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Publication date:
2000

University
of
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Dundee Discussion Papers in Economics

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Working Paper
No. 111
December 2000
ISSN:1473-236X

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* I would like to thank Mono Chatterji, John Moore and Arthur Raviv.
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Abstract

We consider a case of security design, where the optimal contract depends on the nature of the future renegotiations game. It is shown that giving the bargaining power to the debtor in the renegotiations game may not always work in his interest.

Key Words: Debt, renegotiations, bargaining power

JEL Classification No: G33, C70

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I Introduction:

Recent work on security design[1] has shown that the nature of the optimal financial contract depends crucially on (among other things) renegotiations possibilities and the allocation of bargaining power between the debtor and the creditor. In this context, different types of debt contracts have received attention partly because of their simplicity and frequent use. A simple debt contract will normally specify a loan amount which the debtor receives at the beginning to finance some project and repayment amount (s) which the debtor has to pay back at some specified future date. The debt contract will also specify the creditor's liquidation rights, the amount of assets, which the creditor can liquidate if the debtor failed to meet the payment obligation. Two common features of the economic environment make the study of debt contracts interesting. First, project returns are stochastic and for some realizations debtor would not be able to meet the repayment obligation. Second, liquidation is generally inefficient. The project would fetch higher returns to the debtor in future than what the creditor could get by liquidating it. Hence there is always the possibility of renegotiations at the repayment date. As is well known, the outcome of the renegotiations and hence the initial contract between the two parties would be sensitive to the distribution of the bargaining powers.

Suppose the debtor has all the bargaining power at the renegotiations stage. Such a debt contract will be called a debtor-favored contract. It would appear that this possibly could not harm the interest of the debtor. After all, loosely speaking , the debtor is not at the mercy of the creditor. Of course, it has been noted that, in some cases this might dissuade the creditor from extending any loan in the first place. Given that the debtor could exploit his bargaining power in the renegotiations game, the creditor might not achieve the minimum expected returns thus rendering the debt contract infeasible[2]. But within the class of feasible debt contract, is it likely that the debtor is worse off with his bargaining power? The answer is yes. The aim of this note is to show that under certain conditions a debtor is better off when the creditor has all the bargaining power in the renegotiations game.

Section II contains the basic model and the concepts. The main result and discussions are in section III. Section IV concludes.

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[1] See Allen and Winton (95) for a survey.

[2] See Harris and Raviv (95) for more on this and an example of debtor-favored contract performing better than the creditor-favored contract.

II The Model:

The basic model follows Harris & Raviv (95), and Hart & Moore (98). The debtor (entrepreneur) needs a loan from the creditor (investor) to finance a project costing K in date 0. The debtor has no initial capital. The project, lasting only two periods, leads to some verifiable assets and non-verifiable returns at different future dates t = 1,2.. The returns depend on non-verifiable state of nature s which is revealed at date 1. The state s completely determines the date 1 and date 2 returns. In addition, the liquidation value of the assets also depend on the state. We assume that there are only two states, s = 1,2. For simplicity the states occur with probability ½. Let R_{ts} denote the date t returns in state s, t = 1,2 and s = 1,2. Similarly L_s refer to the liquidation value of assets at date 1(asset has no value at date 2) in state s. We assume that assets are divisible so that any fraction δ can be liquidated. If a fraction δ of the assets were to be liquidated date 2 returns would be simply $(1-\delta)R_{2s}$. We make the following assumptions to focus on the interesting cases.

A1: $L_1/ 2 + L_2/2 \geq K$

A2: $1< R_{21}/L_1 < R_{22}/L_2$ denote $R_{2s}/L_s = \alpha_s$

A3: $L_1> L_2$, $R_{11} \geq R_{12}$

As we shall see, A1 guarantees that debt contracts are feasible even when the debtor has all the bargaining power. A3 implies that the project returns are higher when the liquidation value is high and the long-term returns of the project are higher than the short-term returns. A2 implies the costly nature of liquidation. One can consider other cases as well, but we would like to focus on cases where inefficient liquidation is a serious problem. Hence the state where the liquidation value and first period returns are low also happens to be the state where liquidation is more costly.

