Asset Price Amplifications under Bankruptcy Constraints

Shuhei Aoki*

May 3, 2004

Abstract

Several papers (e.g. Kiyotaki and Moore (1997)) argue that asset price decline has a harmful effect on real economy. These models rely on the assumption of borrowing constraints, and there are some empirical evidences which deny the link between borrowing constraints and business cycles. This paper argues that even in case of no borrowing contraints, the harmful effect of asset price decline can happens by chain bankruptcy of firms. That entrepreneurs are bankrupt when they cannot make their promised repayment is the source of the amplification mechanism, and the inefficiency arises as multiple equilibria. In depression, the distressed firms cannot sell their asset at high price. As a result, their profit decreases so that they are bankrupt, and stop production. The lenders of the bankrupt entrepreneurs sell all the asset the bankrupt hold. The distress selling in turn causes the decline of the asset prices.
JEL classification: E32; E44; G33
Keywords: Bankruptcy; Debt overhang; Liquidity; Distress selling; Multiple equilibria

1 Introduction

Along with the decline of the GDP growth rate, the Japanese economy during the 1990s experienced asset price deflation. Many commentators say that the asset price deflation had negative effects on the GDP growth rate, and they even say that it is the main cause of the long-term recession.

They often cite Kiyotaki and Moore (1997) as the theoretical basis.[1][2] Kiyotaki and Moore (1997) analyze how the asset price decline interacts with the severeness of the borrowing constraint, using a rigorous dynamic general equilibrium framework. When asset prices decline, efficient, collateral-constrained entrepreneurs cannot borrow sufficiently, because the collateral values of the asset which they hold also decline. It inhibits efficient use of the asset, which in turn result in the further decline of the asset prices. The interaction amplifies the decline in output. However, the view is criticized by Hayashi and Prescott

*Graduate School of Economics, University of Tokyo. I thank Minoru Kitahara for helpful advices. Email: aoki@grad.e.u-tokyo.ac.jp

[1] See also Shleifer and Vishny (1992), and Stein (1995).

[2] Alpanda (2003) conducts a quantitative analysis to examine whether the Kiyotaki-Moore model can explain the movements in the Japanese land values.

(2002); They empirically show that firms are not under borrowing constraints in Japan during the 1990s.

This paper tackles the problem and proposes another amplification mechanism through asset prices which does not require the borrowing constraint. Instead of the borrowing constraint, I assume bankruptcy: a firm is bankrupt when the firm can not repay the firm's debt. Without the borrowing constraint, the decline of asset prices let the buyers of asset happier because he can buy them at low prices. However, the sellers suffer from low prices. This model focuses on the inefficiency attributed to the sellers. In this sense, the model focuses on the *seller-side* of the asset, while the Kiyotaki-Moore model focus on the *buyer-side*.

I make a model in which the asset price decline harms those who sell the asset. In section 2, I introduce the model. In this model, entrepreneurs have a fixed amount of debt, get idiosyncratic productivity shocks, and use an asset for production. The asset can be traded after the productivity shock. When the entrepreneurs are bankrupt, the production stops, the lenders seize the entrepreneurs' asset and sell it at the market. In section 3, I derive the first-best allocation of the asset, and in the next section, I show that the an decentralized economy can achieve the first-best.

However, as I show in section 5, the decentralized economy has another equilibrium in which the land price becomes lower than that of the first-best. This equilibrium is inefficient in that a fraction of entrepreneurs is bankrupt, and stops production. In the inefficient equilibrium, the entrepreneurs with negative productivity shocks can not sell their asset at high price. As a result, their profit decreases to the level that they can not repay the debt and become bankrupt. The lenders of the bankrupt entrepreneurs sell all the asset the bankrupt hold. The distress selling in turn causes the decline of the asset prices in this equilibrium. This interaction generates the amplification mechnism. The amplification mechanism is not obvious. For when the asset price becomes low, the return from production increases, though the profit by selling the asset becomes low. If the former effect works, the inefficient equilibrium cannot arises when the asset price is too low. I analyze how these effects work.

