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Informal Reorganization of the Financially Distressed Firm and Bivalent Policy of Refinancing Rates

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Abstract

This article deals with the bankruptcy problem. Three main questions are tackled in this research work. Firstly, we consider the property rights reallocation problem. Secondly, we analyze the question of the refinancing cost of the distressed firm under the hypothesis of a new debt financing to face the lack of equity financing. Thirdly, we wonder about the length of the renegotiation period and how it impacts the debt refinancing conditions. We suggest founding the reallocation of property rights, debt rights are supposed to be exchanged for equity rights, on the marginal contribution of new owners (initially debt-holders) in the reorganization process. We do not base this reallocation on the seniority degree of the old claims or on the relative debt corresponding to the status of initial claimer. Thus, we propose to use the Shapley value which is based on the marginal contributions of new shareholders. The analysis points out that the refinancing rate depends on the expected economic profitability and on the synergy effect generated by the new shareholders.

I. Introduction

TO SOLVE ITS problems, the firm in financial distress has to choose between formal bankruptcy procedures or informal renegotiation processes. In lot of countries, formal procedures lead to frequent liquidations (in more than 90% of the cases in France, for instance)[1]. That can be a reason, for the debtor-in-place and the main creditors, to engage the firm in an informal renegotiation process if the reorganization value is positive. Another rationale for pursuing informal renegotiations comes from the fact, as underlined by Couret and *ali.* (1995), that such processes are more adaptable.

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The first goal of this article is to analyze the conditions under which an informal debt renegotiation of the financially distressed firm is possible[2]. The second goal is to study, when an equity financing is not sufficient, the conditions under which the firm can be refinanced by debt (the underlying question is to determine the policy of refinancing rates that creditors can apply under reorganization). From the academic point of view, these questions are important because if research works on formal bankruptcy are numerous, those on informal solutions are rarer. From the managerial point of view, the topic of this paper deals with very concrete questions as how to share the rescuing cost of the distressed firm between claimholders or under which conditions can be financed the activity of the reorganized firm?

To analyze the conditions under which an informal renegotiation could lead to the firm rescue, we consider three types of questions. Firstly, the renegotiation implies to share the rescuing cost between claimholders, to take a reallocation decision of the property rights and to take a reorganization decision (or a liquidation one if the reorganization is not possible). In the framework of an informal renegotiation[3], we implicitly assume that this decision will belong to new shareholders[4], depending on their anticipations on firm's perspectives. So, in our analysis, the main questions are about the sharing rule concerning the rescuing cost and the reallocation decision of property rights in the reorganizing firm. If we could opt for a reallocation of property rights based on the Shapley value, under which conditions a firm anticipated rescue would be possible? Secondly, to achieve the firm rescue, the reallocation of property rights is not sufficient. The firm will probably need some new financing resources. So under which conditions could the firm be refinanced if we assume it seeks a new debt financing? Thirdly, in margin of these two main questions, we could imagine that time plays a crucial role in the success of the firm rescue. So, what would be consequences of delaying the renegotiation exit on success probability of the firm rescue and on conditions under which its refinancing would be possible?

The decision to reorganize or to liquidate the firm, on one side, and the reallocation decision of property rights, on the other side, are considered by Hart (2000) as the two main aspects of the reorganization process. One of the major contributions of our article is to point out a third essential aspect: under which conditions can the reorganizing firm be equipped with a new debt financing by creditors? To discuss this question, we will introduce the concepts of viability and precariousness of the reorganized firm. Our analysis makes appear two situations in the reorganization process. In the first one, the firm will be in a viability state, but a precarious viability. In the second one, it will be in a non precarious viability state. The firm will be considered as viable if the debt refinancing cost does not exceed the expected economic profitability. But, the viability situation will be analyzed as a precarious one if the refinancing cost exceeds a threshold (called the floor rate, in this case) defined as the product of the expected economic profitability by the synergy rate (synergy and synergy rate concepts will be defined infra). On the contrary, the viability situation will not be seen as precarious if the refinancing cost does not exceed this threshold (called ceiling rate, in this case).

There exist three possibilities about the decision to liquidate or to reorganize. The first possibility consists to sell the assets by auction. Bids can be made in cash or not (non cash bids), in the spirit of Aghion, Hart and Moore (1992). For instance, the debtor-in-place can make a bid with a mix of cash payments, debt and equity to creditors. Following that, creditors make a formal vote to select their preferred bid. The principle of vote is to grant creditors with rights according to their rank in the absolute priority order. The second possibility consists to give the firm control to a bankruptcy professional[5] (supervisor, judge...) which will be in charge, on one side, to opt for the best solution (liquidation or reorganization) and, on the other side, to implement this solution after a vote (or not, depending on the legal framework) by a majority of claimers. The third solution consists to leave shareholders the decision power to reorganize the firm or not. The idea is to change all the claims into property rights and to proceed to a formal vote on the reorganization decision. In other words, the idea is to leave standard governance rules be applied as a solution to the financial distress problem. Our work comes within this conceptual framework.

This type of solution implies to think about the way to reallocate property rights in the reorganizing firm. Bebchuk (1988) propose to found this reallocation on the use of options with respect to the absolute priority order. In this model, senior creditors receive all the shares of the reorganized firm. Junior creditors receive options to purchase seniors' shares on a pro rata basis. But, this proposition suffers from the fact that this system would imply new cash infusions from the former creditors.

A contribution of our article is to propose a reallocation solution of property rights based on the synergy concept. According to this concept, every claimholder can accept to reduce its expectations (in terms of profitability or reimbursement level) so as to achieve an agreement for the firm rescue. The synergy concept underlines the idea that every claimholder can bring a contribution in the project to avoid the firm liquidation. It points out the idea of the marginal contribution of each claimer to the different coalitions of creditors leading to a reorganization solution, more than the status of former creditor, the weight of its relative debt or its rank in the absolute priority order.

A last contribution of this research work consists in the analysis of the time factor on the renegotiation exit. There exist different ways to reallocate property rights in the reorganizing firm. For instance, we could opt for a reallocation mode based on the absolute priority order. But, some other reallocation modes are possible. Before the reallocation decision, every claimholder could defend a more favorable reallocation mode so as to preserve its interests. Such a behavior could lead to lasting discussions about the best reallocation mode. During this time, as it will be shown in the article, the success probability of the firm rescue decreases. The more the renegotiation period lasts, the less the synergy will be, because creditors lost, during this time, alternative investments opportunities, that implies enhancement of refinancing rates.

In literature, two questions often arise about informal renegotiations. The first question consists to underline the fact that in such processes there is no automatic stay (as in formal procedures) so as to avoid individual proceedings from some creditors. This problem is known as the 'common pool problem'. In our work this problem does not exist because the expected outcome of the non liquidation strategy exceeds the expected outcome of other alternative investments (as it is formalized, in this paper, in the non liquidation condition). Consequently, creditors do not have incentives to engage in individual proceedings. The second question, comes from Gertner and Scharfstein (1991). It is known as the 'hold out problem'. Some creditors could be incited to not enter in a renegotiation so as to benefit from its success (if an agreement is reached) without sharing its cost. In our article, the unique possible partition of creditors is the large coalition (that is, a coalition of all the claimers). Other partitions do not result in a best solution because the analysis comes in the framework of a suradditive cooperative game. Consequently, in our analysis, there is no 'hold out problem'.

