Revenue Efficiency and Change of Control:

The Case of Bankruptcy

By

Francesca Cornelli and
Leonardo Felli

DISCUSSION PAPER 300
August 1998

FINANCIAL MARKETS GROUP
AN ESRC RESEARCH CENTRE

LONDON SCHOOL OF ECONOMICS

Any opinions expressed are those of the author and not necessarily those of the Financial Markets Group.

ISSN 0956-8549-300

Revenue Efficiency and Change of Control: The Case of Bankruptcy*

Francesca Cornelli
(London Business School and CEPR)

Leonardo Felli
(London School of Economics)

July 1998

Abstract. The restructuring of a bankrupt company often entails a change of control. By efficiency of a bankruptcy procedure it is usually meant that the control is allocated into the hands of those who can maximize its value. In this paper we focus instead on how to allocate control with a procedure that allows the creditors to maximize their returns. The conclusion is that creditors should be allowed to retain a fraction of the shares of the company.

Address for correspondence: Leonardo Felli, London School of Economics, Houghton Street, London WC2A 2AE, England. E-mail: L.Felli@lse.ac.uk.

*We are grateful to Patrick Bolton, Julian Franks, Oliver Hart, Ronen Israel, François Ortalo-Magné, Ben Polak, Oved Yosha, David Webb, Luigi Zingales and seminar participants at Tel-Aviv University, HEC Paris, LBS and Wharton for very helpful discussions and comments. Financial support form the Bank of Italy is gratefully acknowledged. We are solely responsible for any remaining errors. This paper was completed while the authors were visiting the Wharton School and the Department of Economics at the University of Pennsylvania respectively. Their generous hospitality is gratefully acknowledged.

1. Introduction

A bankruptcy procedure—or, even before bankruptcy, any restructuring in a situation of financial distress—has to choose the destiny of the insolvent firm. The first choice is whether to liquidate the company or to restructure it (in the US this is equivalent to a choice between Chapter 7 and Chapter 11). Restructuring the company may entail the transfer of control in new hands. An optimal bankruptcy procedure should therefore transfer the control in an optimal way, that is in the hands of those who can maximize the value of the company. If these are the original shareholders, they should obtain again the control, even if they were not able to repay all existing debt.

As a consequence, the first obvious goal or criterion to evaluate a bankruptcy procedure should be the efficient allocation of the control of the company. In other words an 'efficient' bankruptcy procedure should entail the choice of the restructuring plan which maximizes the *ex post* value of the company (liquidation can be seen as a particular restructuring plan). We shall denote this efficiency criterion *allocative efficiency*.

Although allocative efficiency is very important, it does not take into account another important goal of a bankruptcy law: its effect on the incentives of the involved parties before the firm goes into bankruptcy, even before any clue of financial distress is at the horizon. If the choice of what to do with the firm can be regarded as *ex-post efficiency*, the effect on the incentives can be regarded as *ex-ante efficiency*.

For example, a bankruptcy procedure 'punishing' managers or entrepreneurs of the insolvent firm (for example not giving them control even when it is ex-post efficient) may be seen as providing them with the right incentives to manage the firm so as to avoid ending up in financial distress, for example by undertaking too many risks. The effects of different bankruptcy procedures on the managers' and entrepreneurs' incentives have been extensively studied in the literature (Aghion and Bolton 1992, Berkovitch, Israel, and Zender 1993, Bolton and Scharfstein 1996, among others).

This paper focuses on a different aspect of ex-ante efficiency: the protection of the creditors' claims. By protection of creditors' claims we mean the attempt to

maximize the proceeds to the creditors from the reorganization of the firm. We call this notion of ex-ante efficiency *revenue efficiency*. The revenues to the creditors may seem, from an ex-post point of view, as a pure transfer and therefore irrelevant. However, a bankruptcy procedure which protects the creditors' interests when the firm is in financial distress may reduce the firm's overall costs of borrowing. This has clear efficiency implications. Investment projects that would be financed under a revenue efficient bankruptcy procedure would not be financed under revenue inefficient bankruptcy procedures.

The main lesson we derive from our analysis is quite simple: it is always optimal to leave the creditors the option to retain an equity stake in the distressed firm. This conclusion may seem surprising, given that it is usually argued that giving creditors too much power in a bankruptcy procedure may induce them to liquidate too often (see Aghion, Hart, and Moore (1992) and Franks and Torous (1989)). Indeed this is the case in a situation in which creditors, by liquidating, can be entirely reimbursed. Clearly in this case increasing revenues is not a creditors' concern. However, if — as usual in a bankruptcy situation — the value of the company, even when maximized, is less than the sum of the credits, creditors will want to maximize their revenues.

Of course, if creditors knew the value of the company in the hands of potential buyers then how to maximize their revenues would not be a hard problem to solve. They could make a take-it-or-leave-it offer to the buyer in whose hands the firm's value is the highest and capture most of the increase in value of the firm. However, one of the major source of complexity and delays in bankruptcy is due to the difficulty in evaluating the company's assets.[1] When there is imperfect information, creditors need to leave an informational rent to buyers in order to induce them to reveal the value of the company assets in their hands. By retaining an equity stake in the company, the creditors can free-ride on the improvement of the company value and in this way minimize such rent.

In the paper we characterize the optimal mechanism for allocating control, such a

[1]See, for example, the cases of Sunbeam-Oster (HBS # 5-293-046) and Marvel Entertainment Group (HBS # 5-298-028).

mechanism will also determine what stake in the firm should be sold. When control does not entail any private benefits we show that it is always optimal to sell only the minimum stake necessary to transfer control. In other words it is optimal to separate completely the voting rights from the cash flow rights of the company: the creditor should sell all the voting rights and possibly retain all the cash flow rights. Since the advantage of keeping an equity stake is that it reduces the rents the creditors have to leave to the buyers (due to their private information), one may argue that if, after acquiring the control, a buyer could resell it to someone who values it more, the need to keep an equity stake disappears. In fact, the potential additional revenues from a resale should be taken into account when bidding for the control of the firm. As a consequence, the amount each buyer is willing to pay contains a common component due to the option of reselling. We show that even in that case our result still holds. The reason is that even in case of resale a seller will be able to obtain a higher payment the higher is his own valuation.

A question that comes to mind, given the result described above, is whether the allocation of the control stake of the firm in the hands of the buyer that maximizes the value of the firm and of the minority stake in the hands of the creditors could be implemented in a decentralized way. What we have in mind is to transform the firm in distress in an all equity company distribute the share of this company to the creditors and leave them free to decide the fate of this new all-equity company. In other words we ask whether it is possible to *privatize* the bankruptcy procedure at hand. We conclude that although this procedure may achieve the same allocation of revenues that is obtained when requiring creditors to auction off the minimum control stake of the firm, it is actually better to have a bankruptcy law that imposes a well defined procedure, rather than privatize it. Allocating the ownership rights of the creditors on the bankrupt firm is not enough for the outcome we just described to be achieved through the creditors' spontaneous bargaining. Indeed, each creditor has an incentive to hold on to the shares of the bankrupt firm in the expectation that the other creditors will transfer the control of the firm in the hands of the individual that can maximize the value. In other words each creditor will have an incentive to free

ride on other creditors and hold on to his shares. Therefore the only way in which creditors will be certain to realize the returns from their defaulted credits is through a structured bankruptcy procedure.

The observation that it is not necessarily optimal for the creditors to sell the entire equity stake of the firm can shed light on some of the features of observed bankruptcy cases. Usually, an observed increase in the creditors' equity stake at the end of a bankruptcy restructuring is explained by the need to increase monitoring by large shareholders (see for example Gilson (1990)), or more generally by the fact that an increase in the creditors' stake might affect the value of the company. This paper suggests that this might simply be the best way for the creditors to sell the firm and recuperate as much as possible of their credits.

