Management Pay-off in Corporate Restructuring and the Optimal Composition of Corporate Debt.

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ABSTRACT:

In this paper, we build up a signaling model that links management pay-off in corporate restructuring (widely known as absolute priority violations) and optimal composition of a firm's debt. We show that in the event of corporate reorganization and the renegotiation of debt claims, the management receives a pay-off that consists of two elements. (a) A signaling component that sends a message to outside financiers about the quality of the reorganized firm. (b) Incentive components that induce the management to exert a higher level of effort resulting in a larger firm value. The signaling component of management compensation reduces the interest issued on *fresh* loans needed for refinancing *old* obligations. Faced with a liquidity crisis, the lending bank will prefer to reveal the quality of profitable projects to "arms-length" financiers in order to reduce the costs of refinancing of outstanding junior debt. We show that a renegotiated contract (one in which the manager's payoff is appropriately high and increasing in the firm value) can serve as a credible signal of project quality of a firm. As for the impact of ex-post renegotiations on the ex-ante choice financial structure, we show that the signaling component is fully priced (ex-ante) in the financing costs of the entrepreneur and does not affect the optimal composition of debt. On the other hand, the incentive component enhances the value of the firm and thus prompts the entrepreneur either to issue public debt (along with a senior private debt) or to resort to multiple lenders —a large bank coupled with smaller banks. Hence, it is not only the level but also the composition of debt that exert impact on firm value. Our result holds true when even we allow the bank to issue protective covenants that restrict the amount of the junior debt that a firm can issue. Finally, despite renegotiations, we show that the choice of optimal financial structure results in inefficient liquidation of assets due to endogenous debt-overhang effects.

1. **Introduction**:

A unique feature of debt contract is that terms and conditions written in the original contracts are more than often subject to renegotiations. This is particularly true in the context where the lender is a big bank or a major financial institution. It is well known that such renegotiations often take place whenever the borrowing firm is in financial distress. A host of empirical studies (see below) point out that more than often the outcome of debt renegotiations favors both the original share holders and the management group even if the latter defaulted on loans. Management pay-offs in reorganization are commonly known as violations in the absolute priority rule (APR, hereafter). Several empirical studies document that it is almost a norm that original shareholders and management receive a sizable pie even when they defaulted on past loans and the ownership is transferred to senior lenders. Betker (1995), Franks and Torous (1991) and Weiss (1990) report that the original shareholders retain substantial claims in the reorganized firm even after they failed to meet outstanding obligation to their erstwhile creditors. Betker (1995), Franks and Torous (1994) have shown that original shareholders receive some pay-off during the corporate restructuring about 75% of the time. Eberhart, Moore and Roenfield (1991) find that original shareholders and management retain 7.6% of the firm's value on average. Related empirical studies also show that security markets and bond markets very often anticipate such outcome in restructuring and consequently affect the price of securities and default premiums of the bonds. See Franks and Torous (1989), Gilson, John and Lang (1990) and Eberhart, Moore and Roenfield (1991) for impact of APR violations on the price of securities of financially distressed firms. These studies reveal that often private restructuring of debt not only allows the management to retain stakes in the reorganized firm but also makes both bond holders and share holders better off due to the positive reactions in the financial markets.

In this paper, we address the questions related to the above issues. They are as follows: (1) Under what set of circumstances, share holders and management receive stakes even after the failures in meeting debt obligations? In other words, under what circumstances, such violations in APR occur? (2) What is the relationship between these violations of APR and the value of bonds and equity ? (3) What is the impact of such

violation of APR rule (ex-post) on the choice of a firm's optimal debt structure ex-ante? (3) Are these violations efficient ex-post ?

In this paper, we demonstrate that the violations of APR take place if following factors are present *simultaneously* when default on loan takes place. (a) The pay-off to senior lenders from the proceeds of the on-going firm after meeting outstanding obligations (such as payment of outstanding junior public debt) of the distressed firm exceeds its liquidation value. (b) The quality of the projects of the reorganized firm is unknown to outside financial market to whom the current senior lender resorts for refinancing of the outstanding obligations. (c) The lending bank itself in the middle of liquidity crunch preventing the use of its own fund from refinancing other obligations of the bankrupt firm. Hence, in our model, management pay-off in financial distress and the resulting violations of APR are primarily due to financing and incentive considerations. We also show that the greater is the APR violations (i.e higher is the pay-off of the management), the lower is interest charged on fresh loans issued by the firm and hence the greater is the value of equity. We also show that pay-off to the management consists of two elements. (1) a signaling element that stems from the financing considerations and (2) incentive elements that prompt the management to work harder so that the firm does not go bankrupt for a second time. Turning to the question of the impact of ex-post renegotiations on the ex-ante choice financial structure, we show that the signaling component is fully priced in the financing costs and do not affect the optimal composition of debt. On the other hand, the incentive component enhances the value of the firm and thus prompts the entrepreneur either to issue public debt (along with a senior private debt) or to resort to multiple lenders. (a large bank coupled with smaller banks.) The upshot of this result is that not only the level of debt disciplines managers but the source and the composition of debt play an important role in the context of asymmetry of information. Another important conclusion that emerges from our analysis is that despite renegotiations of debt, we find that there is a trade-off between ex-ante and ex-post efficiency. The multiple nature of debt holders (i.e holders of junior, senior debt or private and public debt etc), enhances the value of the firm via incentive effects ex-ante, but it also leads to liquidation of projects even if they have positive NPV.

The intuitive explanation for our result is as follows. Consider a situation where a firm resorts to a large institutional creditor (which we call here private bank) as a major supplier of private debt, and, in addition issues some junior debt.[1] It is well recognized that, in the event of financial distress, the bank, because of its superior monitoring and bargaining position, exercises the monopoly control over liquidation or reorganization decisions. Although, while making such a decision, a bank ignores the interests of the borrower, it must, however, repay any outstanding junior debt in the event of reorganization. If the value of the reorganized firm is unknown to outsiders and the bank itself is in the middle of a liquidity crisis (so that it does not have sufficient funds to repay the outstanding junior debt), it may be profitable for bank to undertake costly actions that emit a credible signal to its financiers about the quality of the project of the reorganized firm. We show that a private bank can convey information about the quality of the project to its outside financiers via an appropriate contractual arrangement that stipulates sharing of the expected surplus with the entrepreneur. Therefore, the surplus that an entrepreneur receives in the event of reorganization, is a form of information rent conceded to her by the lending bank holding senior debt. Although, sharing the surplus is costly from the bank's point of view, it is offset by the cheaper financing that results in lower face value of the *new* debt that is issued in order to refinance the *old* junior debt. Hence, our explanation of violations of APR primarily rests on grounds of financing in the context of asymmetric information between inside lenders and outside financial markets. Since, APR violations take place only in a separating equilibrium, investors correctly infer the probability of default on the fresh loans. Hence, the higher is the management pay-off, the lower is the interest charged on new loans and also higher is the value of equity. This is consistent with the empirical findings that financial markets react positively to the news of APR violations.

