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Financial Contract and Capital Allocation: A Comparison between Market-based Finance and Bank Finance *

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Abstract: I investigate financial contracting and subsequent capital allocation problems in an incomplete contracting framework and compare the results for two financial schemes: market-based finance and bank finance. At the time of the financial contract, the capital allocation is enforceable when the firm gains financing from banks, but not when gaining financing from market investors because banks have sufficient information and incentive to enforce a capital allocation in contrast to the market investors. The results show that (i) both financial schemes tend to result in under-investment; (ii) market-based finance results in a distorted allocation in favor of liquid assets (or short-term investments), whereas bank finance results in a distorted allocation in favor of illiquid assets (or long-term investments); and (iii) only bank finance eliminates under-investment and distorted allocation as liquidation loss disappears.

Keywords: Incomplete Contract, Capital Allocation, Financial Scheme
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1. Introduction

One of the most significant objectives of research on corporate finance is to explain how financial schemes affect capital allocation and the consequent cash flows. Even when focusing on a specific business line or project, financial schemes affect how firms allocate capital among several opportunities. I consider two distinct financial schemes, which I refer to as market-based and bank finance, and examine their effects on capital allocation between two opportunities in an incomplete contracting framework.

Hart and Moore (1998) explain that when cash flows are observable but not verifiable, the contract becomes be incomplete in that it cannot specify any cash flow contingent terms; in this case, the liquidation of project, which refers to a transfer of control rights from the original entrepreneur to their creditors, plays a significant role in the financing.[1] Moreover, Bolton and Scharfstein (1996) show that in general, stochastic liquidation rather than deterministic liquidation is optimal in the incomplete contracting framework.

Investment opportunities can be divided into two depending on whether or not the outputs are liquid or on the time at which the cash flows are realized. The key to this division is how transfers from the cash flows are implemented.

When cash flows are not verifiable, entrepreneurs have an incentive to repay only because their creditors would liquidate their project at an earlier time, thus eliminating their opportunity to enjoy the fruits in the future if they default on their payments. In this sense, the possibility to continue with a project effectively acts as collateral in the short run.

The market-based and bank finance schemes differ in the enforceability of capital allocation. Capital allocation is enforceable when the firm gains

financing from banks, but it is not enforceable when the firm gains financing from market investors because the bank has sufficient information and incentive to enforce the capital allocation in contrast to the market investors.

The results show that (i) both financial schemes tend to result in under-investment; (ii) market-based finance results in a distorted allocation in favor of liquid assets (or short-term investments), whereas bank finance results in a distorted allocation in favor of illiquid assets (or long-term investments); and (iii) only bank finance eliminates under-investment and distorted allocation as liquidation loss disappears.

This study relates to the considerable amount of research that compares bank finance and market-based finance.[2] One closely related study is Von Thadden (1995). He investigates the effect on intertemporal capital allocation with ex-ante monitoring in an asymmetric information framework, and shows that market-based finance leads to short-termism, a phenomenon in which entrepreneurs favor short-term opportunities. Bank finance mitigates this phenomenon. Dewatripont and Maskin (1995) also demonstrate short-termism under market-based finance in another setting. The result of this study is distinct in that it demonstrates that bank finance results in long-termism rather than only mitigating short-termism. I believe that long-termism could explain the real aspect of Japan's economic bubble in the late 1980s, for example.

Another closely related study is Dietrich (2007). He investigates, in an incomplete contracting framework, a capital allocation problem between two investment opportunities differentiated by asset tangibility and compares the results under transparent and opaque financial circumstances. The opportunity with more (less) tangible assets in his study corresponds to that producing illiquid asset (liquid asset) in this study, and the transparent (opaque) financial circumstances in his study correspond to bank (market-based) finance in this study. He shows, in line with my result, that transparency results in allocation distorted in favor of an opportunity with more tangible assets; however, he also shows that opacity does not result in distorted allocation, in contrast to my result.[3]

The rest of this paper is organized as follows. In Section 2, I introduce the basic model based on Bolton and Scharfstein (1996) and specify two distinct financial structures, market-based and bank finances. I solve the problems and compare the results under the respective financial schemes in Section 3. Finally, I provide the conclusion of this paper in Section 4. The proofs are presented in the Appendix.