We will present, in a second section, notations conventions and definitions used. Then, in a third section, we will expose the renegotiation model based on the Shapley value. We will analyze the conditions under which a non liquidation is possible. We also will expose the two situations of viability, precarious or not precarious. We will conclude in a fourth section. Finally, in annex, we will propose a definition of the equity financing profitability and two numerical examples integrating the conditions under which the firm rescue is possible. The first example deals with an anticipated renegotiation. The second example, based on the first one, treats about a lasting renegotiation. We also propose, at the end of the annex, a table to summarize the results of the model.

II. Notations and Definitions

The aim of this section is to present the different notations and definitions used in the renegotiation model based on the Shapley value.

2.1 *Notations*

We will note

N {1,2,3,...,*i*,...,*n*}, the set of the firm's creditors, with cardinal of N equal to n (card (N) = n) ;

R^p_i the expected reimbursement from the distressed firm to the creditor i ;

R^e_i the effective reimbursement already perceived by the creditor i ;

$R^e_N = \sum_{o=1}^{n} R^e_i$, the effective reimbursement of the large coalition which is equal to the sum of individual effective reimbursements;

$R^p_{N'}$ the expected reimbursement from the distressed firm to the large coalition composed by all the creditors.

To understand the signification of R_N^P, consider two creditors i and j. Suppose that the creditor i accepts to lend an amount C against an interest rate equal to r_i and that the creditor j grants a loan for the same amount, against a cost r_j. Under these conditions, the expected reimbursement of i is equal to $R_i^P = C(1 + r_i)$. The expected reimbursement of j is equal to $R_j^P = C(1 + r_j)$. So, the total of individual reimbursements is $R_i^P + R_j^P = C(2 + r_i + r_j)$.

If the creditors i and j decide to form a coalition $S = \{i, j\}$ then, they will have to define a new offer based on an interest rate resulting from a trade-off between the former financing policies. Suppose that $r_i \geq r_j$, then the new policy should propose an interest rate of $\bar{r}$ such as $r_i \leq \bar{r} \leq r_j$ with $\bar{r} = \alpha_i r_i + \alpha_j r_j$ and such as: if $r_i \geq r_j$ then with $\alpha_i \leq \alpha_j$. The idea is that the new financing policy will more resemble to the policy of the creditor which offered the lowest interest rate. We suppose here that a reduction of the credit cost will be largely compensated by an enhancement of the credit demand (price elasticity of credit is higher than one: if the credit cost diminishes from 1%, then credit demand raises for more than 1%). Such a credit policy would allow to provide easier the necessary funds to rescue the firm, in offering a lower financing cost (so as to facilitate the continuation). This would imply that the expected reimbursement of the coalition $S = \{i, j\}$, would be less than the total of the expected individual reimbursements. Formally, we have: $R_i^P + R_j^P = C(2 + r_i + r_j) \leq 2C(1 + \bar{r})$. Generally, if creditors decide to form the coalition N, we will have : $\forall S \subset N$, $R_N^P \leq \sum_{S \subset N} R_S^P$. The idea is that the expected reimbursement of the coalition N is lower than the total of expected reimbursements of different possible under-coalitions.

2.2 *Definitions*

2.2.1 *Definition 1 : The bid of the creditor i*

Suppose that, in the aim to avoid a liquidation, the creditor i can make a purchasing offer $c(\{i\})$, that is to accept to change its claims in property rights. This bid is defined as the difference between the contractual expected reimbursement and the effective reimbursement: $c(\{i\}) = R_i^P - R_i^e$. The individual bid of the creditor i can be interpreted as a new contribution to restart the firm. It represents the investment cost of the creditor i. It can also be interpreted as a regret, that is, the renunciation of the creditor i to recover the expected reimbursement.

2.2.2 *Definition 2 : The bid of the whole creditors of N*

Consider now the set of all the creditors brought together in the large coalition. The bid $c(N)$ of the large coalition is defined as the difference between the expected reimbursement and the effective reimbursement: $c(\{N\}) = R^P{}_N - R^e{}_N$. This value expresses the global rescuing cost of the distressed firm. As $R_N^P \leq \sum_{S \subset N} R_S^P$, the bid of large coalition is such as $c(N) \leq \sum_{S \subset N} c(S)$: the coalition implies a reduction of the rescuing cost.

These definitions and notations will be useful in the next section, which propose a debt renegotiation model of the distressed firm.

III. DEBT Renegotiation Model of the Financially Distressed Firm Based on the Shapley Value

The aim of this section is, on one side, to expose hypothesis of the model and the Shapley value, on the over side, to determine the non liquidation conditions and the bivalent policy of refinancing rates that could be applied to the distressed firm.

3.1 *The hypothesis of the renegotiation model based on the Shapley value*

3.1.1 *Hypothesis* HO_1

We assume that the renegotiation takes place in the framework of a cooperative game (N, c) which is a transferable utility game. We will consider that the game (N, c) is suradditive.

In this analysis, the suradditivity comes from a synergy effect implied by a common credit policy which is characterized by a lower financing rate (lower than the initial contractual financing rates); the common policy leading to a decrease in the expected reimbursement.

The characteristic function is defined as follows

$$c : P(N) \to \Re \text{ and } c(\varnothing) = 0$$

in which $P(N)$ is the set of all the parties of N

The game (N, c) is suradditive if and only if

$$\forall S, T \subset N,\ S \cap T = \varnothing \Rightarrow c(S \cup T) \leq c(S) + c(T).$$

The interpretation is as follows. The members of the set can have profitable economic activities. If the member of the coalition S decide to cooperate, then they can achieve the common cost $c(S)$. $c(S)$ is the common cost (the common bid) guaranteed by the coalition S. We will note $c(\{i\})$ the guaranteed cost (the individual bid) of the agent $\{i\}$ if he decide to work alone. We assume that if the coalition S is formed and achieve a cost $c(S)$ then $c(S)$ will have to be shared between the members of S. We also assume that each member of N has a perfect knowledge of the function c (that is the bid of all the possible coalitions).

3.1.2 *Hypothesis* HO_2

We assume that the common cost (the common bid) $c(N)$ is shared following the Shapley rule. In our mind, this hypothesis is used to underline the role of the marginal contribution of each creditor in the firm reorganization[6].

3.1.3 Hypothesis HO_3

The more the renegotiation exit is delayed, the more the common bid rises. The renegotiation can last because of discussions, for instance, about how to share the rescuing cost. Some creditors could defend a sharing rule based on the absolute priority order, or on the relative debt. Some other could prefer a sharing rule based on the marginal contribution (Shapley). We also could imagine some other sharing rules.

The more the recovery of the expected reimbursement is delayed, the more the regret is high because there exists a loss, during this time, corresponding to the profitability of an investment that would have to be realized with this amount (opportunity cost).