A debt contract specifies a loan N , repayment amount P and the creditor's liquidation rights following a default. Given our earlier assumption of non verifiable returns and states, P is not conditional on either. As the debtor has no initial wealth, the total amount borrowed by him is N = K + T, where T is some transfer over and above the project cost. Following the literature we can restrict attention to T only. After the state is realized, the debtor can repay P or can default. Once the debtor has defaulted, the creditor has total control over the assets and can liquidate any amount. However, following default, the debtor and the creditor can renegotiate the payment to be made by the debtor and the fraction of assets the creditor would liquidate. Let C_s and δ_s denote the actual payment made by the debtor and the fraction of the assets liquidated. Given the renegotiations possibilities, C and δ need not equal P and 1. Such renegotiations would make sense since $\alpha > 1$. A debtor-favored debt contract (denoted as DF) means the debtor has all the bargaining power in the renegotiations game. This is captured by allowing the debtor to make an offer, which the creditor can accept or reject. If accepted, the offer is implemented. Upon rejection the creditor has control over the assets and chooses to liquidate any amount. Likewise, a creditor favored debt contract (CF) gives all the bargaining power to the creditor. We allow for the possibility that the debtor can liquidate part of the assets on his own to meet the repayment obligation. Lastly, let M be the expected receipt of the creditor. Assuming market interest rate to be zero, the creditor is willing to lend N only if $M \geq N$.

In what follows we shall consider the case where the debtor is cash constrained in state 2 or $R_{12} < L_2$. That leaves two possibilities in the other state, either $R_{11} \geq L_1$ or $R_{11} < L_1$. The analysis is broadly similar in either cases but the details are somewhat different. We restrict attention to the case with $R_{11} \geq L_1$. Moreover we consider a special case of A1 and assume that

$A1^{/}$: $L_1/ 2 + L_2/2 = K$

Finding an optimal contract then boils down to choosing T and P to minimize the following expected cost.

(1) $E(c) = ½[C_1 + \delta_1 R_{21}] + ½[C_2 + \delta_2 R_{22}]$

E(c) refers to the expected cost to the debtor. Note that this cost also includes the amount of period 2 income forgone due to liquidation in period 1. There will be a series of constraints, which the optimal choice of T and P would have to also satisfy. We shall introduce these as we discuss the different contracts.

Debtor-favored Debt (DF): Since the debtor has the bargaining power, he would default whenever $P > L_s$. After defaulting he will simply offer L_s to the creditor who will accept. Hence,

(2) $C_s \leq L_s$

So the maximum that the creditor can hope to get in each state is simply L_s.

(3) $M \leq L_1/ 2 + L_2/2$

For the creditor to advance any loan, his participation constraint must be satisfied as well.

(4) $M \geq K+T$

Finding the optimal DF contract boils down to minimizing (1) subject to the above constraints. Given $A1^{/}$, it can be seen that T = 0. Since $R_{11} \geq L_1$, $\delta_1 = 0$ and $\delta_2 = (L_2 – R_{12})/L_2$.

Creditor-favored Debt (CF): Now the creditor has the bargaining power. In the event of a default, the creditor can extract as much cash as possible in exchange for parts or the whole of the asset. Since the assets are more valuable to the debtor than the creditor, such trading will always take place. Moreover the extent of liquidation will be limited by the amount of cash being held by the debtor. For any state s,

$$C_s \leq (1-\delta_s)R_{2s}$$

According to our assumption, there will always be default in state 2. Moreover, depending on the optimal transfer T* we can have either $\delta_1 > 0$ or $\delta_1 = 0$. The latter is the case when $R_{11}+T^* > R_{21}$. We first deal with the case where $R_{11}+T^* < R_{21}$ and discuss the other case later.

Case 1: $R_{11}+T^* < R_{21}$. Finding the optimal CF contract boils down to minimizing (1) subject to the following constraints.

(6) $[R_{11} + T + \delta_1 L_1]/2 + [R_{12} + T + \delta_2 L_2]/2 \geq K + T$ (creditor's participation constraint)

(7) $R_{11} + T + \delta_1 R_{21} \leq R_{21}$

(8) $R_{12} + T + \delta_2 R_{22} \leq R_{22}$

The last two constraints ensure that the debtor is willing to transfer all available cash to save on liquidation in both states. These two will put upper bounds on the amount of liquidation that the creditor can ask for, in addition to the available cash. Since liquidation is always inefficient, the optimal contract will minimize the amount of liquidation. Since the debtor is cash constrained in state 2 and always defaults, δ_2 can be lowered by raising T. Moreover, repayment can be made higher in state 1 by allowing for some liquidation in that state , as liquidation is costlier in state2. Hence constraint 2 will be always binding. Likewise creditor's participation constraint is also binding, as one can always raise T or lower state 1 payments. Given these two, minimizing δ_2 will be equivalent to maximizing T. The third constraint will also be binding as the creditor will try to liquidate as much as possible. The optimal T as a result can be found to be

(9) $T^* = [R_{11}(\alpha_1-1)\alpha_2 + R_{12}(\alpha_2-1)\alpha_1]/ (\alpha_1+\alpha_2)$

Once we know the optimal transfer, one can easily find the optimal P and consequent liquidation amounts δ_s.

