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Forbearance Impedes Confidence Recovery (Revised)

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Forbearance Impedes Confidence Recovery (Revised)*
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Abstract

This paper is a revised version of DP02-E-005, where the mathematical structure of the model in this paper is substantially different from the previous one.

The finding that countries that take a slow approach to reform during a financial crisis run into problems of persistent stagnation is usually explained as follows: Forbearance policy (i.e., an implicit subsidy to inefficient sectors) distorts resource allocation, causing a supply shortage of resources to the productive sectors. I propose another explanation: Forbearance impedes the recovery of confidence that is lost during a financial crisis.

If confidence is restored through Bayesian learning by economic agents based on observations of government actions, then the inaction of the government (forbearance) impedes Bayesian learning. The model shows that forbearance policy delays economic recovery.

JEL Classification: E22, E23, E61.
Keywords: Confidence, financial crises, Bayesian learning, forbearance policy.

* This paper is a revised version of the previous discussion paper DP02-E-005. The qualitative results are identical to those in the previous version, but the mathematical method is substantially different. In the previous version, I make use of the notion of the Knightian Uncertainty, while in the present version, I derive the same results using the notion of risk, which is much more popular in the literature.

1 Introduction

Many countries have experienced financial crises. Recent research indicates that a quick policy response (e.g., resolving nonperforming loans, recapitalizing the banking sector, reorganizing failed firms) will be followed by quick recovery of economic growth. For example, Bergoeing et al. (2002) compare the quick and sustained recovery of Chile with the long stagnation of Mexico after the external debt crises at the beginning of the 1980s. They show that although both macroeconomic policies and the international trade environment were favorable for Mexico, Chile recovered at a higher rate and with long-lasting economic growth. They argue that what caused the different outcomes are: (1) the different policy reactions to the banking sectors; and (2) the difference in the efficiency of bankruptcy procedures. Chile undertook quick banking reforms devoting the equivalent of 35% of its annual GDP from 1982–86, while Mexico nationalized banks and allocated credit at discretionary below-market rates for a long time. The Chilean bankruptcy procedure had become quite efficient by the time of the 1982 bankruptcy reform law, while Mexico had an obsolete and inefficient bankruptcy law in place from 1943 to 2000. Bergoeing et al. conclude that these differences in banking reform and bankruptcy procedures account for the differences in economic growth subsequent to the debt crises in the two countries.

Other episodes of financial crisis include the bursting of asset-price bubbles in Sweden and Japan in the early 1990s. Both Sweden and Japan experienced price declines in their real estate markets at the beginning of the 1990s. Sweden quickly disposed of nonperforming loans and recapitalized the banking sector from 1992–94, while Japan delayed the resolution of nonperforming loans until 1997. Asset prices in Sweden picked up in 1994 and have continued to rise, while asset prices in Japan have continued to fall for more than a decade. The observation that quick reform seems to produce quick economic recovery is usually explained as follows: forbearance (i.e., an implicit subsidy to inefficient sectors) causes inefficient allocation of economic resources; the resources are absorbed by inefficient sectors, while productive sectors are starved of resources for their activities. Thus, macroeconomic inefficiency is usually explained as a *shortage of supply* of economic resources in productive sectors.

A puzzle One puzzle is the case of the Japanese economy. Although forbearance lending to de facto insolvent firms has been widespread among Japanese banks, these banks still have a huge number of deposits that they feel compelled to invest in Japanese government bonds. This indicates that Japanese banks have had enough money to lend to borrowers who were potentially productive; there was no shortage of resources. Thus, Japanese banks must have been unable to find productive borrowers during the 1990s. In other words, Japanese firms seem to have ceased undertaking productive projects after the collapse of the asset-price bubble at the beginning of the 1990s. We need to clarify why the Japanese corporate sector did not undertake productive projects despite having sufficient funds to do so.