That the debt is uncontingent is crucial for the existence of the low land price equilibrium. Section 6 considers the case that the productivity shocks are public information, and that agents expect the low land price in which B is bankrupt. Then the lenders have an incentive to make a contract that entrepreneurs with bad productivity shocks pay less than those with good productivity shocks so that they are not bankrupt. Therefore, the lenders make this kind of contingent contract so that only first-best equilibrium remains.

While section 5 shows the existence of the inefficient equilibrium by assuming that this low land price is unexpected ex ante, section 7 demonstrates that even if the low land price which brings bankruptcy is expected ex ante, the inefficient equilibrium remains. Moreover, I show that lenders impose bankruptcy premium on entrepreneurs. As a result, there are cases where lenders do not lend money, or entrepreneurs stop investment, if the premium becomes burdensome.

Despite the differences mentioned above, my model has several similarities on assumptions to Kiyotaki and Moore (1997). Following Hart and Moore (1994, 1998), they assume human capital inalienability and renegotiation to derive collateral constraints. In their model, if lenders lend more than borrower's collateral, the borrower threaten the lenders that without him, the lenders can

not recover the debt (human capital inalienability), and require negotiation to reduce the debt (renegotiation). The human capital inalienability corresponds to bankruptcy in my model, in that without the borrower, production stops. The counterpart of renegotiation in this model is asymmetric information. In this model, if the productivity shocks are public information, the inefficient equilibrium disappears. Thus, we can say that this paper considers the situation that lenders refuse renegotiation, but there is asymmetric information. It is important to consider our case, because lenders like large bankers have incentive to make a reputation not to renegotiate, and earn higher profit. Even in such a case, the amplification mechanism can harm the real economy.

In this model, asset has a role of incomplete insurance for bad shocks. So the model shares a similar feature with the literature which argue the role of liquidity (e.g. Diamond and Dybvig (1983) and Holmström and Tirole (1998)). The most closely related to this model are Allen and Gale (2000) and Schnabel and Shin (2003). In Allen and Gale (2000), each bank lends some fraction of its deposit to other banks to insure against liquidity shocks by the depositors. They show that this risk-sharing can have contagious effects when there are unanticipated liquidity shocks. While theirs are the model of bank crisis and they they attribute the source of crises to liquidity preference shock as in Diamond and Dybvig (1983), this model is the model of that of firm sector and it attributs the source to idiosyncratic productivity shocks. Schnabel and Shin (2003) is also about the banking crisis. These papers focus on financial crises. Compared with these models, this model shows that even if the financial system of the economy is not damaged, contagion can occur.

The essence of the model is debt overhang. So the model is closely related to Lamont (1995). Both have the same characteristic that given a fixed level of debt, self-fulfilling expectations generate multiple equilibria. However, there are several different points. First, while in Lamont (1995), the debt overhang problem occurs because he assumes that existing creditors acquire the benefit of new investment by the new investors. In this paper, instead of such rule, I assume that entrepreneurs stop production whenever they can not repay the debt. As a result, underinvestment can occurs in Lamont (1995), while stop of production can occurs in my model. Second, Lamont (1995) emphasize the role of aggregate demand, while my model emphasize the role of asset prices.

2 The Model

The economy The model has three periods ($t = 0, 1, 2$), and there is a continuum of entrepreneurs with unit measure, and there are many lenders. They are risk-neutral, and want to maximize consumption at date 2.

There are two types of good in the economy: land, and fruit. Land is only used as production input, can not be consumed, and becomes fully worthless after the date 2 ends. Fruit can be consumed, in addition can be used for investment. Each entrepreneur is endowed with $\bar{a}$ units of land at date 0, but does not have fruit.

Each entrepreneur has a production technology: by investing a indivisible I units of fruit at date 0 (which we can regard as a fixed cost), and by using divisible units of land at date 1, the entrepreneurs produce fruit at date 2 (see Figure 1). The investment of fruits is irresersible: once invested, it can not be

recovered. Also, because they do not have fruit at date 0, the fruits need to be raised from somewhere.