We show that the expected surplus that goes to the entrepreneur increases with the volume of junior debt issued by her at the stage of financing. This leads us to address the second question. Does it pave the way for junior debt to serve as the entrepreneur's instrument for curbing ex-post information monopoly of the bank? In other words, will an entrepreneur choose to issue some sub-ordinate debt along with a senior bank debt as the

[1] The junior debt could be held either by public debt holders or it could be some other banks holding a sub ordinate loans. For our purpose, this distinction is not important as long as the junior debt holders can not

former increases the expected pay-off in case the firm steps into financial trouble? We show that the signaling component is priced fully in the sense that surplus conceded to entrepreneurs in the renegotiation stage will cause to a proportionate rise in the interest charged by the senior lender. Hence, ex-post gains of the managers stemming from signaling considerations in the restructuring stage will be fully offset by the rise in the interest cost. However, incentive component of the pay-offs increases the value of the firm, as the management tends to work harder. Issuing junior debt, simultaneously with senior debt, however, imposes costs. First of all, if the costs of refinancing (that is, volume of junior debt) are too large, the bank may liquidate the firm. In that event, the entrepreneur does not receive any pay-off. Second, since bank debt in our model is partly secure and senior, junior debt holders do not receive anything in the event of liquidation. As a consequence, the junior debt must have a larger face value in order to cover the losses, and becomes more expensive than the bank debt. The optimal composition of these two different types of debt balances these trade-offs between a greater size of the overall firm value and a smaller size of the surplus stemming from liquidation and a larger face value of junior debt. Thus, junior debt, along with senior private debt, finds its place in the optimal composition of a firm's capital structure.

The explanation (sketched above and substantiated below in *propositions* 2 and 3) behind the simultaneous existence of private and junior debt hinges on three important assumptions that are elaborated below:

(1) In the case of financial distress and consequent reorganization, the bank needs to hire managers to run the firm. It can either hire managers from an outside pool or it can retain the original entrepreneur to do the job. We assume that the bank (weakly) prefers retaining the original entrepreneur due to the specificity of the latter's expertise. This is also a very standard assumption employed in the literature. See Diamond and Rajan (1999)

(2) While the entrepreneur and the bank (insiders) can observe the value of the reorganized firm, the outside investors can not. That a bank can become an informed lender is a realistic assumption, as made abundantly clear in the literature (see Rajan

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coordinate their actions..

1992, Rajan and Winton, 1993). This assumption alludes to the specialized nature of bank lending which accompanies close monitoring of the firm and the collection of information regarding viability of current as well as future projects. However, such information is mostly soft in nature so that it can not be credibly conveyed to outsiders.

(3) Banks may suffer liquidity crisis that render them incapable of refinancing the firm in the event of reorganization. This assumption is vindicated by the extensive literature on liquidity crisis and banking (see, for example Diatragachi, et.al (2000) and Webb (2000)).

The paper is organized as follows: In section A, we briefly review the literature relevant to our paper. In section B, we introduce the basic model in a full information set up and show that there will be no violations of APR and consequently the firm will resort to a single source for obtaining debt finance. In section C, we introduce the asymmetric information model and show that APR violations indeed take place. The management receives stakes in the reorganized firm and we also explore effects of APR violations on the interest charged on new loans. In section D, we analyze the optimal mix of senior (bank) and junior debt by incorporating analysis done in section C. In a concluding section, we discuss further extensions of the model. All calculations are done in the mathematical appendix. We also include a list of notations used in this paper at the end for the convenience of the reader.

***Section A: Relationship with the literature*:**

The existing literature on multiple sources of debt is mostly concerned with the choice between private vs. public debt. The crucial distinction made between these two types of debt is that while private debt holders (bank or intermediary) closely monitor borrowers to alleviate moral hazard and adverse selection problems, the junior debt holders are "arms-length-investors". The production of information via close monitoring is beneficial but it leads to the informational monopoly of banks. This reduces the borrower's surplus from the project. Various models emphasize different aspects of the benefits and costs associated with revelation of information. Sharpe (1990) considers a

model where he investigates the role of contingent contracts in curbing informational monopoly of lenders. Diamond (1991) developed a model where borrowers acquire their reputation in the early phase of their lives by allowing themselves to be closely monitored making by banks. Later on, they save on the costs of monitoring by issuing public debt. Chemmanur and Fulgheri (1994) focus on reputation acquisition from the point of view of banks. Anticipating financial distress, borrowers are on the lookout for banks that would provide better financial services in hard times. Good banks signal their quality by spending greater resources in times of financial distress but also charge a higher rate of interest than public debt. Hence, the borrowers with a higher probability of distress would go for bank debt while the others issue public debt. Holmstrom and Tirole (1997) analyzes the choice between public debt and private debt in the context of of entrepreneurial moral hazard. They show that well capitalized firm would opt for public debt and the less capitalized firm would choose bank debt and the latter would bear the costs of monitoring. Rajan (1992) presents a model where borrowing from a bank involves a trade-off between the benefits associated with flexibility of loan terms in the event of recontracting and the costs that the borrower incurs when banks, by taking advantage of informational monopoly, extract a larger surplus from the entrepreneur in the event of renegotiations. Although ex-post rents captured by banks are reflected in the lower face value of bank debt, they nevertheless, distort the entrepreneur's effort incentives. The public debt holders, being dispersed in nature, do not claim any surplus from the entrepreneur. However, the public debt is more expensive because of the ex-post possibility of default. The higher rate of interest of public debt also alters the effort incentives of the entrepreneur. An entrepreneur cum borrower takes into account the costs and benefits associated with both types of debt. Rajan (1992) shows that borrowers with smaller bargaining power vis-a vis banks will opt for public debt and that the others will opt for bank debt.[2]

While our model shares the existing literature's assumptions involving the informational asymmetry between insiders (bank and entrepreneur) and outsiders (holders of junior debt), and the informational monopoly of banks, there are important differences. First, unlike the existing models where the borrower, in equilibrium, holds

[2] Rajan (1992) also considers long term as well as short term debt and different priority structures in order to examine the choice of the entrepreneur.

either private or public debt at a given point of time, we focus on the optimal composition of debt distributed among senior and junior lenders and how such composition is sensitive to outcome of renegotiation in the event of financial distress. Second, the sub-ordinate debt in our model could be held by either public debt holders or by a consortium of smaller banks. Third, we abstract from reputational considerations and bargaining of surplus between bank and an entrepreneur which are factors that have been studied extensively in the literature. Instead, we focus on the interaction between the financing decisions, the bank's incentive to truthfully reveal its private information in order to reduce the costs of refinancing public debt, and the entrepreneur's payoff. In other words, our explanation for the existence of public debt hinges on the information rent that it confers to the entrepreneur in corporate distress A recent contribution to this literature by Diatragachi (2000) also highlights the importance of liquidity problems of banks, and examines the optimality of borrowing from multiple banks. However, unlike us, this paper does not focus on the strategic use of junior debt in a situation where the firm acquires its private debt from a single bank. Berlin, John and Saunders (1996) discuss a scenario where a lending bank holds equity in the borrowing firm under financial distress so as to emit signal to other stakeholders that the firm is indeed a healthy one. The main difference between this paper and ours is that in our model, signaling takes the form of managerial compensation and we trace its impact on the optimal composition of debt.

Section B: The Model:

We develop a standard two-period (periods 0 and 1) and three date framework in order to analyze interactions between three types of agents – an entrepreneur, a private bank and junior debt holders. The entrepreneur's project requires a fixed amount of capital (represented by $\bar{k}$) to be operational. At the beginning of period 0, the entrepreneur borrows the entire amount by issuing either senior bank debt or junior debt or some combination of the two. Let k represent the amount of capital raised by issuing junior debt at the (gross) rate of interest R_p. The amount raised from incurring private debt is then ($\bar{k}$ - k), the interest on which is denoted by R_b. We assume, for simplicity, that the source of the entire private debt is a single bank, while there are numerous bondholders (or a consortium of small banks) who hold junior debt..