So, consider that the expected reimbursement at the date $t+1$ is higher than the expected reimbursement at the date t, that is $(R^P{}_N)_{t+1} > (R^P{}_N)_t \ \forall t \in \{t_0, t_1, \ldots, t_k, \ldots, t_n\}$, where t_0 represent the date for which the renegotiation takes place immediately and t_n, the date for which the renegotiation is stopped (there is no solution that can be acceptable by everyone). At t_n, each claimer would only recover its individual bid enhanced by the opportunity cost born following the fact the expected reimbursement has not been invested between t_0 and t_n.

Note $c_t(N)$, the bid at the date t. $c_t(N)$ is depending on the expected reimbursement such as : $c_t(N) = f((R^P{}_N)_t) = (R^P{}_N)_t - R^e{}_N$ with $f' = \dfrac{dc_t(N)}{d(R^p_N)_t} > 0$.

The interpretation is as follows. The more time passes, the more the expected reimbursement is high and the regret (the bid) is high.

Moreover, we will accept that: $c_t(S) \to \sum_{i \in S} c_t(\{i\}),\ \forall S \subset N$, when $t \to t_n$. This expresses that the more time passes tendering to a date for which no solution will be acceptable by no claimer, the more the global bid for a coalition S will be similar to the sum of individual bids of members of the coalition S.

3.1.4 *Hypothesis* HO_4

We assume that the probability for a creditor to integer the coalition S at the position t is the same for all the members of the large coalition $N = \{1, 2, \ldots, n-1, n\}$. The idea is that each creditor could request other creditors to integer the renegotiation process. Consequently, the rank of a creditor in a coalition is randomly determined.

3.1.5 *Hypothesis* HO_5

When a creditor integers the coalition S after the other creditors forming S, he benefits from an outcome equal to its marginal contribution, that is $c(S \cup \{i\}) - c(S) = c(T - \{i\}) - c(T))$ which represents its requirement so as to participate to the coalition $T = S \cup \{i\}$.

3.2 *The Shapley Value*

The Shapley value of a creditor i, noted , is equal to the mathematical expectancy of its requirements: $\varphi_i(c) = \sum_{\substack{S \subset N \\ i \in S}} p_i e_i$ where $e_i = c(S \cup \{i\}) - c(S)$ expresses requirement of the creditor i and $p_i = \dfrac{s!(n-s-1)!}{n!}$ the probability of this requirement.

We also have $\varphi_i(c) = \sum_{\substack{S \subset N \\ i \notin S}} p_i e_i \frac{s!(n-s-1)!}{n!} [c(S \cup \{i\}) - c(S)]$.

The Shapley value $\varphi_i(c)$ of a creditor i can be viewed as the average requirement of this creditor in the game (N, c): it is the mathematical expectancy of a random gain (or a reduction of costs). We call Shapley value of the game (N, c), the vector noted $\varphi(c) = (\varphi_i(c))_{i \in N}$ where $\varphi_i(c)$ is the part of the creditor i.

3.3 *Solution of the renegotiation model based on Shapley value*

We propose a solution of the renegotiation model based on the conditions under which the creditors could consider to not liquidate the distressed firm; its rescue appearing as a better alternative.

The reorganization is possible under three conditions: the incentive condition, the participation condition and the non-liquidation condition. The incentive and participation conditions are necessary but not sufficient to avoid the liquidation of the distressed firm.

3.3.1 *Incentive condition*

Note the bid of the creditori following a sharing based on the Shapley rule. A creditor will be incited to accept a renegotiation if:

$$\varphi_i(c) \leq c(\{i\}) \quad \forall i \in N \tag{1}$$

The idea is that the bid of the creditor i within the framework of the large coalition is better than the bid he could make alone. The cost born by the creditor i is reduced if he participates to the large coalition.

3.3.2 *Participation condition*

Note φ_i (c) RF^a, the expected profitability of equity financing[7]. Suppose that the income of the creditor i is equal to $RA^a_i = \varphi_i(c)\, RF^a$, the participation condition is as follows :

$$RF^a \varphi_i(c) \geq r \varphi_i(c) \Leftrightarrow RF^a \geq r \tag{2}$$

r expresses the interest rate for which players can borrow or lend on financial market. The idea is that a creditor will be incited to participate to the firm reorganization if the expected profitability of equity financing exceeds the interest rate he could benefit in investing on financial markets an amount equivalent to the bid guaranteed within the large coalition.

3.3.3 *Non-liquidation condition*

When cooperation is possible (because the game is suradditive) an important question is to determine if costs saved thanks to the reorganization process, resulting from a new policy of financing rate, should be allowed for a part to employees. To avoid a liquidation, should we wait from creditors to benefit from an income equal to the equivalent investment of their individual bid on financial markets if the cooperation would be impossible, or to only verify their participation condition (in this case, employees would benefit from the cooperation without generating a cost reduction)?

We can think that informal renegotiations are often confidential. When the informal process is a success, creditors benefit from a cost reduction equal to $(c(\{i\}) - \varphi_i(c))$. But, we also can think that creditors act as their contributions would be $\varphi_i(c) = c(\{i\})$, that is as if the game were inessential.

So, requirements of each creditor i will exceed the participation constraint. Each creditor will compare its income $RA_i^a = \varphi_i(c)\, RF^a$ to the investment of its individual bid $c(\{i\})$ on financial markets (with an interest rate equal to r) as if the game was inessential instead of making the comparison to the investment of its bid as defined by the Shapley rule (when the game is surraditive).

Formally, the individual non liquidation condition is as follows:

$$RF^a\varphi_i(c) \geq r\varphi_i(c) + r(c(\{i\}) - \varphi_i(c)) = rc(\{i\})$$

$$\Leftrightarrow$$

$$RF^a\varphi_i(c) \geq rc(\{i\}) \tag{3}$$

For all creditors, this condition is :

$$\sum_{i=1}^{n} RF^a\varphi_i(c) \geq \sum_{i=1}^{n} rc(\{i\}) \Leftrightarrow RF^a \sum_{i=1}^{n} \varphi_i(c) \geq r\sum_{i=1}^{n} c(\{i\})$$

$$\Leftrightarrow$$

$$RF^a c(N) \geq r\sum_{i=1}^{n} c(\{i\}) \tag{4}$$

3.3.4 *Non liquidation condition and refinancing mode of the firm*

Imagine that equity financing is not sufficient for the firm continuation. Which condition should verify the leverage ratio (debt to equity ratio) in the aim to allow a non liquidation strategy?

3.3.4.1 *Condition verified by the leverage ratio in a non liquidation case*

Remember that, for the whole creditors, the non liquidation condition is (as given in equation (4))

$$RF^a c(N) \geq r\sum_{i=1}^{n} c(\{i\})$$

The expected profitability of equity financing is[8] as follows:

$$RF^a = RE^a + \left(RE^a - r\right)\frac{D}{FP} \tag{5}$$

After substitution of equation (5) in equation (4), we have:

$$RF^a c(N) \geq r\sum_{i=1}^{n} c(\{i\}) \Leftrightarrow \left(RE^a + \left(RE^a - r\right)\frac{D}{FP}\right)c(N) \geq r\sum_{i=1}^{n} c(\{i\})$$

$$\Leftrightarrow$$

$$\frac{D}{FP} \geq \frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \text{ with } c(N) \neq 0 \ \left(RE^a - r\right) \neq 0 \quad (6)$$

If $c(N) = 0$, synergy would be infinite. This would not be realistic. If $(RE^a - r) = 0$, then the firm reorganization presents no interest because : $RE^a = r$. Why would we seek a reorganization if an investment on financial markets generating an equivalent income is possible?