Case 2: In this case, there is no liquidation in state 1. Here the constraints (6-8) will replaced by the following

(6′) $[P]/2 + [R_{12} + T + \delta_2 L_2]/2 \geq K + T$

(7′) $P \leq R_{21}$

(8) $R_{12} + T + \delta_2 R_{22} \leq R_{22}$

At the optimum, $P = R_{21}$, because by increasing payment in state 1 one can reduce liquidation in state 2. One can proceed as before to find the optimal T in this case . It can be shown that

(10) $T^* = [\alpha_2 (R_{21} - L_1)+ R_{12} (\alpha_2 -1)]/ [\alpha_2 - 1]$

The optimal contract will have $T = T^*$, $P = R_{21}$.

III Comparison of CF and DF contracts:

The analysis of the previous section can be used to compare the two types of debt contracts. A contract will be considered better if it leads to lower expected cost E(c). The following examples illustrate how the optimal contracts are arrived at and would facilitate their comparison.

Example 1: Let $R_{11} = 100$. $R_{12} = 40$, $R_{21} = 200$, $R_{22} = 240$, $L_1 = 100$, $L_2 = 60$ and $K = 80$.

DF Contract: Clearly $T^* = 0$. Moreover $P \geq 100$, as any P less than 100 would mean the creditor's participation constraint will be violated. Hence at the optimum $T^* = 0$, $P^* = 100$. Given T and P, it can be checked that $C_1 = 100$ and $C_2 = 40$ and $\delta_2 = (60\text{-}40)/60 = 1/3$. There is no liquidation in state 1. The expected cost to the debtor is given by

$$E^{df}(c) = ½[100] + ½[40 + 240/3] = 110.$$

CF Contract: Before we find the optimal contract, it can be shown that a CF contract can not achieve a lower liquidation than the previous contract. Given default in state 2, the creditor will offer to liquidate only δ_2 in exchange for the available cash (40+T) such that

$$40 + T \leq (1\text{-}\delta_2)\ 240$$

Since it is in the interest of the creditor to maximize δ_2 subject to the above constraint, we need $T \geq 120$ for $\delta_2 \leq 1/3$. So if the contract has to ensure a liquidation in state 2 smaller than the corresponding liquidation under the DF contract, T must be greater than 120. But we shall show that such a transfer is not feasible. For T = 120, creditor's total receipts in state 2 is given by 160 + 60/3 = 180. To satisfy the participation constraint of the creditor, the total receipts in state 1 must be at least 220 as

$$½\ [220] + ½[\ 180] \equiv M = K + T \equiv 80 + 120$$

But the maximum that the creditor can get in state 1 is 200 as

$$100 + T \leq (1\text{-}\delta_1)\ 200$$

Hence there is no CF contract for this example with $\delta_2 \leq 1/3$. But this in itself does not imply that the CF contract will imply a higher cost to the debtor. Given the transfer, the debtor might enjoy large cash savings in state 1. This raises the possibility that the debtor's expected cost can be lower even with a higher δ_2. However, notice that if the investor's participation constraint is binding in both cases the cash savings S is related to δ and can not be arbitrarily large

$$½\ [C_1 – T] + ½\ [\ 40 + \delta_2 .\ 60] = 80$$

or, $\quad ½\ [\ 100 – S] + ½\ [\ 40 + \delta_2 .\ 60] = 80,\ \ S = 100 – C_1 + T$

So for a higher cash savings would mean a higher δ_2. Given that δ_2 carries more weight in the debtor's cost function, the optimal contract would be the one which achieves the smallest δ_2.

Since a CF contract can never achieve a smaller δ_2 compared to the DF debt contract, it will also imply higher expected cost.