I argue in this paper that forbearance of economic reform impedes the rebuilding of the confidence lost during a financial crisis. In a financial crisis, losses emerge (due to asset-price declines or devaluation of domestic currency) that are unexpected beforehand and should be clarified and borne by banks and firms. If the government expects that asset prices (or domestic currency) will regain value following a spontaneous economic recovery, then it rationally chooses to postpone the reckoning to avoid the social and political costs of a rash of bankruptcies. Suppose, however, that economic recovery depends upon an increase in high-risk, high-return investments and that investments will increase only if the public's confidence is restored, while the confidence people have is based largely on their shared belief in the firmness and fairness of bankruptcy procedures. Let us assume that people's confidence obeys a Bayesian learning rule based on observations of the government's actions toward failed firms and banks. In this case, if the government chooses forbearance, confidence may not be restored and business investment may stagnate. (If the government acts to postpone bankruptcies, peoples' belief in bankruptcy procedures will not be restored.) If the government recognizes that confidence depends on the public's evaluation of the government's action, it will choose not to procrastinate in situations where confidence matters. If the government perceives that a change in confidence is an exogenous event, however, it may choose procrastination, leading the economy into protracted stagnation.

Uncertainty associated with a financial crisis In order to formalize this confidence-rebuilding hypothesis as a theoretical model, we can utilize the Bayesian learning mechanism in the spirit of Barro (1986). The unique characteristic of the expectation problem after a financial crisis is that we need to analyze the expectations of economic agents in a context of *unprecedented events*. For example, land prices in Japan had continued to rise for some 50 years until the beginning of the 1990s. The continuous decline in land prices over the subsequent decade was unprecedented. Economic institutions and business customs in Japan had been formed on the premise that land prices never fall. How to deal with the losses when land prices declined was an unprecedented problem for the economy. Japan had a legal and social system of bankruptcy procedures that worked well until the beginning of the 1990s. The continuous decline of land prices, however, changed the fundamental environment of bankruptcy practices and consequently increased uncertainty concerning the outcome of bankruptcy procedures.

Currency crises in developing countries may introduce a similar uncertainty into domestic economies. Before the crisis, there may be no economic institutions in those countries able to cope with the business and banking failures associated with currency devaluation under large external debts. Business failures arising from external debt problems are usually unprecedented in these countries. And the bankruptcy systems do not seem to function very well in resolving defaults caused by unprecedented external debts.

Literature There is a rich literature on inaction and delay. For example, Sturzenegger and Tommasi (1998) categorize theories of delayed reform into the war-of-attrition approach (Alesina and Drazen, 1991) and the uncertainty-about-net-benefits approach (Fernandez and Rodrik, 1991). My story is quite different from these approaches in the following sense: Whereas the war-of-attrition and uncertainty-about-net-benefits approaches explain the reason why a reform, which is *already known* to be beneficial to society, is delayed, my story explains why a particular reform (resolution of failed banks and firms), which is *not obviously* beneficial to society, is in fact welfare enhancing. The resolution of bankrupt banks and firms is not obviously welfare-enhancing, but its high social cost is clearly evident. This is one of the reasons why forbearance policy has been widely supported in Japan. This paper provides one theoretical account of why the resolution of bankruptcy is necessary to restore economic growth; in existing literature, the reform is merely assumed to restore economic growth. In this paper, the delay of reform occurs because the government does not understand the mechanism by which the reform restores economic growth, while in the existing literature, the delay is due to coordination failure among economic agents.

The organization of this paper is as follows: In the next section I present the basic structure of the model and show that there are multiple equilibria: a good equilibrium and a bad one. In Section 3 I describe a financial crisis hitting an economy that was originally in a good equilibrium, and a restoration of confidence by Bayesian learning. Section 4 provides some concluding remarks.

2 Model

The model is quite stylized so that it can be used to describe the main idea with simple mathematics. In Section 2.1 I show the basic structure in a partial equilibrium setting where asset prices are given exogenously. In Section 2.2 I describe the general equilibrium in which asset prices are determined as an equilibrium outcome.

2.1 Baseline

Although the economy is the infinite-horizon economy where time discretely extends from zero to infinity: $t = 0, 1, 2, \cdots$, the main idea can be shown in a one-period setting. An infinite-period setting becomes necessary when I describe the determination of asset prices in the next subsection. Therefore, in this subsection, I focus on decision making in a single period. The economy consists of many firms (potential debtors), many banks (potential creditors), and a benevolent government. The numbers of firms and banks are equal: M ($\gg 1$).