2. Model

An entrepreneur has a technology with two investment opportunities: Investing x_1 in Opportunity 1 produces an output worth y_1 with probability $\theta \in (0,1)$ and nothing with probability $1-\theta$, and investing x_2 in Opportunity 2 produces output worth y_2 . Both y_1 and y_2 increase with the amount of the investment, but the marginal value of the outputs decrease with the amount. That is, the value of outputs y_1 and y_2 are described as $f_1(x_1)$ and $f_2(x_2)$, respectively, and $f_i' > 0$ and $f_i'' < 0$ hold for $i = 1, 2$. The output of Opportunity 1 is supposed to be a liquid asset or a cash flow at the time and that of Opportunity 2 is an illiquid asset or an asset producing cash flows at a future time with an expected value of y_2 .[4] The output of Opportunity 2 can be liquidated with a fixed cost of c > 0. Liquidation damages the value of the output. Specifically, suppose that the liquidation reduces the value from y_2 to αy_2, where $\alpha \in (0,1)$ represents the degree of liquidity of the output.[5] Let L denote the net liquidation value of $\alpha y_2 - c$ and assume that $L > 0$ holds in optima.

The entrepreneur has no wealth and must borrow from either a set of market investors or a bank with sufficient wealth to lend. Suppose that the entrepreneur, the market investors, and the bank are risk-neutral and the risk-less interest rate is zero.

The time structure is as follows. First, the

entrepreneur offers a borrowing contract and finances the investment if either the market investors or the bank accept the offer. After gaining financing, the entrepreneur determines how to allocate the capital; that is, the set of investment levels (x_1, x_2). Finally, the entrepreneur gains the realized outputs from the two opportunities and subsequently repays the lender(s) if he/she can and is willing to do so. At this time, either the entrepreneur or the lender(s) can liquidate the output of Opportunity 2.

Here, similar to Bolton and Scharfstein (1996), suppose that the production and liquidation technologies are well known while the flows of inputs, outputs, and liquidation are observable but not verifiable. Then, the financial contract specifies that the entrepreneur borrows an amount of K and is obliged to repay R , and the lender(s) can seize and liquidate the output of Opportunity 2 with probability β if the entrepreneur defaults on the obligation.[6]

When the obligatory repayment does not depend on the flow of outputs (and inputs), the entrepreneur has an incentive not to repay even when he/she can do so. Such a behavior is referred to as strategic default. Transferring the liquidation rights to the lender(s) has an effect to make the strategic default less preferable for the entrepreneur on the one hand. However, the liquidation causes an efficiency loss of $y_2 - L = (1 - \alpha)\, y_2 + \mathrm{c}$ even when the repayment is infeasible on the other hand. It follows that the stochastic transfer of liquidation rights is preferable to the deterministic one. By letting the entrepreneur receive nothing from the liquidation, the contract can reduce the entrepreneur's incentive to engage in strategic behavior most effectively. In practice, some firms are liquidated but other firms can continue their businesses with debt forgiveness in case of default. Then, the stochastic transfer of liquidation rights is less unrealistic.

Whether financing from the market investors (market-besed finance) or doing from the bank (bank finance) affects the implementation of capital allocation (x_1, x_2). Market investors are less informed about the capital allocation. Further, each investor has less incentive to enforce a certain capital allocation since he/she holds only a small stake in the credit. Therefore, the entrepreneur cannot commit to any capital allocation at the time of the financial contract in the case of market-based finance. Any covenants specifying capital allocation are not effective when the investments and their results are not verifiable. On the other hand, the bank is more informed about the capital allocation due to the close relationship with the entrepreneur. Further, he/she has more incentive to enforce a certain capital allocation since he/she holds the whole stake in the credit. Then, the entrepreneur can commit to any capital allocation at the time of the financial contract in the case of bank finance.

Given a specified contract, the entrepreneur's expected payoff when the entrepreneur repays in the good state, where he/she receives y_1 , is given by

$$\theta(y_1 - R + y_2) + (1-\theta)(1-\beta)y_2 + K - x_1 - x_2 \equiv \Pi_E. \qquad (1)$$

Since liquidation is inefficient, inducing repayment with no liquidation in the good state is preferable for the entrepreneur in optimum. Therefore, the entrepreneur chooses a pair of contract and capital allocation that maximizes Π_E subject to the constraints presented below.

First, the aggregate amount of investments cannot be more than the capital borrowed from the lender(s). That is,

$$x_1 + x_2 \le K, \qquad \text{(FCA)}$$

which is referred to as feasibility of capital allocation (FCA) constraint, must hold.