Another observed feature of bankruptcy cases may be reinterpreted in light of our result. The fact that equityholders receive a compensation in the form of an equity stake in the restructured company, — before debtholders are completely compensated, — is usually interpreted in the literature on bankruptcy as a violation of creditors' absolute priority rule. This violation is explained through the observation that equityholders retain bargaining power during the Chapter 11 process (see for example Bebchuk and Chang (1992)). This could indeed be what happened, but we argue that also an alternative explanation is available. Consider, for example, the case in which the value of the company is maximized if the control is given back to the old shareholders. Allocative efficiency then requires to give the control stake of the firm to these shareholders. At the same time revenue efficiency requires the creditors to retain a minority equity stake of the firm so as to maximize their revenues. The result is a situation (as many cases in Gilson (1990)) in which both equityholder and creditors might obtain equity stakes in the restructured firm. This is not necessarily due to the shareholders' bargaining power in Chapter 11. Indeed, the equityholders obtain shares in the restructured firm not because of violation of absolute priority rule but because as "new" controlling party they get an informational rent, which the creditors are minimizing by also keeping an equity stake.

We conclude our analysis by considering the case in which the control of the firm

in distress entails some private benefits. In this case we show that it might still be optimal for the creditors to retain part of the equity stake of the firm although it is not optimal any more to auction off the minimum control stake. In other words, it may still be optimal for the creditors to retain part of the cash flow rights, although it is not optimal any more to fully separate ownership of cash flow rights from the ownership of the voting rights.

The analysis of this paper is relevant not only for the change of control in a bankruptcy procedure, but for any transfer of control: the selling party always has an interest in retaining a minority equity stake. In the next section we relate our paper to other papers about the sale of a company or transfer of control, and show how our results apply in that context. The reason we are focusing on bankruptcy is because this case is usually characterized by having more than one potential buyer (or, more specifically, more than one alternative restructuring plan) and by having a structured procedure. In the next section we discuss how such characteristics can make a difference.

The rest of the paper is structured in the following way. We review the related literature in Section 2. Section 3 defines the concept of revenue efficiency and presents the model. Section 4 presents the main result of the paper when the willingness to pay of potential buyers are independent (that is trade of stakes of the firm after allocating control is not allowed). The same result is then proved in Section 5 in the case in which the possibility of trading shares among buyers introduces a common component in these values. Section 6 suggests how to implement the changes in the bankruptcy procedure that are induced by our result and analyzes the possibility of privatizing the bankruptcy procedure. We generalize the result in the presence of private benefits from control in Section 7. Section 8 concludes.

2. Related Literature

As we already mentioned in the Introduction, the results of this paper are relevant also for transfer of control outside the bankruptcy procedure. This is most evident when we compare our results to the following three related papers: Riley (1988),

Zingales (1995) and Bebchuk (1994).

Riley (1988) shows that in the sale, for example, of oilfields the expected revenue of the seller is raised by using royalty rates. In other words the seller increases its revenues by making the winner's payment a function of the information revealed during the auction and of any signal of the value of the object auctioned off that might become available after the oilfield is sold. The main difference with our analysis is that Riley's result holds only when the values of the oilfield in the hands of the potential buyers are correlated across buyers (the case analyzed is affiliated values) while our result holds also when the firm's values in the hands of potential bidders are independent (see Section 4 below).

In particular in Riley (1988) royalties fees are used to allow the price paid by the winning bidder to depend on the entire information on the value of the oilfield revealed during the auction (in the case the selling procedure used is a sealed bid auction) as well as on any information revealed after the auction. Therefore whenever the information revealed does not affect the values of the oilfield to potential buyers royalty fees do not affect the seller's revenue.

Our result instead holds also in the case in which the information revealed in the auction does not affect the different values of the firm in the hands of potential buyers. Indeed, our result depends on the fact that it is possible to transfer the control of a firm without necessarily transferring all the cash flow rights. As a result the seller can capture part of the increase in value induced by the transfer of control and minimize the informational rent left to the seller.

Zingales (1995) analyzes the optimal selling procedure the owner of a firm should use to extract the highest possible surplus from a raider. Zingales shows that the incumbent may want to sell the minority stake of the firm on the stock market before facing the raider, in order to free-ride on any increase in the value of the firm induced by the transfer of control. The main difference with our analysis lies in the fact that Zingales focuses on the case in which only one raider is planning to take over the firm, while we consider the case where there is competition among potential buyers of the firm.

In Zingales (1995), the incumbent, if he owns the entire company when bargaining with a unique potential acquirer, will not be able to extract any additional surplus from the raider by selling only the control stake of the firm. This is because in the bilateral bargaining with the raider the incumbent's reservation price, that makes him indifferent between selling or not the firm, will adjust when only the control stake is sold so that the amount of surplus the incumbent will be able to extract is the same whatever stake of the company is sold. However this is not true if the incumbent has transformed the minority stake of the firm in cash in advance by selling it on the stock market. Therefore in Zingales (1995) the only way in which the incumbent will be able to maximize the rent he extracts from the raider, even in the absence of private benefits from control, is by selling the minority stake of the firm on the stock market in advance.

In our analysis, this is not true. Indeed the presence of competition among potential buyers for the firm prevents the reservation value of the incumbent (the creditors in our case) from adjusting when selling only the control stake. Therefore it is strictly optimal for the creditors to retain the minority stake of the firm so as to extract the highest surplus from the potential buyers. Moreover since the creditors do not know the buyers' willingness to pay for the control of the firm, when there are private benefits from control, it is almost never optimal to sell in advance the minority stake of the firm on the stock market. It is instead optimal to use the number of shares sold as an instrument to maximize revenues from the transfer of control.[2]

The other paper that is relevant for our analysis is Bebchuk (1994). This paper analyzes the efficiency properties of different procedures for the sale of control of a company in the presence of private benefits from control. Bebchuk shows that a procedure that does not give any say to the minority shareholders of the company (market rule) may result in inefficient transfers of control, while a procedure that does give a veto power to minority shareholders (equal opportunity rule) may prevent

[2]Also in the case in which there is only one potential buyers, if the incumbent does not know the buyer's willingness to pay, it might still be optimal not to sell in advance the minority stake of the company on the stock market at the purpose of using the number of shares sold as a screening device.

efficient transfers of control. The paper is closely related to the analysis we present in Section 7.

In Bebchuk (1994) the critical condition that yields (allocative) inefficiencies in the transfer of control is whether the private benefits of the seller and the buyer of the company are positive or negatively correlated with the benefits that are shared by the minority shareholders. The equivalent condition in our analysis (Section 7 below) is whether the private benefits of potential buyers are positively or negatively correlated with the public or transferable benefits associated with their shareholding. The main difference with our analysis is that since we consider a structured procedure creditors with minority stake will not free-ride, hence the transfer of control will always be (allocatively) efficient. However, the correlation between private and public benefits will determine the proportion of shares in excess of the minimum necessary to transfer the control that creditors will decide to auction off. In a privatized bankruptcy procedure, however, creditors have an incentive to free-ride and (allocative) inefficiencies may arise (Section 6 below).

Two additional papers are of relevance for our analysis. These are Baird (1986) and Aghion, Hart, and Moore (1992). Both these paper argue that in a word without cash or credit constraints (like the one we are analyzing) auctions are an efficient bankruptcy procedure, distributional issues not withstanding. We certainly do not disagree with this point, although it should be noticed that in our setting the auction is just one of the set of indirect mechanisms that achieve the optimal allocation. The main point we make in relation to this literature is that while it is true that an auction achieves allocative efficiency, it may not necessarily achieve revenue efficiency, if, as often observed in existing bankruptcy procedures, the creditors are required to auction off the entire company. In other words modifying the procedure so as to allow the creditors to auction off only the control stake of the firm may increase creditors' revenues.

