borrowers' boards, nor veto power on, nor rights to being informed of the renegotiation of managers' contracts. Does this guarantee that debt will not have pro-collusive effects? The reasoning in the previous subsection suggests that, once again, the answer is no.

Consider the case in which each duopolistic firm is financed by a distinct lender, each lender belongs to a distinct business group (e.g. a pyramid), and business groups are fully independent and rival, that is, they behave non-cooperatively towards each other. Still, it can easily happen (or be made to happen) that among the companies in business group G_i, to which firm i's lender L_i belongs, there is a firm, say the insurance company I_i, in business relation (e.g. regularly supplying products) to firm j. Analogously, among the companies in business group G_j – to which firm j's lender L_j belongs – there may be, say, the shipping company T_j who regularly sells services to firm i. Since I_i is a business partner of firm j, nobody would be surprised to find a representative of firm I_i (that is, of group G_i) on the board of directors of firm j; and the same can be said for a T_j's (therefore G_j's) man on firm i's board. This situation is represented in Figure 1.

FIGURE 1 ABOUT HERE

It is easy to derive the consequences of such a plausible situation. Without proof, one can state what follows.

Proposition 10 *Suppose that there are no common (or allied) lenders, that lenders have no representatives on firms' boards, nor veto power on, nor rights to be informed of managerial contracts' renegotiation.*

As long as on each firm's board sits a representative of the business group that (directly or indirectly) controls the lender of the competing firm, managerial contracts are credible commitments and bonus contracts with $\pi_i^B = \pi_i^M$ implement the joint monopoly agreement as the unique subgame perfect collusive equilibrium in the product market at any level of the discount rate.

The point is that to reduce lender L_i's losses, group G_i's man on firm j's board would immediately inform firm i of any renegotiation of managerial contract that might lead firm j to unilaterally deviate from a collusive agreement, and *vice versa*. A firm informed that the other firm is renegotiating its contractual precommitment to a prudent behavior would immediately react abandoning the collusive agreement, thereby nullifying all gains from renegotiation.[26] Even without any form of common lending, bank debt accompanied by a reliable "information network" makes secret renegotiation impossible, delegation to conservative (collusive) managers credible, and tacit collusion sustainable in otherwise competitive downstream industries, independent of the discount rate.

4.5 Seniority

The pro-collusive effect of debt depends on the seniority of the common, allied, or independent-but-interlocking lenders' claims, since this affects the distribution of losses from financial distress between debtholders. Consider the simplest case of one

[26]Note that as long as he acts consistently with his group's interests, G_i's man on j's board would truthfully reveal to firm i's management whether renegotiation is occurring in firm j. He has no reason to falsely report that renegotiation is occurring, since this would lead manager i to deviate, after which owner i is left free to renegotiate his manager's contract and induce him to distribute short-run gains from deviation as dividends instead of repaying the lender (we assumed that the lender has no veto power). For example, the owner could grant the manager an amount of shares sufficient for the related dividends to cover the manager's losses from bankruptcy (the manager expects no future bonuses after a deviation).

Moreover, even if L_i would gain from firm i's unilateral deviation, the manager of firm i (who by deviating loses future bonuses) could test the truthfulness of the report by requiring G_i's man to inform the board, where G_j's man is sitting. Then G_j's man would report to firm j, so that whether or not renegotiation was occurring the static Nash equilibrium is played and everybody loses.

A different issue is owner i's interest in buying G_j's man's silence on renegotiation. All players are aware of this problem so collusion will be supportable only as long as owner i's gains from an unilateral deviation are smaller than G_j's man's cost of betraying his groups (plus the minimum between the manager's reputational cost of bankruptcy and the firm's debt), and the same holds for owner j.

Arguably, large business groups can easily arrange for a few highly reliable representatives, with very much to lose from betraying the group, to employ in the many situations of this kind they face (if not, group owners' family members would do).

common lender with symmetric claims $\gamma_i = \gamma_j = \gamma$, and let η, with $0 \leq \eta \leq 1$, denote the fraction of other creditors' claims that is senior with respect to the common lender's ones. Then $\eta(1-\gamma)$ and $(1-\eta)(1-\gamma)$ are the fractions of the firm's debt that are senior and junior with respect to the common lender's claims. We obtain the following result.

Proposition 11 *The pro-collusive effect of a common lender (or of allied or interlocking lenders) is monotonically increasing with η, i.e. is decreasing in the seniority of its (their) claims.*

The intuition behind this result is straightforward: the more debt has been issued senior to that of the common lender (the larger is η), the larger will be the common lender's losses when collusion breaks down and firms enter financial distress, the larger will be the stake of firms' externalities it internalizes, and the stronger will be its aversion to deviations from collusion through secret renegotiation.

This result implies that in real world industries where large finance-providers play the pro-collusive role modelled here, firms' debt structure should be such that large banks' claims are junior with respect to other debtholders' claims. Further, because in the absence of common or interlocking lenders collusion is harder to sustain, we should expect such debt structure to be reached in two steps. First, firms borrow from large credit institutions who are able to ensure prudent managerial behavior and profitability (collusion) from the beginning; then, senior claims are issued to other debtholders under good conditions, given the expected profitability ensured by the large lender's pre-existing junior debt.

To conclude, it should be noted that our working assumption of given (zero) renegotiation costs is particularly unrealistic in the case of multiple lenders. And that taking into account the positive relation between renegotiation costs and the number of debtholders identified, for example, by Patrick Bolton and David Scharfstein (1996), would further strengthen the anti-competitive effect of multiple lenders.

5 Extensions, policy implications, and conclusions

5.1 Extensions

We have kept the model as simple as possible, therefore it can be extended in many directions. For example, one may wish to introduce demand uncertainty *à la* Julio Rotemberg and Garth Saloner (1986), as done by Stenbacka (1994) for Maksimovic's original model. However, Spagnolo (1996) has already shown that demand uncertainty does not weaken the pro-collusive effect of low-powered managerial incentives like

bonus contracts, although these may make the collusive price pro-cyclical (that is, price wars during booms may not occur). This suggests that the results of this paper should extend to that case, since uncertainty does not affect the ability of lenders to block contract renegotiation.

