DISCUSSION PAPER No. 04-E-001

Refinance and Coordination among Multiple Creditors and a Debtor Firm

Fumiko Takeda Koichi Takeda

April 2004

Refinance and Coordination among Multiple Creditors and a Debtor Firm*

FUMIKO TAKEDA† KOICHI TAKEDA‡

April 2004

Abstract

This paper investigates the conditions under which a large creditor provides a debtor firm with refinance and examines how it affects the decisions of the debtor firm and other creditors. Our analyses are based on a coordination game among multiple creditors and a debtor firm under incomplete information. We find that refinancing can increase the payoff of the large creditor only when the debtor firm faces a substantial, but not hopeless, risk of default. Whether the refinance succeeds in preventing the default caused by the coordination failure among creditors and the debtor firm, or incurs the moral hazard of the debtor firm, depends on how poor the fundamentals of the debtor firm are. Another finding is that the size of the refinance tends to be larger in cases where the prior lending by a large creditor was greater, resulting in more serious moral hazards.

JEL-Classification: D82, G32

Key words: refinance, moral hazard, coordination failure, incomplete information, global game

*Fumiko Takeda gratefully acknowledges financial support from Japan Post.

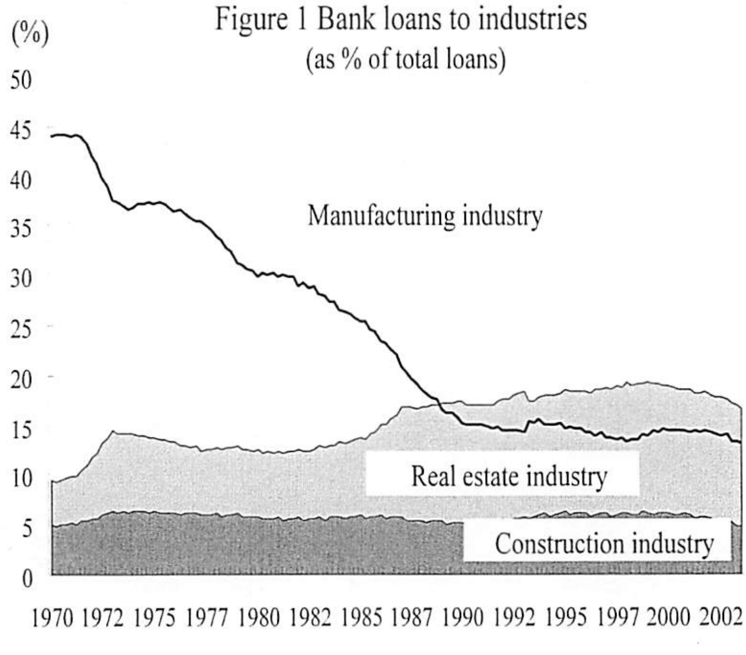
†Department of Geosystem Engineering, University of Tokyo. E-mail: takeda@geosys.t.u-tokyo.ac.jp

‡Faculty of Economics, Hosei University. E-mail: ktakeda@mt.tama.hosei.ac.jp

1 Introduction

Bad loan problems of Japanese financial institutions have been said to deter economic recovery after the collapse of the economic bubble in Japan. Many economists point out that Japanese banks postponed difficult decisions by refinancing, which was often escalated to *forbearance lending,*[1] instead of writing off nonperforming loans immediately. For example, Hoshi (2000) finds that since the mid-1990s bank loans to the real estate industry continued to rise, in contrast with the significant decrease in those to the manufacturing industry, although the profitability of the real estate industry was remarkably lower than that of the manufacturing industry. He argues that bank loans to the real estate industry were forbearance lending that did not induce new investment. Figure 1 shows that bank loans to the construction and real estate industries have exceeded those to the manufacturing industry from 1989 to the present. Kobayashi *et al.* (2002) also suggest the possibility of forbearance lending by estimating the loan demand and loan supply functions of major Japanese industries.

Figure 1 Bank loans to industries
(as % of total loans)



Source: Bank of Japan.