The sequence of events that take place in our model is outlined in the game tree drawn in figure 1. The outcome of the project (we label it as project 0), realized by the end of period 0, is stochastic: it generates a strictly positive return X_0 with probability q, and zero otherwise. We assume that X_0 is high enough for the repayment of all liabilities of the firm, in which case the game moves towards a node (*1a* in *figure 1*) at t =1 where entrepreneur decides whether she is going to take up a new project (project **1**). Since this node is not much relevant to the analysis below, we normalize the entrepreneur's pay-off in the node *1a* to be zero.[3]

If, on the other hand, the old project "fails", i.e. produces zero payoff, the game proceeds to the next period (t =1) towards the node *1b* (in *figure 1*), where the assets of the firm may either be liquidated, or reorganized to initiate the new project. This project can be thought of as a by-product or a sequel to the first project. The liquidation value of the firm at the beginning of period 1 is L, which is assumed to be strictly less than $\overline{k}$. A key feature of our framework is that at the onset of period 1, it is the owner of the residual cash flows who decides whether the firm should be liquidated or to be continued with the new project. If all loans are repaid, then the entrepreneur is in charge of making such a decision. (Node *1a*) On the other hand, if there is a failure at the end of the period 0, then loans due are not paid. In this event, ownership of the assets of the firm is transferred from entrepreneur to senior lender (bank). In that event the decision to continue or to liquidate rests with the private bank. (Node *1b*).

The returns from the continuation of the firm depend on the "type" of the new project that is developed. We assume that there is a continuum of potential projects any one of which may result from the redeployment of the firm's assets. We also assume that no ex-ante contracts can be written on project 1 at date 0.[4] Net cash flow from a typical project available to firm in the continuation stage depends on (1) effort expended by manager and (2) its probability of success (hence, on type of projects) denoted by p, where $p \in [0, 1]$. Hence, in the event of success (which occurs with probability p), the net cash flow, the end of period 1 (at date t =2), is $y(e)$, where e denotes managerial input. With probability $1 - p$, the project yields zero cash flow. In order to capture degree of risk associated various projects, we partition probability of success into two groups. For,

[3] This is done in order to avoid extra notations.
[4] See Grossman and Hart(1986) for discussion on the issue of incomplete contracts.

$p \in [0, \tilde{p}]$, the cash flow is y_1 for *a given level of effort* and for $p \in [\tilde{p}, 1]$, the cash flow is y_2. Our assumption is: $y_1 > y_2$ and $p_i y_1 < p_j y_2$ where $p_i \in [0, \tilde{p}]$ and $p_j \in [\tilde{p}, 1]$.

In a similar fashion, we assume that the management possesses two discrete and indivisible units of the managerial input, and that the net cash flow is increasing in the amount of the managerial input in the following manner

$$y(e) = \begin{bmatrix} = 0 & \text{if } e = 0 \\ = y_1 & \text{if } e = 1 \\ = y_1 + a & \text{if } e = 2 \end{bmatrix} \text{ for } p \in [0, \tilde{p}]$$

and

$$y(e) = \begin{bmatrix} = 0 & \text{if } e = 0 \\ = y_2 & \text{if } e = 1 \\ = y_2 + a & \text{if } e = 2 \end{bmatrix} p \in [\tilde{p}, 1]$$

These formulations above regarding the nature of cash flows are grounded on the following assumptions. (1) Efforts are value enhancing. (2) Larger cash flows are also associated with greater risks.[5] In *figure 2*, we draw the cash flow associated with the new project.

The managerial effort is chosen following the observation of p at the beginning of period 1. The opportunity cost of the first unit is zero, while the opportunity cost of the second unit of e is assumed to be C. We model (i) the variability of net returns to e, and (ii) the increasing marginal cost of managerial effort in such simple manner for purposes of ease of exposition. In period 0, all agents share the common knowledge that p is a random variable distributed over the interval [0,1] with $G(p)$ and $g(p)$ as the distribution function

[5] Such assumptions are very common in most of the literature. See Freixas and Rochet (1997) for a survey of various models in corporate finance. In an earlier version of this paper, we used a formulation where cash flows vary with probability in a continuous fashion. Since, it gave rise to the same qualitative results with a messier algebra, we chose to omit such approach.

and density function respectively. The realization of p occurs at the beginning of period 1, prior to the liquidation or continuation decisions.

The problem of coordinating between the many holders of junior debt makes renegotiation of its terms prohibitively costly in the event of default. This is in particular true if the sub-ordinate debt issued by the entrepreneur takes the form of public debt.[6] Each individual bondholder, holding junior debt, is also incapable of monitoring the firm and gathering information about its future possibilities. We further assume that the free-rider problem prevents the junior debt holders from acting in concert, either for purposes of monitoring and information acquisition, or for establishing seniority of claims. On the other hand, the bank possesses natural superiority in terms of monitoring, project assessment and bargaining power. Thus, in our model, bank debt is assumed to be senior to the rest of the debt issued by the entrepreneur. This, together with the advantages of information acquisition and the ability to renegotiate, imply the following three specific features that are crucial to our analysis:

(i) In case of default at the end of period zero, the bank reserves the right to take ownership of the firm's assets and make the decision for continuation or liquidation. With liquidation, the bank's payoff is given by L.

(ii) In case of continuation with project 1 at period 1, the bank has to repay any outstanding junior debt that the entrepreneur has raised in period 0. In case of liquidation, the bank gets L while the junior debt holders receive nothing. This reflects both the situation that it is legally binding to reach an agreeable settlement with bondholders in the event of a continuation decision, and the fact that coordination problems make all renegotiations with the numerous bondholders prohibitively costly. Consequently, the repayment of all past junior debts is assumed to be the only feasible settlement that allows continuation in our model.

[6] Since, restructuring of public debt are governed by the Trust Indenture Act of 1939, it is not easy to make modifications of the original debt claims. In this paper, we focus on a situation where junior debt has to be paid fully by the senior creditor, if it decides to reorganize the firm after the entrepreneur has defaulted on loans.

(iii) The bank, along with the entrepreneur, can acquire information about new ventures, while the junior debt holders remain uninformed. In particular, we assume that the realization of p is private information to the bank and the entrepreneur at the beginning of period 1. Thus, as is usual, we regard the bank to be in possession of monitoring technology that enables it to perfectly assess the type of the new project before deciding on liquidation or continuation of the firm.

As the above features imply, following default in period 0, the bank[7] enjoys ownership rights of the assets in place, and of the new project (if, after observing p, it decides on continuation). But a continuation decision involves balancing the returns it expects from the new project (as a residual claimant) against the costs of repaying the junior debt and of managerial compensation. Now, the manner of refinancing of the junior debt depends upon whether or not the bank has a liquidity crisis in period 1. If the bank has sufficient funds in period 1, it has the option of repaying the junior debt from its own resources. However, in the event of a liquidity crisis, refinancing involves raising funds from outside investors. We assume that ex-ante (in period 0), there is a probability μ that the bank might encounter a liquidity crisis in the next period (at t =1). As the paper demonstrates, the occurrence of a liquidity crisis has a significant impact on the costs of initiating the new project, and on the nature of the managerial compensation.