Second, the payoff for the lender(s) must be nonnegative. That is,

$$\theta R + (1-\theta)\,\beta L - K \ge 0, \qquad \text{(IR)}$$

which is referred to as individual rationality (IR) constraint, must hold.

Third, strategic default must not be preferable for the entrepreneur. That is,

$$y_1 - R + y_2 \ge y_1 + (1-\beta)\, y_2,$$

which reduces to

$$R \le \beta y_2 \qquad \text{(ICR)}$$

and is referred to as incentive compatibility for repayment (ICR) constraint, must hold.[7]

In addition, when the entrepreneur gains financing from a set of market investors, the capital allocation must be preferable for the entrepreneur given the financial contract chosen by his/herself. That is,

$$(x_1, x_2) = \text{argmax } \Pi_E \text{ s.t. (FCA), (ICCA)}$$

which is referred to as incentive compatibility for capital allocation (ICCA) constraint, must hold.[8]

Note that the amount of repayment cannot be more than the aggregate value of liquid assets. That is, $R \leq K - x_1 - x_2 + y_1$ must hold. Since it is illiquid, the entrepreneur cannot use the output of Opportunity 2 for the repayment.[9] In order to focus the (ICR) constraint, I assume that this constraint is not binding, which is the case in which investing in Opportunity 1 is sufficiently productive, similar to Bolton and Scharfstein's (1996) setting. Further, note that $\beta \leq 1$ must hold since β is a value of probability. As is explained in Bolton and Scharfstein (1996), when this constraint is binding, the project is not financeable. Then, I assume that this constraint is not binding. In general, x_1 and/or x_2 can be zero in optima. However, for explanatory simplicity, I assume that both $x_1 > 0$ and $x_2 > 0$ hold in optima.

The first-best outcome, where no incentive problem matters, is as follows. The entrepreneur finances a sufficient amount for the first-best capital allocation where the marginal product equals the marginal costs of the investments in each opportunities; that is, the first-best capital allocation (x_1^{FB}, x_2^{FB}) statisfies

$$\theta f_1'(x_1^{FB}) = f_2'(x_2^{FB}) = 1, \quad (2)$$

and subsequently chooses this capital allocation. He/she repays a sufficient amount to the lender(s) in the good state and continues with the project without liquidation even after the bad state comes true. Here, the first-best outcome cannot be achieved if the entrepreneur cannot repay a sufficient amount in the good state.[10]

3. Solution and Comparison

First, I consider the outcome in the case of market-based finance. The entrepreneur maximizes his/her expected payoff subject to the (IR), (ICR), and (ICCA) constraints. Let (x_1^M, x_2^M) be the optimum capital allocation. Then the following proposition holds.

Proposition 1. (x_1^M, x_2^M) *satisfies*

$$f_2'(x_2^M) > \theta f_1'(x_1^M) \geq 1, \quad (3)$$

and this condition holds even when (α, c) converges to (1,0).

This proposition implies that under market-based finance, the incentive problems cause under-investments at least in Opportunity 2, which produces an illiquid asset (or long-term cash flow), and a distorted allocation in favor of Opportunity 1, which produces a liquid asset (or short-term cash flow). These results would remain unchanged, even when the loss of liquidation disappears.

The intuition behind these results is as follows. The liquidation rights must be transferred with a positive probability to incentivize the entrepreneur to repay. When this is the case, the marginal benefit for the entrepreneur to invest in Opportunity 2, which is written as

$$\{\theta + (1-\theta)(1-\beta)\} f_2', \quad (4)$$

is below the marginal product of the investment f_2' due to the possibility of liquidation, and then the level of investment is less than the first-best level in Opportunity 2; that is, $x_2^M < x_2^{FB}$. In contrast, the marginal benefit for the entrepreneur to invest in Opportunity 1 is equal to the marginal product of the investment, $\theta f_1'$. Since the entrepreneur allocates the capital such that the marginal benefit for the entrepreneur to invest in both opportunities are equal; that is,

$$\theta f_1'(x_1^M) = \{\theta + (1-\theta)(1-\beta)\} f_2'(x_2^M), \quad (5)$$

so the marginal product of the investment in Opportunity 1 is less than that in Opportunity 2; that is, $\theta f_1'(x_1^M) < f_2'(x_2^M)$. This property implies that the

entrepreneur allocates the capital in favor of the investment in Opportunity 1. Whether the optimum level of investment in Opportunity 1 is equal to or below the first-best level, x_1^{FB}, is indeterminate because increasing the amount of borrowing, K, to increase x_1 produces several conflicting effects.[11] Since a positive probability of liquidation is required to incentivize the entrepreneur to repay, the under-investment and distorted allocation still emerge even when the liquidation loss disappears.