3. Revenue Efficiency

A bankruptcy procedure is revenue efficient if it maximizes the sum of all creditors' proceeds. How creditors are compensated and in what amount may be seen ex-post as a simple redistribution and therefore irrelevant from a welfare point of view. However, failing revenue efficiency may lead to inefficiencies which take the form of additional costs imposed on the borrowed funds by the creditors. Therefore, there may exist investment projects that have a positive net present value under a revenue efficient bankruptcy procedure *but* are not financed if the bankruptcy procedure in place is *not* revenue efficient.

We shall consider a firm, whose capital structure consists of common stock and straight debt, which has declared bankruptcy. The debt is owned by N creditors.[3]

Whenever a firm is insolvent different reorganization plans are available.[4] For example, the firm could be entirely sold for cash to another company, which will transform it in a subsidiary and the cash will be used to compensate the creditors. Alternatively, a consortium of banks could acquire 70 % of the shares, while 30 % of the shares may be given to some creditors as a partial compensation, the other creditors may be completely compensated with the proceedings from the sale of 70 % of the shares.

We shall assume that the new value of the firm is achieved by allocating the control stake of the firm in the hands of possibly different individuals. In other words the firm's value is specific to the individual in whose hands the control stake of the firm is. We denote V_j the value of the firm in the hands of individual j. We further assume that an individual does not need to acquire all the shares of a firm to have the control. In particular we take $0 < \underline{\alpha} < 1$ to denote the amount of shares necessary to have the control of the firm.[5]

[3]For simplicity, we are ruling out situations in which liquidity problems are the source of financial distress.

[4]For simplicity, we consider the case in which the firm is liquidated as one possible reorganization plan.

[5]We take $\underline{\alpha}$ to be exogenous in the paper, we discuss in the conclusions what is the optimal level of $\underline{\alpha}$ if the creditors are free to choose the control stake of the bankrupt firm.

Creditors may be compensated with cash and with share participation in the re-organized firm. We rule out the possibility to compensate creditors through debt claims in the re-organized firm. In what follows we show that this implies no loss in generality.

How the creditors share the returns from the re-organization of the firm is not relevant for our analysis: our result holds true whatever way the creditor choose to share the returns. The only thing that is relevant from our view point is the sum of the returns to all creditors.

4. How to Sell the Company

In this section and the next one we characterize the optimal way to allocate the control of the company. We take the company to have a different value depending on who obtains the control. Such values are private information of the potential buyers and are assumed to be independent across potential buyers. In the mechanism design jargon this case can be described as a situation of *private* values. The next section however considers the case in which whoever obtains the control of the firm can resell it to someone who could increase the company value. If in this way the original buyer could increase his payoff the resulting situation would be one of *common* rather than private values. Finally, in Section 7 we analyze the case in which the control of the firm entails private benefits from control.

All the three cases are analyzed in two stages. First we consider the full information case with two potential buyers for the bankrupt firm and assume that the mechanism to allocate control is an auction. Then we develop a general model with imperfect information where the auction is proved to be optimal. Notice, however, that the auction is only one of the optimal selling procedures which can be used. Other indirect mechanisms will implement the optimum. We will talk about an auction only because it is easier to convey the intuition in that context. What is important is that any optimal mechanism will involve the sale only of a stake of the company.

4.1. The perfect information case

Consider a situation in which there exist only two potential buyers for the insolvent firm, none of them a creditor,[6] labelled 1 and 2. Each potential buyer has a reorganization plan in mind and the firm under his control will have value V_1 and V_2, respectively. Without loss of generality, let us assume that $V_1 < V_2$. We assume that the entire valuation V_i, $i = 1, 2$, is transferable or public, that is there are no private benefits from control. We analyze the case with private benefits in Section 7 below.

If the creditors sell the entire company through an auction, the unique equilibrium of the auction is such that buyer 2 obtains the firm at the price V_1.[7] Allocative efficiency is achieved, since the value of the firm is maximized in the hands of buyer 2. However, the creditors could have obtained a higher revenue by structuring the auction differently.

Consider in fact the following procedure. Assume that only the minimum number of shares necessary to have control $\underline{\alpha}$ is auctioned off.[8] Then buyer 2 buys $\underline{\alpha}$ shares and obtains the control, paying $\underline{\alpha}V_1$. Indeed, $\underline{\alpha}V_1$ is the equilibrium bid in the auction of $\underline{\alpha}$ shares. The creditors are now left with a minority stake $(1 - \underline{\alpha})$ of a firm whose total value is V_2. The total revenue accruing to the creditors are:

$$\underline{\alpha}V_1 + (1 - \underline{\alpha})V_2 > V_1. \tag{1}$$

Notice that, unless the creditors decide to auction off only the control stake of the firm, the competition between the two buyers never leads to the equilibrium bid $[\underline{\alpha}V_1 + (1 - \underline{\alpha})V_2]$. In other words, the buyers never voluntarily bid for only a fraction

[6] This assumption is needed to simplify the analysis of the equilibrium outcome of the auction. Indeed, in the event that a potential buyer is one of the creditors there would exist incentives for him to overbid as exemplified in Burkart (1996) and Bulow, Huang, and Klemperer (1996). The result presented below still holds, however.

[7] Notice that the equilibrium described is the unique trembling hand perfect equilibrium. Indeed the auction under perfect information has a continuum of equilibria, the whole interval $[V_1, V_2]$. Moreover notice that this result holds true whether the auction is structured as a first or a second price auction.

[8] We discuss in the conclusions below the case in which $\underline{\alpha}$ is endogenized and the creditors can choose the voting structure of the control shares.

of the firm, since bidding for the entire firm maximizes the surplus appropriated by the winner, $(V_2 - V_1)$.

Of course, another way to obtain the same revenues is to auction off the entire firm with a reservation price of $\underline{\alpha}V_1 + (1-\underline{\alpha})V_2$. The possibility to auction off only the control stake of the firm is then useful to identify the highest credible reservation price. In a perfect information setting this reservation value could be even higher so this alternative interpretation is meaningful only in a setting of asymmetric information.

4.2. A General Procedure

Let us now assume that each valuation V_i is private information of buyer i but it is common knowledge that each V_i is drawn independently from the same distribution function $F(\cdot)$ over the interval $[0, \bar{V}]$, with density $f(\cdot)$. If $V = (V_j)_{j \in N}$, and $V_{-i} = (V_j)_{j \in N, j \neq i}$, we can define

$$G(V) \equiv [F(V_j)]^N$$

and

$$G_{-i}(V_{-i}) \equiv [F(V_j)]^{N-1}$$

with corresponding densities $g(V)$ and $g_{-i}(V_{-i})$.

Let us look at the selling procedure which maximizes the creditors revenue.

By the Revelation Principle, it is possible to restrict attention to the direct revelation mechanisms where the buyers simultaneously announce their valuation $\tilde{V}_i$ to the creditors and the creditors choose the mechanism $\{p_i(\tilde{V}), \alpha_i(\tilde{V}), t_i(\tilde{V})\}$, where $p_i(\tilde{V})$ is the probability that buyer i gets control; $\alpha_i(\tilde{V})$ is the proportion of shares buyer i obtains if he obtains the control and $t_i(\tilde{V})$ is the amount he has to pay. We look for a Bayesian Nash equilibrium of this mechanism in which buyers truthfully reveal their own valuations.