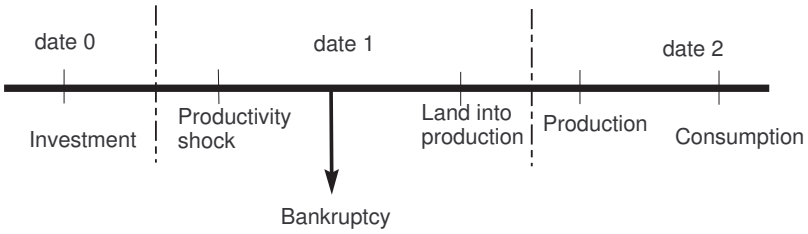

Figure 1: Time schedule 1

The lenders are endowed with huge amounts of fruit at date 0. They have a storing technology which keeps the fruit with no depreciation till date 2. [3]

Productivity shock After investment, each entrepreneur receives an idiosyncratic productivity shock at date 1. There are two types of shocks. π_G fraction of entrepreneurs gets good productivity shocks (I call them G), while the remaining $\pi_B (= 1 - \pi_G)$ gets bad productivity shocks (B respectively). Which productivity shock he receives is not predictable ex ante.

Productivities are different between G and B in that the marginal productivity of land of G is higher than that of B for any land level. More formally, let $f_G(a)$ be the production function of a firm with a good shock, and $f_B(a)$ be that with a bad shock, where a is the amounts of land used as input. We can express the difference of productivity as follows:

Assumption 1 (Productivity Shock).

$$f'_G(a) > f'_B(a) \text{ for all } a > 0, \tag{1}$$

I also assume other standard assumptions:

$$f_i(0) \geq 0,\ f'_i > 0 \text{ and } f''_i < 0 \text{ for } i \in \{G, B\}, \tag{2}$$

and

$$\lim_{a \to 0} f'_B(a) = +\infty. \tag{3}$$

Investment at date 0 is irreversible. When an entrepreneur get bad shock after the investment, his investment can not be recovered. However, he can change land input. Thus, it is efficient to let land input depend on the entrepreneur's shock.

Finally, I also impose an important assumption of the model:

Assumption 2 (Asymmetric information). The productivity shock are private information.

[3] This is the same as considering the international capital market, where the interest rate is normalized to be zero.

Bankruptcy I introduce another important assumption of the model, bankruptcy. I assume that if an entrepreneur produces good at date 2, he has to make an effort: the effort level by the unit of fruit is constant e. An entrepreneur is bankrupt when he knows that his consumption at date 2 falls below e (the payoff when he does not produce is assumed to be zero). Since after the productivity shocks, everything becomes certain, if he is bankrupt, he does immediately after the productivity shock. (for the timing, see Figure 1).

In case of bankruptcy, the project stops. When entrepreneurs are bankrupt, neither the I units of fruit used for investment is recovered nor returns fruits at date 2. Thus the bankruptcy is social loss.

Assumption 3 (Bankruptcy). an entrepreneur of type $i \in \{G, B\}$ is bankrupt if

$$\text{his consumption} < e. \tag{4}$$

Then, the entrepreneur's payoff becomes zero.

I have a comment about the assumption: the assumption that lenders can seize only land when an entrepreneur is bankrupt implies that the entrepreneurs in this model have inalienable human capital.

3 First-Best Solution

I solve the first-best allocation for the case that we assume neither asymmetric information nor bankruptcy. Since all of the agents is risk-neutral, the first-best allocation is the same as the one where output at date 2 is maximized, if the cost of production $(I + e)$ is less than the output by production.

The social planner solves the following problem.

$$V_{fb} = \max_{a_G, a_B \geq 0} \pi_G f_G(a_G) + \pi_B f_B(a_B) \tag{5}$$

$$\text{s.t} \quad \pi_G a_G + \pi_B a_B = \bar{a}. \tag{6}$$

The planner compares V_{fb} with the opportunity cost $I + e$. If the former is greater, the planner allows the investment. I assume $V_{fb} > I + e$.

The first-order condition becomes

$$f'_G(a^*_G) = f'_B(a^*_B), \tag{7}$$

$$\pi_G a^*_G + \pi_B a^*_B = \bar{a}. \tag{8}$$

Next, we assume both asymmetric information and bankruptcy. Suppose that lender's consumption is more than I and entrepreneur's is more than e. Even in this case, the same first-best can be achieved, since investment is conducted and bankruptcy does not happen.

4 Decentralization

We show in this section, that the first-best allocation can be decentralizable. I assume that there are credit market at date 0 and land market at date 1 (See Figure 2).