The inequality (equation) expresses the condition that should be verified by the leverage ratio, that is the financial structure of the reorganized firm, so as to avoid a liquidation.

3.3.4.2 *Interpretation of the condition verified by the leverage ratio*

There are two parts in the condition equation (6) on the right-hand side:

— The first part on the right-hand $\frac{1}{\left(RE^a - r\right)}$ side expresses the inverse of the profitability

— The second part on the right-hand side $\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right)$, integers

three components:

i. r which expresses the investment or refinancing rate on financial markets

ii. $\frac{c(N)}{\sum_{i=1}^{n} c(\{i\})}$ which is the ratio of the large coalition bid to the total individual bids. We will define this ratio as the *synergy rate* generated by creditors during the reorganization process. In condition (3.3.6), we consider the inverse of the synergy ratio

iii. RE^a expresses the expected economic profitability

The interpretation of the condition (6) is as follows: a non liquidation strategy is possible if the leverage ratio exceed the product of the profitability inverse by the difference between the synergy rate inverse, weighted by the refinancing rate, and the expected economic profitability.

3.3.4.3 *Analysis of the condition verified by the leverage ratio*

Consider inequality (equation) Outlined again below

$$\frac{D}{FP} \geq \frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \text{ with } c(N) \neq 0 \ \left(RE^a - r\right) \neq 0$$

As $D \geq 0$ and $FP > 0$ (because the firm is recapitalized), $\frac{D}{FP} \geq 0$ then. This results in two situations[9] :

i. $$\text{Situation 1}: \frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \geq 0$$

ii. $$\text{Situation 2}: \frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \leq 0$$

First, consider the situation 1

$$\frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \geq 0 \quad \Leftrightarrow$$

$$\text{case 1.1}: \begin{cases} \dfrac{1}{\left(RE^a - r\right)} > 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \geq 0 \end{cases} \text{ or case 1.2}: \begin{cases} \dfrac{1}{\left(RE^a - r\right)} < 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \leq 0 \end{cases}$$

$$\text{Examine the case 1.1 : } \begin{cases} \dfrac{1}{\left(RE^a - r\right)} > 0 \\ \left(r \dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a \right) \geq 0 \end{cases}$$

$$\begin{cases} RE^a > r \\ r \dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a \geq 0 \Leftrightarrow r \geq \dfrac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a \end{cases} \quad) \qquad (7)$$

The interpretation of the condition equation (7) is as follows : a financing mode compatible with the non liquidation strategy is such as the refinancing cost exceed the expected economic profitability RE^a weighted by the synergy rate $\dfrac{c(N)}{\sum_{i=1}^{n} c(\{i\})}$

$$\text{Examine the case 1.2 : } \begin{cases} \dfrac{1}{\left(RE^a - r\right)} < 0 \\ \left(r \dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a \right) \leq 0 \end{cases}$$

If $\dfrac{1}{\left(RE^a - r\right)} < 0 \Leftrightarrow RE^a < r$:, then the profitability of an investment on financial markets exceeds the equity expected profitability of the reorganized firm. Consequently, the firm rescue is not profitable. The best strategy is to opt for a debt financing equal to zero. But, even in this case, the equity expected profitability which is equal, for a financing structure without debt, to the expected economic profitability, is lower than the profitability of an investment on financial markets. So, the liquidation cannot be avoided.

Consider now the situation 2

$$\frac{1}{\left(RE^a - r\right)}\left(r\left(\frac{\sum_{i=1}^{n} c(\{i\})}{c(N)}\right) - RE^a\right) \leq 0 \quad \Leftrightarrow$$

$$\text{case 2. 1:} \begin{cases} \dfrac{1}{\left(RE^a - r\right)} > 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \leq 0 \end{cases} \text{ or case 2.2 :} \begin{cases} \dfrac{1}{\left(RE^a - r\right)} < 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \geq 0 \end{cases}$$

$$\text{Examine the case 2.1 :} \begin{cases} \dfrac{1}{\left(RE^a - r\right)} > 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \leq 0 \end{cases} \quad \Leftrightarrow$$

$$\begin{cases} RE^a > r \\ r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a \leq 0 \Leftrightarrow r \leq \dfrac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a \end{cases} \tag{8}$$

The interpretation of the inequality equation (8) in the case 2.1, is the same as the inequality equation (7) in the case 1.1.

$$\text{Examine the case 2.2 :} \begin{cases} \dfrac{1}{\left(RE^a - r\right)} < 0 \\ \left(r\dfrac{\sum_{i=1}^{n} c(\{i\})}{c(N)} - RE^a\right) \geq 0 \end{cases}$$

The interpretation is the same as in the case 1.2.

3.3.4.4 *Interpretation of the viability conditions for a non liquidation strategy*

Inequalities equation (7) and equation (8) express the viability and precariousness conditions for a non liquidation strategy.

i. Viability and non precariousness of the non liquidation strategy : inequality equation (8)

The non liquidation strategy will be considered as viable because the expected economic profitability RE^a exceed the refinancing cost (r): $RE^a > r$. Moreover, the non liquidation strategy is not precarious because the refinancing rate is lesser than the expected economic profitability weighted by the synergy rate : $r \leq \frac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a \ \alpha$.

In this non precarious case, the maximal value of the refinancing cost, under the non liquidation strategy, is $\tilde{r}_{\max} = \frac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a$ which expresses the refinancing ceiling rate.

ii. Viability and precariousness of the non liquidation strategy : inequality equation (7)

As in the previous case, the non liquidation strategy is considered as viable because the expected economic profitability (RE^a) exceeds the refinancing rate (r). Nevertheless, this strategy can be considered as precarious because the refinancing rate exceeds, this time, the expected economic profitability weighted by the synergy rate: $r \geq \frac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a$.

In this case, the minimum value of the refinancing rate is $\tilde{r}_{\min} = \frac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a$ which expresses the floor refinancing rate.

This situation could be explained by a bad notation of the firm on financial markets, resulting in a relative higher risk premium (that is an increase of the refinancing rate). But, the more the refinancing cost is high, the more the reorganized firm has to require a higher profitability from employees. So, the non liquidation strategy could not last, in this case, because employees could experience some difficulties to maintain relative high performances during a long period.

Note that, in the two situations of viability, as $c(N) \leq \sum_{i=1}^{n} c(\{i\})$, the more $c(N)$ is lower than $\sum_{i=1}^{n} c(\{i\})$, the more the reorganization is possible and the more the refinancing rate (floor rate or ceiling rate) is low and thus, the more the equity expected profitability increases[10]. So, the more synergy is high, the more $\tilde{r}$ is low.

iii. Role of time

Renegotiations can last because of differences in the way to share the rescuing cost; the vision based on the absolute priority order could be opposed to the vision funded on marginal contributions. Some others sharing rules could be imagined (and thus discussed between creditors). Discussions about the different ways to share the rescuing cost could so explain why negotiations can last.

The time factor plays an essential role because the more the renegotiation is *late*, the less the synergy will be (creditors do not benefit, during this delay, from other investment opportunities)[11].