The purpose of this paper is to investigate the conditions under which a large creditor provides a debtor firm with forbearance lending and to examine how such

[1]We define forbearance lending as creditors' refinancing of unprofitable projects.

lending affects the actions of the debtor firm and other creditors. Previous theoretical studies of forbearance lending include those of Dewatripont and Maskin (1995), Berglof and Roland (1997, 1998), and Hosono and Sakuragawa (2003). Dewatripont and Maskin (1995) and Berglof and Roland (1997, 1998) analyze forbearance lending using a model with soft budget constraints.[2] They show that it is a rational choice for creditors to refinance an unprofitable project because of the sunk costs of prior investment. In contrast, Hosono and Sakuragawa (2003) focus on the distortion of bank managers' incentive due to the minimum capital requirement. They argue that bank managers have an incentive to disguise the bank's true balance sheet under an opaque accounting system, in order to satisfy the BIS capital adequacy ratio. In other words, bank managers are willing to put off the disposal of bad loans, so as to avoid decline in the book value of the bank capital. In either type of model, forbearance lending bails out inefficient firms and lowers economic efficiency on the whole.

Previous models on soft budget constraints and the BIS capital adequacy ratio study the situation where one creditor is engaged in forbearance lending but do not consider the effect of coordination failure among multiple creditors on the forbearance lending. This paper fills this gap by constructing a model of a coordination game among multiple creditors and a debtor firm. In our model, whether refinance causes moral hazard depends on three factors: financial fundamentals of the debtor firm, self-fulfilling beliefs, and the coordination among creditors and the firm. By classifying creditors into two categories - large and small - based on their size and influence on the firm, we examine the conditions under which a large creditor refinances a debtor firm and how such refinance leads to moral hazard for the debtor firm. We also analyze how the large creditor's refinance affects the coordination among small creditors.

Most of the large Japanese companies in the construction and real estate industries, which were severely damaged by the burst of the economic bubble, were provided loans not only by a single main bank but also by multiple creditors. When the debtor firm, which borrows money from multiple creditors, faces the risk of default, it is not rare that the creditors take non-cooperative action against each other to secure their claims. Such non-cooperative behavior would not occur if a given creditor were the only creditor to the firm. Taking this into account, it seems to be important to analyze the creditor coordination problem when investigating forbearance lending.

[2]Maskin (1996), Berglof and Roland (1998), and Kornai *et al.* (2003) provide theoretical surveys on soft budget constraints. Soft budget constraints were originally formulated by Kornai (1980) to illustrate economic behavior in socialist economies, in which the government bails out loss-making firms and thus undermines ex ante incentives. More generally, soft budget constraints are regarded as firms' lack of financial discipline when they receive ex post financial support that exceeds ex ante efficient amounts.

To examine the influence of forbearance lending on the behavior of creditors and the debtor firm, we employ a theoretical framework building on the global games literature. Global games, pioneered by Carlsson and van Damme (1993), are games with incomplete information whose type space is determined by the players, each of whom observes a private noisy signal of the underlying state.[3] Carlsson and van Damme (1993), Fukao (1994), Morris and Shin (1998), and Frankel *et al.* (2003) show that global games bring a unique equilibrium to the game where there are multiple equilibria when complete information of state variables is available. Thus, in contrast to the complete information game, global games enable us to use comparative statics to investigate the equilibrium resulting from the interaction between state variables and self-fulfilling beliefs.

Corsetti *et al.* (2002) and Morris and Shin (2003) used global games to describe the moral hazard of a debtor caused by coordination failure among creditors. These models describe the role of the IMF as an international lender of last resort, and analyze the conditions under which the assistance lending of the IMF leads to moral hazard of the debtor country. In our study we modify and extend the model of Morris and Shin (2003) by incorporating a large creditor. We present a theoretical framework to examine the effect of refinance of the large creditor on the behavior of small creditors and a debtor firm.

The model presented in this paper treats the actions of the large creditor, small creditors, and the debtor firm as those of interested parties in a game where each player's action is determined endogenously, depending upon other players' actions. For instance, under a certain condition, small creditors will decide to roll over their short-term claims if they believe that the large creditor's refinance will be sufficient to encourage the debtor firm to make efforts to prevent the default. Recognizing the favorable effect of refinance on small creditors, the large creditor will be willing to incur the cost of refinance. The debtor firm will embark on painful restructuring efforts, knowing that such favorable actions of creditors hinge on its own efforts. Thus, the actions of all interested parties are strategic complements. In other words, each player's action provides incentives for the other players to take the appropriate action.

