# Public Credit Guarantee Effects on Business Investment under Asymmetric Information

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Many professions and policy makers have traditionally noted that a financial device could play a crucial role not merely in enhancing economic growth but in smoothing out business fluctuations[1]. There are now discussions in Japan that extensions of the public credit undertaking (the guarantee scheme) may prevent small-scaled business firms lacking credit from going into bankruptcy as well as to launch new creative businesses[2]. Public money injections to private banks may dissolve credit crunch issues by easing balance sheet difficulties. Meanwhile, financial liberalization and deregulation resulted ironically in the appearance of oligopolistic mega-banks in the money and banking industry. Yet, there are few theoretical studies on how these institutional and structural elements in a financial market affect the interaction of business behavior within a money-using economy.

Gertler and Hubbard (1988) presented a heuristic analysis on how financial factors may affect investment. Applying the theoretical framework of this pilot work in our present discussion, our study attempts to show how financial factors, including institutional and structural factors, impact the amount of business investment volume, and by extension, how these impact the whole economy. The simplified model prepared here emphasizes the positive external effects of the public credit guarantee arrangements on

1) For examples of real credit guarantee systems, in Japan as well as in other countries, see the National Association of Credit Guarantee Corporations (1996) and Small Business Credit Insurance Corporation (1996, 1997, 1998, 1999).

2) Under the current Japanese credit guarantee system, local public bodies officially named "Credit Guarantee Corporation" (CGC) generally guarantee small and medium firms' debts to the concerned financial facilities. In default cases, these bodies promise the financing banks 100% coverage of credit with guarantee contracts between the CGC offices and firms. Any firm applicant to the contract necessarily pays a given rate (around a little more than 1%) of guaranteed credit amount to its concerned CGC.

business investment while exerting a suppressive measure against the reserved profits charged by business fund-lenders.

Within a pessimistic and depressed economy, business firms are unwilling to invest more even given very low levels of interest rates. The ability to invest by small enterprises is impaired when relying on stock markets to obtain the necessary financing funds, and often these concerns finance their operations and investment through money loans from commercial banks. Theses small business with fewer securities to offer as collateral for money loans, are more likely to face a shortage of funds, especially commercial banks are unwilling and unable to offer credit lines at par with conventional levels. Yet, small-scaled firms are often expected as a leading figure of technological innovation (Schumpeterian creative destruction), while they are exposed to deeper financial difficulties relative to big businesses.

Among Japanese positive researchers of small-scaled retail stores, construction and manufacturing companies, one observation resounds bitterly: the dual structure of the economy. There are numerous small- and medium-sized firms that are unable to squeeze enough internal revenue fund, equity capital, and net worth. This practical issue urges macroeconomists to examine whether it makes sense to prepare some public credit guarantee arrangement for borrowers and lenders of commercial financing.

We then explore the mechanism through which financial monetary factors may affect the volume of business investment, mainly through the framework of a simple partial equilibrium model. In this model, there are explicitly two kinds of representative market participants: the business firm to invest in physical and non-physical capital and the bank to supply investment funds for the firm. Such analytical viewpoints have now become popular since discussions commenced by New Keynesian economists against the New Classics (Gertler and Hubbard, 1988; Greenwald and Stiglitz, 1984, 1993). Following the traditional line of the New Keynesian emphasis on market frictions, this paper studies the effects of public credit or money provisions for contingent business outcomes on the quantity of investment[3]. We arrive at the conclusion that public interventions are effective in stimulating firm expenditure on investment by controlling the scale of public credit guarantee and by suppressing the bank's monopolistic reserved profits.

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3 ) For the present analysis, we make no distinction between credit and loan guarantees.

## I. Assumptions

In order to examine the relationships between the quantity of business investment and financial factors, including market imperfections, we consider three economic agents: business concern (firm), fund lender (commercial bank), and a third agent who acts implicitly. Further, suppose the business firm is operated by an entrepreneur who virtually owes the entire business, and also suppose the third agent is a government authority, regarded for simplicity as a completely costless non-profit organization. This third agent is expected discretionally to change financial credit provisions and other economic surroundings for public interests. All the agents are assumed to be risk neutral.

The business firm's source of value-added is entrepreneurial investment. However, the firm needs funds to finance new investment projects. Simply assume that, by investing the money amount of $I$ in physical capital at the beginning of a base period, the firm gains with certainty the following net return at the end of the period:

(1.1) $R=\alpha f(I)$ $(0<\alpha<1)$.