A late reorganization leads to a higher common bid and thus, to a higher refinancing cost $\tilde{r} = \frac{c(N)}{\sum_{i=1}^{n} c(\{i\})} RE^a$. In these conditions, the threshold rate (floor or ceiling rate) will be nearer and nearer from the expected economic profitability.

A non late reorganization leads to lower common bid and threshold rate. Thus, this situation implies a rate relatively lower than the expected economic profitability.

This could signify that a late reorganization could tend to enhance refinancing rates because lenders would feel some distrust about the distressed firm when reorganization is delayed. They could decide to offer funds against higher interest rates so as to preserve themselves against a default risk.

IV. Conclusion

Sometimes, firms strike financial difficulties which could result in bankruptcy. A type of solutions consists in ex-post formal reorganization or liquidation. Another type of solution consists in ex-ante informal discussions between creditors and debtor-in-place so as to avoid, if possible, a liquidation. One of the aims of this article is to derive the necessary and sufficient conditions to implement a reorganization, in such a framework.

The first minimal condition for the firm rescue lies on the necessity, for the reorganization, to generate a costs reduction when creditors decide to cooperate in the aim to save the distressed firm. In this spirit, we have analyzed the firm reorganization in the framework of a suradditive

cooperative game in which the large coalition proposes the best bid (compared to the other possible coalitions). If such a costs reduction is possible, the following question deals with the manner to share it. We have proposed a sharing process based on the Shapley value in which property rights allocated to the new shareholders depend on their marginal contributions to the firm rescue.

After the property rights reallocation, our work led to the analysis of three conditions to avoid the firm liquidation: incentive, participation and non liquidation conditions. These conditions are necessary but only the last one is sufficient to the firm rescue.

Effectively, the analysis of the relation between the leverage ratio and the non liquidation condition shows that there exists two situations of viability concerning the reorganized firm. In the first situation, the viability seems to be precarious because creditors require a relatively high refinancing rate (similar to those of pension funds). Such requirements could imply a liquidation in the future because employees would strike some difficulties to keep on relatively high performances during a long period. In the second situation, the viability appears to be non precarious because refinancing requirements are not as high as in the first situation.

Our analysis also underlines the fact that the refinancing rate depends on the expected economic profitability and on the synergy rate generated by creditors. It points out that an augmentation of the renegotiation delay would imply an increase in the refinancing rate.

In this analysis, we used the framework of a cooperative suradditive game which implies a reduction of the common bid. We proposed a reallocation of property rights based on the Shapley rule. But, some other sharing rules could be proposed. Nevertheless, the resolution of the renegotiation model would keep the same dynamic based on incentives, participation and non liquidation conditions, leading to a bivalent policy of refinancing rate.

Notes

1 This is often paradoxical because, like in France, the aim of law can be to favor the firm rescue. But, friendly-debtor bankruptcy codes often fail in the achievement of such a goal.

2 In some countries, the bankruptcy code seeks to favor informal reorganizations. It is the case in France (the law has been recently overhauled, in 2005 and 2008), for instance, with the procedures named *'mandat ad hoc'* and *'conciliation'*. For an overview on the consequences of the bankruptcy law reform in France, see Favario (2009) and Saintourens (2009) Moreover, studies show that informal renegotiations are often used to prepare an agreement between claimholders that will be ratified under an accelerated formal procedure, like in the United-States in which prepackaged bankruptcies are numerous, see Tashjian, Lease and Mc Connell (1996).

3 For a recent renegotiation model in relation with the orientation (debtor or creditors-friendly) of the bankruptcy system, see Chopard and Langlais (2009).

4 It would not be necessary the case in the framework of a formal procedure. Depending on the countries, the role of the different claimholders is quite different. In France, for instance, this decision belongs to a bankruptcy judge. That can be another rationale for the claimholders to avoid a formal procedure.

5 See, for instance, White (1994) for an analysis of bankruptcy systems in United-States and Europe, or Fisher and Martel (1999) concerning the Canadian law. See Bienvenu (2006, 2008) for a description of the bankruptcy procedures in France. For empirical studies on formal procedures in United-States, see Morrison (2007), Weiss and Capkun (2007). For a study in France, see Chopard, Guigou, Fimayer and Blazy (2007).

6 In our analysis, the property rights are funded on the basis of the marginal contribution of each claimer. This vision of the bankruptcy process is different from the point of view of Aghion, Hart and Moore (1992). For them, the reallocation of property rights has to be based on the absolute priority order.

7 See Annexure I for a definition of the expected profitability of equity financing that we use.

8 See Annexure I

9 Consider two values x and y such as $\begin{cases} x \geq 0 \\ x \geq y \end{cases}$, we can face two situations

a) $x \geq y$ with $y \geq 0$

b) $x \geq y$ with $y \leq 0$

10 See appendix 1.

11 See example 2, Annexure II.

12 Another manner to calculate the Shapley value is to use the Shapley formula:

$$\varphi_i(v) = \sum_{\substack{T \subset N \\ i \in T}} \frac{(t-1)!(n-t)!}{n!} \left[v(T) - v(T - \{i\}) \right]$$

References

Aghion, P., Hart O. and J. Moore (1992) "The Economics of Bankruptcy Reform", *The Journal of Law, Economics and Organization* July, 1992, pp. 523-546.

Bebchuk L., (1988), "A New Approach to Corporate Reorganizations", *Harvard Law Review*, Vol 101, pp 775-804.

Bienvenu S, (2006), "Loi de sauvegarde : caractéristiques des différentes procédures et critères de choix", *La Lettre de l'Observatoire Consulaire des Entreprises en Difficultés*, Vol. 28, July 2006.

Bienvenu S, (2008), "La conciliation", *La Lettre de l'Observatoire Consulaire des Entreprises en Difficultés*, Vol. 32, July 2008.

Chopard B. and E. Langlais (2009), "*Défaut de paiement stratégique et loi sur les défaillances d'entreprises*", Working paper of BETA, ULP, Starsbourg.

Chopard B., J.D. Guigou, A. Fimayer and R. Blazy, (2007), "*Financial versus Social Efficiency of Corporate Bankruptcy Law : The French Dilemma*", 3rd Annual Conference on Empirical Legal Studies Paper.

Couret,A., N., Morvilliers and G.A. de Sentenac, (1995), "*Le traitement amiable des difficultés des entreprises*", (1995), Economica.

Favario, T (2009), "De l'attractivité du droit des entreprises en difficultés", *Revue des Procédures Collectives*, July -August 2009, pp. 23-28.

Fisher T.C.G. and J. Martel, (1999), "Should We Abolish Chapter 11 ? Evidence from Canada", *Journal of Legal Studies* , Vol. 28, pp. 233-257.

Gertner R. and D.Scharfstein, (1990), "A Theory of Workouts and the Effects of Reorganization Law", *Journal of Finance*, Vol 46, No. 4, pp. 1189-1222.

Hart, O., (2000), "*Different Approaches to Bankruptcy*", Annual World Bank Conference on Development Economics, Paris, June 21-23, 1999.

Morrison, E.R. (2007), "Bankruptcy Decision Making: An Empirical Study of Continuation Bias in Small-Business Bankruptcies", *The Journal of Law and Economics*, Vol. 50, pp. 381-419.