In fact, the optimal CF contract in this case can be shown to be (T = 104, P = 200)[3]. This leads to a liquidation of $\delta_2 = 2/5$ and no liquidation in state 1. The resulting expected cost is given by

$$E^{cf}(c) = ½ [96] + ½ [40 + 2/5(240)] = 116 > 110.$$

This conforms to general belief that optimal DF contract would imply a lower cost to the debtor compared to a CF contract.

Let us consider another example, which is exactly same as the previous one except that the long term returns in state 2 is lower.

Example 2: Let $R_{11} = 100$. $R_{12} = 40$, $R_{21} = 200$, $R_{22} = 180$, $L_1 = 100$, $L_2 = 60$ and $K = 80$.

DF contract: The analysis of the DF contract remains unchanged. The optimal DF contract will have T = 0 and P = 100, resulting in $C_1 = 100$, $C_2 = 60$ and $\delta_2 = 1/3$. Hence the expected cost will be given by

$$E^{df}(c) = ½[100] + ½[40 + 180/3] = 100.$$

The lower expected cost is due to the fall in opportunity cost of liquidation in state 2.

CF contract: Proceeding the same way as before, it can be seen that since R_{22} is smaller, a lower transfer is required to ensure a smaller liquidation in state 2. Since

$$40 + T \leq (1-\delta_2)\, 180$$

any $T \geq 80$ would mean $\delta_2 \leq 1/3$. Such a transfer is feasible also. In state 2, creditor's total receipts are 140 and by setting P = 180 we can ensure that creditor's participation constraint is met for T = 80. There is no default in state 1 and C = P = 180. One can raise T beyond 80 also, as the debtor would be willing to pay more in state 1. This would mean a lower liquidation in state 2. The debtor can be made to pay more in state 1 where liquidation is less inefficient to subsidize his income in state 2 (through a higher T) and save on the more inefficient liquidation in state 2. Using the analysis of the previous section, the optimal contract in this case can be shown to be T = 92, P = 196. This would mean the debtor would pay out all the cash (100 + 92) and liquidate 1/25 of the assets to meet the payment obligation in state 1. He does not benefit by defaulting as 100 + 92 = (1-1/25) 200. In state 2, the debtor defaults. Following renegotiations he pays (40 + 92) in exchange for 11/15 of the assets (or a liquidation of 4/15). It can be verified that the creditor's participation constraint is satisfied as well. The expected cost can be calculated the same way.

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[3] This corresponds to the second case, hence T* is given by (10).

$E^{cf}(c) = ½ [100 + 200/25] + ½ [40 + 180(4/15)] = 98 < 100.$

Hence, for this example, the CF contract is clearly less costly for the debtor. In fact this is not an isolated case. One can characterize the set of cases when the CF contract is less costly for the debtor than the DF contract.

A simpler characterization is obtained if we restrict attention to cases where there is no transfer (T = 0) under the DF contract. This is the case when $K = (L_1+L_2)/2$.

Proposition 1: Given assumptions A1-A3 and if the optimal CF contract entails some liquidation in state 1 (case 1), then a CF contract implies a lower expected cost for the debtor (compared to the optimal DF contract) if

(C1) $(R_{11}/R_{12}) > (\alpha_2-1)/(\alpha_1-1)$. *Where* $\alpha_s = R_{2s}/L_s$ $s = 1,2$

Proof: It follows from (9) and the analysis of the DF contract that liquidation in state 2 will be lower for a CF contract if the above condition holds. Given that the creditor's participation constraint is binding in both the cases and liquidation is more inefficient in state 2, this will also imply that CF contract has a lower expected cost to the debtor.

It can be checked that this inequality is satisfied for example 2 but not example 1. The only difference between the examples is in the values of R_{22} and hence α_2. As α_2 is reduced from its value of 4 in example 1 to a value of 3, the above condition holds and the CF contract does better. The intuition behind this is quite straightforward. The main advantage of the CF contract is two-fold . First it allows for a high T and second it can enforce higher payments in state 1. In fact some of the liquidation is transferred to this less inefficient state (recall that $\alpha_1 < \alpha_2$). A high T would supplement the cash holdings in state 2 and help reduce liquidation. But note that given our assumptions, there will always be default in state 2, which means the creditor can enforce higher liquidation despite a high T if R_{22} is high. This is the disadvantage of passing the bargaining power to the creditor. To ensure that there is less inefficient liquidation in state 2, R_{22} must not be too high. This is what the above condition stipulates.