If the firm has value V_i under the control of buyer i, then his expected payoff when declaring $\tilde{V}_i$ is given by the value of his equity stake minus the payment to creditors:

$$U_i(V_i, \tilde{V}_i) \equiv \int_{V_{-i}} \left\{ \alpha_i(\tilde{V}_i, V_{-i}) V_i \; p_i(\tilde{V}_i, V_{-i}) - t_i(\tilde{V}_i, V_{-i}) \right\} g_{-i}(V_{-i}) dV_{-i}. \tag{2}$$

The creditors revenues are given by the total payments from the buyers plus the expected value of the minority stake remaining in their hands:

$$\int_V \left[\sum_i t_i(V) + \sum_i [1 - \alpha_i(V)] V_i \; p_i(V) \right] g(V) dV. \tag{3}$$

The creditors maximize their revenues in (3) with respect to α_i, p_i and t_i subject to several constraints. The individual rationality constraint (which guarantees that each buyer is willing to participate)

$$U_i(V_i, V_i) \geq 0, \; \forall i \in N, \; \forall V_i \in [0, \bar{V}], \tag{4}$$

the incentive compatibility constraint (which guarantees that each buyer will declare his true value V_i)

$$U_i(V_i, V_i) \geq U_i(V_i, \tilde{V}_i), \; \forall \tilde{V}_i \in [0, \bar{V}], \; \forall i \in N, \; \forall V_i \in [0, \bar{V}], \tag{5}$$

and

$$\sum_i p_i(V) \leq 1, \tag{6}$$

$$\underline{\alpha} \leq \alpha_i(V) \leq 1. \tag{7}$$

The incentive compatibility condition, constraint (5), can be rewritten as a maximization problem. The first and second order conditions of such problem are then necessary to guarantee that truth telling is optimal for all the bidders. Following Myerson (1981), we show in Appendix A1 how we can can utilize the first order conditions of (5) to transform the objective function of the creditors (3) into the following:

$$\int_V \left\{ \sum_i \left[V_i - \alpha_i \frac{1 - F(\theta_i)}{f(\theta_i)} \right] p_i(\theta) \right\} g(V) dV \tag{8}$$

Proposition 1. *If $F(V)$ has a monotonic increasing hazard rate, the optimal selling procedure is an auction where the creditors sell $\underline{\alpha}$ shares to the highest bidder.*

Proof: The objective function (8) is decreasing in α_i, therefore it is optimal to set α_i as low as possible. Once we set $\alpha_i = \underline{\alpha}$ the problem coincides with Myerson (1981)'s optimal auction problem. Hence the optimal selling procedure is an auction. Further in Appendix A1 we show that the second order conditions of the incentive compatibility problem (5) are satisfied for a constant $\alpha_i = \underline{\alpha}$. ■

Therefore, also in a general setup it is always optimal to sell the minimum possible number of shares, $\underline{\alpha}$.

5. Trading among bidders

One objection to the procedure suggested above is that the result as described relies on the fact that we do not allow the buyers to trade the (control stake of the) firm once in their hands. One might argue that if we allow the buyers to trade stakes of the firm between themselves the value of the firm would be the same for all the bidders. Therefore selling a control stake would be equivalent to selling the entire firm.[9]

In this section we show that our result holds even if we allow buyers to trade stakes of the firm among themselves. In other words it is still optimal for the creditors to retain the minority stake of the firm and to sell only the control stake. The intuition is that even if they can resell their shares, each buyer will use its own value as outside option in the bargaining stage. As a result, his private value is still relevant for his total revenue.

[9] Another way to make this objection is that it is not reasonable to assume that different bidders have different valuation for the firm, unless they hold private benefits from control.

Once again we proceed in two stages. We first prove the result in the simple two buyers perfect information case and then we generalize it to the case of imperfect information and N buyers.

5.1. Two buyers with perfect information

Consider the case in which we allow trading of the stakes of the firm among buyers. In other words assume that buyer 1, after purchasing the firm, can resell it to buyer 2. Let trading be organized in the following two periods. In the first period, the creditors of the bankrupt firm auction off either the entire firm or its control stake; while in the second period, buyers may re-trade it between each other.

We start from the second period in which the creditors trade between each other. Four observations are in order. First, independently from the number of bidders that participate in the auction this stage will take the form of a bilateral trade between the bidder who got the firm in the first period (say bidder 1) and the bidder that can maximize the ex-post value of the firm (bidder 2) — as long as these two bidders are not the same individual, of course. Secondly, if the entire firm is auctioned off in the first period it is a weakly optimal strategy for the seller to trade only the control stake of the firm $\underline{\alpha}$ and retain the minority stake for herself. Thirdly, to keep the model of the bilateral trade as simple as possible we shall assume that with probability ψ the seller (bidder 1) will make a take-it-or-leave-it offer to the buyer (bidder 2), and with the complementary probability $(1-\psi)$ the buyer will make a take-it-or-leave-it offer to the seller. Finally, notice that the highest price the buyer is willing to pay for the control stake of the firm is $\underline{\alpha}V_2$. Conversely, the lowest price the seller is willing to accept for the control stake of the firm is the one that makes him indifferent between selling the control stake of the firm or retaining it for himself at a total value of V_1. This price is therefore $\underline{\alpha}V_1$, if only the control stake of the firm is auctioned off in period one; and V, where $\underline{\alpha}V = V_1 - (1-\underline{\alpha})V_2$, if the entire firm is auctioned off in period one.[10]

[10]For simplicity we assume that $V_1 > (1-\underline{\alpha})V_2$. The whole analysis can be easily adjusted to account for the case in which the above inequality is not satisfied.

Consider first the case in which the entire firm is auctioned off in period one. The price the seller is able to obtain in period two for the control stake of the firm is:

$$\underline{\alpha}\,[\psi V_2 + (1-\psi)V] \tag{9}$$

which yields a total revenue to the seller equal to:

$$\Pi^* = (1-\underline{\alpha})V_2 + \underline{\alpha}\,[\psi V_2 + (1-\psi)V] = \psi V_2 + (1-\psi)V_1. \tag{10}$$

Equation (10) identifies the highest willingness to pay of bidder 1 in the auction in period one and, hence, the equilibrium winning bid. In other words, equation (10) specifies the total returns to the creditors when they auction off the entire firm in period one.[11]

Consider now the case in which the creditors auction off only the control stake of the firm in period one. The price the seller is able to obtain in period two is then:

$$\underline{\alpha}\,[\psi V_2 + (1-\psi)V_1] \tag{11}$$

which is the equilibrium winning bid in the auction of the control stake in period one. Hence, the total returns to the creditors are:

$$\Pi^{**} = (1-\underline{\alpha})V_2 + \underline{\alpha}\,[\psi V_2 + (1-\psi)V_1] \tag{12}$$

Clearly the returns to the creditors are greater when only the control stake of the firm is auctioned off in period one ($\Pi^{**} > \Pi^*$).

The intuition behind this result is simple. By auctioning off only a control stake of the firm the creditors can guarantee themselves a share of the future value of the firm $(1-\underline{\alpha})V_2$ that is not going to be affected by the future trade (hence, the bargaining

[11] Equation (10) shows that it does not matter whether bidder 1 trades the entire firm or only its control stake in period two. He is in fact indifferent. The reason is that the reservation value in the bargaining between the seller and the buyer of the firm at time 2 differs in these two cases so as to leave the seller with exactly the same surplus.

power) between bidders.

A separate issue concerns the case in which the bidder with the higher valuation for the firm is not present at the auction but is available only later on. This is not so unusual in the cases of bankruptcy of large firms, where it is not easy to find immediately the best possible buyers. Sometimes delays in Chapter 11 have been justified by the need to look around for the best buyer. We therefore ask whether it may be optimal for the creditors to hold on to the company, waiting for the individual in whose hands the value of the firm is highest to materialize. We show that even with no discounting, creditors are strictly better off by allocating the control stake of the firm immediately. The reason is that the bidders are able to internalize the possibility to resell the firm and at the auction stage the competition among potential buyers provides the seller with the opportunity to extract a higher surplus from them.