The function $f(I)$ has the properties:

(1.2) $f(0)=0$, $f'(I)>0$, and $f''(I)<0$.

However, suppose there is another amount of $sI$ $(0<s<1)$ to invest in non-physical capital resulting to a total amount of investment that becomes $(1+s)I$, the firm faces either event:

(1.3) $$\tilde{R}=\begin{cases} f(I) & \text{with probability } p, \\ \alpha f(I) & \text{with probability } q. \end{cases}$$

Non-physical capital can be a complementary input to physical capital in order to realize a higher return. In equation (1.3), we assume that $p\geq 0$, $q\geq 0$, and $p+q=1$. The event of the gain $f(I)$ and that of $\alpha f(I)$ at the period-end are called a "good state" and a "bad state," respectively. In the bad state case, the investment amount of $(1+s)I$ incurs only the gain $\alpha f(I)$.

It is possible for the bank to provide necessary financial funds for the firm's investment projects. However, there exist imperfections, namely asymmetric information in the financial market, wherein the bank is unable to monitor whether the loaned funds are spent on non-physical capital or not. It is incapable to observe expenditures on non-physical capital. The firm may invest only the amount $I$, despite borrowing the

total amount of $(1+s)I$ from the bank. It is possible that the amount of $sI$ may be appropriated by the firm for a different use. This possibility is associated to moral hazard, which may be a fundamental source of financial market imperfections[4].

In the case the bad state occurs, $R=\alpha f(I)$, we can project two phases: (1) the non-perquisite case, in which the firm invests all the amount of $(1+s)I$, (2) the perquisite case, in which it takes some amount of $sI$ for personal use and invest only the amount $I$. Under the bad state, the return $\alpha f(I)$ can be realized with no perquisite. However, the bank cannot predict accurately which phase actually occurs.

Suppose that the firm, as the funds borrower, can pay back some amount $G$ in the event of $f(I)$ and some amount $B$ in the event $\alpha f(I)$ to the lender (bank). There is a public authority that guarantees the lender the amount $C$ in the event of a bad state outcome. Suppose that the firm initially has internal funds of $W$ at the beginning, then the firm owes a debt of $(1+s)I-W$ to finance the current investment project, where $(1+s)I>W$.

There are other assumptions. At the end of the period, the firm posses the total net assets valued at $V$, which may include real estate. The firm can utilize investment funds through the financial market in which the interest rate is set at a given level of $r-1$ $(r>1)$. The bank has the capability to exercise oligopolistic power, through substantial regulations covering the entry into the credit and banking industry. Due to impeded entry into the industry, the bank enjoys a certain amount of reserved profits, denoted by $H$, which may include extra profit portions[5].

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4) The word, "moral hazard," may be replaced by another expression, "perquisites," according to financial literature (Jenson and Meckling, 1976). Hereinafter, this paper follows the conventional financial usage.

5) A possible deregulation policy for the industry is to make the extra profits smaller or zero. The recent Japanese economy illustrates this situation since it has wrestled with a wide discussion on industrial deregulation. However, the financial deregulation that attempted to enhance the economic efficiency of capital markets instead resulted in the restructuring of the money and banking industry that precipitated huge-scaled financial groups or mega-banks through mergers and allied holdings.

## II. Social Optimal Investment

In the non-perquisite case, the firm's expected gain from an investment project may be expressed as:

(2.1) $V_{NP}=p[f(I)-G]+q[\alpha f(I)-B]-rW.$

The third term of the right hand in equation (2.1) represents the opportunity cost of using the internal funds of $W$ for the current investment project. $r$ is the risk-free rate in the financial market. On the other hand, in the perquisite case, the firm's expected profits are given by

(2.2) $V_P=[\alpha f(I)-B]+rsI-rW.$

The principle of limited liability requires that

(2.3) $B\leq\alpha f(I)+V.$

A condition disallowing the firm from taking any perquisites is $V_{NP}\geq V_P$, which is called the incentive compatibility condition. The condition may be fully expressed as follows:

(2.4) $(p+q\alpha)f(I)-pG-qB\geq\alpha f(I)+rsI-B.$

Furthermore, since $p=1-q$, we can rewrite the previous equation into:

(2.4)′ $B-G\geq\dfrac{rsI}{p}-(1-\alpha)f(I).$

The inequality suggests that as $B$ is increased and with a small $G$, the less the firm is tempted to divert investment funds for non-physical capital.