Case 1 does not hold when R_{11} is high or R_{21} is low. For case 2, it can be shown that the above Proposition holds if condition C1 is replaced by the following condition[4].

C2: $(L_1/R_{12}) > (\alpha_2-1)/(\alpha_1-1)$. *Where* $\alpha_j = R_{j2}/L_j$ $j = 1,2$

Our analysis has so far assumed that there is no scope for any transfer T under DF contract. However one can relax this assumption also. Let $K = (L_1+L_2)/2 - t$. So, the investor can lend an amount $T \le t$ over and above the project cost K. This will certainly reduce the inefficient liquidation in state 2 and improve the efficiency of the DF contract. If t is such that $R_{12} + t > L_2$,

[4] Let $R_{11} = 120$. $R_{12} = 40$, $R_{21} = 150$, $R_{22} = 165$, $L_1 = 75$, $L_2 = 55$ and $K = 65$. Here C1 holds but C2 does not. It can be shown that CF leads to a higher cost.

then it is possible (depending on R_{11}) that there is no liquidation in state 2. However we shall consider cases where it is not possible to eliminate inefficient liquidation altogether. The CF contract also becomes less costly but is not so straightforward. Hence we consider an example (Example 2) and analyze how the two contracts fare as K is reduced. For given L_1 and L_2 , a reduction in K[5] would mean a rise in t. As K falls, it is natural that E (c) falls but the relative fall in E (c) is higher for the DF contract than the CF contract. Hence for sufficiently low K, the DF will fare better and Proposition 1 does not hold.

Example 3: Let $R_{11} = 100$. $R_{12} = 40$, $R_{21} = 200$, $R_{22} = 180$, $L_1 = 100$, $L_2 = 60$ and $K = 80 - t$. This is same as example 2 except for values of K. The condition in Proposition 1 is also satisfied. We shall see that as t gets large, Proposition 1 is not true anymore.

The analysis of optimal DF contract is easy . For K >60, there will always be a positive transfer T = t. The state 1 payment equals 100 . In state 2, payment equals 40 + t and (60-40-t)/60 of assets will be liquidated. It can be checked that it never pays to set T < t.

The analysis of the CF contract depends on the value of t. It can be shown that for t<10/3 , the optimal transfer T = 92 + 12t/5. In state 1, the debtor pays back 100+t + δ_1 (100), where $\delta_1 = (40-12t)/1000$ and in state 2 the debtor defaults. Following renegotiations, the debtor receives $(1-\delta_2)$ assets in exchange for a payment of 40 + t. Hence there is liquidation in this state also with $\delta_2 = [48 - (12/5)t]/180$. For t > 10/3, the optimal transfer T = 95 +3t/2 . There is no liquidation in state 1, the debtor pays 200. In state 2, the debtor pays 40 + t, in exchange for $(1-\delta_2)$ of the assets, where $\delta_2 = [45-3t/2]/180$.

$$E^{df}(c) = [100 - t]/2 + [40 + 3(20-t)]/2 = 100 - 2t \quad \text{for } t < 20$$

$$E^{cf}(c) = [100+(40-12t)/5]/2 + [40+(48-12t/5)]/2 = 98 - 12t/5 \text{ for } t < 10/3$$

$$= [200 - 95 - 3t/2]/2 + [40 + (45 - 3t/2)]/2 = 95 - 3t/2 \text{ for } t > 10/3$$

This shows that as K is lowered, E^{df} (c) eventually falls at a faster rate than E^{cf} (c) and for K <70 the DF contract is in fact better than the CF contract. This suggests that Proposition 1 applies to situations where limited transfers are feasible in case of the DF contract. This shows that even though Proposition 1 was derived in rather special conditions, it is far more general.

IV Conclusion:

We have shown that a debtor need not always benefit from having all the bargaining power in the renegotiations game. In a similar vein, one can consider more generalized bargaining games and show that a debtor's welfare need not be monotonic in his bargaining power. This is

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[5] Note that t can be raised by raising L_1 and L_2 also and this will have different implications for the optimal contracts. We do not consider such variations.

somewhat similar to examples from labor economics and industrial organization, where agents can be adversely affected by their bargaining power.

The paper abstracted from the source of such bargaining power, but in real life these will be determined by factors like liquidation procedures, bankruptcy laws, union and labor laws. The note points out that in designing these laws one has to carefully consider their implications and allow for the possibility that these laws may end up harming the agent whose interest was sought to be promoted.

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