Technologies A firm lives for infinite periods. At date 0, each firm is endowed with one unit of land. The land is nondepletable and tradable, and it generates consumer goods at each date in accordance with the safe or risky production technology described below. At each date the firm is endowed with one unit of private goods, which gives the same utility to the owner firm as one unit of consumer goods, but it can give no utility to other firms or banks. (The private goods are nontradable and the consumer goods are tradable.) Private goods can be (partially) converted to consumer goods only in the bankruptcy procedure described below. In this subsection I assume that the land price Q in terms of consumer goods is given exogenously, and that Q takes the value of either Q_H or Q_L ($Q_H > Q_L$). There are two production technologies available to firms at each date: S (safe) and R (risky). If the firm chooses technology S, one unit of its land yields y_L (> 0) units of consumer goods. Land is the only input for technology S, and the firm need not borrow from a bank. If the firm chooses technology R, it must provide m units of consumer goods as input to one unit of its land. In that case, the one unit of land yields y_H with probability p and yields nothing with probability $1-p$. I assume that the parameters satisfy the following condition:

$$py_H > y_L + m. \tag{1}$$

I assume the following restriction on technology R:

Assumption 1 *A firm must borrow input m from a bank. The only contract that a firm and a bank can make is a debt contract with fixed repayment.*

The above restriction on financial contracts can be justified by a standard assumption of asymmetric information: The bank cannot observe or verify the outcome of technology R unless it engages in costly monitoring of the firm (see, for example, Gale and Hellwig [1985]). Although it would be necessary to incorporate the monitoring cost explicitly to derive risky debt as the endogenously chosen contract, I simply postulate Assumption 1 in order to avoid unnecessary complications in the following analysis.

I assume that after production the firms and banks sell and buy the land at price Q in the land market. Therefore, when the firm utilizes technology R and fails, it can sell its land to repay the bank. But it may be impossible for the firm to repay the full amount of its debt if the land price is low: Q_L. Suppose that some amount of debt remains unpaid even after the debtor sells all of its own land. I define this situation as *default*. If a debtor defaults on its debt, the government (or the court) can start bankruptcy proceedings.

Assumption 2 *In the bankruptcy proceedings, the government transforms θ units of the private goods of the defaulter into consumer goods and gives them to the creditor. The value of θ ($0 < \theta < 1$) is unknown to firms, banks, and the government, while the probability distribution of θ is known at date 0. The moments are also known at date 0:*

$$E(\theta) = \mu, \text{ and } V(\theta) = \nu.$$

The value of θ is revealed only to the defaulter and the creditor during the bankruptcy proceedings, and is not observable to the public even after the proceedings.

That the parameter θ is unknown represents an intrinsic and technological risk in the economy.[1]

Insurance In order to simplify mathematical exposition of the following analysis, especially that in Section 3, I posit that firms form (several) groups, each of which consists of a sufficient number of firms who establish equitable insurance among themselves as a group to cover the risk of technology R. Note that they cannot write a contract contingent on θ, but, if necessary, they can write an insurance contract contingent on the event of default or bankruptcy knowing that $E(\theta) = \mu$ and $V(\theta) = \nu$. But I simply posit that firms in a group share consumer goods (not private goods) and land equally, after the output of technology R is realized, and trading of land is complete. The most

[1]This assumption does not necessarily imply that a bankruptcy is an *unprecedented event* in this economy. It can be postulated that, observing bankruptcies, the economic agents have updated the prior over θ by the Bayesian rule described in Section 3. The prior of θ in Assumption 2 can be interpreted as a result of the Bayesian learning that has taken place until date 0.

important role of the insurance system is that it guarantees that a firm owns one unit of land at the beginning of the next period even if it undertakes technology R and fails in the current period. This is because if a firm undertakes technology R and fails, it sells its land to another firm; since total amount of land in this economy stays constant, the fair insurance guarantees that each firm has one unit of land after the payoff of the insurance. Without this insurance system, the heterogeneity of landownership among firms would complicate the dynamic analysis, without changing basic intuition of my model.[2]