When the firm uses the investment funds of $sI$ without taking any perquisites (i.e., creation of perquisites is not allowed), the bank has his expected gain:

(2.5) $U_{NP}=pG+q(B+C)-r[(1+s)I-W].$

The bank wants to clear the following inequality condition to loan the amount of $(1+s)I$ to the firm:

(2.5)′ $pG+q(B+C)-r[(1+s)I-W]\geq H.$

This is a necessary condition for the bank's willingness to provide the funds of $(1+s)I$, i.e., the participation condition. A larger amount of credit guarantee $C$ expands the possibility under which the bank participates. In the perquisite case however, equation (2.5) is replaced by

(2.6) $U_P=B+C-r[(1+s)I-W].$

When the firm makes the perquisite case, there occurs the bad state with unitary probability, $q=1$. In this case, the bank receives the repayment of $B$ from the firm and takes

the payment of $C$ as subrogation through the public credit guarantee scheme. In the both cases, the less the amount of $C$, the less the bank promotes financing.

Therefore, the total amount of the firm and bank's gains in the non- perquisite case is

(2.7) $V_{NP}+U_{NP}=X-Y$,

where $X\equiv(p+q\alpha)f(I)+qC$ and $Y\equiv r(1+s)I$. The level of investment that maximizes (2.7) may be referred to as the socially first best level and is denoted by $I^{**}$. The first order condition is

(2.8) $(p+q\alpha)f'(I^{**})-r(1+s)=0$.

Figure 1 illustrates the above-explained nexus.

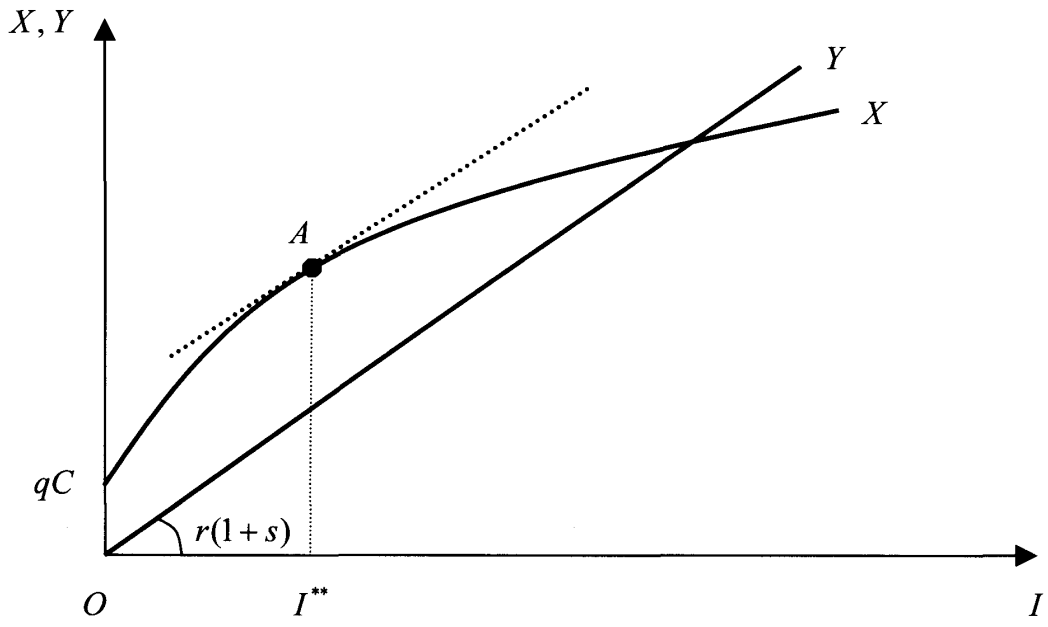


**Figure 1 Social Optimal Investment**

## III. Firm's Maximization

There is an interdependent business relationship between the firm and the bank. The firm invests in physical and non-physical capital to seek profits. In our setting, the firm's venture actions through investment enable the creation of primitive worth. The bank can acquire profits only by the business loan to furnish investment funds for the venture firm. It is profitable for the bank to raise a creative and efficient firm that makes good investment projects. The bank has its motive for suppressing the size of $H$ to build a long-run business partnership with the firm. Furthermore, the bank is aware

of its social mission[6]. Therefore, we set the following maximization problem for the firm.