We assume the following sequence of decisions in period 1. In the beginning of period 1 (at t =1), the bank and the firm privately observe the realization of p. In addition, all parties observe whether or not the bank suffers a liquidity crisis at this time. The bank then announces the (output contingent) compensation schemes for management, and refinances the junior debt. The management then decides on the amount of e. The realization of the stochastic returns takes follows the management's move: if successful, the project yields $y(e)$ at the end of period 1 (t =2); otherwise, its net returns are zero.

Symmetric Information: a Benchmark Case:

We proceed with our analysis by first analyzing the benchmark case of symmetric information where all agents, including the holders of junior debt, are perfectly informed of the realized value of p at the beginning of period 1. Let F denote the cost of refinancing the junior debt from external sources. Obviously, F represents the face value of the *new* debt that is incurred in period 1(t =1) in order to repay the $R_p k$ to the bondholders of the previous period (t =0). For convenience, we assume that F is always low enough to ensure that $y - F$ is strictly positive for all p. Let $w_1(p)$ denote the compensation to the manager, contingent on the realization of positive returns. Then, a little reflection makes it clear that, if the realization of p is public information, a liquidity crisis has no effect on the bank's expected payoff from a continuation decision. Since, in this case, F satisfies $pF = R_p k$, the cost of refinancing the junior debt is the same whether the bank utilizes its own funds, or whether it borrows from external sources, to repay the bondholders. Furthermore, given our previous assumptions, the bank will pay the opportunity cost of investing only one unit of e to the manager. Let $z = pF$. Then, the bank will opt for continuation if the expected pay-off associated with the new project exceeds the liquidation value of the assets-in-place at the start of period 1, i.e., if

$$py_1 - z = L$$

which implies that there exists a critical p^* given by

$$p^* = \frac{L + z}{y_1} \qquad (1)$$

such that, for $p = p^*$, the bank restructures the firm, while it liquidates the assets if p is strictly less than p^*.[8]

[7] From now on, bank debt and senior debt will be used synonymously.
[8] We assume that y is large such that the R.H.S. of (1) never exceeds 1.

In period 0, the junior debt holders anticipate the reorganization possibilities and the face value of junior debt reflects the probability of loan recovery even when the firm initially fails to produce a positive return. Given that financial markets are ex-ante competitive and the assumption of a zero rate of return on risk–less loans, R_p satisfies

$$R_p k[q + (1-q)(1-G(p^*)] = k$$

when

$$R_p = \frac{1}{q + (1-q)[1-G(p^*)]} \qquad (2)$$

Similarly, R_b satisfies

$$qR_b(\bar{k} - k) + (1-q)[G(p^*)L + \int_{p^*}^{1}[py - R_p k]g(p)dp] = \bar{k} - k \qquad (3)$$

Equations (2) and (3) simply state that, ex-ante, all financiers (both bank and junior) are guaranteed their alternative return from the market. Since the signaling role of managerial compensation that is explored in the next section is redundant here, the bank pays the minimum (i.e. zero) to the management after reorganization, irrespective of the method of refinancing the junior debt. The expected pay-off of the entrepreneur at t = 0 is:

$$q[X_0 - R_p k - R_b(\bar{k} - k)] \qquad (4)$$

when, utilizing (2), (3) and (4), the pay-off of the entrepreneur at t = 0 can, alternatively, be represented as

$$p = qX_0 - \bar{k} + (1-q)[G(p^*)L + y_1 \int_{p^*}^{1} pg(p)dp] \qquad (5)$$

From (1), it is easy to establish that, for reasonably high y and q, p^* is increasing in k.

Hence, $\frac{dp}{dk} = -zg(p^*)z_k < 0$ [Since, $z_k > 0$ from (2)].

Since, entrepreneur's payoff is decreasing in k, junior debt is not issued at all in equilibrium.

Proposition 1: **(a) Whenever the outside financiers can observe the realization of (p), the management will not receive any stake in the reorganized firm. In other words, there will be no violations of the APR rule.**
(b) The entrepreneur will not find it optimal to issue junior debt when the realized value of p is public information prior to the liquidation decision of the bank.
© Liquidation is ex-post optimal because firm is liquidated only when the expected pay-off from the project is less than the liquidation value.

The intuitive explanation for the above proposition follows from the fact that an increase in k increases p^* and hence the probability of liquidation. Since liquidation involves zero payment to the junior debt holders, an increase in k will increase R_p and, therefore, R_b due to higher refinancing costs of the bank in the continuation phase. Consequently, in period 0, the cost of acquiring the necessary capital is unambiguously increasing in the amount of junior debt for the entrepreneur. Hence, the latter is better off by not issuing any junior debt under full information.

Section C: Asymmetric Information:

We now consider the case where, at the beginning of period 1, the entrepreneur and the bank observe the type of the second project but all other creditors remain uninformed. Following the failure of project 0, if the bank decides on continuation, it offers a compensation scheme to the management, and refinances the pre-existing junior debt. If the bank utilizes its own funds to repay the junior debt, it is clear that its cost of refinancing is $z = R_p k$, and it will pay only the minimum to management. On the other hand, if it suffers a liquidity crisis, and, in the continuation phase, has to depend on

outside sources for z, the cost of such refinancing will depend on the beliefs that these uninformed providers of finance form about the risk of failure associated with the new project. Specifically, the face value of the debt issued in period 1 will now be given by $F = \frac{Rpk}{p^e}$, where p^e, the expected probability of success of the new project, is given by beliefs of the uninformed agents regarding the realization of p. Banks, therefore, have the incentive to reduce the cost of refinancing by misrepresenting the degree of risk associated with their period 1 projects. Consequently, unless offsetting costs exist, a bank observing a low p would attempt to profit by emulating the decisions of a bank that observes a high p. Such misrepresentation will be absent if the decisions of a bank that relies on external funds for refinancing constitute an observable signal that credibly distinguishes each realization of p to uninformed lenders. We demonstrate that, in the Separating Equilibrium of the present game, liquidity-constrained banks that decide on continuation will, indeed, choose the level of managerial compensation in a manner that appropriately reflects the true project quality. In such a situation, the managerial compensation will be strictly increasing in the observed p, with the management earning a surplus for $p > p^*$. In the Perfect Bayesian Separating Equilibrium (henceforth PBSE) the consistency of beliefs will ensure that $p^e = p$, and $pF = R_p k$. Banks that do not face a liquidity crisis will utilize their own funds to refinance the junior debt and will, therefore, pay only the minimum that is necessary to induce the management to invest a unit of managerial input.

We derive the specific nature of managerial compensation that credibly signals the degree of risk associated with the new venture in the next proposition. Intuition suggests that such a compensation scheme is output contingent in order to avoid the moral hazard problem associated with the exertion of managerial effort. In fact, since there are only two alternative levels of managerial effort (either 1 or 2), and two strictly positive values of $y(e)$, a little reflection makes it clear that, at any $p = p^*$, it is adequate to consider only two classes of yield-contingent offers from the bank:

(i) $w_1(p)$ for $y(e) = y_i$, (i = 1,2)and zero otherwise, and

(ii) $w_2(p)$ if $y(e) = y_2 + a$, and zero for any lower level of return.[9]

While (i) results in the choice of $e = 1$ for any non-negative $w_1(p)$, (ii) is designed to provide incentive for the investment of two units of managerial input. Recall that the opportunity cost of the second unit of managerial input is C, and that e is chosen before y(e) is realized. This implies that any contract designed to induce $e = 2$ must specify $w_2(p) = \frac{C}{p}$ to be effective.