More interestingly, one may wish to introduce imperfect price information *à la* Ed Green and Robert Porter (1984). Such an extension, though, should include the possibility that common, allied, or interlocking lenders might also facilitate communication between borrowing firms, as in Battacharya and Chiesa (1995).[27] Indeed, Battacharya and Chiesa's result that a common lender can implement the efficient level of truthful information-sharing on R&D issues between two competing borrowers suggests that, with imperfect information on prices, a common lender might as well be able to implement full (the efficient level of) disclosure of price information between firms, making secret price-cuts impossible and equilibrium price-wars unnecessary. If this is the case – we plan to verify it in future work – then common/allied/interlocking lenders could facilitate downstream collusion in three ways instead of two: providing coordination and enforcement, as in the present model, and also revealing private information on prices or any other relevant strategic variable.

One may also wish to introduce asymmetric information between borrowers and lenders, or between owners and managers, or both. However, one well known consequence of these kind of information asymmetries is that they make contract renegotiation costly, if not impossible. This should reinforce the pro-collusive effect of debt identified in this paper.

Other possible extensions include considering more sophisticated debt contracts, managerial incentive schemes, or punishment strategies. Our guess is that neither of these complications will change the flavor of the results (of course).

5.2 Policy implications

5.2.1 Competition policy in general

To our knowledge, no competition authority in this world pays attention to who is lending to oligopolistic firms, and to who is sitting on their boards of directors. The model suggests that this is unfortunate. We have shown that a common lender, a coalition of allied lenders, or even fully independent and competing lenders with firm-interlocking directorships can easily monopolize an otherwise competitive downstream product market, whatever the discount rate is. The result is a "hidden horizontal merger," which has worse social welfare consequences than a real horizontal merger. A

[27] When reading Battacharya and Chiesa (1995), after this paper was completed, we were struck by the absence of analogous papers showing how, in oligopolies with imperfect price information, a common lender can facilitate collusion by allowing for truthful information-sharing.

real merger to monopoly might bring about substantial efficiency gains, besides market monopolization. Common, allied, or interlocking lenders, instead, can monopolize the downstream market but cannot bring most of the merger's efficiency gains.[28] At least in bank-dominated economies, particularly when there is a suspicion of price coordination in an oligopolistic industry, the competition authorities should check who is financing oligopolistic firms and who is sitting on their boards; and in the case of different lenders, what is the ultimate relation between them (e.g. do lenders belong to the same pyramid, are there cross-shareholdings?).

5.2.2 Regulation of the banking industry

Credit market competition Most previous theoretical work on the effects of banking competition highlights its negative effects on social welfare: those linked to competing banks' reduced incentives to screen prospective borrowers (Thorsten Broecker, 1990; Michael Riordan, 1993); those linked to the increase in the probability of bank failures (Carmen Matutes and Xavier Vives, 1996); and those linked to the reduced ability to share surplus intertemporally in relationship lending (Mitchell Petersen and Raghuram Rajan, 1995). Among the policy prescriptions originating from these contributions is softening credit market competition to balance these welfare costs against the efficiency costs of market power *in the credit market only.* And indeed, in many countries, mainly for the sake of financial stability, competition in the banking sector has not been encouraged, if not explicitly limited.[29]

The results of the present paper imply that this policy attitude is biased against credit market competition, since it disregards the possibly very large welfare costs linked to a concentrated credit market's ability to monopolize *many other* downstream markets.

Mergers Similarly, in evaluating the effects of the recent wave of mergers in the banking industry, concerns about the increase in concentration are typically limited to the cost of market power in the credit market only (see e.g. Jean Dermine, 1999).

[28] Of course, present a competition authority, a common lender may choose not to fully monopolize downstream oligopolistic markets in order to reduce the (low) probability of being noted by such an authority.

[29] In Italy, for example, competition between banks, the largest of which were public until a few years ago, has never been encouraged, neither by the government nor by the bank of Italy who has competence on competition policy in the credit market. As a consequence, Giovanni Ferri and Sandro Trento (1997) find that interlocking directors between large banks is a very common phenomenon. They give the example of Ugo Tabanelli, director and vice-chairman of Banco di Santo Spirito between 1960 and 1985, who in the same period of time had been simultaneously sitting on the boards of 4 of its main competitors: Banca di Roma, Credit, Comit, and Mediobanca.

And even these limited concerns are often played down on the ground that credit markets are relatively contestable. As argued above, contestability of the credit market does not affect large banks' ability to coordinate their borrowers (or firms' ability to use banks as coordination devices). It only affects the distribution of rents between colluding firms and coordinating banks.[30]

Therefore, again, such a policy attitude may be too accommodating towards banks' supermergers, since it overlooks the additional welfare costs linked to larger banks' improved ability to coordinate downstream industries.

The Glass-Steagall Act A policy debate is in progress on whether in the US the Glass-Steagall Act's (1933) prohibition of banks' shareholdings in industrial firms should be relaxed (see e.g. Anthony Saunders, 1994). One of the major concerns is the question whether such a reform could "...recreate the cartels of [J.P.] Morgan's day?" (*The Economist*, Feb. 1st 1997).

This concern is sometimes reduced to the fear of "the potential growth of large monopolistic banking–commerce conglomerates," and dismissed because "banking in the U.S. has historically been less concentrated than other industries" and "the number of potential entrants and potential competitors will expand" (Saunders 1994, p. 238-239).

On the contrary, this paper shows that the concern is very well grounded. Bank shareholdings reinforce creditors' control on firms' decisions, such as the choice of managers and their incentives. This is exactly what is needed in our model for the monopolization of downstream product markets to occur. And again, the competitiveness and contestability of the banking industry do not reduce banks' ability to act as third parties and coordinate borrowers, they only affect the distribution of rents between firms and banks.

However, this paper also shows that the prohibition of banks' shareholdings in commercial firms is not sufficient to prevent large banks' tendency to monopolize downstream industries.

Competition versus supervision The model highlights the role of collusive rents from oligopolistic product markets as a safe source of stable income for the financial sector. This implies that the policy objectives of stability and competition in the financial sector may sometimes conflict with each other. Letting banks collude, monopolize downstream product markets, and enjoy safe and stable collusive profits

[30]Moreover, it is not that clear that the banking industry is such a contestable one. Recent work has shown that some intrinsic features of banking are direct sources of market power (Luis Granero and Miguel Gonzáles-Maestre, 1999), and that new entrants would face increased adverse selection in their pool of borrowers (Giovanni Dell'Ariccia, Ezra Friedman, and Robert Marquez, 1997).

may reduce bankruptcy risk in the financial sector. Therefore, concentrating both the financial sector's antitrust and supervision authority in the hands of the same institution, as it is the case, for example, for the Italian central bank, may lead to poor results with regard to at least one of the two policy objectives: a loose enforcement of competition policy is a cheap, but socially costly substitute for effort in supervision.