Assume that after the auction an individual, labelled 3, with valuation $V_3 > V_2$ will want to buy the firm and assume no discounting. Assume that this information is known to all the parties to the bankruptcy. If the creditors have not yet sold the firm when buyer 3 appears they can bargain with this buyer and their proceeds are:

$$\psi V_3 + (1 - \psi)\underline{V} \tag{13}$$

where $\underline{V}$ is the value of the firm when kept in the hands of the creditors Recall that, exactly as in (12), it does not matter in this bargaining whether the creditors sell the entire firm to buyer 3 or only the control stake.

Assume instead that the creditors auction off the control stake of the firm in the period 1 to bidders 1 and 2 and let the winner of this auction bargain with buyer 3 later on. Then the value bidder $i = 1, 2$ expects from the firm is

$$\psi V_3 + (1 - \psi)V_i \tag{14}$$

The equilibrium bid is then $[\psi V_3 + (1 - \psi)V_1]$ and the revenues from the auction are:

$$(1 - \underline{\alpha})V_3 + \underline{\alpha}[\psi V_3 + (1 - \psi)V_1] \tag{15}$$

Notice that even if $V_1 = \underline{V}$ the revenues in (15) are higher than the revenues in (13).

5.2. Imperfect Information

We now proceed to consider the case in which there is incomplete information. To simplify the analysis, let us assume that after the control of the firm is allocated, all V_is become common knowledge. In other words, there is imperfect information only during the sale of the firm. This is admittedly a strong assumption, but it allows us to focus on the issue of revelation of information when creditors sell the firm, which is really what the paper is about, and avoid issues of multiplicity of equilibria that would arise if there were imperfect information in the bargaining stage.

Assume that creditors have sold α shares to a buyer i with valuation V_i. This value could be the highest possible for the firm or there may exist an individual j whose valuation is higher than V_i. Consider the second case ($V_i < V_j$). As in the previous section, the price individual i is able to obtain from a buyer j is

$$\underline{\alpha}\,[\psi V_j + (1-\psi)V]$$

where the lowest price i is willing to accept for the sale of the control stake of the firm $\underline{\alpha}V$ is now

$$\underline{\alpha}V = V_i - (\alpha - \underline{\alpha})V_j.$$

The resulting total revenue to i is then

$$\alpha[\psi V_j + (1-\psi)V_i].$$

If instead all the potential buyers have a valuation lower than V_i the shares are not sold to anyone else.

Let us define $V_{-i}^{-} \equiv \{V_j \in (0, V_i), \forall j \neq i\}$ (that is the set of values for which V_i is

the highest value) and V_{-i}^{+} its complement. Then

$$U_i(V_i,\tilde{V}_i) \equiv \int_{V_{-i}^{-}} \Big\{ \alpha_i(\tilde{V}_i,V_{-i}) V_i \, p_i(\tilde{V}_i,V_{-i}) - t_i(\tilde{V}_i,V_{-i}) \Big\} g_{-i}(V_{-i}) dV_{-i} + \\ + \int_{V_{-i}^{+}} \Big\{ \alpha_i(\tilde{V}_i,V_{-i}) [\psi V_j + (1-\psi) V_i] \, p_i(\tilde{V}_i,V_{-i}) - t_i(\tilde{V}_i,V_{-i}) \Big\} g_{-i}(V_{-i}) dV_{-i}. \tag{16}$$

In Appendix A2 we show once again how we can use the first order conditions of the incentive compatibility constraint to transform the objective function of the creditors (8) into:

$$\int_0^{\bar{V}} \Big\{ \int_{V_{-i}^{-}} \sum_i \left[V_i - \alpha_i \frac{1-F(\theta_i)}{f(\theta_i)} \right] p_i(\theta) dG_{-i}(V_{-i}) + \\ + (1-\psi) \int_{V_{-i}^{+}} \sum_i \left[V_i - \alpha_i \frac{1-F(\theta_i)}{f(\theta_i)} \right] p_i(\theta) dG_{-i}(V_{-i} \Big\} dF(V_i) \tag{17}$$

The intuition of this expression is quite simple and it is the same one that applies in the case of perfect information: even when the willingness of a bidder is affected by the option to resale, a higher V_i allows the buyer to extract a higher payment, in proportion $(1-\psi)$. We now have all the elements to prove that once again auctioning off the minimum stake that transfers control $\underline{\alpha}$ is optimal.

Proposition 2. *If $F(V)$ has a monotonic increasing hazard rate, the optimal selling procedure when bidders can trade their shares of the company after these shares are allocated is an auction where the creditors sell $\underline{\alpha}$ shares to the highest bidder.*

PROOF: The objective function in (17) is monotonic decreasing in α_i. It is therefore optimal to minimize α_i. Moreover, a constant $\alpha_i(V) = \underline{\alpha}$ satisfies the second order conditions of the incentive compatibility constraint as in the case of Proposition 1. ■

6. The Suggested Procedure and the Privatization of Bankruptcy

The revenue efficient procedure that we propose in this paper is therefore characterized by the option left with the creditors to sell less than 100% of the shares of the

bankrupt firm. This can be achieved in a number of ways.

One way to proceed would be for example to transform the bankrupt firm in a all equity firm. Then allocate the shares of this new firm to the creditors following whatever procedure is most suitable for the creditors. In particular the creditors might want to follow absolute priority rule using for example the Bebchuk (1988)'s procedure or might decide not to follow absolute priority rule. The main point of this paper is completely independent of the distribution of shares. Once this is done the creditors are required to sell $\underline{\alpha}$ % of their share so as to transfer the control to the buyer with the highest valuation and retain the $(1-\underline{\alpha})$ % of their shares.

Alternatively the same procedure could be implemented by selling $\underline{\alpha}$ % of the shares and distributing, following whatever criterion is preferred by the creditors, both the monetary revenues from the sale and the residual percentage $(1-\underline{\alpha})$ % of shares. Either way the final result would be identical.

One possible objection to this proposal could be why discipline the way in which the creditors decide to sell only the $\underline{\alpha}$% of shares. Why not transform the company in an all equity one, allocate the shares of the new company following whatever priority is chosen by the creditors and let the creditors, now shareholders, decide what to do with the firm? In other words why not privatize the bankruptcy procedure, in the sense of clearly defining the ownership rights of creditors on the firm and let them decide what to do with the firm? In what follows we show that although there always exists in this privatized procedure an equilibrium that coincides with the procedure we propose there also exist other, possibly inefficient, equilibria. Hence disciplining the way the creditors proceed in allocating the bankrupt firm is a way to select the efficient equilibria of the tendering game in which the creditors will be involved.

Assume that each creditor i is allocated s_i shares and that creditors have to decide whether to sell an amount $\overline{s}_i$ of their shares, $\overline{s}_i \leq s_i$. To keep the treatment as simple as possible we shall assume that the creditors only decision is whether to sell or not the amount $\overline{s}_i$ of shares. In other words, we abstract now from the choice of the optimal mechanism to allocate this shares to the most efficient buyer (the one with value V_2), which is what we studied in previous sections.

We assume that the decision is taken by each creditor simultaneously and independently. We denote p the per share price paid by buyer 2. We take $V_1/S \leq p < V_2/S$ where $S = \sum_i s_i$. Clearly a creditor can always decide to sell the remaining shares in his hands $(s_i - \overline{s}_i)$ immediately after the control of the company is transferred in the hands of buyer 2 at the per share market price (V_2/S).