In contrast, we can describe a more pessimistic scenario in which refinance will give rise to moral hazard of the debtor firm, due to the inability of the large creditor to commit to not refinancing. In this scenario, refinance of the large creditor is a strategic substitute for the effort of the debtor firm. In other words, the refinance of the large creditor crowds out the efforts of the debtor firm instead of promoting them.

The results of our study can be summarized as follows. Refinance can increase the payoff of the large creditor only when the debtor firm faces a substantial, but not hopeless, risk of default. The effect of refinance on small creditors and the debtor

[3]For global games, see an excellent survey by Morris and Shin (2002).

firm, however, is quite subtle on the equilibrium. Refinance of the large creditor can promote rollover decisions by small creditors and efforts by the debtor firm to repay the debt and avoid the default caused by the coordination failure, when the fundamentals would be too poor for the debtor firm to embark on painful efforts if refinancing is not feasible. However, refinance can become forbearance lending, which will cause moral hazard of the debtor firm anticipating refinance, when the fundamentals are within the range where the firm's efforts can prevent the default even without refinance. Therefore, whether the refinance succeeds in preventing the default caused by the coordination failure among creditors and the debtor firm, or incurs the moral hazard of the debtor firm, depends on how poor the fundamentals of the debtor firm are. Another finding is that the size of refinance tends to be larger in cases where the prior lending by a large creditor was greater, resulting in more serious moral hazards.

The rest of this paper is organized as follows. Section 2 describes the model we use. Section 3 derives the equilibrium of the model and shows the conditions under which the large creditor chooses to refinance and the debtor firm exerts an effort to repay the debt. Section 4 examines the effect of refinance on the actions of the debtor firm and small creditors in equilibrium, and how changes in the amount of prior lending by the large creditor affect the amounts of refinance and the action of other players. Concluding remarks are provided in section 5.

2 Model

2.1 Setup

The general structure of the model is as follows. Time is divided into three periods, $t = 0, 1$, and 2. The economy is populated by a firm, which is engaged in production, a continuum of ex-ante identical small creditors, and a single large creditor. For simplicity, we assume that the subjective discount rate of all players is 1.

At period 0 the debtor firm starts the project, after receiving short-term loans $S > 0$ from small creditors and long-term loan $D > 0$ from the large creditor. The short-term loans mature at period 1, while the long-term loan matures at period 2. For simplicity, the interest rates of the short-term loans are assumed to be zero. At period 1 the firm needs to pay interest of the long-term loan rD ($r \geq 0$). The proportion $\ell \in [0, 1]$ of the small creditors, who lend the short-term loans, does not roll over their claims and demands that the firm repay principal of S at period 1, while the proportion $1 - \ell$ rolls over the short-term claims until period 2. That is, the firm needs to repay the interest of the long-term loan rD and the principals of the short-term loans that are not rolled over at period 1. The firm can draw on available cash (liquidity) θ to meet this funding requirement. θ is the realization of a normally distributed random variable with mean $\psi + e$. The variable $\psi \in R$

represents the strength of the underlying financial *fundamentals* of the debtor firm. ψ is a random variable with a prior uniform distribution.[4] The variable $e \geq 0$ represents the increased likelihood of additional cash available to the debtor firm if it embarks on a painful restructuring *effort*. As described later, the effort is costly for the debtor firm.

Whether the firm can continue the project until period 2 depends on the size of θ. When $\theta < rD$, the firm is forced to default, since it cannot repay the interest of the long-term debt. When $rD \leq \theta$, it is possible for the firm to avoid the default, since it can repay the interest of the long-term debt. However, when $rD < \theta < rD + S$, the fate of the firm lies in the hands of its small creditors who lend it the short-term loans. If sufficiently many of them roll over, then the cash θ is large enough to meet the debt payment. In contrast, if most of them decline to roll over, θ is not large enough to avoid default. When $rD + S \leq \theta$, the firm can surely continue the project until period 2, since it can repay both the interest of the long-term debt and the principals of the short-term debts. If the firm can continue the project, it is assumed to have sufficient liquidation value to repay both the long-term debts and the short-term debts, which are rolled over.