Firms Given that firms will form fair insurance if they adopt technology R, a firm maximizes the following (flow) utility:

$$u^F = E(c_f) + E(1 - 1_d \cdot \theta) - \gamma V(1 - 1_d \cdot \theta) = E(c_f) - E(1_d \cdot \theta) - \gamma V(1_d \cdot \theta) + 1, \quad (2)$$

where c_f is the consumer goods, and $1_d = 1$ if default occurs and $1_d = 0$ if default does not occur. I assume that the firm obtains utility from its consumption of the consumer goods (c_f) and private goods ($1 - 1_d \cdot \theta$), while the firm exhibits risk-aversion only toward the private goods, which is formalized as the third term ($-\gamma V[1 - 1_d \cdot \theta]$). These nonstandard assumptions that the firm is risk-averse only toward private goods and that risk-aversion is formalized as the deduction of the variance $V(1_d \cdot \theta)$ are introduced to simplify the mathematics needed to analyze the model. The main results of this paper will hold under a more general setting.

Banks A bank lives for infinite periods. At each date, each bank is endowed with m units of consumer goods. The bank can either consume m or lend m to a firm as the input for production. I assume that the bank is risk-neutral and maximizes the following flow utility:

$$u^B = E(c_b) + E(1_d \cdot \theta), \quad (3)$$

[2]By introducing insurance among firms, I slightly abuse the notion that a firm is an atomistic price-taker. A group of firms collectively chooses technology S or R, and forms the fair insurance, given the asset price Q. This collective action does not induce any strategic or monopolistic problems in this economy where agents have simple technologies.

where $c_b = m$ in the case where the bank consumes its endowment, and c_b is the repayment in the case where it lends m to the firm.

Multiple equilibria It is shown that under appropriate parameter values, technology R prevails if the land price is Q_H, and technology S prevails if the land price is Q_L. First consider the optimal debt contract between a firm and a bank when the firm adopts technology R. I assume that the firm has the full bargaining power to decide the amount of repayment r for the borrowing of m. Thus r is determined by

$$\min r$$

subject to

$$\begin{cases} c_b = \begin{cases} r, & \text{(with probability } p) \\ \min\{r, Q\} & \text{(with probability } 1-p), \end{cases} \\ u^B \geq m. \end{cases}$$

I assume that Q_L is so small and Q_H is so large that the solution to the above problem $r(Q)$ satisfies

$$Q_L < r(Q_L) \text{ and } r(Q_H) < Q_H. \tag{4}$$

This condition is verified in the general equilibrium setting in the next subsection. Suppose that $Q = Q_H$. In this case, no default occurs even if the firm adopts technology R and then fails. Thus the solution is $r(Q_H) = m$. Suppose that $Q = Q_L$. In this case, default occurs if the firm adopts technology R and fails. The solution is

$$r(Q_L) = p^{-1}\{m - (1-p)(Q_L + \mu)\}. \tag{5}$$

If $Q = Q_H$ and firms adopt technology R, the expected value (in terms of consumer goods) of the sum of the output and landholding for a firm is $p \cdot (y_H - r(Q_H) + Q) + (1 - p)(Q - r(Q_H)) = py_H - m + Q$. The insurance system ensures that each firm obtains $py_H - m$ units of the consumer good and 1 unit of land. Therefore, when $Q = Q_H$, the expected utility of a firm becomes $u^F = py_H - m + 1$ if it adopts technology R, while $u^F = y_L + 1$ if it chooses technology S. Condition (1) implies that u^F is maximized if firms choose technology R. Therefore, all firms choose technology R if $Q = Q_H$.