The game we just described has a whole set of equilibria. In particular in the case in which $s_i < \underline{\alpha}$ for any $i = 1, \ldots, N$, there always exists an equilibrium in which each creditor tenders zero shares, since he expects the other creditors to tender zero shares as well. In other words, $\overline{s}_i = 0$ for every $i = 1, \ldots, N$, is always an equilibrium of this tendering game. This equilibrium is clearly inefficient. Indeed the firm has value $\underline{V}$ in the hands of the creditors while it has value V_2 in the hands of buyer 2. The problem is the coordination mechanism between the creditors.[12]

It should be noticed, however, that there also exists an equilibrium which reproduces exactly the allocation of shares that we described as the outcome of our suggested procedure. Indeed if creditor i believes that the other creditors will sell exactly the percentage of shares $(\underline{\alpha} - \pi)$ %, where $\pi \leq (s_i/S)$, then creditor i will feel pivotal. It is therefore a best reply for creditor i to tender an amount of shares πS. The result is that the control is transferred to buyer 2, the firm value is V_2 and the total revenue obtained by the creditors is $[\underline{\alpha}\, p\, S + (1 - \underline{\alpha})V_2]$. This equilibrium is therefore not only allocatively efficient but also revenue efficient. Indeed, in the event that $p = (V_1/S)$ the creditors' revenue coincide with the one in (1).

Clearly this implies that the outcome of the tendering game might be efficient but might also be inefficient.

Disciplining the procedure the creditors are supposed to use in one of the ways suggested above solves the coordination problem leading to the inefficient outcome. In other words it isolates as the unique outcome the allocative and revenue efficient one.

Clearly this point is relevant only if one considers the coordination problem a

[12]The logic is exactly the same of Grossman and Hart (1980) and Shleifer and Vishny (1986).

serious one. In any event having a selection device such as the one we propose cannot harm the outcome in any possible way.

7. Private Benefits from Control

This section analyzes an environment in which the potential buyers of the firm derive private benefits from control. In this case we need to distinguish between the transferable or public benefits that the firm produces when in the hand of bidder j, V_j, and the additional non-transferable or private benefits B_j that accrue only to bidder j from controlling the firm. We maintain our assumption that the firm in the hands of different potential buyers produces different public benefits as well as different private benefits.

In this setting it might still be optimal for the creditors not to sell the entire firm. However this result critically depends on whether the public and the private benefits are positive or negatively correlated among the bidders. In what follows therefore we distinguish between the case of positive correlation and the case of negative correlation.

Once again in presenting our result we draw a distinction between the analysis of the case in which both private and public benefits are perfectly known and the case in which private and public benefits are privately known.

7.1. Positive Correlation

Consider the case in which there is perfect information on the public and private benefits of the two potential buyers for the firm. Further, assume that the public benefits V_1 and V_2 are positively correlated with the private benefits B_1 and B_2:

$$V_1 < V_2 \qquad \text{and} \qquad B_1 < B_2. \tag{18}$$

This means that a buyer who is more efficient at maximizing the public value of the company is also more able to extract private benefits from control. In this case, if the

entire firm is auctioned off, the price that buyer 2 pays in equilibrium for the firm is:

$$V_1 + B_1 \tag{19}$$

Suppose that, instead, only the control stake $\underline{\alpha}$ is auctioned off. The equilibrium price of the auction of $\underline{\alpha}$ shares is: $[\underline{\alpha}V_1 + B_1]$. Indeed this is the maximum willingness to pay of buyer 1 for the control stake of the firm. The total revenue accruing to the creditors is therefore:

$$\underline{\alpha}V_1 + (1 - \underline{\alpha})V_2 + B_1 \tag{20}$$

Clearly the revenues in (20) exceed the revenues in (19). It is therefore optimal to auction off the minimum control stake of the firm. When there is positive correlation, there is no potential conflict between public and private benefits, so the only relevant issue is how to extract as much surplus as possible from the winner of the auction and in this case the same effect of the previous sections still applies.

7.2. Negative Correlation

Consider now the more difficult case in which the public benefits V_1 and V_2 and the private benefits B_1 and B_2 are negatively correlated:

$$V_1 < V_2 \qquad \text{and} \qquad B_1 > B_2. \tag{21}$$

In this case it is not always true that it is never optimal for the creditors to sell the entire firm. In particular we can distinguish the following three cases.

Case 1. This case is characterized by the following inequality:

$$\underline{\alpha}V_2 + B_2 > \underline{\alpha}V_1 + B_1. \tag{22}$$

This means that although buyer 1 is better at extracting private benefits, these are not very high. Inequality (22) implies that

$$V_2 + B_2 > V_1 + B_1. \tag{23}$$

Allocative efficiency implies therefore that the control is given to buyer 2. These conditions imply that buyer 2 will obtain the control stake whether the entire firm or only the fraction $\underline{\alpha}$ is sold. The result is that if the entire firm is auctioned off the creditors' returns $V_1 + B_1$ are clearly strictly smaller than the creditors' returns if only the minimum control stake of the firm is auctioned off: $\underline{\alpha}V_1 + (1 - \underline{\alpha})V_2 + B_1$. Therefore it is allocative as well as revenue efficient to sell only the minimum control stake of the firm.

This is the case in which private benefits of control are not high enough to make a lot of difference, so the effect identified in the absence of private benefits dominates.

Case 2. This case is characterized by the following pair of inequalities:

$$\underline{\alpha}V_2 + B_2 < \underline{\alpha}V_1 + B_1 \tag{24}$$

and

$$V_2 + B_2 > V_1 + B_1. \tag{25}$$

This is therefore a case in which the difference in private benefits is quite high, so that if only $\underline{\alpha}$ is auctioned off, the control is not allocated efficiently: buyer 1 obtains it, instead of buyer 2. However (24) and (25) imply that there exists a percentage of shares μ, $\underline{\alpha} < \mu < 1$, such that:

$$\mu V_2 + B_2 = \mu V_1 + B_1. \tag{26}$$

We now argue that it is optimal for the creditors to auction off μ shares of the firm rather than the entire firm. Indeed, from (26), μ is the minimum amount of shares

needed for bidder 2 to obtain the control of the firm. The creditors' returns will then be

$$\mu V_1 + B_1 + (1-\mu)V_2 = V_2 + B_2$$

which are clearly higher than the creditors' returns if the entire firm is auctioned off: $V_1 + B_1$. It is worth noticing that in this case the creditors extract the entire surplus from the winning bidder by auctioning off a percentage of the shares of the firm that is strictly bigger than the minimum control stake $\underline{\alpha}$ but strictly smaller than 100 %. This approach is once again both allocative and revenue efficient.

In this case, our result is still true, even in the presence of a conflict between private and public benefits from control. It is still true that it is optimal to sell as few shares as possible, but μ is the minimum stake possible, compatible with selling the company to the person which is going to maximize its value.

Case 3. This last case is characterized by a high difference in private benefits of control and the following inequality holds:

$$V_2 + B_2 \leq V_1 + B_1. \tag{27}$$

First notice that condition (27) implies that if the entire firm is auctioned off bidder 1 obtains the firm. This is indeed allocative efficient in this case. The creditors' returns in the latter case are:

$$V_2 + B_2. \tag{28}$$

However given that by assumption $V_2 > V_1$ if the creditors decide to auction off a percentage of the shares γ which is sufficient to transfer the control, $\gamma \geq \underline{\alpha}$ but strictly smaller than 100%, $\gamma < 1$, the creditors' returns are

$$\gamma V_2 + (1-\gamma)V_1 + B_2. \tag{29}$$

The return in (28) are clearly higher than the returns in (29). In other words this is the only case in our analysis in which it is strictly optimal for the creditors to auction off the entire firm. This is because in this case benefits of control are very high, so that extracting these benefits is the best the creditor can do.