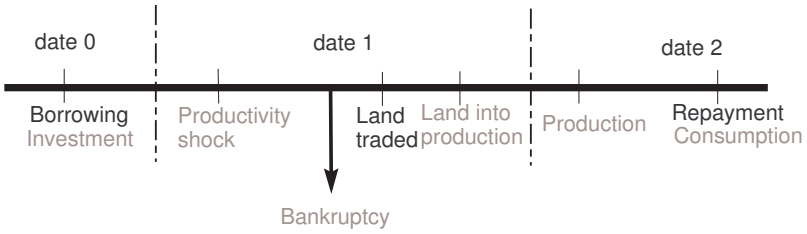

Figure 2: Time schedule 2

At date 0, the credit market opens. Each entrepreneur borrows fruit from the lenders and makes a contract with the lenders. I assume that there are many lenders, so that the market interest rate from date 0 to date 2 is zero. I also assume that if entrepreneur is bankrupt, the lenders seize the asset, i.e. $\bar{a}$ units of land. Then, the lenders sell it in the land market explained below, because the lenders cannot utilize the land, and it becomes worthless at date 2.

At date 1, the land market is open. I assume that each entrepreneur maximizes the profit given the market land price q which is determined in equilibrium. The market land price q is determined to satisfy the market clearing condition:

$$\pi_G a_G + \pi_B a_B = \bar{a}. \tag{9}$$

In this decentralized economy, I impose the following assumption in addition to the assumption of asymmetric information mentioned above.

Assumption 4 (Asymmetric information 2). Each entrepreneur's land input a_i, output $f_i(a_i)$ are unobservable to lenders.

The assumption implies that lenders can not make the contract which is contingent on the entrepreneur's type.

I solve the model by the backward induction. From now on, I only analyze the symmetric equilibrium in which the same type of agents chooses the same strategy and actions.

First, I examine the decision in the land market. I suppose that both types of entrepreneurs (i.e., G and Bad) are not bankrupt. By assumption 4, The entrepreneurs maximize their profit:

$$V_i(q) = \max_{a \geq 0} \ f_i(a) - qa + q\bar{a}, \quad \text{for } i \in \{G, B\}. \tag{10}$$

From the first-order condition, we derive

$$q = f'_G(a_G) = f'_B(a_B). \tag{11}$$

The above condition and (9) indicates that if both types of entrepreneurs are not bankrupt, the allocation is the same as that of the first-best, $\{a^*_G, a^*_B\}$. I define $q^* \equiv f'_G(a^*_G) = f'_B(a^*_B)$.

Next, I solve the bankruptcy decision given actions in the land market. Entrepreneur does not bankrupt, if

$$V_i(q) - D_i \geq e, \quad \text{for } i \in \{G, B\}. \tag{12}$$

D_i is the amount which he repay to the lenders if his type is i. I temporarily suppose that they are not bankrupt.

The contract at date 0 satisfy the following conditions in case entrepreneurs are not bankrupt:

$$\pi_G D_G + \pi_B D_B \geq I$$
$$D_G = D_B.$$

The first equation is the individual rationality condition of lenders. If the IR condition is not satisfied, the lenders do not lend, and use it in their storing technology. The second equation is the incentive compatibility conditions of entrepreneurs. If this equality is not satisfied, either type of entrepreneurs misrepresents his type. From these conditions, we get

$$D_G = D_B = I.$$

By substituting (13) into (12) and by the assumption on productivity, we know that

$$V_i(q^*) - I \geq e$$

is the condition that the decentralized economy achieves the first-best allocation. I assume that this condition holds.

Since the conditions ((9) and (11)) are the same as the FOCs of social planner's problem, the first-best allocation is achieved in the decentralized economy.

In this decentralized economy, B sells land and G buys it. The reason is that $a_G > \bar{a} > a_B$ from (11) and (9). Trading in the land market improves the welfare of both G and B. The existence of the land market helps not only G to use land efficiently, but also helps B to insure the bad shock by selling land; Without the land market, B's profit may be so low that he cannot repay the debt. In the next section, we will see the case that the land market does not work well, and B becomes bankrupt.