If $Q = Q_L$ and firms adopt technology R, the expected value of the output and landholding is $p \cdot (y_H - r(Q_L) + Q) + (1-p) \cdot 0 = py_H - m + (1-p)\mu + Q$. The insurance system ensures that each firm obtains $py_H - m + (1-p)\mu$ units of the consumer good and 1 unit of land. In this case, since a firm goes bankrupt when it adopts technology R and fails, $u^F = c_f + 1 - (1-p)\mu - (1-p)\gamma\nu = py_H - m + 1 - (1-p)\gamma\nu$. I assume the following condition for the parameters:

$$py_H - m - (1-p)\gamma\nu < y_L < py_H - m. \tag{6}$$

Under this assumption, the firm is better off choosing technology S than technology R. Thus firms choose technology S if $Q = Q_L$. It has been shown that there are two equilibria in this economy: a good equilibrium where the average output is high ($py_H - m$) and the asset price is high (Q_H), and a bad equilibrium where the output is low (y_L) and the asset price is low (Q_L).

Confidence recovery The above argument shows that the uncertainty about θ and the risk-aversion of the firms make them choose low productive technology under low asset prices. If the value of θ is revealed, then $V(\theta)$ becomes zero. It is obvious that if $V(\theta) = 0$, the firms choose high productive technology (technology R) even under low asset prices. Therefore, if θ is revealed, the firms always choose technology R, and the average output is always high. That firms become willing to choose the high-risk, high-return technology can be interpreted as the recovery of confidence in the business environment. In this model, the resolution of uncertainty (i.e., revelation of θ) brings about the recovery of confidence. In Section 3, I introduce the Bayesian learning rule for θ and describe how government forbearance hinders the revelation of θ, resulting in prolonging of the bad equilibrium.

2.2 General Equilibrium

In order to complete the model, we need to specify how the land price Q is determined. To determine this asset price, we need to generalize the model into a multiperiod setting.

Time continues from zero to infinity: $t = 0, 1, 2, \cdots$. Redefine u^F as u_t^F and u^B as u_t^B. I assume that firms maximize the discounted sum of the flow utilities: U^F where

$$U^F = E_0 \left[\sum_{t=0}^{\infty} \beta^t u_t^F \right].$$

Here, β $(0 < \beta < 1)$ is the discount factor. I assume that banks have the same discount factor and maximize U^B where

$$U^B = E_0 \left[\sum_{t=0}^{\infty} \beta^t u_t^B \right].$$

Since the firms sell and buy land with each other, the price of land (in terms of the consumer goods) is determined as the discounted sum of the net production of the land, which is discounted by β. Thus if technology R prevails in the economy, the land price is

$$Q = Q_H \equiv \frac{p y_H - m}{\beta^{-1} - 1}. \tag{7}$$

If technology S prevails in the economy, the land price is

$$Q = Q_L \equiv \frac{y_L}{\beta^{-1} - 1}. \tag{8}$$

I assume two conditions for the parameter values:

$$(\beta^{-1} - 1)m < p y_H - m, \tag{9}$$

$$\frac{y_L}{\beta^{-1} - 1} + (1 - p)\mu < m. \tag{10}$$

These conditions ensure that default never occurs if $Q = Q_H$, and that default occurs if $Q = Q_L$ and the firm adopts technology R and fails. Therefore, if conditions (9) and (10) hold, the results in Section 2.1 still hold in the general equilibrium setting where the asset prices (Q_H and Q_L) are determined by (7) and (8): There exist a good equilibrium where the average output ($p y_H - m$) and the asset price (Q_H) are high, and a bad equilibrium where the average output (y_L) and the asset price (Q_L) are low. Note that no default occurs either in the good equilibrium or in the bad equilibrium. Thus in either equilibrium, the true value of θ is never revealed if it is not known at the initial date.

3 Crisis and Forbearance

In the stationary equilibria where the asset price is constant (Q_H or Q_L) for all t, there is no default and thus θ is never revealed. In this subsection, we examine the case where the asset price is changed by an exogenous macroeconomic shock.