Next, I consider the outcome in the case of bank finance. In this case, the entrepreneur maximizes his/her expected payoff subject to the (FCA), (IR), and (ICR) constraints. Let (x_1^B, x_2^B) be the optimum capital allocation. Then the following proposition holds.

Proposition 2. *(i)* (x_1^B, x_2^B) *satisfies*

$$\theta f_1'(x_1^B) > f_2'(x_2^B) > 1, \tag{6}$$

and (ii) $(x_1^{B**}, x_2^{B**}) \equiv \lim_{c\to 0}(x_1^B, x_2^B)$ satisfies

$$\theta f_1'(x_1^{B**}) = f_2'(x_2^{B**}) > 1 \tag{7}$$

and $(x_1^{B*}, x_2^{B*}) \equiv \lim_{(c,\alpha)\to(0,1)}(x_1^B, x_2^B)$ *satisfies*

$$\theta f_1'(x_1^{B*}) = f_2'(x_2^{B*}) = 1. \tag{8}$$

The result of (i) in this proposition implies that under bank finance, the incentive problems cause under-investments in both opportunities and a subsequent distorted allocation in favor of investing in Opportunity 2, which produces an illiquid asset (or long-term cash flow), in contrast to the market-based finance case.

The explanation of the result is as follows. First, note that the (IR) and (ICR) constraints are binding. Intuitively, the entrepreneur could heighten the objective by lowering R if the (IR) constraint were not binding, and he/she could heighten the objective and satisfy the constraints by increasing R and lowering β if the (ICR) constraint were not binding. Then, the entrepreneur's objective can be rewritten as

$$\theta y_1 + y_2 - K - (1-\theta)\beta(y_2 - L), \tag{9}$$

where the last term represents the expected liquidation loss, and the probability of liquidation rights transfer reduces to

$$\beta = \frac{K}{\theta y_2 + (1-\theta)L}, \tag{10}$$

where the denominator of the right-hand side represents the maximum feasible gross payoff to the bank; the creditors can induce the entrepreneur to repay y_2 in the good state and can collect L in the bad state if they certainly receive the liquidation rights.

An increase in the investment in Opportunity 1, x_1, requires to increase the amount of borrowing, K, and then to increase β in order to keep the bank's payoff at the break-even level. Increases in β increase the expected liquidation loss and then reduce the entrepreneur's payoff. Therefore, the marginal benefit for the entrepreneur to invest in Opportunity 1 is lower than the marginal product, and then $x_1^B < x_1^{FB}$ holds.

An increase in the investment in Opportunity 2, x_2, has the same effect to increase β and to reduce the entrepreneur's payoff. However, it also has other two effects. On the one hand, it has an effect to decrease β and then to increase the entrepreneur's payoff because it increases the maximum feasible gross payoff to the creditors. On the other hand, it has an effect to increase the liquidation loss, $y_2 - L$, and then to reduce the entrepreneur's payoff. The investment level in Opportunity 2 and the distorted allocation between the two opportunities depend on the relative significance of these three effects.

The result shows that the first effect dominates the second one and then increasing x_2 increases β. Therefore, the marginal benefit for the entrepreneur to invest in Opportunity 2 is lower than the marginal product and then $x_2^B < x_2^{FB}$. In addition, the result also shows that the second effect dominates the third one and then the first effect is mitigated by the composition of the second and third ones. It follows that the allocation is distorted in favor of Opportunity 2. In other words, the entrepreneur is willing to allocate the capital to Opportunity 2, instead of Opportunity 1, because it has an effect to increase the

creditor's maximum feasible gross payoff and then lower the probability of liquidation, though it has another effect to increase the liquidation loss, which is dominated by the former effect.

The results of (ii) in this proposition imply that the distorted allocation would disappear when the liquidation cost c approaches zero and further the capital allocation would approach the first-best one if the liquidation loss disappears. The result shows that the second and third effects of increasing x_2 would balance if the liquidation cost were zero. It follows that the negative effects of increasing x_1 and x_2 is equivalent, and then the allocation is not distorted if this is the case. The under-investments in both opportunities would remain, even if it were the case. When there was no liquidation loss any more, the effects to increase β would not matter and then no allocational distortion would appear.