Saintourens, B, (2009), "Ordonnance du 18 décembre 2008 : l'esprit et la lettre", *Actualité des Procédures Collectives Civiles et Commerciales*, Vol. 1, January 2009.

Shapley, L.S. and S. Lloyd (1953), "*A Value for n-Person Games*", in H. W. Kuhn and A. W. Tucker, *Contributions to the Theory of Games*, Vol. II, "*Annals of Mathematics Studies*, Vol. 28, pp. 307-317.

Shapley, L.S. and M. Shubik (1954), "A Model for Evaluating the Distribution of Power in a Committee System", American Political Science Review, Vol. 48, pp. 787-792.

Tashjian, E., R.C. Lease, and J.J., Mc Connell (1996), "Prepacks: An Empirical Analysis of Prepackaged Bakruptcies", *Journal of Financial Economics*, Vol 40, pp. 135-162.

Weiss, L.A. and V. Capkun (2007), "*Bankruptcy Resolution: Priority of Claims with the Secured Creditor in Control*", American Law & Economics Association Annual Meetings Working Paper 34.

White, M.J., (1994), "*The Costs of Corporate Bankruptcy : A U.S.-European Comparison*", in "Bankruptcy : Economic and Legal Perspectives", J. Bhandari, ed. Cambridge University Press,1-37.

Annexure I
The notion of equity expected profitability

To analyze the relation between the non liquidation condition and the leverage ratio, we used the well-known leverage relation

$$RF = RE + (RE - r)\frac{D}{FP}$$

wehre, RF expresses the equity expected profitability ;
RE represents the economic expected profitability ;
r represents the refinancing rate ;
$\frac{D}{FP}$ expresses the debt to equity ratio.

Annexure II
Two numerical examples on reorganization

A2.1 *A numerical example in the hypothesis of a non late reorganization*

Consider $N = \{1,2,3\}$, the creditors set of the distressed firm, with bids such as $c(\{1\}) = 10$, $c(\{2\}) = 15$, $c(\{3\}) = 5$, $c(\{1,2\}) = 20$, $c(\{1,3\}) = 10$, $c(\{2,3\}) = 15$ and $c(\{1,2,3\}) = 24$.

To calculate[12] the Shapley value, we begin to determine the creditors' requirements. For the creditor 1, we have

– $c(\{2,1\}) - c(\{2\}) = 20 - 15 = 5$: coalition $\{1,2\}$ leads to save up costs thanks to the integration of the creditor 1 in the coalition. This costs reduction (marginal gain) is appropriated by the creditor 1 (maximal requirement). For instance, in our analysis this would implies the attribution of cheaper equities to the creditor 1 in the reorganization process.

- $c(\{3,1\}) - c(\{3\}) = 10 - 5 = 5$
- $c(\{2,3,1\}) - c(\{2,3\}) = 24 - 15 = 9$; the coalition of creditors 1, 2 and 3 lead to a better result than the coalition of creditors 2 and 3, on one side, and the coalition of creditor 1, on the other side.

For the creditor 2, we obtain:

- $c(\{1,2\}) - c(\{1\}) = 20 - 10 = 10$
- $c(\{3,2\}) - c(\{3\}) = 15 - 5 = 10$
- $c(\{1,3,2\}) - c(\{1,3\}) = 24 - 10 = 14$
- For the creditor 3, we have:
- $c(\{1,3,2\}) - c(\{1,3\}) = 24 - 10 = 14$ $c(\{1,3\}) - c(\{1\}) = 10 - 10 = 0$
- $c(\{1,2,3\}) - c(\{1,2\}) = 24 - 20 = 4$ $c(\{2,3\}) - c(\{2\}) = 15 - 15 = 0$

So, we obtain the following table (Table A1)

Table A1
A Numerical Example in the Hypothesis of a non Late Reorganization

Coalition composition order (permutation) N = {1,2,3}	**Creditors' requirements levels: e_i**			**Probabilities**
	{1}	{2}	{3}	
(123)	$c(\{1\}) - c(\varnothing) = 10$	$c(\{1,2\}) - c(\{1\}) = 10$	$c(\{1,2,3\}) - c(\{1,2\}) = 4$	1/6
(231)	$c(\{1,2,3\}) - c(\{2,3\}) = 9$	$c(\{2\}) - c(\{\varnothing\}) = 15$	$c(\{3,2\}) - c(\{2\}) = 0$	1/6
(312)	$c(\{3,1\}) - c(\{3\}) = 5$	$c(\{1,2,3\}) - c(\{1,3\}) = 14$	$c(\{3\}) - c(\varnothing) = 5$	1/6
(321)	$c(\{1,2,3\}) - c(\{2,3\}) = 9$	$c(\{3,2\}) - c(\{3\}) = 10$	$c(\{3\}) - c(\varnothing) = 5$	1/6
(213)	$c(\{2,1\}) - c(\{2\}) = 5$	$c(\{2\}) - c(\varnothing) = 15$	$c(\{1,2,3\}) - c(\{1,2\}) = 4$	1/6
(232)	$c(\{1\}) - c(\varnothing) = 10$	$c(\{1,2,3\}) - c(\{1,3\}) = 14$	$c(\{3,1\}) - c(\{1\}) = 0$	1/6
$\phi_i(c) = \sum_{i=1}^{6} p_i e_i$	$\frac{48}{6} = 8$	$\frac{78}{6} = 13$	$\frac{18}{6} = 3$	

Note : A numerical example in the hypothesis
Source : Self Computed

The Shapley value is the vector $(\varphi_1(c), \varphi_2(c), \varphi_3(c))$ such as

$$\begin{cases} \varphi_1(c) = \dfrac{48}{6} = 8 < c(\{1\}) = 10 \\ \varphi_2(c) = \dfrac{78}{6} = 13 < c(\{2\}) = 15 \\ \varphi_3(c) = \dfrac{18}{6} = 3 < c(\{3\}) = 5 \end{cases}$$

- The incentive condition is verified. We have: $\varphi_i(c) < c(\{i\})\ \forall i = 1,2,3$.
- The participation condition is verified if:

$$RF^a \varphi_i(c) \geq r\varphi_i(c) \Leftrightarrow RF^a \geq r$$

- Knowing that $\sum_{i=1}^{3} c(\{i\}) = 30$ and $c(N) = 24$, the non liquidation condition is such as

$$RF^a c(N) \geq r \sum_{i=1}^{3} c(\{i\}) \Leftrightarrow RF^a \geq r \frac{\sum_{i=1}^{3} c(\{i\})}{c(N)} \geq r \frac{30}{24} = \frac{5}{4} r$$

$$= 1.25r = r(1 + 25\%)$$

The equity expected profitability would have to exceed 1,25 times the refinancing cost r.