5 Low Land Price is Harmful

With the assumption of bankruptcy, this decentralized economy has the other equilibrium. To verify this, let us see the effect of unexpected land price declines from the equilibrium price in the previous section.[4] Decline from q^* is always beneficial to G. For G is the buyer at q^* and to buyers, the price decline reduces the cost for production.

For B, the price decline has more complicated influence. On the one hand, since B is buyer at q^*, the price decline is bad for B. On the other hand, the land price decline may be beneficial for B too, since the input cost for B's production declines. We can see how these effects works using the model. By the envelope theorem, we obtain

$$\frac{\partial V_i(q)}{\partial q} = -a_i(q) + \bar{a}, \tag{13}$$

[4]Unexpected means that agents expect the land price is q^* at date 0, which achieves the first best.

where $a_i(q) = \arg\max_{a \geq 0}\{f_i(a) - qa + q\bar{a}\}$. If $a_i(q) > \bar{a}$, $V_i(q)$ is upward sloping, and if $a_i(q) < \bar{a}$, $V_i(q)$ is downward sloping. $V_i(q)$ becomes the lowest at $a_i(\bar{q}_i) = \bar{a}$. Since as q goes up, $a_i(q)$ goes down, we can depict $V_i(q)$ as Figure 3. At $q \geq \bar{q}_i$, the entrepreneurs of type $i \in \{G, B\}$ become sellers, and $q < \bar{q}_i$,

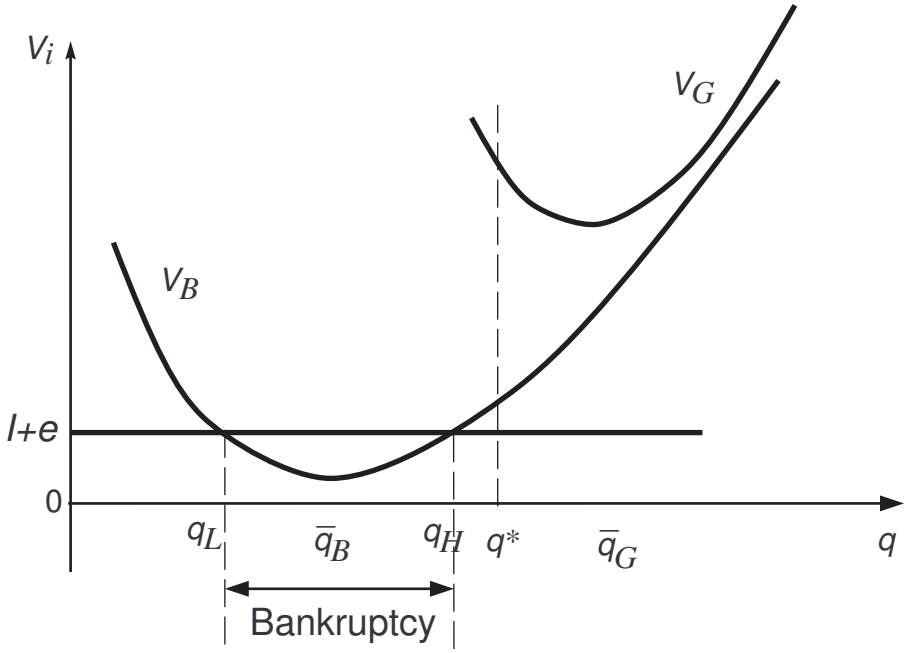

Figure 3: $V_i(q)$

they become buyers.

In the first-best equilibrium of the previous section, because G is buyer, and B is seller,

$$\bar{q}_B < q^* < \bar{q}_G. \tag{14}$$

(In addition, since B is not bankrupt in the equilibrium, $q_H \leq q^*$.) Thus, the land price decline from q^* is always desirable for G, while it is not desirable for B, if the price is less than $\bar{q}_B$.

B is bankrupt if he expects that

$$q \in (q_L, q_H), \tag{15}$$

because when q is in the region, $V_B(q) < I + e$. Then, the land price decline could have a harmful effect, because B's production stops.