Summing up the results in Propositions 1 and 2, the following can be stated.

Theorem. *(i) The levels of investment tend to be below the first-best levels under both market-based and bank finance. (ii) The capital allocation is distorted in favor of opportunities producing liquid assets (or short-term investments) under market-based finance, whereas it is in favor of opportunities producing illiquid assets (or long-term investments) under bank finance. (iii) The destorted allocation disappears as the liquidation cost desappears, and the tendency of under-investment disappears as the liquidation loss desappears only under bank finance.*

Needless to say, the entrepreneur's expected payoff under bank finance is more than that in the case of market-based finance; since the incentive compatibility of capital allocation is not required, the entrepreneur can choose more profitable contract and capital allocation under bank finance. However, it is noteworthy that the under-investment and distorted allocation still appear under bank finance, where any capital allocation is enforceable, as long as liquidating illiquid assets or projects before completion produces some degree of loss.

The result in Proposition 1 implies that market-based finance results in short-sighted management. This implication is similar to those in Dewatripont and Maskin (1995) and Von Thadden (1995).

In contrast, the result in Proposition 2 implies that bank finance results in long-sighted management. This result, which is novel in this study, could explain the Japanese economy's bubble in the late 1980s, for example. In that era, firms that used bank finance invested excessively in illiquid assets (long-term projects), especially in projects to develop leisure and resort facilities, rather than liquid assets (short-term projects). Once the economy deteriorated, even firms with positive continuation values were liquidated in some cases due to the defaults on their payments. Since long-term investments were chosen more intensively, the frequency of liquidation and the level of liquidation loss after the bubble collapse was fairly impressive for many people.

Dietrich (2007) also investigates a capital allocation problem in an incomplete contracting framework. He shows that under transparent financial circumstances, which correspond to the bank finance case in my study, capital allocation is distorted in favor of investment opportunities with more tangible assets, similar to the finding of my study. However, he presents that under opaque financial circumstances, which correspond to the market-based finance case in my study, there is no distortion in the allocation. This result is in contrast to the findings in Dewatripont and Maskin (1995), Von Thadden (1995), and this study.

A comparison among these studies is summarized in Table 1. This study contributes to the literature by showing both short-sighted management under market-based finance and long-sighted management under bank finance in an incomplete contracting framework.

Table 1: Financial schemes, financial circumstances, and investment decisions.

Financial Scheme	Market-based Finance	Bank Finance
This Study	Distortion in favor of liquid asset (or short-term return)	Distortion in favor of illiquid assets (or long-term return)
Dewatripont and Maskin(1995), Von Thadden (1995)	Short-sighted management	N/A
Financial Circumstances	Opaque	Transparent
Dietrich (2007)	No distortion	Distortion in favor of tangible assets

4. Conclusion

I investigate financial contracting and subsequent capital allocation problems in an incomplete contracting framework and compare the results for two financial schemes; market-based finance and bank finance. At the time of financial contract, the capital allocation is enforceable under bank finance but not under market-based finance because the bank has sufficient information and incentive to enforce a capital allocation in contrast to the market investors.

When the output of a project is not verifiable, the optimal financial contract requires liquidation of the project with a positive probability in case of default in order to incentivize the entrepreneur to repay. Under market-based finance, this possible liquidation lowers the marginal benefit for the entrepreneur to invest in opportunities producing illiquid assets, which then results in under-investment in these opportunities and an allocation distorted in favor of opportunities producing liquid assets. These problems would remain even when the liquidation loss disappears since the probability of liquidation would be still positive.

When financing from a bank, the entrepreneur will encounter interdependence between the financial contract and capital allocation, and must especially note effects of capital allocation on the terms of the financial contract. An increase in the amount of borrowing has an effect to heighten the necessity of liquidation and to reduce the entrepreneur's expected payoff, regardless of whether the capital is allocated to opportunities producing liquid or illiquid assets. However, allocating capital to opportunities producing illiquid assets has the other effects of lowering the necessity of liquidation and increasing the liquidation loss. The former effect dominates the latter one, and then these effects combined mitigate the marginal cost for the entrepreneur to invest in opportunities producing illiquid assets. Therefore, financing from a bank results in under-investments in both opportunities and distorted allocation in favor of opportunities that produce illiquid assets. When the liquidation produces no loss, a higher probability of liquidation creates no marginal cost for the entrepreneur. Therefore, the under-investment and distorted allocation would disappear if the liquidation loss disappears.