Additional considerations One should also take into account that concentrated credit markets can further facilitate collusion and increase (firms' and banks') rents in product markets by increasing entry barriers. That is, banks may refuse credit to wealth-constrained entrepreneurs who are planning to enter the oligopolistic industries to which the banks are already lending (Giacinta Cestone and Lucy White, 1998). And in the long run, such collusive financial practices may lead to an aggregate shortage of finance for smaller innovative firms in dynamic industries, those who are creating new markets and have the highest growth opportunities, thus reducing the growth possibilities of the overall economic system, employment, and welfare.[31]

Our model and these additional considerations suggest that, particularly in bank dominated countries, the financial sector should be all the way up on the agenda of the competition authorities.

5.3 Concluding remarks

In this paper we have questioned the standard view that debt finance diminishes firms' ability to collude in the product markets. We have shown that by controlling their borrowers' choice of managers and managerial incentives and making secret renegotiation impossible, concentrated or collusive credit markets may easily monopolize otherwise competitive downstream product markets. And that even when credit markets are competitive and firms have multiple lenders, having either common/allied lenders or independent lenders with interlocking directors remains a powerful collusive device for oligopolistic firms.

The simple picture which we have drawn fits nicely many empirical regularities encountered in applied corporate finance, and delivers relevant policy implications.

There are also several testable predictions. First, the model implies that managerial rents and pro-collusive (low-powered) incentive schemes should be more common where industry leverage is positively related to firms' markups. In cross-country studies, this correlation should also be increasing with the concentration of finan-

[31] This last story fits well the stylized fact that in continental Europe, where finance is dominated by large oligopolistic banks, existing firms have a longer expected life, and a smaller number of new firms are created and financed than in Anglo-Saxon countries, where financial markets are more fragmented and competitive.

cial markets and the predominance of bank finance. One could also check whether large banks (or coalitions of banks) tend to specialize in particular industries, and especially in more concentrated ones; and whether large (common, or allied, or interlocking) lenders' claims tend to be junior and issued before other classes of debt. Finally, an indirect implication of the model is that the highest quality managers will leave countries with highly concentrated credit markets, since their competitive and innovative skills are less valued in highly collusive environments.

6 Appendix

Proof of Lemma 1. With regard to the stage game, managers' compensation under profit–sharing contracts is a monotone transformation of their firms' profit functions; that is, managers' objective function is a monotone transformation of owners' objective function. The set of Nash equilibria of a game is not affected by monotone transformations of payoff functions since these generate ordinally equivalent games.

Example: Cournot oligopoly. Let q_i denote the production level of firm i, Q total production, $p(Q)$ the inverse demand function and $k_i(q_i)$ firm i's cost function. In the static market interaction, managers under NPS maximize the discontinuous objective function

$$\alpha(\pi_i - b_i) = \alpha\left[p(Q)q_i - k_i(q_i) - b_i\right]$$

for $\pi_i \geq b_i$, and

$$-C_i - c_i(b_i - \pi_i) = c_i\left[p(Q)q_i - k_i(q_i) - b_i\right] - C_i$$

for $\pi_i < b_i$.

When $\pi_i \geq b_i$ and when $\pi_i < b_i$ the F.O.C. for profit maximization with respect to q_i is

$$\alpha\left[p'(Q)q_i - p(Q) - k_i'(q_i)\right] = 0, \;\; \Leftrightarrow \;\; p'(Q)q_i - p(Q) = k_i'(q_i),$$

as in the no-debt case, and for $\pi_i < b_i$ it is

$$c_i\left[p'(Q)q_i - p(Q) - k_i'(q_i)\right] = 0, \;\; \Leftrightarrow \;\; p'(Q)q_i - p(Q) = k_i'(q_i),$$

again, as in the no debt case. Because firms' best response functions are not affected by the profit-sharing managerial contracts, by debt, or by managerial bankruptcy cost, the Nash equilibrium is not affected either. **Q.E.D.**

Proof of Lemma 2. Statement (i) follows from (2) and (3) being equivalent to (1). Statement (ii) follows from (3a) being always strictly less stringent than (2). Statement (iii) follows from (3b) being less stringent than (2) when

$$r^{**} < r^{''} \Longleftrightarrow \frac{\pi_i^A - b_i}{\widehat{\pi}_i^A - \pi_i^A} < \frac{\pi_i^A - b_i - \pi_i^{NC}}{\widehat{\pi}_i^A - \pi_i^A - \frac{C_i + c_i(b_i - \pi_i^{NC})}{\alpha}},$$

which a few algebraic manipulations simplify to $\mathbf{C}_i < \alpha(\widehat{\pi}_i^A - \pi_i^A)\frac{\pi_i^{NC}}{\pi_i^A - b_i}$. **Q.E.D.**

Proof of Proposition 1. Since for collusion to be sustainable it must be $b_i \leq \pi_i^A$, (1) not being satisfied, or being satisfied as a strict equality, implies that short-run

gains from a unilateral deviation are larger than, or equal to, the discounted flow of future coupons, that is

$$\widehat{\pi}_i^A + \frac{\pi_i^{NC}}{r} \geq \pi_i^A + \frac{\pi_i^A}{r} \Rightarrow \widehat{\pi}_i^A + \frac{\pi_i^{NC}}{r} \geq b_i + \frac{b_i}{r}.$$