— The relation between the non liquidation condition and the leverage ratio leads to two situations of viability if we follow a non liquidation strategy:
— A viable and non precarious non liquidation strategy:

$$r \leq \frac{c(N)}{\sum_{i=1}^{3} c(\{i\})} RE^a = \frac{4}{5} RE^a = 0.8\, RE^a$$

The refinancing cost cannot exceed 80% of the economic expected profitability. In other words, the maximum refinancing rate (ceiling rate) is equal to 80% of the economic expected profitability:

$$\tilde{r}_{max1} = \frac{c(N)}{\sum_{i=1}^{3} c(\{i\})} RE^a = 0.8\, RE^a$$

– A viable but precarious non liquidation strategy

$$\tilde{r}_{max1} = \frac{c(N)}{\sum_{i=1}^{3} c(\{i\})} RE^a = 0.8\, RE^a$$

– A viable but precarious non liquidation strategy

$$r \geq \frac{c(N)}{\sum_{i=1}^{3} c(\{i\})} RE^a = \frac{4}{5} RE^a = 0.8\, RE^a$$

The refinancing cost exceeds 80% of the economic expected profitability, leading to require from employees a higher profitability; such requirements rising up with the refinancing cost. Such a situation is probably not sustainable on a long period explaining why the reorganization is precarious. In this case, the minimal value of the refinancing cost (floor rate) is:

$$\tilde{r}_{min1} = \frac{c(N)}{\sum_{i=1}^{3} c(\{i\})} RE^a = 0.8\, RE^a$$

A.2.2 *A numerical example in the hypothesis of a late reorganization*

This example is built from the previous one on the basis of the hypothesis 3 of the renegotiation model. This hypothesis points out the three following ideas.

First, the expected reimbursement at the date $t + 1$ is higher than the expected reimbursement at the date t, that is $\left(R_N^p\right)_{t+1} > \left(R_N^p\right)_t \quad \forall t \in \{t_0, t_1, ..., t_k, ..., t_n\}$, with t_0

corresponding to the period for which the renegotiation is immediate and t_n corresponding to the period for which the renegotiation is stopped (no solution is found). In this last case, each creditor recovers its individual bid enhanced with the regret to have not invested this money between t_0 and t_n.

Second, note $c_t(N)$, the bid of the large coalition at the date t. This bid $c_t(N)$ is function of the expected reimbursement. It is such as:

$$c_t(N) = f\left(\left(R_N^p\right)_t\right) = \left(R_N^p\right)_t - R_N^e \text{ with } f' = \frac{dc_t(N)}{d\left(R_N^p\right)_t} > 0$$

The interpretation is that the more time passes the more the regret is high (and so the bid).

Third, consider that $c_t(S) \to \sum_{i \in S} c_t(\{i\})\ \forall S \subset N$, when $t \to t_n$. The interpretation is that the more time passes toward a date for which no solution will be found, the more the bid of a coalition S will approach the total of individual bids of members of the coalition S.

So, consider $N = \{1,2,3\}$, as in the previous example, the set of creditors of the distressed firm. Also consider that the reorganization is later than in the previous case. The new structure of bids which we will note c^* can be such as

- $c^*(\{1\}) = c(\{1\}) + \varepsilon c(\{1\})$ with $\varepsilon \in [0,1]$. Assume that $\varepsilon = 0,2$ as $c(\{1\}) = 10$ then $c^*(\{1\}) = 12$. We assimilate ε to a given investment rate.
- $c^*(\{2\}) = c(\{2\}) + \varepsilon c(\{2\})$ with $\varepsilon \in [0,1]$. Assume that $\varepsilon = 0,2$; as $c(\{2\}) = 15$ then $c^*(\{2\}) = 18$.
- $c^*(\{3\}) = c(\{3\}) + \varepsilon c(\{3\})$ with $\varepsilon \in [0,1]$. Assume that $\varepsilon = 0,2$; as $c(\{3\}) = 5$ then $c^*(\{3\}) = 6$.

We always know, following the hypothesis 3, that $c_t(S) \to \sum_{i \in S} c_t(\{i\})$. So, we pursue the building of c^* in the following manner:

$$c^*(\{1,2\}) \to c^*(\{1\}) + c^*(\{2\})$$

that is: $c^*(\{1,2\}) = (c^*(\{1\}) - \lambda) + (c^*(\{2\}) - \lambda) = 11 + 17 = 28$

with $\lambda = 1$ which allow the game suradditivity.

In the same manner

$$c^*(\{1,3\}) \to c^*(\{1\}) + c^*(\{3\})$$

that is: $c^*(\{1,3\}) = \left(c^*(\{1\}) - \lambda\right) + \left(c^*(\{3\}) - \lambda\right) = 11 + 5 = 16$

with $\lambda = 1$

In the same manner

$$c^*(\{2,3\}) \to c^*(\{2\}) + c^*(\{3\}),$$

that is: $c^*(\{2,3\}) = \left(c^*(\{2\}) - \lambda\right) + \left(c^*(\{3\}) - \lambda\right) = 17 + 5 = 22$

with $\lambda = 1$

In the same manner

$$c^*(\{1,2,3\}) \rightarrow \begin{cases} c^*(\{1\}) + c^*(\{2\}) + c^*(\{3\}) = 36 \\ c^*(\{1\}) + c^*(\{2,3\}) = 40 \\ c^*(\{2\}) + c^*(\{1,3\}) = 34 \\ c^*(\{3\}) + c^*(\{1,2\}) = 34 \end{cases}$$

As the game has to be suradditive, we will consider the lower bid. The common bid tends toward this value: 34.

We can have

- $c^*(\{1,2,3\}) = \left(\left(c^*(\{2\}) + c^*(\{1,3\})\right) - \lambda\right) = 32$ with $\lambda = 2$
- $c^*(\{1,2,3\}) = \left(\left(c^*(\{3\}) + c^*(\{1,2\})\right) - \lambda\right) = 32$ with $\lambda = 2$

So, we have the following new game integrating a longer reorganization delay

$c^*(\{1\}) = 12$, $c^*(\{2\}) = 18$, $c^*(\{3\}) = 6$, $c^*(\{1,2\}) = 28$, $c^*(\{1,3\}) = 16$

$c^*(\{2,3\}) = 22$ and $c^*(\{1,2,3\}) = 32$

To calculate the Shapley value, we begin to determine the creditors requirements.

For the creditor 1, we have

- $c^*(\{2,1\}) - c^*(\{2\}) = 28 - 18 = 10$
- $c^*(\{3,1\}) - c^*(\{3\}) = 16 - 6 = 10$
- $c^*(\{2,3,1\}) - c^*(\{2,3\}) = 32 - 22 = 10$

For the creditor 2, we have

- $c^*(\{1,2\}) - c^*(\{1\}) = 28 - 12 = 16$
- $c^*(\{3,2\}) - c^*(\{3\}) = 22 - 6 = 16$
- $c^*(\{1,3,2\}) - c^*(\{1,3\}) = 32 - 16 = 16$

For the creditor 3, we have

- $c^*(\{1,3\}) - c^*(\{1\}) = 16 - 12 = 4$
- $c^*(\{2,3\}) - c^*(\{2\}) = 22 - 18 = 4$
- $c^*(\{1,2,3\}) - c^*(\{1,2\}) = 32 - 28 = 4$

We obtain the following table (Table A2):