Now consider the maximization problem that the firm faces in the non-perquisite case[7]:

(3.1) $\underset{I,G,B}{\text{Max}}\, V_{NP}(I, G, B)$

subject to

(2.4) $V_{NP} \geq V_P$,

(2.5)′ $U_{NP} \geq H$,

(2.3) $B \leq \alpha f(I) + V$.

Limited to the case that the optimum solution of any endogenous variable is positive, the Kuhn-Tucker's first conditions can be derived from the following Lagrangian:

$$\begin{aligned} L = {} & (p+q\alpha)f(I) - pG - qB - rW \\ & + \lambda[pf(I) - (1-q)\alpha f(I) - rsI - pG + (1-q)B] \\ & + \mu[-r(1+s)I + pG + qB + qC + rW - H] \\ & + \phi[\alpha f(I) - B + V], \end{aligned} \tag{3.2}$$

where $\lambda$, $\mu$, and $\phi$ are Lagrangian multipliers. Namely, denoting the solution of $I$ in this programming problem by $I^*$, we have the following conditions:

$$\begin{aligned} & \left.\frac{\partial L(I, G^*, B^*, \lambda^*, \mu^*, \phi^*)}{\partial I}\right|_{I=I^*} = (p+q\alpha)f'(I^*) \\ & + \lambda^*[pf'(I^*) - (1-q)\alpha f'(I^*) - rs] - \mu^* r(1+s) + \phi^* \alpha f'(I^*) \leq 0 \end{aligned} \tag{3.3}$$

(3.3)′ $I^* \geq 0$,

and

(3.3)″ $\left[\left.\frac{\partial L(I, G^*, B^*, \lambda^*, \mu^*, \phi^*)}{\partial I}\right|_{I=I^*}\right] \times I^* = 0.$

Similarly,

(3.4) $\frac{\partial L}{\partial G} = -p - \lambda^* p + \mu^* p \leq 0$, (3.4)′ $G^* \geq 0$, and (3.4)″ $\frac{\partial L}{\partial G} G^* = 0$;

(3.5) $\frac{\partial L}{\partial B} = -q + \lambda^*(1-q) + \mu^* p - \phi^* \leq 0$, (3.5)′ $B^* \geq 0$, and (3.5)″ $\frac{\partial L}{\partial B} B^* = 0$;

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6) Banks should recognize the public role of their business. Indeed, now in Japan, injections of public money to them can be justified for expected social benefits they can accrue.

7) We will show a case in Appendix where the bank maximizes its expected gain, given the firm's reserved gain.

(3.6) $\frac{\partial L}{\partial \lambda} \geq 0,\ \lambda^* \geq 0,$ and $\frac{\partial L}{\partial \lambda}\lambda^* = 0;$

(3.7) $\frac{\partial L}{\partial \mu} \geq 0,\ \mu^* \geq 0,$ and $\frac{\partial L}{\partial \mu}\mu^* = 0;$

and

(3.8) $\frac{\partial L}{\partial \phi} \geq 0,\ \phi^* \geq 0,$ and $\frac{\partial L}{\partial \phi}\phi^* = 0.$

Since it is assumed that $I^* > 0$, $G^* > 0$, and $B^* > 0$, each of which is an inner solution, the Kuhn-Tucker's conditions are reduced to Lagrangian conditions with equal signs. Since the bank's participation condition given by (3.5)′ is binding, we have the following proposition:

Proposition 1: *Since $\mu^* > 0$, which means that the bank's participation condition is binding, the bank has the reserved profits $H$.*

Proof: Since $\mu^* = 1 + \lambda^* > 0$ from (3.4)″ and $G^* > 0$, the bank's participation condition necessarily becomes binding.

Proposition 2: *If the incentive compatibility condition given by (2.4) is binding ($\lambda^* > 0$), then the limited liability condition given by (2.3) is binding ($\phi^* > 0$), and vice versa. If the incentive compatibility condition is non-binding ($\lambda^* = 0$), then the limited liability condition is non-binding ($\phi^* = 0$), and vice versa.*

Proof: From (3.4) and (3.5), it is obtained that $\lambda^* = \phi^*$.

The equality $\lambda^* = \phi^* = 0$ that Proposition 2 shows implies that the firm may repay the whole amount of debt in the absence of perquisites. At least in this case, the limited liability of the funds-borrower condition never matters.