Then, if managers can retain all profits after a deviation they have sufficient funds to avoid bankruptcy, in which case the relevant condition for collusion being sustainable is (3), which reduces exactly to (1). It follows that when managers under NPS contract can retain all profits, collusion cannot be sustained when (1) is not satisfied, but it can be sustained when (1) holds as equality. Finally, suppose (1) is strictly satisfied. Then, when $b_i = \pi_i^A$ bankruptcy cannot be avoided after a deviation, the condition for a manager under NPS being willing to collude is (3a) if managers are replaced after bankruptcy and (3b) if they are not, these condition are also satisfied as long as, respectively

$$r' = \frac{\pi_i^A - b_i}{\widehat{\pi}_i^A - \pi_i^A - \frac{\mathbf{C}_i}{\alpha}} \geq \frac{\pi_i^A - \pi_i^{NC}}{\widehat{\pi}_i^A - \pi_i^A} = r^* \Leftrightarrow \mathbf{C}_i > \alpha \frac{b_i - \pi_i^{NC}}{r^*},$$

and

$$r'' = \frac{\pi_i^A - \pi_i^{NC} - b_i}{\widehat{\pi}_i^A - \pi_i^A - \frac{\mathbf{C}_i + c_i(b_i - \pi_i^{NC})}{\alpha}} \geq \frac{\pi_i^A - \pi_i^{NC}}{\widehat{\pi}_i^A - \pi_i^A} = r^* \Leftrightarrow \mathbf{C}_i > \alpha \frac{b_i}{r^*},$$

and statement (i) follows. To prove (ii), suppose that managers are committed to pay out as dividends a fraction $0 < \beta < 1$ of net profits, when these are positive. Then, even when (1) is not satisfied, when $b_i = \pi_i^A$ and

$$(1 - \beta)(\widehat{\pi}_i^A - \pi_i^A) < \frac{\pi_i^A - \pi_i^{NC}}{r},$$

a deviating manager will not be able to avoid bankruptcy. In this case, even though (1) is not satisfied, the condition for a manager under NPS being willing to collude is (3a) if managers are replaced after bankruptcy and (3b) if they are not, and as long as respectively $\mathbf{C}_i > \alpha \frac{b_i - \pi_i^{NC}}{r^*}$ or $\mathbf{C}_i > \alpha \frac{b_i}{r^*}$, collusion can be sustained by leveraged firms but not by unleveraged ones. **Q.E.D.**

Proof of Proposition 3. Please see the proof of Proposition 3 in Spagnolo (1996).

Proof of Lemma 3. After the contract is concluded and debt is issued by both owners, if collusion is sustained each period then owners get $\pi_i^A - b_i - B_i$, managers get B_i, and the lender gets $b_i + b_j$. If instead one owner persuades the manager to deviate, that owner gets $\widehat{\pi}_i^A - b_i - B_i$ immediately and $\pi_i^{NC} - b_i$ afterwards, i.e. net expected gains $\widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - B_i - \pi_i^{NC}}{r} > 0$. If a manager deviates he loses future bonuses $\frac{B_i}{r}$, and

must be compensated for such loss in order to be persuaded to deviate. Regarding the lender, we must distinguish two cases. When $b_i \leq \underline{\pi}_i^A$, if a firm deviates the competing firm does not go bankrupt. Then the lender loses and gains nothing from a deviation, since even during the punishment phase owners can repay the debt. It follows that an owner has just to compensate the manager in order to renegotiate the contract, and therefore the contract is renegotiation-proof if

$$\frac{B_i}{r} \geq \widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - B_i - \pi_i^{NC}}{r}, \;\; \Leftrightarrow \;\; 0 \geq \widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - \pi_i^{NC}}{r},$$

which is never satisfied, since the RHS is strictly positive according to our assumption that condition (1) is not satisfied. Statement (i) follows. When $\pi_i^{NC} > b_i > \underline{\pi}_i^A$, if a firm deviates the other firm goes bankrupt. Then, when a deviation occurs the lender loses immediately $b_i - \underline{\pi}_i^A$ from the non deviating firm who goes bankrupt, but he also obtains the right to its residual profit flow $\frac{\pi_i^{NC} - b_i}{r}$. When $\frac{\pi_i^{NC} - b_i}{r} \geq b_i - \underline{\pi}_i^A$ the lender will also have incentives to induce one manager to deviate, and the managerial contract is renegotiation-proof when

$$\frac{B_i}{r} \geq \widehat{\pi}_i^A - \pi_i^A + \frac{\pi_i^{NC} - b_i}{r} - (b_i - \underline{\pi}_i^A) - \frac{\pi_i^A - B_i - \pi_i^{NC}}{r},$$

or, equivalently,

$$0 \geq \widehat{\pi}_i^A - \pi_i^A - (b_i - \underline{\pi}_i^A) + \frac{\pi_i^{NC} - b_i}{r} - \frac{\pi_i^A - \pi_i^{NC}}{r},$$

which is always false, since the RHS is strictly positive by the assumption that (1) is not satisfied. When $\frac{\pi_i^{NC} - b_i}{r} < b_i - \underline{\pi}_i^A$ the lender needs to be compensated for the loss $b_i - \underline{\pi}_i^A - \frac{\pi_i^{NC} - b_i}{r}$, and debt makes the managers' contracts renegotiation-proof when

$$\frac{B_i}{r} + b_i - \underline{\pi}_i^A - \frac{\pi_i^{NC} - b_i}{r} \geq \widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - B_i - \pi_i^{NC}}{r},$$

or, equivalently,

$$b_i - \underline{\pi}_i^A - \frac{\pi_i^{NC} - b_i}{r} \geq \widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - \pi_i^{NC}}{r}.$$

Q.E.D.

Proof of Lemma 4. After debt is issued, managers can sustain a collusive agreement delivering per-period profits $\pi_i^A \geq \pi_i^B$, in which case each period owners get $\pi_i^A - b_i - B_i$, managers get B_i, and the lender gets $b_i + b_j$. To have the lender and the manager agree to a contract renegotiation that leads the manager to deviate, the owner must compensate both of them for their expected losses from the deviation.