2.2 Information

At period 0 the large creditor observes the following noisy signal about θ:

$$y = \theta + \eta, \tag{1}$$

where η is normally distributed with mean 0 and variance $1/\alpha^2$. We assume that the distribution of η is common knowledge. $\alpha > 0$ represents the degree of precision of the private signal received by the large creditor.

The large creditor is willing to refinance so as to maximize the expected payoff. Unless the firm defaults at period 1, the large creditor receives the interest of the long-term debt rD at period 1, then its principal D at period 2. When the firm defaults, however, it loses both the interest and the principal of the long-term debt $D(1 + r)$.

Although small creditors do not observe the realization of θ until period 2, they receive private signals regarding it at period 1. A typical small creditor i receives the signal

$$x_i = \theta + \varepsilon_i, \tag{2}$$

[4]As Morris and Shin (2002) point out, the uniform prior is well behaved, as far as we are concerned only with conditional beliefs, and can be thought of as the limiting case where the information in the prior density becomes diffuse. This assumption enables us to concentrate on the posterior beliefs of creditors conditional on their signals and to simplify the derivation of the equilibrium.

where ε_i is normally distributed with mean 0 and variance $1/\beta^2$. ε_i is i.i.d. across creditors and independent of y. We assume that the distribution of ε_i is common knowledge. $\beta > 0$ represents the degree of precision of the private signal received by the small creditor.

Until observed at period 2, θ is not common knowledge among creditors. Upon receiving a respective signal at period 1, a small creditor infers the value of θ, and the distribution of signals received by the other creditors, as well as their estimates of θ. Likewise, all other creditors form their beliefs while relying on their own private information. The assumption of incomplete information is the key to deriving the unique equilibrium.

2.3 Timing

The timing of the events is as follows:

- Period 0
  - The firm invests its debt-financed fund in the project.
  - Nature chooses ψ. ψ becomes the firm's private information.
  - The firm chooses effort e based on its knowledge of ψ. Once e has been chosen, it is common knowledge among all.
  - After observing the private signal y regarding $\theta \equiv \psi + e$, the large creditor chooses the amount of refinance m based on y. The amount m becomes common knowledge among all.
- Period 1
  - After observing the private signal regarding θ, each small creditor decides whether or not to roll over the short-term loans.
- Period 2
  - θ becomes common knowledge among all. Based on θ, payoffs of the large creditor, small creditors who roll over, and the firm are realized.

2.4 Payoffs

For simplicity, we will normalize the interest of the long-term debt and the principals of the short-term debts so that $r = 0$ and $S = 1$. Since the proportion of the small creditors who decline to roll over is denoted by ℓ, the debtor firm defaults on its debt if and only if

$$\theta + m < \ell.$$

That is, the available cash θ plus the large creditor's refinance m is not enough to meet repayment of the short-term debt.

The small creditor who declines to roll over has an investment opportunity that gives payoff $\lambda \in (0,1)$. In contrast, the small creditor who rolls over receives payoff of 0 if the firm defaults, while his payoff is 1 if the firm does not default.[5] Thus, the payoff of the small creditor who rolls over is given by

$$v(\theta, m, \ell) = \begin{cases} 1 & \text{if } \theta + m \geq \ell, \\ 0 & \text{if } \theta + m < \ell. \end{cases}$$

We now turn to the payoff of the debtor firm. In order to side-step possible complications that arise from distributional issues between a debtor and creditors, we define the payoff of the debtor firm in a simple way. That is, the firm's payoff is identical to the payoff of the small creditor who rolls over, except for the cost of the effort $c(e)$, which is an increasing convex function, as follows:

$$v(\theta, m, \ell) - c(e).$$

We come, finally, to the large creditor's payoff function. We assume that the large creditor incurs the cost of refinance bm, where $b > 0$ is a positive constant, representing the unit cost of the refinance. The large creditor receives repayment of the long-term debt at period 2 when the firm continues the project, while this creditor does not receive it when the firm defaults. The payoff of the large creditor is thus given by

$$w(\theta, m, \ell) = \begin{cases} D - bm & \text{if } \theta + m \geq \ell, \\ -bm & \text{if } \theta + m < \ell. \end{cases} \tag{3}$$

3 Equilibrium

The purpose of this study is to investigate the conditions under which a large creditor provides a debtor firm with refinancing and to examine how that refinancing affects the actions of the debtor firm and other creditors. Hence our main focus is on the adjustment effort e of the debtor firm and the amount of refinance m of the large creditor, and its relationship with the rollover decision of the small creditors. In this section, we will derive the equilibrium values of these variables.