To analyze the existence of the other equilibrium in an easily understood manner, I alter (2) a little: B can not produce more than $f_B(\bar{a})$ by increasing the land input more than $\bar{a}$. It can be restated as

$$f_B(a) = f_B(\bar{a}), \quad \text{if } a \geq \bar{a}. \tag{16}$$

Then, for $q \leq \bar{q}_B$,

$$V_B(q) = V_B(\bar{q}_B). \tag{17}$$

Since for $q < q_H$, $V_B(q) < V_B(q_H) = I + e$, B bankrupts if

$$q < q_H. \tag{18}$$

Can such land price be another equilibrium price? If B is bankrupt, he stops production, and all his land goes to the land market. Then only G uses land. The land price when B is bankrupt becomes

$$q^{**} = f'_G\left(\frac{\bar{a}}{\pi_G}\right). \tag{19}$$

Thus, if

$$q^{**} < q_H, \tag{20}$$

this equilibrium is another self-fulfilling equilibrium. Since $q^{**} < q^*$, this equilibrium necessarily exist if I is sufficiently high (but is sufficiently low not to be bankrupt at q^*).

We can see the multiple equilibria by the supply and demand curve of the land market. The demand curve of G is an ordinary demand curve as G in Figure 4 (the curve in the figure is a_G at each land price). The B's demand

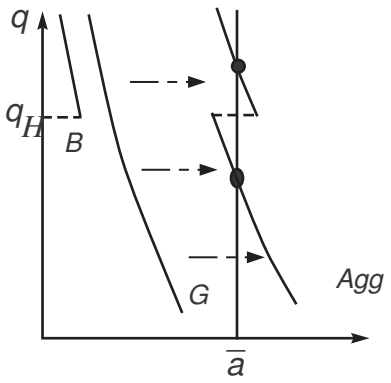

Figure 4: Multiple equilibria

becomes zero below q_H. By adding them up, the aggregate demand becomes Agg in the figure. The total supply is constant $\bar{a}$, since even when entrepreneurs are bankrupt, their land comes to the land market. Thus the line of the total supply becomes vertical. Due to the dent in the demand curve, multiple equilibria could exist.

From this graph, we can see why the multiple equilibria disappear, if the debt level I does not take an appropriate value. If the debt level I becomes too big, the region of land price at which B is bankrupt expands. In this case, equilibrium A disappears as in Figure 5. On the other hand, if the debt level I

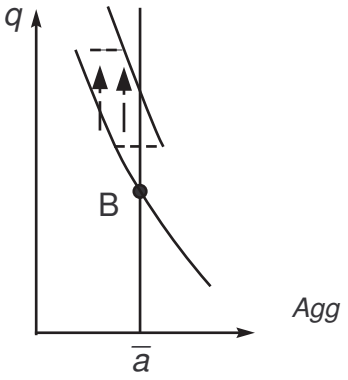

Figure 5: Effect of increase in debt level I

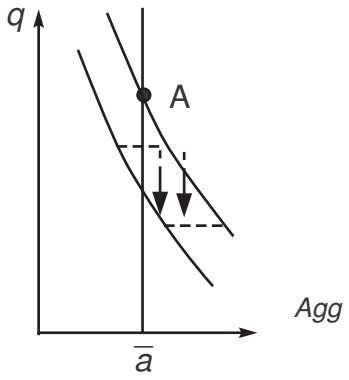

Figure 6: Effect of decrease in debt level I

becomes too small, equilibrium B disappears as in Figure 6. We can also check that given I, if π_G is so big, equilibrium B disappears.

Suppose that we discard (16). The low price equilibrium exists only if

$$q^{**} \in (q_L, q_H). \tag{21}$$

The demand curve of B becomes a dent because B is bankrupt and does not demand land there (Figure 7). When $q^{**} \leq q_L$, the low price equilibrium does

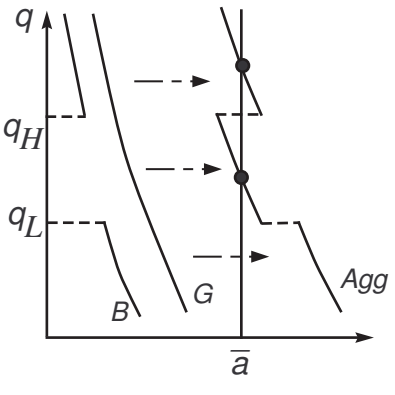

Figure 7: Multiple equilibria when (16) is not assumed.