When a manager deviates unilaterally, his owner i gets $\widehat{\pi}_i^A - b_i - B_i$ immediately and zero afterwards, and his net expected gains are $\widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - b_i - B_i}{r}$, strictly positive according to Assumption 2. If the manager distributes gains from deviation as dividends, the lender of the deviating firm i loses $b_j - \underline{\pi}_j^A$ from the non-deviating firm's immediate default on debt-service payments, the discounted expected flow of debt repayments from the bankrupt non-deviating firm minus its residual value $\frac{b_j}{r} - \frac{\pi_j^{NC}}{r}$, and the discounted expected flow of debt repayments from the deviating firm minus its residual value $\frac{b_i}{r} - \frac{\pi_i^{NC}}{r}$, since in the period after the deviation the deviating firm earns only $\pi_i^{NC} < b_i$ and therefore goes also bankrupt. (Alternatively, the manager of the deviating firm may choose to avoid bankruptcy, either by retaining part of the short-run gains from deviations to pay future coupons, or by buying back all debt immediately; in both cases nothing changes, since avoiding bankruptcy implies a payment to the lender of $\frac{b_i}{r} - \frac{\pi_i^{NC}}{r}$, exactly as when bankruptcy occurs.) If a manager deviates unilaterally, he loses the flow of future bonuses $\frac{B_i}{r}$ whether or not his firm goes bankrupt. The managerial contract is renegotiation-proof if an owner's gains from a unilateral deviation in the product market are not sufficient to compensate both the manager and the lender for their losses from the deviation, that is, if

$$\widehat{\pi}_i^A - \pi_i^A - \frac{\pi_i^A - B_i - b_i}{r} < \frac{B_i}{r} + \left[b_j - \underline{\pi}_j^A + \frac{b_j - \pi_j^{NC}}{r} + \frac{b_i - \pi_i^{NC}}{r} \right],$$

or, equivalently, if

$$r < r_i^D = \frac{\pi_i^A - \pi_i^{NC} + (b_j - \pi_j^{NC})}{\widehat{\pi}_i^A - \pi_i^A - \left(b_j - \underline{\pi}_j^A \right)}.$$

By inspection r_i^D is increasing in b_j, and by direct comparison with inequality (1) $r_i^D > r_i^*$ for every $b_j > \pi_j^{NC}$. This proves statement (i). To prove (ii) rewrite the condition above as

$$r \left[\widehat{\pi}_i^A - \pi_i^A - \left(b_j - \underline{\pi}_j^A \right) \right] < \pi_i^A + b_i - 2\pi_i^{NC},$$

and note that by assumption the RHS is always strictly positive. Consider first the case in which ($\pi_j^B =$) $b_j = \pi_j^A - B_j$, so that the LHS becomes

$$r \left[\widehat{\pi}_i^A + \underline{\pi}_j^A - (\pi_i^A + \pi_j^A) + B_j \right].$$

As long as industry output at the collusive agreement $q_i^A + q_j^A$ is not smaller than the monopoly output, $q_i^A + q_j^A$ is smaller than the industry output when one firm unilaterally deviates by choosing $\widehat{q}_i(q_j^A) > q_i^A$. Therefore (however they are split) industry profits from the collusive outcome are strictly larger than industry profits when one firm deviates unilaterally, that is

$$\pi_i^A(q_i^A + q_j^A) + \pi_j^A(q_i^A + q_j^A) > \widehat{\pi}_i^A(\widehat{q}_i(q_j^A), q_j^A) + \underline{\pi}_j^A(\widehat{q}_i(q_j^A), q_j^A),$$

which implies that

$$r\left[(\widehat{\pi}_i^A + \underline{\pi}_j^A) - (\pi_i^A + \pi_j^A) + B_j\right] \leq 0 \text{ as long as } 0 < B_j \leq \pi_i^A + \pi_j^A - \widehat{\pi}_i^A - \underline{\pi}_j^A.$$

It follows that when $b_j = \pi_j^A - B_j$ and $B_j \leq \pi_i^A + \pi_j^A - \widehat{\pi}_i^A - \underline{\pi}_j^A$, the condition for managerial contracts to be renegotiation-proof is strictly satisfied at any discount rate. By continuity, there exist other levels of debt $b_j < \pi_j^A - B_j$ for which the same condition holds, and there is a lower bound b_j^* such that for $\pi_j^A - B_j \geq b_j \geq b_j^*$ the contract is renegotiation-proof at any level of r, where b_j^* satisfies

$$\widehat{\pi}_i^A - \pi_i^A - \left(b_j^* - \underline{\pi}_j^A\right) = 0 \;\Leftrightarrow\; b_j^* = \widehat{\pi}_i^A + \underline{\pi}_j^A - \pi_i^A.$$

Q.E.D.

Proof of Proposition 4. The first statement follows straightforwardly from Proposition 3 and Lemma 4. For the second statement, consider owners' expected payoffs when a debt contract is offered. If both owners accept the deal each of them gets $D_i = \frac{b_i}{r} - g_i$ immediately and expects net profits $\pi_i^M - b_i - B_i$ in each future period, with total expected profits $\frac{\pi_i^M - B_i}{r} - g_i$. If both owners refuse the deal, they remain stuck at the static Cournot-Nash equilibrium for ever. If one owner, say j, accepts but owner i does not, collusion cannot be supported and firms are again stuck at the Cournot-Nash equilibrium. However, while the firm that refuses the deal gets expected profits $\frac{\pi_i^{NC}}{r}$, the firm that accepts it gets $D_j = \frac{b_j}{r} - g_j$ immediately and expects net profits $max\left\{\pi_j^{NC} - b_j, 0\right\}$ in each future period. When $b_i = \pi_i^B = \pi_i^M - B_i$ owners' expected payoffs matrix in the "capital structure game" is

$$\begin{pmatrix} \frac{\pi_i^M - B_i}{r} - g_i,\ \frac{\pi_j^M - B_j}{r} - g_j; & \frac{\pi_i^M - B_i}{r} - g_i,\ \frac{\pi_j^{NC}}{r} \\ \frac{\pi_i^{NC}}{r},\ \frac{\pi_j^M - B_j}{r} - g_j; & \frac{\pi_i^{NC}}{r},\ \frac{\pi_j^{NC}}{r} \end{pmatrix}.$$

By inspection, as long as the lender limits rent extraction by choosing $g_i < \frac{\pi_i^M - B_i}{r} - \frac{\pi_i^{NC}}{r}$, accepting the debt contract is owners' strictly dominant strategy. **Q.E.D.**