We now move to the case in which private as well as public benefits are private information of the N potential buyers.

7.3. Imperfect information

For ease of exposition we restrict our analysis of the optimal share of the company to be sold in the presence of private benefits from control and imperfect information to the case in which there exist a linear relationship between private benefits from control and public or transferable values of the company:[13]

$$B_i = \bar{B} + \beta V_i \tag{30}$$

If $\beta > 0$ we are in a case with positive correlation. If instead $\beta < 0$ we have negative correlation. Then a buyer i who obtains $\alpha_i \geq \underline{\alpha}$ shares will have a payoff

$$\alpha_i V_i + B_i = \bar{B} + (\alpha_i + \beta) V_i \tag{31}$$

The problem is therefore as in Section 4.2, with the only difference that now equation (2) becomes

$$U_i(V_i, \tilde{V}_i) \equiv \int_{V_{-i}} \left\{ \bar{B} + \left[\alpha_i \left(\tilde{V}_i, V_{-i} \right) + \beta \right] V_i \; p_i(\tilde{V}_i, V_{-i}) - t_i(\tilde{V}_i, V_{-i}) \right\} g_{-i}(V_{-i}) dV_{-i}. \tag{32}$$

Following the same steps as in Appendix A1, the objective function can therefore

[13] Cf. Cornelli and Li (1997). This assumption allows us to analyze the problem without addressing the issue of the multi-dimensionality of the adverse selection faced by the creditors in this setting.

be transformed into:

$$\int_V \left\{ \sum_i \left[(1+\beta)V_i - (\alpha_i + \beta)\frac{1-F(\theta_i)}{f(\theta_i)} \right] p_i(\theta) \right\} g(V)dV \tag{33}$$

Proposition 3. *Assume $F(V)$ has a monotonic increasing hazard rate. The optimal selling procedure depends on the value of β.*

A) If $-\beta < \underline{\alpha}$ then it is optimal to use an auction where the creditors sell $\underline{\alpha}$ shares to the highest bidder.

B) If $-\beta > \underline{\alpha}$ then it is optimal for the creditors to auction off α, where α is equal either to $\underline{\alpha}$ or to β.

PROOF: In Case A) the objective function in (33) is monotonic decreasing in α_i. It is therefore optimal to minimize α_i. In Case B) the objective function is monotonic increasing in α_i provided that $\alpha_i \leq -\beta$. Therefore it is optimal to choose the highest α_i compatible with $\alpha_i \leq -\beta$ if the choice is to allocate the firm to the bidder that announces the highest V_i. Alternatively, it is optimal to choose the lowest $\alpha_i = \underline{\alpha}$ provided that the choice is to allocate the firm to the bidder that announces the lowest V_i. In either case the second order conditions are satisfied for a constant α_i. ■

Case A) covers all cases with positive correlation ($\beta > 0$) and cases where $\beta < 0$ but is not too high in absolute value. This is the case where there is no trade-off between public and private values (positive correlation) or the trade-off is not very acute (Case 1 of the previous section): therefore the presence of private benefits of control does not affect the choice of the optimal stake of the company to auction off and it is still optimal to sell $\underline{\alpha}$ shares.

Conversely, in Case B), when $-\beta > \underline{\alpha}$, it is still true that creditors want to sell the minimum possible stake, but if they sell only $\underline{\alpha}$ shares they are going to attract the buyer with the lowest public value V_i. If they want to sell to the buyer with the highest V_i they have to sell at least β shares. Depending on the overall surplus they can capture (that is depending on the value of β and on the distribution $F(V)$) they

will opt for either alternative. The intuition is simply that increasing α is costly. Therefore the creditors will do it only if it will enable them to end up with a more remunerative buyer.[14]

When the trade-off between public and private benefits is linear, the equivalent of Case 3 of the perfect information analysis never arises and therefore in this case it is never optimal to sell the entire firm.

8. Concluding Remarks

In this paper we argued that a relevant criterion that should be taken into account in judging the quality of a bankruptcy procedure is revenue efficiency: the maximization of the creditor's returns from the procedure. We proceed to show that at this purpose a bankruptcy procedure should leave the creditors free to separate the voting rights of the firm from the cash flow rights. In particular in the absence of private benefits from control they should auction off the majority of the voting rights retaining as much as possible of the cash flow rights. When private benefits are present it is not optimal any more to separate completely voting and cash flow rights although creditors might still gain by retaining part of the cash flow rights of the company.

The result is interesting, as we argued in the Introduction, to interpret some features of observed bankruptcy cases. Moreover it can be used to compare existing bankruptcy procedures. Consider for example Chapter 11 (the standard US restructuring procedure) and Receivership (the standard UK procedure). In view of our analysis it could be argued that Chapter 11 might lead to an allocation of revenues that coincides with the one suggested in this paper. It should be said however that an issue that needs attention is whether the open bargaining among creditors could generate also inefficiencies due to the incentive of every creditor to free-ride on others in line of our analysis of Section 6 above. In other words Chapter 11 might lead to

[14] Cornelli and Li (1997) show in a different context that the seller (in this case the creditors) could actually do even better by not committing to a given number of shares to be sold, but by making α contingent on the bids.

inefficiencies that take the form of inefficient transfers that are not made (as for the equal opportunity rule for transfers of control in Bebchuk (1994)).

The UK Receivership on the other hand would put all the decision power in the hand of the creditor that owns the floating charge (Webb 1991). This might lead to inefficiencies that take the form of efficient transfers that would not be made since the benefits of creditors without the floating charge would not be taken into account when deciding on the transfer (as for the market rule in Bebchuk (1994)).

Therefore revenue efficiency would require a structured procedure that requires the creditors to explicitly allocate the voting rights of the company without bundling them together with the cash flow rights as suggested in Section 6 above.

An additional issue that we did not address in our analysis is how the minimum stake of the company $\underline{\alpha}$ necessary to transfer control could be endogenized. In the absence of private benefits from control clearly it is in the creditors' interests to minimize such stake, for example by auctioning off a minimal number of shares with all the voting rights. This is certainly not the case in the presence of private benefits from control, however this interest of the creditors may lead in general to a violation of the one-share-one vote principle at the restructuring stage of a bankruptcy (Grossman and Hart 1988).

Appendix

A.1. Derivation of the first and second order condition.

The incentive compatibility constraint (5) can be expressed as $V_i = \arg\max_{\tilde{V}_i} U_i(V_i, \tilde{V}_i)$. Assuming differentiability, by envelope theorem

$$\frac{dU_i}{dV_i}(V_i, V_i) = \int_{V_{-i}} \alpha_i(V_i, V_{-i}) p_i(V_i, V_{-i}) g_{-i}(V_{-i}) dV_{-i}. \tag{A.1}$$

Re-integrating it, we get:

$$U_i(V_i, V_i) = \int_0^{V_i} \int_{V_{-i}} \alpha_i(x, V_{-i}) p_i(x, V_{-i}) g_{-i}(V_{-i}) dV_{-i} dx + U_i(0, 0). \tag{A.2}$$

Comparing the expression for $U_i(V_i, V_i)$ in (A.2) and its definition in (2), solving for t_i, we obtain:

$$\begin{aligned}\int_V t_i(V)g(V)dV = \int_V \alpha_i(V)V_i p_i(V)g(V)dV - U_i(0,0)+ \\ - \int_{V_{-i}} g_{-i}(V_{-i}) \int_0^{\bar{V}} g_i(V_i) \int_0^{V_i} \alpha_i(x, V_{-i})p_i(x, V_{-i})dx dV_i dV_{-i}.\end{aligned} \tag{A.3}$$

Integrating by parts, the above expression can be transformed into:

$$\int_V t_i(V)g(V)d \ = \int_V \left\{\alpha_i(V)V_i - \alpha_i(V)\frac{1-F_i(V_i)}{f_i(V_i)}\right\}p_i(V)g(V)dV - U_i(0,0). \tag{A.4}$$

Substituting (A.4) into (3) we obtain equation (8).