Proposition 3: *If the incentive compatibility condition is non-binding ($\lambda^* = 0$), the first best level of investment, $I^{**}$, is achieved. Then, the level of $I^{**}$ is independent on the amount of $C$.*

Proof: If $\lambda^* = 0$, then $\mu^* = 1$ and $\phi^* = 0$. Substituting these results for (3.3), we have the same equation form as (2.8). The variable $C$ never appears in (2.8).

## IV. Financial Frictions and Fluctuations in Business Investment

Any business of the firm is risky. Furthermore, the bank faces another possible problem. The firm may appropriate investment funds initially designed for non-physical capital to increment its personal interest. For the bank, it is difficult to monitor the borr ower's actual behavior. The bank faces the problem of asymmetric information.

Whenever the firm asks for loans, the bank likes the guarantee of the loan by the third agent. Then, the scale of the bank's loan varies according to the credit guarantee — the latter influences the scale of the firm's investment after all.

Under asymmetric information, it is strongly suggested that the incentive compatibility condition is binding. Therefore, we focus on the case that the incentive constraint is meaningful. The reality of economy is hardly free from the case of perquisites. Proposition 2 suggests that the limited liability condition is necessarily binding when the incentive compatibility condition is binding. Proposition 1 entails that the bank's participation condition to loan is binding. Thus, the three conditions are all binding.

The simultaneous equation system of these three constraints with equal signs gives a set of solutions of the endogenous variables. From (2.4), (2.5)′, and (2.3), we obtain

(4.1) $(p+q)\alpha f(I^*)+qC=(1+2s)rI^*-rW+H-V,$

or simply,

(4.2) $X=Y+rsI^*-(rW-H+V),$

where $I^*$ represents what satisfies the simultaneous equation system. Defining the right side of (4.2) by $Y'$ and assuming that the bank's reserved profits are large enough $(H>rW+V)$, we can draw Figure 2(a) and Figure 2(b), which resemble Figure 1. Figure 2(a) exhibits the firm's excess investment case compared with the level of $I^{**}$ as the benchmark. On the other hand, Figure 2(b) illustrates the shortage of investment case. The level of $I^*$ that satisfies (4.1) is shown as the intersection point between the two curves, $X$ and $Y'$, in each diagram.

Proposition 4: *In the case of the shortage of investment equilibrium, an increase in the credit guarantee $C$ can lead the firm's investment toward the first best level $I^{**}$. In the case of excess investment equilibrium, a decrease in the credit guarantee can also direct investment to approach to the first best level $I^{**}$.*

Proof: As exhibited in Figure 3, an increment in $C$ shifts the curve $X$ upward. A fall in $C$ shifts the curve $X$ downward.