Proof of Proposition 5. If one firm renegotiates its manager's contract to induce him to deviate, the lender observes it through his man on the board. To block renegotiation, the lender can threaten to reveal that renegotiation is occurring to the other firm, which would react and nullify the renegotiating firm's gains from deviation in the product market. If it does so, the Cournot-Nash outcome occurs, both firms go bankrupt, and the lender receives $\pi_i^{NC} + \pi_j^{NC}$ immediately and then the residual value of the two firms $\frac{\pi_i^{NC} + \pi_j^{NC}}{r}$. If it does not, the lender gets immediately $\underline{\pi}_j^M$ from the side of the non-deviating firm, some compensation P for its silence from the deviating

firm, where $P \leq \widehat{\pi}_i^M - B_i - \frac{B_i}{r}$ (B_i is the deviating manager's bonus, and $\frac{B_i}{r}$ is the amount that must be paid to the same manager to induce him to deviate), plus both firms' residual value $\frac{\pi_i^{NC}+\pi_j^{NC}}{r}$. Therefore, the lender's threat of revealing renegotiation to the competing firm is credible as long as

$$\pi_i^{NC} + \pi_j^{NC} \geq \underline{\pi}_j^M + \widehat{\pi}_i^M - B_i - \frac{B_i}{r} \Leftrightarrow B_i \geq \frac{r}{1+r}\left(\widehat{\pi}_i^M + \underline{\pi}_j^M - \pi_j^{NC} - \pi_i^{NC}\right).$$

From the proof of Lemma 4 we know that gains from deviation are not sufficient to compensate all parties for the losses caused by renegotiation and the following deviation if

$$\widehat{\pi}_i^M - \pi_i^M - \frac{\pi_i^M - B - b_i}{r} < \frac{B}{r} + \left[b_j - \underline{\pi}_j^M + \frac{b_j - \pi_j^{NC}}{r} + \frac{b_i - \pi_i^{NC}}{r}\right],$$

which, when $b_i = \pi_i^M - B$, becomes

$$\widehat{\pi}_i^M - \pi_i^M < \frac{B}{r} + \left[\pi_i^M - B - \underline{\pi}_j^M + \frac{\pi_i^M - B - \pi_i^{NC}}{r} + \frac{\pi_j^M - B - \pi_j^{NC}}{r}\right],$$

which a few algebraic steps reduce to

$$B < \frac{r}{1+r}(\pi_i^M + \pi_j^M - \widehat{\pi}_i^M - \underline{\pi}_j^M) + \frac{\pi_i^M - \pi_i^{NC}}{1+r} + \frac{\pi_j^M - \pi_j^{NC}}{1+r}.$$

It follows that as long as

$$\frac{r}{1+r}(\widehat{\pi}_i^M + \underline{\pi}_j^M - \pi_i^{NC} - \pi_j^{NC}) \leq B_i < \frac{\pi_i^M - \pi_i^{NC}}{1+r} + \frac{\pi_j^M - \pi_j^{NC}}{1+r} + \frac{r}{1+r}(\pi_i^M + \pi_j^M - \widehat{\pi}_i^M - \underline{\pi}_j^M),$$

or, equivalently,

$$\widehat{\pi}_i^M + \underline{\pi}_j^M - \pi_i^{NC} - \pi_j^{NC} \leq B_i < \frac{\pi_i^M + \pi_j^M - \pi_j^{NC} - \pi_i^{NC}}{r} + \pi_i^M + \pi_j^M - \widehat{\pi}_i^M - \underline{\pi}_j^M, \ \forall i,$$

the lender will oppose any secret renegotiation leading to a breach of the collusive agreement, and can prevent it by the credible threat of revealing the renegotiation to the competing firm. The last condition can be satisfied when

$$r < \frac{\pi_i^M + \pi_j^M - \pi_j^{NC} - \pi_i^{NC}}{2(\widehat{\pi}_i^M + \underline{\pi}_j^M) - \pi_i^{NC} - \pi_j^{NC} - \pi_i^M - \pi_j^M},$$

therefore, given (1), debt facilitates collusion as long as

$$\frac{\pi_i^M + \pi_j^M - \pi_j^{NC} - \pi_i^{NC}}{2(\widehat{\pi}_i^M + \underline{\pi}_j^M) - \pi_i^{NC} - \pi_j^{NC} - \pi_i^M - \pi_j^M} > \frac{\pi_i^M - \pi_i^{NC}}{\widehat{\pi}_i^M - \pi_i^M},$$

or, equivalently,

$$(\pi_j^M - \pi_j^{NC})(\widehat{\pi}_i^M - \pi_i^M) > \left[\widehat{\pi}_i^M + 2\underline{\pi}_j^M - \pi_i^{NC} - \pi_j^{NC} - \pi_j^M\right](\pi_i^M - \pi_i^{NC}),$$

which, in our symmetric case reduces to $\pi_i^{NC} > \underline{\pi}_j^M$, which is satisfied for most specifications of the Cournot model. Finally, the last statement follows from the same argument made in the proof of Proposition 4. **Q.E.D.**

Proof of Proposition 6. As long as $g_i + g_j > 0$ there will be competition among lenders for this rent, and owners may use such competition to reduce the lender's stake indefinitely. Once $g_i + g_j = 0$ the lenders break even, and we can assume that firms will find at least one lender (or one couple of allied lenders) willing to offer and sign the debt contracts. The payoff matrix and the extensive form of the "capital structure game" will be as in the previous proof and, by inspection, because $g_i < \frac{\pi_i^M - B_i}{r}$ it is a strictly dominant strategy for both owners to sign the debt contract. **Q.E.D.**

Proof of Proposition 7. To induce a deviation through renegotiation, owners must compensate the manager for the expected loss of bonuses after the deviation, pay debtholders future coupons, and also compensate the common lender for the extra losses due to the non-deviating firm's financial distress. With $b_i = \pi_i^B = \pi_i^M - B_i$ and without deviations, non-common lenders together expect the full repayment streams with discounted value $(1-\gamma)\left(\pi_i^M - B_i + \frac{\pi_i^M - B_i}{r}\right)$, and the common lender expects the full repayment streams $\gamma\left(\pi_i^M - B_i + \frac{\pi_i^M - B_i}{r}\right) + \gamma\left(\pi_j^M - B_j + \frac{\pi_j^M - B_j}{r}\right)$. After a deviation each firm expects a flow of future profits $\frac{\pi_i^{NC}}{r}$. Therefore, to obtain renegotiation the owner of firm i the owner that firm must pay $\frac{B_i}{r}$ to the manager, $\frac{\pi_i^M - B_i - \pi_i^{NC}}{r}$ to debtholders, plus the common lender's losses from the non-deviating firm's financial distress $\gamma\left(\pi_j^M - B_j + \frac{\pi_j^M - B_j}{r}\right) - \gamma\left(\underline{\pi}_j^M + \frac{\pi_j^{NC}}{r}\right)$. Then managerial contracts are renegotiation-proof and the joint monopoly collusive agreement is supportable when

$$\widehat{\pi}_i^M - \pi_i^M < \frac{B_i}{r} + \left[\frac{\pi_i^M - B_i - \pi_i^{NC}}{r}\right] + \gamma\left[\pi_j^M - B_j - \underline{\pi}_j^M + \frac{\pi_j^M - B_j - \pi_j^{NC}}{r}\right],$$

or, equivalently,

$$r\left[\widehat{\pi}_i^M - \pi_i^M - \gamma(\pi_j^M - \underline{\pi}_j^M - B_j)\right] < \pi_i^M - \pi_i^{NC} + \gamma(\pi_j^M - B_j - \pi_j^{NC}).$$