Now, intuition suggests that $w(p)$ must be increasing in p to be a credible signal of the realized value of p. Suppose that, in the PBSE of the game in period 1, if $p = p'$, the bank offers $w(p')$ contingent on the production of $y(e) = y$, and zero otherwise. The consequent expected payoff of the bank is then represented by

$$p'[y - w_1(p')] - z$$

Suppose that, for the same realization of p, the bank offers $w_2(p') = \frac{C}{p'}$, if $y(e) = y_2 + a$, and zero otherwise. Clearly, if $w(p') = \frac{C}{p'}$, and

$$p[y_2 - w(p')] - z = p(y_2 + a - \frac{C}{p'}) - z \qquad (6)$$

it is profitable for the bank to deviate to offering $w_2(p')$ in order to provide incentive for the higher level of application of managerial input. This raises the possibility that, as $w(p)$ increases with p, (6) may be satisfied with a strict equality at a suitably high $\hat{p}$ beyond which it is strictly profitable to pay for the additional effort in return for the extra payoff that it produces.

[9] Later on we show that the scheme (ii) is not feasible for $y = y_1 + a$

Note: Ex-ante, (before realization of p), compensation schemes resemble a "stock option" from the entrepreneur's point of view in the sense that they depend upon (a) nature of project (b) as well as on the actual realization of cash flows.

Proposition 2: **In the PBSE of the game between the bank, management and the outside lenders during the phase of reorganization, violations in APR takes place because the management is given equity stakes in the firm. In particular, the compensation awarded to management by banks facing liquidity crisis is represented by**

$$w_1(p) = z[(p^*)^{-1} - p^{-1}] - y \qquad \text{if } y(e) = y_2 \qquad (7)$$

and zero otherwise, if *p* is strictly less than $\hat{p}$. For *p* = $\hat{p}$, the compensation is

$$w_2(\mathrm{p}) = z[(p^*)^{-1} - p^{-1}] - y + a \qquad \text{if } y(e) = y_2 + a \qquad (8)$$

and zero for all lower levels of output. Here, $y = y_1 - y_2 > 0$ **Thus, the compensation is an increasing function of the realized value of *p*, and is discontinuous at $\hat{p}$, with**

$$\hat{p} = \frac{C + z}{a + \dfrac{z}{p^*} - y} \qquad (9)$$

Proof: The derivation of (7) is given in the appendix. The critical value $\hat{p}$ satisfies the equation $p[y_2 - w(p^*)] - z = p(y_2 + a - \dfrac{C}{p}) - z$. For $p = \hat{p}$, the compensation for management is

$$w_2(\hat{p}) = \frac{C}{\hat{p}} = \frac{z}{p^*} - \frac{z}{\hat{p}} + a \qquad (10)$$

if the cash flow from the project is $y_2 + a$.

Note: our assumption that $C > p^*[\{y_2 + a_2\} - y_1]$ (implying that if the project quality is too low, it is not worth spending extra effort as the cost exceeds expected incremental gains) ensures $\hat{p} > p^*$. For values of p higher than $\hat{p}$, an exercise similar to the derivation of (7) in the appendix establishes (8).

The proposition 2 states the nature of information rent that accrues to entrepreneur in the event of financial distress and liquidity crisis encountered by the inside bank. Interpretation of this proposition is as follows: Suppose that a bank claims that its project is of higher quality than p, it can obtain financing at a face value of $F = \frac{z}{p}$. Since the arms-length investors do not observe p, they know that a low quality project owner could claim the same. Hence, in order to convince the outside financiers, the bank offers the entrepreneur the surplus $[\frac{1}{p^*} - \frac{1}{p}]z$ that it extracts from financing. However, since a better quality project is also riskier, [cash-flows get reduced by $(y_1\text{-}y_2)$] the compensation is appropriately adjusted. This is the explanation for equation (7).

Since, signaling requires the compensation of the entrepreneur to be increasing in (p), the bank finds it optimal for the entrepreneur to work harder as the quality level crosses a threshold. Since with a larger cash flow (associated with greater effort), it is easier to repay the old debt, the bank offers a compensation scheme for manager that incorporates incentives to work harder. Equation (8) combines *incentive as well as signaling* aspects of such compensation schemes. The effect of the signaling element is manifested in the reduction of costs of financing and the incentive aspects of compensation scheme makes the room for junior debt to co-exist simultaneously with the senior bank debt. The proposition (3) below takes up the signaling aspects of financing and the proposition (4), in the next section, shows how the incentive aspects influence the optimal composition of debt.

Proposition 3: The larger is the compensation of the management (hence, greater is the magnitude of violations of APR), the lower is the costs of financing of the new loans.

Proof: We obtain the proof with the help of the following lemma:

Lemma 1: In a separating equilibrium $F(p)$ and $w(p)$ is inversely related.

Proof: It follows from writing the incentive compatibility conditions for two adjacent types and adding them. A detailed proof can be obtained from the authors on request.

Lemma 2: $w(p)$ is an increasing function of (p).

Proof: This follows from straightforward differentiation of (7) and (8).

Hence, the proposition follows combining these two lemmas.

Section D: Optimal Composition of Debt:

With asymmetric information and the separating equilibrium described in the above proposition, the ex ante payoff of the bank in period 0 differs from that in the previous section. The corresponding form of equation (3) (that is, the equation for the face value of bank debt) is now given as

$$qR_b(\bar{k}-k)+(1-q)[G(p^*)L+(1-m)\int_{p^*}^{1}(py_2-R_pk)g(p)dp+m\int_{p^*}^{\hat{p}}(py_2-w_1(p)-R_pk)g(p)dp$$

$$+m\int_{\hat{p}}^{1}[p\{y_2+a\}-w_2(p)-R_pk)g(p)dp=\bar{k}-k. \qquad (3')$$

The first term is the face value of the bank loan and the second term is the expected pay-off in case the manager fails to repay the face value. The expressions in the last term include the liquidation value as well as the surplus that the bank receives in the event of continuation. Since, the bank may encounter liquidity crisis in the continuation phase, it takes into account the expected cost of signaling in order to repay outstanding junior debt in order to make appropriate adjustments in the face value of its loan.

The face value of the junior debt is the same as before and is reproduced below:

$$R_p=\frac{1}{q+(1-q)[1-G(p^*)]} \qquad (2)$$

The expected pay-off of the entrepreneur at t = 0, is:

$$p = qX_0 - \bar{k} + (1-q)[G(p^*)L + y_2 \int_{p^*}^{1} pg(p)dp + \mu a \int_{\hat{p}}^{1} pg(p)dp \,] \qquad (11)$$

$$q[X_0 - R_p k - R_b(\bar{k} - k)] + (1-q)m[\int_{p^*}^{\bar{p}} w_1(p)\, g(p)dp + \int_{\bar{p}}^{1} w_2(p) g(p)dp]$$

Utilizing the face value of both junior debt as well as private debt from equations (2) and (3′), we can write the expected pay-off of the entrepreneur as (derived section B in the appendix.)

It differs from (5), its corresponding representation in section B, by the addition of the term $\mu a \int_{\hat{p}}^{1} pg(p)dp$. It is easy to check that, for suitably low values of z, $\hat{p}$ will be decreasing in z.