Appendix: Proofs

Proposition 1

The incentive compatibility of the capital allocation (ICCA) constraint can be replaced by its first-order conditions:

$$\theta f_1'(x_1) - 1 - \xi = 0, \qquad \text{(A.1)}$$

$$\{\theta + (1-\theta)(1-\beta)\} f_2'(x_2) - 1 - \xi = 0, \qquad \text{(A.2)}$$

$$\xi(K - x_1 - x_2) = 0, \quad \xi \geq 0, \qquad \text{(A.3)}$$

where ξ is the Lagrange multiplier for the feasibility of the capital allocation (FCA) constraint. These conditions imply that

$$f_2'(x_2^M) > \theta f_1'(x_2^M) = 1 + \xi \geq 1 \qquad \text{(A.4)}$$

holds if $\beta > 0$ is satisfied.

As is explained in the text, both the individual rationality (IR) and incentive compatibility of repayment (ICR) constraints must hold with equality, and consequently,

$$\{\theta y_2 + (1-\theta)L\}\beta = K \qquad \text{(A.5)}$$

must hold. Here, K must be positive since $K \geq x_1^M + x_2^M$, $x_1^M > 0$, and $x_2^M > 0$ are assumed. Therefore, β must be positive and then the result holds.

Proposition 2

The (IR), (ICR), and (FCA) constraints must hold with equality and $\beta > 0$ is satisfied in optimum, similar to the case of marketbased finance. Then, β reduces to

$$\frac{x_1 + x_2}{\theta y_2 + (1-\theta)L} \equiv \beta^R , \qquad \text{(A.6)}$$

where the denominator represents the maximum feasible gross payoff to the bank as is noted in the text.

Substituting the (IR), (ICR), and (FCA) constraints with equalities, the entrepreneur's expected payoff can be rewritten as

$$\theta y_1 + y_2 - x_1 - x_2 - (1-\theta)\beta^R (y_2 - L) \equiv \Pi_E^R, \qquad \text{(A.7)}$$

where the first four terms represent the net value of the project, and the last term represents the expected liquidation loss; in the bad state with probability $1-\theta$, liquidation occurs with probability β^R and generates a loss of $y_2 - L$. Then, the maximization problem can be replaced by the problem of maximizing Π_E^R with respect to (x_1, x_2) .

Differentiating Π_E^R with x_1 and x_2 , the following holds:

$$\frac{\partial \Pi_E^R}{\partial x_1} = \theta f_1^{'} - 1 - (1-\theta)\frac{\partial \beta^R}{\partial x_1}(y_2 - L) \qquad \text{(A.8)}$$

$$\frac{\partial \Pi_E^R}{\partial x_2} = f_2^{'} - 1 - (1-\theta)\frac{\partial \beta^R}{\partial x_2}(y_2 - L) - (1-\theta)\beta^R \frac{d}{dx_2}(y_2 - L) \qquad \text{(A.9)}$$

In the first equation,

$$\frac{\partial \beta^R}{\partial x_1} = \frac{1}{\theta y_2 + (1-\theta)L} > 0 \qquad \text{(A.10)}$$

holds. Therefore, one first-order condition of the above problem, $\partial \Pi_E^R / \partial x_1 = 0$, implies that $\theta f_1^{'}(x_1^B) > 1$ holds.

In the second equation, on the other hand,

$$\frac{\partial \beta^R}{\partial x_2} = \frac{1}{\theta y_2 + (1-\theta)L} - \frac{\{\theta + (1-\theta)\alpha\} f_2^{'}}{\theta y_2 + (1-\theta)L}\beta^R \qquad \text{(A.11)}$$

holds. Here, the second term represents the effect of an increase in the maximum feasible gross payoff to the bank. Note that $f_2^{'}(x_2^{FB}) = 1$ holds and then

$$0 < \{\theta + (1-\theta)\alpha\} f_2^{'}(x_2^{FB})\beta^R < 1 \qquad \text{(A.12)}$$

holds. Therefore, $\partial \beta^R / \partial x_2 > 0$ holds for $x_2 = x_2^{FB}$. In addition, the last term in $\partial \Pi_E^R / \partial x_2$ is negative since $d(y_2 - L)/dx_2 = (1-\alpha) f_2^{'} > 0$ holds. Therefore, another first-order condition of the above problem, $\partial \Pi_E^R / \partial x_2 = 0$, implies that $f_2^{'}(x_2^B) > 1$ holds.