As long as $B_j \leq \pi_j^M - \pi_j^{NC}$, which is always satisfied since no debt contract is feasible if more than total gains from collusion must be paid to the manager, the RHS is strictly positive. It follows that when

$$\widehat{\pi}_i^M - \pi_i^M - \gamma(\pi_j^M - \underline{\pi}_j^M - B_j) \leq 0,$$

or, equivalently,

$$\gamma \geq \frac{\widehat{\pi}_i^M - \pi_i^M}{\pi_j^M - \underline{\pi}_j^M - B_j},$$

the condition is satisfied for any r. This proves claim (i).

When $\gamma < \frac{\widehat{\pi}_i^M - \pi_i^M}{\pi_j^M - \underline{\pi}_j^M - B_j}$, the contract is renegotiation-proof as long as

$$r < r^\gamma \ = \frac{\pi_i^M - \pi_i^{NC} + \gamma(\pi_j^M - \pi_j^{NC} - B_j)}{\widehat{\pi}_i^M - \pi_i^M - \gamma(\pi_j^M - \underline{\pi}_j^M - B_j)},$$

and comparing it with (1) evaluated at $\pi_i^A = \pi_i^M$, $r^\gamma \ > r^*$ when

$$\frac{\pi_i^M - \pi_i^{NC} + \gamma(\pi_j^M - \pi_j^{NC} - B_j)}{\widehat{\pi}_i^M - \pi_i^M - \gamma(\pi_j^M - \underline{\pi}_j^M - B_j)} > \frac{\pi_i^M - \pi_i^{NC}}{\widehat{\pi}_i^M - \pi_i^M},$$

which, because $B_j < \pi_j^M - \pi_j^{NC}$ (if managers capture all gains from collusion owners are not interested in issuing debt in the first place) implies $\gamma(\pi_j^M - \pi_j^{NC} - B_j) > 0$ and $-\gamma(\pi_j^M - \underline{\pi}_j^M - B_j) < 0$, is always satisfied. This proves claim (ii).

Finally, the payoff matrix of the "capital structure game" is as in the proof of Proposition 4 with $g_i < \frac{\pi_i^M - B_i - \pi_i^{NC}}{r}$, and the last statement follows. **Q.E.D.**

Proof of Proposition 9. With $b_i = \pi_i^B = \pi_i^M - B_i \ \forall i$, and without deviations, the non-common lenders of each firm i expect the repayment streams with discounted value $(1-\gamma_i^1-\gamma_i^2)\left(\pi_i^M - B_i + \frac{\pi_i^M - B_i}{r}\right)$, while the common lenders expect repayment streams with discounted value $(\gamma_i^1+\gamma_i^2)\left(\pi_i^M - B_i + \frac{\pi_i^M - B_i}{r}\right)$ from both firms. After a deviation the remaining value of each firm is $\frac{\pi_i^{NC}}{r}$. As before, to have debtholders and manager agree on renegotiation the owner must pay the amount $\frac{B_i}{r} + \frac{\pi_i^M - B_i - \pi_i^{NC}}{r}$, plus common lenders' compensation for their losses from the financial distress of the non-deviating firm $(\gamma_j^1+\gamma_j^2)\left(\pi_j^M - B_j + \frac{\pi_j^M - B_j}{r}\right) - (\gamma_j^1+\gamma_j^2)\left(\underline{\pi}_j^M + \frac{\pi_j^{NC}}{r}\right)$. Therefore, managerial contracts are renegotiation-proof and the joint monopoly collusive agreement supportable when the following no-renegotiation conditions for the two firms are simultaneously satisfied:

$$\widehat{\pi}_i^M - \pi_i^M < \frac{B_i}{r} + \left[\frac{\pi_i^M - B_i - \pi_i^{NC}}{r}\right] + (\gamma_j^1+\gamma_j^2)\left[\pi_j^M - B_j - \underline{\pi}_j^M + \frac{\pi_j^M - B_j - \pi_j^{NC}}{r}\right],$$

$$\widehat{\pi}_j^M - \pi_j^M < \frac{B_j}{r} + \left[\frac{\pi_j^M - B_j - \pi_j^{NC}}{r}\right] + (\gamma_i^1+\gamma_i^2)\left[\pi_i^M - B_i - \underline{\pi}_i^M + \frac{\pi_i^M - B_i - \pi_i^{NC}}{r}\right].$$

Firms' and agreement's symmetry and the common managerial labor market imply that these conditions are identical in all but the factors $(\gamma_j^1+\gamma_j^2)$ and $(\gamma_i^1+\gamma_i^2)$. Because

the conditions must both be satisfied for collusion to be supported, firms' ability to collude is constrained by the more stringent of the conditions only. By inspection, the conditions are more stringent as the factors $(\gamma_j^1+\gamma_j^2)$ and $(\gamma_i^1+\gamma_i^2)$ become smaller. It follows that firms' ability to collude (the maximum discount rate at which collusion is supportable) is increasing in $\min\left\{\gamma_j^1+\gamma_j^2;\ \gamma_i^1+\gamma_i^2\right\}$. **Q.E.D.**