Proposition 4: **With asymmetric information, and a positive probability of a liquidity crisis, the entrepreneur chooses a positive level of the junior debt, along with senior bank debt.**

Proof: The first derivative of equation (11) with respect to k is given by (shown in the appendix, section C) is:

$$\frac{dp}{dk} = -zz_k g(p^*) + ma \quad \frac{z_k}{\left(a + \frac{zy_1}{L+z} - y\right)}\left[\frac{\hat{p}}{p^*}\frac{L}{L+z} - 1\right] g(\hat{p})$$

Evaluated at $z = 0$, the above expression becomes,

$$\left.\frac{dp}{dk}\right|_{z=0} = ma \quad \frac{z_k}{(a-y)}\left[\frac{\hat{p}}{p^*} - 1\right] g(\hat{p}) > 0$$

(Since $a - y \equiv a + y_2 - y_1 > 0$)[10]

Hence, a small amount of subordinate debt is always preferred by an entrepreneur ex ante.

It is easy to see that, under reasonable conditions on the parameters of our model, there will be an interior solution at a value of k that is strictly less than $\bar{k}$. In such a situation, the entrepreneur finds it optimal to maintain a mix of junior and senior private debt.[11]

We use figure 3 to illustrate the benefits of issuing a small amount of junior debt. The managerial pay-off function is drawn against the quality of the project p on the basis of proposition 2. The function takes a discreet jump at $\hat{p}_1$. This is because as the quality of the project increases, bank switches from a low powered incentive scheme to a high powered one that results in a larger amount of cash flow. An increased amount of junior debt (issued at t =0) outstanding for repayment curbs bank's profits. Hence, the bank finds it optimal to switch from a low effort intensive project to a high effort intensive projects at a lower level of (p). Hence, the threshold (p) decreases from $\hat{p}_1$ to $\hat{p}_2$, thereby, increasing expected pay-off of the manager, ex-ante. This is because the range from $\hat{p}_2$ to 1 is greater than the range from $\hat{p}_1$ to 1 as he raises the amount of junior debt marginally.

The consequence of issuing a small amount of junior debt leads to an endogenous debt overhang problem in period 1. Such a problem arises because the value of p^* now increases under asymmetric information. Since, $p^* = \frac{L+z}{y_1}$. Under the full information, the optimal value of z = 0. Since, $z > 0$, under asymmetric information, the corresponding value of p^* increases. The implication is : some projects with positive NPV are not taken up because of the past debt (junior) issued by the entrepreneur. Thus, we have the following proposition.

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[10] Strictly speaking, we do not need this assumption. If the assumption is violated, then all we need is that there is a minimum value of $z = (z_{min})$ at which $a + \frac{y_1 z_{\min}}{L + z_{\min}} - y \geq 0$. Since the expression $\frac{y_1 z}{L+z}$ is increasing in (z) and y is constant, such a ($z_{\min}$) always exists.

[11] For interior solution, we assume that $\bar{k}$ is large enough so that $\left.\frac{dp}{dk}\right|_{z=R_p \bar{k}} < 0$. Since p is continuous, it follows from the mean value function theorem that there exists an optimal $k=k^*$, such that $0 \leq k^* \leq \bar{k}$.

Proposition 5: The critical value of *p is higher than under symmetric information implying that some projects with positive NPV at date 1 will not be undertaken and thus there will be an inefficient liquidation of assets.**

Finally, since issuing of junior debt also curbs bank's information monopoly, it might issue covenants that might restrict the entrepreneur's power to issue the amount of junior debt. However, as long as, covenants are not entirely restrictive so that it does not ban the further issue of debt, the entrepreneur will issue junior debt up to the maximum size permitted by the bank. This is summed up in the proposition 5 below:

Proposition 6: If the maximum size of the junior debt that an entrepreneur can issue(imposed by bank) is given by k_v and the optimal junior debt is k^*, then the actual amount of junior debt issued by the entrepreneur is min.$\{k, k^*\}$.

Proof: The optimization problem is now:

$$Max.\ p = qX_0 - \bar{k} + (1-q)[G(p^*)L + y_2 \int_{p^*}^{1} pg(p)dp + \mu a \int_{\hat{p}}^{1} pg(p)dp\ ]$$

subject to $k \le k_v$

Since $\left.\frac{dp}{dk}\right|_{k=0} < 0$, (from proposition 2 above) and $\left.\frac{dp}{dk}\right|_{k=\bar{k}} > 0$, there exists a $k = k^*$ such that $k \le k^* \le \bar{k}$. Now, if $k_v > k^*$, the constraint is not binding. So k^* will be chosen. On the other hand, if $k_v < k^*$, the constraint binds and the optimal issue of junior debt will exhaust the covenant, i.e $k = k_v$.

5. **Conclusion**:

As stated in the introduction, the renegotiation of debt takes place very often in the event of financial distress. Empirical evidence suggests very often, the management and the controlling shareholders receive stakes in a reorganized firm. In this paper, we aim to explain that financial as well as incentive considerations give rise to such outcomes. Ex-ante, effects of such renegotiations give rise to a composition of debt that includes both senior bank debt and junior (public) debt. We contribute to this literature by considering the role of junior debt as a strategic instrument that curbs the information monopoly of banks. It is well known that under asymmetric information, owners of a viable project need to signal credibly to its new financiers in order to refinance the past debt. We have demonstrated that the lending bank's credible signals can consist of managerial compensation schemes to the original entrepreneur. We also showed that such schemes incorporate signaling effect to new financiers as well as incentive effect on the choice of efforts made by the entrepreneur. When an entrepreneur takes into account effect of such compensation schemes in the event of corporate reorganization, an appropriate mix of junior and private debt is an optimal outcome.

An interesting line of research would be to consider the effects of a change in the nature of debt claims in the event of reorganization. For example, either the entrepreneur or the bank can issue senior debt in the event of restructuring, or part of the existing debt could be swapped for equity. In our future research, we plan to investigate the effect of such debt restructuring on managerial compensation and on the ex-ante choice of the optimal mix of different types of debt.

Notations used in the paper:

a = Extra cash flow that is generated when the effort is at maximum.

C = Costs of extra effort

e = Level of effort

$F(p)$= Face value of the loan issued at t = 1 in order to repay outstanding junior debt (z)

$g(.)$ = The density function of the distribution of quality of projects available at t =1.

$G(.)$ = The distribution function.

$\bar{k}$ = Investment needed to undertake a project at date 0.

$\bar{k} - k =$ Bank debt issued at t =0

k = junior debt at t = 0.

p = Quality of project that is available at date 1(t = 1) and is a random variable.

q = The probability of success of project (0) undertaken at date 0.

R_j = Face value of j-class of debt. j = junior(p)/bank (b)

$R_p k \equiv z$ = outstanding junior debt.

X_0 = Cash flow from the project at t = 0.

y_i = Cash flow from the project available at t = 1. i = 1,2.

Mathematical Appendix:

Section A

Proof of the proposition 2:

We derive the case for $(e) = 1$.

Let the pay-off function of the bank in the reorganization mode be

$$u = u[p, F(p'), w(p')]$$

$$= p[y(p) - F(p') - w(p')] \qquad (1A)$$

where y = cash flow from the project 2, $F(p)$ = face value of the loan that bank of type p, raises from the market (or from other banks) in order to refinance the junior debt incurred by the entrepreneur at date 0, and $w(p)$ = managerial compensation that a bank of type (p) firm .