3.1 Small creditors' decision to roll over

This subsection studies the subgame that begins with small creditors' receiving the private signal regarding θ. A *strategy* for a small creditor is a decision rule that

[5] By assuming that creditors get 0 when the firm defaults, this model abstracts the distribution issues between the debtor, the large creditor, and small creditors who roll over.

maps each realization of the signal to an action (i.e., to roll over the loan, or not). An *equilibrium* of the subgame is a profile of strategies such that each creditor's strategy maximizes the expected payoff conditional on the private signal, when all other creditors are following the strategies in the profile.

We now show that there is a unique equilibrium in which small creditors follow a switching strategy around a critical signal. A unique equilibrium is characterized by the critical value θ^* below which the firm defaults and the threshold signal x^* below which small creditors do not roll over. We will derive two equilibrium conditions to get these threshold values below.

Given the firm's cash θ, the probability that a small creditor i observes the signal below x^* is

$$\Pr(x_i \leq x^* \mid \theta) = \Phi\left(\beta(x^* - \theta)\right), \tag{4}$$

where Φ is the cumulative distribution function for the standard normal. The small creditor does not roll over, when the signal is below x^*. Since the noise $\{\varepsilon_i\}$ is i.i.d., the probability that the small creditor does not roll over is equivalent to ℓ in equation (4).

The condition under which the small creditor rolls over is $\theta + m \geq \ell$, which stands in equality when $\theta = \theta^*$. Thus, the first equilibrium condition, i.e., the *critical mass condition*, which needs to be satisfied by the critical state θ^* below which the firm defaults is given by

$$\begin{aligned} \theta^* + m &= \ell \\ &= \Phi\left(\beta(x^* - \theta^*)\right). \end{aligned} \tag{5}$$

We next consider the optimal switching strategy for a small creditor i who observes a signal x_i given θ^*. The conditional probability that the firm's cash exceeds the critical level θ^*, and is sufficient for the firm to continue the project is given by

$$\begin{aligned} \Pr(\theta > \theta^* \mid x_i) &= 1 - \Phi\left(\beta\left(\theta^* - x_i\right)\right) \\ &= \Phi\left(\beta\left(x_i - \theta^*\right)\right). \end{aligned} \tag{6}$$

Likewise, the probability that the firm defaults when a small creditor i who observes a signal x_i is given by $\Pr(\theta \leq \theta^* | x_i) = \Phi\left(\beta\left(\theta^* - x_i\right)\right)$. Provided the expected payoff to rollover does not exceed the expected payoff not to roll over, the small creditor does not roll over. Since the expected payoff of the small creditor who receives the critical signal x^* is equivalent to the creditor's expected payoff not to roll over, the second equilibrium condition, i.e., the *optimal cutoff condition*, which needs to be satisfied by the critical level x^* below which the small creditor does not roll over, is given by

$$\Phi\left(\beta\left(x^* - \theta^*\right)\right) = \lambda, \tag{7}$$

which implies

$$x^* = \frac{\Phi^{-1}(\lambda)}{\beta} + \theta^*. \tag{8}$$

From this pair of equations (5) and (7), we can solve for the equilibrium value of θ^*[6]:

$$\theta^* = \lambda - m. \tag{9}$$

When $\lambda > m$,[7] the firm defaults with the cash $\theta \in (0, \theta^*)$. This is an inefficient equilibrium caused by coordination failure among the creditors. When $\theta \in (0, \theta^*)$, as long as sufficiently many small creditors roll over, the firm could continue the project, though it defaults since they refuse to roll over. This equilibrium represents the bankruptcy caused by liquidity shortage, which is not socially desirable, in the sense that it is Pareto inferior to the equilibrium where the project continues.

Equation (9) shows that as λ becomes larger or m smaller, θ^* tends to be larger. That is, as the expected payoffs from outside investment opportunity become larger or the amount of refinance smaller, inefficient default caused by coordination failure among creditors is more likely under richer cash available to the firm.