Proof of Proposition 11. Again, with $b_i=\pi_i^B=\pi_i^M-B_i\ \forall i$, and without deviations, managers expect their flow of bonuses, the non-common lenders expect the full repayment streams with expected value $(1-\gamma)\left(\pi_i^M-B_i+\frac{\pi_i^M-B_i}{r}\right)$, and the common lender expects full repayment streams with expected value $\gamma\left(\pi_i^M-B_i+\frac{\pi_i^M-B_i}{r}\right)$ from both firms. To accept a renegotiation leading to a deviation, all these parties need to be compensated for any losses from the deviation induced by renegotiation. After the deviation the manager of deviating firm i expects no bonuses in the future, while the remaining value of the firm after the deviation is $\frac{\pi_i^{NC}}{r}$. Therefore, to obtain renegotiation the owner must pay the amount $\frac{B_i}{r}+\frac{\pi_i^M-B_i-\pi_i^{NC}}{r}$ to compensate firm i's manager and creditors, plus he must compensate the common lender for the extra losses due to the other firm's financial distress. After a firm i deviation, the common lender receives from the non-deviating firm in financial distress the amount

$$\min\left\{\gamma\left(\pi_j^M-B_j+\frac{\pi_j^M-B_j}{r}\right);\left[\underline{\pi}_j^M+\frac{\pi_j^{NC}}{r}-\eta(1-\gamma)\frac{\pi_j^M-B_j}{r}\right]\right\},$$

so that his extra loss from the side of the non-deviating firm only, denoted by $\Gamma(\eta)$, is

$$\begin{aligned}\Gamma(\eta) &= \gamma\left(\pi_j^M-B_j+\frac{\pi_j^M-B_j}{r}\right)\\ &\quad-\min\left\{\gamma\left(\pi_j^M-B_j+\frac{\pi_j^M-B_j}{r}\right);\left[\underline{\pi}_j^M+\frac{\pi_j^{NC}}{r}-\eta(1-\gamma)\frac{\pi_j^M-B_j}{r}\right]\right\}.\end{aligned}$$

By inspection, $\Gamma(\eta)$ is increasing in η. Renegotiation is impossible and collusion is credibly implemented as long as the following condition is satisfied

$$\widehat{\pi}^M-\pi^M<\frac{B}{r}+\frac{\pi^M-B-\pi^{NC}}{r}+\Gamma(\eta),$$

and since $\Gamma(\eta)$ is increasing in η, the larger the value of η, the easier it is to satisfy the inequality and implement collusion. **Q.E.D.**

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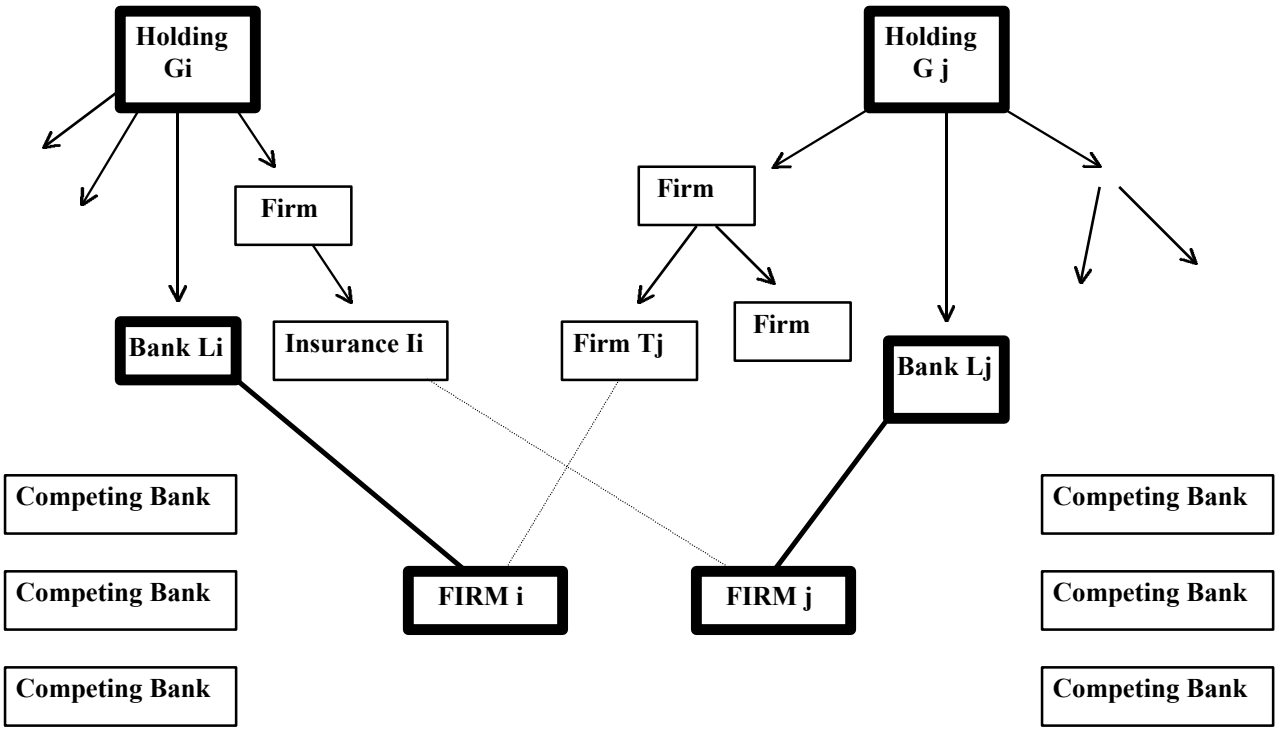
Non-Technical Abstract

Recent empirical work has shown that in concentrated industries, high leverage tends to be correlated with low output, high prices, and more passive investment behavior; that is, debt seems to have anti-competitive effects on product markets.

In this paper we propose a theoretical explanation for this evidence based on the interaction between capital structure, managerial incentives, and firms' ability to sustain collusive behavior. Building on Vojislav Maksimovic's (1988) leveraged oligopoly model, we show that shareholders' commitments to a "prudent" behavior aimed at reducing conflicts with debtholders and the ex ante cost of debt finance – such as choosing a manager with a valuable reputation or low-powered managerial incentives – also greatly facilitate tacit collusion in the product market. The model explains why and how collusive credit markets and large banking groups "export" collusion in otherwise competitive downstream product markets. Even when secret contract renegotiation is feasible and costless, a suitable combination of bank debt and "conservative" managerial incentives has the same product market effects of a "hidden" horizontal merger, making full collusion sustainable where unleveraged firms would be unable to collude at all.


Holding Gi
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Firm
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Bank Lj
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Competing Bank
FIRM i
FIRM j
Control
Loan
Director

FIGURE 1