The incentive compatibility condition requires that

$$\frac{du}{dp'}[p, F(p'), w(p')]\Big|_{p'=p} = 0 \qquad \Rightarrow \qquad p[\frac{dy}{dp} - \frac{dF(p)}{dp} - \frac{dw(p)}{dp}] = 0 .$$

Hence,

$$\frac{dw(p)}{dp} = \frac{dy}{dp} - \frac{dF(p)}{dp} \qquad (2A)$$

The equation $(2A)$ has a nice interpretation. If a bank asks for a lower refinancing costs, (higher probability of success) [i.e, smaller $F(p)$] due to a higher realization of (p), then it must be offering a higher compensation to the entrepreneur so as to convey its private

information to the market adjusted for any changes in cash flow that accompany projects that claim to have a greater success rate.

The face value of the loan in a competitive financial market must satisfy the following relationship:

$$pF(p) = Rpk \equiv z. \qquad (3A)$$

For equilibrium to be separating, each announced (p) will be entitled to pay a unique (p). Hence,

$$F(p) + p\frac{dF}{dp} = 0 \qquad (4A)$$

Using (3A) in (4A), we get:

$$\frac{dF}{dp} = -\frac{F(p)}{p} = -\frac{z}{p^2} \qquad (5A)$$

Finally, using incentive compatibility condition (2A) generates the following:

$$\frac{dw}{dp} = \frac{z}{p^2} - y'(p) \qquad (6A)$$

where a prime (/) denotes derivative.

The equation (6A) is a simple first-order differential equation that gives the incentive compatible schedule of compensation for each (p). The solution to (6A) is given by:

$$w_1(p) = -\frac{z}{p} + y_i + C \qquad (7A)$$

where $y_i = y_1$, for $p \in [0, \tilde{p}]$ and $y = y_2$ for $p \in [\tilde{p}, 1]$

Where (C) is a constant of integration and can be found from the boundary condition:

$$-\frac{z}{p*} + y_1 + C = 0 ------------- (8A)$$

$w_1(p*) = 0$, where 0 = minimum compensation that a bank pays to the manager to run the firm . i.e, the lowest type (the bank which does not gain from reorganization) does not need to signal to the financial market. We can find the value of the constant by using (7A) and (8A) and is given by:

$C = \frac{z}{p*} - y_1$. Now (7A) can be written as :

$$w_1(p) = [\frac{1}{p*} - \frac{1}{p}]z - y. \qquad (9A)$$

where $y = y_1 - y_2$ [12]

For higher level effort (e = 2), the derivation of the equation (8) in the text can be done in a similar manner.

[12] Implicit assumption behind the derivation of the constant C is that at $p*$, $y = y_1$. This is done in order to expend with extra notations.

Section B

The expected pay-off of the entrepreneur is:

$$q[X_0 - R_p k - R_b(\bar{k} - k)] + (1-q)m[\int_{p^*}^{\bar{p}} w_1(p)g(p)dp + \int_{\bar{p}}^{1} w_2(p)g(p)dp]$$

The face value of the loan on public debt must satisfy the following equation.

$$R_p k[q + (1-q)(1-G(p^*)] = k$$

The corresponding equation for bank debt is:

$$qR_b(\bar{k} - k) + (1-q)[G(p^*)L + (1-m)\int_{p^*}^{1}(py_2 - R_p k)g(p)dp + m\int_{p^*}^{\hat{p}}(py_2 - w_1(p) - R_p k)g(p)dp$$

$$+ m\int_{\hat{p}}^{1}[p\{y_2 + a\} - w_2(p) - R_p k)g(p)dp = \bar{k} - k. \quad (3')$$

Adding last two equations and collecting terms, we get:

$$qR_p k + qR_b(\bar{k} - k) = \bar{k} - (1-q)[G(p^*)L + \int_{p^*}^{1} py_2 g(p)dp + ma\int_{\hat{p}}^{1} pg(p)dp)$$

$$+ m\{\int_{p^*}^{1} w_1(p)g(p)dp + \int_{\bar{p}}^{1} w_2(p)g(p)dp\}]$$

Substituting the above expression in the entrepreneur's expected pay-off function generates the following equation, which is equation (11) in the text.

$$p = qX_0 - \bar{k} + (1-q)[G(p^*)L + y_2\int_{p^*}^{1} pg(p)dp + \mu a\int_{\hat{p}}^{1} pg(p)dp] \quad (11)$$

Section C:

In order to find out the optimal composition of debt, we take derivative of equation (11) with respect to (k).

$$\frac{dp}{dk} = [(L - p^* y_1) g(p^*) \frac{dp^*}{dz} - m a_2 g(\hat{p}) \frac{d\hat{p}}{dz}] \frac{dz}{dk} \qquad \text{(A)}$$

Since, $\frac{dz}{dk} > 0$, it is the sign of the expression in the parenthesis that determines the optimality of issuance of junior debt.

$$p^* = \frac{L+z}{y_1} \text{ and } \hat{p} = \frac{C+z}{a + \frac{z}{p^*} - y} = \frac{C+z}{a + \frac{zy_1}{L+z} - y} :$$

Hence, $$\frac{dp^*}{dz} = \frac{1}{y_1} \qquad \text{(B)}$$

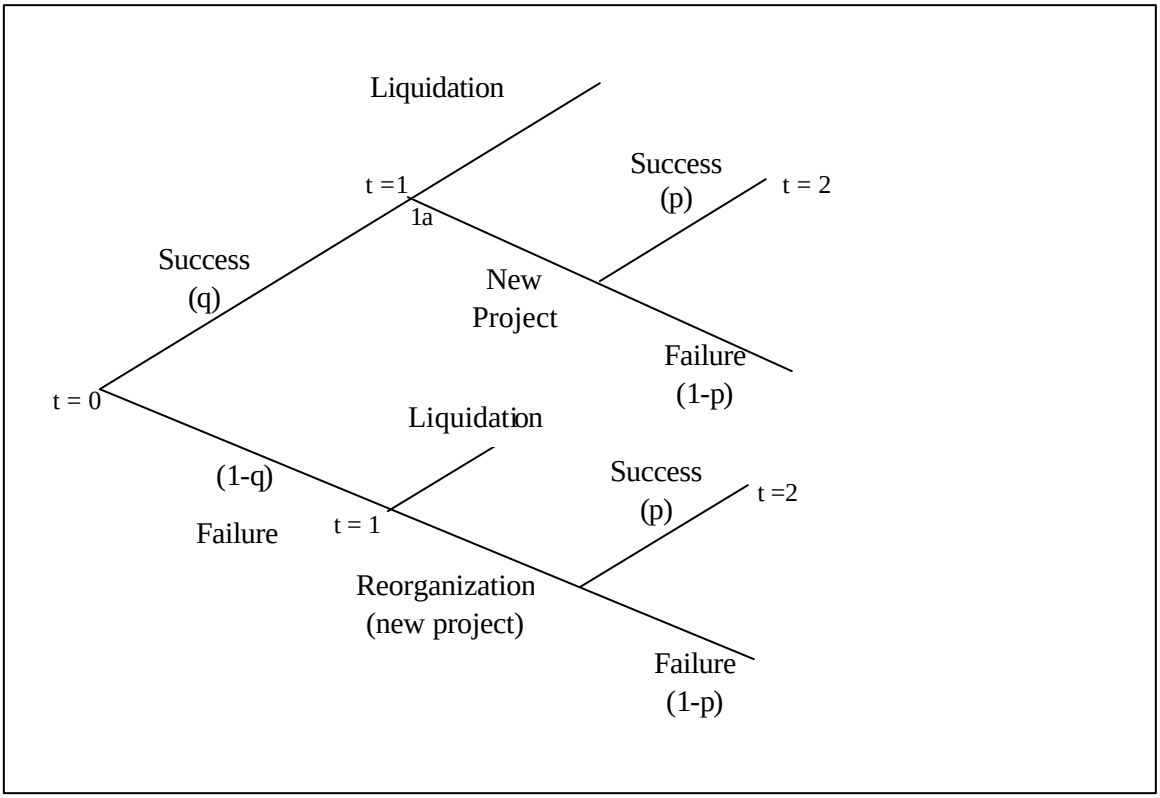
and $$\frac{d\hat{p}}{dz} = \frac{\left(a + \frac{zy_1}{L+z} - y\right) - (c+z)\left(\frac{(L+z)y_1 - zy_1}{(L+z)^2}\right)}{\left(a + \frac{zy_1}{L+z} - y\right)^2}$$