Financial crisis Suppose that the economy is initially at the good equilibrium and that it is suddenly hit by a financial crisis at time τ. The financial crisis consists of the following three events: (a) outputs are destroyed for N firms ($1 \ll N \leq M$), (b) the land price suddenly falls from Q_H to Q_L, and (c) pessimism prevails that the land price will remain at Q_L from date τ onward. As a result, N firms default on their debt obligations at τ because all firms chose technology R at date $\tau - 1$. I assume that

$$(M - N)y_H > (M - N)m + NQ_L. \tag{11}$$

At date τ, a bank obtains on average $(1 - \frac{N}{M})m + \frac{N}{M}Q_L$ units of consumer goods, since they set $r = m$ at date $\tau - 1$. Since land is sold to firms, a firm obtains one unit of land and $(1 - \frac{N}{M})(y_H - m) - \frac{N}{M}Q_L (> 0)$ units of consumer goods (see (11)). The insurance among firms guarantees that each of the firms, including N defaulters, owns one unit of land at the beginning of date $\tau + 1$. The transfer of private goods remains to be done in the bankruptcy proceedings.

Forbearance In the multiperiod setting in this section, I assume the government wants to postpone bankruptcy proceedings. Postponement of the proceedings is a model of forbearance by the government that is often observed when a country is hit by a financial crisis. In a country where corporate accounting standards and banking regulation are loose, the government can postpone recognizing bank insolvency for a long period after the onset of the financial crisis, and the loose practices of bank regulation and corporate accounting enable banks to continue extending credits to de facto bankrupt debtors, resulting in the postponement of the bankruptcy of failed firms.[3] For example, this

[3]The postponement may be feasible without cost if bank regulation is loose, because banks can create credits by lending bank deposits (not cash).

postponement was observed in the 1990s in Japan. After the crash of land prices at the beginning of the 1990s, the Japanese bank regulators chose a forbearance policy, and banks continued lending to de facto insolvent debtors. The evidence of the forbearance is seen in the amounts of bank lending: The total lending to problem sectors (real estate, construction, retail, and nonbank financial industries) increased in the 1990s. While Japan is just one example, an increase of bank lending after the onset of a crisis has commonly been observed in recent banking crises (Boyd et al., 2001). In order to introduce forbearance, I assume the following:

Assumption 3 *The government can undertake bankruptcy proceedings for the N defaulters in a financial crisis at any date $\tau + t$ where $t \geq 0$. For an ordinary default after the financial crisis, the government undertakes bankruptcy proceedings immediately (Assumption 2). The value of θ ($0 < \theta < 1$) is unknown, while the probability distribution of θ is known to be the beta distribution with the following probability density function:*

$$f(\theta) = \frac{\theta^{a-1}(1-\theta)^{b-1}}{\int_0^1 x^{a-1}(1-x)^{b-1}dx},$$

where $a > 1$ and $b > 1$.

The property of the beta distribution (see, for example, Hartigan [1983], pp.76–78) implies that θ satisfies

$$E(\theta) = \mu \equiv \frac{a}{a+b}, \text{ and } V(\theta) = \nu \equiv \frac{ab}{(a+b+1)(a+b)^2}.$$

Therefore, I assume that the parameters a and b satisfy conditions (6) and (10). Since each firm owns one unit of land from date $\tau + 1$ onward, N defaulters continue operating just like healthy firms until the government undertakes their bankruptcy proceedings.

Bayesian learning I introduce the Bayesian learning rule for the value of θ. I assume that even if a bankruptcy proceeding is completed, the true value of θ is not revealed to the public; it becomes known only to the defaulter and its creditor after the proceedings. Instead of the true value of θ, a signal ω that indicates the value of θ is given to the public after the bankruptcy proceeding is over. I assume the following:

Assumption 4 *The exact value of* θ *is never revealed to the public. A signal* ω *is given to the public when a bankruptcy proceeding is over, where* $\omega = 1$ *with probability* θ *and* $\omega = 0$ *with probability* $1 - \theta$*.*