$\partial \Pi_E^R / \partial x_2$ can be rewritten as

$$f_2^{'} - 1 - \frac{(1-\theta)(y_2 - L)}{\theta y_2 + (1-\theta)L} + (1-\theta)\beta^R \left\{ \frac{\{\theta + (1-\theta)\alpha\}(y_2 - L) f_2^{'}}{\theta y_2 + (1-\theta)L} - (1-\alpha) f_2^{'} \right\} \qquad \text{(A.13)}$$

while $\partial \Pi_E^R / \partial x_1$ can be as

$$\theta f_1^{'} - 1 - \frac{(1-\theta)(y_2 - L)}{\theta y_2 + (1-\theta)L}. \qquad \text{(A.14)}$$

Since the last term in (A.13) reduces to

$$\frac{(1-\theta)\beta^R c f_2^{'}}{\theta y_2 + (1-\theta)L} > 0, \qquad \text{(A.15)}$$

$\partial \Pi_E^R / \partial x_1 = \partial \Pi_E^R / \partial x_2$ leads to $\theta f_1^{'}(x_1^B) > f_2^{'}(x_2^B)$.

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1 The incomplete contracting framework is initiated by Grossman and Hart (1986) and applied to various fields of research such as corporate finance, industrial organization, and international trade.

2 Some studies consider an investors' action referred to as monitoring and explain that bank finance better facilitates monitoring compared to market-based finance (ex-ante monitoring by Diamond (1991) and Rajan (1992), interim monitoring by Chemmanur and Fulghieri (1994) and Dewatripont and Maskin (1995), and so on). Other studies consider ex-post negotiations and explain that bank finance eases the negotiation process, which improves ex-post efficiency but heightens the incentive to behave strategically (Berlin and Mester (1992), Bolton and Scharfstein (1996), Miyazawa (2012) and so on). Several studies consider the possibility of coexistence of both bank finance and market-based finance and examine optimal financial structures (Detragiache (1994), Repullo and Suarez (1998), Bolton and Freixas (2000), and so on). See Gorton and Winton (2003) for a survey.

3 His result also contrasts to those of Von Thadden (1995) and Dewatripont and Maskin (1995).

4 This setting is just a variation of that in Bolton and Scharfstein (1996), where they call these outputs date 1 and date 2 cash flows, respectively.

5 Bolton and Scharfstein (1996) consider a bargaining situation among creditors and a buyer

and show that the expected liquidation value depends on the number of creditors. In contrast, I suppose that the liquidation value does not depend on whether there are multiple creditors or not; that is, whether the entrepreneur relies on a set of market investors or a bank.

6 See Bolton and Scharfstein (1996) for a more precise explanation of the optimality of such a contract.

7 Bolton and Scharfstein (1996) consider a renegotiation following a strategic default. I disregard the possibility of renegotiation in this study for simplicity.

8 Following from the assumptions on $f_1(x_1)$ and $f_2(x_2)$, the solution to the maximization problem is unique.

9 Since it is inefficient, liquidating the illiquid asset to provide the repayment in the good state is never optimal.

10 The necessary and sufficient condition for this feasibility is $\theta y_1^{FB} \geq x_1^{FB} + x_2^{FB}$, where y_1^{FB} is equal to $f_1(x_1^{FB})$.

11 Increasing K has an effect to heighten β to incentivize the entrepreneur to repay. It consequently reduces the entrepreneur's expected payoff due to the liquidation loss. Furether, increasing K increases x_2, not only x_1. Increasing x_2 has three distinct effects as follows. The first effect is that it directly increases the entrepreneur's expected payoff since $x_2 < x_2^{FB}$ holds. The second effect is that it increases the liquidation loss of $y_2 - L$, which consequently reduces the entrepreneur's expected payoff. The third effect is that it lowers the liquidation probability of β: it heightens the incentive to repay and continue the project since it increases what to lose for the entrepreneur, y_2, on the one hand, and it reduces the necessity of liquidation since it increases what to get for the creditor, L, on the other hand. Lowering β consequently increases the entrepreneur's payoff. A more precise investigation is beyond the objective of this study.