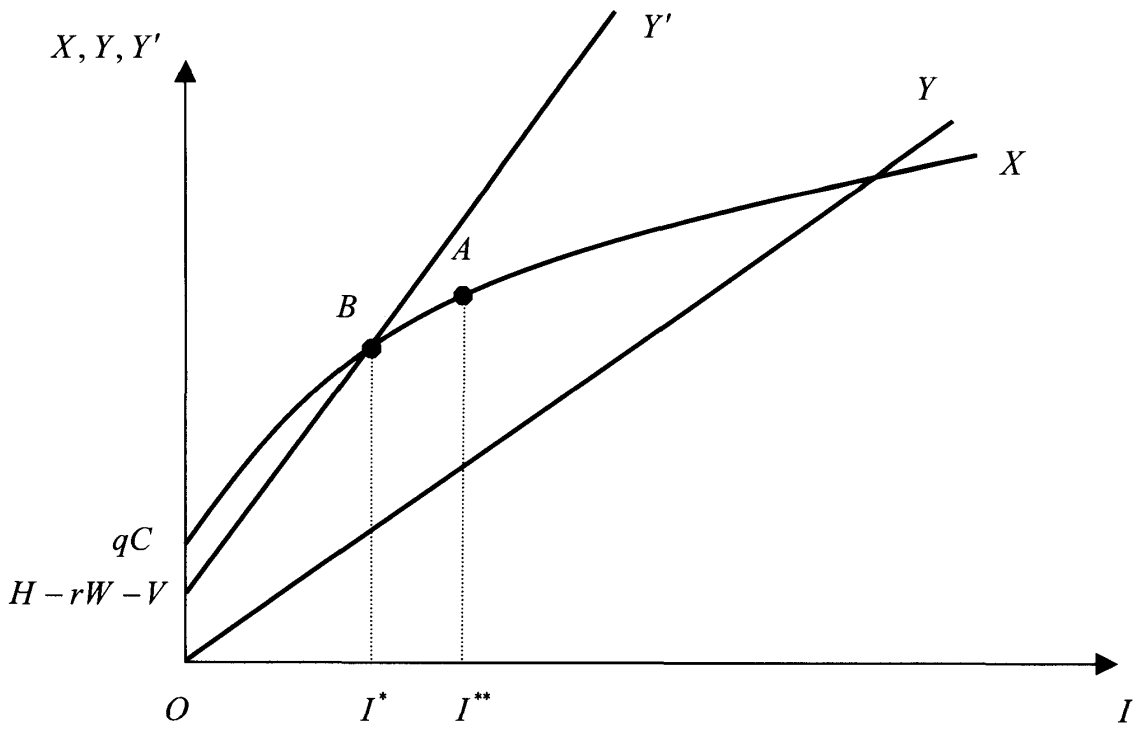


**Figure 2(a) Shortage of Investment**

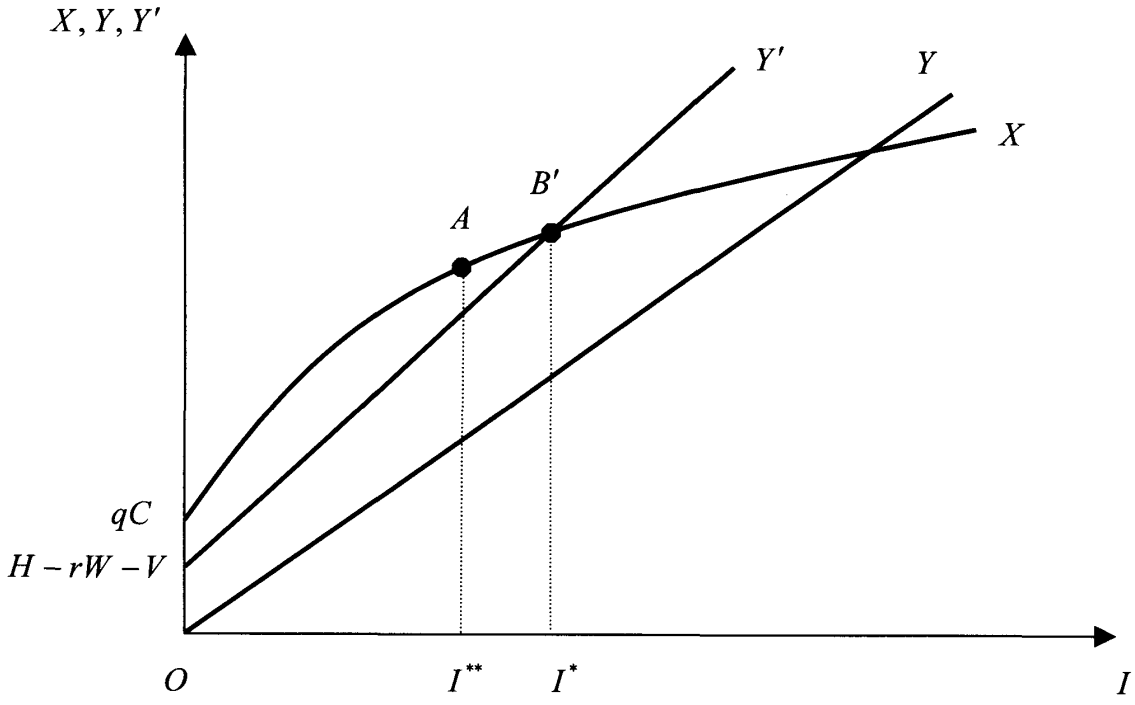


**Figure 2(b) Excess Investment Case**

Proposition 5: *In the shortage of investment equilibrium case, a reduction in the bank's reserved profits can get the firm's investment to approach the first best level* $I^{**}$. *In the excess investment equilibrium case, an increase in* $H$ *can lead the firm's investment to approach the first best level* $I^{**}$[8].

Proof: As shown in Figure 3, an increment in $H$ shifts the curve $X$ upward and a fall in $H$ the converse.