3.2 The size of the refinance and the effort level of the firm

We now derive the equilibrium size of the refinance m provided by the large creditor and the equilibrium level of the effort e exerted by the debtor, using the critical state θ^* below which the firm defaults.

Consider the decision of the large creditor. The conditional probability that θ exceeds the critical state θ^* when the large creditor observes the signal y is given by $\Pr(\theta > \theta^* | y) = \Phi(\alpha(y - \theta^*))$. The large creditor chooses the amount of refinance that maximizes the following expected payoff:

$$\begin{aligned}&\max_{\{m \geq 0\}} \{D\Phi(\alpha(y - \theta^*)) - bm, 0\} \\ &= \max_{\{m \geq 0\}} \{D\Phi(\alpha(y + m - \lambda)) - bm, 0\}.\end{aligned}$$

In deriving the optimal m, we need to consider three cases, depending on the size of y. The first case is $D\Phi(\alpha(y - \theta^*)) - bm > 0$ for $m > 0$, that is, the case in which it is optimal for the large creditor to refinance. In this case, the optimal

[6]Equation (9) is a necessary condition for the equilibrium, but it is also a sufficient condition for there to be a unique dominance-solvable equilibrium (see Morris and Shin (2004)).

[7]We can easily show that $\lambda > m$ stands in equilibrium with refinance by using equation (12) in section 2 below.

m that maximizes the expected payoff of the large creditors is derived from the first-order condition

$$D\alpha\phi(\alpha(y+m-\lambda))-b=0, \tag{10}$$

where ϕ represents the standard normal distribution. From equation (10), the optimal amount of m that maximizes the expected payoff of the large creditor is given by

$$m=\lambda-y+J, \tag{11}$$

where $J=\phi^{-1}\left(b/(\alpha D)\right)/\alpha$.

The second case is $D\Phi(\alpha(y+m-\lambda))-bm\leq 0$, that is, y is so small that the firm is highly likely to default even if it obtains refinancing. In this case, it is optimal for the large creditor not to refinance, i.e., $m=0$. From $D\Phi(\alpha(y+m-\lambda))-bm\leq 0$, the following condition stands:

$$y\leq\lambda+J-K,$$

where $K=D\Phi(\alpha J)/b$. Thus, when $y\leq\lambda+J-K$, it is optimal for the large creditor to choose $m=0$.

In contrast, when y is very large, it is optimal for the large creditor not to refinance ($m=0$), since the probability of default is so small that refinance cannot increase the expected payoff. In this case, the first-order condition for the expected payoff of the large creditor regarding m gives $y>\lambda+J$. Thus, when $y>\lambda+J$, the optimal choice for the large creditor is $m=0$.

Summing up, the optimal amount of refinance can be expressed as a function of y:

$$m^*(y)=\begin{cases}0 & \text{if } y\leq\lambda+J-K,\\ \lambda-y+J & \text{if } \lambda+J-K<y\leq\lambda+J,\\ 0 & \text{if } y>\lambda+J.\end{cases} \tag{12}$$

That is, the large creditor can increase the expected payoff if and only if a lack of refinance will incur default ($y\leq\lambda+J$), but the refinance can prevent default ($y>\lambda+J-K$). The amount of refinance is just sufficient to ensure that the sum of the firm's cash and refinance is sufficient to avoid default, that is, $y+m=\lambda+J$.

Equation (12) shows that the larger λ is, or the smaller y is, the larger the optimal amount of refinance m^* is. In other words, the large creditor needs to provide a larger refinanced sum, as the return from the alternative investment is larger, or the signal regarding the available cash is bad.

From (12), we know that the large creditor decides to refinance when $\lambda+J-K<y\leq\lambda+J$. Assuming, for simplicity, that the private signal of the large creditor is

very precise, ($\alpha \to \infty$), we obtain $y \to \theta = \psi + e$, $J \to 0$, and $K \to D/2b$. Then the firm's expected payoff is given by

$$\begin{cases} 1 - c(e) & \text{if } \psi + e > \lambda - \frac{D}{2b}, \\ -c(e) & \text{otherwise.} \end{cases} \tag{13}$$

The firm chooses the effort e to maximize equation (13). Considering, for simplicity, the case $c(e) \quad = e^2$, the firm's optimal effort level can be expressed as a function of the fundamentals ψ:

$$e^*(\psi) = \begin{cases} \lambda - \psi - \frac{D}{2b} & \text{if } \lambda - 1 - \frac{D}{2b} < \psi \ \leq \lambda - \frac{D}{2b}, \\ 0 & \text{otherwise.} \end{cases} \tag{14}$$

That is, the effort is maximized when $\psi = \lambda - 1 - D/2b$ and decreases monotonically in ψ.