Table A2
Numerical Example in the Hypothesis of a Late Reorganization

Coalition composition order (Premutation) N = {1,2,3}	**Creditors' requirements levels: e_i**			**Probabilities: p_i**
	{1}	{2}	{3}	
(123)	$c^*(\{1\}) - c^*(\varnothing) = 12$	$c^*(\{1,2\}) - c^*(1) = 16$	$c^*(\{1,2,3\}) - c^*(\{1,2\}) = 4$	1/6
(231)	$c^*(\{1,2,3\}) - c^*(\{2,3\}) = 10$	$c^*(\{2\}) - c^*(1) = 16$	$c^*(\{3,2\}) - c^*(2) = 4$	1/6
(312)	$c^*(\{3,1\}) - c^*(3) = 10$	$c^*(\{1,2,3\}) - c^*(\{1,3\}) = 16$	$c^*(\{3\}) - c^*(\varnothing) = 6$	1/6
(321)	$c^*(\{1,2,3\}) - c^*(\{2,3\}) = 10$	$c^*(\{3,2\}) - c^*(\{3\}) = 16$	$c^*(\{3\}) - c^*(\varnothing) = 6$	1/6
(213)	$c^*(\{2,1\}) - c^*(\{2\}) = 10$	$c^*(\{2\}) - c^*(\varnothing) = 18$	$c^*(\{1,2,3\}) - c^*(1,2) = 4$	1/6
(132)	$c^*(\{1\}) - c^*(\varnothing) = 12$	$c^*(\{1,2,3\}) - c^*(1,3) = 16$	$c^*(\{3,1\}) - c^*(1) = 4$	1/6
$\varphi_i(c^*) = \sum_{i=1}^{6} p_i e_i$	$\frac{64}{6} = \frac{32}{3} \approx 10,667$	$\frac{100}{6} = \frac{50}{3} \approx 16,667$	$\frac{28}{6} = \frac{14}{3} \approx 4,667$	

The Shapley value is the vector $(\varphi_1(c^*), \varphi_2(c^*), \varphi_3(c^*))$ such as

$$\begin{cases} \varphi_1(c^*) = \dfrac{32}{3} \approx 10,667 < c^*(\{1\}) = 12 \\ \varphi_2(c^*) = \dfrac{50}{3} = 16,667 < c^*(\{2\}) = 18 \\ \varphi_3(c^*) = \dfrac{14}{3} \approx 4,667 < c^*(\{3\}) = 6 \end{cases}$$

- The incentive condition is verified. We have: $\varphi_i(c^*) < c^*(\{i\}) \ \forall i = 1,2,3$.
- The participation condition is verified if:

$$RF^a \varphi_i(c^*) \geq r \varphi_i(c^*) \Leftrightarrow RF^a \geq r$$

- Knowing that $\sum_{i=1}^{3} c^*(\{i\}) = 36$ and $c^*(N) = 32$, the non liquidation condition is such as:

$$RF^a c^*(N) \geq r \sum_{i=1}^{3} c^*(\{i\}) \Leftrightarrow RF^a \geq r \frac{\sum_{i=1}^{3} c^*(\{i\})}{c^*(N)} \geq r \frac{36}{32} = \frac{9}{8} r = 1,125r = r(1+12.5\%)$$

In this late reorganization case, the equity expected profitability would have to exceed 1,125 times the refinancing cost r (remember that, in the previous case, the equity expected profitability had to exceed 1,25 times the refinancing cost). The more the renegotiation exit is delayed, the more the difference between the equity expected profitability and the refinancing cost tends towards zero.

- The relation between the non liquidation condition and the leverage ratio leads to two situations of viability if we follow a non liquidation strategy:
- A viable and non precarious non liquidation strategy

$$r \leq \frac{c^*(N)}{\sum_{i=1}^{3} c^*(\{i\})} RE^a = \frac{8}{9} RE^a = 0.889\, RE^a$$

In this late reorganization case, the refinancing cost r is closer to the expected economic profitability (in the previous case, we had: $r \leq \frac{4}{5} RE^a = 0.8RE^a$). The more time passes, the more the refinancing cost tends towards the expected economic profitability and the more the equity expected profitability RF^a is low, leading to an increase in the liquidation probability. The ceiling rate $\tilde{r}_{\max 2} = 0.889\ RE^a$ is higher than in the non late reorganization case.

– A viable but precarious non liquidation strategy:

$$r \geq \frac{c^*(N)}{\sum_{i=1}^{3} c^*(\{i\})} RE^a = \frac{8}{9} RE^a = 0.889\ RE^a$$

For a given profitability, the floor rate $\tilde{r}_{\min 2} = 0.889\ RE^a$ is higher than the floor rate $\tilde{r}_{\min 1} = 0{,}8\ RE^a$. Remember that, in the previous case, we had $r \geq \frac{4}{5} RE^a = 0.8\ RE^a$. So, in this situation, managers will have to require a higher profitability from employees. Such a requirement could probably not be born on a long time by employees, leading to a liquidation.

Another manner to explain differences between the inequality $r \geq \frac{8}{9} RE^a = 0.889\ RE^a$ and the inequality $r \geq \frac{4}{5} RE^a = 0.8\ RE^a$ is that a late reorganization lead to an enhancement of the refinancing cost. Lenders feel more distrust about the distressed firm because of such a delay in the reorganization. So, they decide to grant funds against higher refinancing rates, on average, so as to prevent a default.

Annexure II
Synoptic table of the rescue conditions and the bivalent refinancing policy
Table A3
Synoptic table

Coalition composition order (permutation) N = {1,2,3}	**Creditors' requirements levels: e_i**		**Probabilities: p_i**
(123)	$c^*(\{1\}) - c^*(\varnothing) = 12$	$c^*(\{1,2\}) - c^*(\{1\}) = 16$	$c^*(\{1,2,3\}) - c^*(\{1,2\}) = 4$	1/6
(231)	$c^*(\{1,2,3\}) - c^*(\{2,3\}) = 10$	$c^*(\{2\}) - c^*(\varnothing) = 18$	$c^*(\{3,2\}) - c^*(\{2\}) = 4$	1/6
(312)	$c^*(\{3,1\}) - c^*(\{3\}) = 10$	$c^*(\{1,2,3\}) - c^*(\{1,3\}) = 16$	$c^*(\{3\}) - c^*(\varnothing) = 6$	1/6
(321)	$c^*(\{1,2,3\}) - c^*(\{2,3\}) = 10$	$c^*(\{3,2\}) - c^*(\{3\}) = 16$	$c^*(\{3\}) - c^*(\varnothing) = 6$	1/6
(213)	$c^*(\{2,1\}) - c^*(\{2\}) = 10$	$c^*(\{2\}) - c^*(\varnothing) = 18$	$c^*(\{1,2,3\}) - c^*(\{1,2\}) = 4$	1/6
(232)	$c^*(\{1\}) - c^*(\varnothing) = 12$	$c^*(\{1,2,3\}) - c^*(\{1,3\}) = 16$	$c^*(\{3,1\}) - c^*(\{1\}) = 4$	1/6
$\phi_i(c^*) = \sum_{i=1}^{6} p_i e_i$	$\frac{64}{6} = \frac{32}{3} \approx 10{,}667$	$\frac{100}{6} = \frac{50}{3} \approx 16{,}667$	$\frac{28}{6} = \frac{14}{3} \approx 4{,}667$	

Note : Numerical example in the hypothesis of a late reorganization