Proposition 6: *In the shortage of investment equilibrium case, an increase in the firm's net wealth* $W$ *and/or* $V$ *can get the firm's investment to approach the first best level* $I^{**}$. *In the excess investment equilibrium case, a decrease in* $W$ *and/or* $V$ *can get the firm's investment to approach the first best level* $I^{**}$.

Proof: As illustrated in Figure 3, an increment in either $W$ and $V$, or in both, shifts the curve $X$ to the right. A decrease in either $W$ and $V$ or both shifts the curve $X$ to the left.

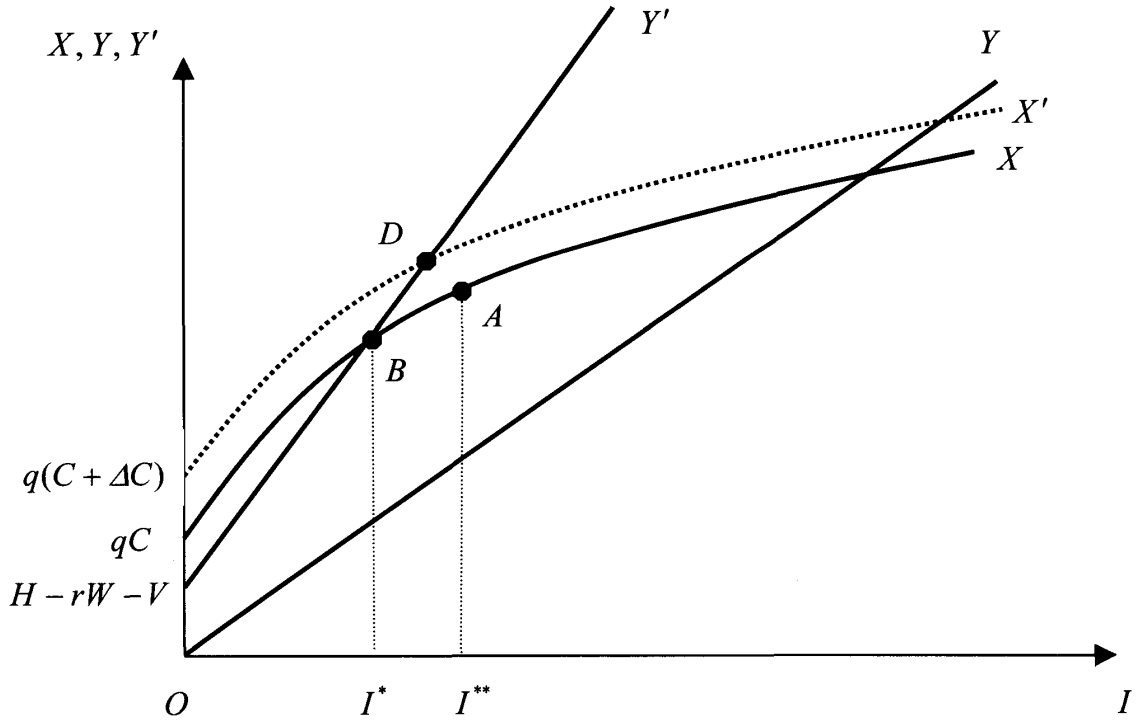


**Figure 3 Effect of Credit Guarantee Increase**

8) Consider an extended actual meaning of what this proposition implies associated with our present economy. Such being the case that public money injections simply cause an increase in the bank's reserved profits, there may occur a credit crunch or restrain phenomenon to suppress business investment in the economy, which deviates from the first best level position father further.

Proposition 6 suggests that in a stagnated state of investment, a deterioration in the fi rm's net wealth position generates a subsequent reduction in the quantity of investment. It follows naturally that crashes in the financial asset and real estate markets may exacerbate the sate of under-investment.

## V. Policy Implications and Conclusions

The present analysis demonstrates the problem of asymmetric information between the firm, as the funds borrower, and the bank, as the funds lender, exists. The real market configuration is consistent with such market imperfections. Many studies, including Gertler and Hubbard (1988) and other New Keynesians', have suggested that capital market imperfections may be significant sources of generating fluctuations in the quantity of output and investment rather than technological changes. This paper also follows an overview that, due to imperfections, business investment fluctuations may be a little attributable to financial factors. Our analysis shows that, by quantitative changes in the public credit guarantee $C$ on the firm's financing investment, the quantity of investment can approach its first best level.