4 Comparative statics

4.1 Refinance and moral hazard of the firm

In this section, we investigate under what conditions refinance causes moral hazard of a debtor firm. For comparison, let us consider the effort of the firm in a world without refinance ($m = 0$). In this case, the critical state θ^* is equivalent to λ. The firm's expected payoff becomes

$$\begin{cases} 1 - c(e) & \text{if } \psi + e > \lambda, \\ -c(e) & \text{otherwise.} \end{cases} \tag{15}$$

Comparing (13) with (15), we can tell that the minimum level of cash ψ+enecessary for the firm to avoid default is higher without refinance.

Without refinance the optimal effort level for the firm can be expressed as a function of the fundamental ψ:

$$\hat{e}^*(\psi) = \begin{cases} \lambda - \psi & \text{if } \lambda - 1 < \psi \ \leq \lambda, \\ 0 & \text{otherwise.} \end{cases} \tag{16}$$

Comparing (14) with (16), we see that when $\lambda - 1 - D/2b < \psi \leq \lambda - 1$ the firm makes an effort only in a world with refinance, but does not otherwise. When the fundamentals are very poor, but not hopelessly so, the firm chooses to make enough of an effort to avoid default, anticipating that refinance can reduce the probability of default. In contrast, without refinance, the firm does not make an effort and chooses default. In this case, refinance provided by the large creditor has the positive effect of avoiding default caused by coordination failure, by encouraging small creditors to roll over and the firm to make an effort. When $\lambda - 1 \leq \psi < \lambda$,[8] however, the optimal effort level is larger without refinance than with refinance. In other words, when the fundamental ψ lies in the region where the firm can avoid default by its own effort without refinance, the anticipation of refinance makes the debtor firm less willing to incur a costly effort. In this case, refinance provided by the large creditor has a negative effect like forbearance lending, which crowds out the firm's effort and incurs moral hazard. This type of moral hazard results from soft budget constraints in the sense that the large creditor, who wants to avoid default, cannot commit to not refinancing.

These comparative statics indicate that whether refinance has the positive effect of avoiding coordination failure by encouraging the firm to make an effort, or the negative effect of making it slack off, is quite a subtle problem, which depends on how poor the firm's fundamentals are.

4.2 Prior lending and moral hazard of the firm

In this subsection, we examine how the equilibrium changes in accordance with the change in prior lending provided by the large creditor. In other words, we investigate the effect of a change in sunk cost of the large creditor on the amount of refinance and effort level.

First, let us consider the relationship between the amount of prior lending D provided by the large creditor and the amount of refinance m^*. From equation (12), we have $\partial J/\partial D > 0$ in equilibrium. Combining this result with equation (12), when the large creditor refinances ($\lambda + J - K < y \leq \lambda + J$), the larger the prior lending D is, the larger the amount of refinance is.

Consider next the relation between the prior lending D and the effort $e^*(\psi)$. Equation (14) shows that when the large creditor refinances, the effort level $e^*(\psi)$ tends to decrease, as the prior lending D increases. That is, the greater the prior lending, the larger the amount of refinance, which causes the firm not to incur a costly effort, by lowering the probability of default even without refinance. These comparative statics show that the prior lending provided by the large creditor serves as a sunk cost, which raises the moral hazard of the firm through soft budget constraints.