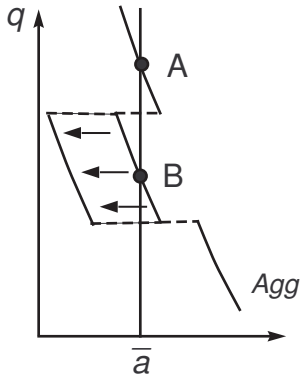

Figure 8: Effect of decrease in π_G

not exist. This case can occur when π_G is small. In this case, the dent in the aggregate demand curve shifts left as in Figure 8. Intuitively, this strange result means that even B can make an enough profit by using cheap land, if the land price becomes very low.

Proposition 1. *Under a fixed debt, the decentralized economy has multiple equilibria, and land price q is different between the equilibria. In high land price*

equilibrium, the economy achieves the first-best. In low land price equilibrium, B is bankrupt, and does not produce.

6 Debt Reallocation

Suppose that there is no asymmetric information in the economy. If lenders expect

$$q^{**} \in (q_L, q_H), \tag{22}$$

at date 0, how they make a contract? The solution is to transfer income from G to B to compensate the decline of B's profit. Without bankruptcy, the low land price yields higher expected profit, thus such compensation is possible. This intuition can be shown as follows. Let V^* be expected profit from investment at q^* and V^{**} be expected profit at q^{**} if firms are not bankrupt;

$$V^* \equiv \pi_G\{f_G(a_G^*) - q^*(a_G^* - \bar{a})\} + \pi_B\{f_B(a_B^*) - q^*(a_B^* - \bar{a})\} - e, \tag{23}$$

and

$$V^{**} \equiv \pi_G\{f_G(a_G^{**}) - q^{**}(a_G^{**} - \bar{a})\} + \pi_B\{f_B(a_B^{**}) - q^{**}(a_B^{**} - \bar{a})\} - e, \tag{24}$$

where $a_i^* = \arg\max_{a \geq 0}\{f_i(a) - q^{**}a + q^{**}\bar{a}\}$ for $i \in \{G, B\}$. These are rewritten as

$$V^* = \pi_G f_G(a_G^*) + \pi_B f_B(a_B^*) - e \tag{25}$$

and

$$V^{**} = \pi_G f_G(a_G^{**}) + \pi_B f_B(a_B^{**}) - \pi_G q^{**}(a_G^{**} - a_G^*) - \pi_B q^{**}(a_B^{**} - a_B^*) - e. \tag{26}$$

Then,

$$\begin{aligned} V^{**} - V^* &= \pi_G f_G(a_G^{**}) + \pi_B f_B(a_B^{**}) - (\pi_G f_G(a_G^*) + \pi_B f_B(a_B^*)) \\ &\quad -[\pi_G q^{**}(a_G^{**} - a_G^*) + \pi_B q^{**}(a_B^{**} - a_B^*)] \qquad (27) \\ &> \pi_G f_G'(a_G^{**})(a_G^{**} - a_G^*) + \pi_B f_B'(a_B^{**})(a_B^{**} - a_B^*) \\ &\quad - [\pi_G q^{**}(a_G^{**} - a_G^*) + \pi_B q^{**}(a_B^{**} - a_B^*)] \qquad (28) \\ &= 0 \qquad (29) \end{aligned}$$

Therefore, by setting the debt of B (D_B) low and that of G (D_G) high such that

$$\begin{aligned} f_i(a_i^{**}) - q^{**}(a_i^{**} - \bar{a}) - e &\geq D_i, \quad \text{for } i \in \{G, B\}, \qquad (30) \\ \pi_G D_G + \pi_B D_B &\geq I, \qquad (31) \end{aligned}$$

B is not bankrupt and the lenders get at least the same level of return. Since all the lenders choose such action, the inefficient low land price equilibrium can not be an equilibrium, and only the equilibrium with the first-best allocation remains.

Proposition 2. *The low land price equilibrium in Proposition 1 disappears if there is no asymmetric information about productivity shocks, and agents expect the low land price at date 0.*

7 Ex Ante Optimal Contract

Suppose instead that entrepreneurs' productivity shocks are private information. Then if lenders expect $q^{**} \in (q_L, q_H)$, how the optimal contract between entrepreneurs and lenders is written? Since output is not observable, G may insist at date 2 that he is B, and may refuse to repay. I add the assumption that if an entrepreneur refuse to repay at date 2, the entrepreneur is bankrupt, and that the entrepreneur's output moves to the lenders. In any way, the contract in this case also becomes uncontingent on entrepreneur's type.