The random variable ω can be interpreted as information on which side *wins* the proceeding: Whether the creditor wins ($\omega = 1$) or the defaulter wins ($\omega = 0$). (Although it may seem peculiar to readers, I assume for simplicity that the amount of transfer θ is not affected by which side wins bankruptcy proceedings.) Let the number of bankruptcy proceedings that are completed by date $\tau + t$ be n_t. ($0 \leq n_t \leq N$.) In the period between date τ and date $\tau + t$, firms and banks observe signals ω_i ($i = 1, 2, \cdots, n_t$). Firms and banks utilizes the information $\{\omega_i\}$ to estimate the value of θ. Suppose that $\omega = 1$ for s_t cases of bankruptcy and $\omega = 0$ for v_t cases of bankruptcy ($s_t + v_t = n_t$). The firms and banks update the prior $f(\theta)$ to $f(\theta; s_t, v_t)$ by the Bayesian rule (Morris, 1996):

$$f(\theta; s, v) = \frac{\theta^s (1-\theta)^v f(\theta)}{\int_0^1 x^s (1-x)^v f(x) dx}. \tag{12}$$

Therefore, at date $\tau + t$ the random variable θ follows the beta distribution with p.d.f. $f(\theta; s_t, v_t)$, and has the following moments:

$$E(\theta | s_t, v_t) = \frac{s_t + a}{n_t + a + b}, \text{ and } V(\theta | s_t, v_t) = \frac{(s_t + a)(v_t + b)}{(n_t + a + b + 1)(n_t + a + b)^2}.$$

Thus $\lim_{n_t \to \infty} V(\theta | s_t, v_t) = 0$ for all a and b that satisfy $a \geq 1$ and $b \geq 1$. The law of large numbers implies that $E(\theta | s_t, v_t)$ converges to θ^* where θ^* is the true value of θ. Therefore, the prior $f(\theta; s_t, v_t)$ converges to the point distribution that $\Pr\{\theta = \theta^*\} = 1$ as n_t goes to infinity. In this sense, firms and banks can learn the true value θ^* by Bayesian learning based on the observations of bankruptcies if there are a sufficient number of defaults at date τ. Thus I assume the following for N, the total number of defaults at date τ.

Assumption 5 *The number of defaulters* N *is large enough to satisfy*

$$y_L < p y_H - m - \gamma(1-p) \frac{(N+a)(N+b)}{(N+a+b+1)(N+a+b)^2}.$$

Condition (6) guarantees that a sufficiently large integer N satisfies Assumption 5. This assumption guarantees that if bankruptcy proceedings for all default cases are complete, the variance of θ under the updated p.d.f. becomes so small that $u^F = py_H - m - (1 - p)V(\theta|s,v) + 1$ is larger than $y_L + 1$, and all firms choose technology R even under the low asset price (Q_L). Thus if the number of bankruptcy proceedings becomes large as time passes, the bad equilibrium vanishes at some point and the economy jumps to the good equilibrium, in which production and asset prices are high.[4]

Forbearance impedes confidence recovery A bankruptcy usually generates social costs associated with the transfer of resources. I assume the government incurs a very small social cost $\Psi(b)$ when it undertakes b cases of bankruptcy proceedings. The government decides the schedule of bankrupcty proceedings: $\{b_t\}_{t=0}^{\infty}$, where $b_t \equiv n_t - n_{t-1}$ is the number of bankruptcy proceedings undertaken at date $\tau+t$. The objective of this benevolent government at date τ is $U_\tau^F + U_\tau^B - \sum_{t=0}^{\infty} \beta^t \Psi(b_t)$, where $U_\tau^F = E_\tau[\sum_{t=1}^{\infty} \beta^t u_{\tau+t}^F]$, and $U_\tau^B = E_\tau[\sum_{t=1}^{\infty} \beta^t u_{\tau+t}^B]$. It is shown that $U_\tau^F + U_\tau^B = E_\tau[\sum_{t=1}^{\infty} \beta^t \{y_{\tau+t} + m + 1 - \gamma V(1_d \cdot \theta)\}]$, where $y_{\tau+t} = y_L$ if technology S is adopted, and $y_{\tau+t} = py_H - m$ if technology R is adopted. Note that the insurance among firms gives the same share of output to all firms. Since the insurance among firms guarantees that each firm owns one unit of land at each date, the firm's choice problem of technology S or R in this multiperiod setting is reduced to a single period problem described in Section 2.1. Therefore, given that the government determines the schedule $\{b_t\}_{t=1}^{\infty}$, the equilibrium price $\{Q_{\tau+t}\}_{t=1}^{\infty}$ and production $\{y_{\tau+t}\}_{t=1}^{\infty}$ are determined by

$$Q_{\tau+t} = E_{\tau+t}\left[\sum_{s=1}^{\infty} \beta^s y_{\tau+t+s}\right], \tag{13}$$