5 Concluding remarks

This paper analyzes how refinance affects the actions of a debtor firm and other creditors by constructing a model of an incomplete information game, which endogenizes the actions of a large creditor, small creditors, and a debtor firm. We find

[8]We assume here $D/2b > 1$, that is, the unit cost of refinance is not extremely large compared to prior lending.

that refinance can increase the payoff of the large creditor only when the debtor firm faces a substantial, but not hopeless, risk of default. The effect of refinance on small creditors and the debtor firm, however, is quite subtle on the equilibrium. Refinance of the large creditor can prevent a default caused by coordination failure and promote roll over decisions of small creditors and efforts of the debtor firm in cases when the fundamentals would be too poor for the debtor firm to embark on painful efforts if refinancing was not feasible. However, refinance can become forbearance lending, which will cause moral hazard of the debtor firm anticipating refinance, when the fundamentals are within the range where the firm's effort can prevent the default without refinance. Therefore, whether the refinance succeeds in preventing the default caused by the coordination failure among creditors and the debtor firm, or incurs the moral hazard of the debtor firm, depends on how poor the fundamentals of the debtor firm are. Another finding is that the size of the amount to be refinanced grows as the prior lending of the large creditor increases, resulting in more serious moral hazards.

Our results imply that refinancing by a large creditor, which was expected to prevent a default caused by the coordination failure among interested parties, may turn into forbearance lending incurring moral hazard of the debtor firm once the fundamentals of the firm vary. To prevent this, the large creditor needs to recognize that the window of effectiveness for refinancing for a debtor firm facing liquidity shortage is quite narrow.

References

BERGLOF, E. AND G. ROLAND (1997) "Soft Budget Constraints and Credit Crunches in Financial Transition" *European Economic Review* 41, 807-817.

BERGLOF, E. AND G. ROLAND (1998) "Soft Budget Constraints and Banking in Transition Economies" *Journal of Comparative Economics* 26, 18-40.

CARLSSON, H. AND E. VAN DAMME (1993) "Global Games and Equilibrium Selection" *Econometrica* 61, 989-1018.

CORSETTI, G., B. GUIMARÃES, AND N. ROUBINI (2002) "International Lending of Last Resort and Moral Hazard: A Model of IMF's Catalytic Finance" mimeo, available at `http://aida.wss.yale.edu/~corsetti/`.

DEWATRIPONT, M. AND E. MASKIN (1995) "Credit and Efficiency in Centralized and Decentralized Economies" *Review of Economic Studies* 62, 4:541-555.

FRANKEL, D. M., S. MORRIS, AND A. PAUZNER (2003) "Equilibrium Selection in Global Games with Strategic Complementarities" *Journal of Economic Theory* 108, 1-44.

FUKAO, K. (1994) "Coordination Failures under Incomplete Information and Global Games" Discussion Paper Series A, 299, Institute of Economic Research, Hitotsubashi University.

HOSHI, T. (2000) "Naze Nihon wa Ryuudousei no Wana kara Nogarerarenainoka? (Why is the Japanese Economy Unable to Get Out of a Liquidity Trap?)," in *Zero Kinri to Nihon Keizai (Zero Interest Rate and the Japanese Economy)*, ed. by M. Fukao, and H. Yoshikawa, pp. 233-236. Nihon Keizai Shimbun-sha, Tokyo (in Japanese).

HOSONO, K. AND M. SAKURAGAWA (2003) "Soft Budget Problems in the Japanese Credit Market" Discussion Papers in Economics No. 345, Nagoya City University, available at http://www.econ.nagoya-cu.ac.jp/~oikono/nefs.html.

KOBAYASHI, K., Y, SAITA, AND T. SEKINE (2002) "Forbearance Lending: A Case for Japanese Firms" Working Paper 02-2, Research and Statistics Department, Bank of Japan.

KORNAI, J. (1980) *Economics of Shortage*, Amsterdam: North-Holland.

KORNAI, J., E. MASKIN, AND G. ROLAND (2003) "Understanding the Soft Budget Constraint" *Journal of Economic Literature*, Vol. XLI 1095-1136.

MASKIN, E. (1996) "Theories of the Soft Budget-Constraint" *Japan and the World Economy* 8, 125-133.

MORRIS, S., AND H. S. SHIN (1998) "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks" *American Economic Review*, 88, 587-597.

MORRIS, S., AND H. S. SHIN (2002) "Global Games: Theory and Applications" in *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress*, edited by M. Dewatripont, L. P. Hansen and S. J. Turnovsky, Cambridge University Press.

MORRIS, S., AND H. S. SHIN (2003) "Catalytic Finance: When Does It Work?" Cowles Foundation Discussion Paper, No. 1400, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=383604.

MORRIS, S., AND H. S. SHIN (2004) "Coordination Risk and the Price of Debt" *European Economic Review* 48, 133-153.