There are two strategies for lenders: one is to reduce debt not for B to be bankrupt, the other is to make a contract taking into account that B is bankrupt. Lenders do not choose the former strategy, because then, the repayment becomes less than I, and lenders are profitable to invest I in their storing technology. As a result, lenders make a contract on the ground that B is bankrupt.

When the anticipated land price at date 0 is q^{**}, the fixed debt D is determined by the arbitrage condition

$$\pi_G D + \pi_B q^{**} \bar{a} = I. \tag{32}$$

From (32) and $D > q^{**}\bar{a}$, we obtain

$$D > I. \tag{33}$$

This means that lenders increase debt to compensate the loss by B's bankruptcy.

If $D > V_G^{**} - e$, the lenders do not lend. Moreover, for the entrepreneurs, ex ante expected profit also declines when lenders impose the bankruptcy premium. Other usage of land, which does not requires to borrow, like parking, may become more attractive. Suppose that the expected payoff of parking V_p for entrepreneurs satisfies

$$V(q^*) > V_p > V(q^{**}).$$

Then, if q^{**} is anticipated at date 0, entrepreneurs stop investment, and use land as parking instead.

Proposition 3. *Under asymmetric information, if agents anticipate the low land price equilibrium before they start investment, the debt increases as a bankruptcy premium, and entrepreneurs' profit decline. If even G can not repay the debt, the lenders do not lend. If other usage of land like parking becomes more profitable, the entrepreneurs do this instead of investment.*

8 Concluding Remarks

In this paper, I analyze the amplification mechanism by chain bankruptcy of firms and show that inefficiencies can arise as multiple equilibria. Yet there are several things not considered in the paper.

First, in this model, there are only two types of productivity shocks. If there are continuous types of different productivity shocks, how does the equilibrium outcome change? For example, does multiple equilibria remains in such a case?

Second, by changing the model more dynamic, the model would have richer implications. For example, if the interest rate is endogenous, the interest rate

may become lower in the low land price equilibrium. This may weaken the harmful effects of low land price. Also, by letting the interest rate endogenous, we may be able to argue the effect of monetary policy. Another example is the dynamic effect of consumption. If lenders can consume before investment, it could worsen the effect of low land price even if there is no storing technology.

Third, in this paper, I do not consider the case agents contract insurance to prepare for asset price fluctuations. The inefficient equilibrium may be able to remove by such an insurance.

These issues are left for future research.

References

Allen, Franklin, and Douglas Gale, 2000, Financial contagion, *Journal of Political Economy* 108, 1–33.

Alpanda, Sami, 2003, Land and corporate valuation in Japan, mimeo.

Diamond, Douglas W., and Philip H. Dybvig, 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* 91, 401–419.

Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *Quarterly Journal of Economics* 109, 841–879.

——— , 1998, Default and renegotiation: A dynamic model of debt, *Quarterly Journal of Economics* 113, 1–41.

Hayashi, Fumio, and Edward C. Prescott, 2002, The 199s in japan: A lost decade, *Review of Economic Dynamics* 5, 206.

Holmström, Bengt, and Jean Tirole, 1998, Private and public supply of liquidity, *Journal of Political Economy* 106, 1–40.

Kiyotaki, Nobuhiro, and John Moore, 1997, Credit cycles, *Journal of Political Economy* 105, 211–248.

Lamont, Owen, 1995, Corporate-debt overhang and macroeconomic expectations, *American Economic Review* 85, 1106–1117.

Schnabel, Isabel, and Hyun Song Shin, 2003, Foreshadowing LTCM: The crisis of 1763, mimeo.

Shleifer, Andrei, and Robert W. Vishny, 1992, Liquidation values and debt capacity: A market equilibrium approach, *Journal of Finance* 47, 1343–1366.

Stein, Jeremy C., 1995, Prices and trading volume in the housing market: A model with down-payment effects, *Quarterly Journal of Economics* 110, 379–406.