[4]The earlier version of this paper (Kobayashi, 2002) demonstrates almost identical results using the Knightian uncertainty on priors over θ. In that paper, debt is repaid in full with probability θ in the bankruptcy procedure. The Knightian uncertainty is modeled à la Gilboa and Schmeidler (1989); θ is unknown and the economic agents have multiple priors over θ; they are assumed to maximize the minimum expected utility over the multiple priors; and, observing the outcomes of bankruptcy procedures, they update the multiple priors by a Bayesian-type learning rule.

$$y_{\tau+t} = \begin{cases} py_H - m, & \text{if } Q_{\tau+t} > r_{\tau+t} \text{ or } py_H - m - (1-p)V(\theta|s_{\tau+t}, v_{\tau+t}) > y_L, \\ y_L, & \text{if } Q_{\tau+t} < r_{\tau+t} \text{ and } py_H - m - (1-p)V(\theta|s_{\tau+t}, v_{\tau+t}) \leq y_L, \end{cases} \tag{14}$$

where $r_{\tau+t} = p^{-1}\{m - (1-p)(Q_{\tau+t} + E[\theta|s_{\tau+t}, v_{\tau+t}])\}$. If the government understands that firms and banks update $E(\theta|s, v)$ and $V(\theta|s, v)$ by the Bayesian learning rule described above, it undertakes all N bankruptcy proceedings at date τ in order to enhance the Bayesian update of θ, resulting in the switch in prevalent production technology from low productivity (technology S) to high productivity (technology R). The proof of this statement is straightforward: If N bankruptcy proceedings are undertaken at τ, Assumption 5 and equation (14) imply that firms undertake technology R even under the pessimism that $Q_{\tau+t} = Q_L$, and that $y_{\tau+t} = py_H - m$ for all $t \geq 1$. Then equation (13) implies that $Q_{\tau+t} = Q_H$ for all $t \geq 1$; therefore, immediate resolution of failed firms brings the economy back into the good equilibrium. In this case, the social welfare becomes $U_\tau^F + U_\tau^B - \Psi(N) = \frac{\beta}{1-\beta}(py_H + 1) - \Psi(N)$, since there are no defaults in the good equilibrium. Assuming that $\Psi(N)$ is sufficiently small compared with $py_H - y_L - m$, social welfare is maximized by immediate bankruptcies of N defaulters.

But in reality, the government may regard the recovery of confidence as an *exogenous event* to its own actions. If the government assumes that private agents do not learn from its own actions, i.e., $E(\theta|s, v)$ and $V(\theta|s, v)$ in equation (14) do not depend on $\{s_t, v_t\}$, then it will postpone bankruptcy proceedings forever, since $U_\tau^F + U_\tau^B$ is perceived by the government as exogenous to its actions, while $\Psi(b_t)$ is increasing with the number of bankruptcy proceedings undertaken. In this case, $E(\theta|s, v) = \mu$ and $V(\theta|s, v) = \nu$ for all $\tau + t$, and firms choose technology S under the pessimism that $Q_{\tau+t} = Q_L$; equation (13) implies that $Q_{\tau+t} = Q_L$, thereby validates the pessimism; the economy will be stuck in the bad equilibrium forever.

4 Conclusion

I have analyzed a simple model of stagnation following a financial crisis, in which the government's forbearance policy hinders the Bayesian learning of private agents. Asset prices and outputs stagnate, since agents cannot build confidence through learning. If the government endogenizes the effect of its own actions on learning by private agents, it can choose the optimal schedule of reform, i.e., a fast bankruptcy schedule for those who fail during a financial crisis. In other words, after an economic crisis, the restructuring of failed businesses may promote economic growth through the enhancement of confidence-building.

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