$$= \frac{1}{\left(a + \frac{zy_1}{L+z} - y\right)} - \frac{(c+z)\left(\frac{(Ly_1}{(L+z)^2}\right)}{\left(a + \frac{zy_1}{L+z} - y\right)^2}$$

$$= \frac{1}{\left(a + \frac{zy_1}{L+z} - y\right)}\left[1 - \frac{\hat{p}}{p^*}\frac{L}{L+z}\right] \qquad \text{(C)}$$

Substituting expressions from (B) and (C) into (A), we get the following expression that has been used in proposition 4.

$$\frac{dp}{dk} = -zg(p^*) + ma \quad \frac{1}{\left(a + \frac{zy_1}{L+z} - y\right)}\left[\frac{\hat{p}}{p^*}\frac{L}{L+z} - 1\right]g(\hat{p})$$


Liquidation
t =1
1a
Success
(p)
t = 2
Success
(q)
New
Project
Failure
(1-p)
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Liquidation
(1-q)
Success
(p)
t =2
Failure
t = 1
Reorganization
(new project)
Failure
(1-p)

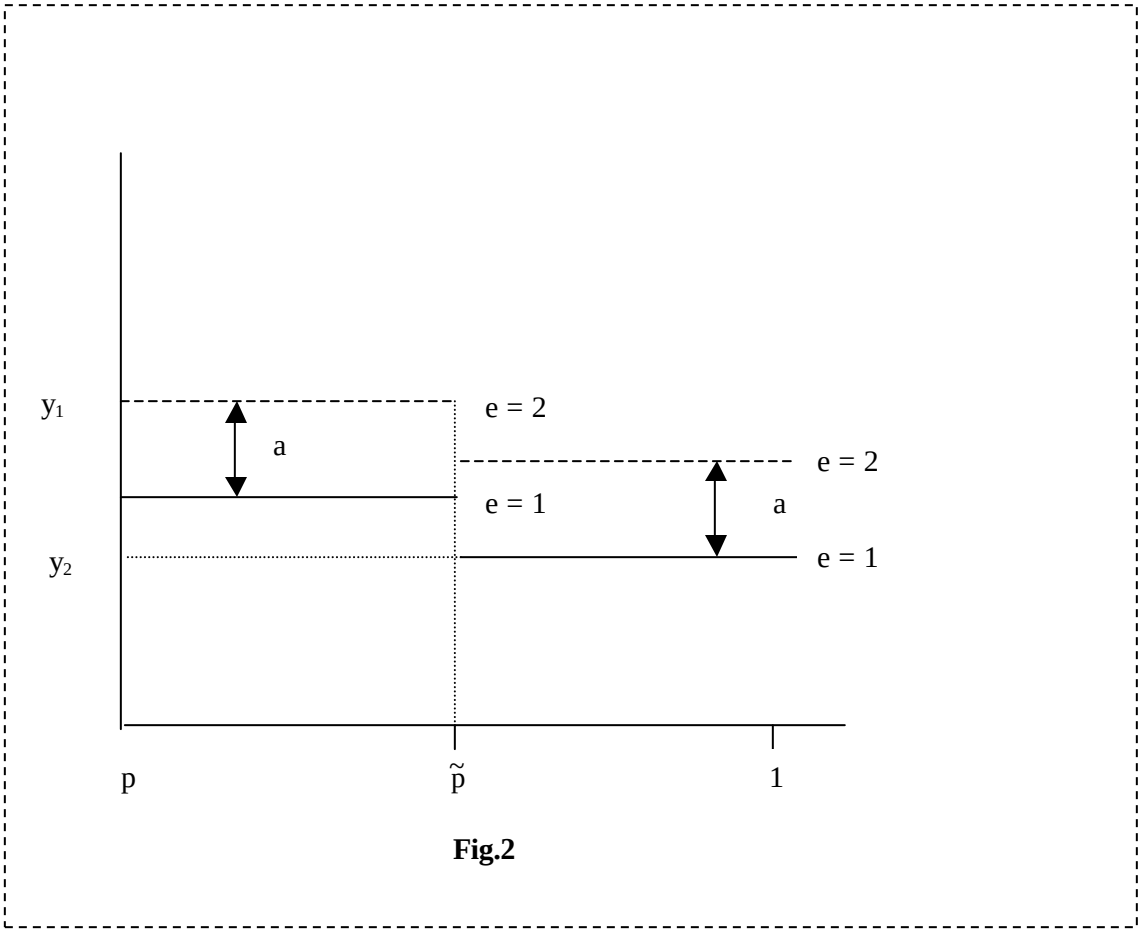

Fig.2

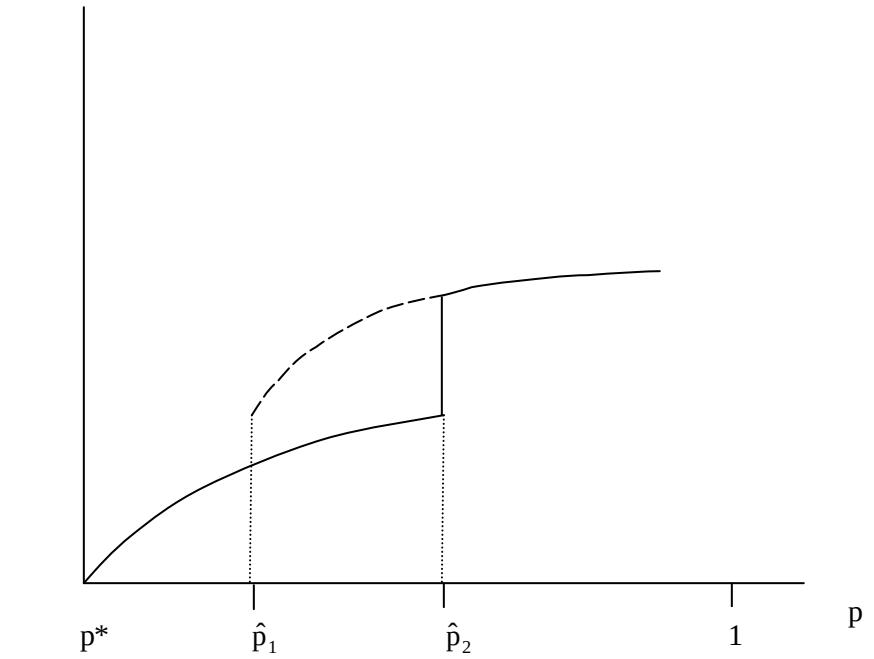

Fig. 3

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