What we have discussed here by our benchmark model is associated with our research program of how to interpret the real operation of money-using economy. The results obtained in the present work may argue for economic policy implications for the real economy. When the economy is confronted with the shortage of investment, and therefore that of aggregate demand, public interventions to improve the state of business confidence and credit may be effective to stimulate vivid transaction activities.

It has been highly possible in our present discussion that financial factors will affect changes in investment volume, therefore business fluctuations. An increase in the public credit guarantee $C$ may encourage the willingness of business firms to invest and that of banks to loan necessary investment funds. This may be interpreted as: public money injections to banks are analogous to what is expected in the industrial and financial policy framework of the public guarantee arrangements to deal with unexpected bad state outcomes.

Regarding the Japanese economy suffering from a pessimistic deep depression, our analysis suggests a deregulation policy to lower the reserved profits charged by oligopolistic banks in the money and banking industry. It is obvious from the discussion in our model that the lowering of the bank's reserved profits $H$ leads the

quantity of investment to approach the first best level. It suggests that public money injections to banks are never acceptable if they may result only in increments in their reserved profits. The model also predicts that deterioration of any kind of the firm's net wealth conflicts with improving the stagnated economy caused by the shortage of aggregate demand.

Small-scale firms hardly depend on stock markets to secure investment funds. In the meantime, under a lackluster economy, these firms may find it viable to carry out technological innovations and new product developments. Recent endogenous growth theory confirms the significant role of non-physical capital investment in improving physical capital and total factor productivity. A public credit guarantee devise that prepares for possible bad debts encourages small-scaled firms into enhancing investment, which makes it possible to support new demand and supply creations. Proper extensions of the existing Japanese public credit guarantee system for small-scaled firms may not contradict the theoretical implications we have shown[9].

Here is a belief that our model could have an advantage simply in describing the causation between financial factors and investment fluctuations. The present model is useful in construing the complicated real financial economy, upon which we contrive economic policy that encourages it to achieve superior welfare position. Yet, there is another task to perform: it is necessary for us to confirm or test our theoretical outlook by observable facts and statistical data with some econometric elaboration.

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9) Another problem figures in the public guarantee system under which both fund borrowers and lenders may have less incentive to exert their potential business efforts. Indeed, as insurance companies, central and prefectural credit guarantee bodies have faced moral hazard problems, by which not only firms often appropriate borrowed funds, but banks shirk effective information production when loaning investment and operation funds to firms. Then the Japan Small and Medium Enterprise Corporation and local offices of the Credit Guarantee Corporation are urged to find an effectual way of minimizing economic loss due to moral hazard behaviors.

*Appendix:* Bank's Maximization

The bank's returns source is ascribed to the demand for funds that the business firm wants. The bank faces the non-linear programming problem in our setting as follows:

(A.1) $\underset{I,G,B}{\text{Max}} U_{NP}(I, G, B)$

subject to

(2.4) $V_{NP} \geq V_P$,

(A.2) $V_{NP} \geq K$,

(2.3) $B \leq \alpha f(I) + V$

where $K$ stands for the firm's reserved profits. Since all the conditions are binding, we have

(A.3) $(p+q\alpha)f'(I^{**}) - r(1+s) - sr\lambda^* = 0$.

The above can be rewritten as

(A.4) $X - qC = r[(1+s) + s\lambda^*]$.

Therefore, the bank's funds supply level is less than the level of $I^{**}$ as shown in Figure A.1. If the constraint (2.4) is not binding, it is consistent with the first best level.

Proposition A.1: *If the incentive compatibility condition is binding, the bank's supply of investment funds is necessarily short of the social first best level. If it is not binding, the bank's supply of investment funds is necessarily achieved at the social first best level.*

Proof: Since the firm's participation condition suggested by (A.3) is binding, the incentive compatibility condition necessarily becomes binding, $\lambda^* > 0$. Furthermore, from that $\lambda^* = \phi^*$, then all the Lagrangian multiplies become positive, which implies that all the constraints are binding. Since the slope $(1+s)r$ is smaller than $[(1+s)+s\lambda^*]r$, and since the curve $X - qC$ is depicted below the curve $C$. If the Lagrange multiplies of (2.4) and (2.3) are zero, that of (A.3) becomes unity. Then, writing the new Lagrangian for the bank as $L'$, the equation $\left.\frac{\partial L'}{\partial I}\right|_{I=I^*} = 0$ results in the same as (2.8).

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