The second order condition for the maximization is: $\frac{\partial^2 U_i(V_i,\tilde{V}_i)}{\partial \tilde{V}_i^{\,2}} \mid_{\tilde{V}_i=V_i} \leq 0$. Recall the first order condition: $\frac{\partial U_i(V_i,\tilde{V}_i)}{\partial \tilde{V}_i} \mid_{\tilde{V}_i=V_i} \equiv 0$. Differentiating this first order condition on both sides with respect to $\tilde{V}_i$, we have

$$\frac{\partial^2 U_i(V_i,\tilde{V}_i)}{\partial V_i \partial \tilde{V}_i} \mid_{\tilde{V}_i=V_i} + \frac{\partial^2 U_i(V_i,\tilde{V}_i)}{\partial \tilde{V}_i^{\,2}} \mid_{\tilde{V}_i=V_i} = 0.$$

Therefore, the second order condition is satisfied if: $\frac{\partial^2 U_i(V_i,\tilde{V}_i)}{\partial V_i \partial \tilde{V}_i} \mid_{\tilde{V}_i=V_i} \geq 0$, which can be rewritten as

$$\int_{V_{-i}} \left\{\frac{\partial \alpha_i(V)}{\partial V_i}p_i(V) + \alpha_i(V)\frac{\partial p_i(V)}{\partial V_i}\right\} g_{-i}(V_{-i})dV_{-i} \geq 0, \quad \forall i \in N, \ \forall V_i \in [0, \bar{V}] \tag{A.5}$$

Notice that this second order condition is simply a more complex version of the normal monotonicity condition in conventional auction designs.

A.2. Derivation of the first and second order condition with trading

Proceeding as in the case before, by envelope theorem

$$\begin{aligned}\frac{dU_i}{dV_i}(V_i, V_i) = \int_{V_{-i}^-} \alpha_i(V_i, V_{-i})p_i(V_i, V_{-i})g_{-i}(V_{-i})dV_{-i}+ \\ + (1-\psi)\int_{V_{-i}^+} \alpha_i(V_i, V_{-i})p_i(V_i, V_{-i})g_{-i}(V_{-i})dV_{-i}.\end{aligned} \tag{A.6}$$

(the effects of a change of V_i on the extremes of integration compensate each other). Re-integrating it, we get:

$$U_i(V_i,V_i) = U_i(0,0) + + \int_0^{V_i} \Big\{ \int_{V_{-i}^-} \alpha_i(x,V_{-i}) p_i(x,V_{-i}) g_{-i}(V_{-i}) dV_{-i} + \\ + (1-\psi) \int_{V_{-i}^+} \alpha_i(x,V_{-i}) p_i(x,V_{-i}) g_{-i}(V_{-i}) dV_{-i} \Big\} dx. \tag{A.7}$$

We can set $U_i(0,0) = 0$ using the individual rationality constraint. Then, comparing the expression for $U_i(V_i,V_i)$ in (A.7) and its definition in (16), solving for t_i, we obtain:

$$\begin{aligned} \int_V t_i(V) g(V) dV = & \int_0^{\bar{V}} \Big\{ \int_{V_{-i}^-} \alpha_i(V) V_i p_i(V_{-i}) g(V_{-i}) dV_{-i} + \\ & + \int_{V_{-i}^+} \alpha_i(V)(1-\psi) p_i(V_{-i}) g(V_{-i}) dV_{-i} \Big\} f(V_i) dV_i + \\ + \int_0^{\bar{V}} & \Big\{ \int_{V_{-i}^-} \int_0^{V_i} \alpha_i(x,V_{-i}) p_i(x,V_{-i}) g_{-i}(V_{-i}) dx dV_{-i} + \\ & + \int_{V_{-i}^+} \int_0^{V_i} \alpha_i(x,V_{-i})(1-\psi) p_i(x,V_{-i}) g_{-i}(V_{-i}) dV_{-i} \Big\} f(V_i) dV_i. \end{aligned} \tag{A.8}$$

Integrating by parts, the above expression can be transformed into:

$$\int_V t_i(V) g(V) dV = \int_0^{\bar{V}} \Big\{ \int_{V_{-i}^-} \alpha_i(V) \left[V_i - \frac{1-F(V_i)}{f(V_i)} \right] p_i(V) dG_{-i}(V_{-i}) + \\ + (1-\psi) \int_{V_{-i}^+} \alpha_i(V) \left[V_i - \frac{1-F(V_i)}{f(V_i)} \right] p_i(V) dG_{-i}(V_{-i}) \Big\} dF(V_i). \tag{A.9}$$

Substituting (A.9) into (3) we obtain equation (17).

References

Aghion, P., and P. Bolton (1992): "An Incomplete Contracts Approach to Financial Contracting," *Review of Economic Studies*, 59, 473–94.

Aghion, P., O. Hart, and J. Moore (1992): "The Economics of Bankruptcy Reform," *Journal of Law, Economics and Organization*, 8, 523–46.

Baird, D. (1986): "The Uneasy Case for Corporate Reorganization," *Journal of Legal Studies*, 15, 127–47.

Bebchuk, L. (1988): "A New Approach to Corporate Reorganization," *Harvard Law Review*, 101, 775–804.

Bebchuk, L. (1994): "Efficient and Inefficient Sales of Corporate Control," *Quarterly Journal of Economics*, 109, 957–93.

Bebchuk, L., and H. Chang (1992): "Bargaining and the Division of Value in Corporate Reorganization," *Journal of Law, Economics and Organization*, 8, 253–79.

Berkovitch, E., R. Israel, and J. Zender (1993): "The Design of Bankruptcy Law: A Case for Management Bias in Bankruptcy Reorganization," Discussion paper.

Bolton, P., and D. Scharfstein (1996): "Optimal Debt Structure and the Number of Creditors," *Journal of Political Economy*, 104, 1–25.

Bulow, J., M. Huang, and P. Klemperer (1996): "Toeholds and Takeovers," Discussion paper.

Burkart, M. (1996): "Initial Shareholdings and Overbidding in Takeover Contests," *Journal of Finance*, forthcoming.

Cornelli, F., and D. Li (1997): "Large Shareholders, Private Benefits of Control, and Optimal Schemes of Privatization," *Rand Journal of Economics*, 28, 585–604.

Franks, J. R., and W. N. Torous (1989): "An Empirical Investigation of U.S. Firms in Chapter 11 Reorganization," *Journal of Finance*, 44, 747–67.

Gilson, S. C. (1990): "Bankruptcy, Boards, Banks, and Blockholders: Evidence on Changes in Corporate Ownership and Control When Firms Default," *Journal of Financial Economics*, 27, 355–87.

Grossman, S., and O. Hart (1988): "One Share One Vote and the Market for Corporate-Control," *Journal of Financial Economics*, 20, 175–202.

Myerson, R. (1981): "Optimal Auction Design," *Mathematics of Operation Research*, 6, 58–73.

Riley, J. G. (1988): "Ex Post Information in Auctions," *Review of Economic Studies*, 55, 409–30.

Webb, D. (1991): "An Economic Evaluation of Insolvency Procedures in the United Kingdom: Does the 1986 Insolvency Act Satisfy the Creditors' Bargain?," *Oxford Economic Papers*, 43, 139–57.

Zingales, L. (1995): "Insider Ownership and the Decision to Go Public," *Review of Economic Studies*, 62, 425–48.